United Nations University
Institute for Integrated Management of Material Fluxes and of Resources

SUSTAINABLE TRANSFORMATION IN COAL REGIONS OF THE GLOBAL SOUTH:

Challenges from a Resource Nexus Perspective (NEXtra Core)

UNU FLORES

german cooperation
DEUTSCHE ZUSAMMENARBEIT

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Executive Summary

The NEXtra Core report presents updated context information on the coal sector of 4 countries: Colombia, Indonesia, Mozambique and South Africa, it inquires about the challenges and opportunities of coal phase-out processes and just transitions for each case, explores potential lessons learned -or to be learned- in other contexts and presents recommendations.

Chapter 1 shall present the reader with a general overview of the energy and coal sectors in the selected countries, along with an outline of the environmental impacts of the latter. It will also identify the current just transition policies, plans, programmes, and regulations associated with these impacts. Chapter 2 describes both the challenges and opportunities that have been recognised regarding the resource nexus and its connection to, environmental impacts, energy transition, and employment. Next, Chapter 3 presents the lessons that have been learned, or are yet to be learned from countries that have previously conducted either partial, or total coal phase-out processes. Finally, Chapter 4 offers recommendations drawn from the previous sections.

The report comes at a particularly challenging time. The conflict between the Russian Federation and Ukraine has led to the substitution of Russian fossil fuels imports by the European countries. Other importing nations have followed suit and have severed commercial ties. The resulting coal scarcity in the markets has led to an increased demand from alternative sources -like the NEXtra Core countries-, along with soaring prices. This, in turn, has made it feasible to propose or start new coal operations and also to expand existing ones, hindering transitions in the near future. Political changes in some of the studied countries have meant regulatory and policy changes of various degrees of intensity, that are duly noted in this report. This document shows the pertinence and urgency of conducting research and taking action on coal phase-out processes. Coal is not only responsible for approximately 40% of the global CO2 emissions, but they also reached their highest level in history in 2021 according to the International Energy Agency (IEA, 2022a).

This study emphasizes the need for energy and economic transitions in these four countries focusing on three main indispensable characteristics: Timeliness, sustainability and fairness ("just transition").

Timeliness, from a global (climate) perspective, is related to opportune national contributions to the global decrease of coal use in an overall manner consistent with the objective drafted in the

Paris Agreement (+1.5C), especially considering that about 40% of the global CO_2 emissions are attributable to coal combustion. From a local (resource nexus) perspective, this characteristic refers to the opportune management of specific social and ecological impacts (land use-related degradation, perpetual air and water quality decrease, job and livelihoods losses, increase of pollution-related diseases, etc.) in a way that prevents irreversible damages.

Sustainability refers to multiple aspects ranging from a healthy physical environment to human and economic development. It concerns the capacity of the transition processes to persist in time in spite of changes (economic, political, social) that could deviate outcomes to unwanted or previous states. From an ecological perspective, it covers both the local and regional scale where environmental health (water quality, soil quality, air quality and ecosystem functionality, etc.) can be considered an important objective by itself but also a prerequisite for socio-economic development, and the global scale. Especially when it comes to the solution of the grand challenges of the early 21st century such as mitigating climate change or stopping the unprecedented loss in global biodiversity.

As environmental problems at different scales are interlinked, a Resource Nexus perspective is the most suitable approach to create synergies and avoid, as much as possible, trade-offs between different resource-related goals. Equally important is the socio-economic dimension, particularly at the local and regional scale (job opportunities, viable livelihoods, adequate living quality, etc.) but also with respect to national economies which sometimes depend strongly on coal use or exports.

Finally, fairness relates to the recognition of past, present and future burden distributions of the impacts of the coal era, from a human rights and environmental justice perspective. The well-being of communities and ecosystems along the coal value chains as well as issues such as energy sourcing and coal revenue substitutions are key to achieve just transitions. National legal frameworks and political conditions, as well as international cooperation, play a definitive role in reaching this goal.

In the end, the three aspects of timeliness, sustainability and fairness are closely interwoven and require careful co-consideration. The report finishes by providing country-specific recommendations in areas such as energy justice and access, trade-offs accounting, independent monitoring, institutional capacity building, economic reorientation strategies, transparency initiatives, revenue substitution, impacts prevention and mitigation, among other issues.

Acronyms and abbreviations

General terminology (Units of measurement, general terms, currencies, methods, indexes, etc.)

ABBREVIATION / ACRONYM	MEANING
µg/liter	Microgram per liter
AMD	Acid mine drainage
BAT	Best Available Technology
BOD	Biochemical Oxygen Demand
BOE	Barrel of Oil Equivalent
CCS	Carbon Capture and Sequestration
CCS	Carbon Capture and Storage
CDP	Coal phase-down
CFPP	Coal-fired power plants
COD	Chemical Oxygen Demand
COP	Colombian Peso
C	Degree Celcius
EIA	Environment Impact Assessment/Analysis
EIS	Environmental Impact Statement
ENSO	El Niño Southern Oscillation
FOB	Free on board
GDP	Gross Domestic Product
GEM	Global Energy Monitor
GHG	Greenhouse Gas
GW	Giga-Watt
ha	Hectare
IDR	Indonesian Rupiah
km^2	Square kilometer
LCOE	Least Cost of Electricity
LCOH	Levelized Cost of Hydrogen
mg/l	Miligram per liter
mm/annum	Millimeters per year
MPI	Multidimensional Poverty Index
MPN	Most Probable Number
Mton	Million tonnes
Mtpa	Million tonnes per annum
MZN	Mozambican Metical
NDC	Nationally Determined Contribution
NOx	Nitrogen Oxide
PtCo	Platinum-Cobalt
PV	Photovoltaics
RE	Renewable Energy
SO_2	Sulphur dioxide
SOE	State-own-enterprises
tCO_2eq	Ton CO_2 equivalent
TEG	Total Electricity Generation
UBI	Unsatisfied Basic Needs
USA	United States of America
USD	United States Dollar
WDI	Water Demand Index
WQI	Water Quality Index
ZAR	South African Rand

International organizations, programmes, concepts, etc.

ABBREVIATION / ACRONYM	MEANING
ACT	Accelerating Coal Transition
AfDB	African Development Bank
ASEAN	Association of South East Asian Nations
CPO	Coal Phase-Out
EITI	Extractive Industries Transparency Initiative
ETM	Energy Transition Mechanism
ETP	Energy Transition Package
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
FES	Friedrich-Ebert-Stiftung
HRW	Human Rights Watch
IEEFA	Institute for Energy Economics and Financial Analysis
IMF	International Monetary Fund
JET	Just Energy Transition
NDC	Nationally Determined Contribution
REDD+	Reducing Emissions from Deforestation and Forest Degradation Programme
RNA	Resource Nexus Approach
SADC	Southern African Development Community
SEI	Stockholm Environmental Institute
UNDP	United National Development Program
UNESCO	The United Nations Educational, Scientific and Cultural Organization
UNRCO	United Nations Regional Coordinator Office
UNU-FLORES	United Nations University - Institute for Integrated Management of Material Fluxes and of Resources
UNU-WIDER	United Nations University - World Institute for Development Economics Research
US EPA	United States Environmental Protection Agency
WB	World Bank
WHO	World Health Organization

Abbreviations and Acronyms for the study case Colombia

ABBREVIATION / ACRONYM	MEANING (SPANISH)	MEANING (ENGLISH)
ADR	Agencia de Desarrollo Rural	Rural Development Agency
AEM	Área Estratégica Minera	Strategic Mining Reserve Area
ANLA	Agencia Nacional de Licencias Ambientales	National Environmental Licences Agency
ANM	Agencia Nacional de Minería	National Mining Agency
ARE	Área de Reserva Especial	Special Reserve Area
BECO	Balance Energético Colombiano	Colombian Energy Balance
CAR	Corporación Autónoma Regional	Regional Autonomous Corporation
CGR	Contraloría General de la Nación	General Comptroller's Office
CIPAME	Research Center for Fair Development of the Colombian Mining and Energy Sector	Centro de Innovación e Investigación para el Desarrollo Justo del Sector Minero Energético de Colombia
CNR	-	Colombian Natural Resources
CREG	Comisión de Regulación de Energía y Gas	Energy and Gas Regulatory Commission
DNP	Departamento Nacional de Planeación	National Planning Department
ECOPETROL	Empresa Colombiana de Petróleos	Colombian Petroleum Company
ENA	Estudio Nacional del Agua	National Water Assessment
FARC	Fuerzas Armadas Revolucionarias de Colombia	Revolutionary Armed Forces of Colombia
FINAGRO	Fondo para el Financiamiento del Sector Agropecuario	Agribusiness Financing Fund
ICA	Instituto Agropecuario Colombiano	Colombian Agricultural Institute
IDEAM	Instituto de Hidrología, Meteorología y Estudios Ambientales	Institute of Hydrology, Meteorology and Environmental Studies
IGAC	Instituto Geográfico Agustín Codazzi	Agustín Codazzi Geographic Institute
MADS	Ministerio de Ambiente y Desarrollo Sostenible	Ministry of Environment and Sustainable Development
MIN AGR	Ministerio de Agricultura y Desarrollo Rural	Ministry of Agriculture and Rural Development
MIN CIT	Ministerio de Comercio, Industria y Turismo	Ministry of Commerce, Industry and Tourism
MME	Ministerio de Minas y Energía	Ministry of Mines and Energy
OLTJ	Labour Observatory for a Just Transition in the Coal Sector	Observatorio Laboral para la Transición Justa
PAR	Plan de Acción para el Reasentamiento	Resettlement Action Plan
PIDARET	Plan Integral de Desarrollo Agropecuario con Enfoque Territorial	Integral Agricultural Development Plan with a Territorial Approach
PNCTE	Programa Nacional de Cupos Transables de Emisión de Gases de Efecto Invernadero	National GHG Tradable Emission Quotas Programme

ABBREVIATION / ACRONYM	MEANING (SPANISH)	MEANING (ENGLISH)
POMCA	Plan de Ordenamiento y Manejo de Cuencas Hidrográficas	Basin Management Plan
POT	Plan de Ordenamiento Territorial	Land Use Management Plan
SGR	Sistema General de Regalías	General Royalties System
SIN	Sistema Interconectado Nacional	National Interconnected System
SINA	Sistema Nacional Ambiental	National Environmental System
SISAIRE	Subsistema de información sobre la calidad del aire	Subsystem of Air Quality Information
UPME	Unidad de Planeación Mineroenergética	Mining and Energy Planning Unit
UPRA	Unidad de Planificación Rural Agropecuaria	Rural Agricultural Planning Unit

Abbreviations and Acronyms for the study case Indonesia

ABBREVIATION / ACRONYM	MEANING (BAHASA INDONESIA)	MEANING (TRANSLATED TO ENGLISH)
AMDAL	Analisis Dampak Lingkungan	Environmental Impact Assessment
Bappenas	Kemenetrian Perencanaan Pembangunan Nasional	Ministry of National Development Planning
BPJS	Badan Penyelenggara Jaminan Sosial	National Health Insurance System
CEF	-	Clean Energy Facility
CRF	-	Carbon Reduction Facility
Dirjen EBTKE	Direktorat Jenderal Energi Baru Terbarukan dan Konservasi Energi	Directorate General of Renewable Energy and Energy Conservation
DMO	-	Domestic Market Obligation
ESDM	Kementerian Energi dan Sumber Daya Mineral Republik Indonesia	Ministry of Energy and Mineral Resources (MEMR)
ETM	-	Energy Transition Mechanism
IESR	-	Institute for Essential Services Reform
IPSDA	Izin Penggunaan Sumber Daya Air	Water Resources Use Permit
IUP	Izin Usaha Pertambangan	Coal mining permit
JATAM	Jaringan Advokasi Tambang	Mine Advocacy Network
Kemenko Perekonomi	Kementerian Koordinator Bidang Perekonomian	the Coordinating Ministry of Economic Affairs
KEN	Kebijakan Energi Nasional	National Energy Policy
KLHK	Kementerian Lingkungan Hidup dan Kehutanan	Ministry of Environmental and Forestry (MoEF)
KLHS	Kajian Lingkungan Hidup Strategis	Strategic Environmental Studies document

ABBREVIATION / ACRONYM	MEANING (BAHASA INDONESIA)	MEANING (TRANSLATED TO ENGLISH)
KPC	Kaltim Prima Coal	A coal company in East Kalimantan
LCDI	-	Low Carbon Development Initiatives
LTS-LCCR	-	Long-term Strategies for Low Carbon and Climate Resilient
NZE	-	Net Zero Emission
PLN	Perusahaan Listrik Negara	State Electricity Company
PP	Peraturan Pemerintah	Government regulations
PT	Perseroan Terbatas	Limited Liability Company (LLC)
PUPR	Kementerian Pekerjaan Umum Dan Perumahan Rakyat	Ministry of Public Works and Public Housing
RPJMN	Rencana Pembangunan Jangka Menengah Nasional	National Medium-Term Development Plan
RPJPN	Rencana Pembangunan Jangka Panjang Nasional	National Long-Term Development Plan
RUED	Rencana Umum Energy Daerah	Regional Energy Plan
RUEN	Rencana Umum Energi Nasional	National Energy Plan
RUKD	Rencana Umum Ketenagalistrikan Daerah	Regional electricity plan
RUKN	Rencana Umum Ketenagalistrikan Nasional	National electricity plan
RUPTL	Rencana Usaha Penyediaan Tenaga Listrik	National Electricity Supply Business Plan
SIPA	Surat Ijin Pengambilan Air Tanah	Groundwater Extraction Permit
UKL-UPL	Upaya Pengelolaan Lingkungan dan Upaya Pemantauan Lingkungan	Environmental Impact Assessment for small businesses
UU	Undang-Undang	Act / Law
UUD	Undang-Undang Dasar	Constitution of Republic of Indonesia

Abbreviations and Acronyms for the study case Mozambique

ABBREVIATION / ACRONYM	MEANING (PORTUGUESE)	MEANING (ENGLISH)
AAAJC	Associação de Apoio e Assistência Jurídica às Comunidades	Associação de Apoio e Assistência Jurídica às Comunidades
AAEI	Alta Autoridade da Industria Extractiva	High Authority for the Extractive Industry
AQUA	Agência Nacional para o Controlo da Qualida-de Ambiental	National Agency for Environmental Quality Control
ARA - Zambeze	Zambezi Regional Waters Administration	Administração Regional de Águas do Zambeze
ATM	Autoridade Tributária de Moçambique	Tax Authority of Mozambique
BdM	Banco de Moçambique	Bank of Mozambique

ABBREVIATION / ACRONYM	MEANING (PORTUGUESE)	MEANING (ENGLISH)
BHR	Beacon Hill Resources	Beacon Hill Resources
CFM	Portos e Caminhos de Ferro de Moçambique	Mozambican Ports and Railroads
CIMOZ	Centro de Integridade Publica	Mozambican Centre for Public Integrity
DNGM	Diretorio Nacional de Geologia e Minas	National Directorate of Geology and Mines
DNGRH	Water Management National Directorate	Direcção Nacional de Gestão de Recursos Hídricos
DUAT	Direito do Uso e Aproveitamento da Terra	Right of use and tenure of land
ICVL	-	International Coal Venture Private Ltd.
I-GMRE	Inspetoria Geral de Recursos Minerais e Energia	Inspectorate-General of Mineral Resources and Energy
INAMI	Instituto Nacional de Minas de Moçambique	National Institute of Mines of Mozambique
JA!	Justiça Ambiental!	Environmental Justice!
JSPL	-	Jindal Steel and Power
MADER	Ministério da Agricultura e Desenvolvimento Rural	Ministry of Agriculture and Rural Development
MiARD	Ministro da Agricultura e Desenvolvimento Rural	Minister for Agriculture and Rural Development
MiIC	Ministério da Indústria e Comércio	Minister for Industry and Commerce
MiLE	Ministro da Terra e Meio Ambiente	Minister for Land and Environment
MiMRE	Ministro de Recursos Minerais e Energia	Minister for Mineral Resources and Energy
MIREME	Ministério de Recursos Minerais e Energia	The Ministry of Mineral Resources and Energy
MiTC	Ministro de Transporte e Comunicaçoes	Minister for Transport and Communications
MiTESS	Ministro do Trabalho, Emprego e Segurança Social	Minister for Labour, Employment and Social Security
MML	Mozambique Minerals Limitada	Subsidiary of Jindal Steel and Power
MOPHRH	Ministry of Public Works, Habitat and Water Resources	Ministério das Obras Públicas, Habitação e Recursos Hídricos
MRV	-	National Climate Mitigation, Monitoring, Reporting and Verification System
MTA	Ministério da Terra e Ambiente	Ministry of Land and Environment
NCCAMS	-	National Climate Change Adaptation and Mitigation Strategy
NLC	Corredor de Nacala	Nacala Logistics Corridor
OdMR	Observatório do Meio Rural	Observatório do Meio Rural
PM	Primeiro Ministro	Prime Minister
RM	Riversdale Mining	Riversdale Mining
RT	Rio Tinto	Rio Tinto
SAfRW	Southern Africa Resource Watch	Southern Africa Resource Watch
SINTCIM	Sindicato Nacional dos Trabalhadores da Indústria Quimica e Afins	National Union of Construction Industry, Wood and Mine Workers of Mozambique

ABBREVIATION / ACRONYM	MEANING (PORTUGUESE)	MEANING (ENGLISH)
TA	Tribunal administrativo	Administrative Tribunal
UEM	Universidade Eduardo Mondlane	University Eduardo Mondlane
UU	-	Utrecht University
Vale	Companhia Vale do Rio Doce	Doce Valley Company
VR	-	Vulcan Resources

Abbreviations and Acronyms for the study case South Africa

ABBREVIATION / ACRONYM	MEANING
AATC	Anglo American Thermal Coal
BUSA	Business Unit South Africa
CER	Centre for Environmental Rights
CGS	Council for Geoscience
CIF	Climate Investment Fund
CMA	Catchment Management Agency
COGTA	Cooperative Governance and Traditional Affairs
COM	Chamber of Mines
COPAC	Cooperative and Policy Alternati-ve Center
	Human Rights Watch
COSATU	Congress of South African Trade Unions
CSIR	Council for Scientific and Indust-rial Research
CSP	Concentrated Solar Power
CST-SU	Centre for Complex Systems in Transition – Stellenbosch University
D&O	Derelict and Ownerless
DALRRD	Department of Agriculture, Land Reform and Rural Development
DARDLEA	Department of Agriculture Rural Development and Environmental Affairs
DBSA	Development Bank South Africa

ABBREVIATION / ACRONYM	MEANING
DET	Department of Education and Training
DFFE	Department of Fisheries, Fores-try and Environment
DMR	Department of Mineral Resources
DMRE	Department of Mineral Resources and Energy
DoE	Department of Energy
DPE	Department of Public Enterprise
DPWRT	Department of Public Works, Roads and Transport
DT	Department of Tourism
DWAF	Department of Water Afairs and Forestry
DWS	Department of Water and Sanitation
EIG	Energy Intensive Group
EIUG	Energy Intensive User Group
EMG	Environmental Monitoring Group
EMP	Environmental Management Plans
EMPR	Environmental Management Program Reports (EMPR)
Eskom	Electricity Supply Commission
EWRP	eMalahleni Water Reclamation Plant
FES	Federation for a Sustainable Environment
GW SA	Ground Work South Africa

ABBREVIATION / ACRONYM	MEANING
HIPRO	High Recovery Precipitation Reverse Osmosis
HIV	Human Immunodeficiency Virus
HPA	High Priority Area
HSRM	Hydrogen Society Road Map
HVA	High Veld Area
ICF	International Climate Finance
ICMM	International Council for Mining and Minerals
IDC	Industrial Development Corporation
IDP	Integrated Development Plans
IFC	International Finace Corporation
IPG	International Partners Group
IPP	Independent Power Producers
IRENA	International Renewable Energy Agency
IUCM	Inkomati Usuthu Catchment Management Agency
JET IP	Just Energy Transition Investment Plan
JTF	Just Transitional Framework
JTT	Just Transition Transaction
KOICA	Korea International Cooperation Agency
MAR	Mean Annual Rainfall
MCCMS	Mpumalanga Climate Change Mitigation Strategy
ME	Meridian Economics
MEC	Minerals Energy Complex
Mintek	Council for Mineral Technology
MIR	Market Intelligence Report
MP COGTA	Mpumalanga Cooperative Governance & Traditional Affairs
MWCB	Mine Water Coordinating Body
NAQMP	National Air Quality Management Plan
NBI	National Business Initiative

ABBREVIATION / ACRONYM	MEANING
NERSA	National Energy Regulator of South Africa
NEVA	National Employment Vulnerability Assessment
NIHL	noise-induced hearing loss
NIWIS	National Integrated Water Information System
NPC	National Planning Commission
NT	National Treasury
NUM	National Union of Mineworkers
NUMSA	National Union of Metal Workers South Africa
ORASECOM	Orange Senqu River Commission
PAA	Protected Agricultural Areas (PAA)
PCC	Presidential Climate Commission
PIC	Public Investment Corporation
PPAs	Power Purchase Agreements
PVA	Platinum Valley Initiative
RBCT	Richards Bay Coal Terminal
REDZs	Renewable Energy Development Zones
REIPPPP	Renewable Energy Independent Power Producer Procurement Programme
RMB	Rand Merchant Bank
RMIPPPP	The Risk Mitigation Independent Power Producer Procurement Programme
SALGA	South African Local Government Association
SANEDI	South African National Energy Development Institute
SANGOCO	South African NGO Coalition
SARS	South African Revenue Service
SASOL	South African Synthetic Oil Limited
SAWS	South African Weather Service
SB	Standard Bank
SEA	Strategic Environmental Assessment
SETs	Sectoral Emission Targets

ABBREVIATION / ACRONYM	MEANING
SJRP	Sector Job Resilience Plan
SLP	Social Labour Plans
SPLUMA	Spatial Planning and Land Use Management Act
SPP	Special Presidential Package
SSEG	Small Scale Embedded Generation
Stats Sa	Statistics South Africa
TB	Tuberculosis
TFR	Transnet Freight Rail
TIPS	Trade Industrial Policy Strategies
TWQR	Target Water Quality Range (TWQR)
UCT	University of Cape Town
UFS	University of Freestate
UJ	University of Johannesburg
UP	University of Pretoria
WESSA	The Wildlife and Environment Society of South Africa
WITS	Witwatersrand University
WMA	Water management Area
WRC	Water Research Commission
WWF SA	World Wide Fund South Africa

Introduction

Coal-based electricity generation is the main source of Green House Gases at the global level (GHG) (IEA, 2021). To mitigate this, scientists have determined that global warming must be limited to 2°C – the achievement of which will require over 80% of the coal reserves to be kept underground (McGlade & Ekins, 2015).

In the case of developing nations, coal extraction must decrease within a decade, with a total cease of extraction by 2040 (Calverley & Anderson, 2022). By 2030, coal-based power generation should be reduced to 80% below levels recorded in 2010 levels, and the complete phase-out of coal should occur before 2040 (Climate Analytics, 2019).

Aside from this global impact, the local and regional effects of coal extraction on water, land use, and other resources must be acknowledged. To that end, the Resource Nexus represents an ideal framework to highlight the relations, dependencies, and trade-offs between different elements.

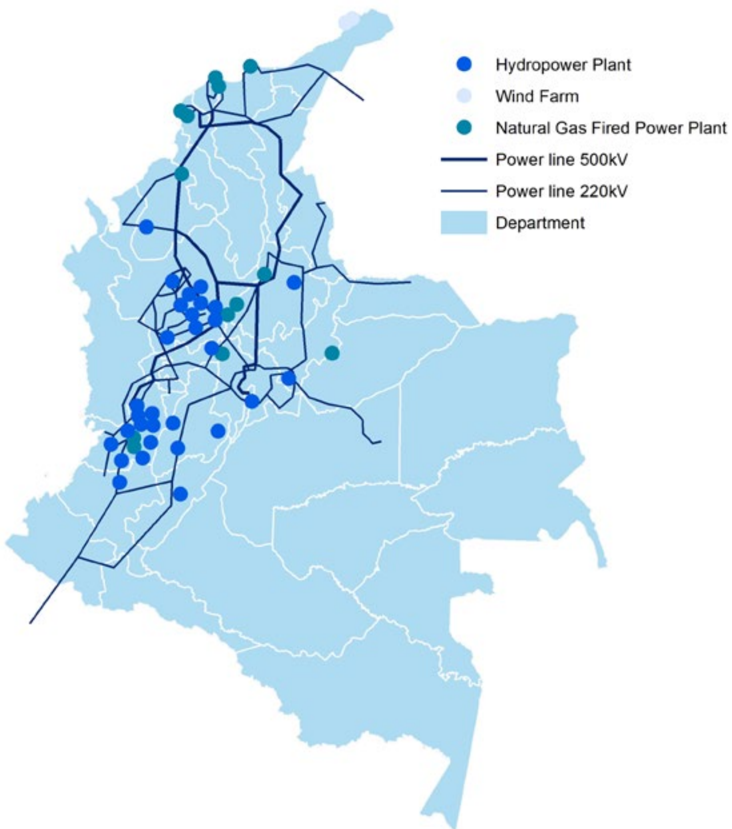
1 General Overview

1.1 Energy Sector in Colombia, Mozambique, Indonesia and South Africa

This section aims to provide the reader with historic information about the energy sectors of the countries and their specific policies and regulations; to summarise the power and electricity matrix of each, and to briefly describe demand and supply projections and scenarios.

1.1.1 Colombia

Figure 1. Map of the main elements of the electric grid in Colombia
Source of data: GEM (2021) and UPME (2022)

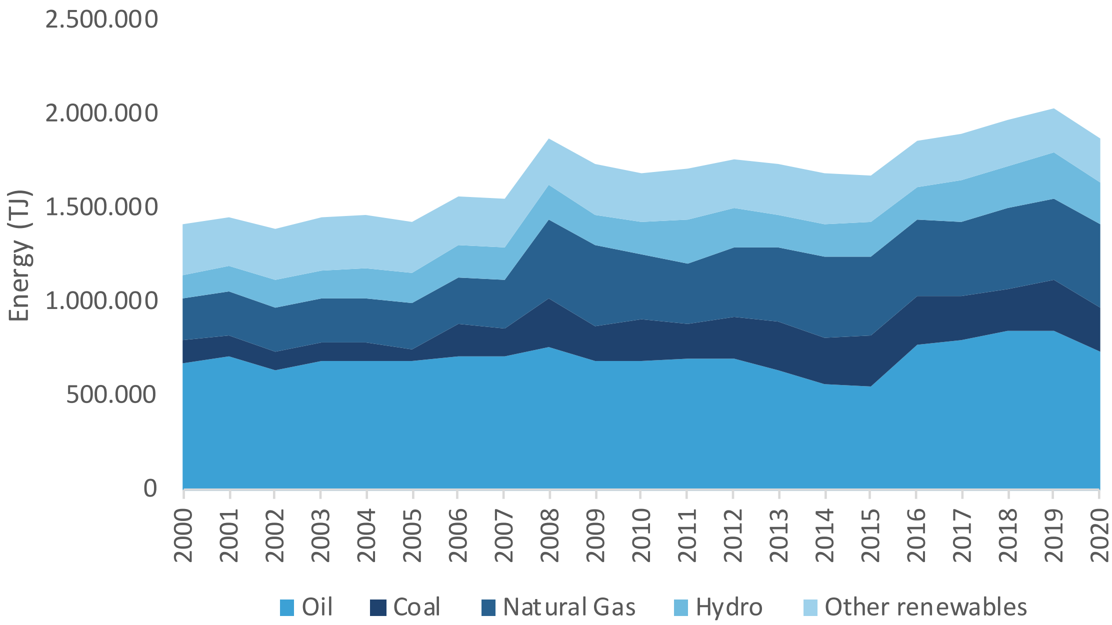


Colombia's energy matrix is mainly based on oil (~40%) and natural gas (~20%), as seen in Figure 2b, while coal makes up less than 10% of the energy supply. In terms of energy demand by sector, the most current data available is that from 2020 (UPME, 2022a). According to this data, transport presents the highest energy consumption, followed by the residential and industrial sectors (Figure 2c). Energy supply in Colombia has grown from 1410PJ to 1865PJ between 2000 and 2022, respectively (Figure 2a).

Figure 2a. **Energy supply in Colombia 2000-2020 (TJ)**

Figure 2b. **Energy supply in Colombia 2000-2020 (percentage)**
Source of data: UPME (2022a)

2a.



2b.

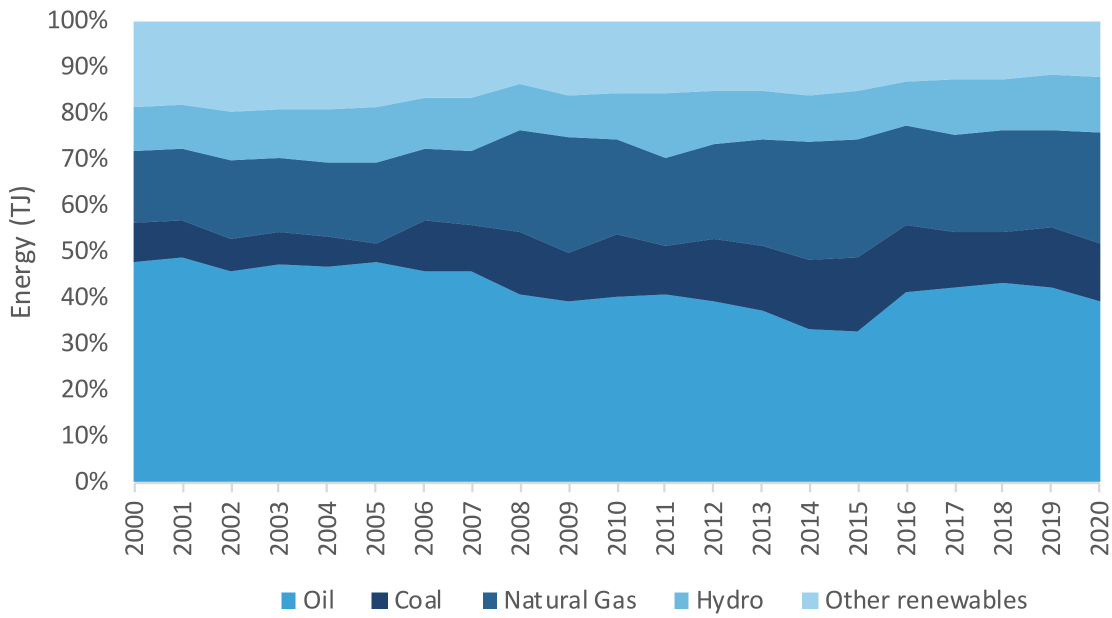
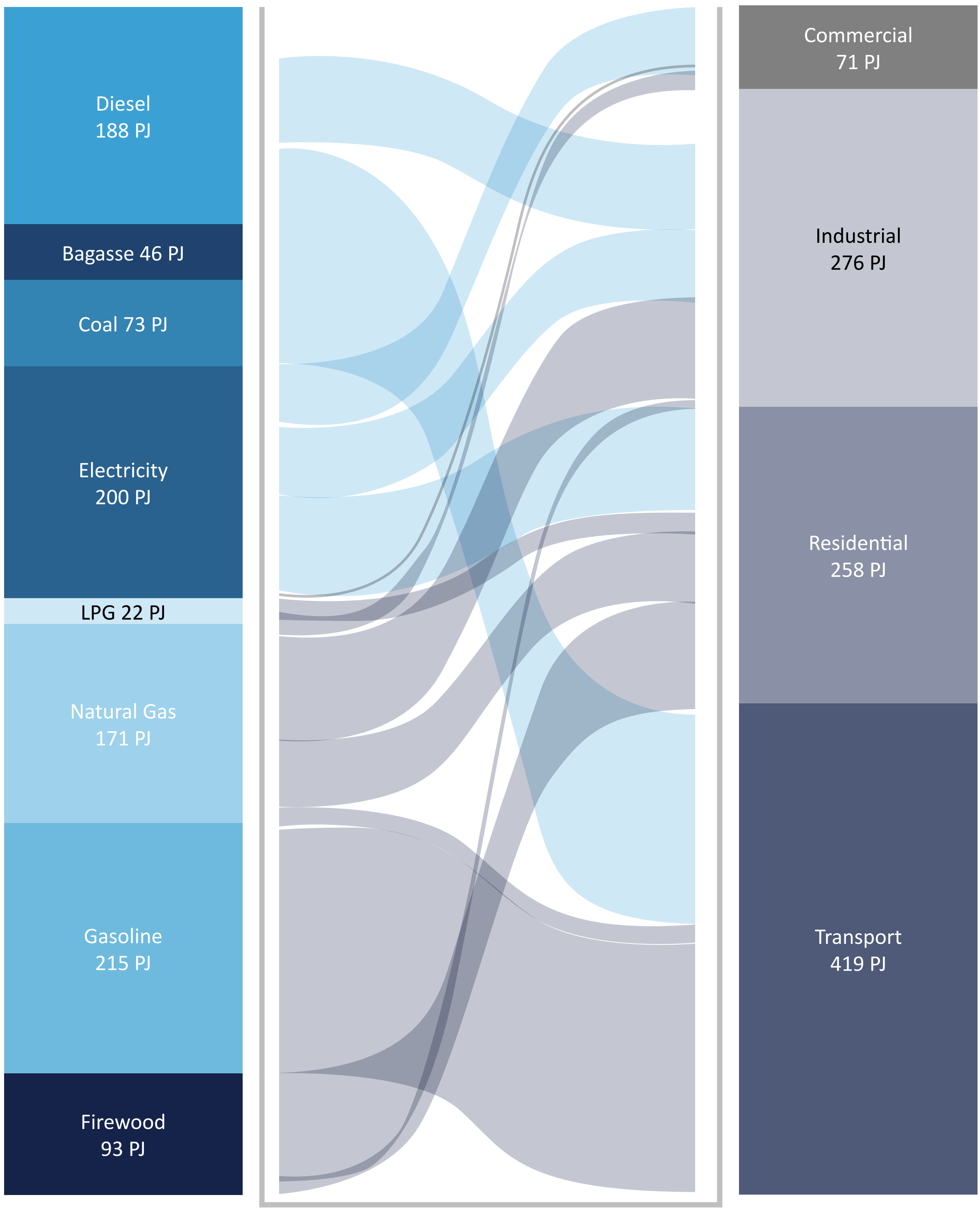


Figure 2c. Energy demand by sector in Colombia, 2020
Source of data: UPME (2022a)



Currently, Colombia has an installed capacity of 17,771 MW (ACOLGEN, 2022), with around 70% to 80% of nationwide electricity being historically generated by hydropower plants (Figure 3a), with a current installed capacity amounts to 11,942 MW (ACOLGEN, 2022). This type of generation is highly dependent on precipitation regimes, which results in the high volatility of listed energy prices (BBVA Research, 2021). Gas and coal thermopower plants generate between 15% and 30% of the total electricity (Figure 3a), with a current installed capacity 5543.24 MW (ACOL-

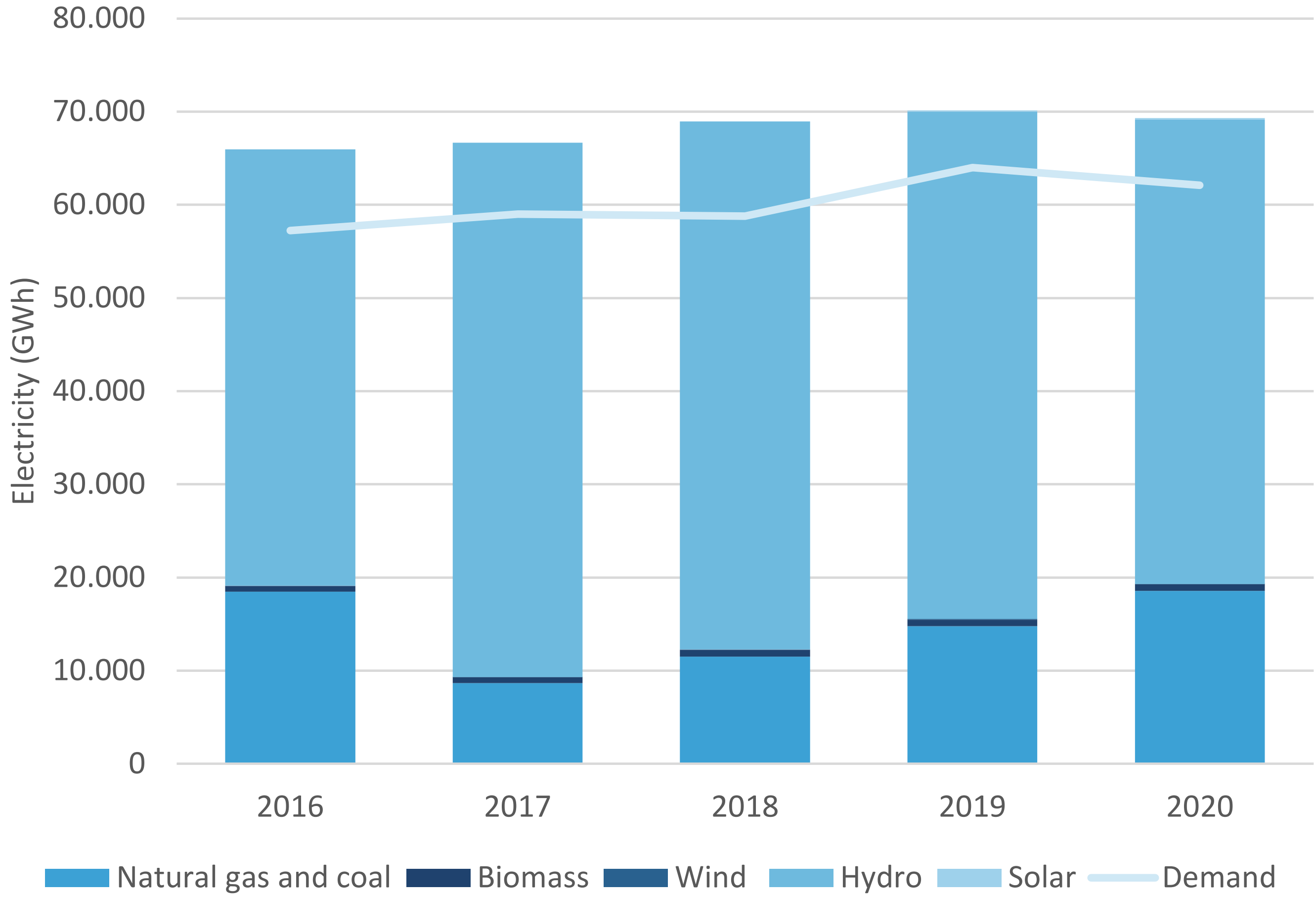
GEN, 2022), while non-conventional renewable energy (NCRE) sources are negligible (less than 1% (135.03 MW) (ACOLGEN, 2022)). The country's goal is to increase NCRE share to 10%-20% by 2050, in one of the possible scenarios in the future (UPME, 2020).

In regard to the total electricity generation (TEG), capacity, and demand, an average increase of 5% and 1.7% respectively was seen in the period between 2000 and 2020 (BBVA Research, 2021). From 2016 to 2020, TEG increased from 65,942 GWh to 69,324 GWh (Figure 3b), from which about 4% was consistently imported until 2015, whereupon, a significant exports reduction can be observed, along with the subsequent increase in imports - mainly from Ecuador - for price control purposes (Portafolio, 2020).

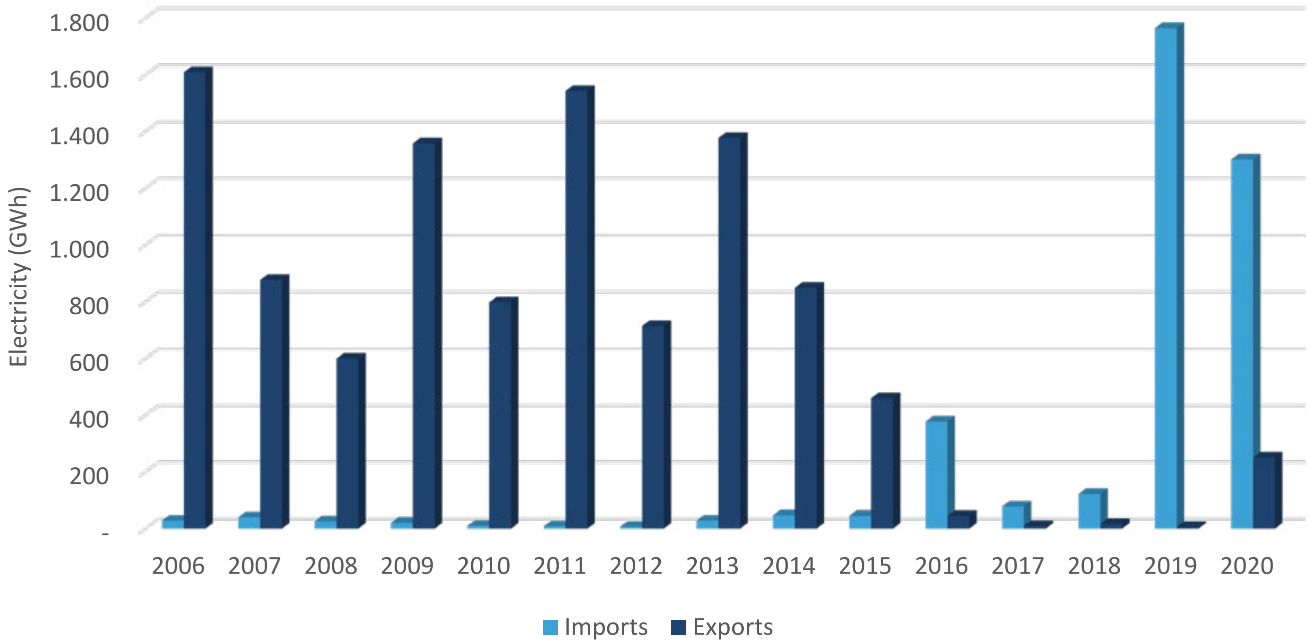
Figure 3a. **Electricity generation in Colombia by source 2016-2020**

Figure 3b. **Electricity imports and exports in Colombia 2006-2020**
Source of data: UPME (2022a) and XM (2021)

3a.

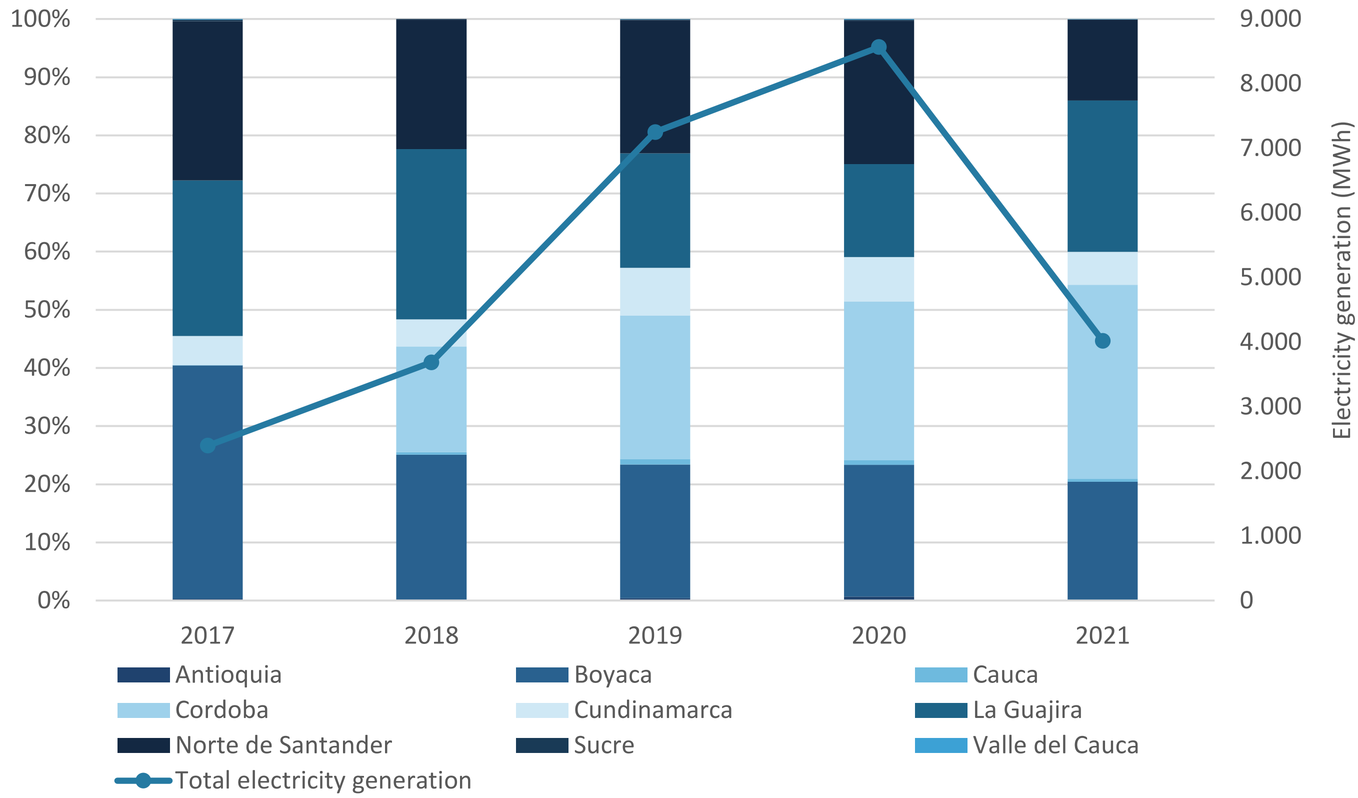


3b.



Electricity generation from coal-fired power plants increased 3.5 times from 2017 to 2020, peaking at over 8.5GWh in 2020. Departments where this source is most used are Cordoba, Antioquia, and Boyaca (Figure 4).

Figure 4. **Total coal-fired generation in Colombia by Department, 2017-2021**
Source of data: UPME (2022d)



The national grid of Colombia, known as the National Interconnected System (Sistema Interconectado Nacional – SIN, acronym in Spanish), has a 96.5% coverage, meaning that 495,000 households are still excluded (Consejo Privado de Competitividad, 2020; UPME, 2018). Moreover, 24 of the 33 Departments[1] of Colombia have between 90% to 100% of electricity coverage, while La Guajira, Vichada, and Vaupes Departments have coverage below 60%. In particular, La Guajira is seen as the Department with the highest number of houses without electricity service (81,960 houses) (UPME, 2018).

As part of the energy diversification strategy, the Mining and Energy Planning Unit (Unidad de Planeación Minero Energética - UPME, acronym in Spanish) proposed the addition of new coal-fired power plants in the central region of the country in the 2015 - 2050 National Energy Plan (UPME, 2015). Projections have suggested, however, the need for an additional 1050 MW, and propose small-scale coal mining as suppliers – the uptake of which would represent an increase of 12.5% in the current installed capacity. UPME (2015) includes mitigation of CO_2 emissions through the implementation of the so-called ‚clean coal technologies,‘ such as Carbon Capture and Storage (CCS) in this scenario. During the last update of the National Energy Plan (UPME, 2020), UPME proposed 4 possible indicative long-term scenarios to achieve the energy transformation – namely the consideration of the energy supply, contribution to climate change, technological risks, and the cost for the energy sector. None of these scenarios include new coal-fired power plants, but CCS is considered for the mitigation of CO_2 emissions from existing plants.

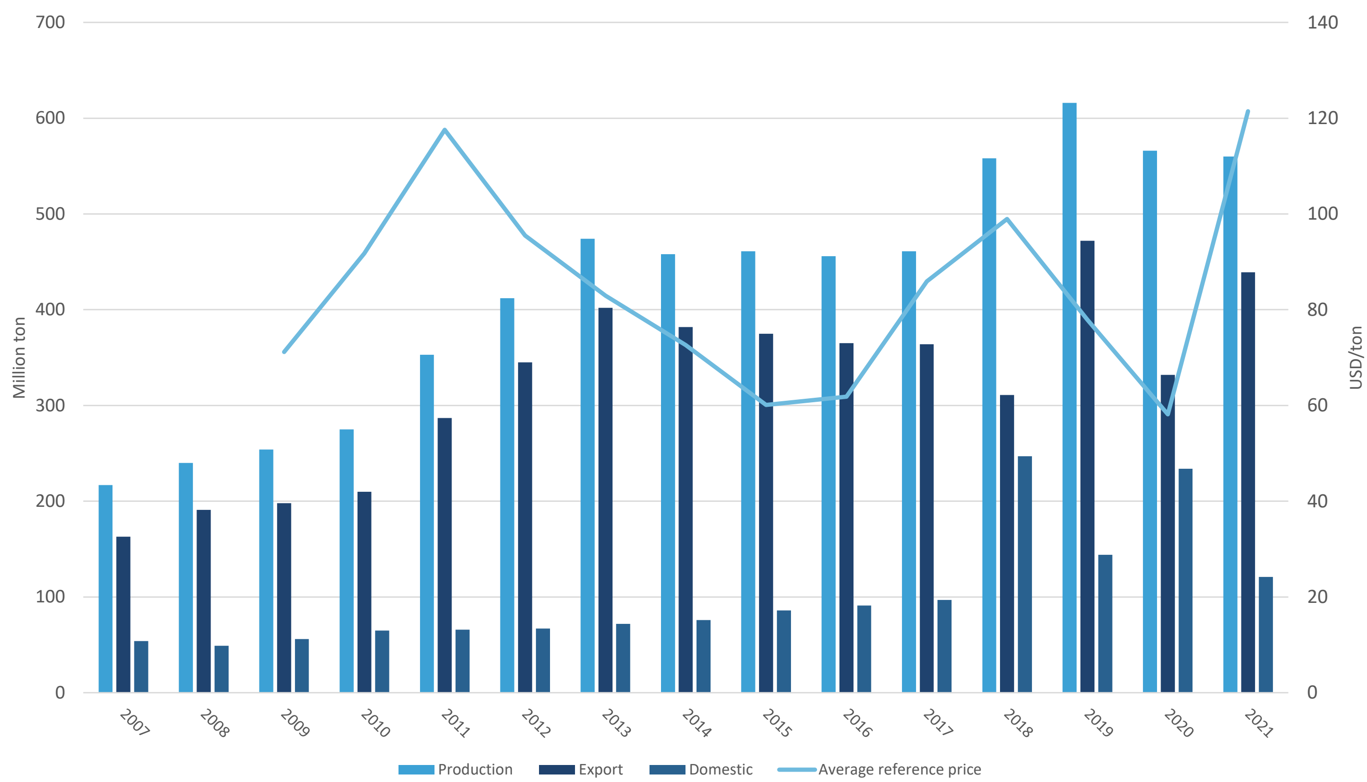
Cocora Valley, Colombia **Source: Fernanda Fierro on Unsplash**

[1] Administrative division in Colombia equivalent to Province, Region or State in other countries.

1.1.2 Indonesia

Indonesia has relied on coal to supply domestic demand since the beginning of 19th century, with the country beginning to export this commodity in the 1990s (Stanford, 2013). A constant surge in coal prices in response to the global increase in coal-fired power plants (CFPP) in the 2000s afforded significant power to Indonesia's coal company, solidifying the country as one of the world's largest coal exporters (Friederich & van Leeuwen, 2017; Stanford, 2013). According to the coal production, export, and reference prices from the Ministry of Energy and Mineral Resources (Kementerian Energi dan Sumber Daya Mineral - ESDM, acronym in Bahasa Indonesia), as reported in Indonesia Investment (2017), Lokadata (2021), and Mudassir (2021), only 15-40% of the extraction is utilised within the domestic market. This is because the global market is more economically attractive, although the 2020 pandemic resulted in the highest domestic use (Figure 5).

Figure 5. **Comparison of coal export and domestic uses, indirectly affected by coal reference price**
Source of data: Indonesia Investment (2017); Lokadata (2021); Mudassir (2021)



Although Indonesia has declared their Net Zero Emission (NZE) target in the Long-term Strategies for Low Carbon and Climate Resilient (LTS-LCCR) publication[2] , the use of coal as the main energy source will not be stopped immediately without strong political will. Until 2021, the sum of

2 Which at present stands at 2060 or sooner, with the renewable energy share target based on the National Energy Policy (Rencana Umum Energi Nasional - RUEN, acronym in Bahasa) for 23% in 2025.

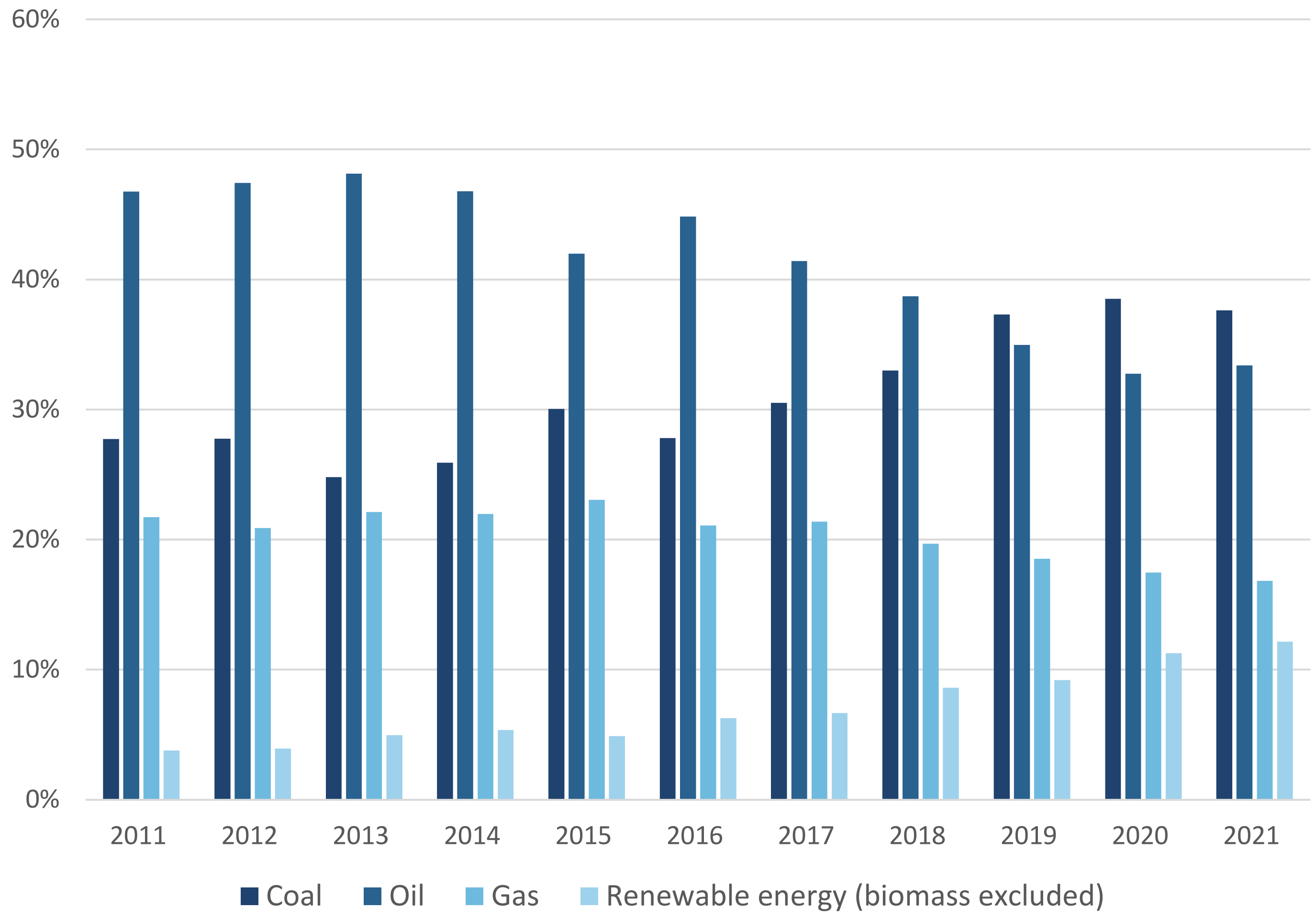
all non-renewable energy sources still dominated with more than 80% of the primary energy mix share. Renewables accounted for only 11.7% (Figure 6b), which is only 1% higher than the share for the previous year (2020). The renewables share growth is positive but remains at only 1-2% annually (Figure 6a), while the coal share itself reached 38%.

Based on the latest ESDM report (2022), of the 3,434,852 thousand BO-generated electricity across various sources, 58% of it was exported, while 6% was classified in stock changes last year – most of which was coal, due to the spike in the reference price. Therefore, 1,545,557 BOE of energy supply constitutes 22% from imported energy, with the rest being from national capture.

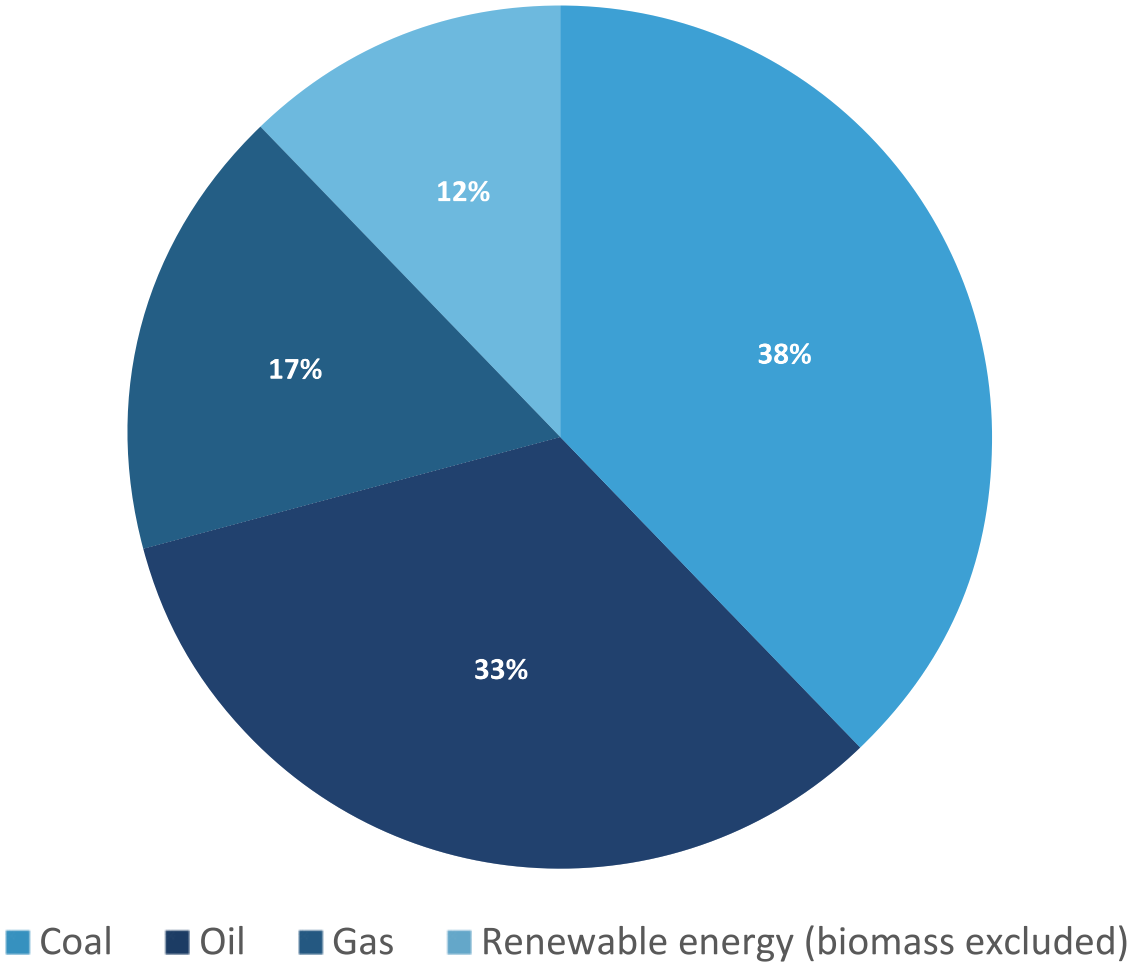
Figure 6a. **Energy sources trend 2011-2021**

Figure 6b. **Primary energy mix in 2021**
Source of data: ESDM (2022)

6a.



6b.



According to the LTS-LCCR established in 2021 by the Ministry of Environmental and Forestry (Kementerian Lingkungan Hidup dan Kehutanan – KLHK, acronym in Bahasa Indonesia), there are no significant differences between the energy demand projection using Business-as-usual (CPOS), transitional (TRNS), and low carbon (LCCP) scenarios as seen in Figure 7a. The energy demand projection in the LCCP scenario is only 10% lower than that of the CPOS scenario.

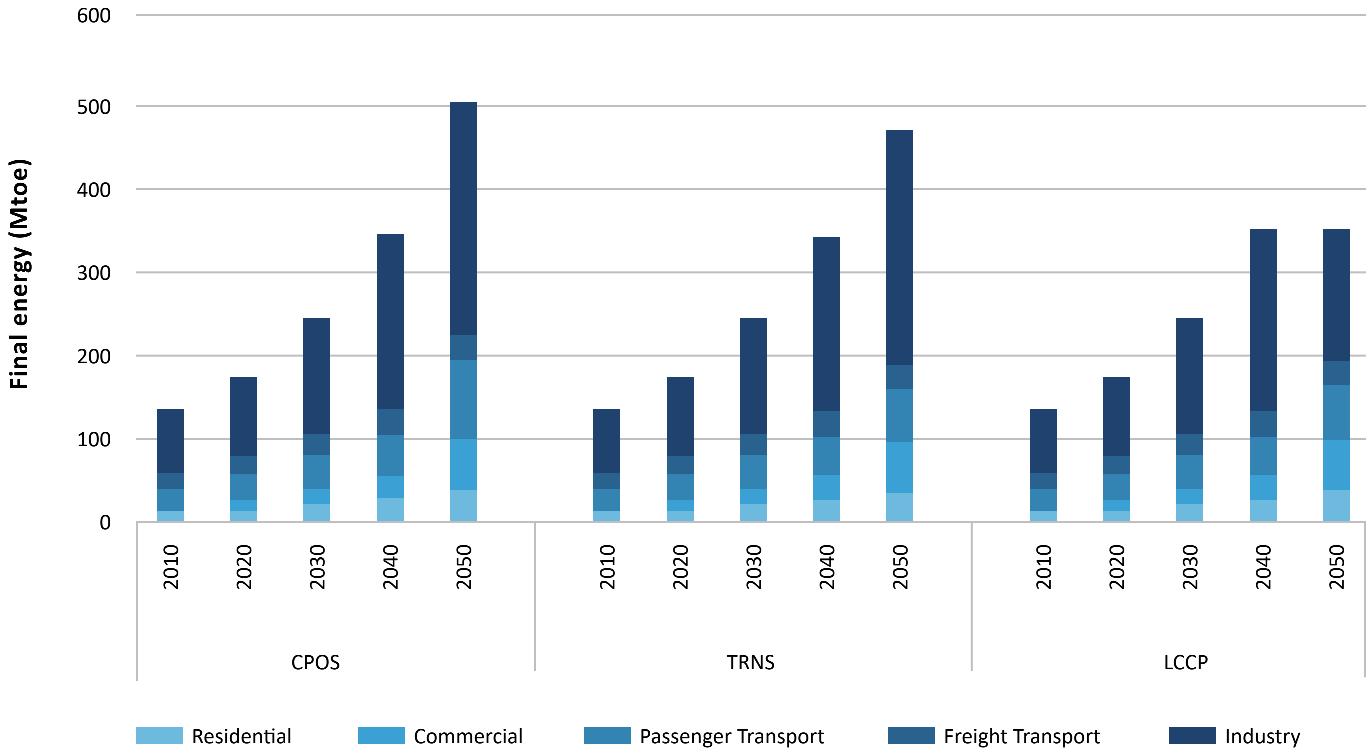
The projection for 2050 sees the demand of the residential and commercial sectors increase significantly in all scenarios, due to the contribution of the commercial sector to the economy, and the increase of social welfare (based on energy consumption measured by GDP and demographic changes). Although the LTS-LCCR document is claims to demonstrate Indonesia's enthusiasm for reducing emissions to net zero from all sectors by 2060 or sooner, coal will still be a factor in the energy mix throughout the 2050s, although it will be complemented by Carbon Capture Storage (CCS), as can be seen in Figure 7b.

This alternative raises many questions due to uncertainties in costs, emissions, and the efficiency of these systems (Chen et al., 2022; Durmaz, 2018; Greig & Uden, 2021).

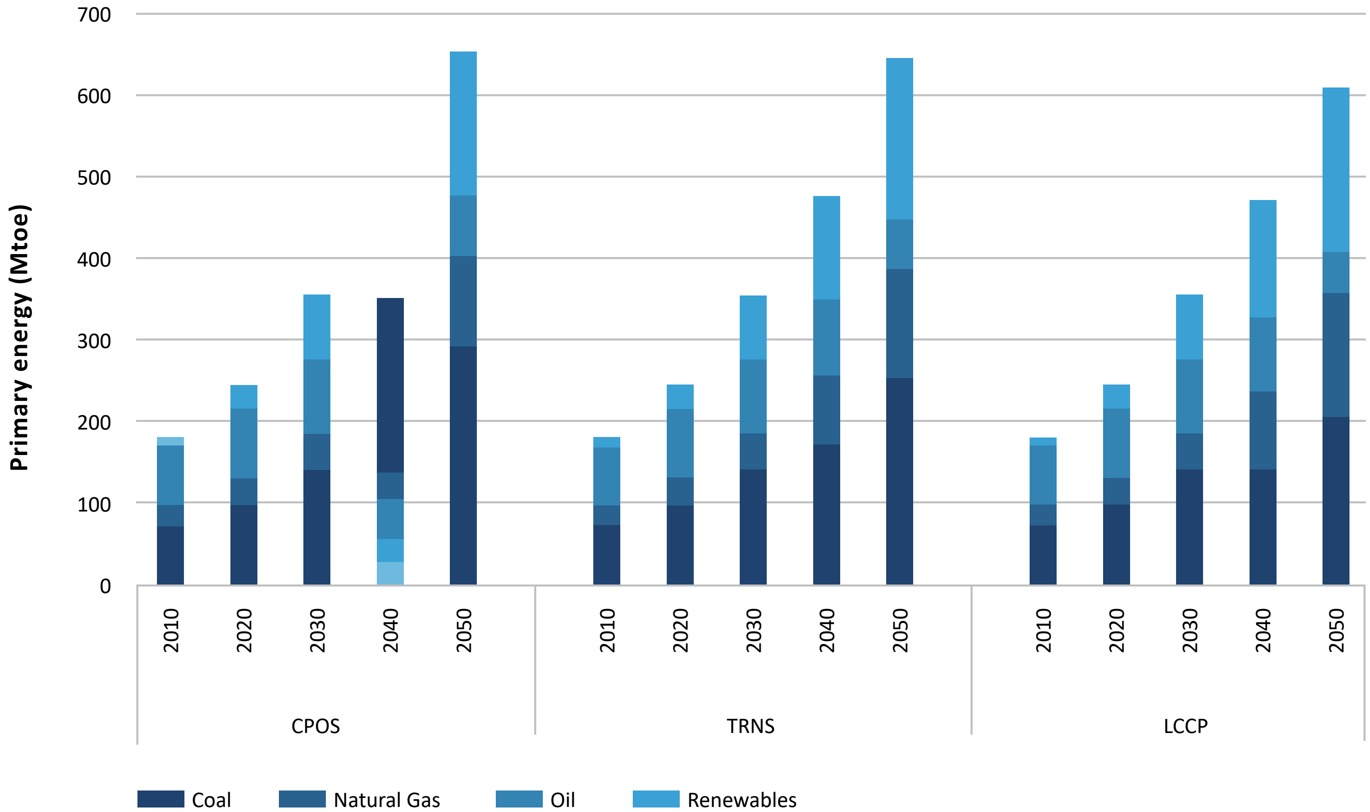
Figure 7a. Demand projection of Business-as-usual (CPOS), transitional (TRNS), and low carbon (LCCP) scenarios 2010-2050

Figure 7b. Primary energy supply projection for demand depicted in 7a.
Source of data: KLHK (2021)

7a.

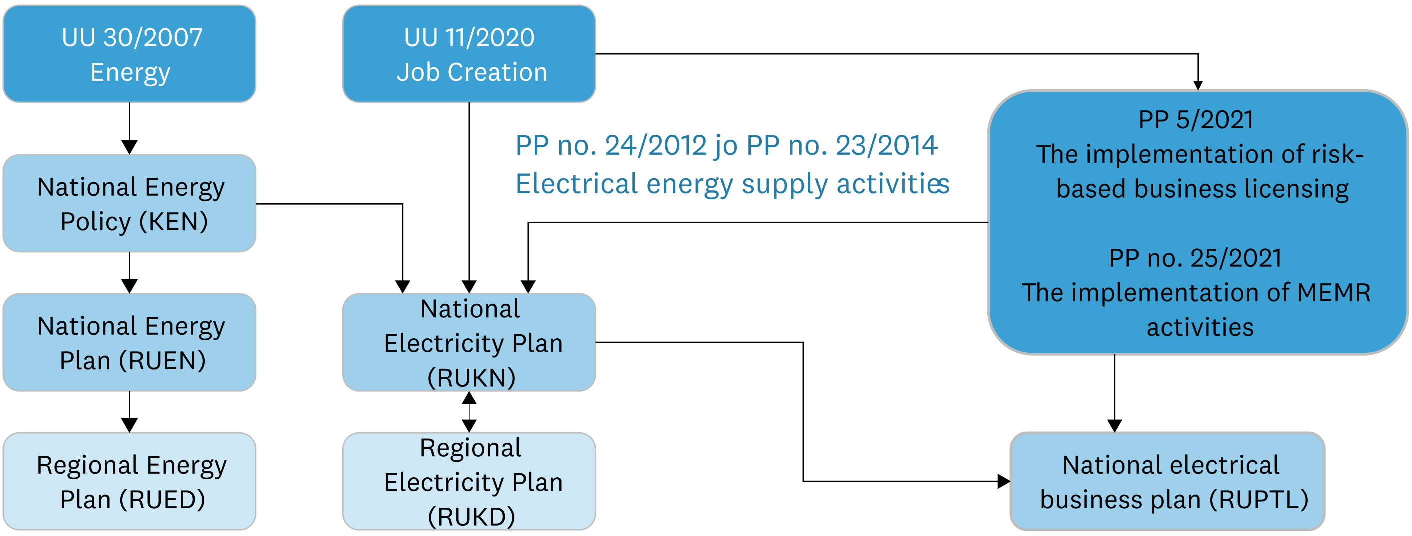


7b.



Several pieces of legislation and policies are in place to regulate and guide the energy supply and demand of Indonesia to provide affordable, abundant, and clean energy for all (Figure 8). On the subject of energy sector planning, we can highlight Law No. 30/2007 as the foundation for all energy regulations in Indonesia, specifically the National Energy Policy (Kebijakan Energi Nasional, KEN, acronym in Bahasa Indonesia), the National Energy Plan (Rencana Umum Energi Nasional, RUEN, in Bahasa), and the Regional Energy Plans (Rencana Umum Energy Daerah, RUED, in Bahasa).

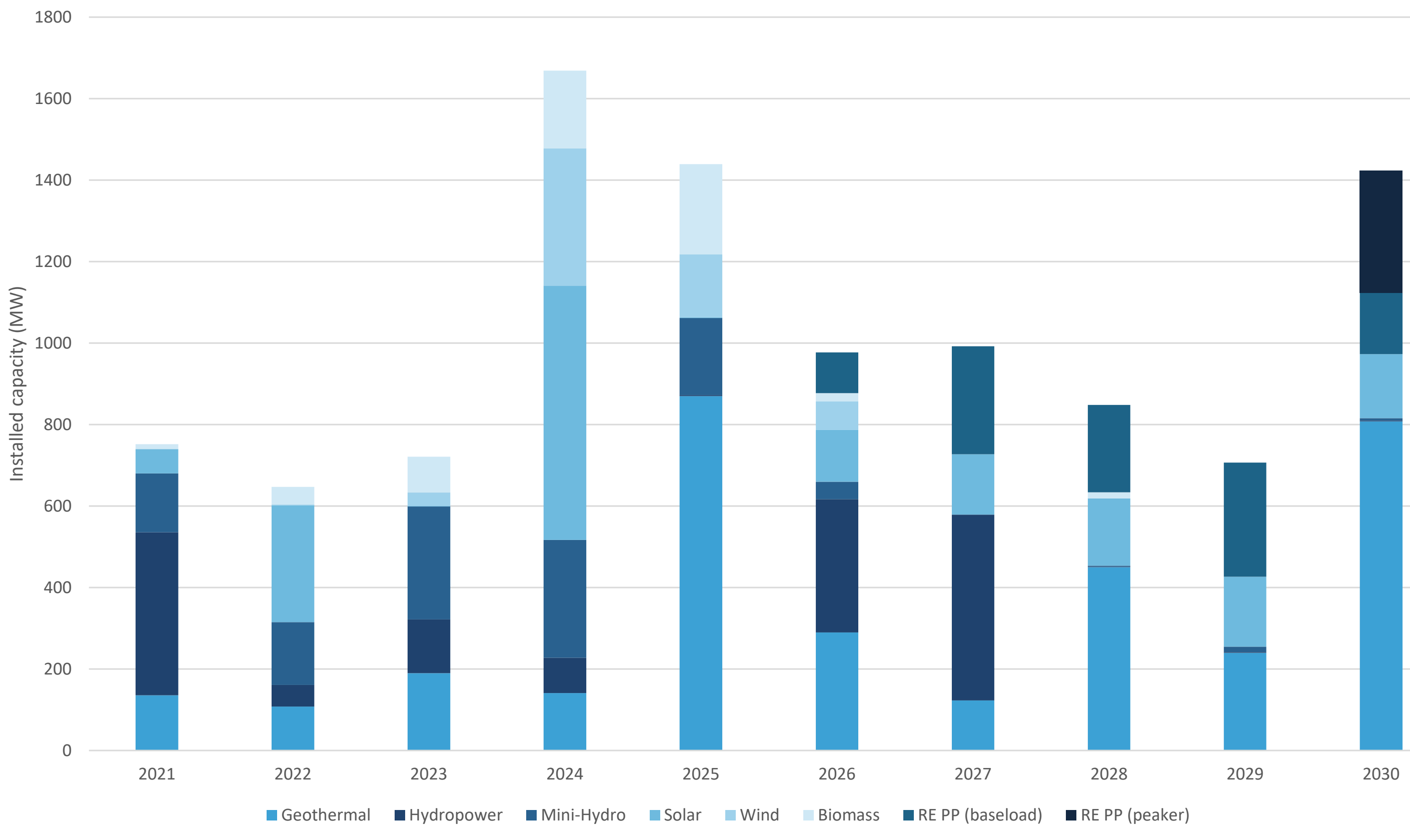
Figure 8. **Main regulations in the energy and electricity sectors according to ESDM's matrix**



National and regional electricity plans (Rencana Umum Ketenagalistrikan Nasional dan Daerah, RUKN and RUKD, acronyms in Bahasa Indonesia) have also been established: based on UU No. 11/2020 on job creation, the Government Regulation (PP) No. 5/2021 on the implementation of risk-based business licensing, PP No. 25/2021 on the implementation of MEMR activities, and PP No. 24/2012 amended by PP No. 23/2014 on electrical energy supply activities.

The National Electrical Business Plan (Rencana Usaha Penyediaan Tenaga Listrik, RUPTL, acronym in Bahasa Indonesia) has subsequently been created to follow all the targets and regulations stated in RUKN. The most recent KEN and RUPTL were launched in 2014 and 2021. RUPTL 2021-2030 claims to be the greenest RUPTL overall, presenting 20.9GW of new and renewable energy that has been incorporated in Indonesia's matrix up until 2030, with the highest development set to take place in 2024-2025 (Figure 9).

Figure 9. **Figure Renewable energy projection by source**
Source of data: RUPTL 2021-2030



As of September 2022, 25 out of the 34 Indonesian provinces have launched a RUED. With the goal of 2025, the provincial states' renewable energy sectors share targets of between 11.52% and 55.95%, while percentages for the year 2050 range from 17.16% to 76.65% (see Table 1). This broad range is attributed to a lack of precise directives from the national government regarding the targets at the provincial scale, which has resulted in the big question as to the inclusion of regional authorities in the policy making process. Such gaps may lead to Indonesia failing to achieve its national targets, which are at least 23% and 31% of the renewable energy mix of the total primary energy share in 2025 and 2050, due to the less-ambitious goals of regional authorities. More information about the RUEDs is detailed in the Appendix RUEDs.

Table 1. Renewable energy targets for 2025 and 2050 in each province that issued a RUED

Source of data: RUEDs of the listed provinces

PROVINCE	RENEWABLE ENERGY SHARE TARGET (%)	
	2025	2050
West Java	20.10	28.44
Central Java	21.32	28.82
East Java	17.09	19.56
NTB	35.00	50.00
NTT	24.00	39.00
North Kalimantan	55.95	76.65
East Kalimantan	12.39	28.72
Lampung	36.00	47.00
Bengkulu	37.00	52.00
Central Sulawesi	30.51	42.09
Gorontalo	15.45	37.90
Jambi	24.00	40.00

PROVINCE	RENEWABLE ENERGY SHARE TARGET (%)	
Aceh	25.50	41.30
Bangka Belitung	17.21	30.97
West Sumatera	51.70	70.90
South Kalimantan	19.60	24.70
DIY	11.52	17.16
South Sumatera	21.06	22.56
Bali	11.15	20.01
West Sulawesi	46.00	65.00
Southeast Sulawesi	20.00	32.00
West Kalimantan	32.20	32.50
South Sulawesi	20.00	32.00

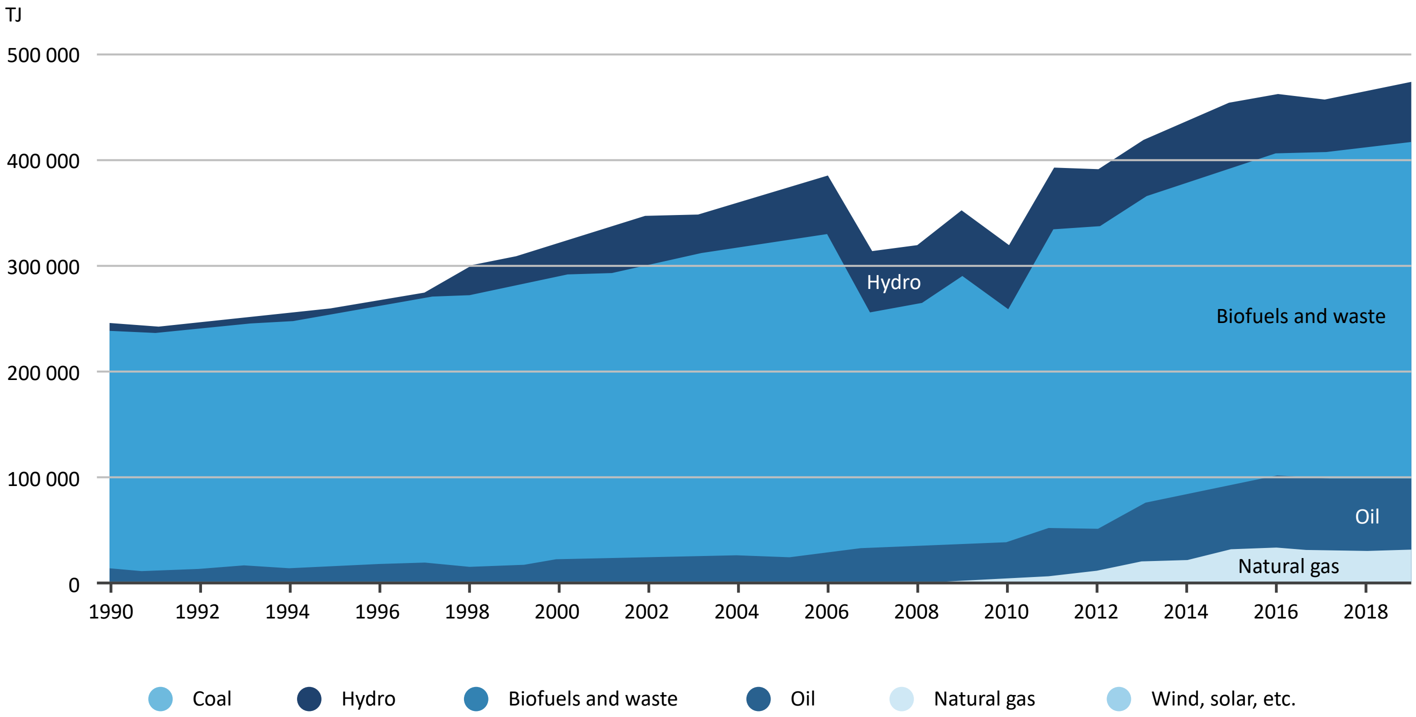
Gedung Negara Grahadi, Embong Kali Asin, Indonesia

Source: Prananta Haroun on Unsplash

1.1.3 Mozambique

Despite being one of the world's poorest nations, Mozambique has an immense energy potential across diverse sources: hydropower, natural gas, oil, biofuels, and renewables. However, under 30% of the population has reliable access to electricity, most of which is found in urban areas. As illustrated in Figure 10, most of the energy use is from biofuels and electricity generation from hydropower.

Figure 10. **Total Energy Supply in Mozambique 1990-2019**
Source of data: IEA (2020)



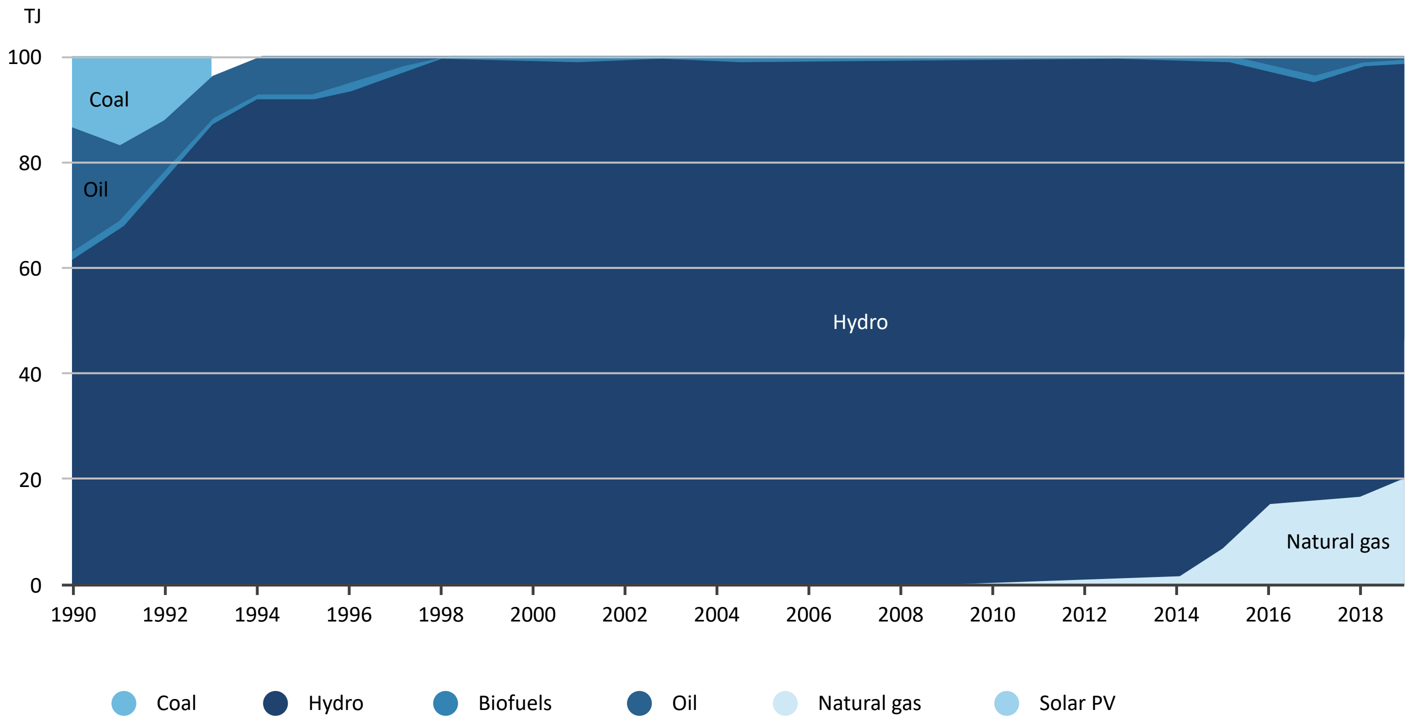
The most updated data on historic energy consumption is from 1990 to 2019, and shows the industry sector to have gradually become the main consumer of the energy produced in the country (see figure 11).

Figure 11a. Electricity generation in Mozambique by source 1990-2019

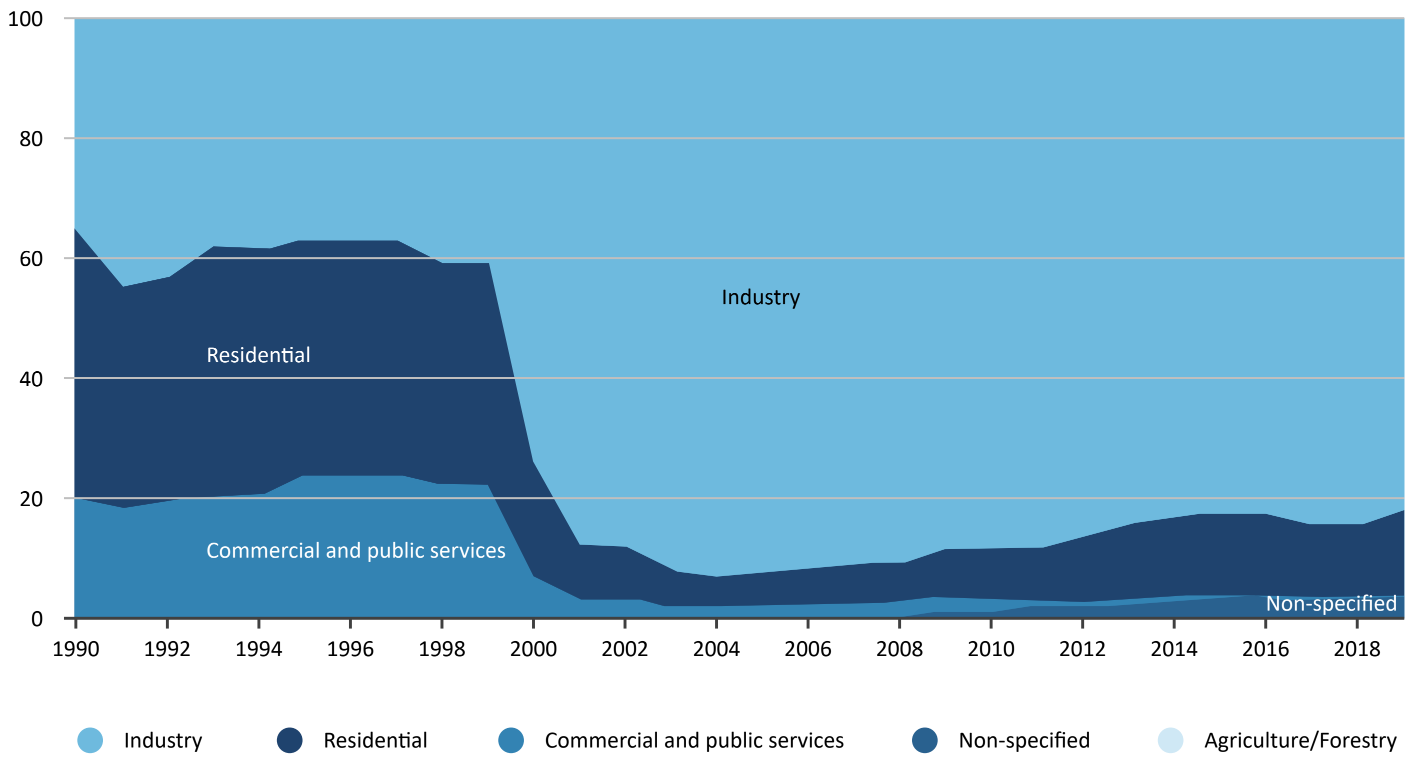
Figure 11b. Electricity Consumption in Mozambique by sector 1990-2019

Source o data: IEA (2020)

11a.



11b.



Mozambique has a total installed capacity of 3,001 MW (USAID, 2022). In terms of the energy mix, for 2020 hydropower was the dominating electricity source with 79% (2,189 MW), followed by 16% from gas (442 MW), 4% from heavy fuel oil (HFO) (108 MW) and 1% from solar (41 MW) (ALER & AMER, 2021).

Currently, there are six working hydropower stations across the country:

- Hidroeléctrica de Cahora Bassa (HCB): 2,075 MW
- Mavuzi (52 MW)
- Chicamba (38.4 MW)
- Corumana (16.6 MW)
- Cuamba (1.9 MW)
- Lichinga (0.73 MW)

The below table listing Mozambique's Key Energy Indicators shows the most recent energy indicators available. In 2018, the total primary energy supply was 10.43 Mtoe, from a total of 20.23 Mtoe produced that year. Final electricity consumption was only 13.63 TWh, however, this number has increased drastically by more than 2000% since 1990.

Table 2. **Key Energy Indicators for Mozambique**
Source of data: EIA (2022)

INDICATOR	VALUE
Energy capture	20.23 Mton
Total primary energy supply	10.43 Mton
Total electricity consumption	13.63 TWh
Electricity consumption per capita	0.5 MWh

There has been a continued trend of increased use of biofuels since 1990, which is highly detrimental to the environment due to the deforestation associated with monocultures, and its subsequent impact on habitat loss and biodiversity (Mokveld & von Eije, 2018). Access to electricity is concentrated in urban areas, and although estimates vary, in the time since the early 2000s, the electrification rate of Mozambique has gone from 5% (2001) to between 26% to 44% (see CESET Team, 2020). Electricity demand is expected to increase by 8–10% within the next decade (Koubek & Karanitsch, 2022)

Mozambique generates 159% of its energy consumption and has significant potential to deploy further solar and hydropower (WorldData.org, 2022). However, the national transmission system does not cover all areas in the country. For example, Maputo's energy is imported from South Africa's ESKOM, as no direct connection exists between HCB and the city (International Trade Administration, 2021). Due to these infrastructure challenges, Mozambique only procures up to 500 MW from its largest hydropower dam, Hidroeléctrica de Cahora Bassa (HCB) for domestic use (Energypedia, 2022) and transports the rest to South Africa, Zimbabwe, Botswana, and other countries in the region.

Mozambique relies heavily on the export of commercial electricity to South Africa from HCB to generate foreign exchange income. In 2020, Mozambique exported USD310 million in electricity. Main destinations were South Africa (USD249 million), Zimbabwe (USD48.3 million), Lesotho (USD7.65 million), Eswatini (USD3.21 million), and Zambia (USD1.18 million). In the same year, Mozambique imported USD251 million in electricity, mainly from South Africa (USD 250 million), Zambia (USD233.000), Malawi (USD203.000), Zimbabwe (USD94.100), and Eswatini (USD37.400) (OEC, 2020).

Table 3 highlights the overall balance of trade in energy from Mozambique, showing that the country's net trade is in exports, and that its energy self-sufficiency has grown over a 5-year period.

Table 3. **Primary Energy Trade**
Source of data: IRENA (2022)

PRIMARY ENERGY TRADE	2014	2019
Imports (TJ)	114,972	99,273
Exports (TJ)	300,370	470,951
Net trade (TJ)	185,398	371,678
Imports (% of supply)	28	23
Exports (% of production)	47	59
Energy self-sufficiency (%)	156	187

Boat in Mozambique's coast

Source: Deborah Varrie on Unsplash

1.1.4 South Africa

South Africa's economic and industrial development is highly dependent on the energy sector, with coal at the core of fossil fuel systems (CIF, 2020; WWF, 2017; Winkler et al., 2020). The Electricity Supply Commission (Eskom), along with the South African Coal, Oil, and Gas Corporation (SASOL) are the biggest consumers of domestic coal, estimated at 90%. Eskom generates 95% of the country's electricity, 90% of which is from coal-fired power plants. The energy-intensive user group (EIUG) is a non-profit association of energy intensive consumers whose members account for over 40% electricity consumption in South Africa (DPE, 2019; Eskom, 2019).

Eskom is a public electricity company that initially started as a non-profit organisation in 1923 with the aim of developing South Africa's EIUGs. Eskom was exempted from paying tax and expected to sell electricity cheaply (Chavez et al., 2020). The low cost of coal was also attributed to the long-term supply contracts, cheap labour, and strategic location of the power plants across the coal mining regions to reduce transport costs (Steyn et al., 2017). During the Apartheid era, electricity access was limited, with only one-third of the population being connected to the grid. After attaining independence in 1994, the national electrification programme aimed to connect 2.5 million households by 2000. This led to a drastic increase in electricity access from 35%, to 85% of the population (Baker & Phillips, 2019; World Bank, 2020).

Electricity supply challenges have affected the country, with shortages in supply to the national grid starting in 2007 to date scheduled load shedding to cater for the shortfall (Winkler et al., 2020). The decline in demand for electricity is associated with the exorbitant increase in electricity prices and tariffs, plus the financial, political, and technical crises under Eskom (Cassim et al., 2021; Chavez et al., 2020).

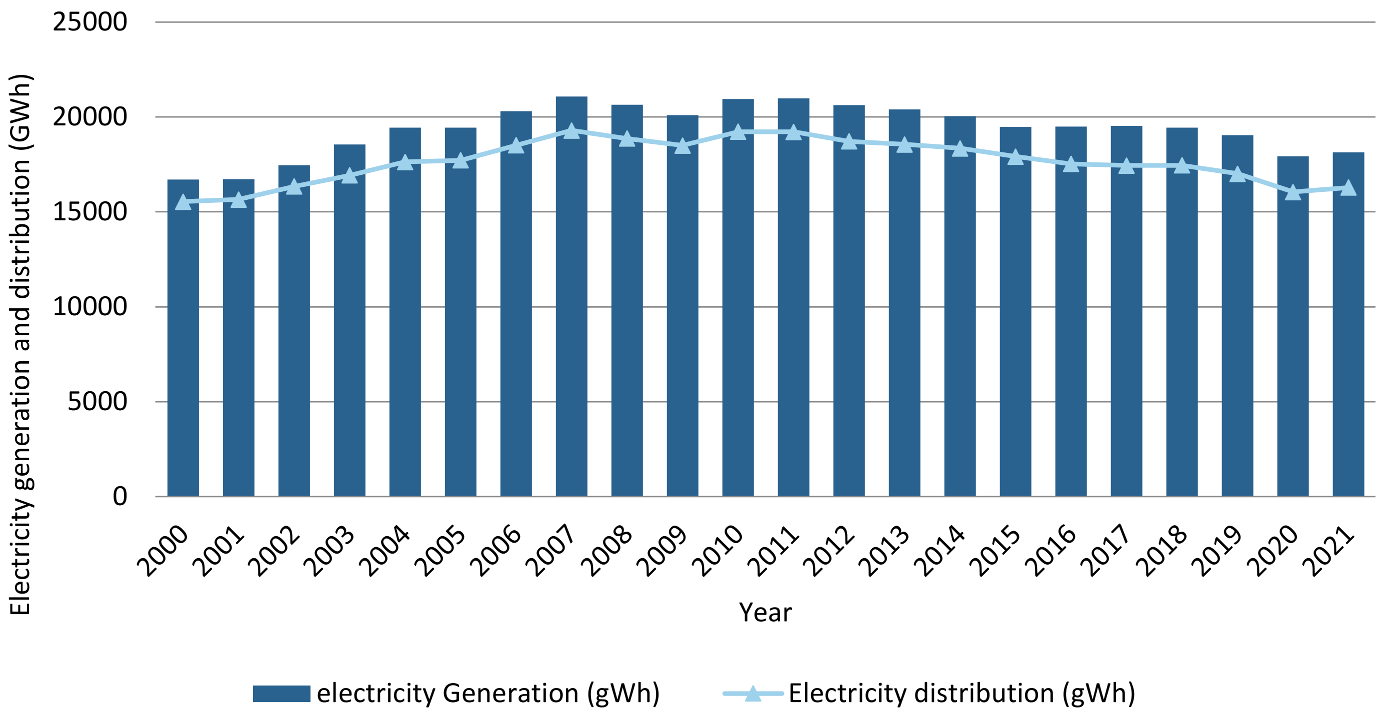
As figure 12 shows, coal-fired power plants dominate generation capacity with over 90%, followed by nuclear power and others. It can also be noted that coal has continually dominated the energy sector over the years. In 2021 alone, coal contributed 74% of the total, while renewable energies only accounted for 5%.

Figure 12a. **Eskom electricity generation and distribution**

Figure 12b. **Eskom total electricity generation**

Sources of data: a. Stats SA (2021) b. Eskom (2022) and c. CT (2021) (adapted)

12a.



12b.

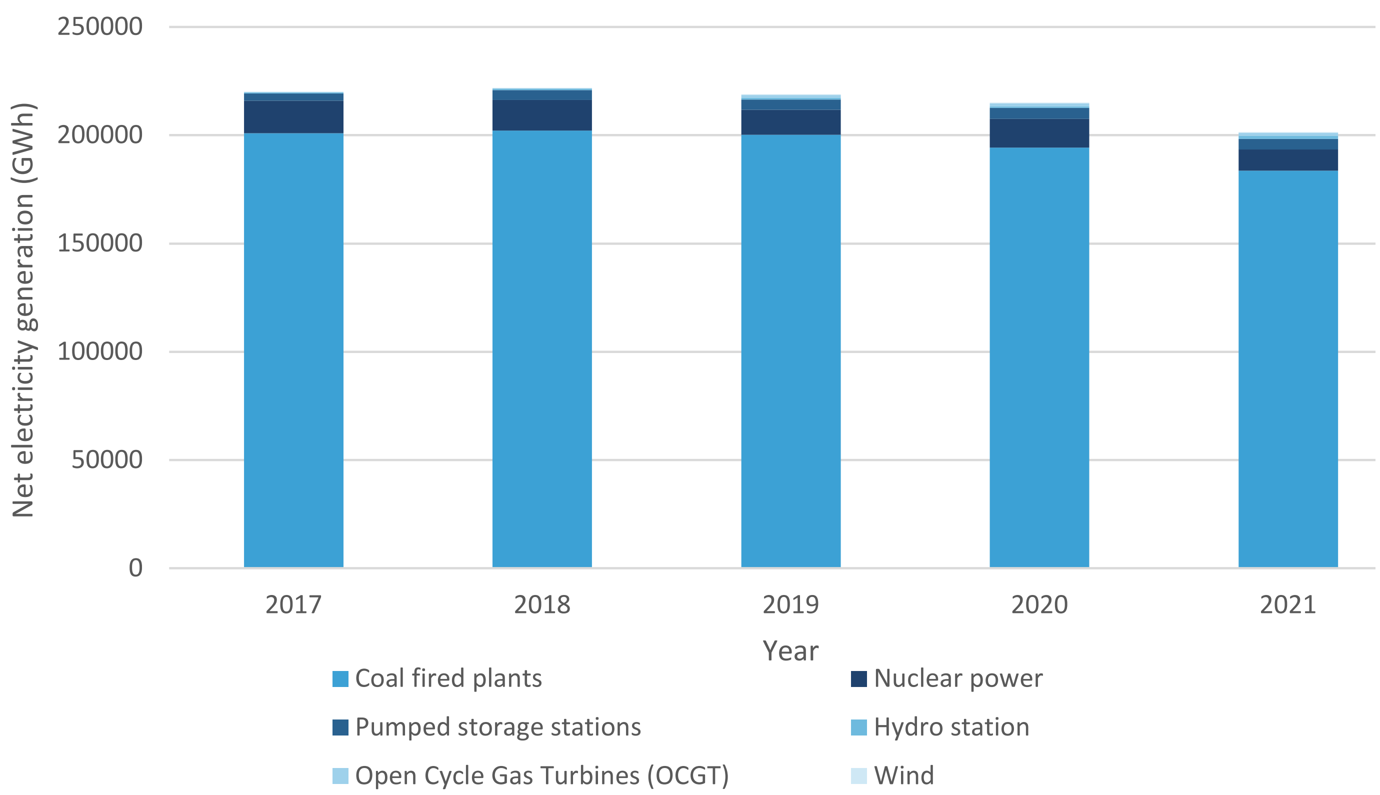
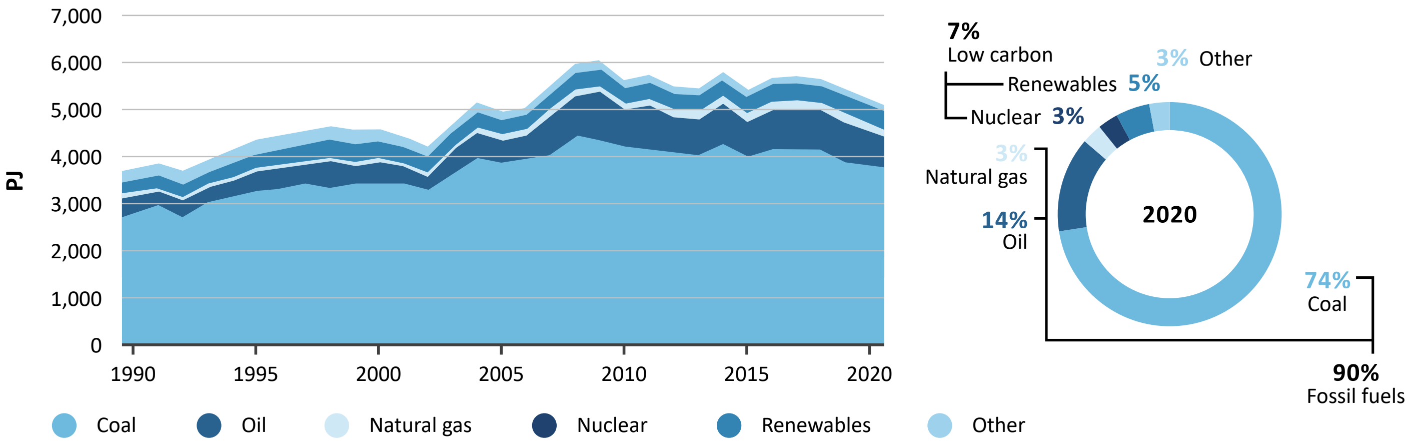


Figure 12c. Historical total primary energy supply 1990-2020



In recent years, the National Energy Regulator of South Africa (NERSA) has increased tariffs, which Eskom then passes on to the customers and municipalities. Figure 13 shows a gradual price increase per kWh of electricity sold over the years from 2007 to 2020. Some of the causes of the crisis are attributed to decades of mismanagement that has led to periodic load-shedding (rotational national power outages) and high debt (Cassim et al., 2021; Eskom, 2020). The highest load-shedding – at stage 6 - was first noticed in 2019 and was repeated multiple times in 2022 due to severe strain from failing generation units. Figure 14 presents the purchase of electricity in the water, coal, and agricultural sectors, with the results indicating agriculture to be the main consumer of electricity for the period assessed. In the year 2016, all 3 sectors showed a significant electricity purchase in comparison to other years.

Figure 13. Prices of electricity for the different consumers
Source of data: DMRE (2021)

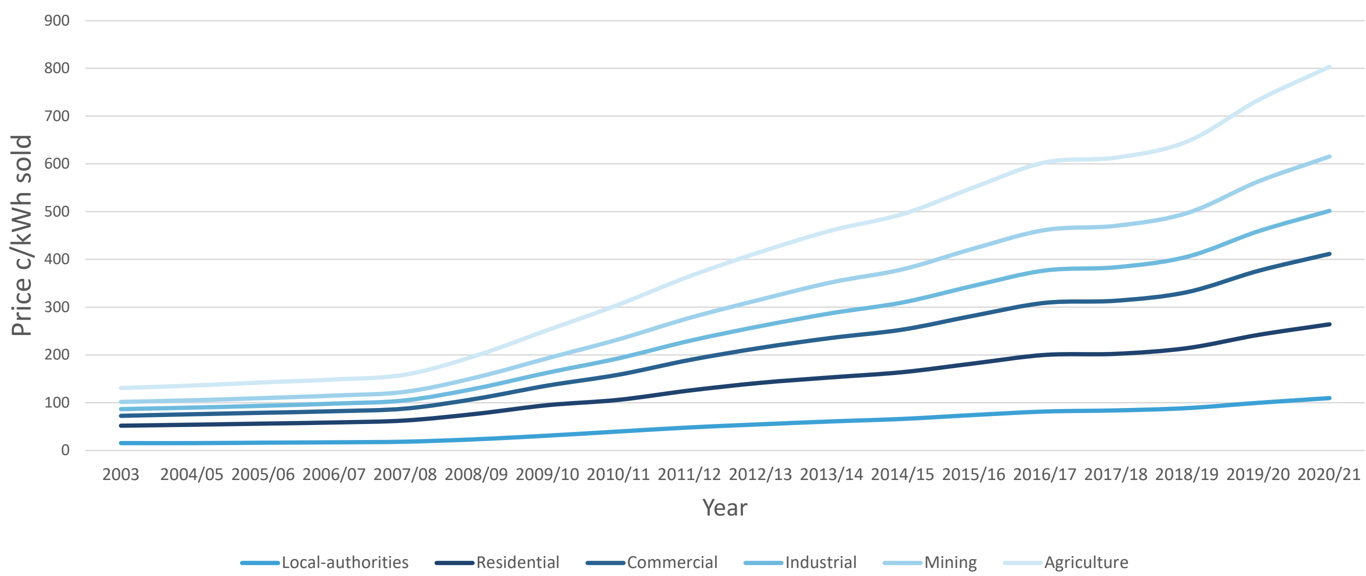
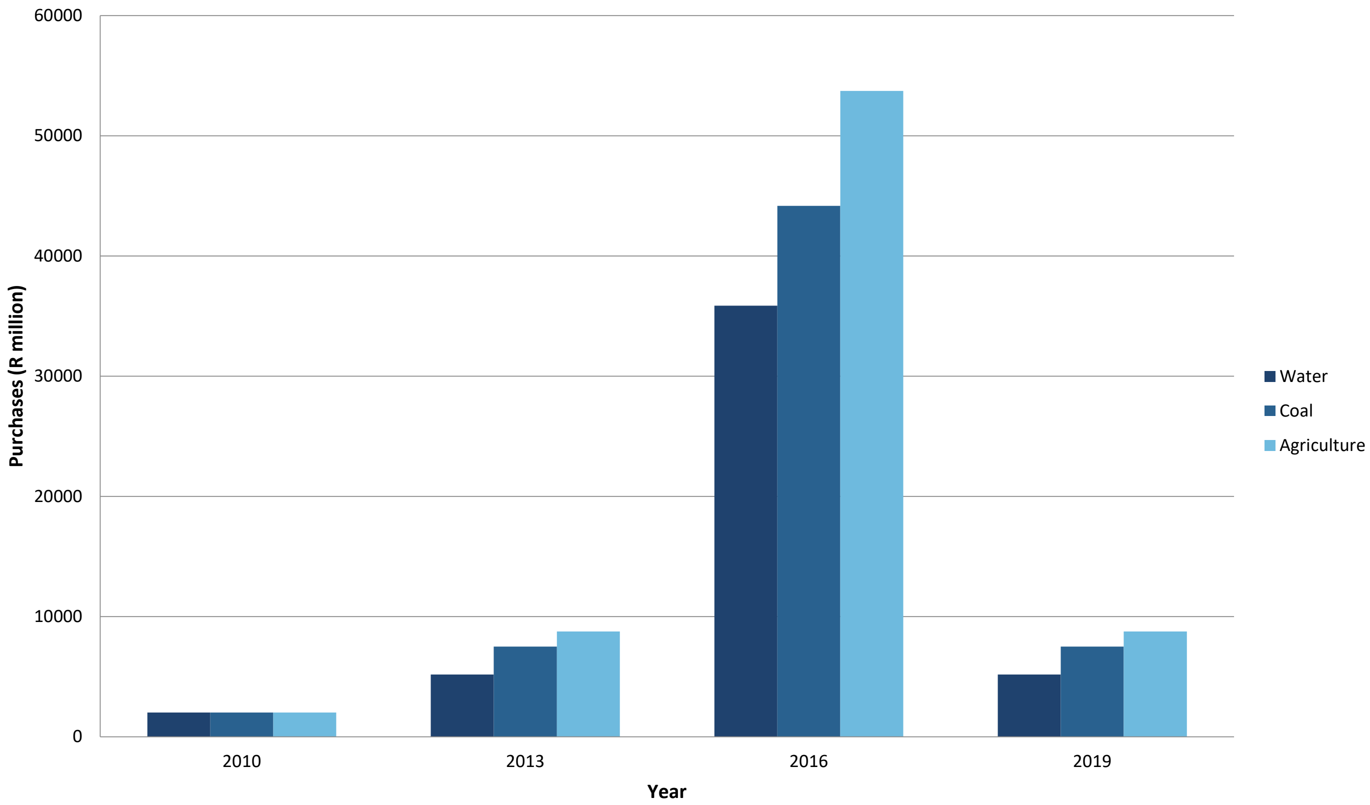


Figure 14. Purchases of electricity for water, coal and agriculture
Source of data: Stats (2019)



These energy policies are influenced by the Minerals Energy Complex (MEC), a system where minerals and energy are interdependent with coal at the centre of South Africa's economy (Louise et al., 2017; Marquard, 2006). Table 4, provides a summary of the policies, regulations, and plans that have come to influence the energy sector. Despite the basic provision of free electricity to low-income consumers of up to 50 KWh/month, as stipulated in the Electricity Basic Services Support Tariff Policy, 2003 (RSA, 2003), it is not sufficient to meeting basic household needs. In many low-income households, alternative energy sources such as paraffin, wood, and coal are used due to the high cost associated with grid-connected electricity (Baker & Phillips, 2019; Tait, 2016).

Table 4. Energy Policies, Regulations and Plans

TYPE	AREA	DESCRIPTION
Policy	The White Paper on the Energy Policy of the Republic of South Africa of 1998	The policy contains the government's plans regarding the supply and consumption of energy for the next decade. It strengthens existing energy systems, calls for the development of under-developed systems and demonstrates a resolve to bring about extensive change to the energy sector
Legislation	National Energy Act, 2008 (Act No. 34 of 2008)	Its purpose is to ensure availability and diversity in energy resources, in sustainable quantities at affordable prices. All, considering environmental management requirements and interactions amongst economic sectors
Legislation	Electricity Regulation Act, 2006	It aims to: a) Establish a national regulatory framework for the electricity supply industry; b) Make the National Energy Regulator the custodian and enforcer of the national electricity regulatory framework; c) Provide for licences and registration as the manner in which generation, transmission, distribution, trading and the import and export of electricity are regulated; d) Provide for matters connected therewith.
Legislation	Electricity Regulation Act: Independent Power Producers (IPP) Procurement Programme. Determination under Section 34(1) of the electricity Regulation Act, 2016 (Act No. 4 of 2006)	2000 megawatts (MW) should be procured from a range of energy source technologies in accordance with the short -term risk mitigation capacity allocated under the heading "Others ", for the years 2019 to 2022, in Table 5 of the Integrated Resource Plan for Electricity 2019 - 2030
Policy	Electricity Pricing Policy, 2008	It seeks to obtain a balance between competing objectives such as affordable electricity tariffs for low-income consumers and cost reflective electricity tariffs for all other users.
Policy	Electricity Basic Services Support Tariff (Free Basic Electricity) Policy, 2003	It establishes that grid-connected households must be provided with 50kWh of free basic electricity funded mainly through relevant intergovernmental transfers, subject to the contractual obligations between the Service Provider and the consumer being met.
Plan	National Integrated Energy Plan (IEP), 2016	The purpose of the IEP is to provide a roadmap of the future energy landscape at the national level, which guides future energy infrastructure investments and policy development. The National Energy Act requires the IEP to have a planning horizon of no less than 20 years.

South of Java, Indonesia

Source: Silas Baisch for Unsplash

1.2 Coal sector in the NEXtra Core countries

This next section contains the description of the coal regions that have been considered for the purpose of this study, including the associated infrastructure along the coal value chain (roads, railroads, ports, and terminals, etc.). It also contains the main regulations associated with the exploration, exploitation, closure, and post-closure stages, and addresses the employment estimates of the sector in each country.

1.2.1 Colombia

Colombia has 6,500Mton of coal reserves and 15,000 Mton of coal resources, which represents 90% of the metallurgical coal and 47% of thermal coal of Latin America and the Caribbean (ANLA, 2013). Figure 15a shows the location of some 1034 coal mining concessions, with a total area of 4965.1km2 and 14 coal-fired power plants (CFPP) currently in operation (ANM, 2022b; UPME, 2022d; XM, 2022). According to UPME (2022), no new CFPP are under construction. In Colombia, CFPP are used as a support/emergency source of electricity when water in the reservoirs is scarce due to the El Niño Southern Oscillation (ENSO).

La Guajira and Cesar are characterised by very a few but very large, and open-pit mines. According to the Colombian Mining Cadaster (Catastro Minero Colombiano – CMC, acronym in Spanish), there are 33 and 10 mining concessions in La Guajira and Cesar respectively (ANM, 2022b). Together, they account for 33% of all coal mining areas in the country (Figure 15b). Similarly, both departments were responsible for 96% of the total annual extraction in 2021. Conversely, the others are characterised by a very large number (991) of very small concessions and underground mines (67% of the total coal mining area).

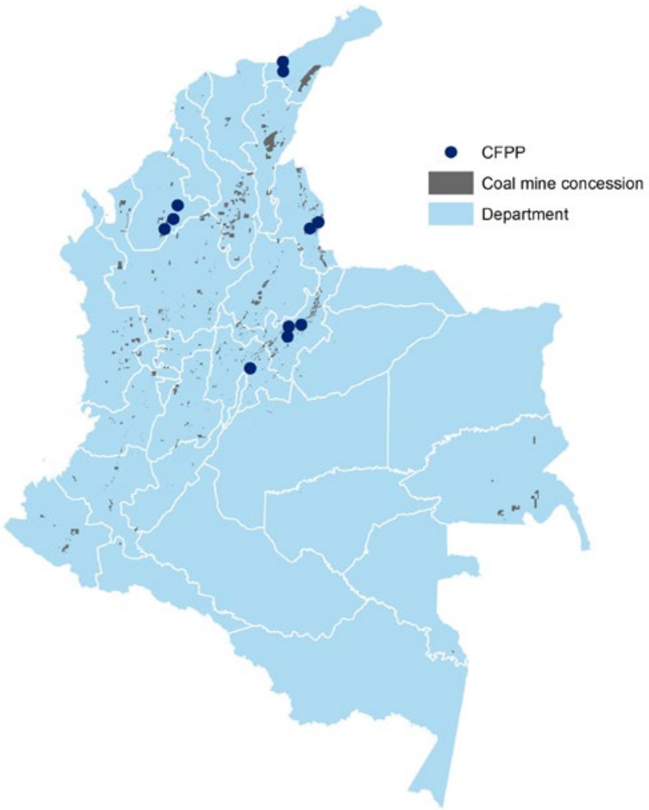
The data collected and analysed for this report focuses on La Guajira, Cesar, Cordoba, Cundinamarca, Norte de Santander, and Boyacá, due to the locations of coal mines, CPFFs and export facilities (railroads and ports) in these areas. This data was clustered into two main groups: The North region (La Guajira and Cesar Departments), and the Central region (Norte de Santander, Boyaca, Cordoba and Cundinamarca Departments).

Figure 15a. Location of coal mining concessions and CFPPs in Colombia

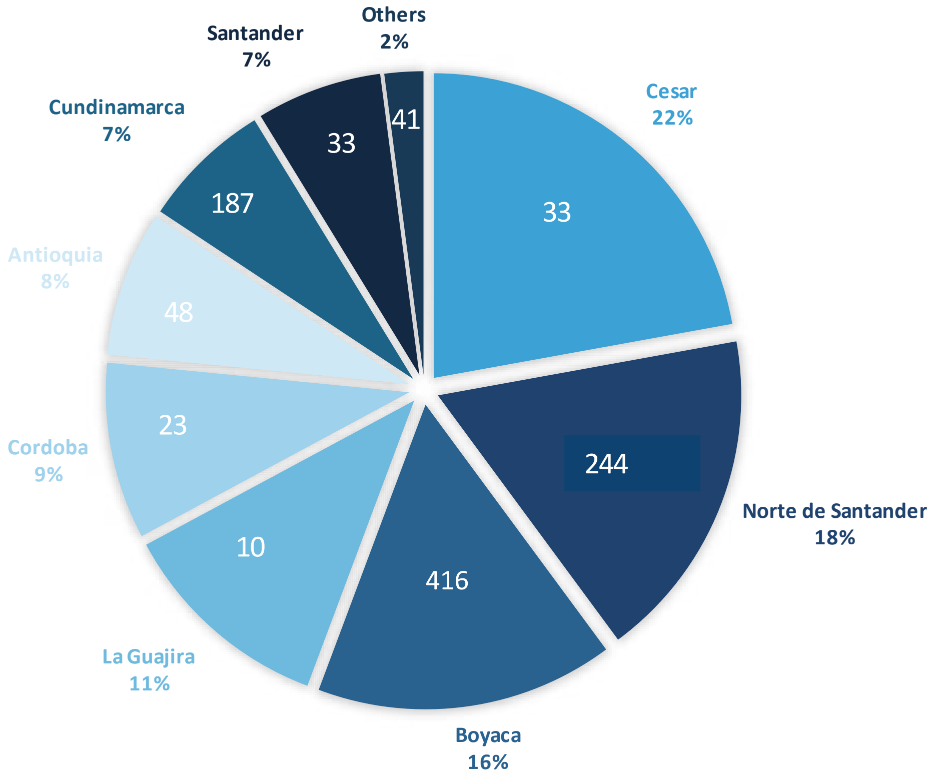
Figure 15b. Pie chart with percentages of area occupied by coal mining concessions with respect to the total area of mining concessions in the country and number of coal mining concessions (inside)

Source of data: ANM (2022c)

15a.



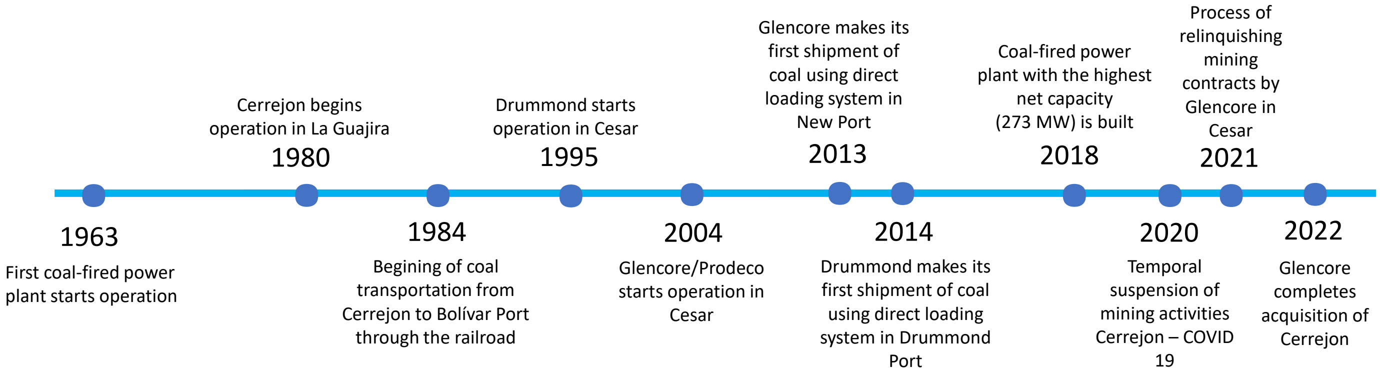
15b.



In terms of coal infrastructure, there are six main coal ports in Colombia: Two in La Guajira (Bolívar and Brisa Ports), three in Magdalena (Río Córdoba, New Port and Drummond Port). Coal is transported to these ports via railroad. 80% of coke is exported from the Port of Barranquilla (Fenalcarbón, 2022). Railroads belong to the coal companies operating in La Guajira (Glencore) and Cesar (Drummond and Glencore).

Figure 16 shows the most significant events in the history of the country's coal sector. Milestones include the commencement of operations for the first open-pit coal mine (La Guajira, 1980); the start of mining in Cesar (1995); the first mining concession relinquishment in history (Prodeco, a Glencore subsidiary, 2021), etc.

Figure 16. **Coal timeline in Colombia**



Before referring to the basic regulatory framework for coal mining in Colombia, it is necessary to mention Law 99 (1993) created the Ministry of Environment and Sustainable Development (Ministerio de Ambiente y Desarrollo Sostenible – MADS being the acronym in Spanish) reorganised the public sector in charge of environmental management and conservation in Colombia (Congreso de la República, 1993). The current Mining Law, also referred as the Mining Code, is the 2001 Law 685 (Congreso de la República, 2001). It defines the set of guidelines and procedures to regulate the exploration and exploitation of minerals in Colombia.

On the other hand, Decree 2820 (2010) regulates section VIII of Law 99 (1993) regarding environmental licenses (MADS, 2010). It defines the methodology for Environmental Impact Studies and establishes the criteria for the approval or denial of environmental licenses. It should be noted that those mining concessions granted before the ratification of Law 99 did not require an environmental license; this is the case for some of the coal mining concessions for Cerrejon in La Guajira.

Although the Environmental Impact Study includes a mine closure plan, there are limited regulations concerning the technical parameters that are to be achieved by the owners of the mines - both at the closure and post-closure phases. Additionally, there are other legal instruments - such as the relinquishment of mining concessions - that lack the procedures and protocols to ensure the responsible end of operations.

There are certain relevant elements in Law 685 of 2001 that are worth mentioning, namely that:

- All minerals are owned by the State. Operators must opt for a concession contract, to be duly granted by, and registered in the National Mining Registry. There are also association contracts that can explore and exploit concession areas without requiring a commercial company.
- The concession contract is granted for an initial term of 30 years at most, later renewable for another 30.
- Prior to operations, an Environmental License is required; this is granted upon the review and approval of an Environmental Impact Statement from the prospective operator.
- In cases of the termination of the mining concession, the operator must take all environmental measures necessary for the closure or abandonment of the mine site. For this purpose, the operator is required to continue funding for three (3) years following the date of termination of the contract.

Additionally, Law 685 (2001) defines the Special Reserve Areas (ARE, being the acronym in Spanish), declared by the National Mining Agency (Agencia Nacional de Minería – ANM) as free areas in which there are traditional, informal mining operations – and for which a concession shall only be granted to those communities that have exercised these traditional mining activities. Conversely, Law 1753 (2015) declared that, as the ANM has defined the strategic minerals of the country, it can allocate the title of Strategic Mining Reserve Area (AEM, acronym in Spanish) accordingly. These particular areas are to be granted under a special concessional contract, and do not subscribe to mining concessions contracts (ANM, 2022a).

Coal mining operators must make a series of environmental-purposed payments that are divided into environmental offsets[3], and retributive fees[4]. Table 5 describes these fees and their associated decrees and resolutions. In general, the environmental offset fees (for forestry use) represent the highest fee paid by coal companies. It is important to highlight that data is voluntarily shared with EITI by the companies. Therefore, some payment information is missing, including that of

[3] The environmental impacts that cannot be prevented or mitigated in mining projects, which are subject to environmental licensing in Colombia, should be offset.
[4] The differentiation between each of the fee definitions can be found in EITI (2019).

one of the largest operators in Cesar. It was also noticed that other companies had not reported information for some years.

Resolution 256 (2018) updated the Environmental Offsets Manual for the biotic component (MADS, 2018b), which is the instrument used by mining companies to compensate biodiversity loss-related impacts. However, the General Comptroller's Office (Contraloría General de la República – CGR, acronym in Spanish) has identified that in general, coal mining projects have not complied with this Resolution, and, even in some cases of compliance, the Resolution has not proved itself to be an effective environmental mechanism for the conservation of resources (CGR, 2021).

Table 5. **Environmental Payments by the Mining Sector in Colombia**

FEE	DESCRIPTION	REGULATION
Water use fee	Charge related to a water concession. Depends on the volume used.	Decree 155 of 2004
Retributive fee	Charge related to the discharge/emission of pollutants/waste with a harmful effect, into the atmosphere, water, or soil.	Decree 901 of 1997
1% Tax	Mining projects must allocate no less than 1% of the total investment for the preservation, monitoring and recovery of the basin used.	Decree 2099 of 2016
Other environmental offsets	Offsets are environmental obligations that are classified in five types: biodiversity loss, forestry use, lifting of the ban, channel use, and subtraction of forest reserve. The charge is defined according to the type of activity that requires to be compensated.	Decree 1791 of 1996 Resolution 213 of 1977 Decree 2811 of 1974 Resolution 256 of 2018 Resolution 1526 of 2012 Decree 1272 of 2016 Decree 1390 of 2018

Law 685 (2001) also encompasses certain tax benefits awarded for mining, which has been the subject of debates as to how the country benefits from this. For example, Pardo (2018) shows that mining, gas, and oil companies paid taxes amounting to $1.8 billion COP in 2016, but the fiscal cost of their tax benefits (exemptions, deductions, etc.) totalled $19.3 billion COP.

One of the characteristics of large-scale coal mining in the Caribbean region is a relatively low connection to local economic activities. The Friedrich Ebert Stiftung (2014) demonstrated that non-capital municipalities outside of the coal mining regions received more than four times the taxes per capita from industry and commerce, compared to the municipalities in La Guajira and Cesar where coal is extracted. Consequently, large-scale coal mining has minimal positive impact on economic activities other than that of the extraction itself. Additionally, these municipalities have very limited capacity to generate their own tax resources, independent from royalties. CGR concluded that royalties have become a fiscal substitute for taxes, which increases both dependency and concerns around mine closure processes (CGR, 2014).

Data from the Ministry of Labour that has been obtained in the context of this project shows that although the coal mining sector seems to be responsible for the most relevant economic activities in some regions, it did not generate the highest number of jobs between 2015 and 2020. This is also true historically insofar as this sector is capital-intensive, but not labour-intensive (ADR & FAO, 2021b). In Cundinamarca, Boyaca, and Cordoba, the sector that generated the most jobs was "Agriculture, livestock, hunting, forestry, and fishing". For the cases of Norte de Santander and Cesar, it was "Trade and vehicle repair" while for La Guajira, it was the "Manufacturing industry". followed very closely by "Agriculture, livestock, hunting, forestry, and fishing" (Ministry of Labour, 2022).

According to the data provided by the ANM (2022c) and Table 6 shows that from 2016 to 2022, the employment levels generated by the coal sector accounted for less than 2% of the total employment for each department in the selected coal mining regions, except for in Cesar where in 2017 and 2018, coal value chain employment share generation was 2.7% and 3.4%, respectively. Since 2019, the number of employees has decreased across every department, except Cordoba, as it can be seen in figure 17a. For 2021, the coal sector generated 18,402 jobs, while Cesar reported 5,257 employees - the highest number of all departments for that year.

Table 6. **Percentage of total (permanent and temporal) employment attributable to the coal sector in selected mining regions**
Source of data: ANM (2022e) and Ministry of Labour (2022)

	YEARS				
DEPARTMENT	**2016**	**2017**	**2018**	**2019**	**2020**
La Guajira	1.4%	1.4%	1.4%	1.3%	1.3%
Cesar	1.6%	2.7%	3.4%	1.9%	1.8%
Cundinamarca	0.3%*	0.5%*	0.1%*	0.4%	0.3%
Boyaca	4.3%*	3.7%*	4.1%*	1.3%	0.9%
Cordoba	0.5%*	0.5%*	0.5%*	0.1%	0.2%
Norte de Santander	0.5%*	0.6%*	0.8%*	0.9%	0.7%

* Data available for the mining sector, not only the coal sector.

Most jobs in the coal sector across the different departments are on a permanent[5] basis (>70%), with the exception being that of Cordoba in 2021, where jobs in the sector were mostly temporal

[5] The data provided by ANM (2022c) does not specify what is considered a permanent job. In the present report, it is assumed that a permanent job is any that does not depend on a temporal contract (based on the definition of the Ministry of Labour (2019)).

(Figure 17b). This department's coal sector jobs are associated with Gecelsa S.A. CFPP. For the selected coal mining regions, worker typology is dominated by operators (>70%) except for in La Guajira, where executives and administrative workers account for around 50% of total employment (Figure 17c). This is likely due to a higher number of operators being outsourced (indirect employees) in La Guajira, compared to those in the other coal mining regions.

Although Cesar and La Guajira (North cluster) show the highest coal extraction, local employees made up the smallest section of the total labour force compared to other regions, with an average close to 40% (Figure 17d). Conversely, in Boyaca, around 70% of employees come from the same municipality. In terms of gender, more than 90% of the positions are occupied by men, except for Cordoba (Figure 17e).

Figure 17. **Characteristics of coal workers in the selected coal mining regions in Colombia 2019-2021**

Figure 17a. **Number of employees**

Figure 17b. **Percentage of temporal and permanent jobs**

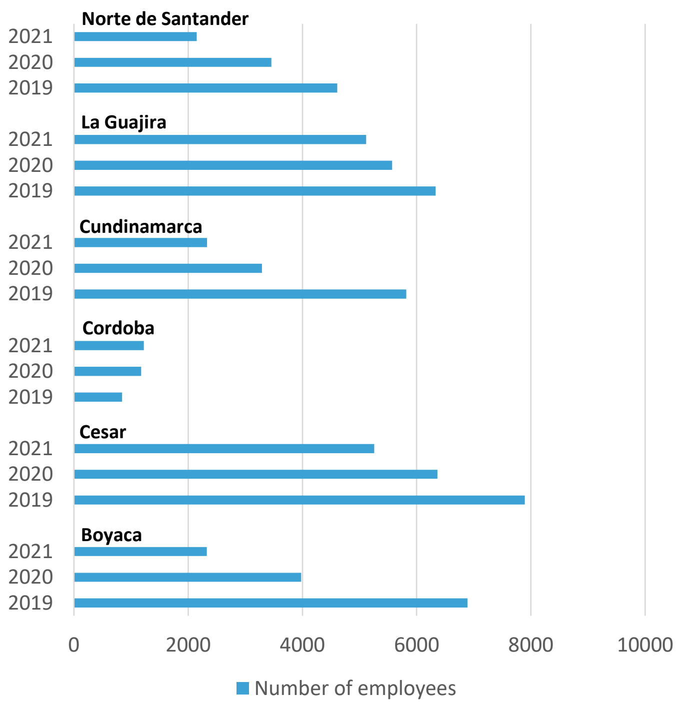
Figure 17c. **Distribution of types of jobs**

Figure 17d. **Origin of workers**

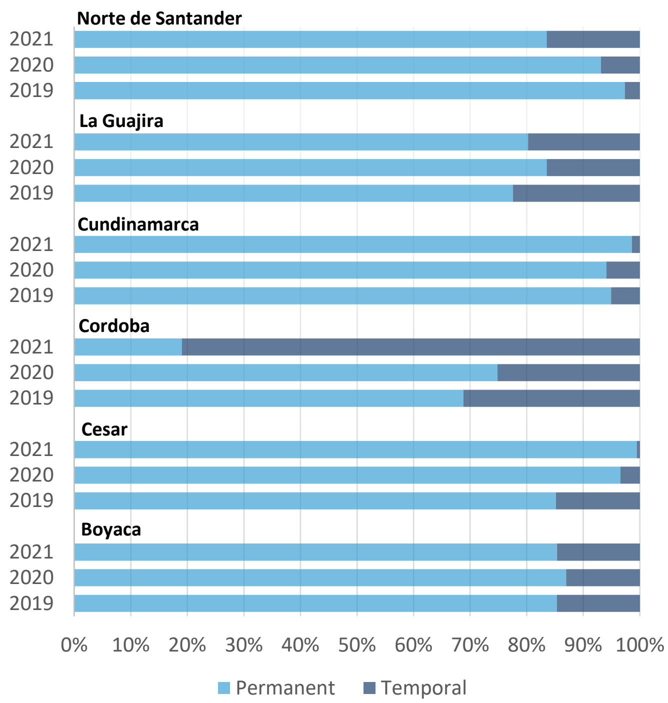
Figure 17e. **Gender distribution**

Source of data: ANM (2022c)

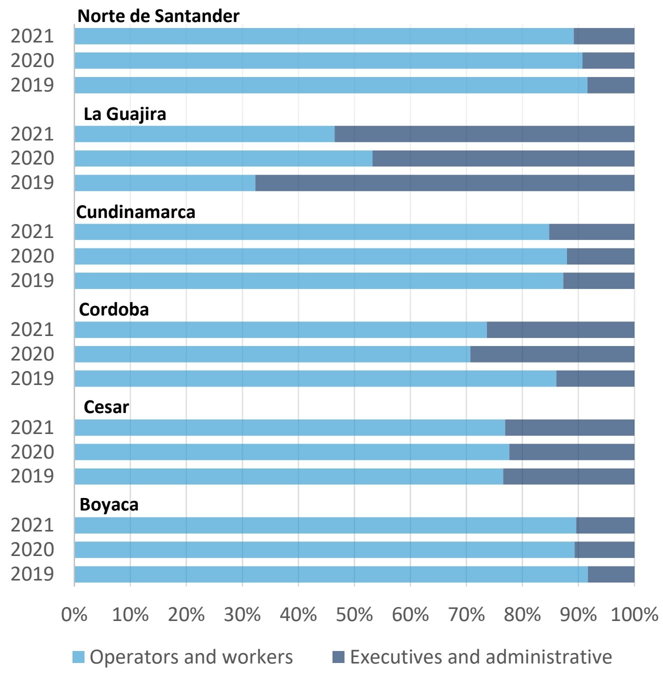
18a.



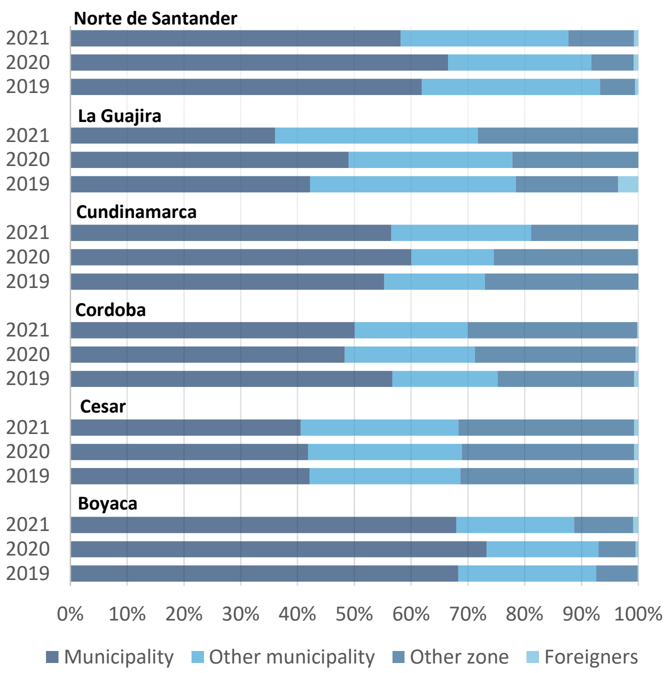
18b.



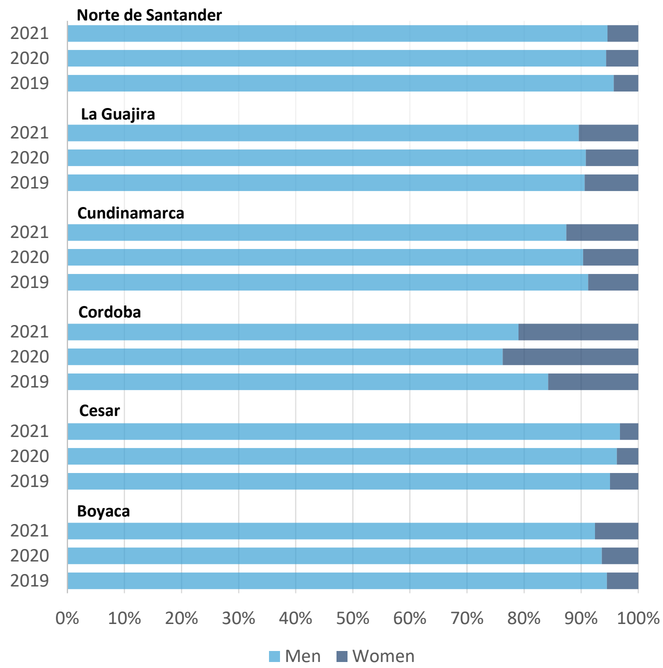
18c.



18d.



18e.



Those working in Colombia's coal mining sector often do so in an environment that is often hampered by adverse working conditions, massive layoffs, long working hours, negative health effects, acts of harassment and murder to union leaders, and gender inequality in labour participation (Industrial global union, 2021; Quiroz et al., 2022; SINTRACARBÓN, 2020; SOMO, 2021).

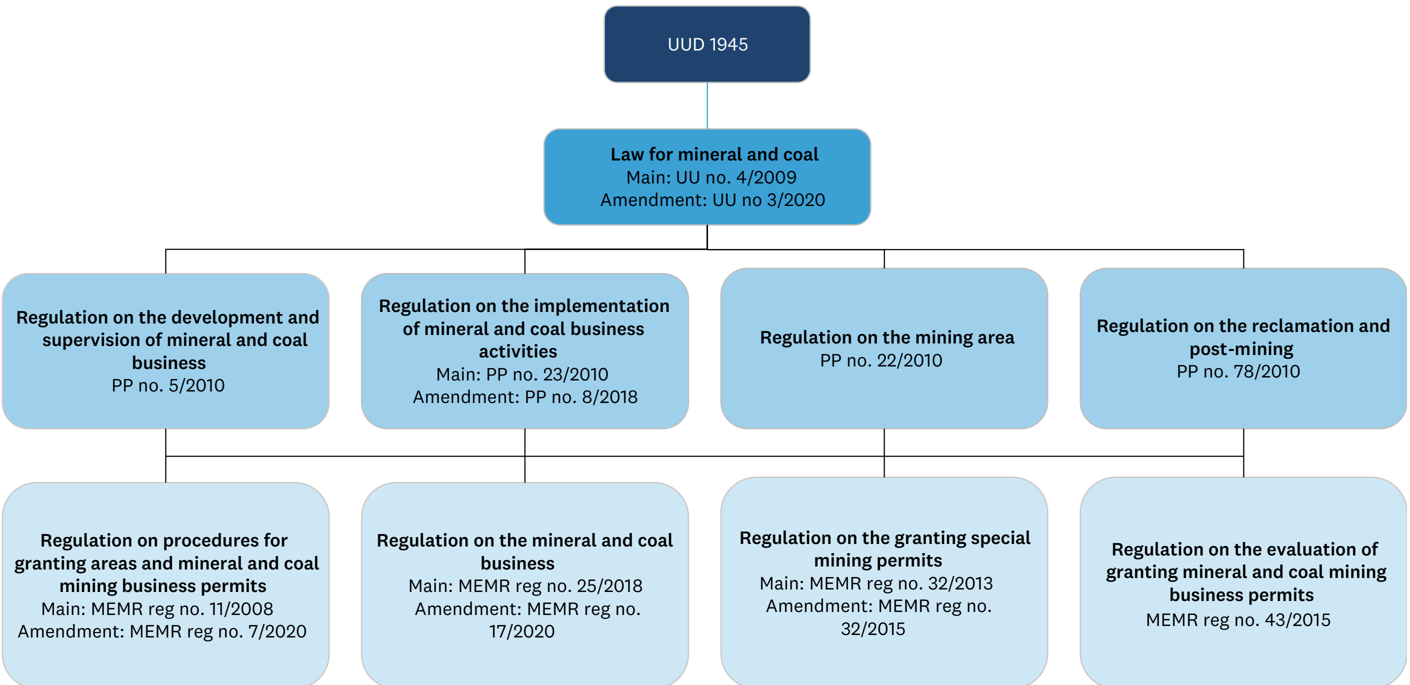
Although no specific policies or regulations for post-closure employment currently exist, two institutions are working to mitigate with this topic – namely, the Innovation and Research Center for Fair Development of the Colombian Mining and Energy Sector (Centro de Innovación e Investigación para el Desarrollo Justo del Sector Minero Energético de Colombia - CIPAME by its Spanish acronym), developed by sectorial unions (CIPAME, 2022), and the Labour Observatory for a Just Transition in the Coal Sector (Observatorio Laboral para la Transición Justa – OLTJ, acronym in Spanish), which is an initiative developed by civil society organisation CNV Internationaal "to accompany the path towards a low-emissions economy that considers all stakeholders, leaving no one behind" (CNV Internationaal, 2022a).

1.2.2 Indonesia

The main regulation pertaining to mining in Indonesia is the Mineral and Coal Law (UU No. 4/2009). Figure Main regulations for mineral and coal mining in Indonesia shows both the mineral and coal law and applicable subsidiary pieces of legislation. The 1945 Constitution of the Republic of Indonesia (Undang-undang Dasar 1945, UUD, Acronym in Bahasa) states in the Article 33 (paragraph 3): Earth, water and natural resources contained therein are controlled by the state and used for the greatest prosperity of the people.

Article 33 provides the foundation of Mineral and Coal Law. Other relevant regulations include PP No. 5/2010 and PP No. 8/2018; mining areas, reclamation, and post-mining management are regulated by PP No. 22/2010 and PP No. 78/2010. All permits are then regulated in MEMR Regulation No. 7/2020, 17/2020, 32/2015, and 43/2015. Additionally, PP No. 81/2019 contains provisions financial and fiscal requirements for activities under the supervision of MEMR. MEMR Regulation No. 43/2018 defines divestment procedures and price determination mechanisms for share divestment in coal and mineral mining, while MEMR Regulation No. 48/2017 provides the framework for the supervision of business activities in the sector. Finally, MEMR Regulation No. 26/2018 lays out the good mining principles and guidelines for the supervision of coal and mineral mining. Figure 18 shows an overview of the main regulations.

Figure 18. Main regulations for mineral and coal mining in Indonesia
Adapted from: Indrawan (2021)



Most coal mining sites are in East Kalimantan and South Sumatra, totalling 67% and 17% respectively. Indonesia is home to more than 154 active coal mines and 227 operating CFPPs according to data from Global Energy Monitor updated in July 2022 (Global Energy Monitor, 2022a, 2022b). CFPPs are distributed throughout the country, but are particularly concentrated in Java, Sumatra, Kalimantan, and Sulawesi as shown in Figure 19.

Figure 19. **Location of coal mines and CFPPs in Indonesia**
Source of data: Global Energy Monitor (2022a) and Global Energy Monitor (2022b)

Figure 20a. depicts the areas identified as having coal resources and their quality. Most of Indonesia's coal mines operate under the open-pit method and are associated with some of the highest observed deforestation rates both on and off-site (Sievernich et al., 2021). According to the Global Energy Monitor (2022a), the average dimensions of these mines are 50.9 km2 (area) and 54.6m (depth), with a mean extraction rate of 3.7 Mtpa.

Figure 20a. **Areas identified as having coal resources and their quality in Indonesia**

Figure 20b. **Location of main coal ports and railroads in Indonesia**
Source: ESDM OneMap (2022)

20a.

20b.

Coal is sent to Indonesian CFPPs, mostly located in Java, and abroad via special ports located both in East Kalimantan and South Sumatra, as shown in Figure 20b, those ports are not only located in the coastal areas, but also on rivers.

In South Sumatra, coal must be transported to the ports via railroad in accordance with the Governor Regulation no. 540/2359/DESDM/2018. Conversely, as East Kalimantan has no railroads and very poor road infrastructure for truck transport, coal is shipped in barges down the Mahakam River.

A recent factor that may change the current export dynamics of East Kalimantan is the ongoing construction of the new capital city, Nusantara, located a mere 50km from the Mahakam River delta. The project itself has already raised many questions concerning its sustainability, with concerns expressed regarding vulnerability to floods (i.e. Ramadhan et al., 2022 and Wang et al., 2022), deforestation (Global Forest Watch, 2021), and social welfare (Carnawi et al., 2022; Dewi et al., 2005). In fact, coal mine expansion in East Kalimantan was the primary cause of direct forest loss in Indonesia, accounting for 58.2% of the 1,901 km2 deforested area (Giljum et al., 2022).

Particularly relevant for the coal sector are concerns around the improvement of surrounding infrastructure and the potential construction of new roads and railroads that may enable an increase in coal transport and exports. Nusantara is being built with the intention of being fully powered by renewable energy according to the Presidential Regulation No. 63/2022, but its mere existence stands to stimulate the province‘s economy which, in turn, will result in additional demand for power. As Indonesia's power sector is still dominated by coal, the project will most likely increase coal demand – at least indirectly - for East Kalimantan‘s CFPPs.

The increase in coal extraction in Indonesia is mainly driven by three factors. Firstly, it must be noted that the country has built its energy infrastructure around this form of energy capture, resulting in a lock-in condition for the primary energy supply. Next, the sheer abundance of medium- and low-quality coal reserves, and the strategic geographical position in terms of markets (Indonesia Investment, 2018) is a hugely influential factor, combined with a high global demand to affect the high volume of extracted coal - and thus job creation - in this sector. There were 150,000 workers in the national coal industry in 2019 (ESDM, 2020).

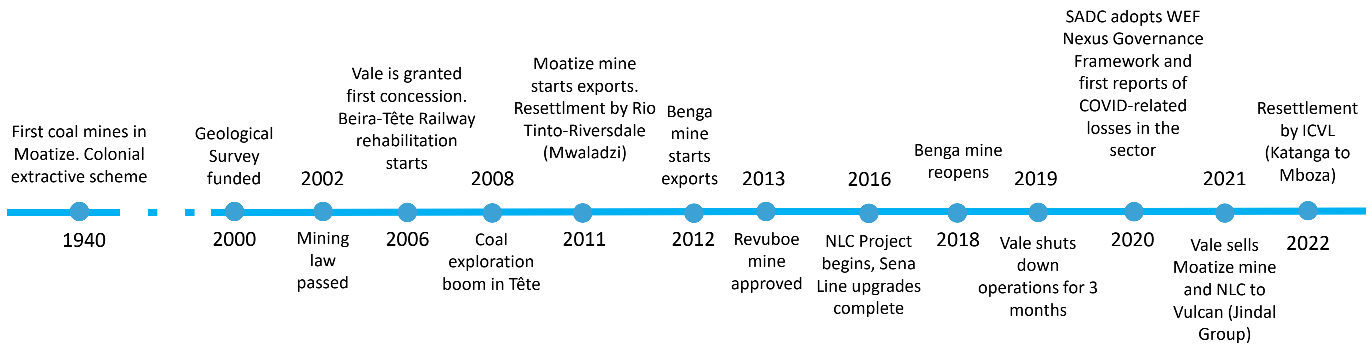
Leuwidamar, Indonesia **Source: Yalia Agnis for Unsplash**

1.2.3 Mozambique

By 2021, Africa was home to 9% of proposed coal mine capacity on the globe, with 198 million tonnes per annum (Mtpa). About one third of this is in Mozambique, with 54 Mtpa of new coal mining capacity planned (on top of already existing 10.3 Mtpa). This potential "coal rush" would represent the largest percentage shift of national coal output worldwide (see Tate, Shearer, and Andiswa, 2021: 24), though it is, of course, conditional on companies meeting their plans, which has not always been the case - as highlighted in the following. Figure 21 shows a summarized timeline of events around coal in Mozambique.

Infrastructure development, especially transport, is the main challenge faced by private investors of the coal sector in the country. However, this has been steadily improved over the last decade via 4 projects, namely: The Sena Railway, Port of Maputo and Port of Beira upgrades and the Nacala Corridor Project (NLC). The latter includes upgrades to the Nacala Port. Although on the global scale, Mozambique is a small coal exporter and consumes very little domestically (see BGR, 2019), its burgeoning coal sector has been heralded as one of the world's largest in the coming years. The sector is now well-established in the Province of Tête with supportive infrastructure, and the Maputo corridor has seen massive growth since the coal boom of 2021. All of this has been enhanced by an improved regulative environment more amenable to the private sector.

Figure 21. Timeline of the coal sector in Mozambique



Considering that 40 different companies hold various types of coal licences in the country, with 95% of them located in Tête (Hatton & Fardell, 2012: 3; Besharati, 2012), this province is considered in the present report as the Coal Region. Additionally, most of the current coal depositsare already under either a mining exploration licence (*Licença de Prospecção e Pesquisa*) or, to a far less extent, a Mining Concession (*Concessão Mineira*). Most of them, however, have not yet been developed.

A relevant tool to explore the coal region is the Mozambique Mining Cadastre Map Portal (2022), launched in 2013. The Portal is the official repository of geographical information and is frequently updated. It contains the latest official licencing agreements, includes all mining tenures, mining contracts, and the extent of the concessions. As an official government source, it should be considered authoritative. In addition, several sets of mining data, including geological and geochemical data, are available for private investors; this is pertinent considering investments in Mozambique's mining sector at the National Directorate of Geology and Mines (Viana, Daniel and Fialho, 2021). Moreover, there are some entries in the Environmental Justice Atlas (EJAtlas) related to coal in the Tête Province that can also be consulted (Environmental Justice Atlas, ND).

At the time of writing this report, 15 Mining Contracts have been signed between various companies and the Mozambican government that have been listed at INAMI (2022). A number of these relate to coal, including: Reversdade Moçambique Lda.; JSPL Mozambique Minerais, LDA; Mina de Rovúboé, Lda.; Rio Tinto Zambeze LDA; Midwest Africa, Lda.; Minas de Moatize; Capitol Resources Limitada. Some of these have since been transferred to other parties or were revoked. The MIREME (2022) website has some of these items listed, including mining contracts, but most of the links do not open, or have no available documentation.

So far, five Mining Contracts for different coal companies in Tête province are listed on the Mozambique Mining Cadastre Map Portal (2022) (see Table Mining Contracts). These are the most important mining sites, as these are essentially a separate agreement between the company and State. Larger-scale projects can have their own separate terms or conditions, but are always consistent with legislation, and are overlapped with concessions/licences:

Table 7. **Coal Mining Contracts in Tête**
Source of data: Mozambique Mining Cadastre Map Portal (2022)

IDENTIFIER / MINE NAME	OPERATOR	AWARD DATE	EXPIRY DATE	STATUR / OBSERVATIONS
3365C (Benga)	ICVL Riversdale	2009	2034	5% public capital
3605C (Chirodzi)	JSPL	2011	2035	3% tax rate
1163C	Minas Moatize Ltda.	2013	2040	Ended in 2015 3% tax rate
867C (Minas Moatize)	Rio Doce Moçambique (now Vulcan Resources, subsidiary of JSPL)	2007	2032	3% tax rate 5% public capital
9744C (Minas Revuboé)	Non-operational	2013	2038	3% tax rate

Other relevant characteristics of these projects are summarised in the following section, with further details provided in Appendix Coal Mine Sites and other infrastructure:

- The Benga Coal Mine, owned by ICVL under licence 3365C is an open pit mine located east of the Revuboé and Zambezi rivers junction, from which coal is extracted for both metallurgical and thermal usage. Operations started in January 2010, with the first exports taking place in June 2012, although they were suspended due to the coal price for a short period in 2017. According to USGS (see USGS & Plaza-Toledo, 2022: 30.7) the capacity was 2.4 Mtpa in 2018, and the Global Energy Monitor (2022) reported that extraction reached 2.4 Mtpa in 2020. Estimations of reserves range between 120 Mton (2012) and 234 Mton (2021).
- Chirodzi is a mine owned by JSPL Mozambique Minerals Ltda. under licence 3605C. It is an open-pit mine that mainly extracts coal for metallurgical use. The first exports took place in 2013, and estimations put reserves in approximately 700 Mton (Jindal Africa, 2016). In early 2016, the mine had been placed on care-and-maintenance status because of low demand for coking coal, but extraction resumed in October 2016. In 2017, the company gradually ramped up operations at the mine, producing 125,000 metric tons per month of coal (see JSPL, 2016: 15; JSPL 2017: 7). In 2018, USGS reported a capacity of 3mtpa (USGS & Plaza-Toledo, 2022: 30.7).
- The open-pit mine, Minas de Moatize, operated from 2013 to 2015 under licence 1163C, for the purpose of extracting metallurgical and thermal coal. The first exports were made in 2011 and, according to USGS, it had a capacity of 2.88 Mtpa in 2018, although its operation could not be determined (USGS & Plaza-Toledo, 2022: 30.7). Reserves are estimated in 23.46 Mton, from which 8.72 Mton are metallurgical (BHR, 2012).
- Moatize Mine, owned by Vulcan Resources (JSPL subsidiary) under licence 867C is an open-pit mine from which coal for metallurgical and thermal use is extracted. It has estimated reserves of 719.2 Mton Operations commenced in August 2011 under Vale. Although USGS estimates a capacity of 2022 Mtpa, plans canvassed in 2019 to expand to 15mpta were re-scheduled due to the Covid-19 downturn (Tribunal Administrativo, 2021: v-2). Extraction rates have shifted dramatically, for example; 3.5 Mton metallurgical coal and 2 Mtpa of thermal coal in 2016; 7 Mtpa and 4.3 Mtpa in 2017; and then an overall volume of 5.87 Mtpa in 2020 (USGS & Plaza-Toledo, 2022: 30.7). This mine, due to its association with the NLC through Vale, constitutes the largest investment in the coal sector in the country. It is estimated that it could have a lifespan of up until 2046.

It should be noted that in 2020, ten concessionaires were notified by the regulator with notice of revocation. Eight mining titleholders corrected the irregularities. Mina Moatize Lda. had not paid the Production Tax, and Midwest Africa, Lda. requested a review (see Tribunal Administrativo, 2021: v-6).

To accurately capture the whole spectrum of the coal value chain, it is important to also refer to the main infrastructure through which coal is transported:

- The 1,000 Km. Sena Railway links Dondo, in Mozambique, to Chipata, in Zambia. It dates to the 1900s and comprises two main branches: Dona Ana to Moatize, and Inhamitanga to Marromeu, and was built as a narrow-gauge (1,067 mm). It traverses Malawi and therefore, is very relevant for both Malawi and Zambia as it connects them to the Beira and Nacala ports. Considering these are landlocked countries, its relevance is even more acute. It is managed by state-owned Portos e Caminhos de Ferro de Moçambique (CFM).
- The Port of Beira is the oldest coal port in the country (2012). It is located on the left bank of the Pungwe river, just north of the city of Beira; it has a capacity of 6 to 6,5 Mtpa and comprises 12 berths along almost 2 Km. of quayside. It is operated by CFM and started as a joint venture between CFM, Vale, and Rio Tinto. A new terminal (New Coal Terminal Biera – NCTAB) was proposed in 2014 and awarded to CFM and Esser Ports in 2016 - mainly to serve exports growth to India, although there has yet been no progress in this regard. Moreover, with JSPL now sending all its coal through the NLC, investing in Beira upgrades is not feasible.
- The Nacala Logistics Corridor (NLC) refers to the set of railway and port projects. The narrow-gauge (1,067 mm) railway of Nacala has three branches: Nacala-a-Velha to Andre Mossuril, Lumbo, and Cuamba to Lichinga – the combination of which total 912 km in length. The port is located west of the Bengo bay, at Nacala-a-Velha, with a 30 Mtpa capacity and no ship size restrictions.
- South of Mozambique, the Port of Maputo includes two sub-structures: the Main Port and the Matola Terminal, operated by Grindrod Mozambique Limitada (GML) and Terminal de Carvão da Matola (TCM), respectively. The main use for coal in this instance is smaller than that of Matola. Wheras Maputo has a capacity of 1,5 to 4 Mtpa; Matola has a capacity between 7,3 to 7,5 Mtpa, with plans to expand capacity being currently under development.

There are also some project proposals which will now be explained:

- Minas de Rebúvoé is a proposed coal mine without a start date (see IEA, 2021: 117). 9744C. Details vary, but it is claimed the mine has reserves of 850 Mton (Minas de Revuboè, ND). Campbell (2014) later reported a potential full capacity of 17 Mtpa of coking and thermal coal and the mine was expected to produce 5 Mtpa by 2019, and updated figures from the IEA in 2021 gave the figure of 7 Mtpa (IEA, 2021). Nippon secured a Mining Concession in 2013, 4604C, and from this had planned an investment program before production would begin in 2016. The extent of infrastructure required pre-mine was a key issue, especially transportation (Mining Technology, 2013). It appears that lack of capital for the joint venture has been the cause of the delays after the death of Ken Talbott who owned the majority stake, with other shareholders still seeking a new partner (see Baxter, 2019).
- Zambeze Coal Mine: ICVL Zambeze, Lda (IZL), under Mining Concession 4695, is a proposed coal mine in the East of Tête, adjacent to the Benga mine. It would be an open-pit operation of bituminous coal, with an extraction projection of 12 Mtpa. When Rio Tinto procured Riversdale, it took over the Zambeze prospect and then sold to ICVL in 2014 along with its other exploration titles in Tête for USD50 million (Rio Tinto, 2014). When ICVL suspended operations in 2015 at the Benga Mine, this project was placed on hold as well. There have been claims to revive the proposal. In 2017, ICVL said it was reconsidering its plans when the coking coal price rebounded – but this was reliant on shipping the coal to Macuse Port that has still not entered construction (AIM, 2017).
- Ncondezi Ncondezi Project: The Ncondezi Project is a proposed integrated thermal coal mine and 300 MW power plant near Songo, also in Tête. The open-pit mine would produce thermal coal with an estimated output of 1.3 - 1.5 Mtpa to power the station (Campbell 2014). In 2013, the government granted a Mining Concession to Ncondezi Energy, but the power purchase agreement with Electricidade de Mozambique had not been agreed. As of 2021, it was still under negotiation (see Ncondezi Energy, 2021). Currently, the company describes the project as being ‘advanced’ with plans to expand into transnational neighbouring states and to provide solar PV & storage solutions (Ncondezi Energy, 2020). Arguably, the New Electricity Law (2022) aimed at facilitating the private sector and renewables may assist in this power purchase agreement.

- Macuse Deepwater Port: A deepwater port in Macuse has been proposed with a capacity of 33 Mtpa. It could be expanded to 100 Mtpa for coal and other goods (see Thai Mozambique Logistics, ND). Located in Zambézia province, the port would offer Tête coal mines a much shorter distance and pass exclusively through Mozambican territory. The cost is estimated at USD$2.7 billion. However, it was reported that the project needed to operate at an initial 25 Mtpa to be economically viable (Campbell, 2015). Direct competition coming from the NLC decreases its feasibility significantly. In November 2017, the Mozambican government signed an agreement to extend the railway to Chitima (AIM, 2017). Thai Mozambique Logistics claimed work will begin in 2021 and be completed in 2024 (AIM, 2020) but there is no evidence of its construction having begun.

The coal sector is governed at the national level by the Constitution; nationwide laws (enacted by the Parliament); a dedicated Minister and ministry for the mining sector, The Ministry of Mineral Resources and Energy (MIREME, acronym in Portuguese); other related ministries; and implementing regulations (approved by the government). Most important of which is The Mining Act, which can be seen as a legislative attempt to unify the regulation of the mining industry and create an 'umbrella' body.

Under the Mozambique Constitution, the land and its associated resources are the property of the State. All mineral resources found in the soil, subsoil, all waters (in riverbeds, lakes and seafloor), and in its Exclusive Economic Zone (EEZ), are the sole property of the state. This principle is also found in the Mining Law (Law 20/2014 of 18 August 2014), a law developed between 2002 and 2014, when it was finally passed.

Rights of use and enjoyment of mineral resources are granted by the State via a range of mining titles (Amaral & Mussagy, 2020). Investors in mining activities can be granted the right to use and exploit the land by means of a Direito do Uso e Aproveitamento da Terra (DUAT) and foreign entities can obtain a DUAT by application to the Geographic and Cadastral Services, a complex and often lengthy authorisation process (see Kathrada, 2014). Before mining operations commence a DUAT must be granted, an environmental licence must be obtained and any required resettlements and compensation plans must also be made (see Viana, Daniel, and Fialho, 2022). Mining rights are awarded by the Ministry of Mineral Resources and Energy (MIREME). This institution directs the implementation of Government policy in geological research, exploitation of mineral and energy resources and infrastructures for the supply of electricity, natural gas and petroleum products.

Private prospecting and exploration are only permitted under mineral titles awarded by MIREME. These are either awarded on a 'first come, first awarded' basis or through a public tender, even in protected areas, if public interest is invoked by the state.

The grant of a mining tittle provides a right to apply for right to use and enjoy the land necessary for the mining activity if these are consistent with the national interest (Mining Law, Article 24), meet the industry's best practices, comply with environmental legislation, and the benefit of the national economy (Amaral & Mussagy, 2020). Only legal entities that are incorporated and registered in Mozambique can own mining rights such as exploration, mining, treatment, processing, and trade or other forms of disposal of mineral products (Amaral & Mussagy, 2020). Many of the larger Mining Contracts stipulate a very modest 3% tax-rate, and most of the corporations have sought to obtain even further concessions from the state, for example when Vale posted losses in Q1-2014 and sought further tax-breaks unsuccessfully (see Fletcher, 2014).

At an international level, Mozambique has entered into some agreements relevant to the coal sector. Firstly, it is a member of the Extractive Industries Transparency Initiative (EITI), beginning around 2010, and declared compliant in 2012. Their standard has helped ensure information along the extractive industry value chain and was instrumental in the publication of the Mining Cadastre.

Secondly, Mozambique has ratified several international economic partnerships and agreements which pertain to mining, such as the EU-SADC economic partnership agreement (2017), the bilateral investment cooperation treaties with Angola (2009) and Portugal (2014) and the EU-Africa infrastructure trust fund (EU-AITF). The latter, to implement the first renewable energy auction in Mozambique. The country is also signatory to the New York Convention on the Recognition and Enforcement of Foreign Arbitral Awards of 1958. For Mining Contracts, a dispute resolution mechanism must be specified. Further information on the coal mining industry statutes and regulations can be consulted in the Coal Mining Laws and Regulations Appendix.

There are number of government bodies relevant for the coal sector in Mozambique (See Viana & Daniel 2020; Amaral & Mussagy, 2020). Among them, the Ministry of Mineral Resources and Energy (MIREME), the Ministry of Land and Environment and the Inspectorate-General of Mineral Resources and Energy, established in 2019. A key figure given that MIREME has estimated the state loses millions to illegal mining and smuggling of minerals. More details are provided in Table 8:

Table 8. **Relevant government bodies**
Sources of data: Viana & Daniel (2020); Amaral & Mussagy (2020); Correia & Gulamhussen (2016)

GOVERNMENT BODIES	MISSION
Ministry of Mineral Resources and Energy – MIREME	Government policy direction in geological research, award of mining rights.
Ministry of Agricultural and Rural Development – (MADR)	Rural labour regulation and farming/agriculture
Ministry of Land and Environment – (MTA)	Territorial Development Plans guidelines and oversight (including resettlements), Development objectives articulation.
National Institute of Mines – (INAMI)	Mining activities guidelines and oversight and regulation, under the Minister for Mineral Resources (incl. exploration, treatment, exports and imports).
National Directorate of Geology and Mines – (DNGM)	Industry liaison, technical initiatives coordination, administrative procedures facilitation and information dissemination.
Inspectorate-General of Mineral Resources and Energy – (IGRME)	Mine and Oil & Gas projects inspection, monitoring, quality assurance and evaluation of activities.
Tax Authority of Mozambique – (ATM)	Taxation revenue administration, payments investigation. It ensures the payment of coal exports revenue
High Authority for the Extractive Industry – AAIE	Not operational yet, but its creation is ordered by Art. 25 of the Mining Law.
Bank of Mozambique	Monetary policy control, foreign exchange regulation. Also ensures public interests during privatization processes.
Local Courts – (Especially Tribunal Administrativo)	Mining rights protection and enforcement, disputes resolution. The TA examines states and corporations compliance with public law.

The TA is probably the strongest and most effective watchdog on the mining sector by the state, being part of the administrative court system on public law. It gathers information related to collection of revenue or tax collection, and public bodies related to extractives, that are carried out by audits on the INP, AQUA and INAMI, or obtain data from MIREME or IGREM. The TA completes a CGE Report and Opinions (for example see Tribunal Administrativo, 2021, 2020) which has included ‚Capitulo V Industria Extrativa' with focus on coal and gas since 2014. In terms of the coal sector, the TA is particularly concerned with:

- Verifying the compliance of contracts between the Government and concessionaires.
- Assessing the inspection procedures of concessionaires for the environmental and technical security of operations.

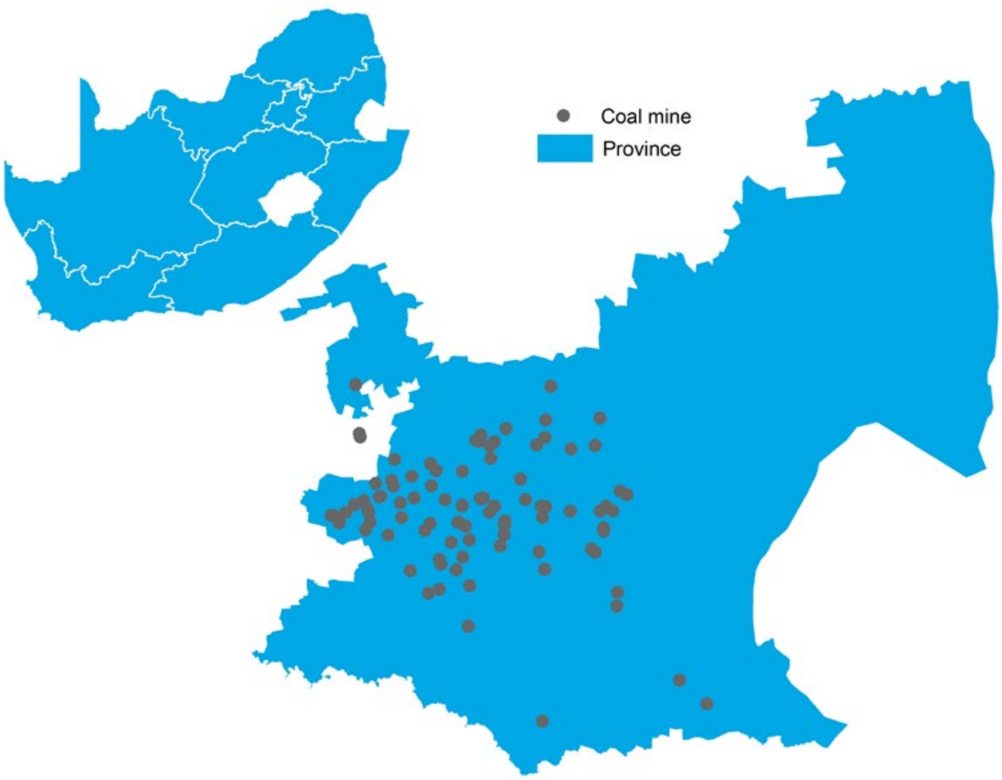
The Ministry of Land and Environment (MITA) includes two important units for mining: the National Directorate for the Environment, and the Inspectorate for Land, Environment and Rural Development. These units help draw-up environmental policies and controls and aim at compliance through environmental management standards and procedures, via Environmental Quality Audit and Control and in Environmental Inspections. The TA, in turn, in order to assess whether the entities responsible for ensuring that the activities of the Extractive Industries are carried out in compliance with the criteria of environmental sustainability, carried out audits of AQUA, INP, INAMI and carried out a survey of information from the MIREME, IGREME, DINAB and EMEM (see Tribunal Administrativo, 2021, 2020).

People in Maputo, Mozambique **Source: Farah Nabil for Unsplash**

1.2.4 South Africa

South Africa's reliance on coal dates as far back as 1800, with the largest reserves being found in the Ecca deposits of the Karoo super group (Fine & Rustomjee, 2018; Hancox & Götz, 2014). Out of the identified 19 coal fields, about 5 have the highest remaining reserves, including Waterberg, Highveld, Witbank, Free State, and Ermelo (DMR, 2014; Jeffrey et al., 2014). Approximately 80% of coal extraction in SA comes from the Mpumalanga province, with Witbank (since renamed Emalahleni) being the main centre for the industry (Munnik, 2010). The Highveld area (Middleburg, Emalahleni, Hendrina, Secunda, Ermelo) contains 12 of Eskom's 15 coal-fired power plants, Sasol's petrochemical plant, and many coal mines (CER, 2018). Areas with high coal prospects in Mpumalanga province include those in Nkalanga district municipality in the western part of the province (Emalahleni, Victor Khanye, Steve Tshwete), and the eastern part of Gert Sibande (Mkhondo and parts of Msukugaligwa) (CER et al., 2017; Makgetla & Patel, 2021; MP COGTA, 2019). Within the Waterberg coal field, Lephalale is the main local municipality in Limpopo province, boasting an estimated remaining coal reserve of 40% (DMR, 2009; Hartnady, 2010; MINTEK, 2020). The coal mining sector contributes about 80,000 jobs directly, and at least 300,000 jobs indirectly, with an estimation of ZAR19 billion generated in income for employees (Minerals Council, 2021; NBI, 2021). Figure 22 shows the coal mining sites and power plants that are highly concentrated in the Mpumalanga province.

Figure 22. **Coal mine sites in Mpumalanga Province**
Source of data: Global Energy Monitor (2022)



There are 6 large coal mining companies that account for 85% of all coal extraction, and about 150 coal mines having been identified by 2020 DMR (2014, Hancox & Götz (2014) and Maseko (2021).

Anglo-American Thermal Coal (AATC) has historically been a major player in South Africa, although it gradually divested its mines to Exxaro, Seriti, and in June of 2017, to Thungela Resources Limited ("Thungela")[6]. Thungela currently runs 7 coal mines, including include Zibulo, Greenside, Goedehoop, Khwezela, Mafube (50%), Isibonelo and Rietvlei collieries, all in the Mpumalanga province (Thungela, 2022).

Established in 1950 and commencing extraction in 1955, Sasol is another major coal mining company in the region. Sasol currently extracts about 40 Mton of saleable coal annually, the majority of which are used as a gasification feedstock for Sasol synfuel in the Secunda and Sasolburg operations. The coal mining points of operation for Sasol are at Bosjesspruit, Brandspruit, Middelbuit, Syferfontein, Twistdraai in Secunda, and Sigma in Sasolburg (Sasol, 2022).

Exxaro Resources Limited is one of the largest black-empowered and diversified coal companies in South Africa. It was formed following the merging of Eyesizwe coal and Kumba Resources Limited and possesses estimated assets of R$75.7 billion. Its coal operation sites include Matla, Belfast, Leeupan, Mafube - all in the Mpumalanga province - and Grootegeluk in the Limpopo province (Exxaro, 2022).

Glencore Xstrata is one of the largest exporters of thermal and metallurgical coal, contributing about 85% of the total resource. The company operates across 4 complexes in South Africa, which include the Impuzi Complex, Izimbiwa coal, the Tweefontein complex, and a joint venture of the Goedgevondenplex (Glencore, 2022)

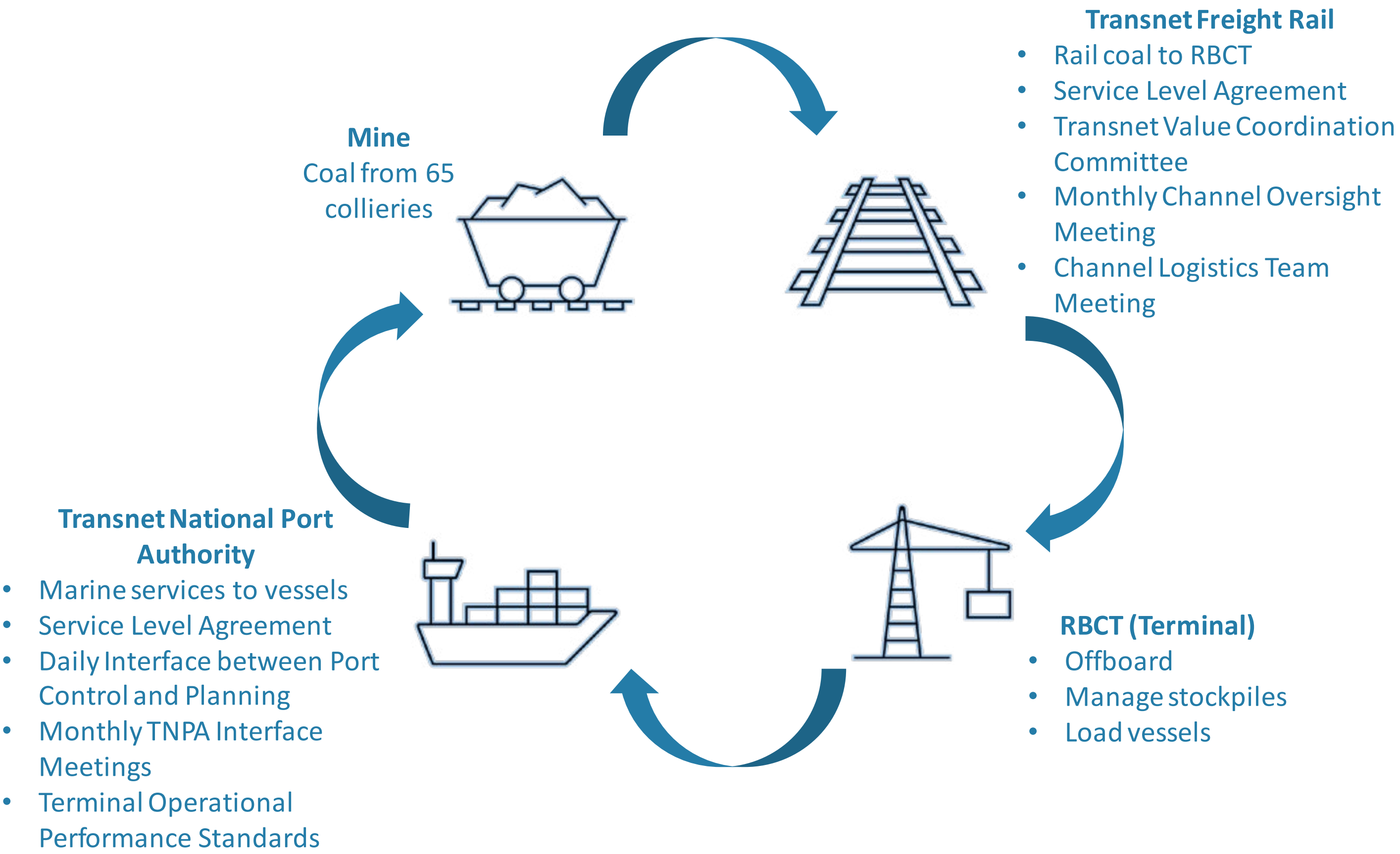
The globally diversified mining and metals company, South 32, completed the divestment of its 100% shareholdings in South Africa to Seriti in June 2021. Seriti acquired Khutala, Klipspruit, and Middleburg Mine Services (MMS) – all which supply coal to the Kendal and Duvha power plants, and coal exports via the Richards Bay port. Other coal operations under Seriti include New Vaal, New Denmark, and Kriel collieries (Seriti, 2022).

Eskom and Sasol transport most of the coal used for domestic consumption using conveyor belts due to the plants' close proximity to the mining sites. Even so, at least 50% is transported by rail and trucks (Makgetla & Patel, 2021). The Richards Bay Coal Terminal (RBCT) is the main port for almost all coal exported, with minor volumes also exported through Durban (South Africa) and Mozambique (DoE, 2016). The RBCT was established in 1976 and is one of the deepest seaports in the world, with a stock yard capacity of 8.2 Mton (RBCT, 2021). Transnet Freight rail (TFR) is a prominent

[6] https://www.angloamerican.com/media/press-releases/2021/07-06-2021

figure in the transportation of coal from Mpumalanga to the RBCT for export. Figure 23. Coal Value Chain at the RBCT shows a representation of the export chain from mining sites to the ports.

Figure 23. **Coal value chain at the RBCT**
Adapted from: RBCT (2020)



The Minerals Energy Complex (MEC) was formed in 1887 with the aim to protect and promote mining interests and plays a particularly important role in influencing mining policies and regulations (Louise et al., 2017). Table 9 provides the summary of policies, regulations, and strategies of the coal mining industry in South Africa. The Minerals Act (No. 50 of 1991) was the first draft to contain specific environmental requirements provided in the Environmental Management Program Reports (EMPR). The Act was replaced by the Mineral and Petroleum Resources Development Act – MPRDA (No. 28 of 2002) (RSA, 2002), which featured detailed Environmental Management Plans (EMP) including, among others, post closure plans and water-use licensing prior to mine authorisation.

The White Paper on Minerals and Mining policy of 1998 acknowledges that downscaling of mine workers is inevitable due to the finite nature of mining (DMR, 1998) and highlights the need to monitor it unemployment rates. It also stresses the importance of consulting with mining employees before downscaling, as well as providing retraining and assistance in finding alternative jobs. The Integrated Development Plans (IDP) and Local Economic Development Plans are very relevant instruments that require the municipalities to take on the responsibility of monitoring downscaling.

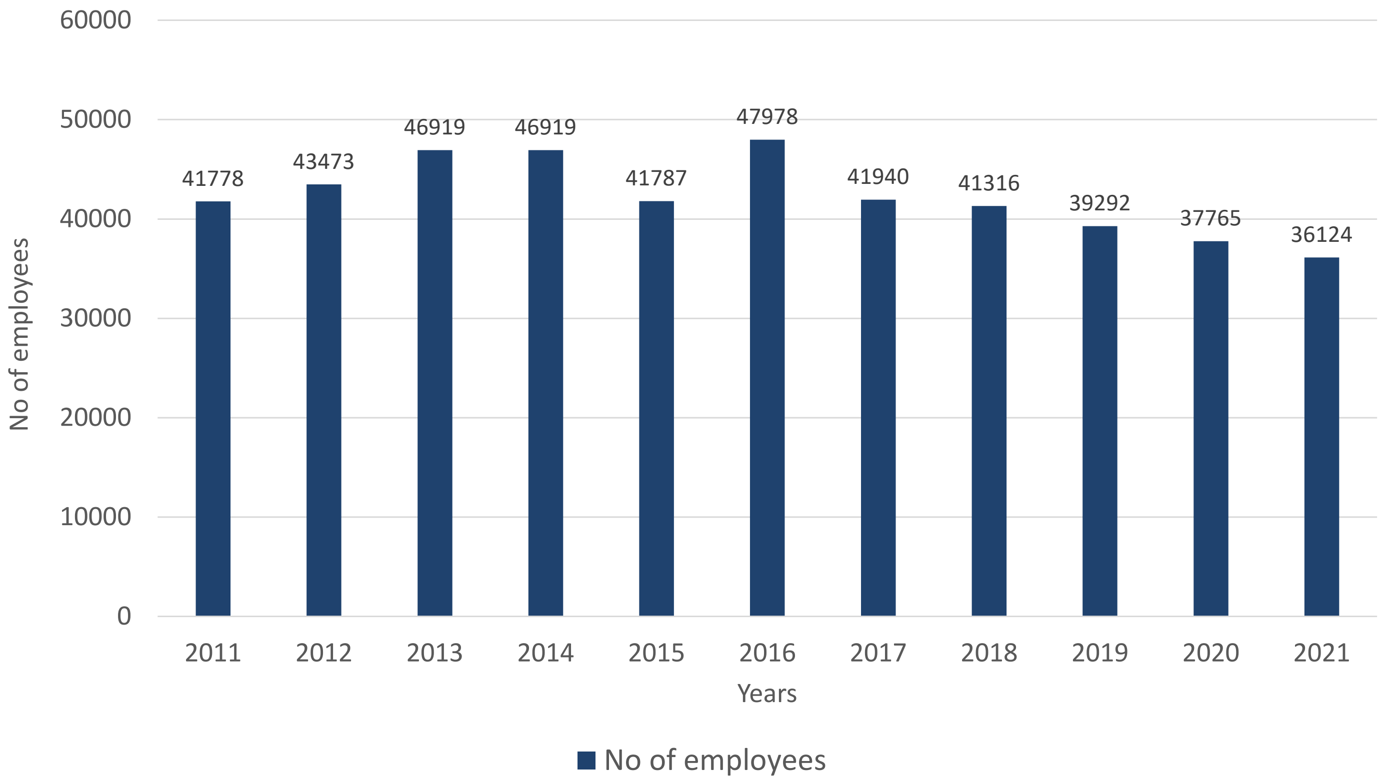
The Social Labour Plans (SLP) act as a driver for local economic diversification as required in terms of the regulation 46 of the MPRDA (Act No. 28 of 2002) (RSA, 2002), and are a prerequisite for mining companies before a mining right is granted. The DMRE provides guidelines for developing and implementing the SLP. These include, among others, the Human Resources Development Programme, Mine Community Development Plan, Employment Equity Plan, and the Housing and Living conditions Plan. The SLPs are only valid for a period up until the mining company acquires a closure certificate, which creates complications during care and maintenance even after mine closure.

Table 9. **Table Mining Policies, Regulations and Plans**

GUIDING POLICIES, REGULATIONS AND PLANS	DESCRIPTION
The White Paper on Minerals and Mining Policy, 1998	Considers the right to an environment that is not harmful to health or well-being and to have the environment protected for the benefit of present and future generations. States this must be done through reasonable regulations that prevent pollution and ecological degradation, promote conservation and secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development
Mineral and Petroleum Resources Development Act (MPDA No. 28 of 2002)	Considers investigation, assessment, and communication of environmental impacts of prospective mines in section 24 (7) of the NEMA Act of 1998
Mineral and Petroleum Resources Royalty Act 28 of 2008	Contains provisions for paying royalties in benefit of the National Revenue Fund in respect of the transfer of that mineral resource
National Environmental Management Act (No. 107 of 1998)	Provides for investigation of the potential impacts including cumulative effects of the activity and its alternatives on the environment, socio-economic conditions, and cultural heritage, as well as assessment of the significance of that potential impact. Also, provides for mitigation measures to keep adverse impacts to a minimum, as well as the option of not implementing the activity (Chapter 4)
The Draft National Mine Closure Strategy 2021	Aims to prevent or minimise adverse long term environmental and socio-economic impacts by aligning mining closure plans and application requirements for mine closure through Environmental Management Plans (EMP), Social Labour Plans (SLP), financial provisions and corporate social investment
The Exploration Strategy for Mining Industry of South Africa, 2022	Aims to attract mineral exploration investment, reignite mineral development, accelerate new mineral discoveries and encourage optimal utilisation of the South African mineral resources in line with the environmental, social, and corporate governance principles for sustainable growth
The National Water Act (36 of 1998)	Promotes the management of catchments within a water management area in a holistic and integrated manner and thus recognises that Integrated Water Resource Management (IWRM) must be achieved by considering the impact of land- and water-based activities on the resource base
South Africa's Exploration Implementation Plan, 2022	Catalyses mineral exploration in South Africa, secures more than 5% share of the global exploration expenditure within 3-5 years and bolster the mining sector's contribution to the GDP, consistent with the "South African Economic Reconstruction and Recovery Plan"

The Minerals Council Report on Facts and Figures provides an estimated number of employees in the coal sector (Minerals Council, 2021). The figure increases from 2008 to 2013, and then a general decline is observed in 2015 and 2016. Thereafter, a general increase continued until 2021, as Figure 24 shows.

Figure 24. **Employees in the coal sector 2008-2021**
Modified from: Minerals Council (2021)



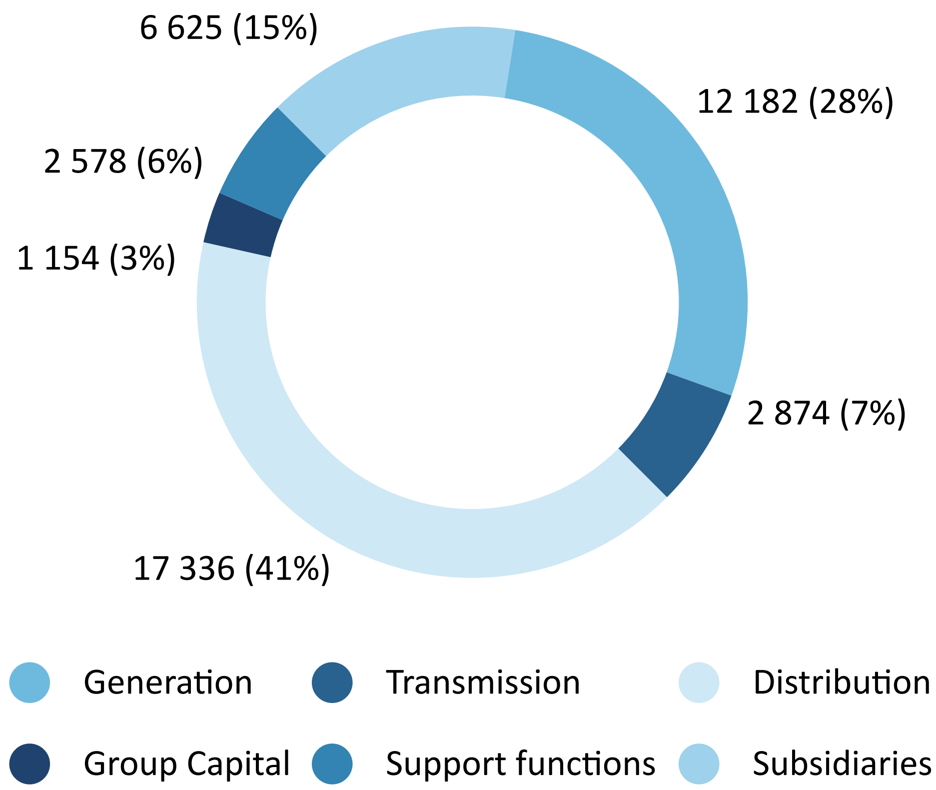
The largest employer of the energy sector, Eskom, has demonstrated a progressive decline in the number of employees over the years, with 44,772 personnel in 2020, and 42,749 in 2021, including both permanent and fixed term contractors (Eskom 2021). Employment trends found the highest peak to be in 2016, followed by a general decline until 2021 Eskom distribution showed the largest number of employees in the distribution at 41%, followed by generation at 28% and subsidiaries (15%) (see Figure 25a). The Eskom Integrated report of 2021 further illustrates employment by age, with the highest age group being between 30 and 39 years old (see Figure 25b). Eskom is generally viewed as portraying a good gender ratio of 67% male to 33% female (Eskom 2021). On the other hand, Sasol, another major employer in the coal sector, has about 7.811 employees in the mining sector (Statistica, 2022).

Figure 25a. Eskom employees by division

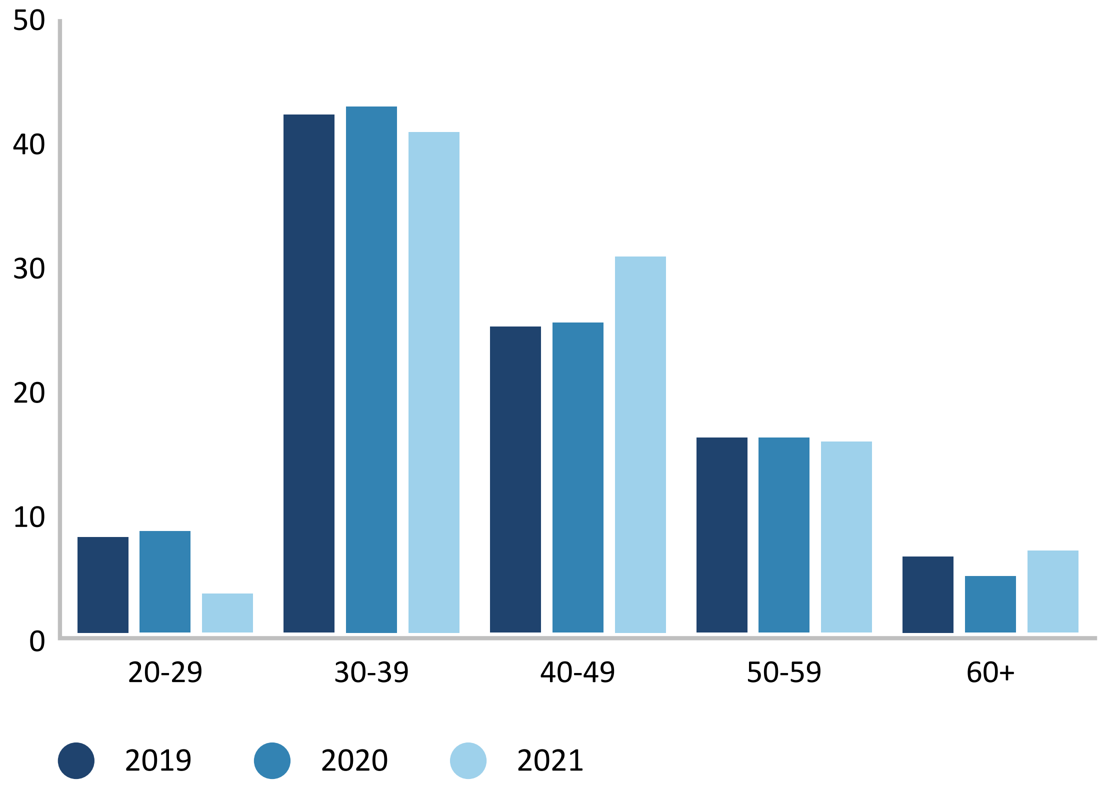
Figure 25b. Eskom employees by age

Source of data: Eskom (2022) and Eskom (2021)

25a.



25b.



Drainage of a mine in La Jagua, Cesar, Colombia Source: María Elena Huertas

1.3 Coal value chain dynamics

The dynamics of the coal value chain are addressed in this section, with the provision of extraction rates and volumes covering the last years, along with an overview of the coal market, both internal and external, whenever applicable, or in reference to the main institutions involved in these processes.

1.3.1 Colombia

Colombia is the sixth coal exporter by volume in the world, and the first in South America (BP, 2022). This commodity is the second export product of the country and the largest contributor to the General Royalties System of all the mining sector (Sistema General de Regalías – SGR, acronym in Spanish) (EITI, 2020). Figure 26a depicts the extraction according to UPME (2022b). Over 50% of the national extraction takes place in Cesar, followed by La Guajira, Boyaca, Cundinamarca, Norte de Santander, and Cordoba, with these 6 Departments representing more than 99% of the total commodity. Between 2012 and 2019, extraction increased from 85 to 92 Mtpa, however, the COVID-19 pandemic brought it down to 52.32 MTon in 2020 and 26.60 Mton in 2021.

The majority of coal extracted from the central region is used for domestic consumption (Vargas et al., 2022), with the rest being allocated for exports. Only 5% of the total coal extraction on average is used in Colombia – specifically, 30% for energy generation, 23% for cement production, and 47% across the brick and ceramic industry, textile industry, and beverage and food industry (TRANSFORMA, 2021). Figure 26b shows the historical coal exports, headed again by Cesar, followed by La Guajira, Cundinamarca, Norte de Santander, Boyaca, and Cordoba, which make up more than 98% of the total coal exports. It is also of note that coal exports have decreased since 2017. This tendency has been associated with the decrease in European demand, which has historically been the main buyer, followed by North America (Figure 26c). Finally, Figure 26d depicts the amounts bought by the main buyers, namely Turkey, The Netherlands, Chile, and the United States.

Before the war in Ukraine, the international market showed a downward trend attributed to by the efforts made by the European countries, and to a lesser extent Turkey, to decarbonise their energy matrix (Corral-Montoya et al., 2021; TRANSFORMA, 2021; Yanguas Parra et al., 2021).

Although it has been suggested that the Asian market could be a viable export option (Portafolio, 2022d), the increase in transport costs would be prohibitive due to the location of Colombian export terminals in the Caribbean Sea, as well as likely non-competitive when compared to other potential sources like Indonesia.

The war has resulted in a European increase demand of more than 200% in the first four months of 2022 (Portafolio, 2022b) in efforts to replace Russian coal. It is unlikely, however, that this trend will continue in the long term. Considering the already-high costs to livelihood that coal mining has brought to communities, some voices in the German institutions have urged mine expansions to be avoided in La Guajira and Cesar (German Federal Council, 2022).

Figure 26a. **Coal extraction by Department and total extraction 2012-2021**

Figure 26b. **Coal exports by Department 2010-2021**

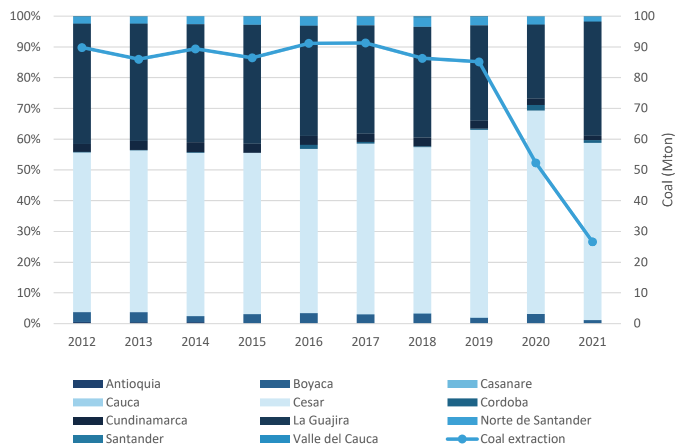
Figure 26c. **Buyers of Colombian coal by continent 2010-2021**

Figure 26d. **Main buyers of Colombian coal by country 2010-2021**

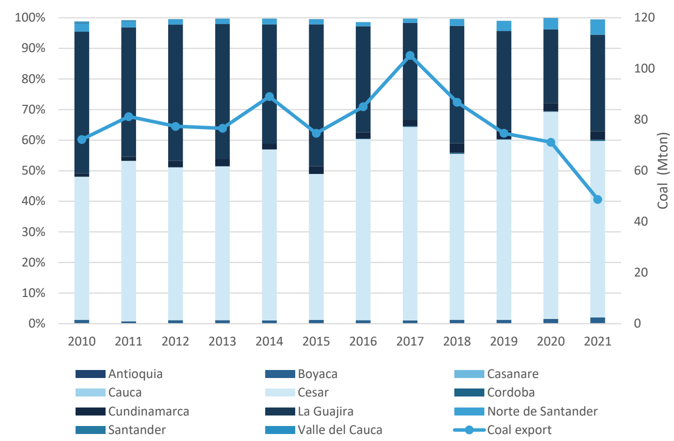
Figure 26e. **Royalties contribution by Department and total revenue 2012-2021.**

Figures 28b, 28c and 28d also show total extraction and 28e. shows total revenue.
Source of data: UPME (2022b)

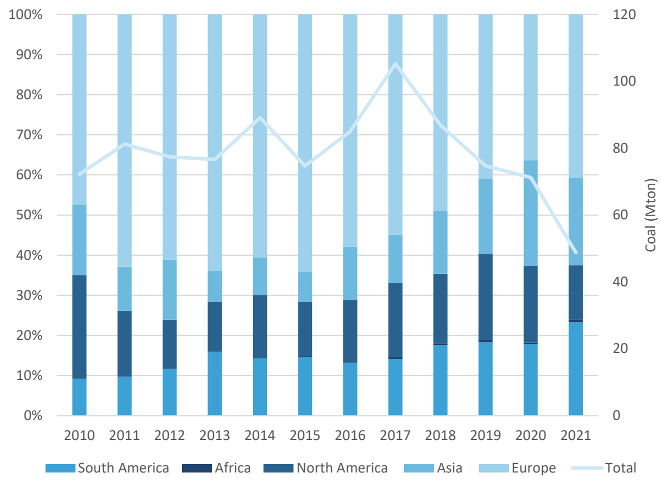
26a.



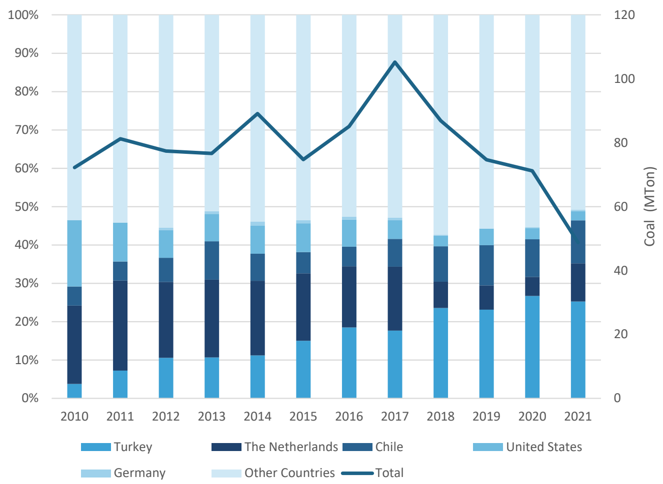
26b.



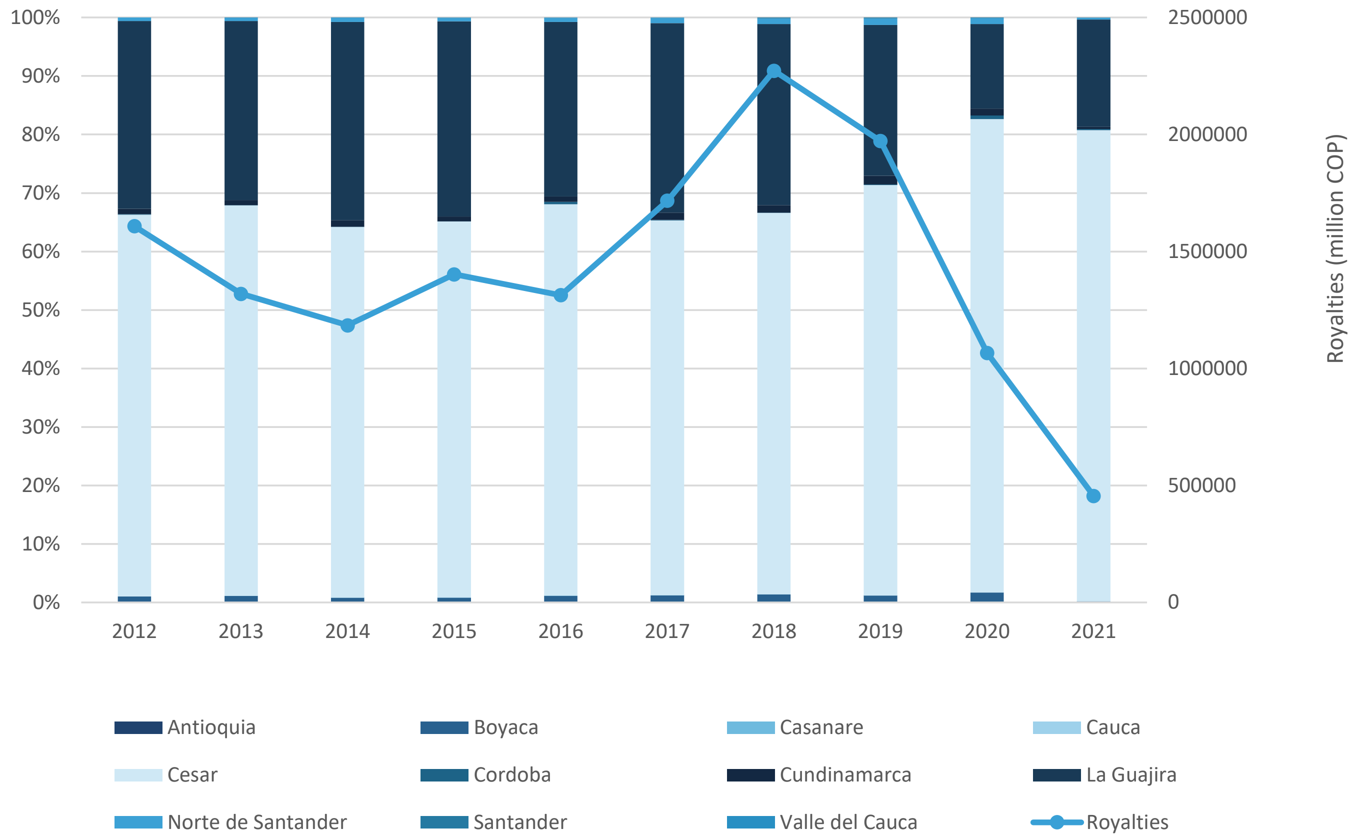
26c.



26d.



26e.



Coal companies must pay royalties. In Colombia, these can be either 5% or 10% of the extraction base price at mine gate, if extraction is below or above 3 Mtpa, respectively (ANLA, 2022a). Figure 28e shows the revenue from coal royalties over the past 9 years, with a peak of COP$2.27 billion (around €560 million) in 2018[7]. In 2021, royalties decreased to only 20% of levels observed in 2018, due to COVID-19 (TRANSFORMA, 2021).

The SGR was created in 2011 following constitutional reform; royalties hence serve two purposes: development projects, and infrastructure and savings funds, particularly the Pensions Saving Fund and the Savings and Stabilization Fund (Benítez Ibagué, 2013; Bohórquez Camargo, 2013). In general, the largest amount is used for financing projects in transportation, city infrastructure, education, etc. The last reform made to the SGR was by Law 2056 (Congreso de la República, 2020) and included changes to the percentages of allocation for royalty resources.

Figure 27a shows the total royalties from 2012 to 2022 disaggregated by savings and investment in the coal mining regions[8] and figure 27b shows the sectors in which the resources were invested for the Departments of interest. In contrast to other mining regions, Cesar and La Guajira show a higher investment in Mines and Energy (5.3% and 5.5%, respectively) than in Agriculture and Rural Development (2.7% and 4.6%, respectively).

[7] Conversion rate: 1 EUR = 4054,27COP

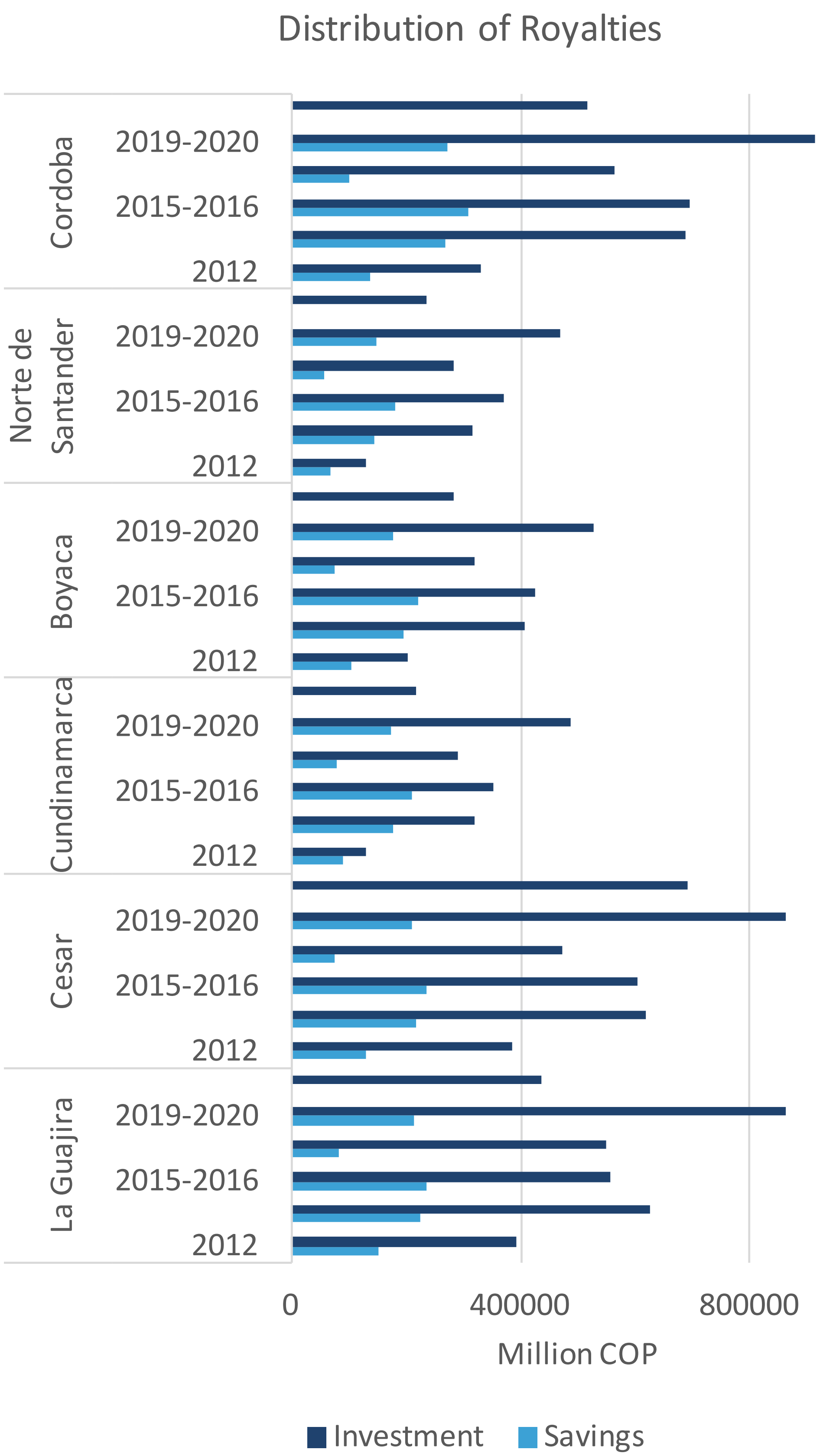
[8] Including royalty payments from minerals extraction (e.g. gold, nickel, etc.) and fossil fuels (petrol and coal).

Figure 27a. Distribution of royalties in selected Departments 2012-2022

Figure 27b. Investment on projects by sector in selected Departments 2012-2022

Source of data: MME (2022b); SGR (2022)

27a



27b

Investment by sectors (billion COP)

DEPARTMENT	LA GUAJIRA	CORDOBA	NORTE DE SANTAN-DER	CUNDINA-MARCA	BOYACA	CESAR
Number of projects	931	1377	582	853	1176	987
Transport	1176	1828	723	455	676	1334
Housing, city and territory	606	397	115	76	244	941
Education	431	403	386	273	406	548
Science, technology and innovation	271	452	180	265	205	168
Environment and Sustainable de-velopment	239	145	41	29	18	117
Sports and Recreation	217	293	62	61	82	453
Mines and Energy	195	53	47	18	26	239
Agriculture and Rural development	165	138	47	139	136	123
Health and Social protection	124	23	10	61	29	184
Social inclusion and reconcilation	49	21	6	26	26	154
Territorial goverment	33	5	2	20	2	4
Information and communication technologies	20	1	21		1	26
Culture	16	52	4	19	24	172
Planning	10	3			1	12
Work	10	26				4
Commerce, Industry and Turisim	8	28	1	4	1	24
Inside	1	1		4	3	15
Statistic information	0	0		1		
Defense	0	0		1		1
Justice		1		9		2
Total investment (billions COP)	**3571**	**3870**	**1645**	**3341**	**1880**	**4521**

1.3.2 Indonesia

There was no significant growth in coal extraction volumes between the 1990s and the 2000s, as the global CFPP boom had not yet occurred (Carbon Brief, 2019). Conversely, global demand started to increase in 2001-2012, before decreasing slightly until 2015 due to a combination of global low gas prices, the introduction of renewable energies, and stricter environmental regulations - specifically in China and USA (Boren & Myllyvirta, 2015; U.S. Energy Information Administration, 2016). This trend reversed from 2015 until 2019, however, due to the COVID-19 pandemic.

Although global coal demand has grown significantly, coal mining companies have additional incentives to export rather to sell locally, because of the increase in reference prices (15-30% annually over the last years) except during the start of the pandemic. In 2020, to secure the domestic market, and to supply CFPPs, the Indonesian government launched a MEMR Decree No. 255.K/30/MEM/2020 regarding domestic market obligations, for which coal producers must allocate 25% of the total production to the domestic market, with the price being set at USD70 per tonne.

Those coal companies that do not abide by this regulation will not be able to export their products and must pay financial penalties until they can fulfil their obligations. The penalty is equal to the subtraction between exported coal price and DMO, multiplied by the exported volume. Coal prices increased considerably due to the global energy crisis and in 2022, the war in Ukraine, reaching USD323.9 per tonne in June of that year. Consequently, exports spiked, and the government prohibited exports for 31 days in January 2022 through the Letter of the Minister of Energy and Mineral Resources B-1605/MB.05/DJB.B/2021. Exported coal is projected to be 38% from the total extraction for 2022 (ESDM, 2022b).

1.3.3 Mozambique

Although coal is one of the largest exports for Mozambique, there are considerable discrepancies amongst sources as to the output and values. As such, while we have provided data from a range of sources (see below), we cannot verify their accuracy. Overall, it can be observed that coal exports slowly have increased despite the coal price slumps in 2010 and 2014, and as infrastructure came online, coal exports incrementally increased until 2019 when the Covid-19 retraction began. At this time, demand retraction in Asia caused a dramatic fall in the coal price from Mozambique (Zitimar, 2020). After this, the post-Covid recovery and increased demand from India and Europe have seen a coal export surge in Mozambique.

Some of the most authoritative data regarding Mozambique's actual trade values of coal, as registered through its national bank (the Bank of Mozambique) is contained in Table, Export of

Coal Goods - Bank of Mozambique (see table value of coal exports) that shows the value of coal exports (in USD10 million). This record shows the high volatility of the coal sector; a tremendous expansion took place from 2014 (just over USD500 million), before tripling this output in 2017 and 2018, until the 2020 COVID outbreak led to a steep decline, that reverted again in 2021. This trend also suggests the high likelihood for growth in 2022.

Although the data provided to the Administrative Tribunal (2021) by MIREME has different values, it does generally corroborate this history of coal expansion amidst volatility. This data highlights 2017 and 2018 as peak years for both thermal and coking coal weight and value extraction and depicts the steep decline of 2019. Notably, the 2020 PES set a target of 1.5% growth in the Extractive Industry, compared to 2019 on mineral coal - with 5, 700,000 tonnes of coking and 4,310,00 of thermal coal (with an increase of 6.4% and 13.5%, respectively, on the previous year). This was not achieved, with actual amounts of coking coal reaching 4,670,626 tonnes and thermal at 3,370,585 tonnes. This reveals a gap between expectation and reality that could affect the expected revenue and funding of state programmes, especially dealing with debt.

The development of coal exports has been charted by the MIREME and it shows a general expansion in the sector from 2016 (2Mton of thermal coal and 4Mton of coke) to 2018 (almost 7Mton and over 8Mton respectively), 2019 was marked by a drop in extraction with both commodities barely reaching 5Mton) and a further decrease in 2020 with 3Mton thermal and coke staying in the previous level. MIREME reported that this reduction was due to the stoppage of export markets and the reduction of workers at the mining sites in compliance with the minimum distancing requirements to limit the spread of coronavirus.

The destinations for Mozambique's coal exports have shifted over the years, but as of 2022, India was the largest recipient, with around 42% (totalling around USD250 million) of all coal exports from Mozambique. South Korea was second at 12.7%. It should be noted European states do import coal; Poland received about 9.44% and the Netherlands accumulated just under 2% (Trendeconomy, 2021). Mozambique also exports coal to Germany (Kaufmann, Winfried Borowczak, 2019), with reports claiming a total of USD19.3 million arriving in 2020 (see OEC, 2022) – a figure likely to increase in 2022.

Even though coal is one of the country's most important exportation products, the revenue generated is not high for the state. This trends against Mozambique's international commitments to revenue-raising, such as the SDGs and in particular, the African Union Agenda for 2063 that emphasises negotiations favourable to revenue-sharing mechanisms in the extractives sectors to allow for the maximisation of revenue as a central aspect of Mozambique policy (TA, 2020: v-1).

Highlighting the relative importance of gas compared to coal, the TA reported in 2021 that 8,795 million Meticais of revenue were collected from the gas sector, representing 85.6% of the total collected across the two sectors, against 1,475 million Meticais (approx. USD23 million) collected in the coal sector, making up 14.4% of the total collected (TA, 2021: v-20). In 2020, the gas and coal sectors contributed 10,270 million Meticais to state revenue, which represents 4.4%9 of its total (235,213 million Meticais) (see TA, 2020: v-20).

The TA, more problematically, highlighted that the reporting of divergent data in the CGE is a recurring problem. The TA stated:

"The reporting of divergent data on revenue collected in extractive industries, albeit in smaller and smaller differences, persists in the 2020 CGE, which contains inconsistent information information issued by the Tax Authority (DGI Tax Directorate). This situation, which affects the reliability of information on the value of revenues, mentioned in the 2020 CGE, contradicts what is recommended in paragraph 1 of article 46 of law no. n.º 9/2002, of 12 February. The General State Account must be prepared with clarity, accuracy and simplicity, in order to enable its economic and financial analysis, regarding the reporting of taxes paid by companies in the oil and gas and coal sectors" (TA, 2020: section 5.3)

Tax and revenue provisions for coal mining are allocated under the Taxation of Mineral Operations (Law No. 28/2014, of 23 September 2014, as amended by Law No. 15/2017, of 28 December) and the relevant Regulations (approved by Decree 28/15, of 28 December 2015). In terms of revenue, the Tax Authority of Mozambique administers taxation revenue, ensuring payment of revenue derived from the export of coal. Increases in coal production have enabled the government to raise more revenue, as the tax (royalties) paid to the government make up the second major source of revenue in the coal sector, after corporate income taxes. However, as Mondjane warns, with its share of GDP increasing "there is tendency for the country to move from aid dependence to natural resource dependence" (see Mondjane, 2019: 192, 189)

In addition, one of the more novel developments have been legislative attempts to generate more state and local participation in the mining sector. One of these attempts has been through the Mega Projects law, and the so-called Free Carry State Participation by Company, that partly addresses the social capital contribution noted in all mining contracts. The Megaprojects Regulations establishes that the State reserves the right to negotiate the free participation of no less than 5 per cent during any phase of a mining project, as consideration for its awarding of exploitation rights over natural resources (Viana, Daniel, Fialho, 2019).

1.3.4 South Africa

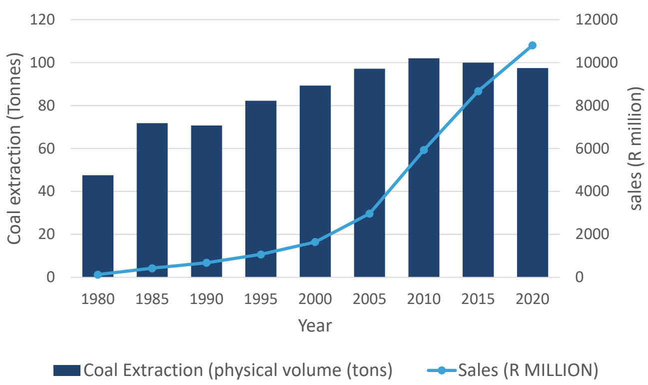
South Africa is ranked 6th in terms of coal reserves with an estimated 53,156 Mton in 2021, with the mining sector playing a key role in South Africa's economy. In 2020, it contributed R$353.2 billon (7.1% GDP) and contributed R$480.9 billion in 2021 (8.7%) (Minerals Council, 2021). Coal rents were estimated at 1.671% and 1.624% in 2019 and 2020 respectively (The World Bank Group, 2022), and is the largest contributor to mineral sales, totalling 77.1% (Stats SA, 2022). Figure 28a shows an increase in the coal extracted and subsequent sales in the years between 1980 and 2020.

Moreover, the figure 28b shows how the increasing trend until 2019 declined in the years to follow. The drastic reduction in 2021 is attributed to the National COVID-19 clearance regulation that delayed vessels, and security and operation issues at the rail lines connecting to the Richards Bay Coal Terminal (RBCT) (Nicholas & Buckley, 2019; RBCT, 2021). Coal royalties showed a relative increase from 2016 to 2021, regardless of the amount of coal extracted, as seen in the same figure.

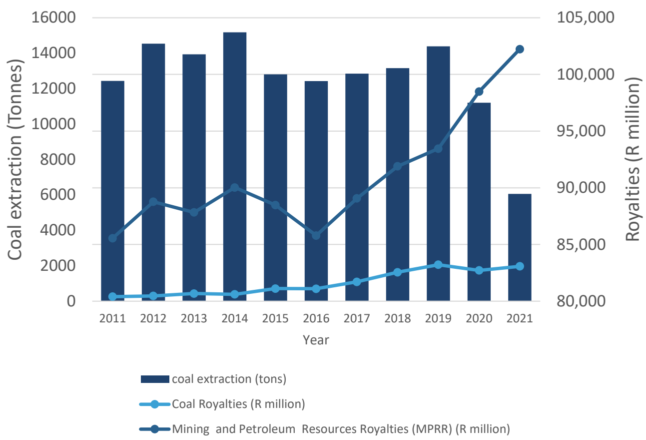
Figure 28a. **Coal extraction and sales 1980-2020**

Figure 28b. **Coal extraction and royalties**
Source of data: STATS SA (2021)

28a.



28b.



About three quarter of extracted coal is consumed domestically (Maseko, 2021). Of this amount, Eskom uses about 67%, Sasol 21% and industry and households, 12%. Figure 29 the domestic and exported coal from the major coal mining companies. A large percentage of the coal is consumed domestically, with Exxaro providing the most (35%) for domestic use, and Glencore exporting the most (48%) as of 2019/2020 financial year. Figure 30 further illustrates historical energy consumption per commodity with a notable general decline from 2006 to 2017. This is partially attributed to the depleting coal reserves, competition for low-grade coal for export, and the global pressure for cleaner energy generation (Winkler & Marquand, 2009).

Figure 29. Domestic consumption and coal exports from major coal operators in 2019-2020

Adapted from: Maseko (2021)

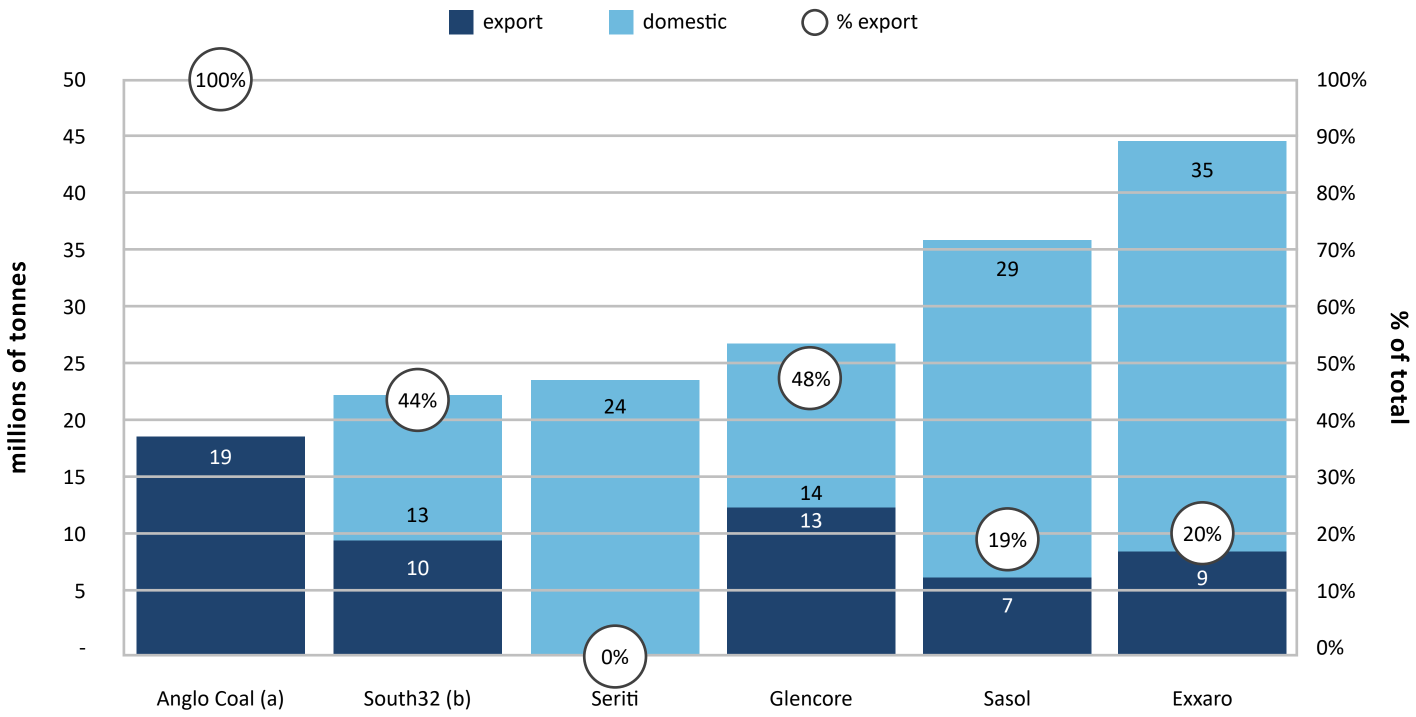
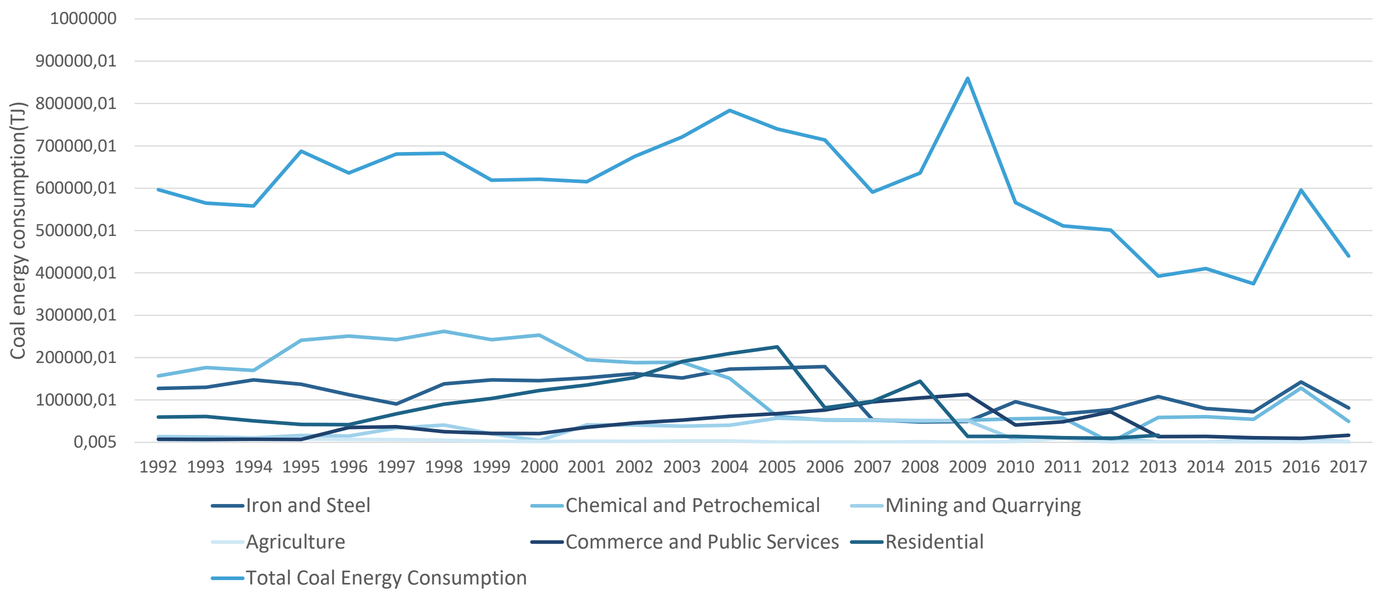


Figure 30. Domestic coal energy consumption per sector 1992-2017

Source of data: DMRE (2019)



Coal exports are estimated to be at about 30% of the total extraction, with about 40-50% of this designated to the Indian market alone (CoM, 2018; NBI, 2021). Historically, Europe was the main export market, particularly The Netherlands, Belgium, and the United Kingdom, but these countries reduced imports in 2005, as an initial step to comply with the Kyoto Protocol (CoM, 2018). In 2006, India began to emerge as an important market, with a surge in sales volume from 3% to 13% in 2007. Asia has continued to dominate the coal exports market, particularly India, Pakistan, and China from the RBCT, with about 87% (50.7 Mton) in 2021 (Figure 31a). Coal exports from South Africa to China increased as an alternative to Australian coal amid trade tensions in 2020 (Engineering news, 2021).

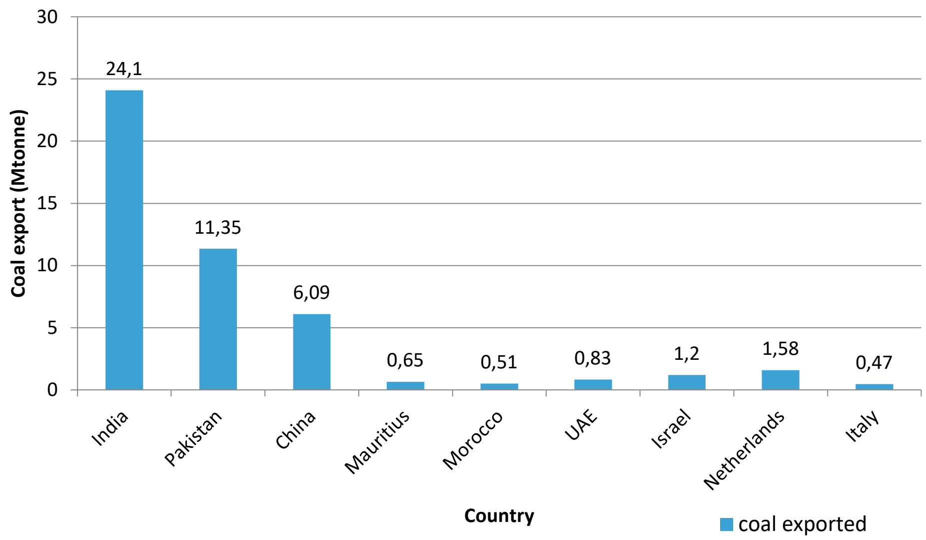
No significant differences in coal exports were evident for the period of 2015 to 2020, but there was a drastic decline to 58.72Mton in 2021 as shown in figure 31b. This decline has been attributed to the delays associated with national COVID-19 pandemic clearance regulations, and the security and operation challenges surrounding the Transnet railway line (RBCT, 2021). At the end of May 2022, the RBCT coal exports had risen from 4% for the whole period of 2021, to 15% in just 5 months due to the European countries seeking alternatives to Russian coal (Mining weekly, 2022).

Figure 31a. RBCT coal export destination 2021

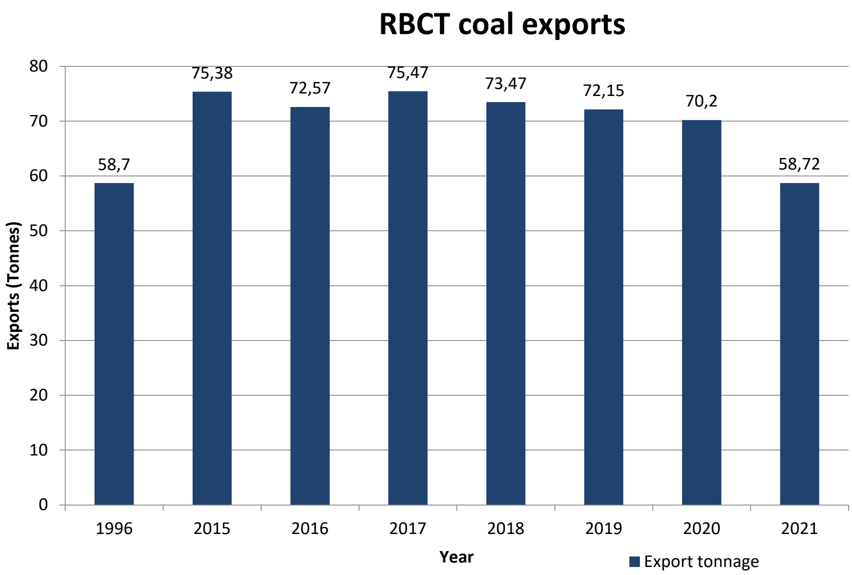
Figure 31b. Coal exports from RBCT 1996 and 2015-2021

Adapted from: RBCT (2021)

31a.



31b.



1.4 Climate change and the coal sector

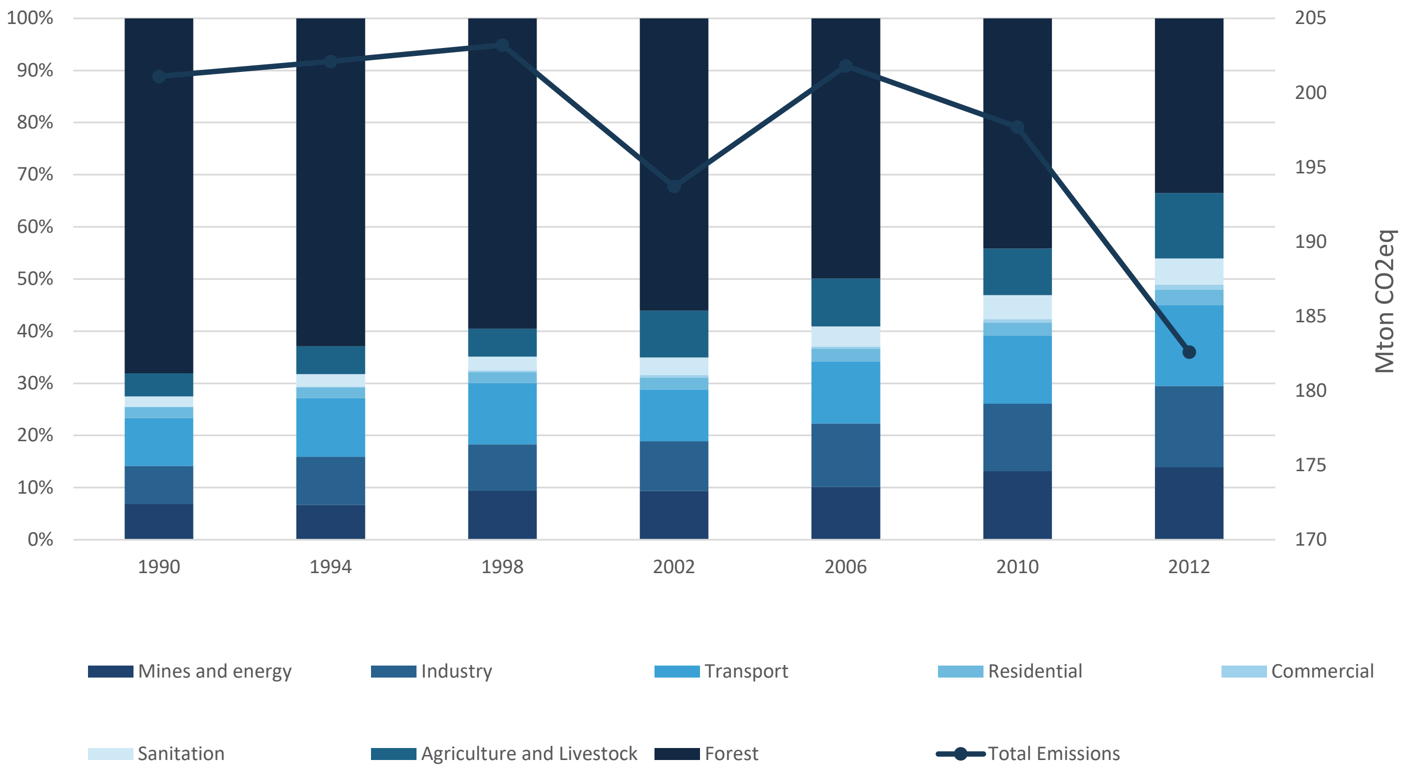
The next section will address the current emissions profiles of the selected countries and the relations between the coal sector and climate change at large. It will also describe the policies, regulations, and international commitments that the States have made with regards to climate change.

1.4.1 Colombia

Colombia updated its Nationally Determined Contributions (NDCs) target in December 2020, thereby committing to reduce GHG by 51% (169.44MTon CO2eq max.) and black carbon emissions by 40% by 2030, compared to 2014 levels (Gobierno de Colombia, 2020). Colombia expects to decrease its emissions between 2027 and 2030, with the aim of moving towards carbon neutrality by mid-century.

Figure 32 shows the historical Green House Gases (GHG) emissions for Colombia from 1990 to 2012. The highest contributions since 1990 have been from the forestry sector, followed by the agriculture and livestock, transport, and the industry sectors. Since 2016, there has been a reduction in emissions from the forestry sector, because of a decrease in deforestation, although the effects of the Peace Agreement between Colombia and the Revolutionary Armed Forces of Colombia (Fuerzas Armadas Revolucionarias de Colombia – FARC, acronym in Spanish), the largest guerrilla group in the country (Ganzenmüller et al., 2022), has seen deforestation increase. The mining and energy sectors have seen the gradual expansion of emissions levels over time, accounting for around 13% of total national emissions in 2012. Specifically, the coal sector released 4.1Mton CO2eq for 2020, representing 1.4% of the total national emissions (MME, 2021).

Figure 32. **Net GHG emissions of Colombia 1990-2012**
Source of data: IDEAM et al. (2016)



To comply with the Paris Agreement, Colombia has developed a long-term climate strategy (E2050) (Gobierno de Colombia, 2021) that outlines 7 'opportunities' to achieve carbon neutrality. One of these opportunities is the diversification of the energy matrix to fulfil the demand through renewable sources. In this sense, it is intended that CFPPs will continue operating until the end of their useful life, alongside mandatory energy efficiency measures such as energy use and storage, and carbon capture.

In addition, the Congress of Colombia issued Law 2169 of 2021 (Congreso de la República, 2021) to establish minimum targets and measures by sector to achieve carbon neutrality. Coal mining is required to incorporate climate change guidelines within operating conditions to include new scenarios of operational and environmental demands for 2025. Furthermore, the MME should incorporate energy efficiency plans into mining activities to reduce energy emissions and quantify the associated co-benefits.

The country also created the Comprehensive Climate Change Management Plan for the Mining and Energy Sector (MME, 2021), which estimates that the coal mining sector will release 6.3 Mton CO_2eq and 6.6 Mton CO_2eq for 2030 and 2050, respectively, becoming the third energy sector with the highest GHG emissions. Therefore, to mitigate emissions from the coal mining sector, the proposed strategies are methane recovery in underground coal mining[9]; the improvement of energy efficiency in the extraction process, and the substitution of project-energy sources by hydrogen. These strategies are evaluated under five mitigation scenarios, for which the most ambitious mitigation scenario sees 1.41 Mton CO_2eq being reduced; this is about 20% of the estimated total emissions.

Policies, plans, and regulations in Colombia have not been oriented towards a coal phase-out. Instead, the institutional vision has promoted the continuity of extraction, while plans have focused on technology solutions, energy efficiency strategies, and offsets. However as of the 2022 Presidential election, political intent appears to be changing. Whether this this is the case, and conditions shall allow for a deeper reorientation, is yet to be seen.

The new Government Plan states that there will be a "gradual de-escalation of the economic dependence on oil and coal, exploration and exploitation of non-conventional oil & gas deposits will be outlawed…no new licenses will be granted for [conventional] oil & gas exploration, nor will large-scale open-pit mining be allowed[10]" (Pacto Histórico, 2022).

On the other hand, Colombia created a carbon tax as part of the Law 1819 (2016) to discourage the use of fossil fuels, while promoting technological improvements leading to their efficient use. To achieve this objective, the carbon content generated during the combustion of seven fossil fuels that areused for sale to industrial users, has been priced (DNP, 2022).

Colombia has participated in the carbon market since 2007, through programmes like the Reducing Emissions from Deforestation and Forest Degradation (REDD+). This programme is an offset system that aims to transform forest into spaces valued for their carbon sequestration function through the creation of equivalence units, and provides carbon offsets to polluting industries to compensate their emissions (Gilbertson, 2021). This offset system has been implemented by coal mining companies to secure the tax benefit associated with the carbon tax payment.

Law 1931 (2018) has established the tradable emission coupons of GHG as a mechanism to manage climate change. These coupons are defined as a tradable right to entitle the holder to emit one tonne of CO_2 or other GHG for an amount equivalent to one tonne of CO_2 (Congreso de la República, 2018). The coupons are established and auctioned by the National GHG Tradable Emission Quotas Programme (Programa Nacional de Cupos Transables de Emisión de Gases de Efecto Invernadero – PNCTE, acronym in Spanish). In other words, the Law 1931 has allowed GHG emissions to be credited to the carbon tax offsets system; linking carbon taxes and emission offset systems (Gilbertson, 2021). However, the PNCTE is not yet operational.

[9] Currently, in Colombia there is no regulation for the extraction of this type of non-conventional resources.

[10] Translation made by the authors of this report.

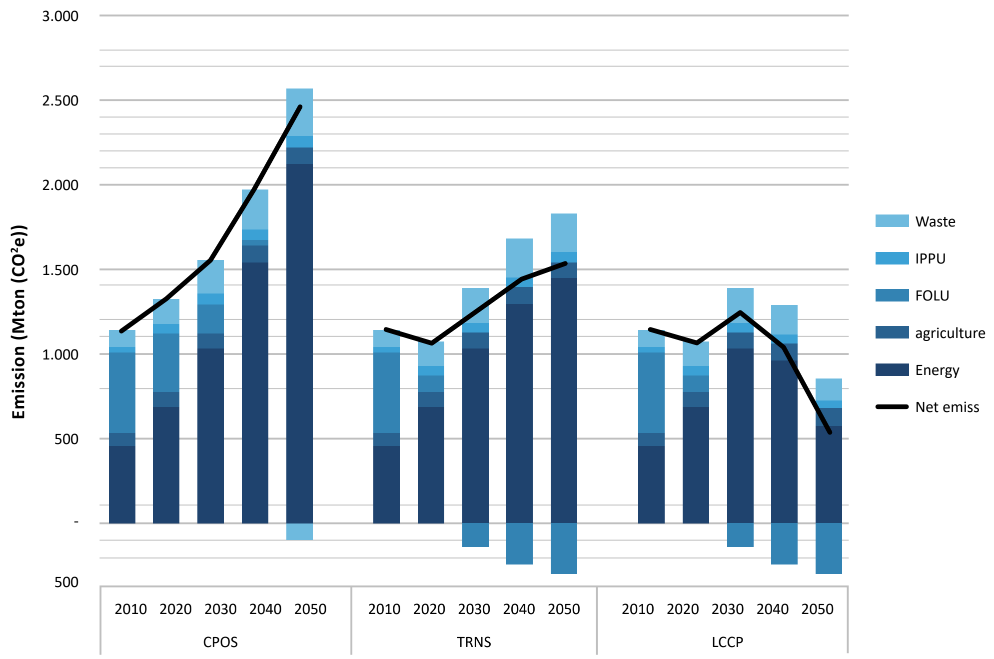
1.4.2 Indonesia

As the energy sector is the largest GHG contributor in Indonesia (MoEF, 2021, see Figure 33a), the Indonesian government has expressed its intent to reduce sectoral emissions by increasing shares of renewable energy (Figure 33b). Among the country's targets are the Nationally Determined Contribution (NDC), and the National Net Zero Emission (NZE) target stated in LTS-LCCR (detailed in table 10).

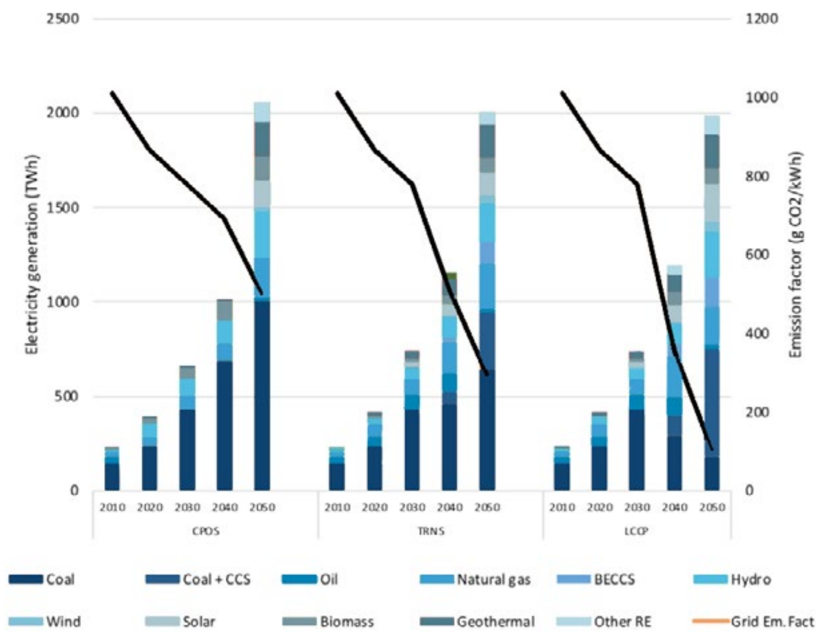
Figure 33a. GHG emissions data and projections by sector 2010-2050 in three scenarios

Figure 33b. Electricity generation data and projections by source 2010-2050 (BAU and low emission scenarios illustrated as CPOS and LCCP)
Source of data: KLHK (2021), (MoEF, 2021)

33a.



33b.



To reach the NZE target by 2060 or sooner, the emission peak must be achieved by 2030 at the latest, according to the LCCP scenario results. An intensive use of natural gas, renewable energy, and CFPP, complemented by CCS, will be able to rapidly reduce emissions. However, this result is not without controversy. The idea of using natural gas as a bridging fuel is considered an impractical solution due to the 3-fold increase of the global gas price compared to the prices of June 2022 and June 2021 (Statista, 2022). As a new technology, CCS continues to encounter many issues regarding price, efficiency, and development, and as such, cannot be truly regarded as an alternative (Durmaz, 2018; Liu et al., 2022; Regufe et al., 2021).

Table 10. **Descriptions of emissions reduction plans and programmes from the energy sector in Indonesia**

DOCUMENT	LAUNCH YEAR	EMISSION REDUCTION TARGET	RENEWABLE ENERGY SHARE TARGET
National Determined Contribution	2014 (updated in 2021)	Emission reduction from 2020-2030 by 29% (unconditional) up to 41% (conditional) compared to the BAU scenario in 2030	At least 23% in 2025 and at least 31% in 2050
RUEN	2017	Emission in the energy sector is 1,949.9 million tonnes CO2eq (58% lower than BAU)	At least 23% by 2025 and at least 31% by 2050
LTS LCCR	2021	Peak of emission in 2030, reaching 540 million tonnes CO2eq in 2050 (about 1.61-ton CO2e per capita), and NZE by 2060 or sooner	Power generation in 2050 contains 43%, renewable energy, 38% coal, 10% natural gas, and bioenergy with carbon capture and storage (8%).

According to a survey by IESR (2021), while 93% of the 28 surveyed companies are aware of the Paris Agreement, only 21% of them have set net zero emission targets; this demonstrates a lack of participation of the private sector in emissions reduction. Most of the targets are set for delivery by 2060, like those of the government. Four main ways to achieve these targets are through carbon removal and offset, renewable energy penetration to the system, energy efficiency, and even supply chain decarbonisation.

1.4.3 Mozambique

Mozambique has long recognised the threat posed by climate change, with the country presenting their first communication on the topic to IPCCC in 2003 and passing the National Climate Change Adaptation and Mitigation Strategy in 2012. It also passed the Intended National Determined Contribution in 2015 (INDC, 2015) and made the First National Determined Contributions in 2018 (FNDC, 2018). Mozambique's commitment includes a reduction of 76.5Mton from 2020 to 2030 and prioritises adaptation.

Mozambique is listed as one of the top five most vulnerable countries to climate change, and the fifth most affected by extreme weather over the last two decades (2021 Global Climate Risk Index, 2021). The World Food Program (WFP and Met Office, 2019) noted Mozambique to be the country most affected by extreme weather events in 2019. These vulnerabilities place pressure regarding food security and is greatly exacerbated by exposure to climate hazards. The country's risks have also been recognised as being increased by "its low adaptive capacity, poverty, limited investment in modern technology, and weaknesses in its infrastructure and social services, especially those related to health and sanitation" (NAP-GSP, 2020).

Similarly, the Government of the Netherlands' Climate Change Profile: Mozambique (2019) projected recurrent agricultural losses because of droughts, floods, and uncontrolled bush fires; also, that the densely populated coastal lowlands will be increasingly affected, and that changing rainfall patterns and reduction in transboundary river flows will decrease the availability of surface water. USAID (2018) made similar findings as well, with particular focus on agriculture, human health, coastal resources, and water, highlighting likely effects on coastal areas, and increased frequency and severity of intense storms, droughts, and floods.

Mozambique is historically responsible for less than 0.01% of global CO2 emissions, with cumulative production-based emissions available from 1927 through to 2020 (see Global Carbon Project, 2021; Andrew & Peters, 2021) and the main contribution coming from land use change. Mozambique's government has put various climate strategies in place in recent years; the most important of which is the National Climate Change Adaptation and Mitigation Plan (2012) (NCCAMS) (see Appendixes). The Plan was approved by the Council of Ministers and developed by a group representing sectoral ministries, the private sector, and civil society. This document defines the state's primary goals and key priorities in meeting a variety of climate challenges; promoting the vision of "A prosperous and climate change resilient Mozambique, with a green economy in all social and economic sectors."

Mozambique has been active in most international forums regarding climate change, and has used its diplomacy to push for emissions targets, while strengthened its mitigation targets. However, at the same time, Mozambique's recent strategies have typically either overlooked the coal sector or have not explicitly integrated mining in its climate actions.

Indeed, Mozambique's Initial National Communication to the UNFCCC (2003) made direct reference to coal, highlighting its budding potential for development and economic growth at the time. It stated "Among the mineral resources mentioned above the coal has the largest potential" asserting that existing extractive capacity was 9 Mtpa (MICOA, 2003: 21). It noted "fugitive emissions" associated with the extraction of this coal as negligible (2003: 27-28, 36, 40).

Mozambique's Intended National Determined Contribution (2015) (INDC, 2015) was passed, but made no reference to coal or mining. This contribution was updated at the end of 2021 (Government of Mozambique, 2021) and registered at the UNFCCC (see Republic of Mozambique, 2021). Here, energy was listed, but in ways that focused on assuring access (consistent with the government's stated universal electrification by 2030 platform), rather than renewables per se. Notably absent was any mention of the mining sector or coal from mitigation or adaptation efforts.

At COP26, Mozambique agreed to two key achievements: to halt and reverse forest loss and land degradation by 2030, and to reach 62% of renewable energies by 2030. In terms of the latter, however, it emphasised that it favoured a "gradual transition" due to fears of economic (developmental) impact following the termination of coal production and exports. Extractives have continued to be at the core of the state's development and were prioritised accordingly.

Fauna in Mozambique, Mozambique **Source: Deborah Varrie for Unsplash**

1.4.4 South Africa

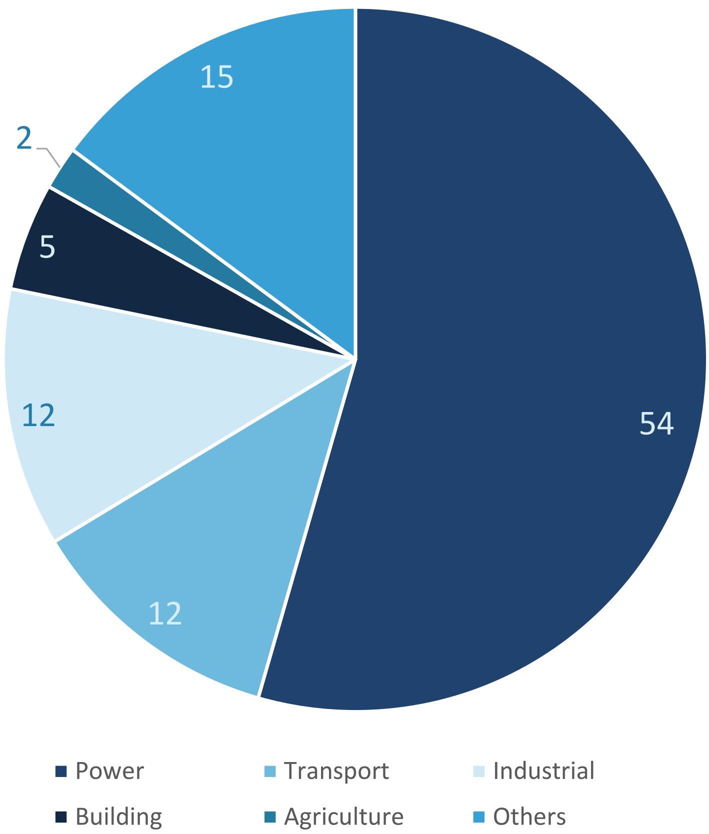
South Africa is committed to net zero emissions by 2050 through the approved Low Emissions Development Strategy (LEDS). LEDS was developed based on guiding policies including the Nationally Determined Contributions (NDC), the National Climate Change Response Policy (NCCRP), and the Climate Change Bill. The country submitted its NDC in September 2021 to keep annual Green House Gas (GHGs) emissions between 398 to 440 Mton CO2eq by 2030 (DFFE, 2020). The Minimum Emissions standards (MES) and the Atmospheric Emissions Licenses (AEL) are the primary tools to regulate the reductions of emissions, as detailed in the National Environment Management: Air Quality Act No. 39 of 2004 (RSA, 2004).

It is estimated that each kilowatt-hour of electricity emits 879g of CO2 (Climate Transparency, 2021; Makgetla & Patel, 2021). Figure 34a shows that in 2020 the energy sector ranked first with 55% of CO2 emissions, while agriculture ranked last, with 2%. In the updated First Nationally Determined Contribution (NDC) report of South Africa, the energy sector was found to contribute to the highest CO2 emissions, with an average of 92% from 2000-2020 (DFFE ,2022) followed by industry and agriculture.

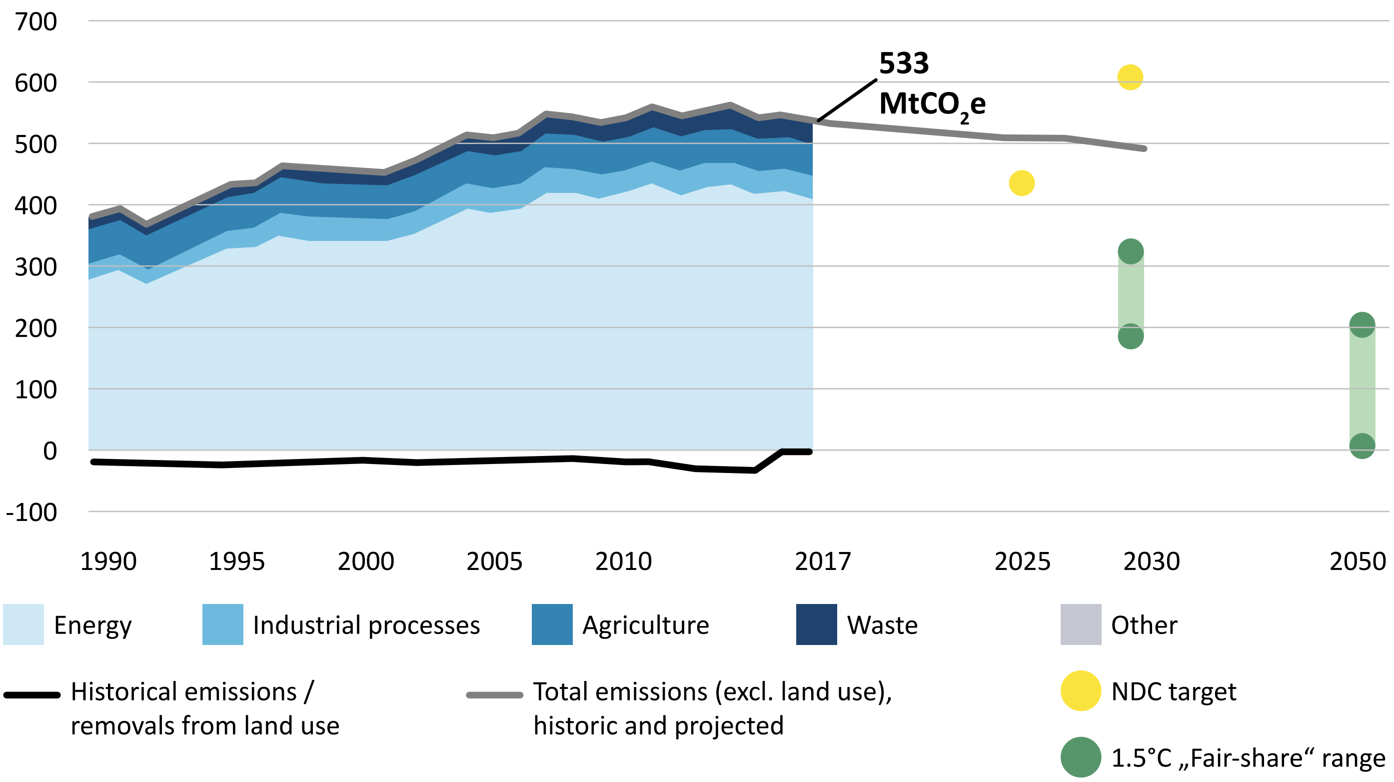
Figure 34a. **Energy-related emissions per sector in 2020**

Figure 34b. **Total GHG emissions per sector 1990-2017 (Mton CO_2eq)**
Adapted from: Climate Transparency CT (2021) and CT (2020)

34a



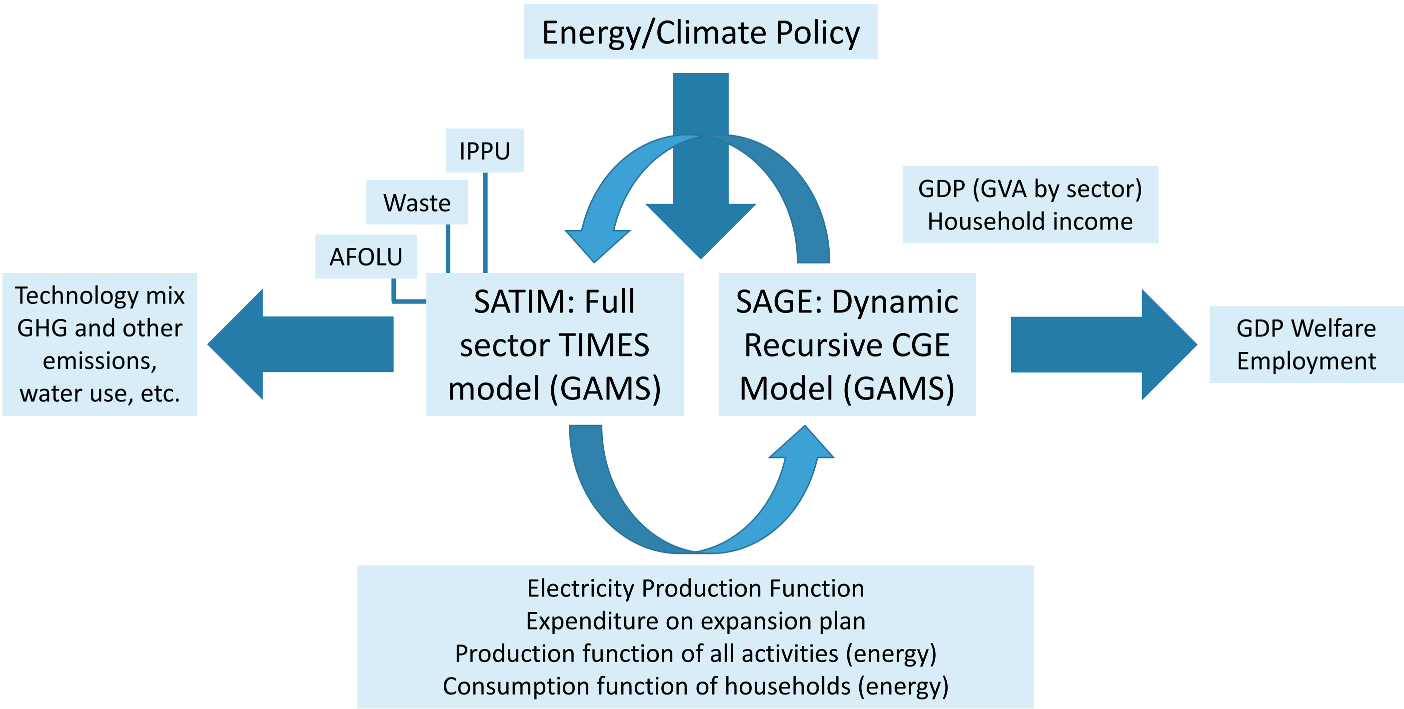
34b



South Africa's first Nationally Determined Contribution was submitted in 2015 to UNFCC, stating a commitment to keep GHG emissions within a range of 398-440 Mton CO2eq. It has since updated the NDC using SATIMGE, an integrated modelling framework that combines technologies and economy-wide computational General Equilibrium (PCC, 2021). The SATIMGE consists of the South African TIMES model (SATIM) linked to the eSAGE (a variant of the South Africa Generalized Equilibrium CGE model as shown in Figure 35. The SATIMGE includes all sectors and the IPCC National Emissions Inventory.

The SATIM model used the technical details of the energy sector to consider the demand and supply to compute the least-cost energy efficient technology. In other sectors, the planned policies and measures were modelled, including the (IRP, 2019) in the electricity sector, the Green Transport Strategy, the draft post-2015 National Energy Efficiency Strategy, and the carbon tax. The information was then fed into the eSAGE model to assess the economic impacts of the various sectors. The outcome of the modelling process estimated GHG emissions of between 370-395Mton CO2 which is below the proposed NDC range of 398-440Mton CO2eq (Arndt et al., 2016; DFFE, 2020; Rodriguez, D. J., 2017). A weakness that must be mentioned in this process is that of the model being an endogenous model that considers both energy supply and demand, but only used the exogenous IRP 2019 that only shows electricity demand.

Figure 35. **SATIMGE Integrated Modelling Framework**
Adapted from: Government of Mozambique, 2021



The Climate Change Bill is a legislative framework for the implementation of the Republic's national climate change response. The Bill determines the Sectoral Emission Targets (SETs) for each GHG emitting sector in line with the national emission target for every five years, with carbon budgets then being allocated to major emitting companies (RSA, 2022). In 2019, the carbon tax Act 15 was launched, defining a fee of USD8 per tonne CO2, starting with the Scope 1 emitters[11] in phase I to include fossil fuel combustion emissions, industrial processes and product use emissions, and fugitive emissions such as those from coal mining up until 2022. Unfortunately, the carbon tax design provided a significant tax-free emission allowance of up to 95% and revenue recycling measures.

The first phase was initially scheduled to end in December 2022 but was extended to December 2025 with no mention of plans for phase 2. The Department of Forestry, Fisheries and Environment proposed a voluntary budgeting system for companies over a five-year period, and the phase-out of carbon allowances of 5%, which is to be realised as of 1st January 2023 (KPMG, 2022; RSA, 2022; Szabo, 2021). Table 11 contains a quick summary of the policies, regulations and plans in the country.

[11] Scope 1 emissions are direct GHG emissions that occur from sources that are controlled or owned by a company (e.g., emissions associated with fuel combustion in boilers, furnaces, vehicles).
https://www.epa.gov/climateleadership/scope-1-and-scope-2-inventory-guidance

Table 11 **Policies, regulations and plans**

TYPE	AREA	DESCRIPTION
Policy	The National Climate Change Response Policy (NCCRP) 2011	Comprehensive policy framework to respond to climate change. Management of inevitable impacts through interventions. Contribute to global efforts to stabilise GHG concentration in a timely and sustainable manner.
Strategy	South Africa's Low Emissions Development Strategy (SA LEDS) (February,2020)	Sets out in the NDC as the instrument to represent their part of the global effort to reach the global peaking of GHG emissions. SA-LEDS is founded upon: The National Development Plan (NDP); The National Climate Change Response Policy (NCCRP) and The Climate Change Bill.
Bill	Climate Change Bill (B9 2022)	Enables the development of an effective climate change response and a long-term, just transition to a low-carbon and climate-resilient economy and society.
Legislation	The Carbon Tax Act No. 15 of 2019	Provides for the imposition of a tax on the carbon dioxide (CO2) equivalent of greenhouse gas emissions; and to provide for matters connected therewith.

Aerial view of Cape Town, South Africa

Source: Tobias Reich for Unsplash

Rice Field, Indonesia

Source: Handriyanti Puspitarini

1.5 Environmental Impacts

In this section, the research concerning the state of the resources, biophysical impacts, and the resource nexus approach in each country will be presented. First, the water uses in the coal regions will be addressed, along with issues surrounding water quality and quantity, land use changes, health impacts, and energy consumption.

Acid mine drainage (AMD) is arguably the most serious environmental concern for water quality in mining, with the potential to persist in the long-term or in perpetuity. In the process of coal mining extraction, the extracted materials, pit walls, and any other material exposed to surface conditions may react with oxygen which, depending on the sulphur content of the rock, could trigger significant acidification; a condition that favours the leaching of elements of environmental interest (Forigua Quicasán et al., 2017; Maest et al., 2005), AMD is characterised by low pH (typically 4.5 or lower), high concentrations of sulfates (> 2500 mg/L) and high concentrations of dissolved metals including Mn^{2+}, Fe^{2+}, Zn^{2+} (> 200, 35, 20 mg/L, respectively) (Vasquez et al., 2016).

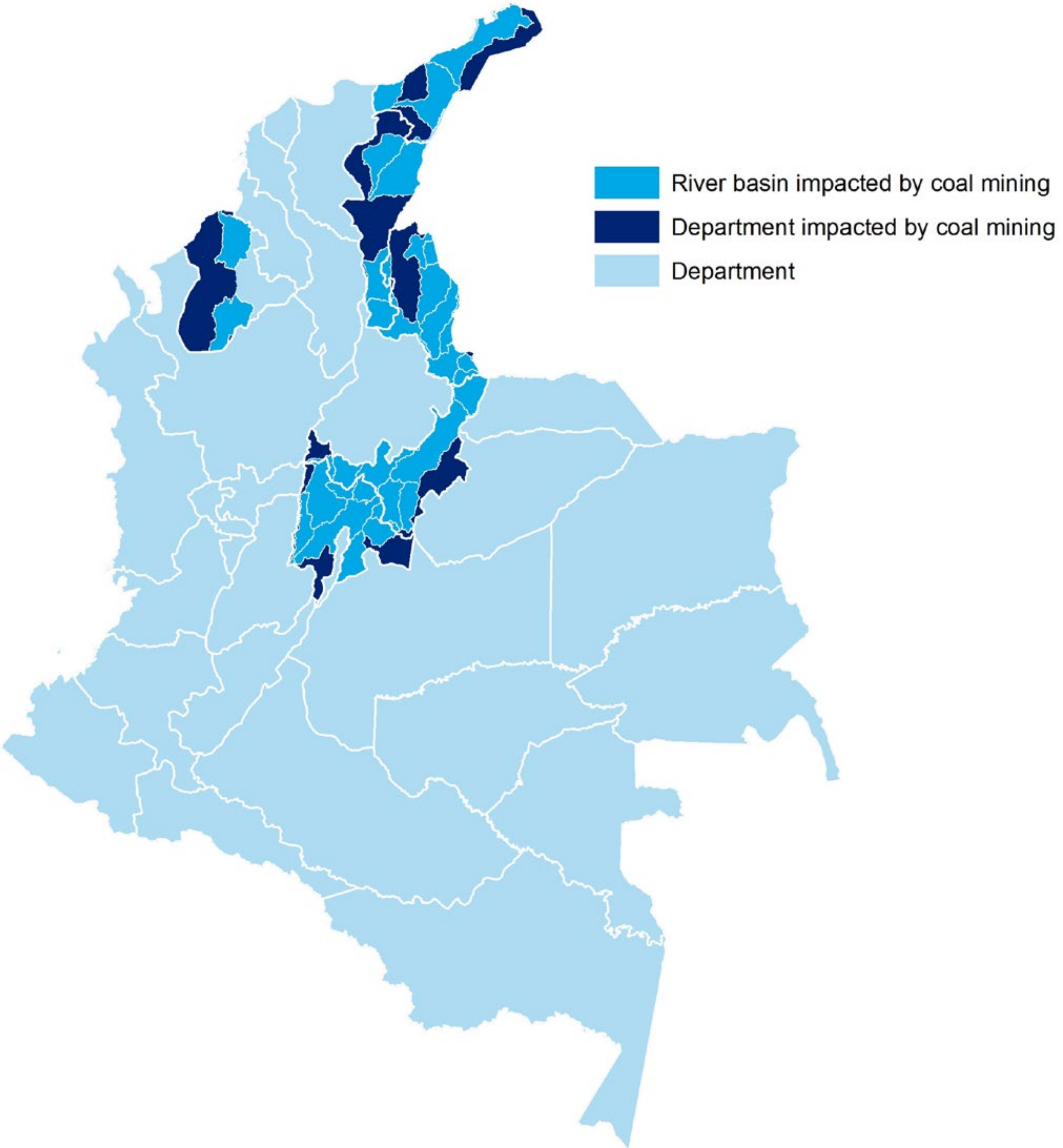
AMD as an impact may compromise water resources for decades in the future, but also decrease the productivity or quality of crops and constrain other land uses so it will be given special attention in the following section.

Tatacoa Desert, Colombia **Source: Gabriel Levy for Unsplash**

1.5.1 Colombia

Colombian coal regions are composed of 5 hydrographic regions that are subdivided into 316 hydrographic basins (IDEAM, 2019). Coal mining activities are carried out mainly in the 3 hydrographic regions (Caribe, Magdalena-Cauca, and Orinoco) that are comprised of the 28 hydrographic basins identified in this document as containing coal value chain-related activities (see Figure 36).

Figure 36. Departments and hydrographic basins impacted by coal mining



The Institute of Hydrology, Meteorology and Environmental Studies (Instituto de Hidrología, Meteorología y Estudios Ambientales – IDEAM, acronym in Spanish), is a technical government agency under MADS that is responsible for estimating the Water Use Index (WUI)[12]. The appendix, water data contains information on water-use pressure across the Magdalena, Cauca, and Caribbean hydrographic regions (orange and red WUI marking insufficient supply).

In La Guajira, demand at the Río Rancheria hydrographic basin has increased for domestic and agricultural use, while aquifers have also been impacted due to coal mining (Corpoguajira, 2011). The National Agency for Environmental Licensing (Agencia Nacional de Licencias Ambientales – ANLA) indicates that La Guajira is one of the regions that are most vulnerable to water shortages due to low surface water availability, low humidity retention, and high water demand (ANLA, 2020). These results are consistent with data reported in IDEAM (2019) , which shows that 100% of La Guajira's municipalities are affected by water shortages. This is also true for 90% of Cesar's municipalities.

ANLA (2021a) has already identified both high and very high potential environmental sensitivity relating to surface and groundwater, ecosystem vulnerability, and air quality, because of the coal mining projects in the Cesar Department[13]. Furthermore, through hydrological modelling, ANLA (2021a) has identified drastic reductions of approximately 60% in the maximum water flows since the commencement of coal mining projects in Cesar, and slight increases in medium and minimum flows. These indications point out that that changes in the natural flow regime are not only attributable to these projects, but also to the other activities that have taken place in the Río Calenturitas basin over the years.

For the other hydrographic basins of the Magdalena-Cauca hydrographic region, water demand for electricity generation has increased (hydropower plants). Moreover, the Tasajero CFPP and the agricultural sector have contributed to the increase of water use in the hydrographic basin Rio Zulia (IDEAM, 2019).

To consider the resource nexus, water demand from the coal and agricultural sectors in the coal regions has been estimated to create an index that the Authors names the Water Demand Index (WDI). The WDI estimation is depicted in the appendix on water data. Results showed Boyaca, Cesar, and La Guajira to be the Departments for which the greater quantity of water is used per tonne of coal extracted. Furthermore, the Caribbean coal mining region presented the highest water consumption to produce one tonne of food - at about 30 times the value of Departments such as Cundinamarca (around 334 m^3).

[12] The WUI is the relation between the amount of water used by the different user sectors, in a given period (e.g. annually) and spatial unit of analysis (e.g hydrographic basin), and the surface water supply.

[13] Cesar is composed of three hydrographic basins: Medio Cesar, Bajo Cesar and Río Ariguaní.

The appendix on water data shows the Water Quality Index (WQI) estimated in these monitoring sites from 2005 to 2020, based on the data provided by IDEAM (2022) and additional data from the National Water Study (IDEAM, 2019). The water Quality Index shows 'regular' to be the most frequent WQI category, with La Guajira as the only place with values in the 'very bad' category, namely at the Río Rancheria basin, while also being the region with the lowest data availability.

Water discharge and extraction permits are issued either by ANLA or the Autonomous Regional Corporations (Corporación Autónoma Regional - CAR, acronym in Spanish). They also monitor quality and quantity of water bodies (surface and groundwater) used for these purposes. Based on the information provided by ANLA (2022b), the water extraction and discharge points in the coal mining regions (which are part of its jurisdiction) can be seen in Table 12. It is evident that there is no linear connection between the number of extraction and discharge sites and the extraction or discharge flow permitted. This means that more water sites are not concurrent with quantities of extract or discharge water. The high quantity of water discharge permitted in Cesar is remarkable compared with that of La Guajira, and extraction and discharge flows permitted in Norte de Santander and Boyaca.

Table 12 **Water discharge and extraction in coal mining regions**
Source of data: ANLA (2022b)

Department	Number of extraction sites			Extraction flows (L/s)			Extraction basins	Discharge		Discharge Basins
	Surface	Groundwater	Total	Surface	Groundwater	Total		Surface sites	Effluent (L/s)	
Cesar	80	70	150	7,064.6	377.2	7,441.8	Medio Cesar and Bajo cesar	132	299,220.2	Medio Cesar and Bajo cesar
La Guajira	57	243	300	6,830.9	324.3	7,155.2	Rio Rancheria and Rio Ancho y otros directos del Caribe	90	902.6	Alta Guajira, Rio Rancheria, Rio Ancho y otros directos del Caribbean
Cordoba	15	10	25	411.7	8.6	420.4	Alto San Jorge	97	2,926.5	Alto San Jorge
Norte de Santander	5	0	5	35,000	0.0	35,000	Rio Zulia	8	7,527.1	Rio Zulia
Boyaca	5	0	5	314.9	0.0	314.9	Rio Chicamocha	32	38,449.9	Rio Chicamocha

Note: For Cesar and La Guajira, data is related to mines predominantly. For Cordoba, Norte de Santander, and Boyaca, data is related to CPFFs.

On the other hand, the water data appendix contains information on the characteristics of the discharges of some of the coal mining companies – namely those located in the Caribbean region - showing water parameters related to AMD. Overall, it was identified that companies exceeded the national and international standard for iron (Fe) and sulphate, and there are also exceedances for zinc (Zn) and pH, although less proportionally.

That same appendix also shows the concentrations of metals like iron (Fe) and zinc (Zn) at monitoring sites, based on the information provided by IDEAM (2022). While pH values lower than 7 were identified in Boyaca, there were no indications of high concentrations of metals such as Fe and Zn. However, the number of available samples is insufficient to draw a conclusion, and additional studies will be required to identify the cause(s) of acidity. Coal mines are, of course, a potential explanation. For example, in Zipaquirá, a 197 km2 municipality in the central coal region, there are about 600 small coal mines; it is estimated that these generate about 70.400 m3 of AMD-polluted water each month (Vasquez et al., 2016).

In the Central and Caribbean coal regions, the land is mainly used for livestock, followed by forestry and agriculture (see appendix soil data). Figure 37a depicts the land use for food production per Department, from data provided by the (Ministry of Agriculture, 2022). Of all Departments where coal is mined, La Guajira and Cesar exhibited the highest requirements of land per tonne of food - about four times the amount of Boyaca and Cundinamarca, although the latter two showed the highest food production overall (Figure 37b) and are the main food suppliers in the country (Agronegocios, 2020).

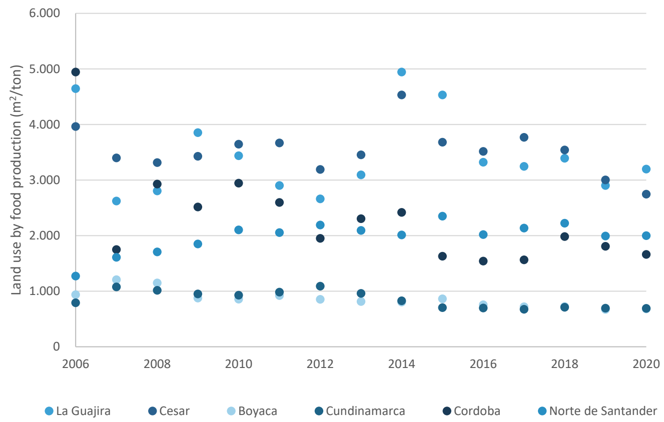
The differences in food production and land use can be explained by the different types of crops grown in each coal region, which is also related to the differences of weather in each region. The appendix soil data presents the historical food production for the most common agricultural products by the Caribbean and Central coal mining regions, from data provided by the Ministry of Agriculture (2022). The same appendix also shows that bananas, palm oil, and plantain are the most common food crops in the Caribbean region, while potatoes, corn, and rice are the main food products planted in the Central region. A special case was also observed in Cesar, in that palm oil has replaced other agricultural products, which makes the Department uniquely dependent on this activity.

The Rural Development Agency (Agencia de Desarrollo Rural – ADR, acronym in Spanish), with support from the Food and Agriculture Organization of the United Nations (FAO), have created the Integral Agricultural Development Plans with Territorial Approach (Planes Integrales de Desarrollo Agropecuario con Enfoque Territorial – PIDARET, acronym in Spanish). These documents show a high agricultural potential of La Guajira and Cesar, but that the land allocated for agriculture has decreased since 2014 as a result of the growth of the coal mining sector (ADR & FAO, 2021b, 2021a).

Figure 37a. **Land use for food production in selected Departments 2006-2020**

Figure 37b. **Food production in selected Departments 2006-2020**
Source of data: Ministry of Agriculture (2022)

37a.



37b.

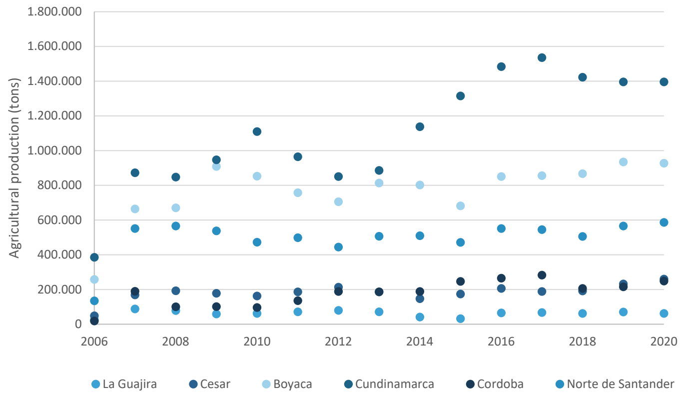
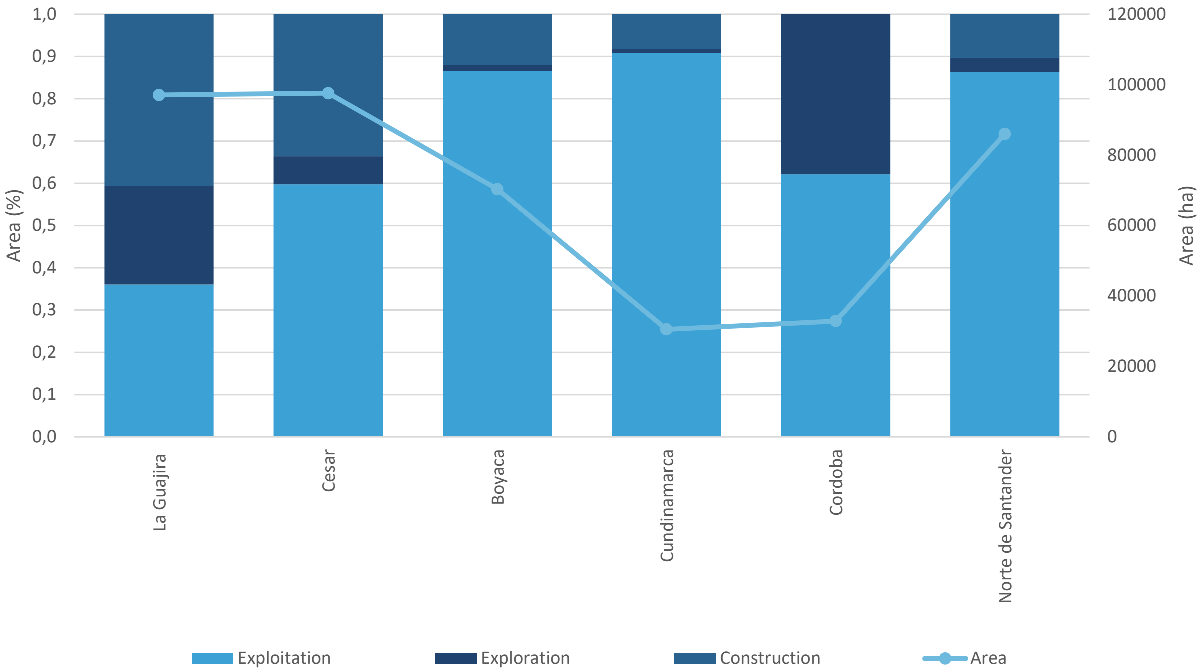


Figure 38 shows the area used occupied by coal mining concessions according to their corresponding Legal status/phase (exploration, construction, exploitation). In all Departments, except La Guajira, the predominant status is exploitation, and La Guajira and Cesar are notable for the high proportion of projects in construction. It is also relevant to note that Cordoba leads exploration initiatives per Department.

Figure 38. **Status and area occupied by mining concessions per Department in 2022**
Source of data: ANM (2022b)



The appendix on soil presents a comparison between the area used by coal mining and the food production of the selected coal mining regions in 2019, consolidating data provided by the ANM (2022d) and the Ministry of Agriculture (2022). The land used per tonne of food produced compared to land used per tonne of coal extracted is shown to be much higher in La Guajira and Cesar than in the other Departments. Norte de Santander and Cundinamarca have similar indicators for both activities. Discrepancies are associated with the type of crops and the typology of mining.

Another factor to consider is the agricultural frontier[14]. The corresponding appendix shows the overlap between coal mining concessions and this legally defined category. Some overlaps can be observed, especially in Norte de Santander, thereby reflecting tension between this economic activity and protected areas.

Particulate matter[15] is the main criteria pollutant released by coal extraction (rock blasting, coal transport, etc.), while sulphur dioxide (SO_2) and nitrogen oxides ($NOx = NO + NO_2$) are also relevant air pollutants emitted by CPFF. As La Guajira and Cesar are the places with the largest open pit mining areas and major health problems, this study analysed the PM10 and PM2.5 concentrations as measured by the Subsystem of Air Quality Information (Subsistema de información sobre la calidad del aire – SISAIRE, acronym in Spanish).

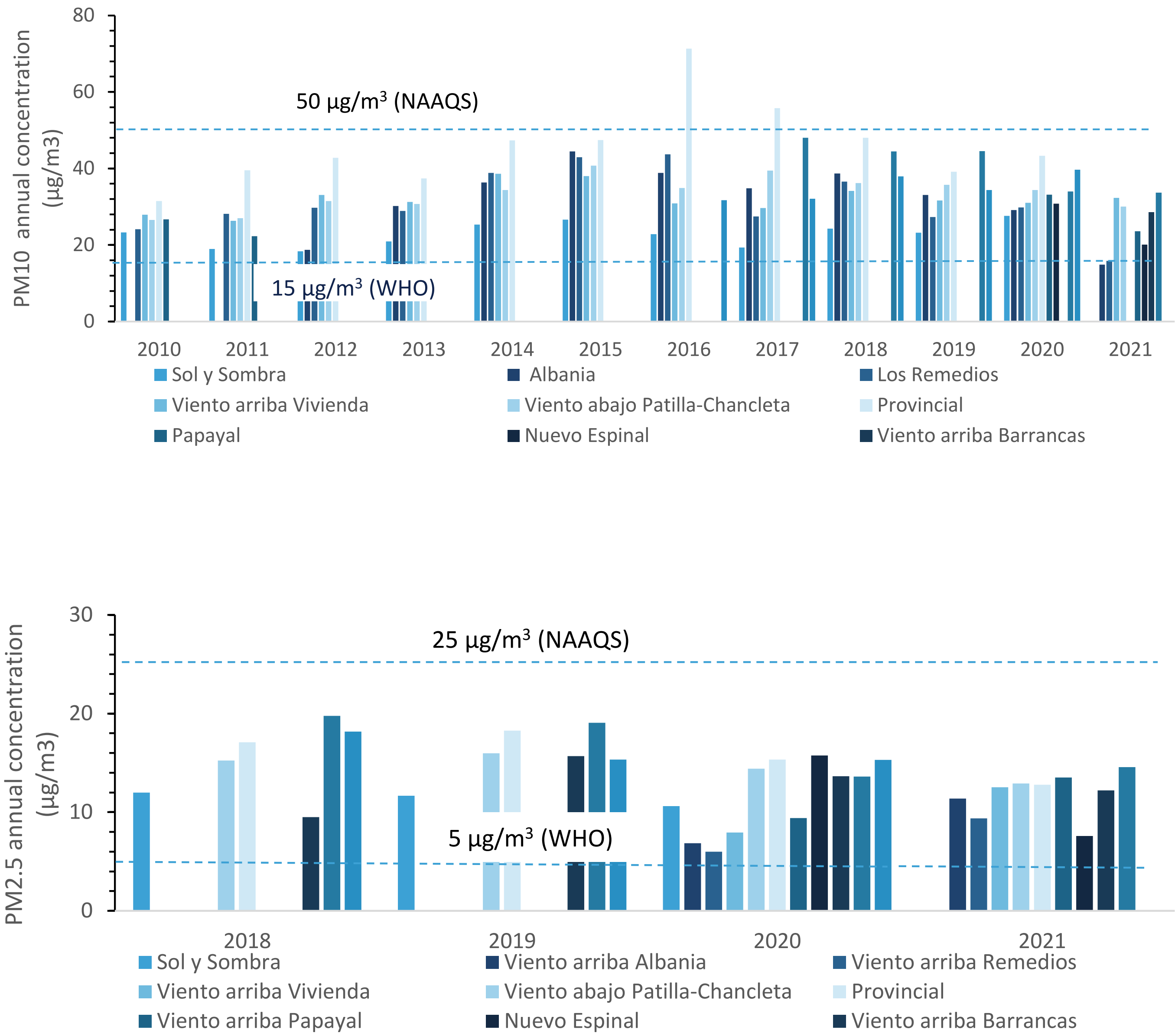
Figure 39 shows the annual concentrations of PM_{10} and $PM_{2.5}$ in monitoring sites around the La Guajira and Cesar coal mines. Overall, for both pollutants, the national air quality standards (NAAQS) have not been exceeded (except for several air quality station in Cesar). However, the international standard established by the World Health Organization (WHO) has been exceeded by a considerable margin. In La Guajira, Rojano et al. (2020) found that during 2012 to 2017, open pit mining was the main source of emissions of PM_{10}, contributing to concentrations higher than 45 ug/m^3.

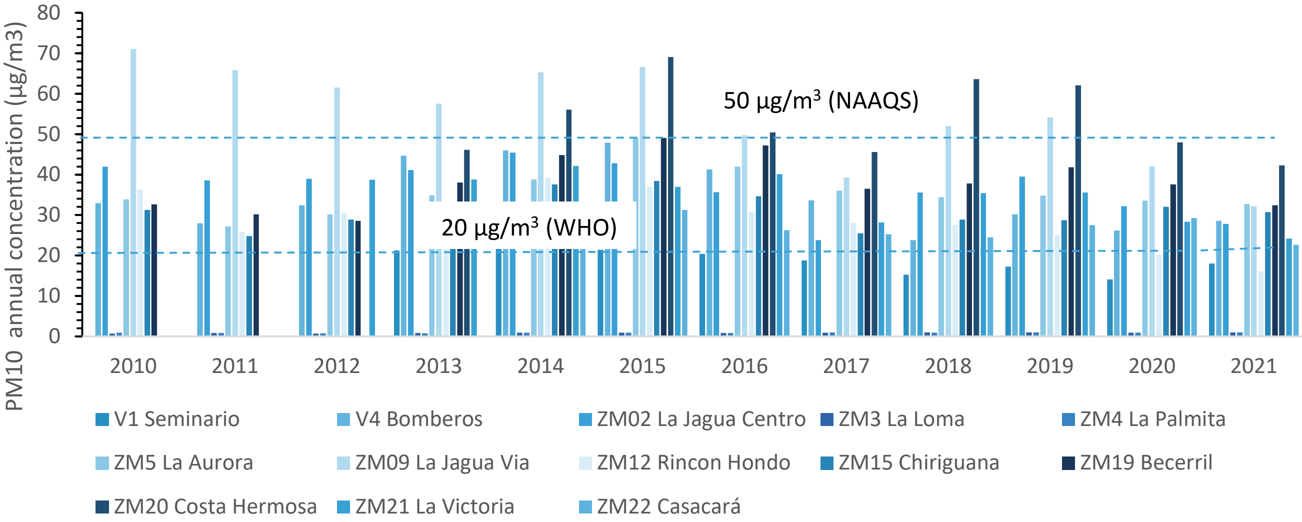
[14] The Agricultural Rural Planning Unit (Unidad de Planificación Rural Agropecuaria – UPRA, acronym in Spanish) defines the agricultural frontier as “the boundary of rural land that separates areas where agricultural activities are permitted from protected areas, areas of special ecological importance, and other areas where agricultural activities are excluded by law or regulation” (UPRA, 2018). (Translated by the authors).

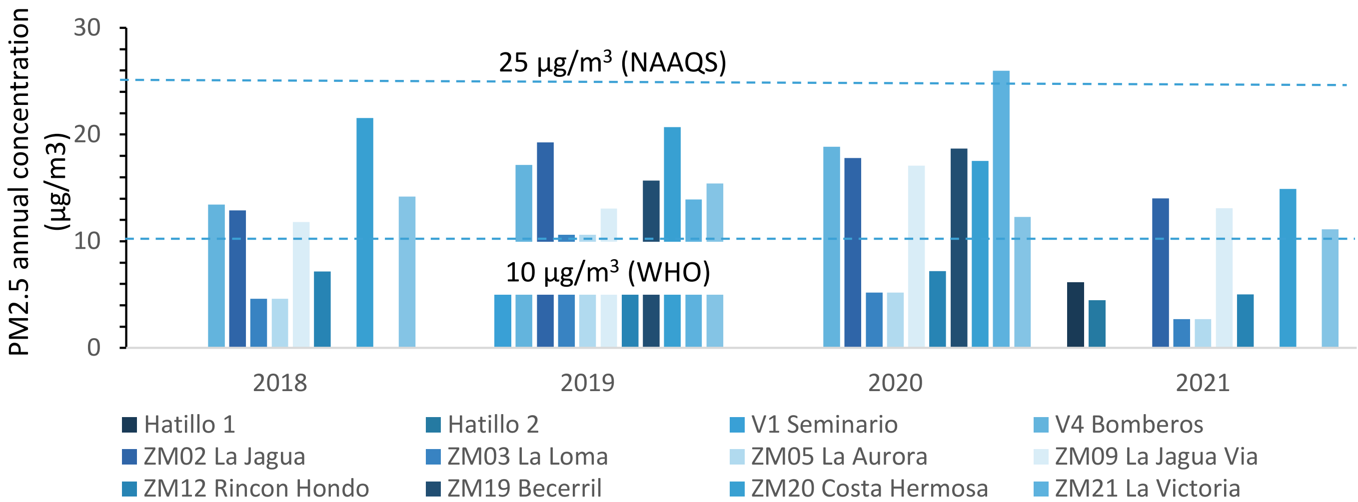
[15] Divided into PM10 (particulate matter with an aerodynamic diameter ≤10 µm) and PM2.5 (particulate matter with an aerodynamic diameter ≤2.5 µm).

Figure 39. PM$_{10}$ and PM$_{2.5}$ annual average concentrations in La Guajira (first and second graphs) and Cesar (third and fourth graphs)

Sources of data: IDEAM (2022a)







There is scientific evidence of respiratory diseases and genotoxic effects of particulate matter due to exposure near coal mines. Quiroz-Arcentales et al. (2013) found that children living in communities near to coal mining activities and roads, such as Las Palmitas, Boqueron, and La Sierra, had a higher probability of suffering asthma. Arregocés et al. (2020) found increased cancer risks in populations exposed to PM10-bound heavy metal concentrations, while Salcedo Arteaga et al. (2017) observed higher risks of genotoxic effects on the DNA of workers exposed to coal mining waste. These findings are consistent with studies in La Guajira (León-Mejía et al., 2011) and Cesar (Cabarcas-Montalvo et al., 2012),. with similar results also deduced in wild population of house mice (*Mus musculus*) and green iguana (*Iguana iguana*) in these areas.

In addition, communities in La Guajira and Cesar have observed air pollution caused by coal mining activities to affect, which is also backed up by scientific publications showing coal dust to be harmful for plant growth (Pandey et al., 2014; Wang et al., 2016).

The coal value chain perpetuates a variety of environmental impacts that cannot be prevented – simply due to the nature of the process. López-Sánchez et al. (2017) list the diverse impacts of mining on the physical, biotic, and social environment, while Cardoso (2018) refers to specific impacts such as ecosystems services loss, communities' displacement, loss of agricultural land and fishing sites, impacts on marine ecosystems, among others.

The lack of a legal framework for socio-ecological liabilities, and no official inventory of environmental liabilities prevents coal mining impacts from being correctly assessed and managed. The General Appendix contains a list of historical and current legislative initiatives regarding environmental liabilities in Colombia.

According to Rodríguez-Zapata & Ruiz-Agudelo (2021) , coal extraction is liable for the largest number of contingent environmental liabilities[16] in Colombia, followed by oil. Cardoso (2015) estimated coal-related liabilities in Cesar to be 110.10- 161.01 USD/tonne (2012), which at the time, was considerably higher than the coal market price. A similar analysis was made by Corral-Montoya et al. (2021) , who identified the cost to be 144-210 USD/tonne in Cesar, before including global damages from coal combustion – upon which, the cost could exceed 2,000 USD/tonne

A noticeable aspect of the unaccounted costs of coal mining extraction is the unpaid domestic work carried out by women. Children suffering from the adverse health impacts cause by by coal mining activities pose an extra burden of care for women (Vargas et al., 2022). On the other hand, the presence of armed groups in the coal mining regions has contributed to the separation of familial and community ties – for which, women are the most at risk. Moreover, an increase in feminicides, sexual exploitation, and deaths of female social leaders in Colombian coal mining regions have also been reported (Ulloa, 2016; Vargas et al., 2022).

Resettlements have been factored into the socio-ecological liabilities of coal mining extraction in Colombia. Before 2002, the expansion of the Cerrejon mine in La Guajira resulted in the relocation of eleven Afro-Colombian and indigenous communities (Hérnandez, 2018). The number of indigenous persons from La Guajira who were displaced by coal mining activities recached seven thousand by 2010, according to the same author. These processes have only continued, with five communities (Las Casitas, Chancleta, Patilla, Roche, and Tamaquito II) being displaced or partially resettled between 2012 to 2015 (CINEP, 2016).

Moreover, negative effects to health caused by air pollution have resulted in further resettlements in Cesar. Based on air quality modelling and air pollution data analysis produced by Huertas et al. (2012), the MADS passed Resolution 970 of 2010, in which a resettlement plan of three

[16] Rodríguez-Zapata & Ruiz-Agudelo (2021) defines contingent environmental liability as an "environmental liability that has not been configured, but due to historical activity knowledge, it is possible to determine who will be responsible and what will be the effects in the future".

communities (El Hatillo, Boqueron, Plan Bonito) was outlined[17]. After 12 years, however, Boqueron had not been resettled; in response, MADS modified the resolution, claiming that Boqueron was not in the influence area (MADS, 2021). This decision did not consider the previous health effects brought on by exposure to PM_{10} and $PM_{2.5}$ (CGR, 2022)

It has yet to be decided as to whether the Boqueron resettlement is legally required. In the meantime, and because of the Resolution, it is not legal to invest in infrastructure in Boqueron, which creates very challenging living conditions for the communities (see General Appendix). Finally, another oft-neglected liability is the damage inflicted upon by housing infrastructure close to mines and railroads, due to the sustained blasting and train-induced vibrations. (Field trip Cesar, 2022).

The Mining Code (Congreso de la República, 2001) establishes the obligation to develop mine closure plans. Decree 1076 (MADS, 2015) indicates the mandatory components of these plans and establishes 3-year post-closure liability insurance. However, it does not contain provisions for long-term/perpetual impacts[18], nor do any other pieces of legislation[19]. Finally, according to ANLA (2016), mining companies must update their closure plans at least every five years. Closure plans provided by ANLA (2021c) shows 57% of them to be out of date (see Table 13).

Table 13 **Mine closure plans for projects in Cesar and La Guajira**
Source of data: ANLA (2021c)

CODE	COMPANY	MINE	YEAR
LL	Drummond	La Loma	2019
CE	Glencore	Cerrejon	2015
LJ	Glecore / Prodeco	La Jagua	2017
EH	CNR	El Hatillo	2016
LF	CNR	La Francia	2014
DE	Drummond	Descanso Sur	2013
CA	Carbones colombianos del Cerrejon	Caypa	2014

[17] The process was carried out under the instrument of Resettlement Action Plans (Plan de Acción para el Reasentamiento -PAR, acronym in Spanish) elaborated by the coal mining companies responsible for resettlements (Red por la Justicia Ambiental en Colombia, 2016).

[18] Perpetual impacts are defined by Ángel (2019) as “impacts of anthropogenic origin that are expected to persist for centuries, millennia or longer, whose end date cannot be predicted with reasonable and substantial evidence, and which entail wicked institutional challenges” (Translated by the authors).

[19] Morales & Hantke Domas, (2020) lists the applicable regulations for mine closure in Colombia.

Even though mine closure is considered in the Colombian legislation, there are no regulations to satisfactorily address the economic, social, and environmental needs that will need to be met post-mining (M&M Estudio Jurídico, 2013; Morales & Hantke Domas, 2020). The General Appendix also contains the assessment of the coal mines closure plans for some of the coal mining companies in La Guajira and Cesar – the evaluation criteria for which has been based on the dimensions suggested by Geological Survey of Finland (2020) and Morales & Hantke Domas (2020).

In terms of closure and post-closure financial insurance, also the General Appendix contains the most updated information provided by ANM (2022d). Many instruments have evidently contemplated insurances that are not intended to mitigate environmental impacts, but rather, to cover conventional costs, including wages and others. Although the MME (2022c) mentions the 'ecological insurance' created by Law 491 of 1999 (Congreso de la República, 1999) (Herrera, 2018), UPME has declared (UPME, 2022c) that „to date, there are no policies, strategies and/or recommendations from UPME on coal mining closure, nor any studies with that objective have been carried out"[20].

Coal Mine Pit in Cesar (Drummond), Colombia **Source: Génesis Romero, Instituion: STEUnimagdalena**

[20] Translated by the authors.

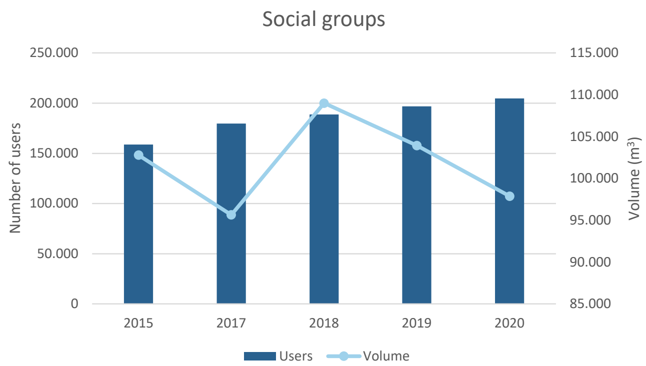
1.5.2 Indonesia

The coal sector consumes energy in the extraction, transportation, and distribution processes, with the required energy sources being derived from fuel, oil, and of course, electricity generated in CFPPs. Energy used in coal mining amounted to around 0,33 GJ/Ton extracted in 2020, according to information from the Directorate General of Renewable Energy and Energy Conservation (Direktorat Jenderal Energi Baru Terbarukan dan Konservasi Energi – Dirjen EBTKE, in Bahasa, 2020).

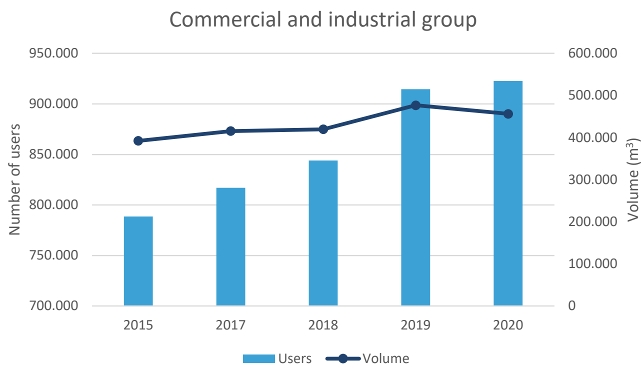
This sector has reported energy savings of about 12,192,765 GJ between 2013 and 2020 as a result of reducing the energy consumed in the crushing and grinding processes, reducing idle time, optimising transportation distance, and evaluating truck performance.

Figure 40a, b, c and d Number of clean water users and volume grouped by type of customers 2015-2020
Source of data: Badan Pusat Statistik – BPS (2021)

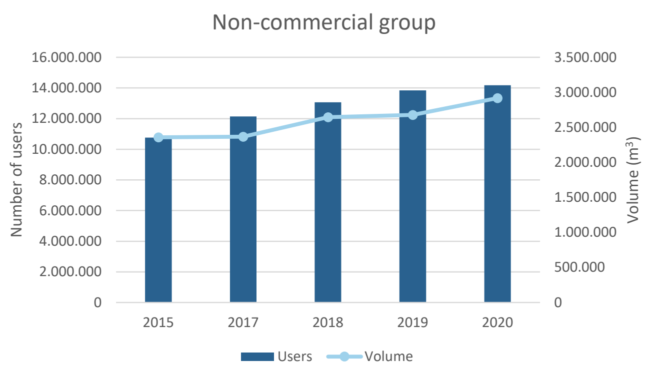
40a.



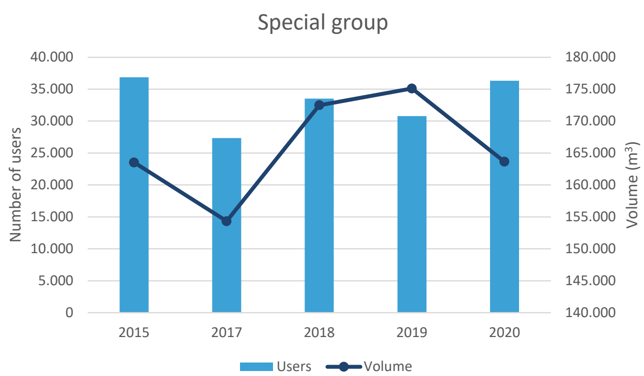
40b.



40c.



40d.



Aside from energy, water is one of the main inputs in the coal mining process. The use of surface water in Indonesia must be permitted (Water Resources Use Permit or Izin Penggunaan Sumber Daya Air-IPSDA, in Bahasa Indonesia) by the Minister of Public Works and Public Housing (Menteri Pekerjaan Umum Dan Perumahan Rakyat – PUPR, in Bahasa Indonesia). For groundwater use, a Groundwater Extraction Permit (Surat Ijin Pengambilan Air Tanah – SIPA, in Bahasa Indonesia) is required.

Table 14 Parameters to monitor wastewater quality from the coal industry

PARAMETER	STANDARDS FROM EACH ACTIVITY	
	Mining	Coal laundering
pH	6-9	6-9
Total Suspended Solids (mg/l)	400	200
Iron (mg/l)	7	7
Manganese (mg/l)	4	4
Maximum wastewater	–	2m3 per tonne of coal
CA	Carbones colombianos del Cerrejon	Caypa

There are four groups of water consumers in Indonesia, namely social, non-commercial, commercial including industries, and special. Social refers to religious services, public services and spaces, as well as governmental buildings. Non-commercial corresponds to residential areas, while commercial consumers refers to the service sector (hotels, restaurants, manufacture, etc.). Finally, 'special' customers are those from social institutions, foundations, orphanages, etc. Water volume used by the non-commercial and commercial sectors increased from 2015 to 2019, but this trend changed during the pandemic due to social dynamics changes (Badan Pusat Statistik, 2021). See Figure 42.

To mitigate damages from coal mining effluents, the Minister of Environment and Forestry established Decree No. 113/2003. The parameters used to monitor wastewater from the coal industry include pH, turbidity, Iron, and Manganese – and are detailed in Table 14. However, some do not comply with these standards, polluting the surrounding rivers (Hernandi et al., 2019). A compilation of measurements made in rivers by the previous source is presented in Table 15.

Table 15 Water quality of nearby coal mines in East Kalimantan

Source of data: Hernandi et al. (2019)

PARAMETERS	UNIT	KE-DAYAN RIVER	KE-RAMBA RIVER	TENG-GARONG RIVER	JAMBU RIVER	ENDAU RIVER	JEM-BAYAN RIVER	KUTAI BARU RIVER
PHYSICS								
Temperature	C	28.55	27.30	27.33	27.35	27.10	26.75	29.02
Dissolved residue	mg/liter	150.25	155.00	18.95	165.15	155.30	140.18	129.83
Suspended residue	mg/liter	33.00	14.50	40.00	28.00	34.00	53.00	48.75
Color	PtCo	27.57	43.50	120.20	55.46	83.35	407.07	107.25
INORGANIC CHEMISTRY								
Total hardness	mg/liter	83.22	80.98	23.81	57.48	53.51	43.19	23.10
pH	–	6.95	7.15	6.79	7.07	7.05	6.94	7.05
BOD	mg/liter	2.45	0.84	1.44	1.45	1.84	0.74	1.54
COD	mg/liter	7.53	10.54	14.43	15.46	21.74	10.61	6.31
Dissolved oxygen	mg/liter	6.90	6.81	4.74	5.97	5.61	5.51	3.70
Total phosphate	mg/liter	0.02	0.02	0.02	0.03	0.05	0.03	0.17
Nitrate	mg/liter	0.99	0.46	0.06	0.27	0.19	0.58	0.88
Cobalt	mg/liter	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Chromium	mg/liter	0.02	0.03	0.05	<0.01	0.06	0.02	0.01
Copper	mg/liter	<0.003	<0.003	<0.003	<0.003	<0.003	0.00	0.00
Lead	mg/liter	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Chloride	mg/liter	4.76	4.39	7.15	9.80	10.55	8.36	11.68
Flouride	mg/liter	<0.002	0.02	0.03	0.09	0.05	0.15	0.12
Free chlorine	mg/liter	0.20	0.07	0.20	0.68	0.21	0.31	0.34
Sulfur	mg/liter	0.51	1.22	1.83	1.74	1.05	1.94	0.77
MICROBIOLOGY								
Fecal coliform	MPN / 100 ml	14	9	80	3000	160000	1050	1650
ORGANIC CHEMISTRY								
Oil and fat	µg/liter	800.00	500.00	1050.00	1000.00	400.00	300.00	400.00
Detergent	µg/liter	19.67	<25	121.87	<25	<25	30.08	37.03
Phenol compounds	µg/liter	228.01	198.76	180.33	165.84	62.93	198.64	711.92

CFPP also impacts surface water with residue from the cooling processes. MoEF Regulation no. 8/2009 regulates wastewater standards from CFPP, which were established in 2009 (see table 16). However, this regulation is considered incomplete by Marino (2019) because of a lack of wastewater quality standards, and the allowance of water disposal directly to the sea; 82% of Indonesia's CFPPs are in the coastal areas. The increase of sea temperature due to wastewater from such plants can disturb the ecosystem (Marino, 2019). Widiawaty et al. (2020) found high Total Suspended Solid (TSS) values in the Mundu Bay, close to Cirebon CFPP, as detailed in the Table 17. Similar results can also be expected for these, as well as for the other parameters in waters close to the CFPPs that do not apply best practices and/or conform to strict regulations. Moreover, 8/2009 also does not include standards for heavy metals.

Table 16 **Wastewater standards from the main processes in CFPP**
Source of data: MoEF regulation no. 8/2009

PARAMETER	UNIT	MAXIMUM VALUE
pH	–	6-9
TSS	mg/l	100
Oil and fat	mg/l	10
Chlorine (Cl2)	mg/l	0.5
Total Chromium (Cr)	mg/l	0.5
Copper (Cu)	mg/l	1
Iron (Fe)	mg/l	3
Zinc (Zn)	mg/l	1
Phosphat (PO-4)	mg/l	10

Another instance associated with high environmental risks is coal transport – perhaps the best example of which is the extensive polluting of the Mahakam River waters, which severely threatens local populations of Irrawaddy dolphin, an already endangered species (Anggraini, 2022; Indonesia.go.id, 2019).

Table 17 **Water quality in Mundu Bay monitored in 1999, 2014, and 2019**
Source of data: Widiawaty et al. (2020)

PARAMETER	YEAR	MIN	MAX	MEAN
TSS (mg/l)	1999	6.75	4.95	12
	2014	7.42	1143.6	30.75
	2019	21.25	270.59	49.49
Sea surface temperature (oC)	1999	20.96	26.28	22.34
	2014	16.34	20.35	17.66
	2019	21.94	25.83	23.6
Chlorophyl-A (mg/m3)	1999	0.14	1.83	0.37
	2014	0.09	1.43	0.18
	2019	0.14	1.52	0.2
Sea surface salinity (psu)	1999	5831.43	5882.63	5871.65
	2014	5821.73	5880.13	5854.05
	2019	5798.38	5856.36	5836.53

Land use changes is an extremely relevant issue in Indonesia; not only because of coal mining itself, but due to CFPP operation. Dwiyanto et al. (2021) studied the land use changes in the Penajam Paser Utara region, in East Kalimantan, and found degradation of forest to bare lands of between 24% and 53% due to the increase of coal mining areas, which totals 285% from 2009 to 2019 (see Table 18). JATAM (2017) also mentions changes to agricultural areas, resulting in a significant reduction in crop production, especially rice. There are no regulations managing the limitation of coal mining development in an area, other than that of prohibiting mining in protected areas.

Table 18 **Land use changes in Penajam Paser Utara due to the increase of coal mine area**
Source of data: Dwiyanto et al. (2021)

LAND COVER	AREA (HA)	
	2009	2019
Water body	604.38	454.89
Forest	50,465.89	49.111.38
Building area	922.22	1,770.89
Bare land	7,499.35	3,560.54
Farms	12,358.84	12,218.55
Mining area	2,547.46	7,281.89

Another issue of note concerns the health problems of communities living in the vicinity of coal mines and CFPPs. Polluted water surrounding coal mines is known to cause skin diseases, diarrhoea, and hepatitis A, while polluted air carrying coal dust generates respiratory diseases. Fatmawati et al. (2018) found that the Kutai Timur region had the highest numbers of pharyngitis cases in 2016, due to the increase of coal mining activities. Moreover, there also health issues for those living close to coal storage for CFPPs. This issue was covered intensively by national reporters in the context of coal storage in the north of Jakarta at the beginning of this year.

Kenjeran Beach, Indonesia

Source: Handriyanti Puspitarini

1.5.3 Mozambique

Environmental information about Mozambique is very scarce. In the context of NEXtra Core, most data were retrieved in scientific literature. We also approached public institutions and independent researchers and were able to collect reports and other grey literature from international organizations but not much more. Transparency of environmental information is still an issue and the quality of the information retrieved by public institutions and made available to the public must be improved to facilitate research around the Resource Nexus Approach.

This section will describe to the extent possible, the antecedents, advances and gaps in the study of the environmental impacts of coal mining in the Province of Tête, and of the coal value chain in the rest of the country, including the rest of the infrastructure (roads, railroads and ports/terminals) and their associated activities.

In terms of advances and availability of geoscientific data and the history of geological data surveys in the country, Mozambique was in dire need of development following the Civil War. In this context, the Geological Survey: 2000-2004 (see Pekkala, Lehto and Mäkitie, 2008) was crucial in drawing attention to the potential of the extractives sector. Prior studies in the 1980s had suggested immense reserves, but these were unproven. In 2007, the GTK Consortium undertook the 'Geochemical and Industrial Mineral Surveys' project, producing geological and mineral resource maps to cover an area of 480,000 km (about 60% of Mozambique). This project involved the compilation of all existing geochemical surveys = and new targeted surveys to identify the areas with mineral potential for exploration and for infrastructure expansion (Pekkala, Lehto and Mäkitie, 2008).

This mapping was part of Geological Infrastructure Development Program (financed by the World Bank and MIREME Mineral Resources Management Capacity Building Project) (World Bank, 2001) to help Mozambique's mining policy focus on promoting private/foreign investment, and was supported by MIREME and DNGM

Since the mapping, INAMI has executed airborne geophysical surveys across 75% of the country; it has further mapped the mineral-rich provinces of Niassa, Cabo Delgado, Tête, and Manica on a 1:50,000 scale, as well as commenced the mapping of a 950,000 km2 area between the provinces of Nampula and Zambezia. In 2019, INAMI started producing 25 maps of this area on 1:50,000 scale, and five maps on 1:250,000 scale; 10 of these have been completed so far, (see Sênvano, 2020) and the project is ongoing.

In late 2004, a consortium of companies headed by Brazilian iron-ore mining company, Vale, won the right to develop parts of the Moatize coal deposit, bidding USD122.8 million for the rights to explore and develop the coal deposit (see Hatten & Fardell, 2012).

Further discoveries were made over the years, with some of the most important being the confirmation of coal deposits in Changara, Cahora Bassa, and Magoe in September 2010. Coal discoveries have continued since this period but have often been revised along with the downsizing of mining capacities. Some examples including Vale's downgrading of the Moatize mine by 1.6 billion tonnes in 2016, the various re-assessments of the Benga Mine and Coal India's findings of very poor grade rocks "not good enough to be called coal" (NS Energy, 2015). Mozambique's total proven coal reserves at the end of 2016 were 25.6 billion; they later increased to 38.4 billion in 2020, although the BGR estimate for 2019 was 39.5 billion (see Baxter, 2019). As such, many geological studies have suggested that re-assessments of old estimates should be undertaken regularly (Hatten and Fardell, 2012: 9-10).

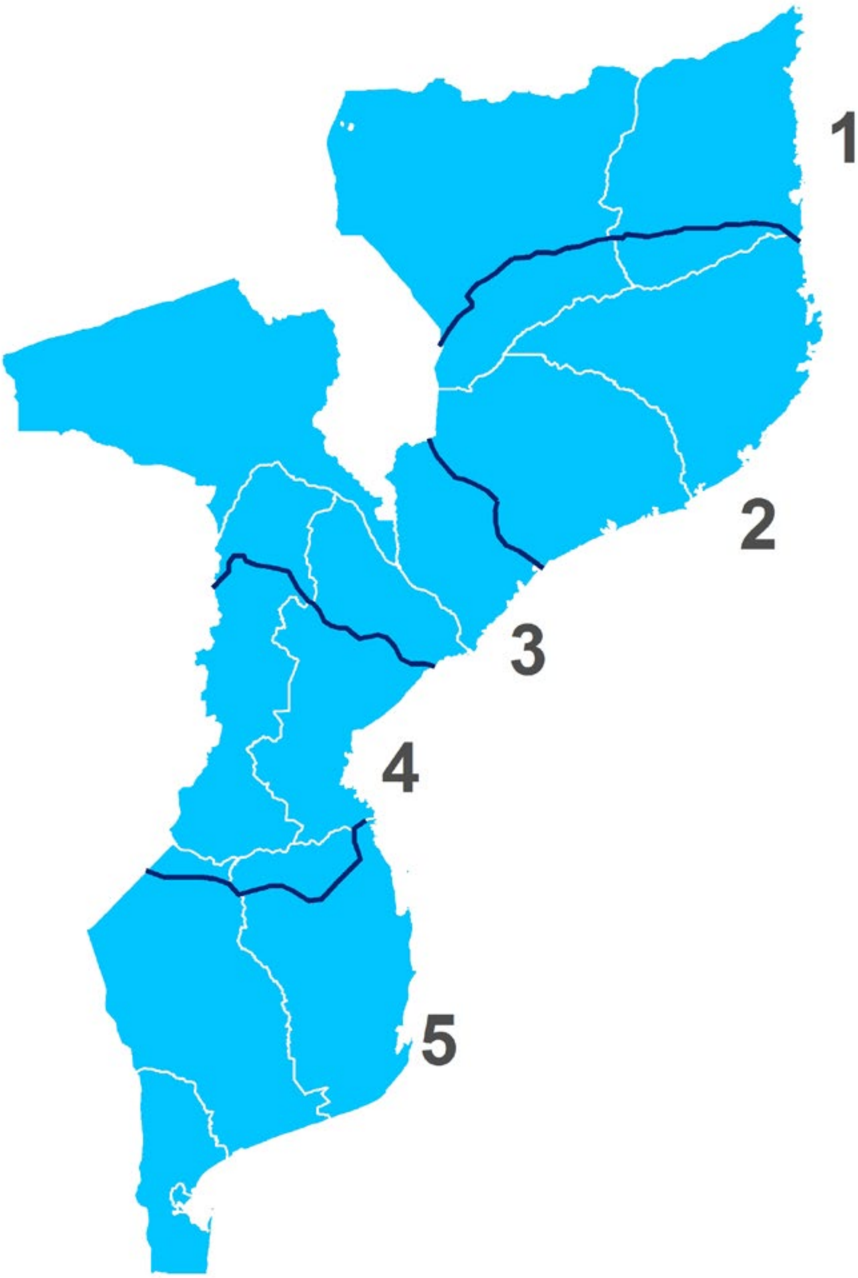
Despite these events, the country may yet have far greater coal reserves that remain untapped and unmined. Consequently, the overall potential is not to be underestimated and if confirmed, it would allow for a dramatic increase in coal extraction. Such a discovery would make the issue of JET of acute importance for the planning of the country's future economic development and energy security.

Water management has been improving in Mozambique and neighbouring countries thanks to the advent of SADC in the 1980s. Historically, transboundary issues have not always been effectively managed considering all environmental impacts throughout the basin (Shela, 2000) but SADC and similar coordination efforts have allowed some progress in the past decades.

As it has already been described, current coal mining projects in the country are located near the cities of Tête and Moatize, and the town of Benga in the western Province of Tête. This means they are in the lower basin of the Zambezi River, more specifically, in the sub-basin of the Revúboé river. The Zambezi basin is one of the largest of the Southern region of Africa and partially covers 8 countries. Namely Angola, Botswana, Malawi, Mozambique, Namibia, Tanzania, Zambia and Zimbabwe. Mozambique is downstream from all of them, and it is estimated that about 54% of the country's freshwater resources originate in upstream countries. Some waters, especially those in the Limpopo basin, already face contamination issues due to urban wastewater and agricultural effluents (USAID-SWP, 2021).

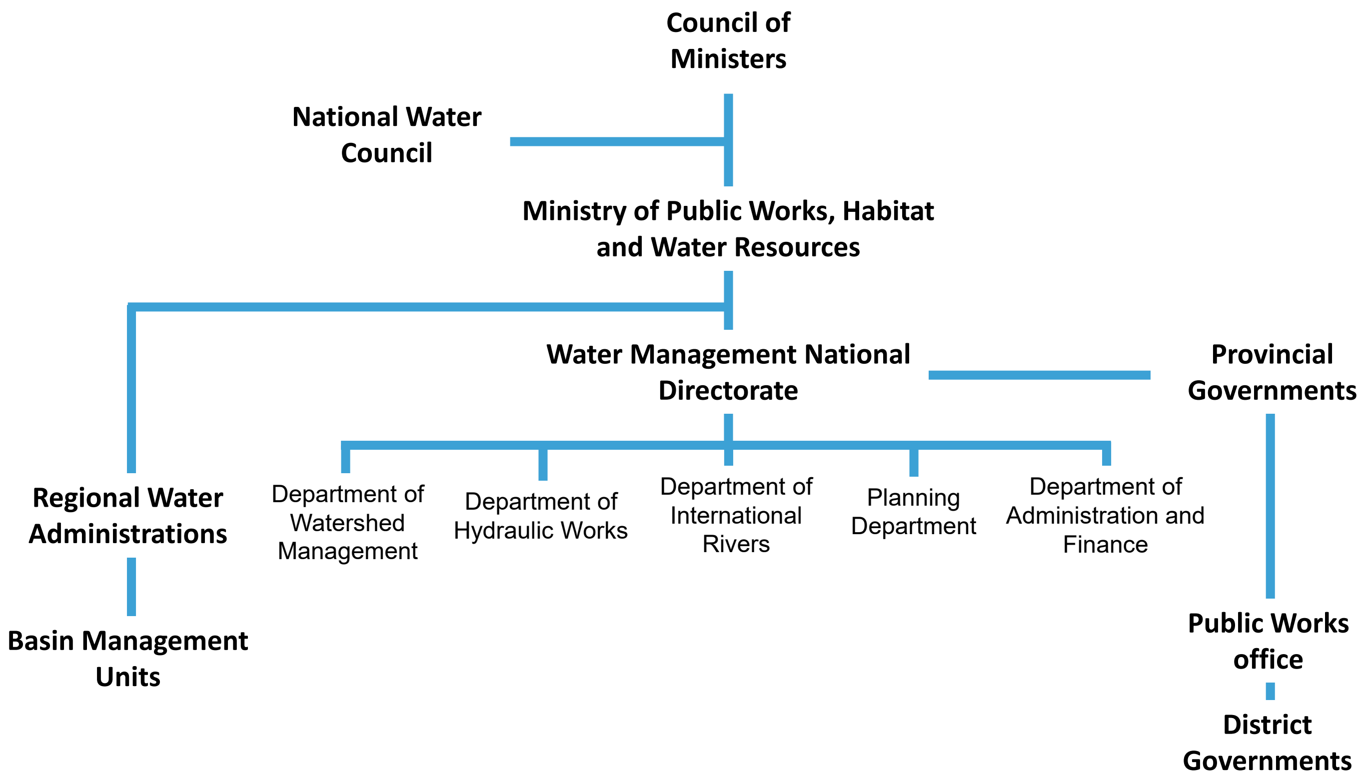
In terms of stakeholders and governance, one of the most important actors for water in Mozambique, and specifically for the basins related to coal mining, is the Zambezi Regional Waters Administration (Administração Regional de Águas do Zambeze - ARA-Zambeze). Along with other four Regional Water Administrations, it guarantees the integrated management of water in one of the five hydrographic regions (ARA-Zambeze, 2022) as shown in Figure 41.

Figure 41. Hydrographic regions of Mozambique. From north to south: 1. ARA Norte, 2. ARA Centro Norte, 3. ARA Zambeze, 4. ARA Centro and 5. ARA Sul
Source of data: Ministério das Obras Públicas (2017)



These institutions, along with the Water Management National Directorate (Direcção Nacional de Gestão de Recursos Hídricos – DNGRH, Acronym in Portuguese) are under the Ministry of Public Works, Habitat and Water Resources (Ministério das Obras Públicas, Habitação e Recursos Hídricos – MOPHRH, Acronym in Portuguese) (Ministério das Obras Públicas, 2022). Over the latter, only the National Water Council and the Council of Ministers exist, as shown in Figure 42 DNGRH also coordinates with the Provincial Governments, which in turn coordinate with district authorities. Note that not all of these bodies are reflected in the stakeholders map to be presented afterwards, but only the most relevant ones.

Figure 42. Organizational Chart National Directorate of Water Resources Management
Source of data: DNGRH (2022)



Regarding the relationship between coal extraction and water quality, we found that pollution issues related to coal extraction in Tête have already been observed and measured by some researchers. (Pondja et al., 2017) analyzed samples taken at two undisclosed mine sites in Moatize (Revúboé basin and Condedezi sub-basin), revealing AMD potential and very high concentrations of sulfates, calcium, magnesium, and manganese in some of them. Concentrations are so high, that the authors recommend carrying out treatments to reduce them before any use. AMD potential is attributable to, among other factors, favorable conditions such as a higher carbonates weathering rates compared to sulfur. Although this was found in just one of the mines, it is likely that coal deposits in proximity to one another share geochemical similarities and that a larger number of larger mines will have synergic negative impacts that have to be managed in the future.

A positive aspect is that, at larger scales, the natural attenuation capacity in large basins like the Zambezi is generally very high due to the large discharge of the rivers. For the case of the Zambezi River, discharge is calculated at about 4100m3/s (Nhantumbo et al., 2015) at the point it reaches the ocean. However, for water quality purposes, it is important to account for the effects of the Cahora Bassa dam, 130 km. upstream from the mining area, which significantly reduces the discharge to keep the dam at optimal levels. This depends on many factors, including seasonal variability. As an example of this, an increase of up to 2000m3/s has been recently planned and the opposite is also carried out in the dry season. It is estimated that the Zambezi basin, where the coal region is, has a total of 5,000 MW of installed hydropower capacity and a potential to triple that figure (International Bank for Reconstruction and Development / The World Bank, 2018). This is a factor to consider when evaluating the effluent quality from the coal mines. Appropriate models must be used to design pertinent standards.

Due to the low number of mines and their relatively small scale, this issue might not be the most pressing now, but future attenuation capacity must be considered in the light of three factors: 1. Discharge variations linked to climate change, 2. Potential new coal mines in the area/region and 3. New hydroelectric projects upstream that would further decrease the available discharge at Tête.

The latter is the case of the Boroma, the Mphanda Nkuwa and the Cahora Bassa North dams, the first two proposed at a mere 20 km. upstream from the mining area and the third very close to the current Cahora Bassa dam (International Bank for Reconstruction and Development / The World Bank, 2018). Studies on the new attenuation capacity must be conducted to determine how new discharge regimes will affect pollutant transport and concentration downstream.

For the case of water use and its distribution, since the early 2000s, there have been many proposals of management mechanisms, including the Framework for Water Quality Monitoring – FWMQ (Nhantumbo et al., 2015).

The basin management mechanisms proposed in the past have not only been related to energy capture and electricity generation, but also to water use for agricultural purposes by the states upstream from Mozambique. These mechanisms have not been able to guarantee water quality or quantity in the Zambezi, as observed by (USAID-SWP, 2021).

It is relevant to mention the uses besides energy because in the region many countries depend and have historically depended on agriculture as one of the main sectors. Even Mozambique's economy as a developing country was based on agriculture until the 1990s (Nhantumbo et al., 2015). Using the data of the last Agricultural Statistical Survey, available in the site of the Ministry of Agriculture and Rural Development and carried out in 2020, the number of agricultural exploitations by size In Tête is divided as follows:

Table 19 **Agricultural exploitations in Tête Province by size**
Source of data: Ministério da Agricultura e Desenvolvimento Rural (2020)

SMALL		MEDIUM		LARGE		TOTAL	
N	%	N	%	N	%	N	%
595.176	96.75	19.958	3.24	42	0.01	615.176	100

According to the same source, Tête is third between the 10 Mozambican provinces reported in number of small exploitations only after Zambézia (822.346) and Nampula (749.406), first in medium size exploitations and sixth in large ones. In terms of cultivated area, Tête ranks 2nd in the country after Nampula Province (726.273 units)[21] and with regards to overall food production in the region, the figures are the following (in tonnes/annum for 2020): Maize (461.394), sorghum (38.463), millet (11.363), manteiga beans (26.651) and orange sweet potato (39.562). All rank 1st in Mozambique (Ministério da Agricultura e Desenvolvimento Rural, 2020), which means that Tête is one of the most important regions for agricultural production in the country.

As Tête is a relatively large province with 15 districts, it does not mean that currently the coal value chain is affecting food production with its current scale, but it is important to consider the potential of these districts for several economic activities, including food production, when deciding the future of the region and when valuing the costs and benefits of developing one sector over the other. This is not only referred to the land use itself but to the potential effects on water quality that a larger coal sector may bring considering what the evidence has shown regarding AMD and other indications shown by Marove et al., 2020). In this research, it is shown that although levels of pollutants analysed from coal ash leachate mostly stayed within environmental standards (except arsenic), some pollutants from the coal leachate like manganese and iron are of concern.

In a growing sector with serious oversight concerns already, it is difficult to assume that environmental management will be sufficient to prevent impacts. As the very authors put it “storage of coal and disposal of coal wastes and ash in Tete Province should be done carefully and monitored to avoid the contamination in the region” (Marove et al., 2020).

Although it was evident during the research that closure plans and bonds were in place in the country, they could not be reviewed due to the lack of access to the closure plans themselves. Thanks to the information retrieved from the Administrative Tribunal of Mozambique however, it is possible to report the state of the closure plans and bonds as of 2021 for the coal mining projects (Table 20).

[21] This number is not the actual area cultivated, but the sum of production units of 6 categories: less than 0.5 ha, between 0.5 and 1, between 1 and 2, between 2 and 5, between 5 and 9 and larger than 9.

Table 20 **Status of Closure Plans and Financial Collateral**
Source of data: TA (2021). Doc. V-35, Table No. V. 23

CONCESSION	CLOSURE PLAN	SECURITY DEPOSIT
867, Vale Mozambique, SA	Presented the Closure Plan	Presented the Closing Bond
3356, Minas de Benga Ltd	Submitted the Closure Plan	Submitted the Closing Bond
3605, JSPL Mozambique Minerais, Lda	Submitted the Closure Plan	Submitted the Closing Bond
1163, Minas Moatize Ltd	Presented the Closing Plan	Did not present closing bond. Submitted letter to INAMI informing that it is still in negotiation process with banks to obtain a bank guarantee. INAMI notified this holder to present the bond within 30 days
4695, ICVL Zambeze, Lda	Submitted the Closure Plan	Did not submit closing bond; invoked force majeure.
5967, Ncondezi Coal Company Mozambique, Lda	Presented the Closing Plan	Did not submit closing bond. Requested an extension of the start of production due to force majeure
7254, Osho Gremach Mining, Lda	Submitted the closing plan	Did not submit closing bond. Requested an extension of the start of production. INAMI issued the notice of revocation
7521, ICVL Zambeze, Lda	Submitted the Closure Plan	Did not submit closing bond. Requested an extension of the start of production due to force majeure
7626, ICVL Zambeze, Lda	Submitted the Closure Plan	As above
7644, ICVL Zambeze, Lda	Submitted the Closure Plan	As above
7646, ICVL Zambeze, Lda	Submitted the Closure Plan	As above
JSW Adams Carvã Lda	Presented the Closing Plan	Did not submit closing bond. Requested an extension of the start of production due to force majeure
6998, Kingho Investment Company, Lda.	Did not present Termination Plan	Did not submit closing bond. Mining concession revoked
Minas de Revuboe, Lda.	Did not submit Termination Plan	Did not submit closing bond. Requested an extension of the start of production due to force majeure

CONCESSION	CLOSURE PLAN	SECURITY DEPOSIT
5086, Midwest Africa, Ltd.	Did not submit the Plan Shutdown	Did not submit closing bond. Mining concession revoked; Midwest appealed this decision to the TA
5814, Eta Star Mozambique, SA	Did not submit Termination Plan	Did not submit closing bond. INAMI issued a notice of revocation for failure to start production
5818, Sol Mineração Mozambique, SA	Did not submit Termination Plan	Did not submit closing bond. Requested an extension of the start of production due to force majeure. Requested total abandonment of license
6127, Enrc Mozambique, Lda	Did not submit Termination Plan	Did not submit closing bond. Requested an extension of the start of production and invoked force majeure. INAMI requested the Closure Plan within 30 days
6128, Enrc Mozambique, Lda	Did not submit Termination Plan	As above
6195, Enrc Mozambique, Lda	Did not submit Termination Plan	As above

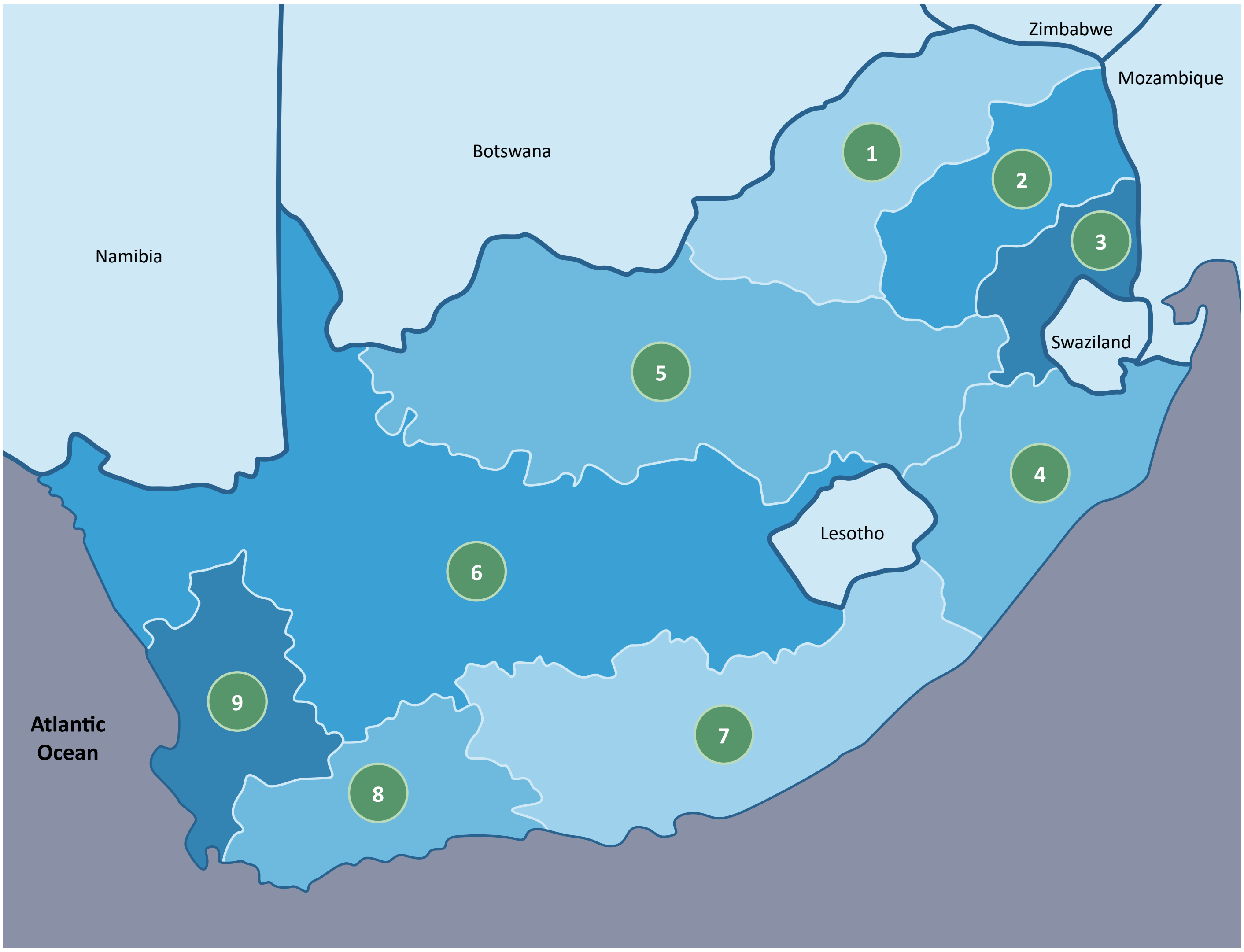
Another major concern, like in other case study countries in this report, is the long-term and perpetual care of the facilities left behind by mining. No evidence was found that these are considered in the closure plans nor that the associated costs are calculated in the bonds or other mechanisms (like funds) that allow the use of interests, returns or dividends to pay for the necessary monitoring, maintenance, and mitigation efforts in the future. A necessary discussion must begin around this issue. It is already concerning that the projects in place might not be considering this nor the institutions taking actions, but in an enlarged coal sector, the cumulative and synergic impacts will become more prevalent and costly to mitigate.

1.5.4 South Africa

South Africa's water resources are scarce, with a mean annual rainfall of 400-500 mm per annum. The Mpumalanga province receives a mean annual rainfall within the range of 593-748mm in the lowveld area and 748-971mm in the high veld (Shai, 2021, Simpson et al 2019) Water resources management is largely based on catchment boundaries, except for transboundary borders.

There are nine Water Management Areas (WMA) in the country; the management of which is the responsibility of the Catchment Management Agencies (CMA). WMAs include Limpopo, Olifants, Inkomati-Usuthu, Pongola Mtamuvna, Vaal, Orange, Mzimvubu-Tsitsikamma, Breede-Gourtz and Berg Olifants, as shown in figure 43. The main CMA found in the coal region are Upper Olifants, Inkomati-Usuthu, Vaal, and Limpopo.

Figure 43. **Water Management Areas (1 – Limpopo, 2 – Olifants, 3 – Inkomati-Usuthu, 4 Pongola-Mtamvuna, 5 – Vaal, 6 – Orange, 7 – Mzimvubu-Tsitsikamma, 8 – Breede-Gouritz, 9 – Berg-Olifants)**
Adapted from: DWS (2016)



Under the National Water Act of 1998, Eskom is listed as the only strategic water user. Olifants WMA is one of the most heavily utilised catchments in the coal region in terms of both the water requirements and quality. This is mainly due to intensive coal mining, CFPPs, agriculture, and the steel and petrochemical industries (Dabrowski & de Klerk, 2013; Hobbs et al., 2008; MP COGTA, 2019). The Mean Annual Runoff (MAR) for the Olifants WMA is 2,042 million m^3 per annum, while the surface water is supplemented by the return flow. Upper Olifants, a sub-catchment of the Olifants WMA is a key economic industrial hub for South Africa as it contains the Witbank coal fields arguably the most mined deposits overall. Upper Olifants WMA has a MAR of 466 m^3 per annum and an average yield of 2,000 million m^3 per annum (DWAF, 2004; Munnik, 2010).

Highveld has 3 main water reservoirs which include Witbank, Middleburg, and Loskop dam. Estimates for the specific water requirements for mining in 2020 found the highest to be that of Upper Vaal WMA at 173 million m^3 per annum, followed by Olifants at 94 million m^3 per annum. Water requirements for power generation were highest in the Olifants WMA, followed by Upper Vaal (see Table 21). These specific WMAs have the highest concentration of coal mines and power plants respectively, although the projected water requirements for Limpopo, Olifants, and Inkomati may increase by 2025, with the last of the three showing the highest change - from 844 to 1,742 million m^3 per annum.

Table 21 **Available yield vs. water requirements (in million m^3/annum)**
Source of data: Stats SA (2010)

WMA	SPECIFIC WATER REQUIREMENTS, 2000					TOTAL AVAILABLE YIELD, 2000	2025 PROJECTED AVAILABLE YIELD	TOTAL WATER REQUIREMENTS, 2000	2025 PROJECTED WATER REQUIREMENT
	Irrigation	Domestic (urban / rural)	Mining	Power generation	Afforestation				
Limpopo	238	62	14	7	1	281	295	322	379
Olifants	557	132	94	181	3	609	665	967	1143
Upper Vaal	114	678	173	80	0	1130	1036	1045	957
Inkomati	593	89	24	–	138	897	1486	844	1742

*These values exclude water transfers in and out of the WMAs

In the Vaal River system, there are 3 bulk water users: Eskom, the petrochemical company Sasol, and Mittal Steel. Sasol's Secunda complex receives most of the bulk from Grootdraai, while the Burg Complex relies on the Vaal dam. Mittal Steel also receives from the Vaal dam (DWAF, 2009). The Vaal River Eastern sub-system augmentation scheme transfers 160 million m3/annum to the Vaal and Olifants catchments. The water is committed to Eskom and Sasol's Secunda in the Vaal catchment (DWA, 2011).

The Grootdraai dam supplies Standerton, Sasol II and III, and the Tutuka CFPPs and power stations, as well as fulfilling water requirements from the nearby Olifants, Duvha, Matla, Kendal, and Kriel coal power plants. The new power stations receive water from the Zaaihoek system (DWAF, 2009). Vaal dam and Vaal Barrage are downstream of the Upper Vaal catchment, with a return flow of 392.95 million m3 per annum and 681.72 million m^3 per annum respectively. Vaalharts' irrigation scheme is the main user in the lower Vaal WMA, with water supplied from the Bloemhof dam (Mare, 2007). The new power stations receive water from the Zaaihoek system.

Within the Inkomati-Usuthu CMA, the major water requirements in the catchment include those from power generation in the neighbouring Olifants WMA, irrigation, afforestation, industrial activities, and increased domestic water demand (Mallory & Beater, 2021). The Upper Komati transfers significant amounts of water from Nooigedacht and Vygeboom to the Eskom plants in nearby Olifants WMA. This is reflected in Table 22, which shows significant transfer out, particularly from the Vygeboom dam, at 76.6 million m^3 per annum.

Table 22 **Water requirements in the Upper Komati catchment**
Source of data: DWAF (2006); Stats SA (2010)

SUB CATCHMENT	TRANSFER OUT	TRANSFER IN	IRRIGATION	INDUSTRIAL	DOMESTIC	FORESTRY	TOTAL DEMAND	FSC	MAR	FSA (km2)
Nooitgedacht dam	28.1	9.8	2.6	-	0.6	0.1	41.2	78.21	73.6	7.63
Vygeboom dam	76.6	24.2*	2.7	-	-	14.4	93.7	83.32	258.8	6.70
Gladdespruit	24.2*		8.6	0.1	-	16.6	25.3	-		-

*Transfers within catchment to Vygeboom dam

The Mokolo dam, found in the Limpopo WMA, supplies water to the Matimba and Medupi CFPPs, and the Grootegeluk coal mine. Due to the significant water use and existing stree in the catchment, no increase in water required is expected (Lombaard J et al., 2015). Table 23 shows an increase in demand based on the projection of water requirements, especially in the mining, power, and associated industries. The water requirements for Irrigation and livestock are projected to remain the same.

Table 23 **Summary of water requirements for the Mokolo catchment (in million m³/annum)**
Source of data: Lombaard J et al. (2015)

	INDUSTRY/POWER/ MINING	DOMESTIC	IRRIGATION	LIVESTOCK	COMMERCIAL FORESTRY AND INVASIVE ALIEN PLANTS (IAP)
2015	64	105.6	464.8	23.4	9.1
2020	111.4	109	464.8	23.4	9.1
2025	157.9	115.8	464.8	23.4	9.1
2030	204.7	122.6	464.8	23.4	9.1
2035	237.3	128.3	464.8	23.4	9.1
2040	249.1	134	464.8	23.4	9.1

The geological strata that contains the coal and the coal itself contain significant amounts of pyrite which is the main contributor to Acid Mine Drainage (AMD). There are extensive coal mining activities currently carried around the Wilge river, Bronchorstrpruit, Klein, Olifants, and the Olifants river with acid mine leachates (DWA, 2011). Acid Mine Drainage is one of the most serious environmental issues in the country, compounded by the over 6000 abandoned mines in South Africa (Munnik, 2010). Coal mining started in the 1890s at the Olifants catchment, and by 2004, it was estimated that about 50,000m3 of mine water from abandoned mines had been released at a rate 64,000m3/day (Munnik, 2010). Acid mine drainage has also been observed to come from rock dumps. Also according to Munnik (2010), existing mines in the Olifants use seasonal high flows to dilute AMD through the "Controlled Release Scheme" (CRS).

The CRS was introduced in the Olifants catchment in 1997, after a sulphate concentration of over 300mg/L was found in the Witbank dam in 1996 (Hobbs et al, 2008). The system was modified and extended to the Middleburg dam. The CRS works in such a way that during periods of high rainfall, high runoff dilutes the pollutants in rivers. During this period, industries are allowed to release polluted water under controlled conditions, with such releases being prohibited during times of low flow. The acceptable release of pollutants during high flow is calculated daily through the estimation of waste allocation load and assimilative capacity. Moreover, the polluted water to be released in the rivers is only considered after source controls, waste minimisation, and recycling processes have been undertaken (Colemann, 2003). The system managed to control short-to-medium term water quality issues in the Olifants catchment. All participating industries are required to apply for annual controlled release licenses to the Department of Water Affairs (Hobbs et al, 2008).

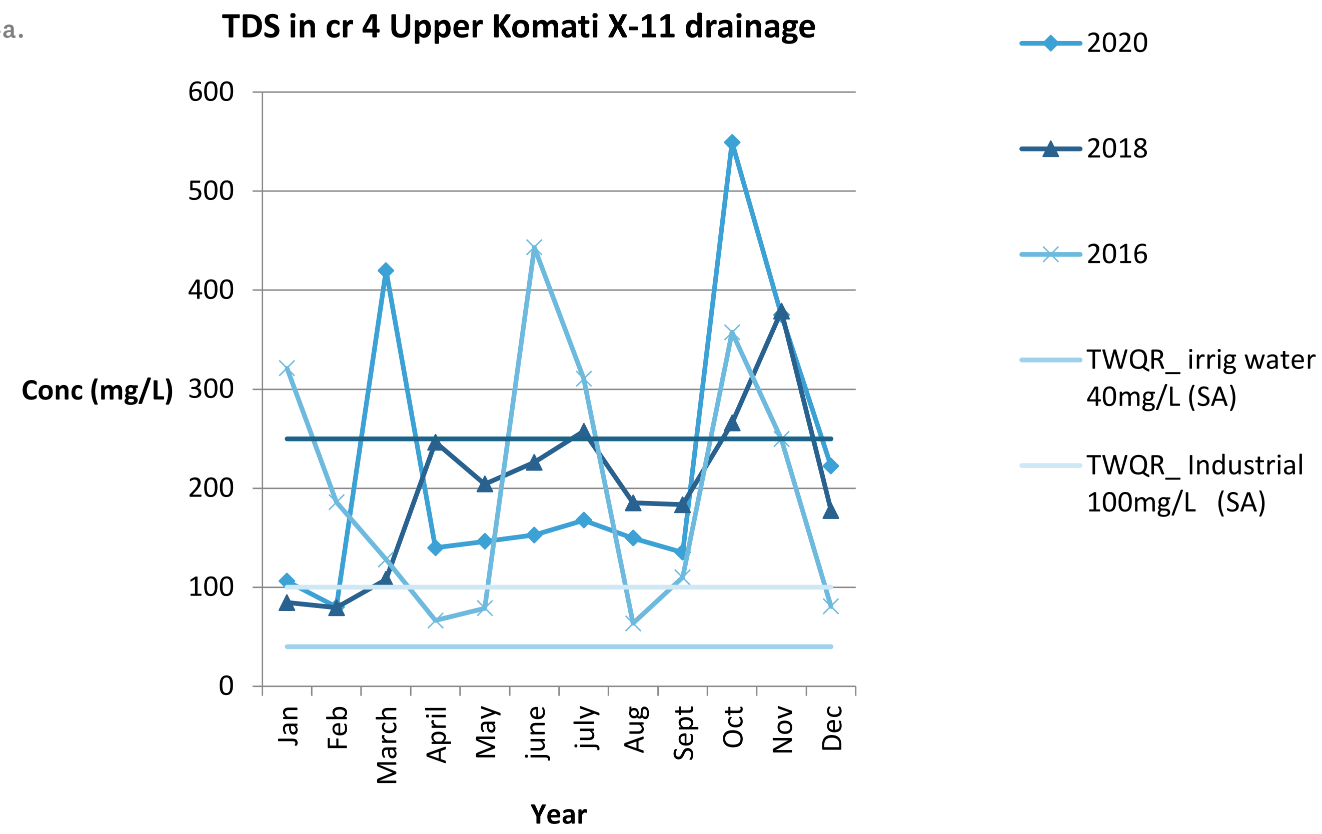
Carolina, Eerstehoek, Machadodorp, Waterval Boven, Ekulindeni, Mbojane, Barberton, Emangweni, Sibayeni, and Komatipoort are located on the banks of the Komati River, which also faces AMD issues. For example, the contamination of the water treatment works at Boersmanspruit dam came to light on 11 January 2012, when it was noted that inadequate water treatment at the water treatment works led to the very poor living conditions for the residents of Carolina (McCarthy and Humphries, 2013). Indeed, pH values of 3.7 were measured, while metals such as iron, sulphur, and aluminium, among others, were found to be above acceptable limits. The fish in the dam were dying, and the residents could not use the water for over 7 months (McCarthy & Humphries, 2013; Tempelhoff et al., 2014).

The National Integrated Water Information System (NIWIS) provides nationwide data on water quality and quantity. Sample data from the NIWIS was used to provide an overview of the river water quality in the CMAs of interest. The Bosmanspruit, upstream of Witrand coal mine (Cr 1), and downstream of Witkrans coal mine (Cr 4) was selected for the Inkomati-Usuthu WMA. In the Olifants, points WMA B12_188387 and B1H005Q01 were selected. Some observations from these datasets can be observed in the figure 44 and are described in the following points:

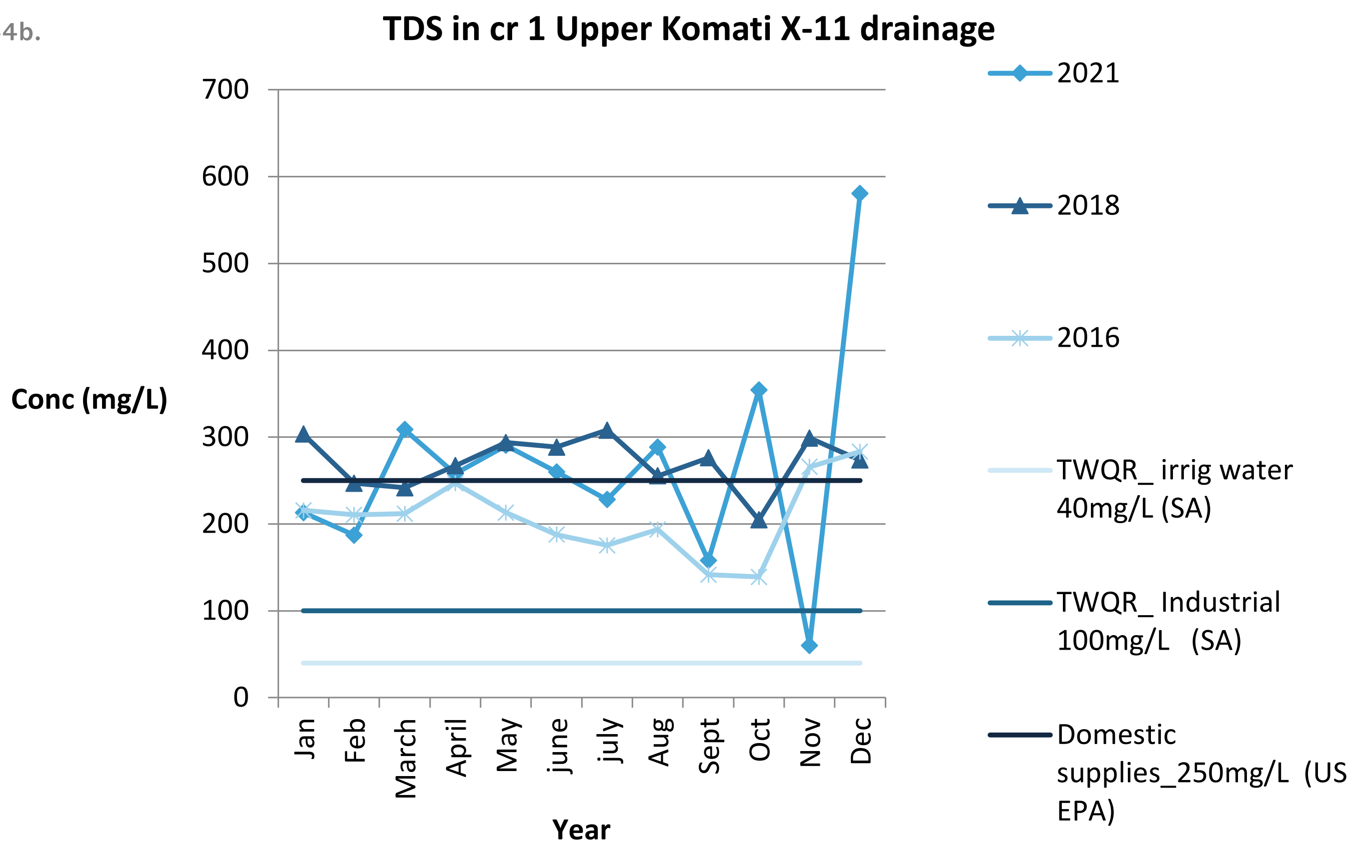
- Total Dissolved Solids (TDS) exceeded the recommended domestic supply intake of 250 mg/L (US EPA) for sites Cr 1 and Cr 4 in Inkomati-Usuthu.
- TDS also exceeded the recommended Target Water Quality Range (TWQR) for irrigation water and industrial water set at 40 mg/L and 100mg/L respectively.
- Sulphate concentrations were especially high in Cr 1 between July and August in 2019.
- Manganese (Mn) and Iron (Fe) was relatively higher for both Cr 1 and Cr 4, particularly in 2016.

Figure 44a and b. Selected parameters concentrations at interest WMAs (in different years)
Source of data: DWS (2022); Mallory and Beater (2021)

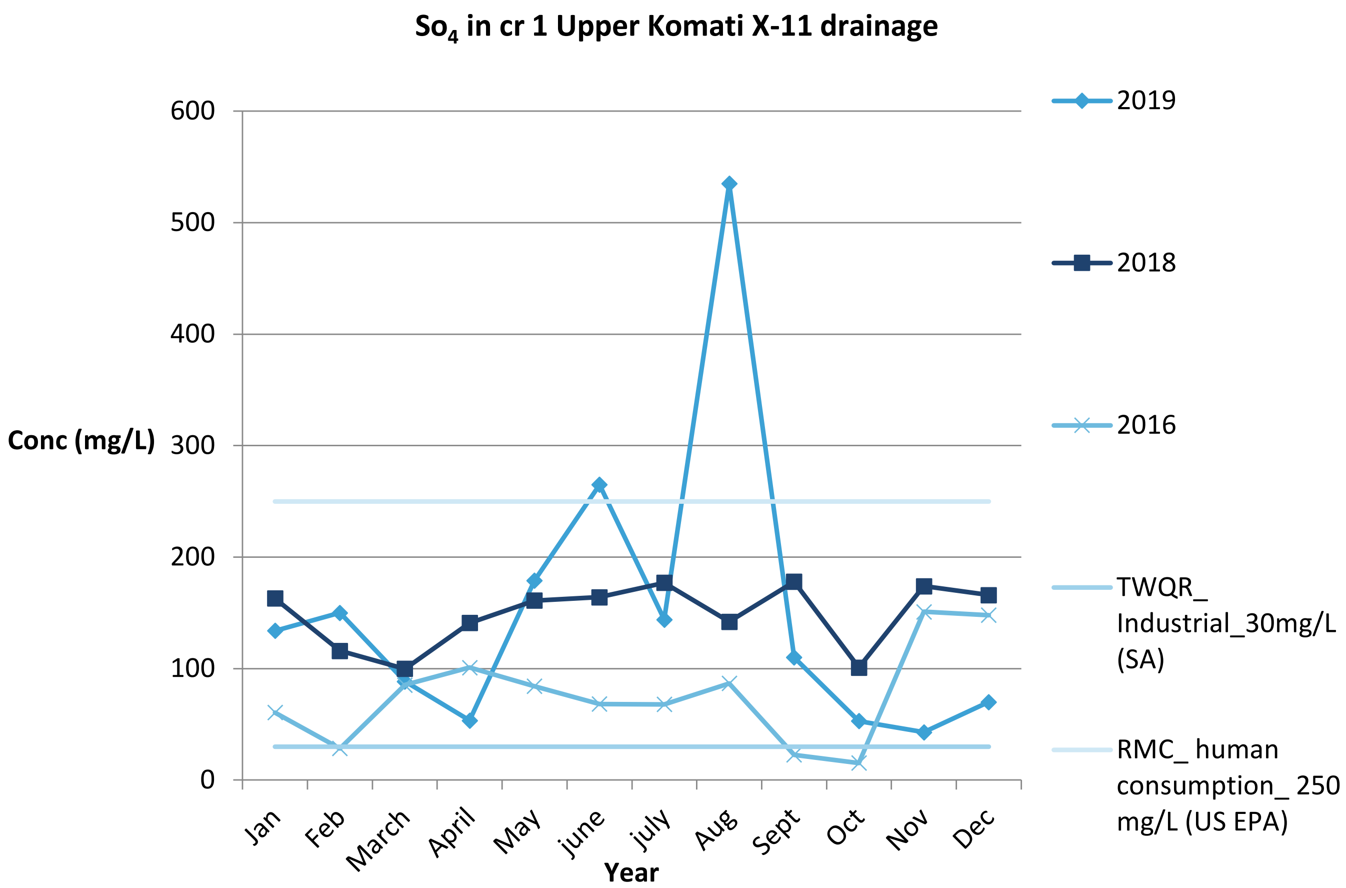
44a.



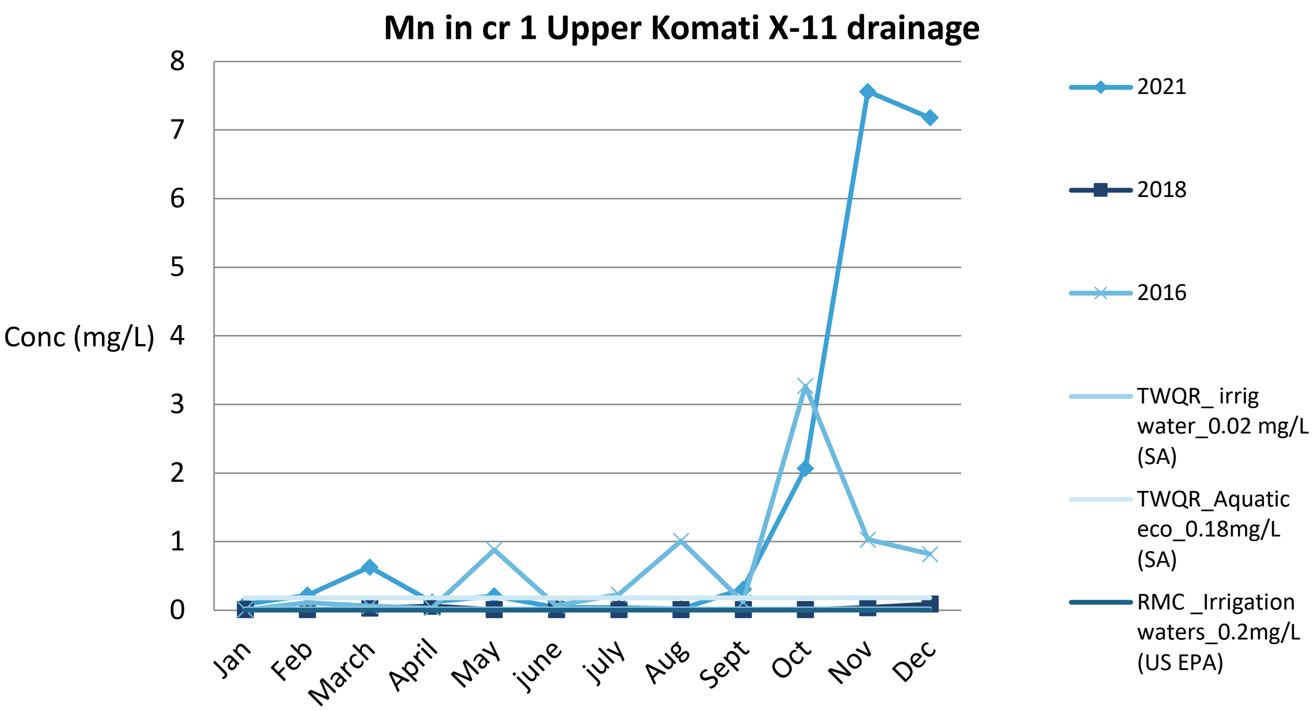
44b.



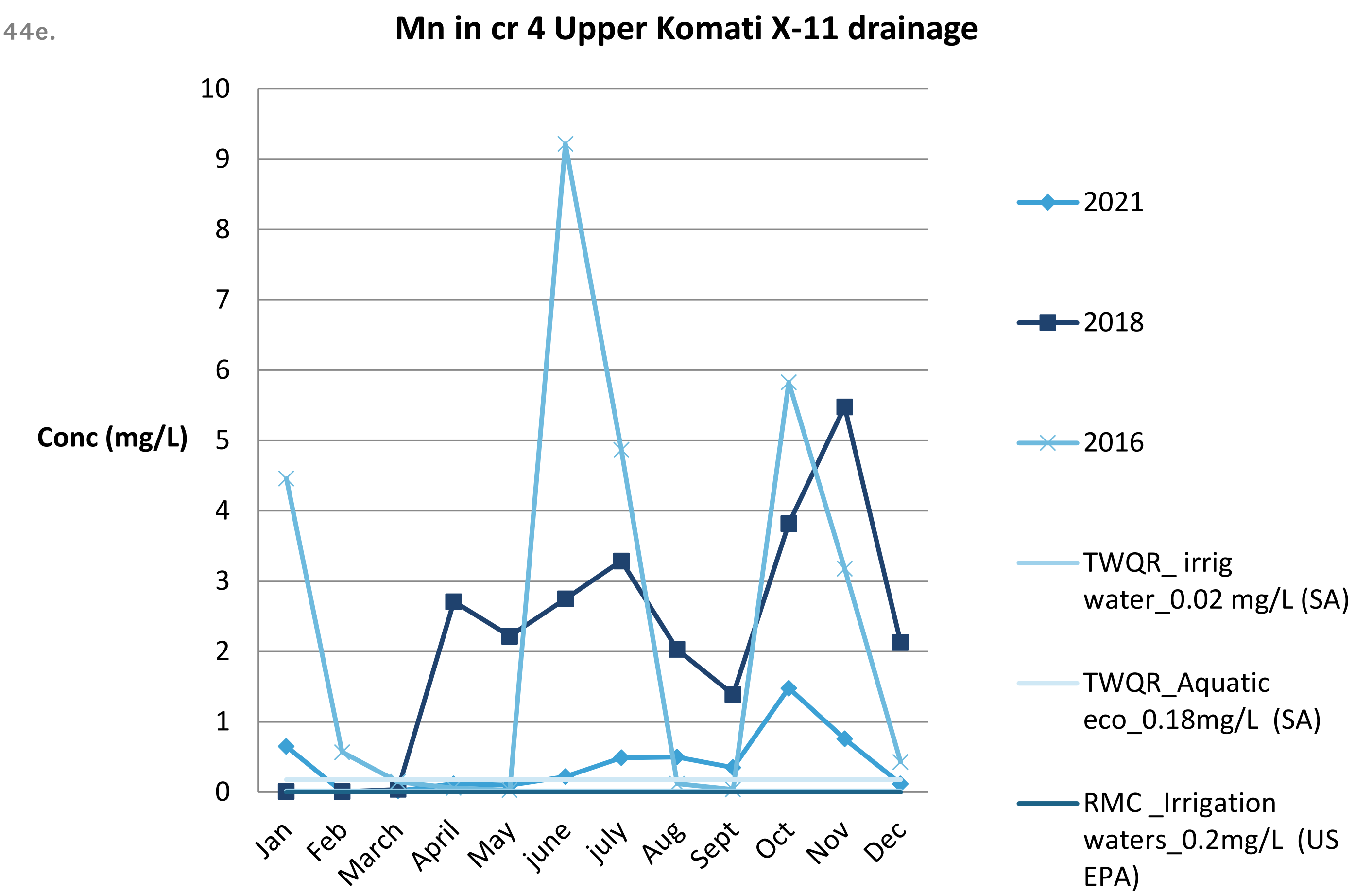
44c.


SO_4 in cr 1 Upper Komati X-11 drainage
600
500
400
Conc (mg/L)
300
200
100
0
Jan
Feb
March
April
May
june
july
Aug
Sept
Oct
Nov
Dec
Year
2019
2018
2016
TWQR_ Industrial_30mg/L (SA)
RMC_ human consumption_ 250 mg/L (US EPA)

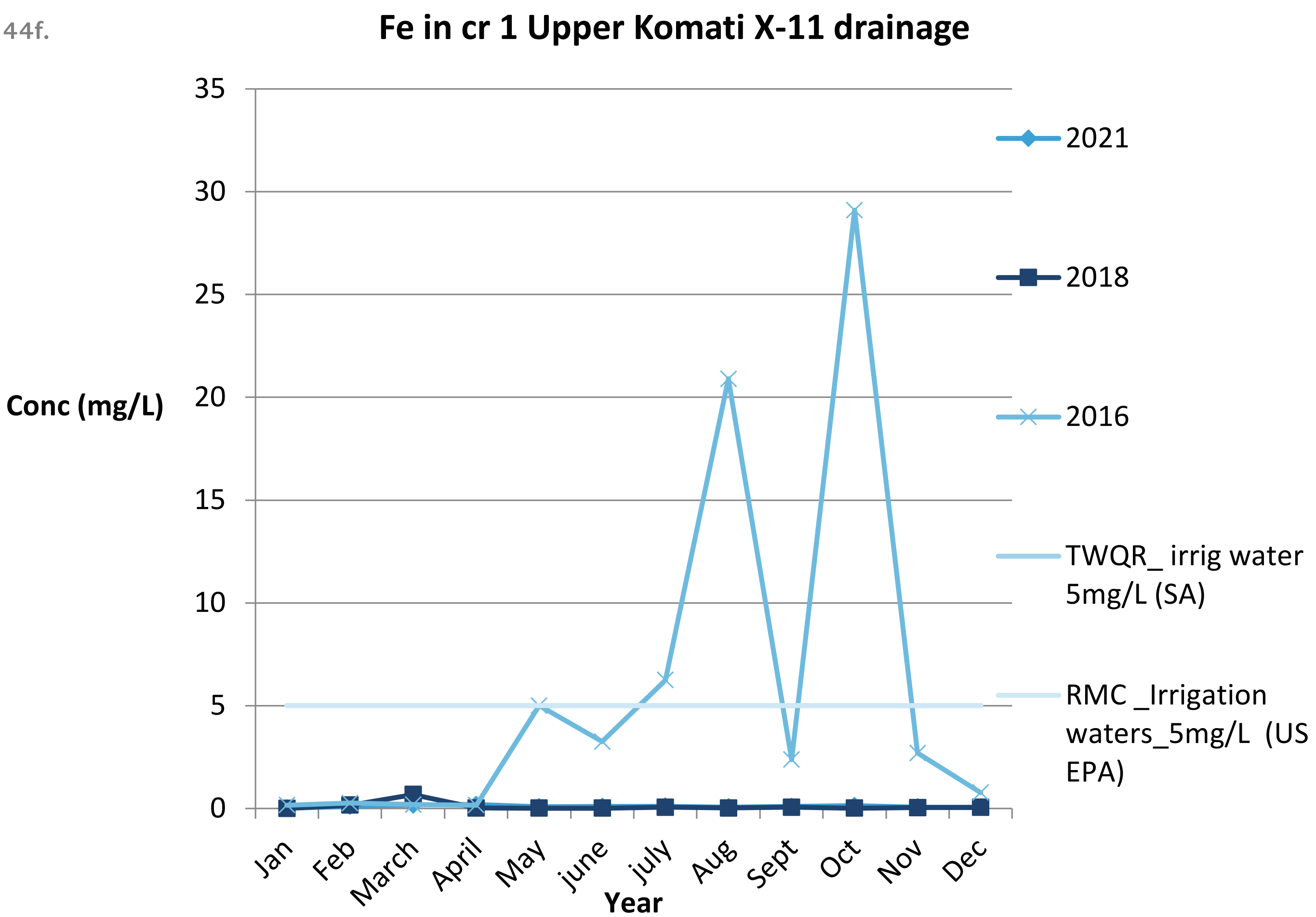
44d.


Mn in cr 1 Upper Komati X-11 drainage
8
7
6
5
Conc (mg/L)
4
3
2
1
0
Jan
Feb
March
April
May
june
july
Aug
Sept
Oct
Nov
Dec
2021
2018
2016
TWQR_ irrig water_0.02 mg/L (SA)
TWQR_Aquatic eco_0.18mg/L (SA)
RMC _Irrigation waters_0.2mg/L (US EPA)

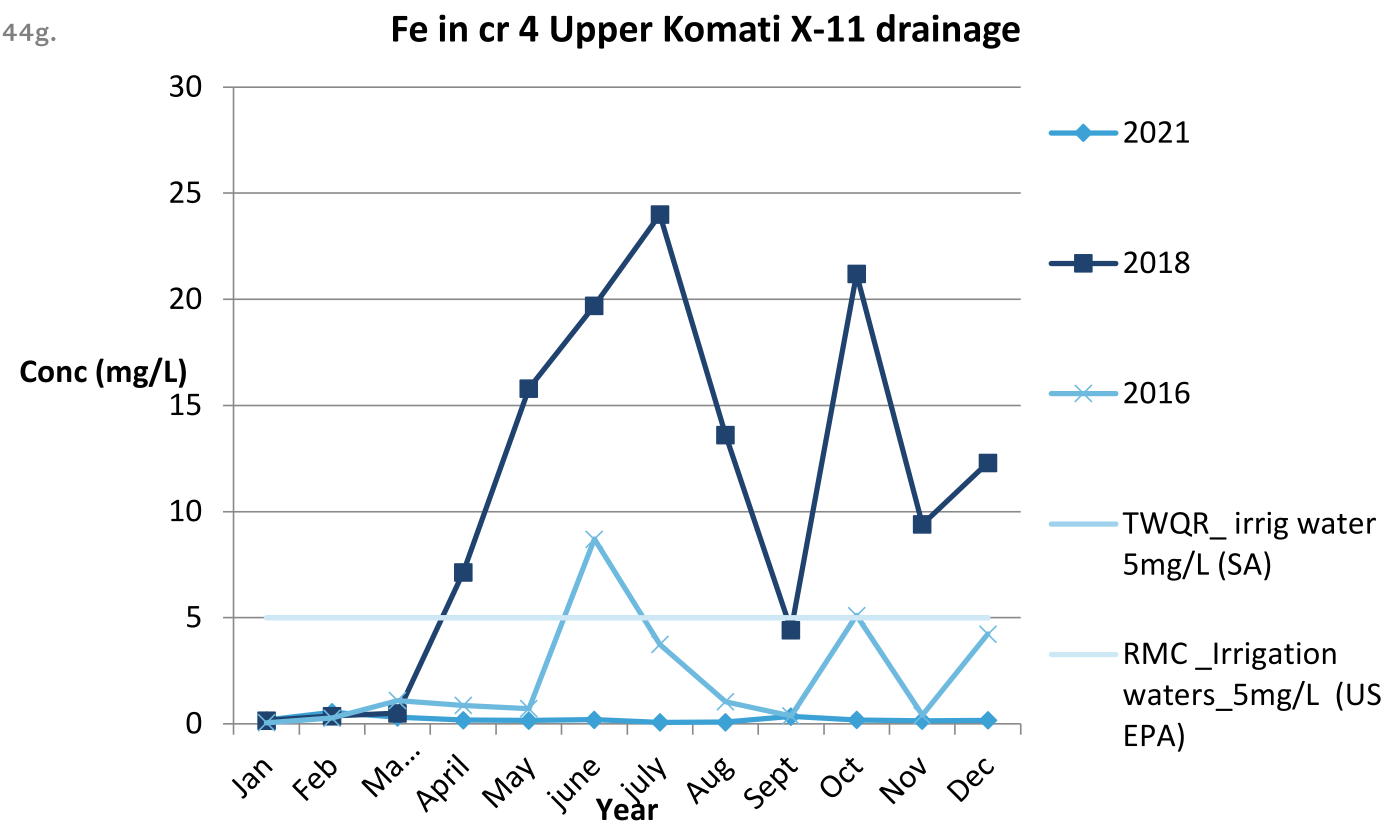
44e.


Mn in cr 4 Upper Komati X-11 drainage
Conc (mg/L)
0
1
2
3
4
5
6
7
8
9
10
Jan
Feb
March
April
May
june
july
Aug
Sept
Oct
Nov
Dec
2021
2018
2016
TWQR_ irrig water_0.02 mg/L (SA)
TWQR_Aquatic eco_0.18mg/L (SA)
RMC _Irrigation waters_0.2mg/L (US EPA)

44f.


Fe in cr 1 Upper Komati X-11 drainage
Conc (mg/L)
0
5
10
15
20
25
30
35
Jan
Feb
March
April
May
june
july
Aug
Sept
Oct
Nov
Dec
Year
2021
2018
2016
TWQR_ irrig water 5mg/L (SA)
RMC _Irrigation waters_5mg/L (US EPA)

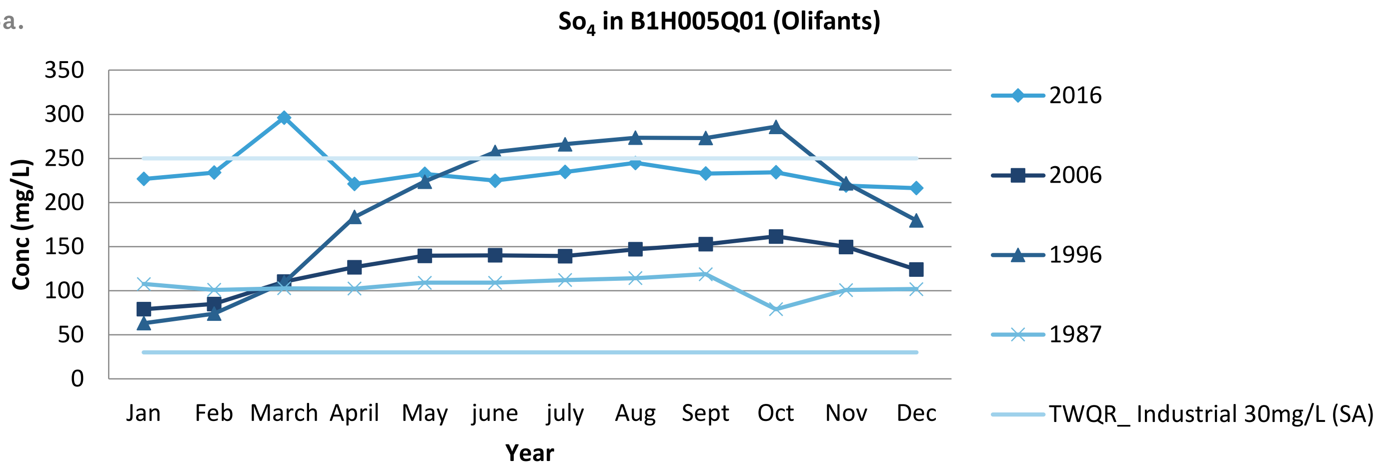
44g.



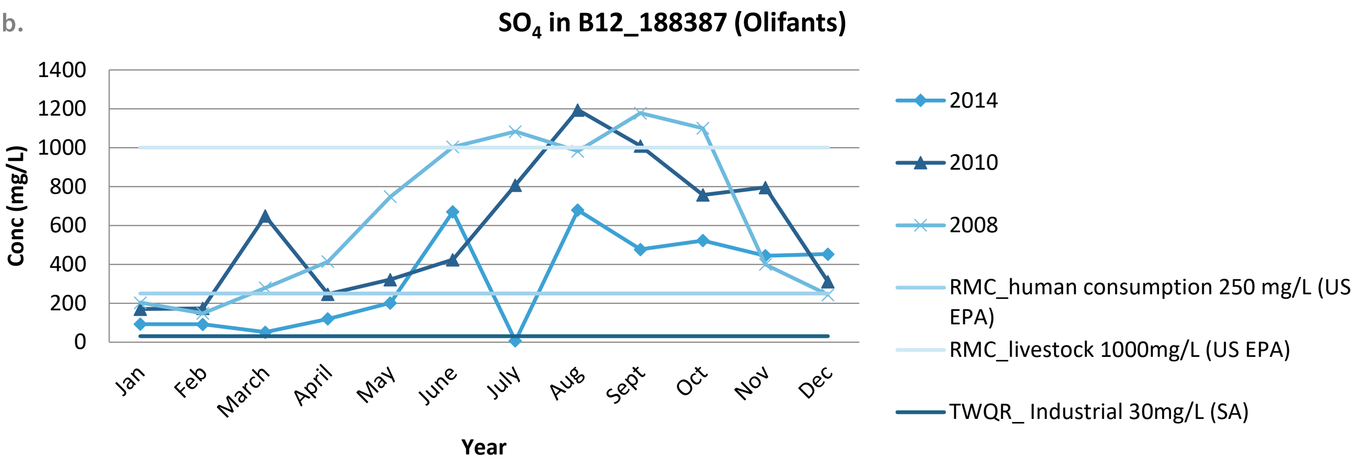
At Olifants, the sulphates concentration was above the TWQR of 30mg/L for industrial water over all the years. This could imply high levels of pollution mainly due to the presence of CFPPs in the WMA. Additionally, high levels of TDS and sulphates in groundwater were beyond the recommended industrial water and irrigation water levels in South Africa and US EPA domestic supply ranges for all years. Corresponding graphs are below. See figure 45.

Figure 45. **Selected parameters concentrations at interest WMAs (different years) (II)**
Source of data: DWS (2022)

45a.

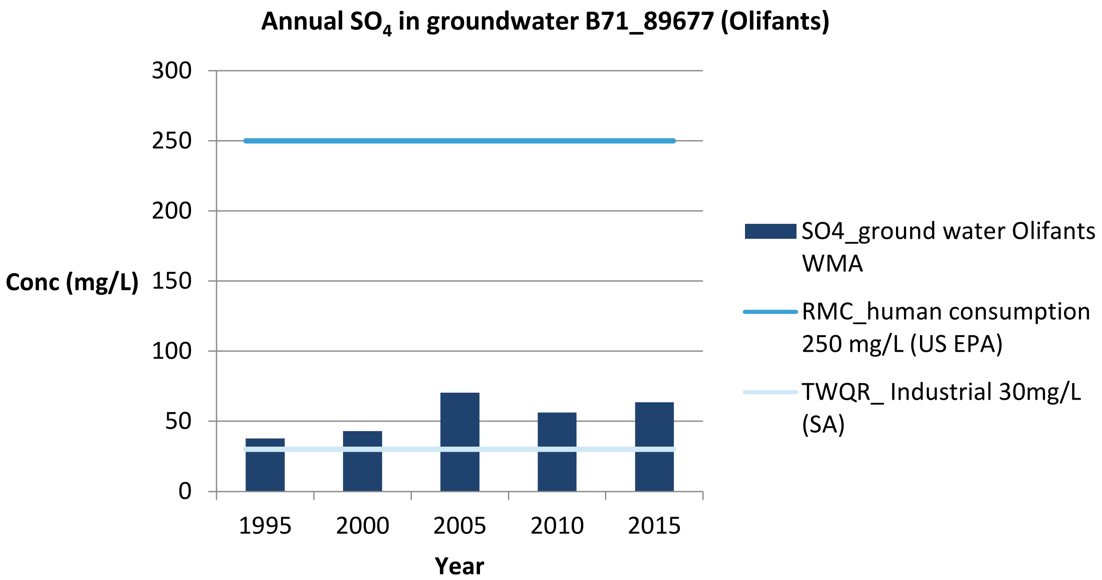


45b.



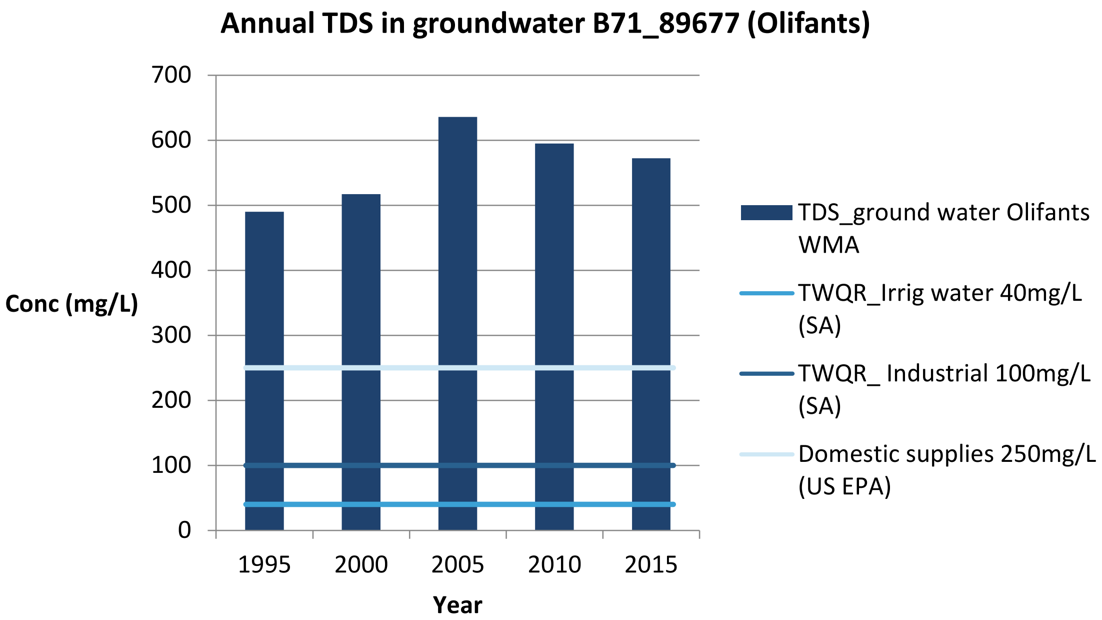
SO4 in B12_188387 (Olifants)
1400
1200
1000
800
600
400
200
0
Conc (mg/L)
Jan
Feb
March
April
May
June
July
Aug
Sept
Oct
Nov
Dec
Year
2014
2010
2008
RMC_human consumption 250 mg/L (US EPA)
RMC_livestock 1000mg/L (US EPA)
TWQR_ Industrial 30mg/L (SA)

45c.



Annual SO4 in groundwater B71_89677 (Olifants)
300
250
200
Conc (mg/L) 150
100
50
0
1995
2000
2005
2010
2015
Year
SO4_ground water Olifants WMA
RMC_human consumption 250 mg/L (US EPA)
TWQR_ Industrial 30mg/L (SA)

48d.

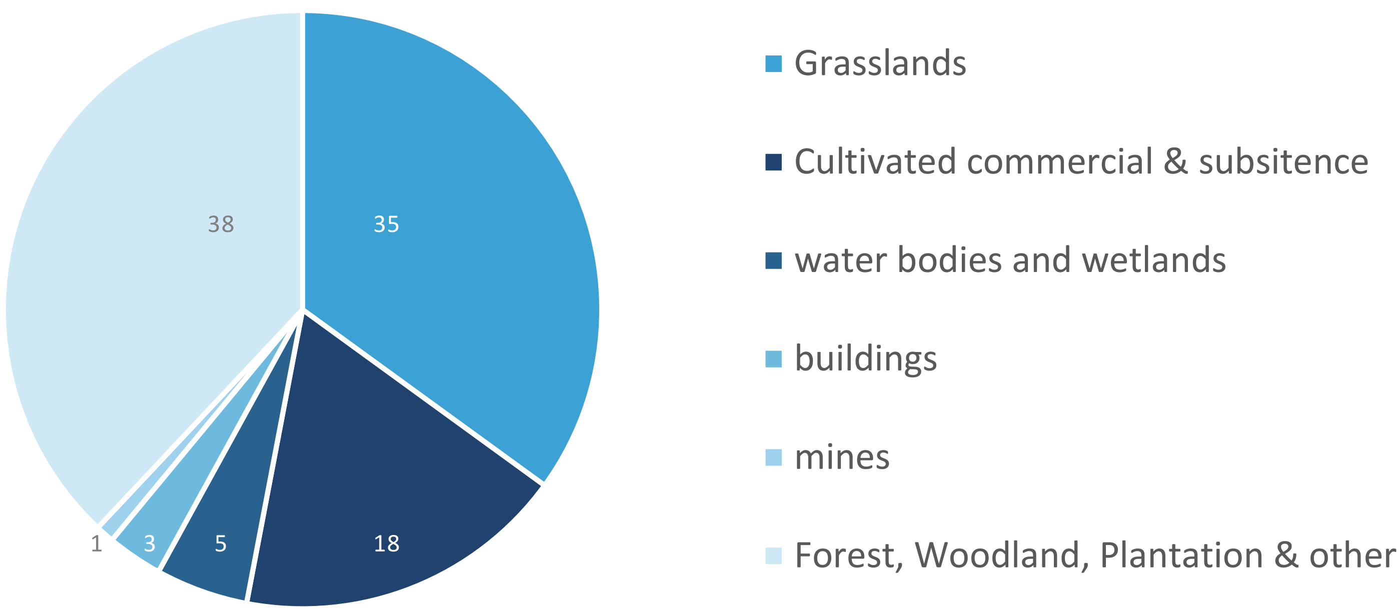


Annual TDS in groundwater B71_89677 (Olifants)
700
600
500
400
Conc (mg/L)
300
200
100
0
1995
2000
2005
2010
2015
Year
TDS_ground water Olifants WMA
TWQR_Irrig water 40mg/L (SA)
TWQR_ Industrial 100mg/L (SA)
Domestic supplies 250mg/L (US EPA)

About 80% of total land surface area in South Africa is categorised as arid to semi-arid, with only 12% considered to have arable potential. Out of this 12%, 46% of the arable land is in the Mpumalanga province (Delport et al., 2015; Stats SA, 2021), 38% of land is forest and woodlands, followed by 35% grasslands - as shown in the figure 46. Land cultivated for commercial and subsistence use occupies 18%, with only 1% designated for mining. Despite the majority of land being under dryland cultivation, the agriculture sector still uses up to 55% of the water consumed (Shai, 2021)

Agricultural land in the Mpumalanga province faces severe land degradation due to poor soil management and mining activities (Delport M et al., 2015; Maseko, 2022), while a high potential for soil compaction due to open-pit and strip coal mining in Mpumalanga has decreased land productivity in the province (MP COGTA, 2019).

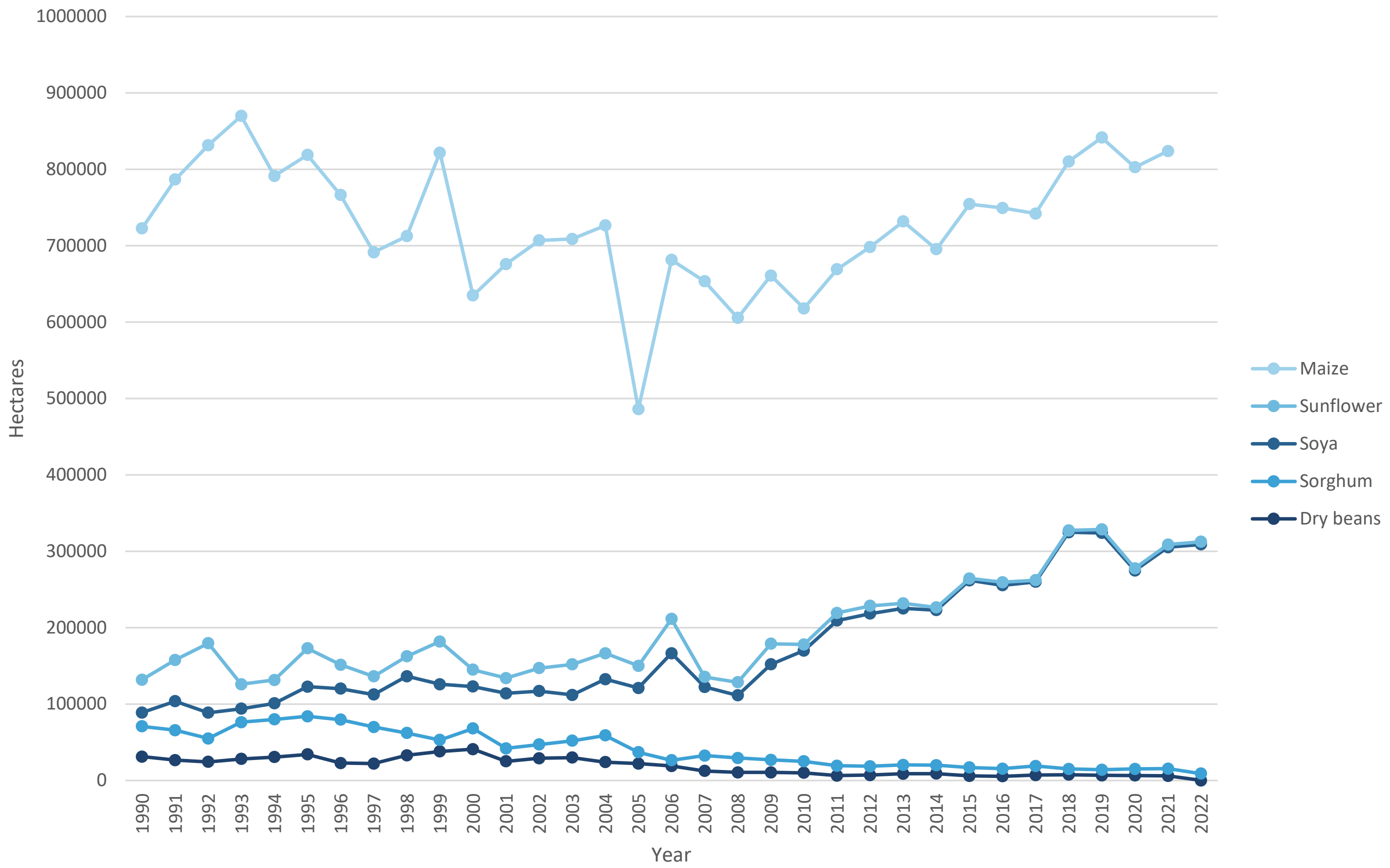
Figure 46. **Land use classification in Mpumalanga**
Modified from Shai (2021)



The 2021 Bill on Preservation and Development of Agricultural Land B8 applies to all agricultural land and provides principles for its management, as well as for agricultural land evaluation and classification, and for the declaration of Protected Agricultural Areas (PAA). The PAA have been included in the Spatial Development framework under the Spatial Planning and Land Use Management Act (SPLUMA 16) of 2013, agriculture sector plans, and rural development plans. All the areas under irrigation, particularly those for commercial irrigation schemes in South Africa are demarcated as PAAs (DALRRD, 2020). This could be attributed to the fact that approximately 80% of the food produced in South Africa comes from large-scale commercial farms.

For example, the Loskop irrigation scheme is the second largest in South Africa, with a scheduled area of about 16,117 hectares in the Mpumalanga province. Most of the crops grown are intended for export, including wheat, vegetables, tobacco, peanuts, cotton, and citrus fruit. Another example is the Lower Olifants irrigation scheme, with a scheduled area of about 9,510 hectares - also found in Mpumalanga (Van Vureen, 2015, DWA, 2011). The challenge concerning these irrigation schemes is that due to their downstream location on the upper Olifants, they are prone to pollution from industries and mining in the upstream catchment. The Olifants catchment is estimated to facilitate about 945,948 ha of rain-fed agriculture (McCartney & Arranz, 2013).

Figure 47. **Cultivated area of selected commercial crops in Mpumalanga 1990-2022**
Source of data: DALRRD (2022)



The High Veld mostly produces summer grains and oil-producing plants such as maize, dry beans, sorghum, soybeans, and sunflower (Maseko, 2022). Figure 47 shows a general decline in planted areas for dry beans and sorghum from 2006 to 2022 in the Mpumalanga province. As High Veld has both the most coal mines and favourable conditions for grains, the competition for land is inevitable. Over the past few decades, large areas of agricultural land have been sold or transferred to mining companies, which are now classified as 'mining farms'. (BFAP, 2015). Table 24 indicates an overlap in mining and cropped area in Mpumalanga of about 490,238 hectares (Ha). Mining properties/cadastral farms showed almost double the area utilised, compared to the cropped land as illustrated by the resource competition for agriculture and mining land farm boundaries resources published BFAP (2015).

Table 24 **Competition for land (Agriculture and mining)**
Adapted from: BFAP (2015)

COMPETITION FOR LAND (AGRICULTURE AND MINING)	MPUMALANGA PROVINCE (HA)	NATIONAL (HA)
All cash crops, cultivated, planted pasture field boundaries (excluding sugarcane)	1 198 382	-
Mined area (surface/open cast	151 412	403 233
Mining properties/ Cadastral farm area	4 394 859	12 127 071
All mining properties/ cadastral farms overlaid with cropped area	490 238	-

The Vaal Triangle Airshed was the first to be declared a priority area in terms of the National Environmental Management Air Quality Act, 2004 (Act No. 39 of 2004, Section 18(1)) under Notice No. 365 of April 21st 2006, as amended by Notice 711 of August 17th 2007. The area is highly industrialised, with several coal mines and a CFPP emitting large volumes of air pollutants.

The High Veld Area (HVA) contributes the highest scheduled emissions with approximately 90% being sulphur dioxide, nitrogen oxide and industrial waste (MP COGTA, 2019; Wells RB et al., 2016). As such, it was declared a High Priority Area (HPA) (31 106 km2 in part of Gauteng and Mpumalanga) in November 2007, under Chapter 18 of the NEMA Air Quality Act, 2004 (Act no 39 of 2004). Its population then was estimated at 3.6 million people. The Air Quality Management Plan (AQMP) was subsequently published in 2012 to comply with the National Ambient Air Quality Standards (NAAQS) (MP COGTA, 2019).

The HPA in the High Veld has 5 monitoring stations, those being Hendrina, Middleburg, Secunda, Ermelo, and Witbank (currently eMalahleni), which are monitored by the South African Weather Service (SAWS). Monthly data is recorded for Particulate Matter and substances[22], for which significant exceedances of permissible levels are recorded, as provided in the network monitoring data and reports by the South African Air Quality Information System (SAAQIS, 2022; SAWS, 2021).

[22] PM_{10}, $PM_{2.5}$, SO_2, NO, NO_2, NO_x, O_3, CO, benzene, toluene, ethyl benzene and Xylene.

Stats SA (2022) provides data on some of the underlying natural causes of death, for which hypertension related to heart disease is ranked 4 out of 9 provinces, as seen in table 25. It was estimated that about 2,239 deaths annually are related to particulates from CFPPs (Holland, 2017; Langerman & Pauw, 2018). Steyn & Kornelius (2018) further estimated cardiac admissions related to CFPPs at 1,500, and respiratory admissions at 5,420, and child mortality < 5 years at 85.5.

Table 25 **Underlying causes of death occurrence in Mpumalanga**
Source of data: Stats SA (2018)

DISEASE	NO OF DEATHS	RANK OUT OF 9 PROVINCES
Ischaemic heart disease	1,260	7
Chronic lower respiratory disease	-	-
Hyper intensive disease	1,656	4
Other forms of heart disease	1,091	8
Other natural causes	12,815	-

Aerial view of Johannesburg city centre, South Africa

Source: Jacques Nel for Unsplash

1.6 A Just Energy Transition

This section covering the just energy transition will shed light on the policies, plans, programmes, and regulations around the energy transition and coal phase-out in the selected countries. It will also consider the impacts of this process - both positive and negative - and will discuss current NCRE projects.

1.6.1 Colombia

In 2022, the National Planning Department (Departamento Nacional de Planeación -DNP, acronym in Spanish) issued a document on Energy Transition from the Council on Economic and Social Policy - CONPES (DNP et al., 2022). It was based on four pillars, those being Security and reliability of energy supply, Knowledge and innovation in energy transition, Development and economic growth based on energy transition opportunities, and Development of an energy system that contributes to GHG emissions reduction. The document identifies some challenges concerning the energy transition and its relationship with coal mining, such as exports dependency, the need for labour reconversion and economic diversification, regulatory gaps in mine closure and environmental liabilities, and post-closure infrastructure use.

However, this policy does not consider a coal-phase out - or even a coal-phase down - as part of the energy transition; on the contrary, coal extraction is encouraged until the reserves are depleted. Although the initial assessment highlighted relevant gaps, they have not been addressed with specific strategies in its action plan. In general, this national policy is oriented toward the diversification of the electricity matrix and includes geothermal energy generation and hydrogen (both blue and green). It means that the decarbonisation of the economy and coal phase-outs are not considered aspects of the energy transition; indeed, the continuation of coal extraction is even portrayed as a key element of the process.

Furthermore, in both the E2050 strategy and the carbon-neutrality strategy, Just Energy Transition (JET) is approached through emissions-reductions technology alternatives and by promoting green jobs - enabling people working for the energy sector to set up new companies for energy generation from renewable sources. However, this last aspect is not clearly addressed.

One of the biggest topics of the energy transition in Colombia is the incorporation of renewable energies into the country's energy matrix. In that sense, table 26 shows the most relevant legal instruments that have been issued. Overall, Colombia has seen some public support for investing in the NCRE through, for example, tax reductions and other fiscal incentives, financial support, and less environmental license requirements (MADS, 2018a).

Table 26 **Table Relevant legal instruments of NCRE in Colombia**

REGULATION	DESCRIPTION
Law 1715 of 2014	Promotes non-conventional energy sources in the national energy system through their integration in the electricity market and their participation in non-interconnected areas. It includes financial (Non-Conventional Energy and Efficient Energy Management Fund -FENOGE) and operative instruments (e.g., fiscal incentives) for different types of NCER.
Law 1964 of 2019	Promotes the use of electric and zero-emission vehicles to contribute to sustainable mobility and the reduction of GHG emissions and air pollution.
Law 2099 of 2021	Law that updates sections of the Law 1715 of 2014 and issues regulations regarding energy transition, integration of NCER in the energy market and public utilities of electric power and fuel gas.

Sectorial institutions from the previous government had also heavily promoted energy sources like blue and green hydrogen, and offshore wind, to the extent of considering blue hydrogen as a NCRE, despite the obvious fact that the source of energy is fossil-based. According to the Colombian hydrogen roadmap (MME et al., 2021), it could help in an early decarbonisation of specific industrial applications that already use grey hydrogen[23], such as oil refineries and steel manufactures. The strategy aims to produce 50Ktonne of blue hydrogen by 2030, and to have an installed electrolysis capacity of between 1 and 3 GW for green hydrogen, with a Levelised Cost of Hydrogen (LCOH) at 1.7 USD/kgH_2.

For 2050, a production of 1,850 Ktonne of green hydrogen (mainly used for fertiliser production), is expected. Departments with the highest capacity for green hydrogen production include La Guajira and Cesar. Currently, the public oil company, Colombian Petroleum Company (Empresa Colombiana de Petróleos, ECOPETROL – acronym in Spanish) has a pilot project for green hydrogen production through a solar farm of 324 photovoltaic panels and one electrolyser, with the aim of producing 15 Tonnes per annum of green hydrogen (Portafolio, 2022c) and hydrogen-based mobility tests (Portafolio, 2022a). Currently, Decree 1476 (Presidencia de la República, 2022) specifies the responsibilities of ministries "to define the mechanisms, conditions and incentives

[23] Ullman & Kittner (2022) remark that hydrogen production from fossil fuels like coal could generate increments in air pollutants and trace metals - aspects that are not considered in Colombia's hydrogen roadmap.

to promote local development, innovation, research, production, storage, transportation, distribution and use of hydrogen”24.

Colombia also has an offshore wind energy roadmap (The Renewables Consulting Group et al., 2022), in which La Guajira is identified as the region with the largest electricity generation capacity, with an estimated 50 GW potential. The offshore wind energy roadmap recognises that the most pressing issue is a lack of transmission capacity in these areas.

According to MME & UPME (2022), as of July 12th, 2022, there are a total of 245 ongoing NCRE projects in Colombia. Figure 51shows the number of NCRE projects according to type. The largest numbers correspond to solar (217) and wind (19); in both cases, around 70% of projects are in phase 2 (economic, technical, financial, and environmental feasibility stage), the rest, in are in pre-feasibility (phase 1). Currently, there are no projects in phase 3, which means that engineering details are being defined before construction can begin.

Figure 48 shows current NCRE in the Departments of interest. The highest number of wind projects (95% of the total in the country) are situated in La Guajira. According to Gonzalez & Barney (2019), La Guajira may accommodate up to 60 wind farms by 2031; installing 2,500+ of wind turbines and generating 7 GW to the SIN.

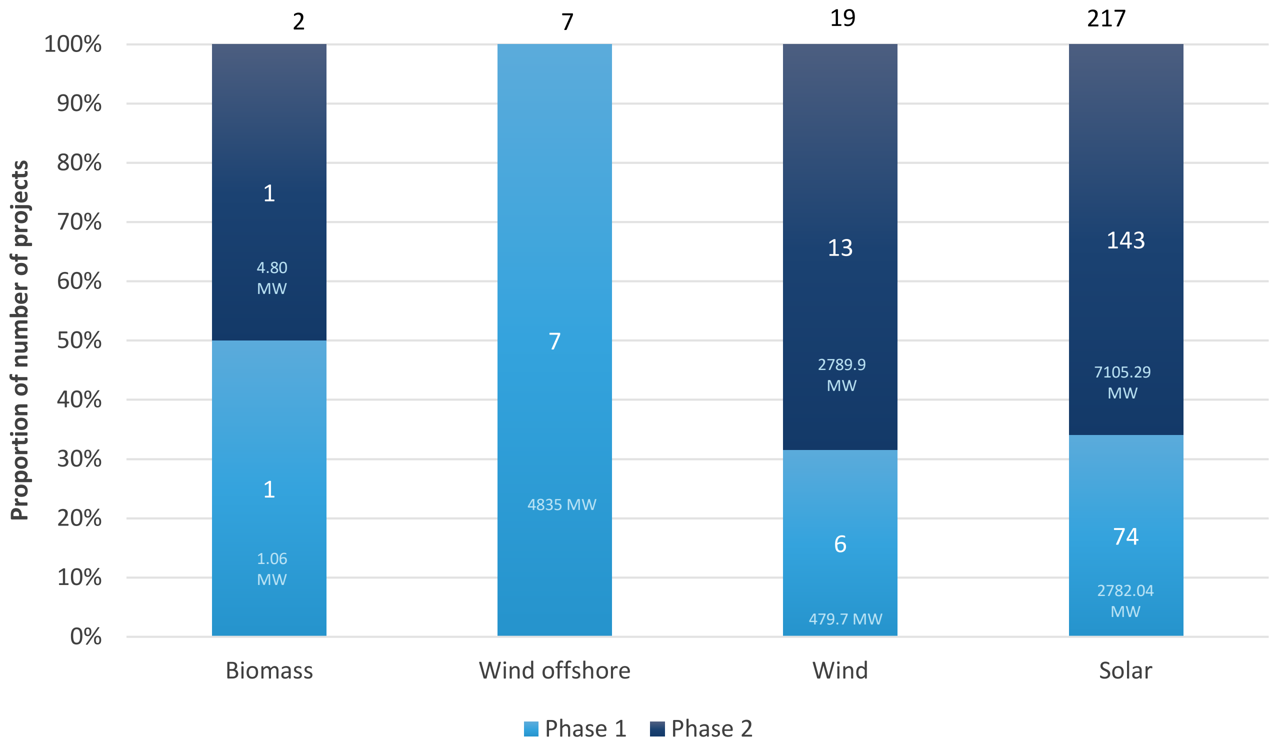
Town of Guatapé, Colombia **Source: Saul Mercado for Unsplash**

[24] Translated by the authors.

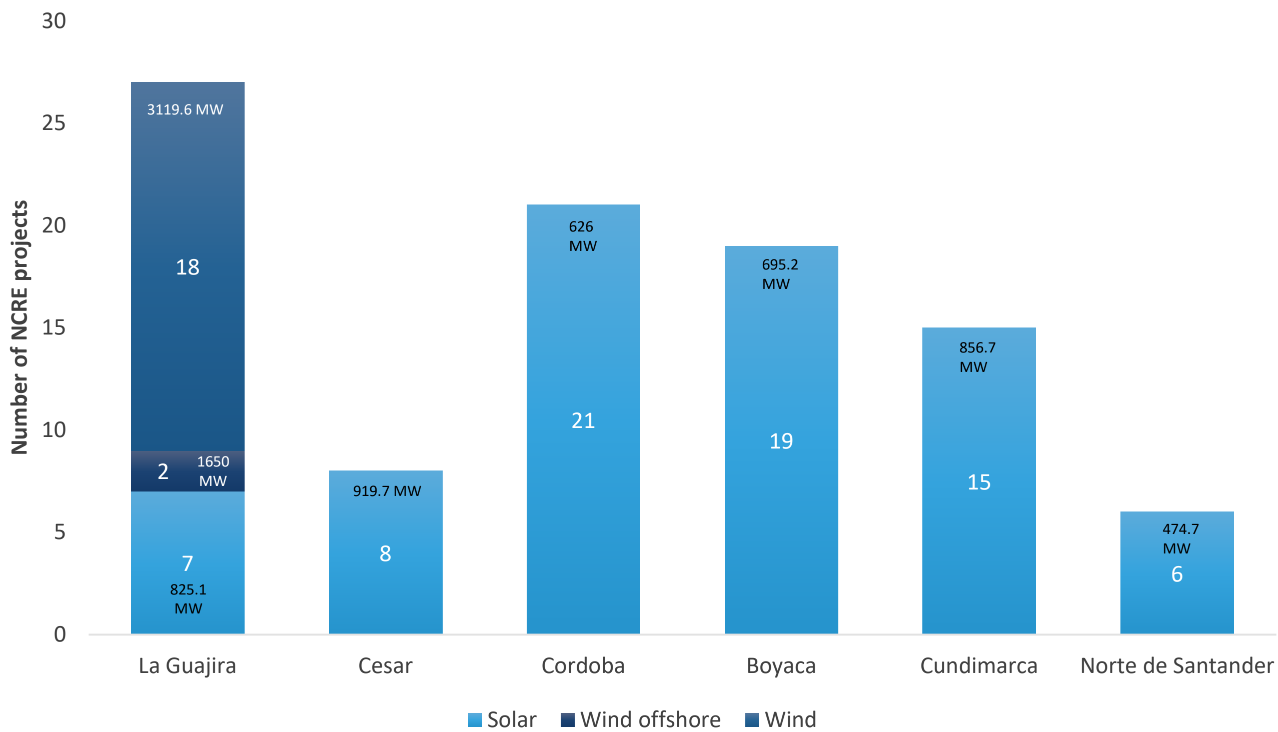
Figure 48a. Number of NCRE projects (Numbers at the top of each bar represent the total number of projects. Numbers inside bars represent the number of projects by phase. Accumulated power is shown in MW).

Figure 48b. Number of NCRE projects in the selected coal mining regions and corresponding power.
Source of data: MME & UPME (2022)

48a.



48b.



1.6.2 Indonesia

Indonesia has both a National Long-Term Development Plan (Rencana Pembangunan Jangka Panjang Nasional 2005-2025 – RPJPN, acronym in Bahasa Indonesia) and a National Medium-Term Development Plan (Rencana Pembangunan Jangka Menengah Nasional 2020-2024 – RPJMN, acronym in Bahasa Indonesia). On the topic of a just energy transition, RPJPN states that energy development must consider several factors including energy resources management, production infrastructure and facilities improvement, human resources quality improvement, technology development, the increased role of the community, and concern for the environment in energy utilisation.

There are no specific targets to address these aspects in this document. Indeed, RPJMN briefly comments on the low carbon development in the energy sector, although there are again no targets stated regarding the transition from a coal-based system to a renewable-based system - including green job targets. Rather, target is more general and describe energy provision for all citizens (100% electrification). The renewable energy targets in this document follow RUEN.

The Ministry of National Development Planning (Kemenetrian Perencanaan Pembangunan Nasional – Bappenas, in Bahasa Indonesia) modelled the needs of Indonesia to reach NZE 2060 as part of a so-called Low Carbon Development Initiative (LCDI), including investment and green jobs. Investment needed by 2060 will reach almost USD2 trillion. Using the NZE scenario in 2050, Bappenas projects that there will be 1.8–2.2 million new jobs in 2030 in the fields of renewable energy, electric vehicle technologies, energy efficiency, land use interventions, and improved waste management (Bappenas, 2021a). In their green recovery roadmap for 2021-2024 (Bappenas, 2021b), there are three pilot projects:

1. Stimulus for waste management improvement
2. Rooftop solar installation
3. Crop productivity improvement

These projects are expected to create more than 300,000 jobs and remove more than 400 Mtonnes of CO_2eq over the next 25 years.

Aside from the aforementioned documents, PLN's RUPTL 2021-2030 mentions not only the efforts to increase renewable energy to reach carbon neutral development, but also the target of retiring 1.1GW of CFPP and 20.9GW of renewable energy by the end of 2030. However, there are still additional 13.8GW of new CFPPs. Moreover, the old CFPPs may be refurbished, retrofitted, or extended, provided they can still be operated economically over the next 10-20 years.

According to IESR (2019), there are some important elements to a just energy transition in Indonesia, namely that of good governance in planning the energy transition pathway, creating conditions for investment in renewables, public consultation and social dialogue, social protection and skill development policies, economic transition, diversification, and the establishment of funding mechanisms to support a just transition.

There are some negative economic impacts to be expected at the beginning of the process, namely the reduction of Gross Regional Domestic Product due to lower contributions from coal industry to the state budget, a trade deficit in the coal sector due to the energy source shift, and unemployment in the coal sector.

However, there will be more benefits in the longer run, with affordable system costs, economic diversification, increased green jobs, improved air, water, and soil quality over time, and reduced health costs. The latter was observed almost immediately after Indonesia began phasing out the first CFPPs (IESR, 2022).

1.6.3 Mozambique

Energy transition in Mozambique aims to increase the use of renewable energy sources, as well as maximising the efficiency of energy use, alongside the broader national policy of providing universal electrification by 2030. Many academic studies have highlighted energy justice as a crucial issue in the debates around Mozambique's energy transition process, positing that reliable and accessible energy use is a precondition for justice, self-determination, and autonomy (see Broto & Baptista, 2020).

In early 2022, it became clear the force majeur on gas projects in Cabo Delgado (such as TotalEnergy) would remain in place, and coincided with the government ruling out any possibility of abandoning coal mining as part of the energy transition. This position was solidified by The Permanent Secretary of MIREME, Teodoro Vales, during a seminar on "The Challenges and Opportunities for Promoting an Inclusive Energy Transition in Mozambique" organised by the Centre for Democracy and Development (CDD). Here, it was reiterated that coal is crucial for Mozambique's balance of payments and that any energy transition should always take into account the "real conditions" in the country. In the case of Mozambique, this includes its developmental and electrification needs for which renewables are the "stand out action" (such as hydropower stations built in Mocuba and Dondo), and "less polluting fossil fuels" such as natural gas (Tena, 2022).

In this context, Mozambique presents a unique case regarding the potential for a Just Transition (JT). On the one hand, there is no official government statement, policy, law, or regulation specifically addressing energy transition, coal phase-out, or coal export substitution. There is no mention of the specific concept of Just Transition, or any commitment to any framework of the concept (i.e. ILO Framework, 2015). JT, and the more general phrase of energy transition, is noticeably absent in the key documents where it would be expected to be found, for example, the NCCAMS (2012) and Mozambique's Update First Nationally Determined Contribution 2020-2025 (Republic of Mozambique, 2021). On the other, the government of Mozambique has made many official statements about energy transition and numerous policy commitments to renewable energy, from which its position on JT can be deduced.

There are five crucial factors that must be considered when contextualising JT in Mozambique, those being that:

- the state is committed to ensuring all citizens have electricity by 2030 (beginning with the ‚Programa Nacional de Energia para Todos' (Energy for All' strategy, 2018) (see AfDB, 2021);
- the state is committed to having 62% renewables in its power share by 2030 (see British High Commission Maputo, 2021);
- the state views extractives (like coal) as the fundamental means by which Mozambique can develop its economy, and create a revenue stream for the government and ruling party FRELIMO;
- the state is committed to coal export, rather than domestic coal consumption
- local communities in Tête are not enthusiastic about the coal-sector in relation to employment or housing needs.

Mozambique does not overly rely on coal domestically, but coal does make up the country's primary export commodity. As such, as the local communities in Tête are not protective regarding the impact of the coal sector on their livelihoods; these conditions present a unique opportunity in which JT can thrive if the following is met:

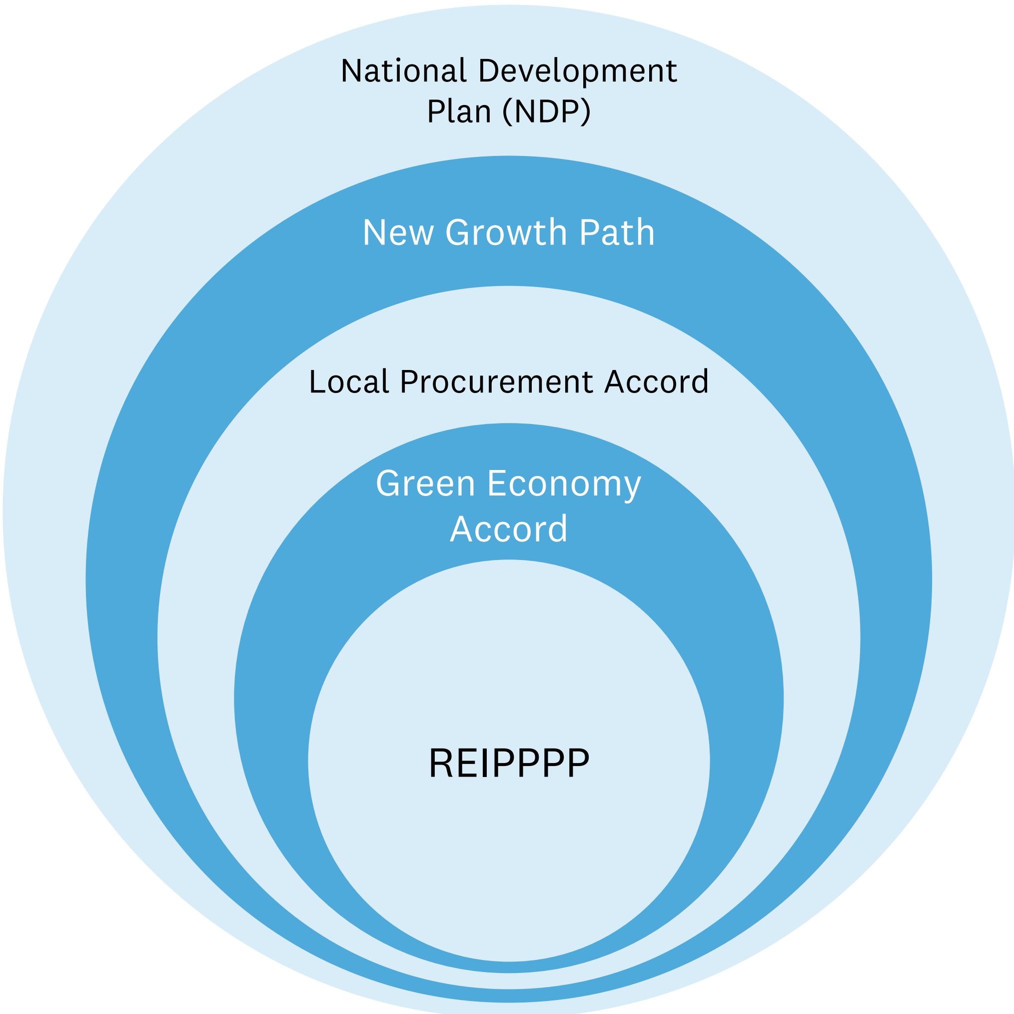
- Grid expansion and electrification programme designed with NCRE and decentralisation from the outset
- Ambitious programmes of exports substitution are implemented
- Local communities are compensated or provided with employment opportunities.

1.6.4 South Africa

South Africa is well endowed with solar and wind power as potential sources of renewable energy (NDP, 2022). The renewable energy Market Intelligence Report (MIR) (Mkhize & Radmore, 2022) under the Mpumalanga Green Cluster Agency highlights the major factors that have influenced the country's energy market attitude to diversifying into the distributed generation model. These include the rising energy prices, supportive energy policies for renewables, the competitive low-cost renewable technologies, and financial support and incentives for renewables – for example, the falling global prices of renewables such as solar PV electricity, with an approximate 84 % drop from 2010 to 2021.

The White paper, 1998 on energy policy is the primary guiding document to develop current and future energy policies, regulations, and plans. The White paper on Renewable Energy (2003) sets a target of 1000GWh for renewable energy contribution, which was approved by NERSA in 2009. Other notable guiding policies and plans are shown in figure 49.

Figure 49. **Guiding policies, plans and regulations for renewable energy development**
Adapted from: Mkhize & Radmore (2022)



The National Development Plan has recognised the need for infrastructure investment by intending to procure at least 20,000MW of renewable electricity through the Integrated Resources Plan (IRP, 2010) by 2030. The revised IRP (2019) provides an added capacity of 29,488MW, and as such, it is expected that at least 24,100MW of ageing CFPPs will be decommissioned between 2030 and 2050. Table 27 provides a list of Eskom decommissioning schedules, compared with the IRP 2019 schedule.

Table 27 **ESKOM decommissioning schedule**
Source of data: Eskom (2019)

STATION	IRP 2019	ESKOM SCHEDULE AS OF 2020 JUNE	UNIT SHUT DOWN AS OF JULY 2020	DECOMMISSIONING PLAN
Camden*	2020	2025	----	----
Hendrina*	2020	2021	1, 3, 8	Nov, 2022
Arnot*	2021	2021	----	Nov, 2022
Komati*	2019	2022	1-8	Nov, 2022
Grootvlei*	2018	2021	4-6	Nov, 2022
Kriel *	2025	2026	----	----
Tutuka*	2035	2035	----	----
Majuba	2046	2046	----	----
Kendal	2038	2039	----	----
Matimba	2037	2038	----	----
Lethabo	2035	2036	----	----
Duvha	2030	2032	----	----
Matla	2029	2030	----	----

***ESKOM oldest power station's decommissioning schedule**

In 2012, the Renewable Energy Independent Power Producers Procurement Programme (REIPPPP) replaced the feed-in tariff scheme through the Bid Windows (Eskom, 2020; Mkhize & Radmore, 2022), becoming operational in November 2013 (IPPO, 2022). REIPPPP is based on the private sector developing renewable energy projects and entering into Power Purchase Agreements (PPAs) with Eskom. The renewable technologies include wind, solar, concentrated solar power (CSP), small hydro, biomass, and landfill gas. By 2019, at least 6,422MW were procured from 112 renewable energy IPP projects and 3,976MW of electricity generation were added to the national grid from 64 projects (see table 28).

Wind is one of the well-developed renewable energy sources, contributing 59,761GWh to the national grid. As of June 2021, wind energy contributed the most energy procured at 3357MW, followed by solar energy at 2292MW for large scale renewables. Most renewable energy projects are based in the Northwest province, with over 59 projects, followed by Eastern Cape with 17 projects as of 2018. This is attributed to the potential for reliable solar and wind energy. Mpumalanga province had only 2 projects for biomass.

Table 28 **Large scale renewable procured, operational and determined**
Modified from: Mkhinze and Radmore (2022)

TECHNOLOGY	PROCURED (MW)	OPERATIONAL	UNIT SHUT DOWN AS OF JULY 2020
(MW)	Determined to date (MW)	2025	----
Wind	3357	2513	11160
Solar PV	2292	2212	8225
Concentrated solar power	600	500	1200
Land fill gas	13	----	----
Small hydro	19	25	540
Biomass	42	----	----
Energy Storage	----	----	513

Eskom established two renewable energy projects: the Sere Wind Farm, with an estimated capacity of 100MW in the Western Cape, and the Upington Concentrated Solar (100MW) in the Northern Cape Province. Through its subsidiary, Cennergi Renewable Energy, the coal company, Exxaro Resources Limited has 2 wind projects: the Tsitsikamma Community Wind Farm (95MW), and Amakhala Emoyeni (134MW) in the Eastern Cape. Exxaro is also in the process of establishing a 70MW Lephalale solar Project to supply the Grootegeluk coal mine complex (Exxaro, 2021)

The Redstone CSP plant is slated to be one of the largest commercial renewable projects in the Northern Cape Province. This plant will be equipped with 12-hour thermal storage systems to provide electricity to about 200,000 households and is scheduled to start operations in 2023. Redstone CSP will offset an estimated 440 tonne per annum of CO2, while also providing value-adding ancillary services to Eskom; they will be the first renewable energy project to offer such services in the country (DBSA, 2022)

It was announced that the Electricity Regulation Act, Schedule 2 would undergo amendments to exempt a generation facility of up 100MW from requiring a power generation licence from the National Energy Regulator NERSA by the DMRE. The amendment is in favour of the national Small Scale Embedded Generation (SSEG) and energy users alike. The Western Cape province holds at least 25% of the national SSEG for rooftop PV (Mkhize & Radmore, 2022).

Aerial view of a river, South Africa **Source: Lina Loos for Unsplash**

2. Challenges and opportunities for the coal regions

In this section, three main areas of challenges and opportunities will be covered. First, the environmental perspective, including standards and regulations, mine closures, mitigation initiatives and the general applicable policy framework is discussed, then the energy transition perspective will be described, in it, areas such as the positive and negative aspects of the financial plans, knowledge gaps, technical aspects and the interactions between stakeholders will be touched upon. For the last point, stakeholder maps were prepared for each country. Finally, a third section will deal with employment issues, among them, work alternatives, reskilling, labour diversification strategies, economic reorientation and the perspectives from different stakeholders on the process as a whole.

CFPP in Indonesia

Source: iStock.com/Abdur.Rohman

2.1 Environmental impacts

In this section, the challenges and opportunities for each country will be discussed. The strengths and weaknesses of the environmental regulatory and policy frameworks are briefly described to then pass to topics such as EIA standards, labour programmes (substitution, reskilling) and mine closure regulations. Monitoring and health management programmes are also mentioned wherever possible.

2.1.1 Colombia

There are multiple environmental policy and regulatory gaps in Colombia regarding the country's coal mines, however, these disparities also bring opportunities to promote a Just Energy Transition, as well as challenges to achieving this. From a governance perspective, for example, a significant in the public sector is the ability (or lack thereof) of the territorial planning institutions (DNP, UPRA, UPME), environmental monitoring and control departments (ANLA and the CARs), and mining regulation/promotional institutions (ANM and MinMin) to coordinate actions towards the coal phase-out and JET from a resource nexus perspective. As these actions must be evidence-based, further research on the opportunity costs between the intersecting components of the nexus is needed.

So far, Colombian energy policy has been formulated on the basis that CO2 capture is suitable as an emission-offset alternative and therefore, extraction may continue indefinitely. This premise is scientifically and technically questionable, and very much warrants reconsideration. Scientific literature has shown that the significant capital cost of new CCS facilities, and the time required for them to lower the net CO2 emissions, would, in general, increase electricity costs and prevent a carbon budget that is consistent with the +1.5ºC target. To that end, a better strategy would be investing in cost-competitive renewable systems (Calverley & Anderson, 2022).

From a nexus perspective, there is a clear political isolation regarding the relationship between water, land use, and energy in Colombia. The regulatory framework to prioritise water use is unclear (CEPAL, 2017) although general statements by the institutions on the hierarchy of uses is present. Land use prioritisation is also unclear, which is especially true in the operation of large-scale projects such as coal mining and NCRE. As a result, territorial and socio-ecological conflicts have deepened, particularly in those coal mining regions inhabited by indigenous and/or Afro-colombian communities. According to several sources, these communities' fundamental rights to food, water, security, and health have been violated by actors in the coal value chain, as well as by renewable energy companies, and even by the public institutions responsible for their protection (ABColombia, 2022; CINEP, 2016; INDEPAZ, 2021a; Semana, 2020; SOMO, 2021).

An adequate prioritisation framework is needed; one that is founded upon updated biophysical and social studies from a resource nexus perspective, and that considers trade-offs at the local and regional scales across different scenarios. These studies should be used to elaborate decisions on land use in the short, medium, and long term.

In terms of opportunities, a renewed political will from the current national Government has been identified. The new Government Plan emphasises the need for a JET in the context of coal phase-out. The harmonisation of land-use instruments (POTs, POMCAs, PIDARETs, etc.) and the multipurpose cadastre[24] have the potential to aid in this task, and to indicate socially and ecologically appropriate future land uses.

Another challenge is the lack of a legal definition for environmental liabilities, which, if applied to the coal value chain, has the potential to start a conversation on post-closure liability regimes and mechanisms. Moreover, regulations for the management of long-term or perpetual environmental impacts are also missing, which in turn, hinders the creation of standards and protocols for the rehabilitation processes to be incorporated in land use planning. This also means that the rehabilitation terms of reference and success indicators should be designed and evaluated according to future land use expectations.

The implementation of a resource nexus approach from a preventive perspective in the context of coal mining requires the update of EIA terms of reference and standards. In addition, environmental due diligence has the potential to improve risk identification from the potential operators, investors, buyers, and other stakeholders in the value chain. It would also account for the current and potential effects of mining activities, and establish prevention and mitigation actions (Sydow, J. et al., 2021).

The quality of closure plans is another significant challenge to address. The general appendix contains assessments of some of the closure plans for La Guajira and Cesar. This assessment shows that most of the closure plans reviewed describe the basics of physical, chemical, and ecological stability, but have no detailed provisions, nor show sound and robust strategies to respond to each of those needs. It is observed that cost estimations and financial provisions are either poorly or not considered in most of them, while none refer to the effects of climate change on their effectiveness (e.g., an increase in precipitation can affect water quantity and quality in mi-

[24] The cadastre must be updated through a participatory process in accordance with the recommendations of the Truth Commission (Comisión de la Verdad, 2022).

ning pits and compromise the stability of rock dumps due to increased erosion rates; an increase in temperature could in turn increase the likelihood of spontaneous coal combustion). In addition, cultural stability, referring to the maintenance of livelihoods and the persistence of the relationship between communities and territories (e.g., continuation of cultural practices, existence of sacred sites, etc.), has been generally overlooked or misrepresented.

Closure plans must clearly identify the environmental risks after coal extraction, and incorporate programmes and activities aimed to prevent, remediate, mitigate and/or compensate the negative impacts of coal mining projects up to the post-closure stage. They must contain clear provisions for post-mining physical, chemical, ecological, and cultural stability, security measures for leftover infrastructure, and socioeconomic post-closure alternatives. Closure plans should always include a reasonable time frame for their implementation, and the associated costs should be properly described (Geological Survey of Finland, 2020; Morales & Hantke Domas, 2020).

From a biophysical perspective, coal mine operators must be required to implement the best available technologies (BAT) and carry out reasonable predictions of future impacts, considering the potential effects of climate change in the remnant infrastructure, its vicinity, and communities. This is especially important when dealing with water quality impacts and treatment costs (Maest et al., 2005).

The CGR identified that ANLA has not been effective in monitoring the environmental management plans by coal mining companies, as well as the environmental offsets (CGR, 2021; CGR, 2022). This is particularly true when it comes to the oversight of mine closure plans and post-closure activities. There are serious gaps in technical skills from the institutions at the environmental licensing stage, which is the first instance where unacceptable damages can be identified and thus, avoided. A contract between ANLA (the environmental licences authority) and a public university shows that the first does not count with professionals in areas such as geochemistry, ecology, hydrology and others to carry out environmental assessments of large-scale mining projects (ANLA & UNAL Sede Medellín, 2019).

The biggest coal mining companies in Colombia have adopted the standard 'Towards Sustainable Mining (TSM)' which is a performance system developed by the Mining Association of Canada (MAC) and is based on three pillars and nine protocols. The assessment process is made annually by mining companies, and by an external evaluator every three years (ACM, 2022a). These tools may play a supplementary role in helping performance but should not replace applicable legal provisions.

On the other hand, guaranteeing environmental monitoring and control in coal mining regions requires a permanent network of devices to provide high time and spatial resolution data. To foster transparency, this information should be available to any person in real time. These challenges were identified for both water quality and quantity, and air quality information, and have not been addressed by any current transparency initiatives in place.

Although IDEAM has an extensive water quantity monitoring network, data collection and interpretation still pose challenges to be faced. The lack of technical independent support to communities, with user-friendly platforms to understand and visualise data, is yet another hurdle to be resolved. This is also an issue when it comes to water quality. Datasets received from the ministries and agencies in the context of this research show that, in general, there are not enough monitoring sites, the longitude of the data series is insufficient, and that sampling frequency is inadequate. These three factors make it impossible to estimate the true impact of mining activities in many cases.

The current water and air quality monitoring systems may be strengthened by adding participatory community-based monitoring. Danielsen et al. (2009) identified five types of local monitoring schemes. Collaborative monitoring with local data interpretation, and schemes externally driven by local data collection are frameworks that have been implemented in developing countries, and which could also be applied in coal mining regions. Colombia has clear guidelines for participatory community-based monitoring (IDEAM et al., 2018) that are mainly applied for the National Forest Monitoring Systems, but the general methodology could also be applied to water/air quality monitoring in coal mining regions. From a financial perspective, international cooperation is key in promoting these initiatives.

Air pollution and water quality have significant implications for human health in coal mining regions. Therefore, investment in infrastructure such as hospitals and drinking water treatment facilities is required in those areas of influence where coal is extracted. These investments must entail financial provisions for as long as the impacts persist. The monitoring of health programmes is yet another challenge, as they must be carried out periodically and provide statistical data to identify prevalent health issues.

Securing and democratising electricity access (energy security) poses a significant challenge for the communities in the coal mining regions, however, there remains an opportunity for the use of renewable energies at the local level, and the current regulatory framework for distributed generation (UNEP, 2022). Indeed, there are multiple opportunities to support the creation of decentralised energy communities as an alternative to ensure electricity access. An example of these cooperations is the case of Medellín, Colombia, with the Community Solar Energy project by the EIA University (Universidad EIA, 2020).

Another opportunity that is particularly relevant to the Caribbean region, is the advocation of large-scale and communitary PV projects for both local consumption and to be added to the National Interconnected System. To deliver on this potential, however, requires starting pilot projects and tackling the knowledge gaps on solar technologies in communities (including economic benefits, technical operation, and maintenance), this alternative should be further enhanced by building capacities and advocacy campaigns. In this sense, academia could have a significant contribution, in alliance with municipalities and cooperations with international institutions.

2.1.2 Indonesia

UU no. 32/2009 is the fundamental law on environmental protection and management. It creates the obligation for every regional, provincial, and the central government to have environmental protection and management plans (Rencana Perlindungan dan Pengelolaan Lingkungan Hidup – RPPLH, in Bahasa Indonesia).

The stated objectives are: to know the capacity of an area to absorb impacts derived from an economic activity; to maintain and protect the environmental quality; to control, monitor, utilise and preserve natural resources; and to adapt and mitigate climate change impacts. The central and local governments are also obliged to create a Strategic Environmental Studies document (Kajian Lingkungan Hidup Strategis – KLHS, Acronym in Bahasa Indonesia) to ensure that the principles of sustainable development are integrated in development projects, policies, plans, and programmes. It also establishes the Environmental Impact Assessment (EIA) as a mandatory document for sectors that have the potential to pollute. To obtain the business permit, the EIA and environmental permit (or so called Izin Lingkungan, in Bahasa Indonesia) are indispensable. Companies which do not follow all environmental standards might get administrative sanctions and/or criminal sanctions. It is important to mention that this law was amended by UU no. 11/2020 about job creation.

Job creation law under UU no. 11/2020 is now the main reference of the EIA in Indonesia. According to Kemenko Ekonomi (2020), the process from making to submitting an EIA is now less complex and business permits will be immediately revoked if the environmental permit of a company is revoked. Another relevant piece of legislation is PP no. 22/2021, which is derived from UU no. 11/2020. It specifically deals with the Implementation of Environmental Protection and Management. EIA standards mentioned in those two regulations are the core to get an environmental licence.

Economic activities expected to entail large environmental impacts must count with an EIA document named Analisis Dampak Lingkungan (AMDAL). If the impact is not expected to be so severe, another document, the Upaya Pengelolaan Lingkungan dan Upaya Pemantauan Lingkungan (UKL-UPL), applies. The criteria to determine the scale of the impacts is available in UU no. 11/2020. Coal industry, specifically coal mining, is categorised as entailing large environmental impacts. Four main aspects that must be included in the AMDAL of coal industry are geophysical-geochemical analyses; public health and social-economic-cultural issues and impacts to the biotic component.

According to MEMR regulation no. 26/2018, a mining permit can be frozen for a maximum of 60 days or revoked if it violates the standards of technical mining, coal and mineral conservation, workers' health and safety, environmental management during operations, reclamations, etc.

This decision will be taken after the auditors from the local authorities and/or MEMR do a periodical evaluation. The coal companies must report the implementation of mining business activities at least once every 6 weeks. However, there is a huge hole in this regulation regarding parameters affecting the mining closure due to the revoked permit and the obligation to prepare workers who lose their jobs. Moreover, the most important issue in terms of the evaluation method is that environmental impacts are only evaluated in the mining area and not in the vicinity. Many coal mines in East Kalimantan, for instance, disturb the water system affecting downstream water quality (e.g., Hernandi et al., 2019). Coal transportation is also not integrated in the document as part of a larger process. Most of the extracted coal in East Kalimantan is transported via Mahakam River, not only lowering water quality, but also threatening one of the most important habitats of the Irrawadi dolphin (Orcaella Brevirostris), an endangered species also living in that river (Anggraini, 2022; Indonesia's government, 2019).

Reclamation activities are regulated in UU no. 3/2020, including all planning until evaluation processes. Unfortunately, this regulation was revoked by UU no. 11/2020. The latter regulation was made with the objective of creating jobs and increasing foreign and domestic investments by reducing the complexity of regulatory requirements for business licences and land acquisition in all sectors. Due to a broad scope of this law, there are many details that are not mentioned and yet more gaps in some activities. For instance, no detailed information on the requirement of coal companies to remediate the areas as one of the post-mining activities, only for its definition, causing a regulatory gap in mine closure that persists to this day. Thus, derivative laws and other supporting regulations must be established to fill this gap.

PP no. 96/2021 mentions that the mining business license (Izin Usaha Pertambangan – IUP, in Bahasa Indonesia) is only valid for exploration and exploitation processes, which are 7 years and 20 years respectively for coal mining operations. For coal mining integrated with development and utilisation activities in the coal downstream scheme IUP can last for 30 years. Regarding the post-mining activities, PP no. 96/2021 states that coal companies must prepare or secure a guaranteed budget for funding any post-mining activities, including reclamation. Without securing this budget, the permit can be revoked by the government.

Reclamation must be done until the success rate is 100% (land management, revegetation, and finalisation with the criteria listed in. According to MEMR's Decree 77/2022 (Keputusan Menteri ESDM 77.K/MB.01/MEM.B/2022), all mining activities, including reclamation, are monitored, and evaluated by experts and stakeholders periodically, yet no exact monitoring frequency stated.

Table 29 **Successful criteria of mining reclamation**

RECLAMATION ACTIVITY	SUB-ACTIVITY	PARAMETER	SUCCESS CRITERIA
Land management	Surface setting	Landfill stability	No landslide
	Backfilling of ex-mining land	Landfill stability	No landslide
	Material management for acid mine drainage	Acid mine drainage material	Effluent quality meets water quality standard
	Erosion control facilities	Drainage	No erosion and active sediment in the managed land
		Erosion control building	No erosion
		Sediment deposition pond	Water quality meets the standard
Revegetation and civil works	Top soil management	Cover crops	Improved land quality
	Root zone spread	Area	• Good (more than 75% of mining area); • Moderate (50-75% of mining area)
		Soil pH	• Good (5 to 6); • Moderate (4.5 to less than 5)
	Plantation	Plant type	• Good (80% as planned); • Moderate (60-80% as planned)
		Plant growth	• Good (growth rate more than 80%); • Moderate (growth rate 60-80%)
		Tree crown coverage	More than 80%
	Maintenance	Fertilization	As per dose
		Weed control	Based on the company's analysis
		Re-planting	Based on the number of dead plants during reclamation

Although there is clear evidence on the environmental impacts from coal mining activities, there is no decision from the government to reduce its intensity yet optimise the resources. For optimising the domestic use of coal, the sustainability of coal industry, national income and optimising the reserves, MEMR announced the coal downstream scheme, namely coal gasification, coke making, underground coal gasification, coal liquefaction, coal quality improvement, briquette manufacturing, and coal slurry or coal water mixture (ESDM, 2020b).

The nearest plans for achieving this are upgrading coal quality and gasification. MEMR targets the addition of 3 coal upgrading facilities in 2024, 2026, and 2028 with the capacity of 1.5 million tons per year for each facility. The gasification process will be carried out by PT Bukit Asam and PT KPC as an effort to substitute Liquified Petroleum Gas (LPG) through Dimethyl Ether (DME) with two plants for each mentioned company that will operate in 2024. Moreover, coal briquette factory and coke making facilities are planned to be completed in 2026 and 2028. The capacity of the first mentioned factory is 20Kton/year, while the later mentioned facility is 1Mton/year.

One of the hurdles of this plan is lack of funding. Due to the increased global interest in climate change, renewable energy projects and sustainable development, coal-related projects are not preferred as an investment. To continue showing the inconveniences of coal-related projects is a clear opportunity to foster divestment and the Indonesian example is a successful antecedent. However, the total investment for fossil fuels, including coal, is still higher than for renewable energy (IESR, 2022a). Many incentives will be given to support the coal downstream in the form of fiscal and non-fiscal incentives. Non-fiscal incentives will facilitate the extension of business licenses more than 20 years depending on the mining reserves whereas royalty exemptions are also a major concern still. Fiscal incentives will be in the form of royalty exemptions for coal used as downstream raw material. It is believed that the zero percent royalty will not reduce state revenue because coal downstream will be able to open more jobs and increase the regional income. These incentives are designed to avoid losing state revenue as they will also come with jobs creation and more dynamic regional economies.

Unfortunately, this plan has many gaps and still needs thorough analyses before its implementation (Syahni, 2020). To name just three of them: a) Current costs associated to the Least Cost of Electricity (LCOE) of gasification power plants, are still 3-6 times higher than conventional ones. b) The increased number of stranded assets from coal mining, which will need more investment and/or budget allocation to do the reclamation and employment transition in the future and c) The issue of the payback period of this plan is still a factor. Gasification power plants, for instance, can have a payback period longer than 20 years.

LTS-LCCR document from MoEF clearly mentions the mitigation actions to reduce carbon Green

House Gases from CFPP. However, MoEF regulation no. P.15/MENLHK/SETJEN/KUM.1/4/2019 lists only 4 parameters that must be monitored for CFPP, which are sulphur dioxide, nitrogen oxide, particulate matter, and mercury (Table 30). Carbon dioxide, carbon monoxide, and temperature are not listed. Periodicity of this monitoring is defined as 3 months and there are also gaps on the water pollution standards mentioned in MoEF regulation no. 8/2009.

Table 30 **Air pollution standards for CFPP**
Source of data: MoEF regulation no. P.15/MENLHK/SETJEN/KUM.1/4/2019

PARAMETER	MAXIMUM VALUE (mg/Nm^3)	
	CFPP operated before the regulation is established	CFPP operated after the regulation is established
Sulphur dioxide (SO_2)	550	200
Nitrogen Oxide (NOx)	550	200
Particulate matter	100	50
Mercury	0.03	0.03

2.1.3 Mozambique

In Mozambique, environmental issues are broadly underpinned by the National Environmental Policy (Resolution 5/95 of December 6, 1995), which considers sustainable development as a "realistic compromise between the country's socioeconomic development and environmental protection". On the other hand, the Fifth Report on Biological Diversity (MITADER, 2014) identified how the unplanned expansion of the extractive industry had led to unsustainable patterns of resource consumption that pose a threat to the biodiversity of the country.

The various environmental laws and regulations related to mining in Mozambique are set out in the Table 31.

Table 31 Most relevant laws related to environmental management and the mining sector in Mozambique

NAME AND LAW/REGULATION NUMBER	TOPIC
The Environmental Law (Law No. 20/97, of 1 October 1997)	• framework for sustainable development • preventing environmental damage • promotes environmental management • prescribes pollutants) (see Appendix 2.2)
Land Law (Law 19/97 of 1 October 1997)	• General principles apply on environmental obligations and rights holders
Regulamento Ambiental para a Activida-de Mineira [Basic Rules and Directives for Environmental Management] - 20 De Agosto De 2004	• Provides regulation of environmental management across the state (see Appendix 2.2)
Directiva Geral para a Elaboração de Estudos do Impacto Ambiental [General Guidelines for how to make Environmental Impact Assessments] - Ministerial Diploma (Nr. 129/2006)	• protect biodiversity/ecosystems • to value local communities • "Polluter pays" principle • prioritise prevention of environmental degradation
Mining Law (20/2014)	• ensure the competitiveness and transparency • protect the rights and define the obligations of the mining holder • safeguard the national interest

The Mining Law (2014) did impose more stringent environmental requirements than were previously in place, but this is relative. The environmental compliance requirements were changed from the environmental impact of each project (as was the case under the 2002 Mining Law (Art 69), to imposing different requirements based on the type of mining title held (see Shearman & Sterling LLP, 2014). However, some reviews have been highly critical of the legal system that governs mining and the environment. MineHutte, a firm that that focuses on risk analysis in the mining sector, posited that "the law contains numerous conceptual and drafting weaknesses" which indicates that legislation was passed "at the height of a commodity boom".

Due to these errors "a host of supplementary regulation have ultimately been found necessary to paper over the cracks left by a poorly conceived governing text" (see MineHutte, 2022). Similarly, Chisompola (2019) has noted how the legislation "effectively overrules local land rights through what is essentially a 'national interest' approach". Although fair indemnification is promised to the holders of pre-existing rights, the state has precedence.

The Ministry of Land, Environment and Rural Development (MITADER – formerly the Ministry for Coordination of Environmental Affairs, or MICOA) was installed in 1995 as Mozambique's environmental regulator, which subsequently increased the focus on environmental licensing and the issuance of the Right to Use and Benefit of Land (DUAT). As of 2020, however, MITADER's functions have been taken by the Ministry of Land and Environment (MTA), as stated in the Presidential

Decree No. 1/2020. The MTA has authority over environmental legislation and policy, and coordinates with other ministries on environmental matters. The MTA also approves environmental impact assessments, and ensures compliance with international environmental protocols (i.e. climate commitments such as the Kyoto Protocol, or the Clean Development Mechanism applications). Notably, it appears that MTA is not required to report to the TA directly as part of its auditing of the extractives sector. However, two of its important units, the National Directorate for the Environment and the Inspectorate for Land, Environment and Rural Development, through which environmental policies are drawn up and their control is ensured, are audited by the TA; this may overcome any potential gaps in public accounting.

Several sets of mining data, including geological and geochemical data, are available for private entities to consult with the DNGM and INAMI regarding investments in the mining sector, but are not public, which again limits the capacity for the public accounting of the environmental aspects of the extractives sector (see Viana, Daniel, Fialho, 2022).

In regard to the environmental provisions within this legal system, the general position is that all mining titleholders must undertake mining activities in accordance with the applicable legislation/regulations and best environmental (including social and cultural) practices. These principles are articulated under the Mining Law (2014), Article 68 (Principles) that stipulates that mining activities are carried out according to:

a. Laws and regulations on the use and enjoyment of mineral resources, as well as environmental protection and preservation rules, including socio-economic and cultural aspects.
b. Good mining practices in order to ensure the preservation of biodiversity, minimise waste and the loss of mineral resources, and protection against adverse effects to the environment
c. Technical safety rules in accordance with specific regulations

Nearly all key principles in the legislation have been left undefined. For example, the Preambulatory clause to „safeguard the national interest", what „environmental norms" are considered to be in the context of Mozambique (Article 64), or who determines what constitutes „good mining practices" (Article 68), are broad and vague.

Under Mining Law (2014), issues pertaining to the environment may be grounds to revoke a mining licence. Specifically, Article 64(a) stipulates that a violation of environmental norms, or, as in Article 64(d), a mining activity resulting in serious environmental damage, constitute grounds for revocation. However, the basis to raise these concerns is not specified. For example, the government holds responsibility for the community under Article 32 (for organising community engagement), but the statute does not outline the revocation mechanisms that the community could initiate, or how they could do so. Exactly who is responsible for or can make claims in the case of environmental damage, and who has the authority to validate this, is undetermined under law.

Article 36(j) outlines the obligations emanating from the EIA; it emphasises the need for community involvement, although under legislation, this regulation is murky at best. Article 70(2) of the Mining Law (2014) stipulates that all mining categories must ensure that "communities must be heard throughout the process of implementation of the environmental management tool until the closure of the mine". What constitutes being "heard" is not defined and community participation in the decision-making process has been lax.

To specifically advise on protected areas and land use, the Land Law (Law No. 19/97 of 1 October 1997) differentiates between fully protected areas and partially protected areas. While no rights may be awarded over fully or partially protected areas, special licences can be obtained for specific and limited activities (see Viana, Daniel, Fialho, 2022). Fully protected areas are those reserved for nature conservation and state military activities. Partially protected areas, including those on sea and within 100 metres of the coastline, may affect coal ports, although no disputes over protection have been either recorded or made by civil society or community groups.

In terms of coal mining concessions, the EIA must be approved by the MTA and MIREME. An environmental licence is valid for the period of the corresponding concession, but it is subject to review every five years, and its issuance is subject to certain conditions. In addition, the Environmental Regulations for Mining Activities encourages stakeholders to enter a memorandum of understanding for a five-year period on the methods and procedures to outline the management of environmental, social, economic, and cultural matters during operation and decommissioning.

Finally, an environmental management report that details the results of environmental monitoring must be submitted to the MTA each year (Viana, Daniel, Fialho, 2019). The EIA process has been regulated by the Decree of 26/2004 and updated via Decree No. 54/2015 (see the appendixes). Prior to submitting the EIA, the applicant must undergo an environmental pre-viability assessment that defines the scope of the EIA in regard to what environmental components are likely to be affected. As such, the biophysical and socio-economic information of the area, and a thorough description of activities is crucial to this process (for a discussion, see APIEX Mozambique, 2022).

SIPA has criticised the time in which the document is open for comments on EIAs – a mere timeframe of 45 days (SIPA, 2013:14). Considering they are highly technical documents, and the asymmetries in capacity between stakeholders are often stark, it is a valid critique of the process. Environmental laws and mining laws should be designed as a coherent partnership, so that all environmental and social concerns are properly addressed in extractive projects.

The Mining Law (2014), Mining Regulations, and the Environmental Regulations for Mineral Activities provide for a range of liabilities and protections. Mining operators are required to submit a Decommissioning Plan (Mine closure Plan) and to provide financial guarantees to cover decommissioning costs (Article 71).

The timeframe for such a guarantee to be provided, and on what grounds would it be payable, are covered in the implementing regulations. They do remain somewhat vague, however, specifying that the mining titleholder is liable for any loss or damage that results from its mining operations caused to property, land, or persons; for damage caused to the environment, and for loss or damage to affected families under resettlement processes.

The Mining Law (2014) also imposes significantly more stringent obligations on any operators that may require resettlements within an area affected by mining operations, including with respect to the compensation payable to those affected by resettlements (see Arts 29-32). In practice, however, these compensations have been difficult for the communities to access. If any damage occurs, the concessionaires have the obligation to indemnify the affected stakeholders and are responsible for restoring the site where mining operations were undertaken (see Article 41, Article 44(o)(p), Mining Law, 2014). Whilst MIREME can mediate cases and take them to court, these are extremely costly and therefore inaccessible for communities, let alone individual families.

The Mining Law Article defines a Mine Closure Programme as “decommissioning a mine and the rehabilitation and monitoring the environmental and of adjoining areas affected by mining activity” Mine rights holders are obligated under Article 71(1) to not close or abandon a mine without the prior execution of a rehabilitation and Mine Closure Plan that has been approved by the competent authority, and potential payment of the bond. However, wider aspects of mine closure, such as redeploying and retraining the workforce, or the long-term effects on community, are not specified in the legislation. It should be noted that decommissioning is now also emphasised under Article 35 of the NEL (2022), showing a more concerted focus on this area by the government. Comparable to the Mining Law, it specifies that prior to the start date of commercial operation, the concessionaire must open an interest-bearing account in a bank located in Mozambique (the “Decommissioning Fund”) based on a calculation accepted by the regulator ARENE.

The amount of the bond is based on an estimate of the costs of the restoration (calculated during, or after the active life of the project) and the terms of the EIA. The amount is set by MIREME and is reviewed every two years. If the mining companies in Tête are beholden under limited liabilities, the shareholders are not liable for actions or omissions of the corporation. If any of these mines go bankrupt, limited liability reduces the claims possible to be brought on them. If the corporation ceases when the mine ceases extraction, the only way forward is if the bond covers adequate reclamation and/or rehabilitation.

Worryingly, it was found that five coal Mining Concessions had not yet presented closure plans, while seventeen had not confirmed their respective financial guarantees. The TA stated that “It is therefore urgent for the regulatory authority to ensure compliance by concessionaires…”. A table made by the Administrative Tribunal in 2021 with the status of closure plans is provided in the Appendix (TA, 2021: V-35).

The TA also identified specific coal companies that were problematic in terms of their environmental record. As recently as 2019, the Administrative Court highlighted the importance of paying special attention to JSPL (Mozambique Mineral, Ltda) and ICVL (Benga Coal Mine), both of which, “on a recurring basis, are classified as having a negative performance in terms of environmental management”.

INAMI has also provided evidence to the TA that 90 mining holders across the country operated without an environmental licence, with an expired licence, or without information – and in Tête, there were 5 coal operations without environmental licences (see TA, 2021: V.21). INAMI revoked the licence of the company Midwest, in response to its failure to provide the required Report on Activities Developed and late submissions of Annual Activity Reports for 2014, 2017 and 2019.

2.1.4 South Africa

Prior to 1991, South Africa lacked the appropriate mining policies and regulations for rehabilitation and mine closure, although commercial mining has existed since the 1870s (Swart, 2003). During this period, mines were required to adhere to the concept of “safe making” for surface mining and submit a basic rehabilitation plan. The Mineral and Petroleum Resources Development Act (MPRDA 28 of 2002) and the National Environmental Management Act (NEMA Act no. 107 of 1998) are key guiding regulations to govern mine closure and rehabilitation. The appendixes to this report provide an outline of the policy and regulations for mine closure in South Africa. In the amended NEMA act No. 25 (2014), One Environmental System (OES) was established, alongside the repeal of all mining environmental management provisions by the MPRD. Prior to the OES, the application process for the mining rights apparently entailed garnering multiple environmental approvals from various departments, some of which called for duplicate or conflicting requirements.

The challenge with the OES is that the Department of Mineral Resources and Energy (DMRE) is the authority tasked with issuing environmental authorisations for prospecting and mining operations, a task that would be more appropriate for the Department of Forestry, Fisheries and Environment (DFFE) in collaboration with the Department of Water and Sanitation (DWS). The DFFE and DWS must work within limited timeframes to conduct the Environmental Impact Assessments, which is further exacerbated by the limited capacity. Even so, the DMRE has the final say as to who should be awarded the mining rights, demonstrating a system lacking in transparency. The new system has been criticised by environmental activists and community groups alike in regard to the DMRE not taking environmental obligations seriously (CER, 2018; CSIS & CIF, 2021; Humby, 2015).

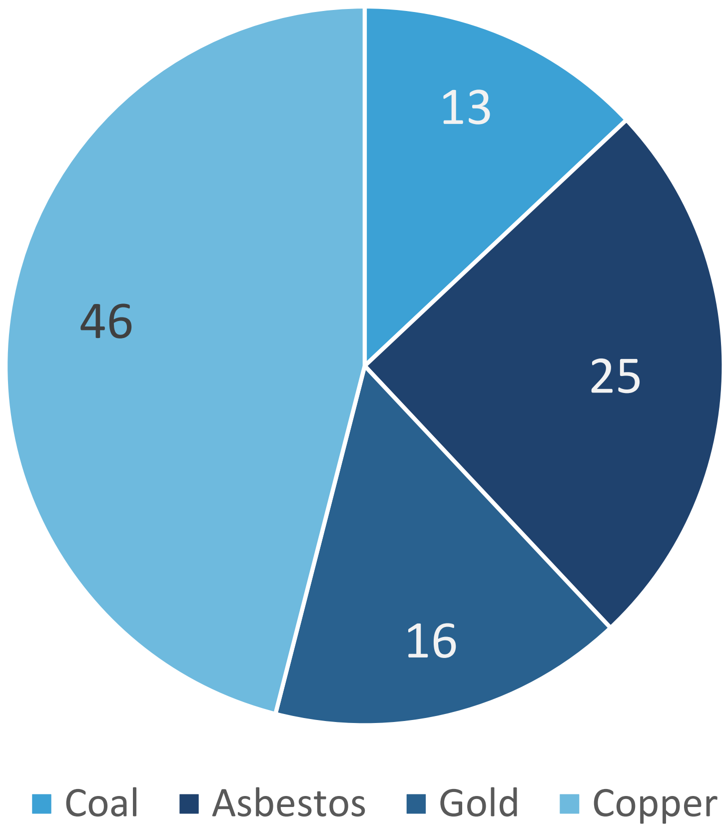
The requirements for the mining license include conducting and submitting the Environmental Impact Assessment (EIA) to also encompass social and labour plans (SLP), and an Environmental Management Programme (EMPR). The EMPR requires the mining company to provide three closure plans, namely: a. an annual rehabilitation plan, b. a decommissioning plan, and c. a closure plan. However, in most cases, the enforcement and implementation of these legislations are still difficult because of the limited capacity of the relevant authorities. The EIAs in South Africa are well designed with clear environmental requirements, but a lack of a well-coordinated and transparent implementation process hinders the regulation and enforcement of compliance with defaulting mining companies. Additionally, mining companies hire consultants to design very lengthy EIAs, often containing limited environmental assessments and stakeholder engagements.

The Land Rehabilitation guidelines for surface mines in South Africa (Coaltech & Minerals Council of South Africa, 2018) hint at the occasional lack of technical experience with the EIA practitioners that can hinder their ability to recommend the most suitable mitigation measures. This is also exacerbated by the regulators' lack of willingness or capacity to compare the mine performance against EMP requirements. Some authors have also criticised the lack of coherence between the policy and regulatory frameworks, governments' inconsistency to regulate effectively, and a lack of coordination and cooperation. All these factors contribute to the generally ineffective regulatory framework of mine closure and rehabilitation in South Africa (CER, 2019; Feris & Kotze, 2015; Mpanza et al., 2021; Strambo et al., 2019). The WWF briefing paper (Perkins et al., 2020) highlighted the ambiguity as to what constitutes a "sustainable end state" as defined in the amended Financial Provisioning Regulations to the NEMA Act 107 of 1998. The brief advocates for the need for absolute clarity pertaining to end-state responsibility and liabilities, including a transformative mine closure and rehabilitation.

South Africa is still grappling with over 6100 abandoned mines, of which 2568 are classified as high risk (Auditor General 2021). Acid mine drainage (AMD) is one of the major environmental problems associated with the so-called derelict and ownerless mines (D&O), that is, mines that are categorised as being not operational, that are not being maintained to manage their safety, and whose holders, as defined in the Act, have abandoned the mine, and cannot be traced. The challenge with AMD is the continuous release and seepage of acidic water, for which it may be difficult to estimate treatment costs. For example, on the 14th of February, 2022, a high volume of water burst from the south shaft of the old Kromdraai coal mine, which was closed in 1966. This mine caused the loss of aquatic life in many rivers in Mpumalanga (Daily Maverick, 2022).

The responsibility of rehabilitating abandoned mines lies with the government, with the total rehabilitation cost being estimated at R47 billion – of which an estimate of about R120 million is allocated annually (Auditor General, 2021; Mhlongo & Amponsah-Dacosta, 2016). Thus, there has been very little progress made to rehabilitate mines since the enactment of the MRPDA in 2002. This is partially attributed to inadequate and delayed funds from the National Treasury (Auditor General 2021). The mines are found to be near communities, further creating a public health and safety issue. The abandoned coal mines classified as high risk are estimated at 25%, as provided in the Figure 50.

Figure 50. **High risk abandoned mines by target material**
Source of data: Auditor General, 2021



The cumulative impacts of environmental pollution, in particular Acid Mine Drainage, spurred various policies and regulations to be put in place to monitor the operating mines, subsequently leading to the closure of many mines (Matsumoto, 2016). In 2021, the draft National Mine Closure Strategy was released under the MPRDA with the aim of preventing adverse long-term environmental and socio-economic impacts at a broader integrated scale. The strategic plan intends to align the regional closure plans with the individual mine closure plans to minimise the environmental impacts of closing a mine on the rest of the region. The challenge faced by the Plan is that it may not necessarily deter those mining companies that may close on claims of bankruptcy to avoid the full cost of rehabilitation.

The MRPDA provides for temporary closure or care and maintenance for mines that are experiencing financial difficulty but are likely to resume operations should circumstances change. Moreover, the legislation on corporate distress designates a company ‘insolvent’ if it is not able to pay its debts within 6 months – making it eligible to close during that period (Humby, 2015; Mpanza et al., 2021b). As a result, companies can use liquidation to avoid the full cost of mine rehabilitation. This trend is set to increase as mining companies attempt to avoid the liabilities associated with mine closure. Furthermore, it is argued that in the liquidation process, funds are never allocated to environmental degradation (Durand et al., 2009). The DMRE strategic plan 2020-2025 implies that a significant number of mines are still under care and maintenance and require further investigation before decommissioning; it is clear that a framework to deal with these mines is very necessary (DMRE,2020).

Large mining companies are passed down to junior companies when mines are close to their end-of-life, with the knowledge that they cannot afford the historical rehabilitation cost required after mine closure (CER, 2019; Human Rights Watch, 2022). These mines are then abandoned and present an opportunity for illegal miners (commonly referred to as zama-zamas[25]) to step in - hence causing health and safety issues for the communities. The invasion of ownerless mines by artisanal and small-scale miners contributes to the already-existing challenges of successful mine closure and rehabilitation. As such artisanal mining activities, including zama-zamas’ are illegal, accidents and death rates are higher than what is normally reported (Human Rights Watch, 2022).

The monitoring of the environmental and socioeconomic impacts of mining activities has been compromised due to a lack of systemic coordination in South Africa. Mining activists strongly put forward that the mining sector has political protection, which makes monitoring and enforcement a complicated process (CER, 2018; Human Rights Watch, 2022; Munnik, 2010). The mining companies -including coal- often do not provide detailed information about the cost of rehabilitation (CER, 2019; Human Rights Watch, 2022). Moreover, there is no correlation between the financial information for annual rehabilitation provided by mining companies, and that of DMRE.

On the other hand, mining companies argue against the long and laborious legislative process to acquire a Water Use License (WUL). The delays in WUL are partially due to the need to determine the water reserve for that specific water resource, which forms the first step in the licensing process. This has led to some mining companies commencing operations as they await the outcome of the WUL, creating a potential pollution problem prior to the provision of a WUL. Although some mines are closed temporarily after establishing mining operations without the WUL, inevitably the environmental damage has already been done.

[25] *zama zamas* is an isiZulu term meaning “to try and try again”.

The Centre for Environmental Rights (CER) analysed the adherence of water use licensing processes of 8 coal mining operations in 2019. Out of the mandatory number that the audit report required for the analysis (being 8), 5 were not present as the Department of Water and Sanitation (DWS) had not received them (CER, 2019). Based on their analysis, the DWS is facing a complete institutional and regulatory breakdown. The report also highlights that the WUL does not make financial provisions for water treatment and the impacts of which the government and public must bear the full risk, such as the case of the Olifants catchment. The Forever Mines report (Human Rights Watch, 2022) indicated that even though 103 mines -including coal- were operating without the required water use licenses as of July 2014, only 6 cases saw enforcement actions, with no criminal prosecution taking place.

The Department of Minerals and Energy (DMR) established the Rehabilitation Oversight Committee (ROC) in 2009 with aim of implementing the D&O mines rehabilitation programme. The ROC consists of the departments and 2 currently implementing agencies (the Council for Mineral Technology, or Mintek; and The Council for Geoscience, or CGS). The rehabilitation cost of abandoned mines exceeds the annual budget of the government (CSIS & CIF, 2021). Mintek was allocated a contract worth R570 million from 2016-2019; CGS received one for about R171 million to implement the rehabilitation of abandoned mines. The project scope included the D&O mine database management and maintenance with specialist studies on environmental, geochemical, geohydrological, hydrological, geotechnical, phytoremediation, dust, and air quality, among others.

The National Audit (Auditor General, 2021) carried out a detailed audit and provided insights on the rehabilitation of D&O mines. One of the measures that was identified as being inadequate was a formal detailed site-specific monitoring programme. A lack of accountability and inefficient service delivery, leadership, and oversight -and therefore delays in the progress of planned projects- were pointed out. For example, DMRE's five-year strategic plan for 2020-25 did not include the rehabilitation of D&O mines, nor did it mention performance measures and targets for other high-risk mines (Auditor General, 2021).

With over 53% of South Africa's coal being extracted via surface mining, from opencast or open pit mines, rehabilitation is difficult due to the high amount of topsoil and rock required for backfilling. The core components of land rehabilitation are outlined in the Land Rehabilitation Guidelines (Coaltech & Minerals Council of South Africa, 2018), including surface landform design and profiling, soil stripping, stockpiling and replacement, soil amelioration, revegetation, and surface infrastructure. When an open pit mine is built, the compacted topsoil usually loses its nutrients due to leaching, contamination, or physical alteration over time. This creates the challenge to revegetate the area with plant species that can tolerate the acidic and/or saline conditions of coal mining sites. In most cases, the costs associated with backfill prevent its complete undertaking, resulting in a permanent alteration in topography (CER, 2018).

Some companies have made efforts in terms of land rehabilitation and land capability, with trials for maize and soy farming using the crop rotation method in the areas disturbed by coal mining – the results of which have been promising (AngloAmerican, 2016). These initiatives increase yield through soil improvement and the reduction of pests. However, carrying out tests for potential nutrient deficiencies in the crops is still needed.

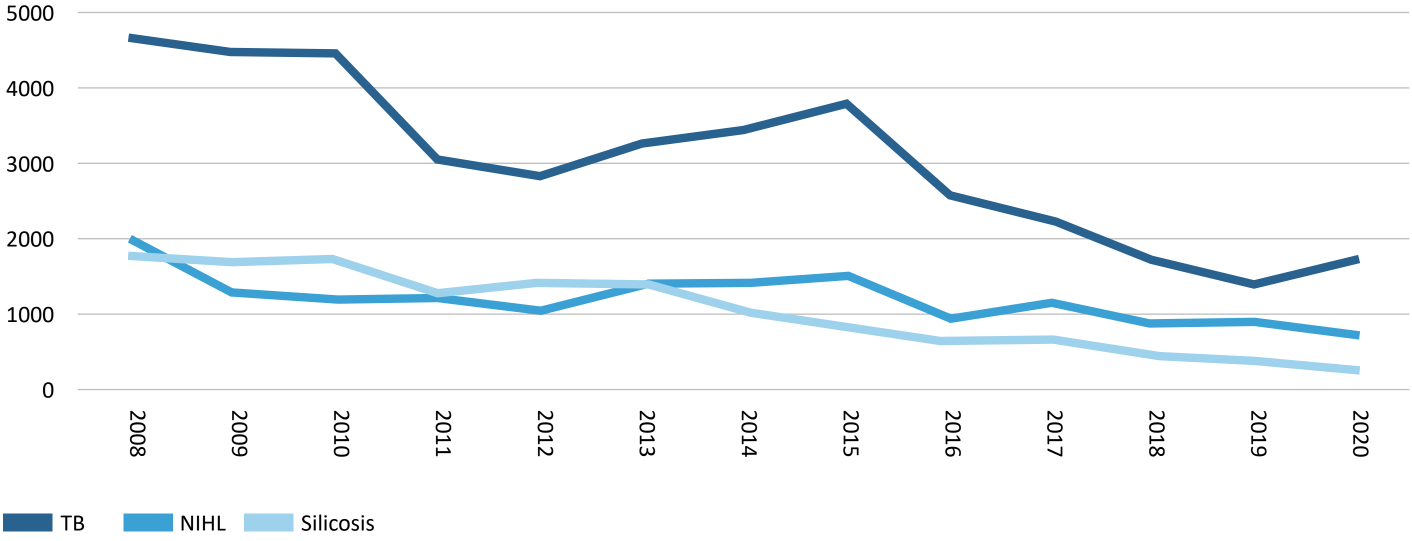
Anglo coal and BHP Billiton Energy coal (now owned by South32) created a joint initiative with the eMalahleni municipality to recover potable water from acid mine discharge through the operation of the eMalahleni Water Reclamation Plant (EWRP). The water is received from the Greenside colliery, Kleinkopje colliery, South Witbank colliery and the Navigation colliery. The recovery of potable water is enabled using High Recovery Precipitation Reverse Osmosis (HIPRO) (Anglo American, 2010; Broadhurst, J. et al., 2019), resulting in the EWRP doubling its capacity to 50 million litres/day. This has enabled additional thermal coal operations to use potable water from their facility and reduce stress on the already strained Upper Olifants river. The eMahleleni municipality and Upper Olifants catchment also benefits from the portable water. Similarly, Sasol mining, in collaboration with Mpumalanga Economic Development Department (Goveni Mbeki), is undertaking a project to utilise coal fly ash to make bricks as a way of minimising waste. Discards and slurry being recycled into saleable coal product is standard practise for many mining companies already .

South Africa's Mine Health & Safety Act, No. 29 of 1996 (MH&SA) provides legislative guidelines for occupational health and safety for mining companies. The primary occupational health concerns associated with coal mining in South Africa are dust-induced occupational lung diseases, noise-induced hearing loss (NIHL), and tuberculosis (TB) (Hermanus, 2007; Minerals Council, 2022). A co-benefit study on decarbonising the energy sector projected that for all coal energy generation scenarios, the health cost continued to rise in a range of R13 billion (lower estimate) to R45 billion (upper estimate) in 2022 alone (IASS et al 2019). The government departments are responsible for monitoring and enforcing compliance with health and safety measures, as well as carrying out audits and inspections to reinforce compliance with the regulations. Daily dust suppression is a requirement for mine operations, with reports being submitted to the Department of Mineral Resources.

The mining industry has made significant progress in reducing health-related incidences. The Minerals Council provided an estimated decrease of 36% between 2019 and 2020 in the reported occupational diseases. The total number of TB cases was 1,726 in 2020. Figure 51 shows a general decline for all the three occupational health-related diseases between 2008 and 2020.

[26] https://www.news24.com/News24/from-waste-to-bricks-20161022

Figure 51. **Occupational diseases in the mining sector**
Adapted from Minerals Council (2022)



Occupational programmes within the mining sector are designed to prevent and mitigate associated health risks. One of the most common diseases is pulmonary tuberculosis (TB), as it is the leading cause of death for people living with the human immunodeficiency virus (HIV) (Coal Mining Matters, 2019). The coal mining sector initiative includes HIV wellness programmes to provide testing, counselling, and treatment, while specialist early warning programmes have been introduced to effectively manage NIHL.

The Minerals Council highlights two health programmes, the first of which is the Masoyise health programme, a multistakeholder initiative aiming to protect the health and wellness of employees, with a specific focus on reducing the incidences of TB, HIV, occupational lung diseases, and non-communicable diseases. The second programme, the Khumbul'ekhaya health and safety initiative, aims to reduce health and safety fatalities in the mining industry (Minerals Council, 2022).

Harvesting Rice, Indonesia

Source: iStock.com/ti-ja

CFPP in Medupi, South Africa

Source: iStock.com/fivepointsix

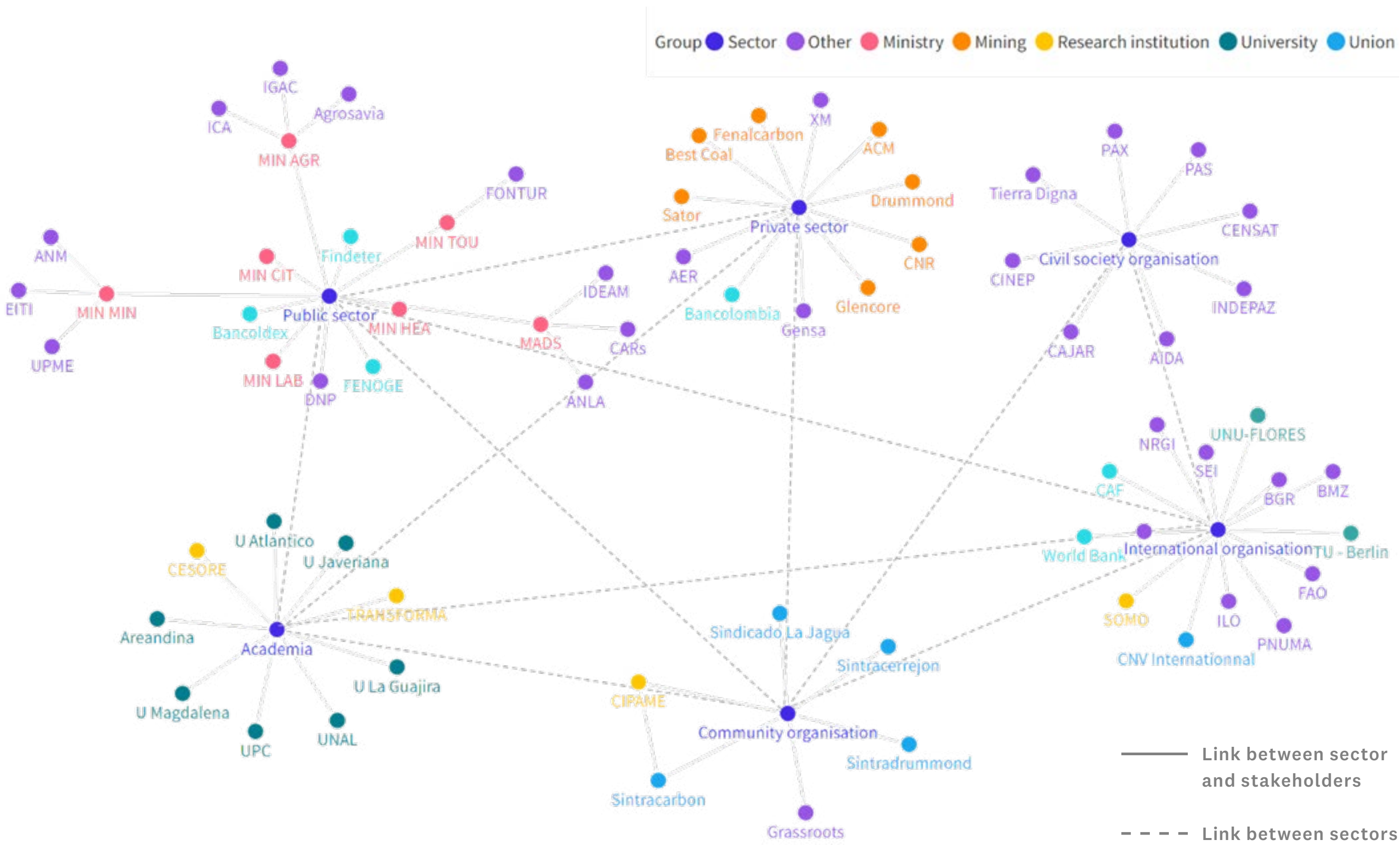
2.2 Energy Transition

This section includes information pertaining to the financial plans, institutions, and instruments for the JET, as well as knowledge gaps (shortcomings, neglected factors, etc.). It also presents stakeholder maps for the countries, in which the relationships between actors are outlined. It is important to note, however, that the map does not identify the type of relationship; rather, this aspect and others are discussed in the accompanying texts.

2.2.1 Colombia

During the development of this research, 65 meetings and interviews were carried out with diverse stakeholders related to the coal value chain and energy transition in Colombia. Figure 52 shows the main stakeholders related to CPO and JET.

Figure 52. **Stakeholder map of the coal value chain in Colombia**



First, it is important to note that the present stakeholder map is based on the results of the bibliographic research and documentation, as well as on the interviews held by the researchers in the context of this project in 2021 and 2022. Therefore, any changes that might have come with the new Government (as of August 2022) have not been reflected.

During the interview process, the Research Team identified the public sector to be much closer to the private sector and some international organisations, than to academia and community organisations. In particular, their relationship with grassroots communities was weak, and historically has triggered social conflicts in Colombia's coal mining regions. The public sector must ensure that mechanisms of human rights protection are installed for communities in the coal regions. Colombia is one of the world's leading countries in terms of violence against environmental leaders (Global Witness, 2022; INDEPAZ, 2021b). Additionally, there are serious deficiencies in the implementation of prior consultation, not only on coal mining projects, but also on NCRE projects (Orduz, 2020; Strambo & Puertas, 2017). In addition, some researchers have denounced links between coal mining companies and illegal armed groups in the Cesar Department (SOMO, 2021).

Grassroots, civil society organisations, and some international organisations maintain close links with each other. However, the latter two have mainly focused on human rights violations related to socio-ecological issues, and there is still a lack of scientific support to help community organisations in legal processes.

The academic sector has significant technical capacities for rehabilitation processes in coal mining regions (Barliza et al., 2019; Domínguez-Haydar et al., 2018, 2019, 2022; Muegue et al., 2017), as well as knowledge on socio-environmental liabilities, offsets, and conflicts (Cardoso, 2015, 2018). Therefore, there is significant potential for collaborations between universities and research institutions to carry out research projects on the rehabilitation of mine sites. Academia, both nationally and internationally, has become a key stakeholder in the labour reconversion process by describing the challenges faced by, and even by providing training to, coal workers[27] (Santamaría et al., 2022; Yanguas et al., 2021).

During the interview process, the Team identified risk aversion from private financial institutions to the investment in NCRE projects. This aversion is based on two elements, namely distrust of the operational feasibility of new technologies (hydrogen production and offshore wind farms), and land use issues - given the high uncertainty of their final implementation. In that sense, another challenge relates to fortifying the credibility of government institutions to ensure profitability, and a swift and fair resolution of conflicts.

[27] University of Magdalena is organizing a training course called Just Mining-Energy Transition in the Colombian Caribbean (Translation by authors) for coal workers (UniMagdalena, 2022).

As of now, the financial sector is not investing in coal mine expansion or coal power plants. However, the Congress of the Republic recently approved Law 2177 (Congreso de la República, 2021a), which regulates the access of the mining sector to the financial sector. This law establishes that state-owned banks, like Findeter and Bancoldex, should provide financing to circular, green mining projects, or any other project that meets the Sustainable Development Goals. In this regard, the financial sector should guide its policies not only by considering the possible reductions in CO2eq emissions, but also by considering the socio-ecological effects of the projects that are financed. This implies a more holistic perspective as to what the energy transition entails.

One of the most pressing challenges for Colombia is the provision of financial resources for the energy transition. Currently, the financial sector has focused its investment on NCRE projects, with a portfolio of financial services prioritising preferential rates and sometimes, technical support (Bancoldex, 2022; Bancolombia, 2022). To accelerate the energy transition, Bancoldex has a line credit, which includes a loan of approximately USD45 million from the Interamerican Development Bank (IADB), as well as co-financing for USD3.5 million, and non-reimbursable financing for USD1.5 million from the Clean Technology Fund (CTF)[28] (IADB, 2021). This fund is a financial intermediary fund of the Climate Investment Fund (CIF), although it is, of course, still insufficient for the reconversion of the electricity matrix, which is calculated at USD532.000 million (Bloomberg Línea, 2022).

The reorientation of coal royalties to NCRE and JET could provide extra resources, as along with using the new tax reform bill that has been accepted by the Congress of the Republic (Portafolio, 2022). The increase of coal extraction and the changes in trade during 2022 due to the war in Ukraine will bring an increase in the quantity of royalties (DANE, 2022), which could be allocated to economic reorientation and labour reconversion in coal mining regions.

The accepted tax reform bill considers the fiscal aspects that have direct implications for coal companies and includes the elimination of royalty deductibility from income taxes incurred by mining companies, a tax on coal exports in the event international prices overtake reference prices (windfall taxes), and a carbon tax for the thermal coal used to generate electricity in the country (MinHacienda, 2022). Coal mining companies showed a strong resistance to this reform, stating that higher taxes could affect future investments in the country, which could translate into job losses (ACM, 2022b). Some companies even participated and supported protests in both the coal regions and in Bogota (Semana, 2022; Wradio, 2022). Considering the current high coal prices (UPME, 2022), windfall taxes could make significant contributions to JET financing.

One of the most cumbersome hurdles, however, is the lack of transparency regarding royalties managed by public institutions. Recently, Congresswoman Esmeralda Hernandez (Pacto Histórico)

[28] Currently, the CTF has a fund balance of USD 2960.20 million which the United Kingdom is the highest contributor (The World Bank, 2022)

presented irregularities in 1,200 contracts that were financed by the SGR, which represents a loss of $3.8 billion COP. As a result, a reform proposal of the SGR is underway (el Espectador, 2022c).

From the financial perspective in the context of the coal phase-out, the new government has proposed "to obtain offsets for leaving coal and oil reserves in the ground" (Pacto Histórico, 2022). This is an opportunity with the potential to be explored, in which governments from the Global North could contribute to the JET in the Global South through international climate funds like the CIF or individual support by other states.

Recently, the first Regional Agreement on Access to Information, Public Participation and Justice in Environmental Matters in Latin America and the Caribbean, known as the Escazú Agreement (CEPAL, 2022), was ratified and signed by the President of Colombia (Minister of Foreign Affairs, 2022). The Escazú Agreement is an accomplishment in the fight for the access rights and guarantees for environmental defenders, however, its implementation is a huge challenge to be overcome (el Espectador, 2022d).

The relinquishment of Glencore mining concessions in Cesar[29] poses a significant barrier to Colombia's JET. The relinquishment was based on economic grounds (low coal prices, high operational costs, and the denial of environmental permits) (El Espectador, 2022a). This process is far from being a positive event from the CPO perspective; indeed, it is worrisome, because it arises from an unplanned closure, for which the relinquishment was approved without the presence of an applicable responsibility framework, or full understanding of the consequences. The relinquishment resulted in considerable uncertainties concerning the environmental and social obligations (reclamation, resettlements, post-closure job alternatives) that still persist.

Both ANM and ANLA (under the new government) are currently assessing the status of Glencore's obligations. During the Public Hearing carried out in La Jagua de Ibirico (Alcaldía de La Jagua de Ibirico, 2022), ANLA identified that Glencore had achieved 61% and 47% of its environmental obligations in the Calenturitas and La Jagua mines, respectively. It also considered the modification of the biotic component of the Environmental Offset Manual to be an opportunity[30] (Resolution 256 of 2018).

The major of La Jagua de Ibirico -the municipality located in the vicinity of the coal mining concessions in question- mentioned that around 85% of their budget depended on royalties. As a result, the municipality downgraded its category[31] from third to fifth, becoming less eligible to re-

[29] These concessions were offered in the most recent mining concessions auction (ANM, 2022). However, they were not acquired by any company and the process was suspended by the Administrative Court of Cundinamarca (el Espectador, 2022b).

[30] Currently, the mining companies decide where to apply the offset, and somethings the decision do not include the local communities affected by the coal mining activities.

[31] Municipalities in Colombia are classified into seven categories: special, first, second, third, fourth, fifth, and sixth. The DNP each year distributed the national economic resources to municipalities according to its categorization (DNP, 2015).

ceive resources from the National level. In addition, he mentioned that unemployment rate is now around 25%, despite rates of 8 – 10% during the pandemic (Mutante, 2022). Therefore, Glencore's relinquishment is also an opportunity to implement an emergency JET pilot in La Jagua de Ibirico

For the specific conditions of this municipality, the JET plan will require an environmental assessment (an analysis of the rehabilitation process needs and a technical evaluation of soil and water conditions, as well as a land use assessment). In addition, the socio-economic situation will require the development of new employment opportunities.

Although coal is a significant economic resource in coal mining regions, its benefits do not necessarily mean that local communities experience a better quality of life. Between 2016 and 2020, coal extraction represented an average of 1% of the country's GDP and 16% of Colombia's total exports (MME, 2021). In terms of regional GDP, it amounts to 35% and 38% for La Guajira and Cesar, respectively (NGRI, 2021). Despite this, La Guajira ranks fifth in the proportion of Unsatisfied Basic Needs (UBI) at 53.33% (DANE, 2018). Other Departments in which coal is mined, like Cordoba and Cesar, show UBIs of 35.08% and 23.04%, respectively. In regard to the Multidimensional Poverty Index (MPI), La Guajira scored 48.7% in 2021(DANE, 2021), ranking fourth among the country's 32 Departments. Therefore, the new government must rise to the challenge of ensuring that coal's economic benefits are reflected in decreased inequalities for local communities.

The adequate use of the economic resources facilitated by coal poses a substantial barrier, considering the corruption present in local governments, and a lack of knowledge of local needs. Figure 53 shows deficient housing and infrastructure (central square) that are not suitable for efficient use and enjoyment in the Boqueron and Becerril municipalities (Cesar). The latter project was the subject of an official corruption investigation (CGR, 2020). This square is rarely used, as its design did not consider the environmental conditions of the region and the social needs of the population (el Pilón, 2020).

Figure 53. **House in Boqueron (left) and Central square in Becerril (right) 2022**
(Taken by Ma. Elena Huertas)

The Afro-Colombian and indigenous communities who have experienced resettling processes have also suffered the implications of these actions to their cultural heritage and world views. For example, a 2013 resettlement highlighted the struggles of the *los mayores* (elderly or wise people of the Wayuu communities in la Guajira), who suffer from sleep and mood disorders when they are displaced from the cemeteries of their ancestors - a vital aspect of the Wayuu cosmogony. In addition, new houses that are built with materials and designs ignorant of indigenous traditions, represented a loss of customs and cultural identity (CINEP, 2016). Resettlements could be avoided in the event of an adequate plan for long-term land use being developed, along with the inclusion of communities in the decision-making process, to take their traditions and livelihoods into account. If resettlements are still required, it is important that the State embody the role as guarantor of equity conditions in the negotiations between communities and mining companies.

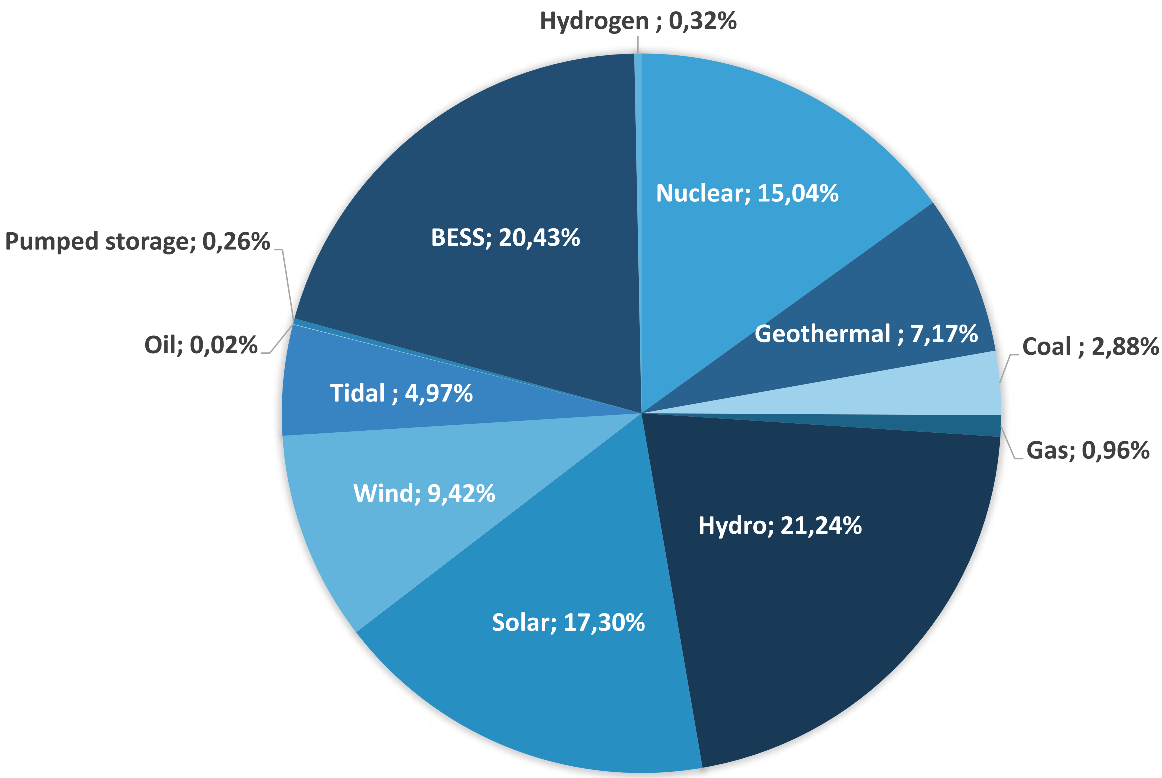
A final challenge pertains to the design and operation of the PNCTE. This programme should consider the asymmetric relationships between CO2 sequestration and CO2 absorption reflecting the non-linearity of the Earth system (Zickfeld et al., 2021). Gilbertson (2021) has demonstrated that the communities that actively protect the Colombian forests which are located outside of the coal mining regions have seen their traditional practices and livelihoods put at risk. On the other hand, it has been demonstrated that net emissions reductions could not be achieved because of the "waterbed effect"[32] (EIA, 2020).

2.2.2 Indonesia

Indonesia needs USD1.13 trillion to reach net zero emission in 2060, which equals to USD29 billion/year, with the highest portion for hydropower development as detailed in Figure 54 (Setiawan, 2021). The stated budget needed is not only for technology development but also for other supporting factors, such as employment and infrastructure. In the context of recovering from the pandemic by developing more sustainable energy, CASE Indonesia (2022) lists five important sectors, namely energy including electricity, transportation, building and energy efficiency, natural capital, and research and development. Yet, there are two main concerns from the MoF regarding financial plans for energy transition: a) Costs for coal retirement and other fossil fuel utilisation discontinuation and b) Front capital expenditure for renewable energy. Therefore, a detailed plan on the financial aspect is crucial to reach the net zero emissions target, because it is not only about creating policies to welcome more renewable energy in the system, but also about policies addressing risks and tariffs. Indonesia's public fund is not enough to complete this and thus international support is needed.

[32] The "waterbed effect" is the phenomenon where emissions reductions induced by companion policies take place under an emissions trading system cap. This can reduce allowance demand and, in turn, allowance price." (EIA, 2020)

Figure 54. Percentages of total investment needed to reach net zero emissions
Source: Setiawan (2021)



According to IESR (2021), Indonesia spent IDR102.65 trillion for climate change mitigation activities annually in 2018-2020, which equals to only 4.3% of the public fund. Moreover, there were no improvements on the budget allocated for renewable energy development in 2021, which is only USD1.17 billion, while the allocation for coal is USD2.49 billion. (IESR, 2022a) also marks a small improvement on renewable energy investment, which is only USD1.51 billion in 2021. MEMR targets to have renewable energy investment for about USD8 billion per year to reach renewable energy share of 23% in 2025. Such condition indicates a warning on the investment insufficiency to reach targets in 2025 and 2060.

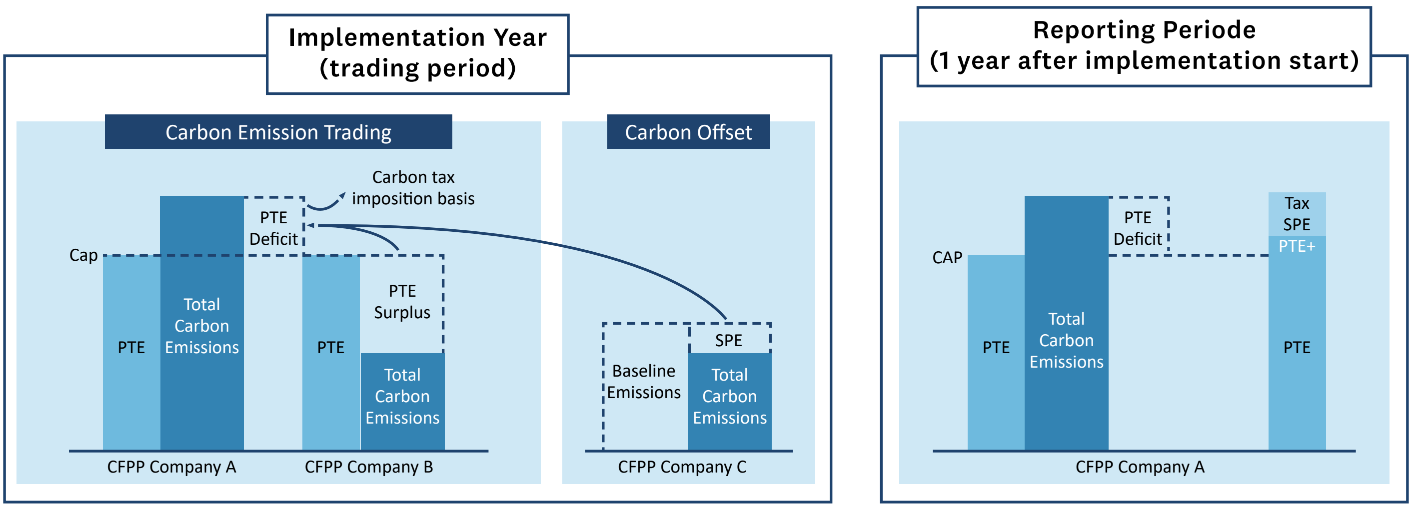
Cui et al. (2022) study the investment needed to implement a just coal phase-out in Indonesia (Table 32). In the beginning of such just transition, the cost needed is USD4,58 billion for stranded assets, decommissioning, employment transition, and losses from coal industry revenue. However, there are some indirect benefits that will be produced, namely from avoided coal subsidies and avoided health costs, which is USD10,73 billion, more than twice of the costs.

Table 32 **Coal Phase-out Cost Estimation**
Source of data: Cui et al. (2022)

METRIC (MILLION USD)	2022-2030	2031-2040	2041-2050
COSTS			
Stranded Asset	3,233	9,628	6,740
Decommissioning Cost	533	1,259	729
Employment Transition (CFPP & Mining)	272	1,041	1,161
State Coal Revenue Losses	542	1,363	1,012
Benefits			
Avoided Coal Subsidies	4,442	15,998	14,396
Avoided Health Costs	6,292	28,121	26,843

There are several financial instruments that are planned to be implemented to reach just energy transition in Indonesia mentioned in IESR (2022). First is carbon "cap, trade and tax" scheme (Figure 55), that has been delayed for a long time due to several concerns in economic and regulatory aspects although it will indeed accelerate the energy transition. Furthermore, there are 92 CFPP required to implement a carbon tax scheme in 2022, with the value of only IDR30,000 per tCO2eq (USD2, approximately) due to energy affordability considerations.

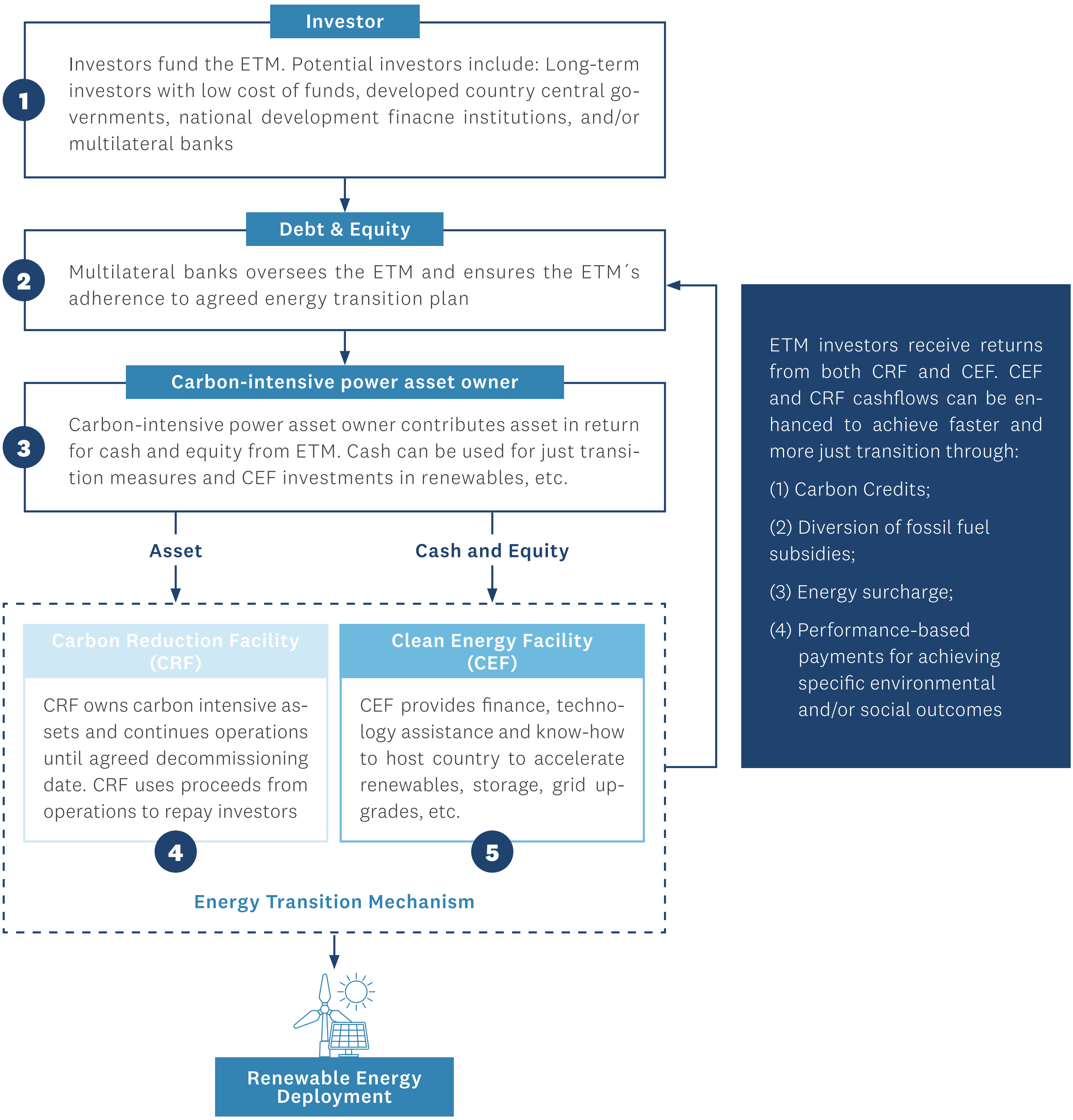
Figure 55. **Planned carbon "cap, trade and tax" scheme**
Adapted from: IESR (2022a)



The second financial instrument is the Energy Transition Mechanism (ETM) from the Asian Development Bank (ADB) that is also mentioned in IESR (2022) with the implementation detailed in Figure 56. There are two schemes in ETM, which are Carbon Reduction Facility (CRF) for CFPP early retirement and the Clean Energy Facility (CEF) for developing renewable energy. ETM plans are expected to fund the early retirement of 1.77GW CFPPs in Indonesia. An ETM Country Platform, whose Steering Committee consists of the ministries and the country platform manager, is developed in 2022 to define and accommodate requirements for ETM implementation leading to the acceleration of the energy transition. This board tasks are to provide directions, to establish targets, and to approve grants related to financing instruments at the project level. PT SMI is chosen to manage the blended finance, including public and non-public budgets and providing financial de-risking instruments according to Minister of Finance Decision (KMK) No.275/2022.

Bali, Indonesia **Source: Jeremy Bishop for Unsplash**

Figure 56. **Energy Transition Mechanism implementation**
Adapted from: IESR (2022)



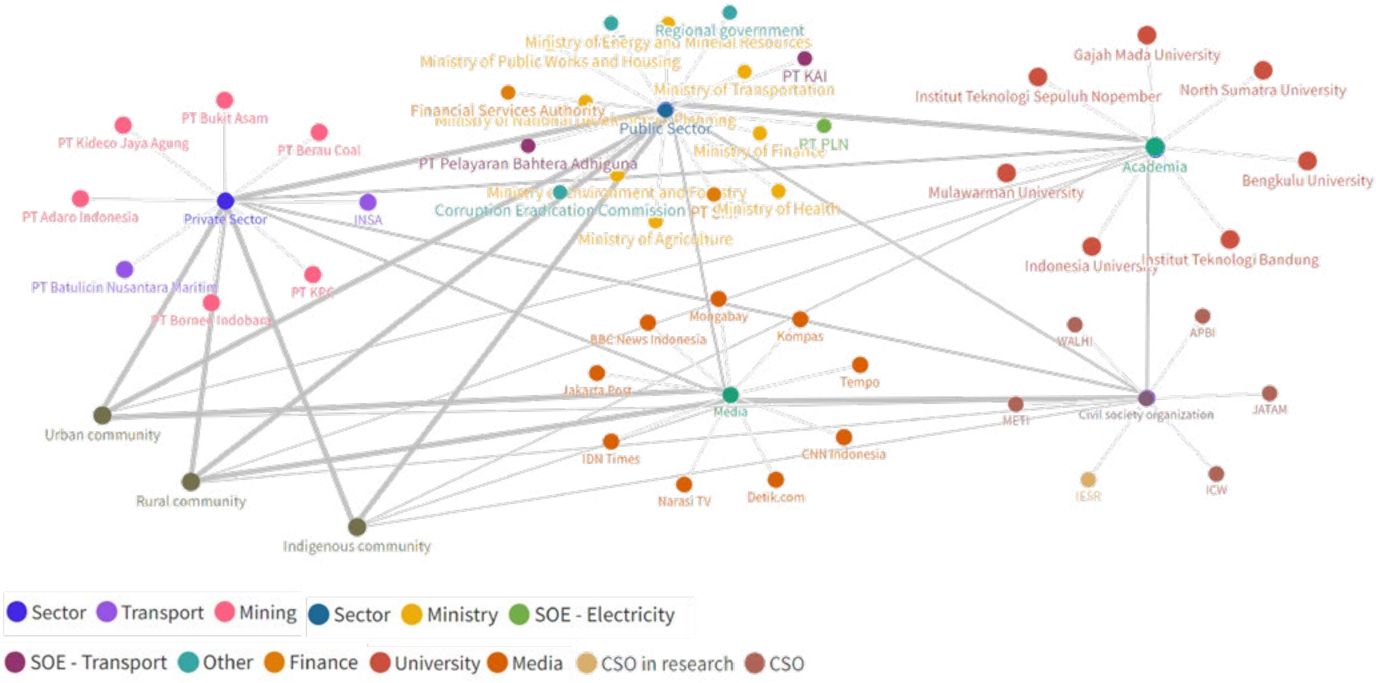
Indonesia's energy sector is controlled by State-own-enterprises (SOEs), including PT Pertamina for oil and gas and PT PLN for electricity. The role of SOEs in Indonesia is strong and many policy-makers depend on the SOEs' decisions, regulations, and plans (Ordonez et al., 2021). For instance, electricity plans in Indonesia must follow the RUPTL, if it is connected to the national grid. This centralized governance of energy affects the limited regulatory transparency due to lack of public participation in the policy making process. ADB (2020) notes that this type of governance also affects the project preference.

Another challenge is that many renewable energy projects cost more than the power purchase cap price causing difficulties for stakeholders in winning renewable energy tenders. ADB (2020) also mentions the issues on a high-risk renewable energy project in Indonesia due to the regulation instability and uncertainties, local content regulation, and complex procurement processes. The frequency of RUPTL establishment, which is almost every year, impacts on the frequent changes in the electricity plan and thus reduce the hesitancy of stakeholders to start developing low-carbon electricity systems intensively. The local content regulation, 40% for solar power project for instance, increases the investment needed in renewable energy projects since local products are often more expensive than the imported ones.

The lack of coordination between ministries is also a challenge. Nasir et al. (2022) study the complex governance in the coal mining sector of Indonesia. They highlight the lack of coordination between regional, provincial, to national levels generating inefficiencies and complexities in the way the permits for changing land use are granted. Several articles also mention this coordination gap in other sectors. For instance, Waskitho et al. (2021) study this topic for the water resource management case and (Yudha et al., 2022) for the development of geothermal energy capture projects. Addressing the JET needs a better coordination between government bodies. Especially at the national level between MEMR, MoEF, Ministry of Agriculture, Ministry of Public Works and Housing, and others as illustrated in Figure 57.

Coal Train **Source: iStock.com/traveler1116**

Figure 57. **Stakeholder map of the coal value chain in Indonesia**



In the coal industry, challenges to move into renewable energy-based systems also appear. Ordonez et al. (2021) listed four main challenges: a) the creation of domestic coal demand, b) public revenue from coal, c) private profits, and d) regional development. DMO regulation and coal downstream plans will impact the constant dependence on coal and even increased coal demand soon. There is a certain royalty from coal as stated in UU no. 1/2022. For example, for the coal that is extracted 12 miles from the coast, 16% of royalty goes to the provincial government, 32% to the district government and 12% to the nearby district government, 12% to other districts inside the province where coal industry is located, and 8% to the district processing the coal. Moreover, many coal mines are owned by the influential key actors in the politics, making this industry difficult to oversee. Those factors keep the hesitancy of policymakers to make great changes in Indonesia's coal industry.

Such complex governance and ownership issues leave room for corruption. Bersihkan Indonesia et al. (2018) give an example of practices that blur the line of lobbying, conflicts of interest and outright corruption, such as coal industries funding political campaigns leading to many businesses permits issued after the elections and insufficient monitoring processes or inaction on the coal industry, due to the involvement of the main political actors.

Due to the potential in economic growth, public support, and renewable energy resources, Indonesia's government has a great chance to prove that the Just Energy Transition (JET) in a coal-dependent country is possible. With the largest population among ASEAN countries and the fourth globally, Indonesia has a big resiliency to economic crises, even during the COVID-19 pandemic. World Economics (2021) notes that Indonesia has the highest GDP based on the purchasing power parity. Indonesia also has a great amount of renewable energy sources, which can be converted into more than 7,000GW of electricity (IESR, 2021a). The highest technical potential comes from solar power. The new capital of Indonesia is even planned to be supplied by 100% renewable energy according to the Presidential Regulation no. 63/2022, including solar power. Thus, the remaining issue is how to harness them to substitute coal contribution in the energy system. Once all those supports can be accommodated, in addition of answering all the abovementioned challenges, Indonesia can definitely reach net zero emission in 2060 or sooner.

Regarding social aspects, the public is aware of the potential of renewable energies, but they are reluctant to pay higher electricity prices to support the utilization of new technologies (IESR, 2021). This indicates that the knowledge gap on the high upfront investment needed, on payback periods, and other benefits from renewable energy technologies, such as rooftop solar.

Presently, Indonesia is issuing more regulations to facilitate the Just Energy Transition. Presidential Regulation no. 112/2022, contains an article about the urgency to create a coal retirement roadmap. This roadmap is planned to be launched in 2023 and it is expected to have significant impact on the upcoming updated RUPTL and RPJMN.

Moreover, during the G20 event held in November 2022, the country platform of ETM and Just Energy Transition Partnership (JETP) were launched. The objectives of the first are: Achieving the optimum energy to reduce GHG aligned with NDC and NZE in power sector, accelerating coal retirement by reducing CFPPs' economic performance, and accelerating renewable energy investments. With respect to the latter (JETP), Indonesia will receive USD20 billion to support energy transition for the next 3-5 years. The detailed JETP's investment plan is planned to be launched 6 months after G20.

Attracting more investors to support energy transition is not enough. JET will only be achieved with contributions from all stakeholders. Lock-in condition is the main issue. Most regulations still favour the coal sector. For instance, there is no limit on the royalties from coal industries going to the public budget of local governments. Moreover, IESR (2022) documented a proposed compensation scheme for coal companies to alleviate the price differences between DMO and global market. This compensation would be collected from all licensed coal companies and would not require allocating any public budget. If implemented, the scheme will give a breeze to coal business opportunities and become an obstacle to phase out coal from energy system.

The two opposite aforementioned conditions will have to be analysed next year when more investment on energy transition and a more complex situation to stop coal contributions in all aspects is expected. Then, government's commitments and implementation will be evaluated by national and international Just Energy Transition counterparts.

2.2.3 Mozambique

As previously canvassed, the Mozambican Government has periodically addressed the topic of energy transition and has since made more substantive commitments to energy transition via NCRE and conventional renewables - specially hydropower- in a range of forums. This section analyses the potential of these commitments; first by examining recent changes to the electricity laws and regulations that promote renewables and universal electrification by 2030, as well as some additional commitments made for energy transition considering climate change.

The overarching legal instrument for electrification in Mozambique was the former Electricity Law (1997) (Law No 21/97), since superseded by the so-called new Electricity Law 12/2022 (NEL). In addition, Mozambique's Energy Policy of 1998 aimed to promote economically viable programmes for the development of energy resources, to ensure reliable energy supply, and to improve energy access in the domestic sector. While general orientation has not shifted, it has been improved upon with legislative developments over the last 2-3 years. Table 33 shows an overview of the sectorial regulations.

Table 33 Most relevant laws related to electricity in Mozambique

REGULATION NUMBER	NAME / TOPIC
Law 12/2022	(new) Electricity Law (NEL)
Decree 93/2021	Regulation for Energy Access in Off-Grid Areas
Law 21/1997 (October 1st)	(former) Electricity Law
Decree 5/1998 (March 3rd)	Energy Policy
Law 15/2011 (August 10th)	Law on Public-Private Partnerships (PPPs)
Law 11/2017 (September 8th)	Regulatory Authority for Energy
Decree 16/2012 (June 4th)	Regulations on the PPP Law
Decree 5/2016 (3 November)	Public Procurement Regulations
Law 11/2017 (September 8th)	Creates „Autoridade Reguladora de Energia" – ARENE
Resolution 2/2019(March 19th)	Organic Statute of ARENE

The NEL is the concretion of Mozambique's commitment to energy transition. A new Regulation for Energy Access in Off-Grid Areas had already been approved in December 2021 to support the sector. The secondary goals of this regulation included providing a more clear and transparent process for the implementation of off-grid electrification projects by the private sector. On the other hand, NEL recognises the electricity sector and aims to adapt the legal framework toward the new realities of Mozambique's energy needs, in support of the energy transition, NCRE, and the universal access to energy.

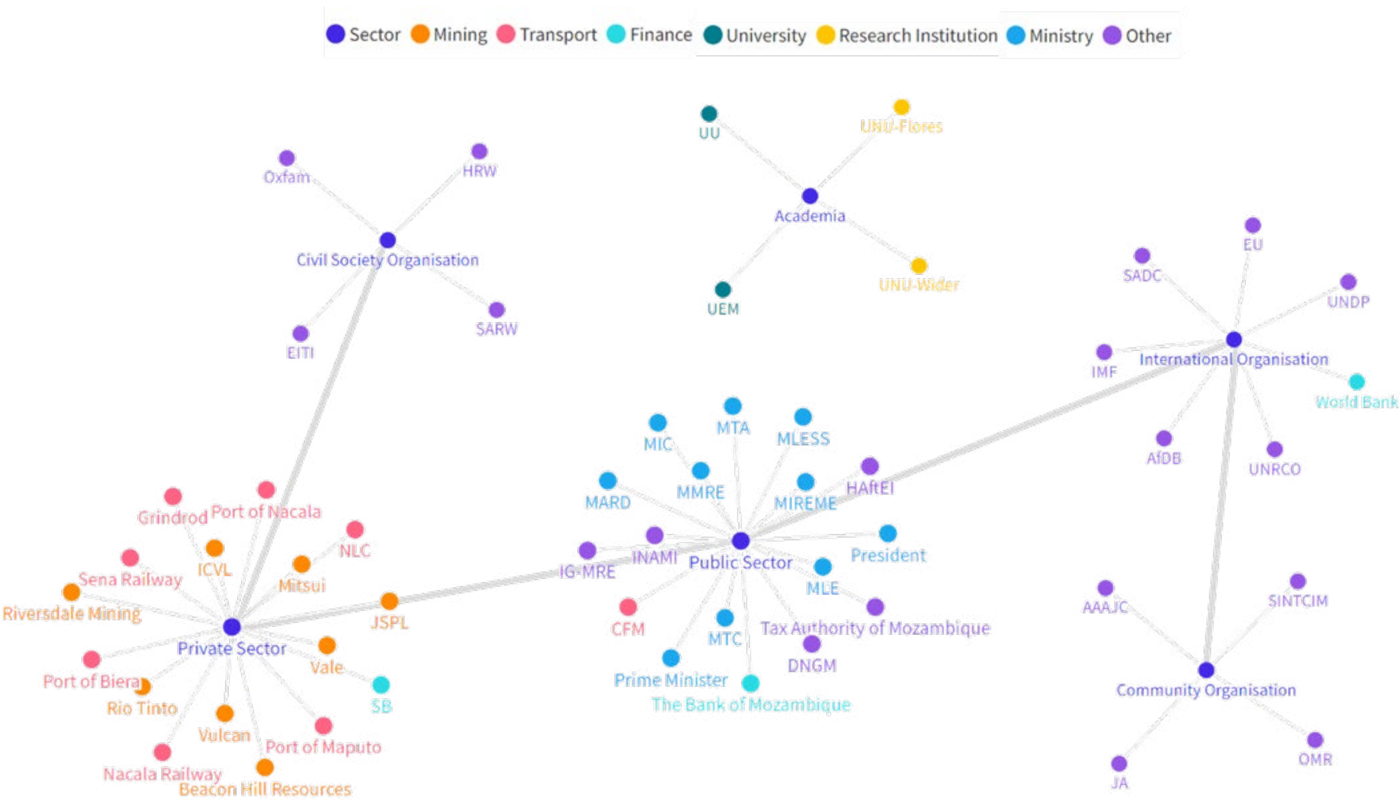
The government has reiterated that NEL shall achieve universal access to quality, efficient and reliable energy via "all energy sources, with emphasis on renewable energy sources and the reduction in the use of fossil sources" (TSE4ALLM, 2022). NEL is pragmatic, considering the unique and contradictory needs of the State in relation to energy capture and use, encouraging electricity generation and supply by the private sector, universal access, and promoting renewables and micro utilities.

Although regulations are also necessary to support the NEL (some have been passed; others are in process) supporting policies such as the current five-year Plan 2020-2024, have been installed to establish strategies to increase renewable production capacity and transmission.

The regulatory framework provided in the Regulation on Access to Energy in Offgrid Areas (approved by Decree 93/2021) provides a greater certainty for the private sector. In addition, NEL is one of the first laws to make provisions amenable for a coal phase-out, calling for the "Decommissioning Fund" (PLMJ, 2022). Some groups, such as the Towards Sustainable Energy for All - Mozambique (TSE4ALLM) project, have applauded the New Electricity Law for advocating for a conducive policy and regulatory environment to promote the involvement of the private sector in the development of integrated renewable energy for the country's rural areas (see TSE4ALLM, 2022). However, it is important that policy outcomes regarding pricing and access are monitored by public institutions.

Moreover, it should be noted that these developments have raised contradictions with other transition and planning strategies from other agencies. For example, USAID (2020) promotes extractives for Mozambique's development, with its 2020-2025 Country Development Cooperation Strategy (CDCS) outlining how USAID will support Mozambique on its Journey to Self-Reliance (J2SR) - ending its need for humanitarian and development assistance. This is not a transition strategy but is premised on a future transition - the timing of which will depend upon the prior arrival of significant extractives revenue. It makes no mention of energy transition, instead placing all emphasis on immediate economic development. Such incoherent messaging from international donors may foster contradictory policymaking in this area. To further understand the actors involved in the coal value chain both domestic and international, a stakeholder map is presented in

Figure 58. Stakeholder map of the coal value chain in Mozambique



The Energy for All (Programa Nacional de Energia Para Todos) (Government of Mozambique, ND) aims to provide electricity access to more than 10 million Mozambicans by 2024. The Promoçao de Leilões de Energias Renovaveis ("Promotion of Renewable Energy Auctions" -PROLER) was an initiative involving a public tender model contracted by MIREME and financially supported by the European Union through the AFD (Agence Française de Développement) in 2018. This was to be a driver for private investment in solar and wind projects to be connected to the National Power Grid. See Table 34.

Table 34 **Strategies for development of energy access**
Source of data: Energypedia (2022)

IMPLEMENTING BODY	NAME	FOCUS	PERIOD
EDM	Electricity Law (Law No. 21/91)	Regulation of renewable energy	2017 – present
Gov. Of Mozambique EDM	Electric Infrastructures Integrated Master Plan (o Plano Director de Infraestruturas Eléctricas 2018-2043)	Power generation, transmission, and distribution planning for 25 years 20% integration of RE into the grid	2018 – 2043
Gov. Of Mozambique EDM ARENE	National Electrification Strategy (ENE) - Energy for All (Programa Nacional de Energia Para Todos)	"Providing high-quality, affordable and sustainable electricity by 2030" 70% from grid and 30% from off-grid Ensure new energy access for more than 10 000 residents	2018 – 2030

The country's commitment to the development of renewable energies has remained at the top of the priorities of the Mozambican Executive at both domestic and international forums on energy (O Pais, 2021). There have been many projects in support of renewables since the 2010s, and whilst these are not on scale to meet Mozambique's electrification needs, they highlight the possibilities of renewables to serve the energy needs of Mozambique. Some key examples of these include the FUNAE installation of 1.2 MW of PV capacity, with Asian and European donor support. According to FUNAE (2012), 1.5 million people had benefited from the solar systems by 2012, although the distribution was uneven due to costs that were expensive for community members.

From the PROLER initiative discussed above, one wind power and three solar PV projects were covered in PROLER's schedule. The first solar PV project was launched in October 2020, while viability studies will be carried out for the rest of the projects from 2021 to 2022. Later projects have been more ambitious, such as the 19MWp (15MWac) solar PV plant and 2MW (7MWh) energy storage system in Cuamba, the country's first wind projects in Namaacha, and tender for the 40MWp Dondo solar power project (Smith, 2021). More recently, during the African Energy Forum (June 2022), EDM partnered with the International Finance Cooperation (IFC) from the World Bank Group to develop four solar PV and battery storage facilities with an expected total production of 50 MW. These plants are planned to be part of the National Grid (See Africa Energy Forum, 2022). It is relevant to mention, however, that Mozambique has increased liquified natural gas and hydrocarbon research in general (see Minister Carlos Zacarias, Mozambique's Minister of Mineral Resources and Energy, in Lusa, 2022).

The government has also proposed to use its natural gas reserves (primarily from Cabo Delgado) as a transitional energy source on the way to a greater reliance on renewables. Despite disputes about the green claims behind this energy source, it is these types of pragmatic projects that promote both revenue capture and coal phase-out. However, the resource nexus approach must be considered to assess whether the impacts of this new sector will the

The NCCAMS (2012: 35, 4.6.2.1.1) can be broadly seen to promote aspects of a JT – and such government strategies can be leveraged to create a baseline of support or principles for JT in the future. Three aspects of the broad NCCAMS strategy are most relevant to JT, those being access to renewable energy, increasing energy efficiency, and technology transfer.

NCCAMS advocates for the electrification of rural communities using renewable energy; promoting the use of renewable energy sources (biogas, biomass, solar, wind, thermal, wave and geothermal); promoting the expansion of the national energy network, or the creation of micro-power distribution networks; evaluating mitigation mechanisms in infrastructure for the production and transmission of electricity.

At COP26, according to Deputy Foreign Minister Gonçalves, Mozambique favoured a "gradual transition" due to its concern for a chaotic impact in the event of coal production and exports being abruptly terminated. Mozambique's priority, he added, is the implementation of an energy transition programme based on a diversified energy mix with cleaner, environmentally friendly sourcing (hydroelectric, wind, and solar energy), in coordination with the country's development programmes. But the transition, he insisted, must be gradual and phased accordingly to minimise the impact on the country's economic development (AIM, 2021). At COP27, Mozambique championed the „loss and damage" principle, seeking USD2 billion to repair the damage incurred following cyclones Kenneth and Idai, the effects of which were further worsened by the climate crisis. President Nyusi is now the Africa Union Champion for Disaster Risk Management and will be running a parallel meeting to COP27 on this.

Two examples show the potential for international assistance in promoting Mozambique's energy transition in this manner. Firstly, during COP26, Belgium pledged financial commitments worth close to USD13 million to locally led adaptation initiatives, the LoCAL Facility, in Mozambique (and Uganda), in an effort to promote further finance at the local level (see UNCDF, 2021). It stands to reason that Mozambique will also be closely watching the promised 8.5 billion promised to South Africa as it transitions from coal under the Renewable Energy IPP Procurement Programme (Hanspal, 2021).

2.2.4 South Africa

South Africa adopted a National Development Plan (NDP 2030) that recognises the need for the energy transition to low carbon technologies, with a focus on environmental sustainability. The path to a just transition is still in its early phases, however, and much remains to be formulated in the form of policy guidelines (Patel, 2021). In 2020, President Cyril Ramaphosa established the Presidential Climate Commission (PCC), a multi stakeholder body to facilitate the just and equitable transition towards a low emission and climate resilient economy. June 2022 saw the PCC release its Just Transitional Framework (JTF) as the result of consultative meetings, dialogues, and extensive work already undertaken by various departments, civil society organisations, businesses, academia, and trade unions (PCC, 2021). The JTF is built upon 3 principles, those being Distributive Justice, Restorative Justice, and Procedural Justice; it highlights the importance of including gender dimensions, particularly as women are especially vulnerable to the effects of the climate crisis.

The PCC dialogues have focused thus far on the nature of a just transition from coal, as well as the associated costs and benefits for different stakeholders; the nature of governance systems, employment and livelihoods; financing a just transition, governance for a just transition, and water security (Beukman R & Reeler, 2021; Patel, 2021). It is worth noting that the PCC dialogues identified the interdependencies of the energy sector with other sectors, and encouraged discussion on water resources, agriculture, ecosystems, and livelihoods. Despite efforts to engage other sectors, the overarching emphasis is on the energy sector -particularly coal-powered energy- showing a need to holistically encompass all resources in the just transition efforts.

To contribute to the environmental efforts, the Mpumalanga Provincial Government developed various strategic plans, for example, the Green Economy Development Plan in 2016, and as recently as 2021, drafting the Mpumalanga Climate Change Mitigation Strategy (MCCMS) to be implemented up until 2025, with the aims of achieving a more sustainable energy mix, improving energy efficiency, and reducing GHG emissions, among others (PCC, 2022). Potential collaborators with the MCCMS include the Department of Public Works, Roads and Transport (DPWRT), the Department of Education and Training (DET), Cooperative Governance and Traditional Affairs (COGTA), and the National Treasury.

The Renewable Energy Development Zones (REDZs), created by the Minister of Mineral Resources and Energy, is another opportunity to enable a just transition of the energy sector in Mpumalanga. REDZs are geographical areas where wind and solar PV development can occur in a concentrated manner. The first phase of the Strategic Environmental Assessment (SEA) of wind and solar identified eight REDZs in South Africa, of which Mpumalanga was not listed. Mpumalanga was considered in Phase 2 of the SEA for potential solar PV and wind, and recommended the addition of 3 REDZ, including Emalahleni (DFFE, 2019)

The regions with the most NCRE potential have not been identified in the coal regions, so it remains a question as to whether workers are willing to move to other provinces to take jobs on NCRE projects. This uncertainty calls for further economic diversification of the coal region to easily absorb those who may not be willing or able to move, such as the elderly, or those close to retirement age.

Through the Mpumalanga Green Economy Cluster, the Province has been able to engage Green Cape to replicate the cluster model for the Western Cape. The Green Cape cluster model expanded its focus to 6 areas to include the renewable energy, energy efficiency, alternative waste treatment, the industrial symbiosis programme, water, agriculture, and bio-based value chains.

The Highveld was identified as a hot spot for the replication of this cluster model, as it hosts the most power plants and mining activities in the province. Some of the initiatives put forward include repurposing decommissioned land for renewable energy projects and decommissioning assets. The potential intervention projects are estimated at a cost of about R60 billion, while the cluster is expected to engage communities to create a green and sustainable economy through managing its natural resources.

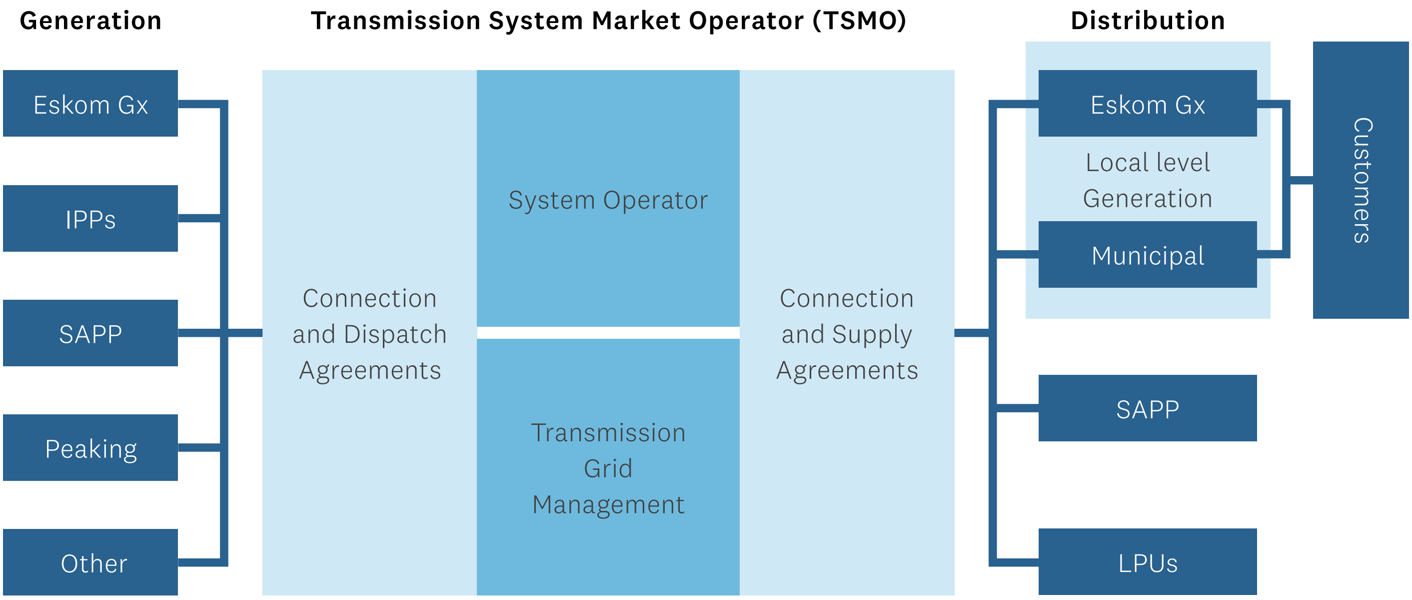
One of the major challenges facing Eskom's financial stability is liquidity, with limited access to investor funding (Eskom, 2021). Eskom's debts account for 40% of bond principal and interests, of which approximately R200 billion is derived from international funds; putting the whole South African economy at risk (Winkler et al., 2020). Moody's and Fitch provided a rating for Eskom, which saw its downgrading to the sub-investment grade level. The highest debt servicing and the arrears from non-payment by municipalities and Soweto residents exacerbates the liquidity challenge (Eskom, 2021). Under the Special Appropriation Act of 2019, the government is committed to financially supporting Eskom.

In 2020, R230 billion were allocated to restructuring the electricity sector over 10 years (Eskom, 2021; Winkler et al., 2020). The restructuring/unbundling of Eskom into separate subsidiaries provides an opportunity for operational and financial sustainability. This is aimed at improving transparency, efficiency, and enabling greater visibility of the entity to attract more investors (DPE, 2019b). Eskom's new business model will be informed by:

- Adopting appropriate best practices to provide energy security and universal access
- Improving the utility's financial position and minimising dependence on the state's fiscus
- Meeting the legislative requirements of a lower carbon trajectory
- Implementing a Just Transition
- Developing a pipeline of new products, based on research and development
- In addition, develop and execute "no regret" products that can immediately increase revenue and position the business for longer term growth

The unbundling started with the first phase of separating the entities into generation, transmission, and distribution, and was completed in 2020. The second phase was to separate the entities legally - a process which started in 2021 and is still ongoing (ERRG, 2020). Figure 59 shows the planned pathway for the unbundling of Eskom.

Figure 59. **Structure representing the path to unbundling Eskom**
Adapted from: DPE (2019)



Eskom established a Just Transition Unit with a programme on the topic, as outlined in Table 35. Eskom's initial plan is to decommission four power plants: Camden, Grootvlei, Komati, and Hendrina. In March 2020, Eskom issued an Expression of Interest (EoI) requesting to submit proposals for repurposing the power plants with cleaner technology based on the four principles of infrastructure reuse, new generation capacity development, ancillary services provision, and socio-economic impacts mitigation.

Table 35 **The Just Energy Transition programme under Eskom**
Adapted from: IASS et al. (2022)

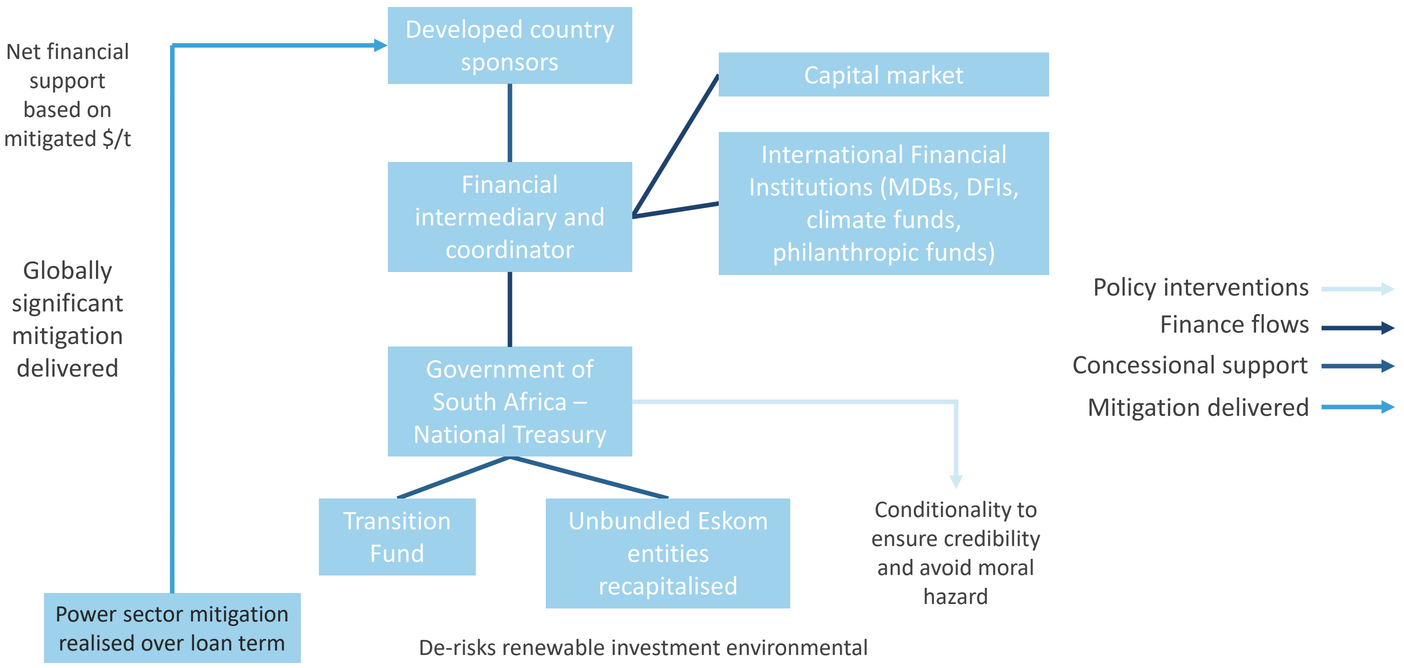
PROJECT IN DEVELOPMENT	CAPACITY (MW)	# OF PROJECTS	DESCRIPTION
Solar PV	1,556.2	12	• 7 projects at existing coal plants (382 MW) • 3 phases Sere expansion (600 MW) • Olyvenhouts and Gamma substation (585 MW)
Wind	600	3	• Kleinzee (300 MW) • Aberdeen (200 MW) • Other wind projects (100 MW)
Gas	4,000	2	• Komati gas (1000 MW) • Richards Bay (3000 MW)
Battery	61	1	• Komati battery storage (244 MW)
Microgrids	1,400	TBC	• 3 x containerised microgrid installations planned by March 2022
Pumped storage	390	1	• Tubatse pumped storage scheme
Total	8,017.2	19	-

Since its online launch in 2013, the large-scale Renewable Energy Independent Power Producer Procurement Programme (REIPPPP) has seen at least 91 projects reach financial close. Eskom has procured 6.422MW, of which 5.250MW was operational and made available to the grid. Eskom has also commissioned 1.332 MW of Ingula pumped storage, 4.764MW of coal (Medupi), 2.397MW of coal (Kusile), with three units of 800MW -each still under construction- and 100MW of wind (Sere Wind Farm) (Mkhize & Radmore, 2022).

South Africa has been identified as one of the model countries through which the just energy transition can be replicated. As the main energy supplier, Eskom does not have access to capital markets due to debt. Furthermore, there is limited political support for renewable energy (Winkler et al. 2020). The National Treasury and the Department of Public Enterprises have provided guidance on financing the debt in a sustainable manner through financing from public funds. Moreover, COSATU proposed the use of South Africa's Public Investment Corporation (PIC) fund for Eskom's debt (CIF, 2020). The difficult aspect of this option is how to determine who is responsible for reimbursing the public funds, and if there is a commitment in place to guarantee this reimbursement.

The Just Transition Transaction Fund (JTT) from the International Climate Finance (ICF) is intended to support and accelerate South Africa's transition to a low-carbon economy using a concessional debt instrument with support from developed countries, which is designed along 3 broad pillars (G. Steyn et al., 2021), namely ambition, financial support, and incentives. The JTT would indirectly enable Eskom's access to capital markets, for example, through blended finance, which could encourage investors to reconsider Eskom. The JTT's conditions for financing the just transition in South Africa include the restructuring of the energy sector, the accelerated CFPP decommissioning of power plants, and addressing socio-economic impacts, such as job losses. Figure 60 shows the JTT's institutional structure and the flow of funds, with conditional funding for the unbundling of Eskom. The purpose of Just Transitional Transaction fund is to provide support for direct additional costs to accelerate decommissioning and is not responsible for the direct funding of Eskom debt. The baseline for emissions reductions for the JTT fund is the IRP, 2019 but the plan unfortunately does not provide sufficient projections on the emissions profile (Winkler 2020).

Figure 60. **Figure JTT Institutional structure and flow of funds**
Adapted from: Steyn (2021)



An example of such funds was secured by South Africa at the UNFCCC's (United Nations Framework Convention on Climate Change) 26th Conference of the Parties (COP26), with a partnership to support South Africa's decarbonisation efforts announced between the Republic of South Africa, the United Kingdom of Great Britain and Northern Ireland, the United States of America, the Republic of France, the Federal Republic of Germany, and the European Union (EC, 2021). The Partnership aims to accelerate the decarbonisation of South Africa's economy, with a focus on the electricity system, to help it achieve the ambitious goals set out in its updated NDC emissions goals. An initial commitment of USD8.5 billion is intended for the first phase of financing through various mechanisms financing instruments and sources, as provided in the Table 36.

Coal

Source: iStock.com/xtrekx

Table 36 **Financing instruments and plans for the USD8.5 billion offer to JET SA, in million USD**
Modified from: RSA (2022)

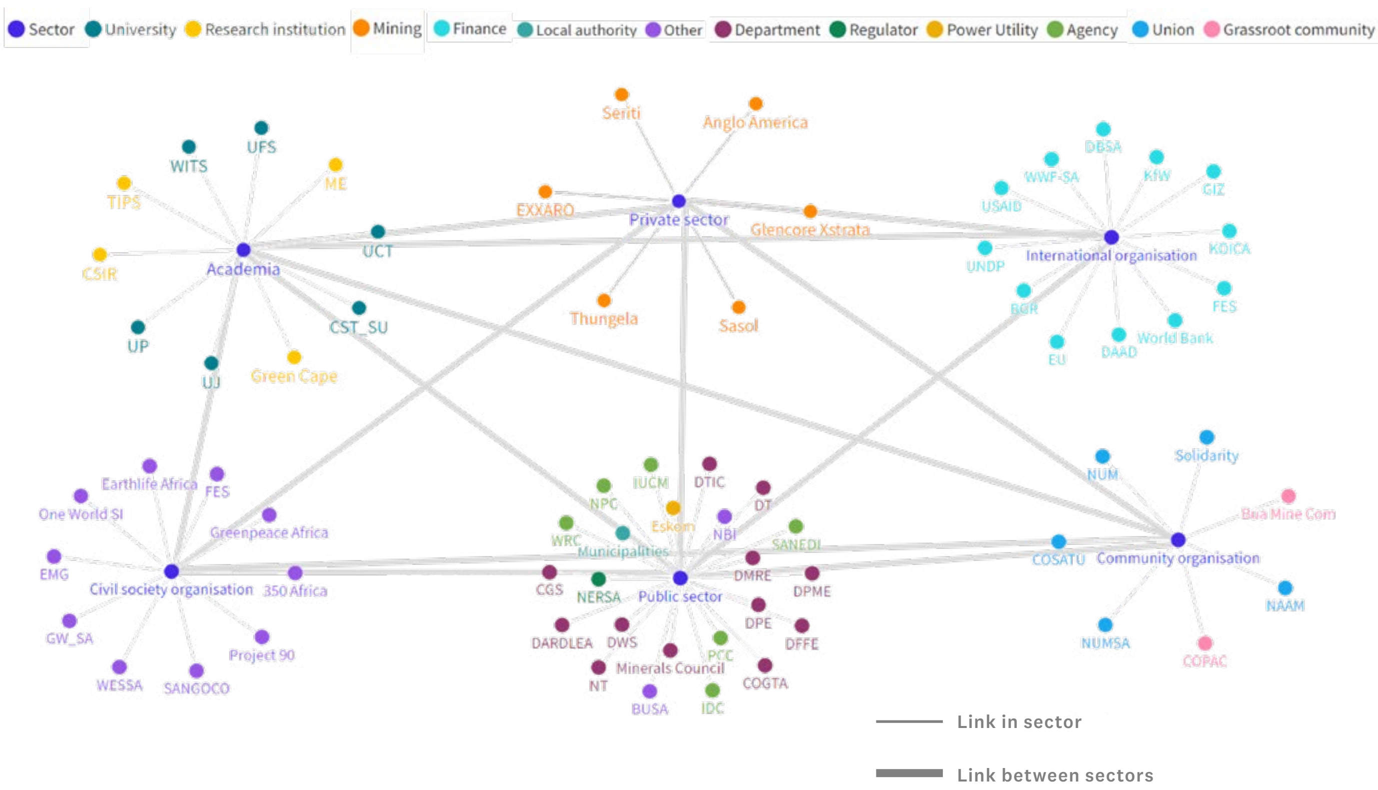
INVESTORS	GRANT	CONCESSIO-NAL LOANS	COMMERCIAL LOANS	GUARAN-TEES	TOTAL	PLANNED INVESTMENTS FOR JUST ENERGY TRANSITION
CIF/ACT	50	2555	0	0	2605	governance, people, and infrastructure
EU-EIB	35	1000	0	0	1035	decarbonisation of freight logistics
France	2.5	1000	0	0	1002.5	long-term strategic planning for the JET, advisory services, support for local authorities,
Germany (GIZ & KfW)	198	770	0	0	968	policy and regulatory reforms; support to local authorities to prepare for the transition; promotion of renewable energy, including green hydrogen; and the skilling and reskilling of the decarbonised energy workforce.
United Kingdom	24	0	500	1300	1824	research and development related to decarbonisation, green transportation, and energy storage feasibility studies.
United States	20.15	0	1000	0	1020.15	technical assistance, feasibility studies and pilot projects
Total	329.7	5 325	1500	1300	8.455	

In response to the financing needs of the energy transition, South Africa's Just Energy Transition Investment Plan (JET IP) was released in November 2022. The JET IP will initially cover a 5-year period (2023-2027). The JET IP financing needs are estimated at USD98.7 billion with the electricity sector alone requiring about USD47.2 billion (RSA, 2022). The investment plan also provides for the allocation of the USD8.5 billion from the International Partners Group (IPG); of this, 81% (USD6.9 billion) is allocated to infrastructure development in the electricity sector. The infrastructure investment shall target the upgrade of the transmission and distribution network to accommodate the renewable energy generated over the next 5 years and beyond.

The Plan also highlights the investment needs of the Mpumalanga province in terms of decommissioning the electricity sector and investment in coal communities. The priority areas are categorised in phase 1 (pre-closure planning in 1,5 years), phase 2 (coal mine and power plants closure in 3+ years) and phase 3 (regional transformation in 10+ years). The JET IP provides a detailed investment plan for the energy sector, with no specific budget/plans for the impacted water resources from coal mining activities.

Other investors, including local ones, have contributed to the transition to renewable energy, for example, through the bid window system for independent power producers, as shown in Table 37. A total of 25 projects with a combined capacity of 2.583 MW were identified as preferred bidders for bid window 5. The total investments made in the programme (debt and equity) over the procured bidding windows -excluding the expedited round- totalled more than R209.7 billion as of June 2021 (IPPO, 2021). This amount is split 80%-20% between domestic and foreign investments - R167.9 billion and R41.8 billion, respectively (Mkhize, M., & Radmore, J., 2022). All these actors can be seen in the stakeholder map for the country (Figure 61).

Figure 61. **Stakeholder map of the coal value chain in South Africa**



Local financing institutions have not been overly enthusiastic to finance start-up projects in South Africa due to the higher risks associated with projects that have no track record. This implies that the emerging green technologies for the energy transition are at risk of low funding locally. It is also of note that financial institutions generally lack appropriately skilled personnel to evaluate the particularly technical components of low carbon and just transition projects. This, in turn leads, to a misappropriation of risk and financing decisions (Lowitt, 2021).

Table 37 **Table Investors in the REIPPPP projects in South Africa**
Source of data: Green Cape (2020)

FINANCIAL INVESTORS	BID WINDOW 1	BID WINDOW 2	BID WINDOW 3	BID WINDOW 4
DBSA	9	2	6	2
RMB	5	4	3	2
IDC	10	5	5	0
ABSA	3	4	7	7
Standard Bank	11	5	2	5
IFC	2	1	1	0
Ned Bank	9	5	8	7
Future Growth	7	1	0	0
Investec	0	3	2	0
Total	56	30	34	23

South Africa is well endowed with critical minerals that are useful in transitioning to cleaner technologies. Minerals such the platinum group metals, e.g.: platinum, ruthenium, iridium are essential in fuel cell catalyst and electrolyses for green hydrogen production. The Hydrogen Society Roadmap (HSRM) released in October, 2021 provides insight in the high-level action plans for green hydrogen production (DSI, 2021). South Africa still produces grey hydrogen from fossil fuels mainly from Sasol. With Sasol already having infrastructure which can be repurposed for the green hydrogen, the country has the capacity to compete in the global market. Through the Platinum Valley Initiative (PVI), hubs were identified based on potential to supply green hydrogen. The hubs are intended to operate as pilot projects for the green hydrogen. For example, the Boegoebaai in the North Cape Coast is one of the strategically selected hub to pilot green hydrogen production duet its close proximity to an existing hydrogen production plant (Engineering news, 2022). The technology has the potential to create job opportunities through re-skilling of workers already employed in the production of grey hydrogen.

GIZ has provided financial grants of over USD70 million to the DMRE and Eskom for technical advisory and socio-economic aspects as part of the Just energy transition program. KfW has provided Eskom loans over USD735 million for coal transition and integration of renewables to the grid. GIZ to provide USD11.5 grant to the Department of Higher Education for reskilling of coal workers. KfW committed USD220 million in loans to support the green hydrogen technology. Kfw is providing support for scaling up of the renewable energy in Cape Town through planned loan of USD165 million, Transnet loan to improve electric locomotives at USD220 among other projects (RSA, 2022)

Coal Train

Source: María Elena Huertas

2.3 Employment

2.3.1 Colombia

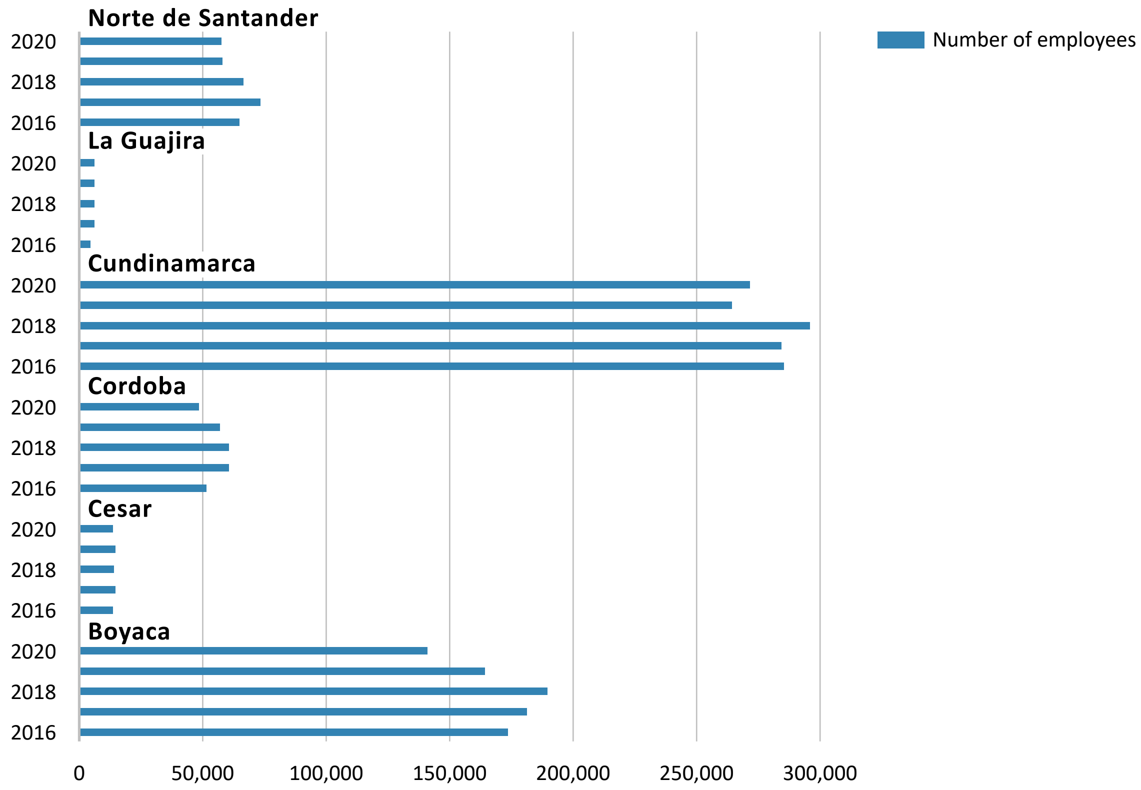
Economic diversification is one of the greatest challenges faced in coal mining regions. In Cesar, after Glencore stopped its activities in the context of the concessions' relinquishment, commercial activities such as accommodation, restaurants, and tourism were immediately impacted (Sintracarbón, 2021). The reconstruction of the local economy is needed, however, this should not be achieved through simply diversifying the economy, but should come from structural change, such as an economic reorientation, as proposed by Oei et al., 2020.

The MME has promoted programmes for the economic diversification of Cesar and La Guajira, known as "Diversifica Cesar" (MME, 2022a) and "Diversifica La Guajira" (MME, 2022b), respectively. Firstly, the topics of agroindustry and tourism feature in both programmes, while in Cesar, education was also identified as a key sector to strengthen. Secondly, a list of required activities to boost both sectors was drafted. For the case of Cesar, some activities include strengthening bilingualism, technological tools training, improving credit access, and creating new markets and networks, among others. For La Guajira, activities include regaining civil society's trust in the public sector, institutional strengthening, and planning of megaprojects.

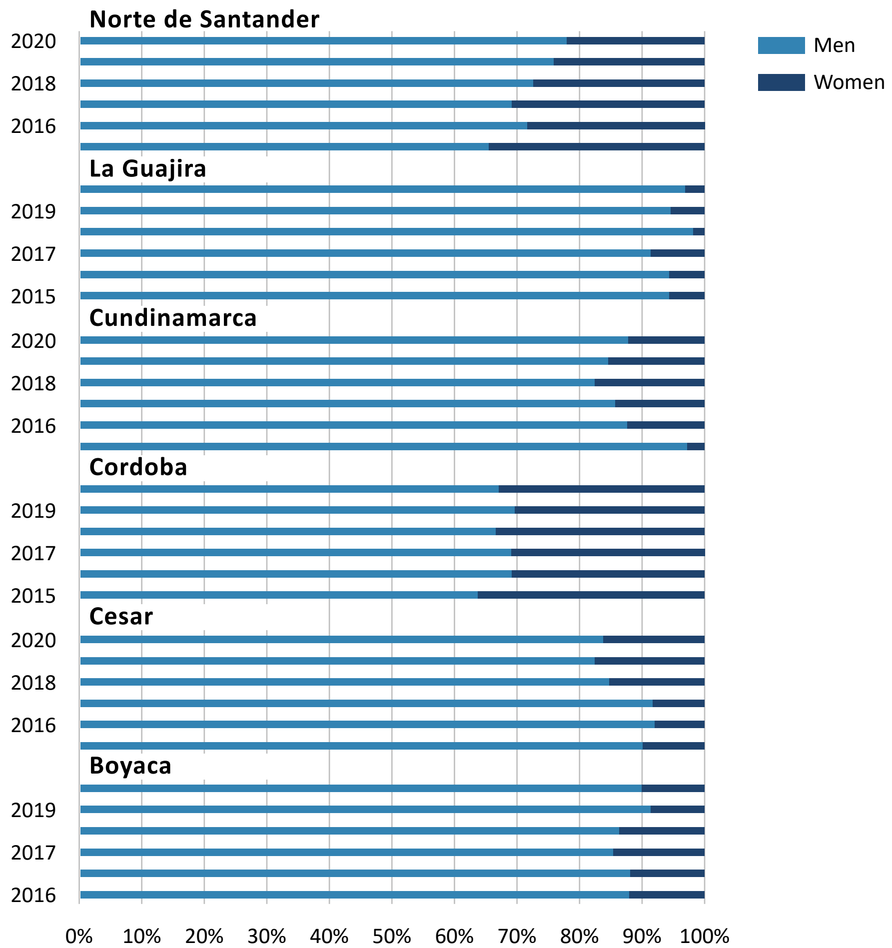
Currently, the agricultural sector plays an important role in the employment across the nominated coal mining regions. Figure 62 shows the number of employees generated by that sector in those areas. It is observed that Cundinamarca and Boyaca show the highest number of employees - more than 40 times of those in the coal sector. In La Guajira, a comparable number of jobs are generated by both agriculture and the coal mines, while in Cesar, the number of employees in agriculture is double the number of employees in coal mining. These two Departments exhibit the lowest number of employees in agriculture in comparison to the other coal mining regions. It is also relevant to point out that the agricultural sector is dominated by men.

Figure 62. a: Agriculture sector employees in in selected Departments 2016-2020.
b: Historical participation of women and men in the agriculture, livestock, hunting, forestry, and fishing sectors 2015-2020

a:



b:



Agriculture is one of the sectors with substantial potential for economic reorientation. According to the analysis made by ADR and FAO (ADR & FAO, 2019, 2021c, 2021e, 2021a, 2021b, 2021d), these regions have significant land availability, however, the following challenges must be addressed:

1. **Significant investments in transportation (secondary and tertiary roads)**
2. **Strengthening the markets by building efficient production chains**
3. **Providing technical assistant coverage**
4. **Expanding access to credit and financing mechanisms**
5. **Promoting agricultural sciences and building capacity in it, in Information and Communication Technologies and in innovation**
7. **Increasing associativity**

Cesore (2021) identified that most of the municipalities in Cesar are located in rural areas and have a high proportion of young people. Therefore, the creation of new jobs in agriculture is indispensable.

Tourism is another sector with high potential to be developed in the selected coal mining regions both due to their significant cultural heritage and the diversity of ecosystems (ADR & FAO, 2019, 2021c, 2021e, 2021a, 2021b, 2021d). However, according to the Regional Tourism Competitiveness Index (ICTRC) (Centro de Pensamiento Turistico, 2019) only the Zipaquira municipality in the coal mining central region featured as part of the top 20 municipalities with a tourism vocation. In this sense, diverse challenges should be addressed in coal mining regions, such as the identification of the current assets for tourism, the design and promotion of tourist products, and the design and implementation of instruments known as Municipal Tourism Development Plans. In that regard, the National Tourism Fund (FONTUR), offers opportunities to support these processes through financial and technical assistance (FONTUR, 2020).

It is essential to note that tourism is extremely sensitive to certain aspects like security and transport infrastructure. If these are threatened for any reason, or are simply not present, the viability of this alternative is swiftly and sharply decreased. Finally, the future impacts of climate change should be considered in the design of tourist products, and the preservation of the natural and cultural wealth of the local communities must be held paramount.

The ANM has been involved in labour reconversion in Cesar to encourage former coal workers to change their occupations (ANM, 2021). Most of the coal mining jobs do not require high qualifications, nor are relatively higher incomes provided in the coal regions. Young people are invariably expected to become employees of a coal mining company (Field trip Cesar, 2022a), and some choose not to pursue higher education in favour of work as machinery operators (Field trip Cesar, 2022b).

Labour reconversion unequivocally requires the participation of mining workers. The biggest challenge lies in ensuring a progressive transition that guarantees labour security for mining workers, while avoiding employee layoffs - as already happened when Glencore ceased operations in Cesar (CNV Internationaal, 2022). This implies considering their limitations (especially the health problems arising from coal-related jobs), skills, life projects, and job expectations. After this assessment is complete, it will be possible to identify and create new capacities (requalification) through a detailed programme designed for each coal mining region. One of the promising aspects to assist the delivery of labour reconversion is the participation of the research centre, CIPAME (2022); a space in which unions, coal workers, and academia coalesce.

Most of the NCRE projects and potential in the country are situated in La Guajira and Cesar Departments. However, two considerations are important:

1. **The number of jobs of the NCRE value chain are generally lower than those in the coal value chain (Santamaría et al., 2022). This is true, of course, when not taking into account the upstream production of inputs needed for NCRE deployment (PV cells fabrication, turbine construction, etc.)**
2. **In general, NCRE projects demand a larger proportion of specialised employees. Therefore, academic training is required in the event of coal miners being interested in transferring from the coal value chain to these types of projects.**

For the case of Glencore's coal mines, there remains an opportunity for labour reconversion, should they not resume operations in the future as it seems to be the case. Mine closure will require labour force in decommissioning and rehabilitation tasks, as well as in monitoring, control, and maintenance. This option may help reduce unemployment, but also depends on the company and the State.

Cartagena, Colombia

Source: Reiseuhu.de for Unsplash

2.3.2 Indonesia

Several former coal mines have become tourist attractions because of the pit lakes left behind. However, there have been several incidents of drowning in them as most of these pit lakes tend to be deep and acidic in nature, also, there is no protection except for the fences installed at the end of the mining projects (Yovanda, 2020).

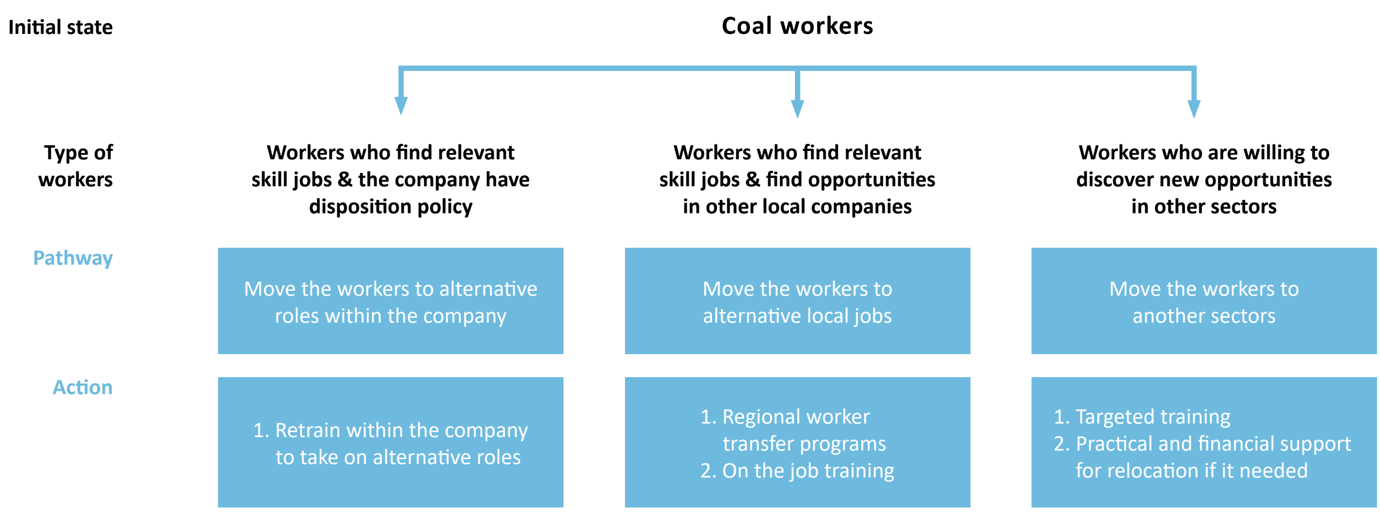
Kaltim Prima Coal (KPC), which is one of the largest coal companies in East Kalimantan, successfully opened a 270 ha-tourist facility in 2020 that has been restored since 2001 (ESDM, 2020a). 12.43 ha are being transformed into the Telaga Batu Arang pit lake while other areas surrounding this pit are now being used for chicken farming, producing 48% of the local eggs in the region. The pit has also reportedly become a source of water for 22,000 people (KPC, 2021) as water in Telaga Batu Arang is categorised as class A, meaning that it can be used for daily activities. It is important to remark that this facility is currently open only for a limited number of tourists. KPC is now planning to replicate their achievement to convert other mine sites in similar business ideas (Hastuti, 2019).

Ombilin coal mine in Sawahlunto, West Sumatra is one of the oldest mines in Indonesia and in the whole ASEAN region. It was declared a historical site by UNESCO in 2019 (BBC, 2019), it is currently opened to the public and absorbs many local job positions to be the tourist guides.

ILO (2022) has studied the changes in employment on the coal phase-out programme in Indonesia. Two main addressed issues to intervene social and economic aspects are the improvement of workers' capacity and public participation. The goal of addressing the first issue is to provide new skills, which is expected to lead to more competitiveness and better job positions. Regarding public participation, ILO found that improving communication methods and channels between the private and public sectors and communities can increase the employment rate of local people in other sectors with enhanced social and labour security.

Bappenas (2021) estimates that there will be between 1.8 and 2.2 million new jobs introduced in the scenario of net zero emissions 2050. RPJMN 2020-2024 mentions that there will be intensive trainings for public to prepare them to start jobs in renewable energies, and similar businesses. However, there is no exact target for that. It also states that the trainings will consider the digital economy to prepare the workers on the use of new technologies. Since Indonesia's GDP and micro, small, and medium-sized companies' growth is projected to be the highest among ASEAN countries, there will be more opportunities for workers who want to switch jobs if there is sufficient training in the digital economy and sustainable development, allowing them to create sustainable products and services (Wijayani & Puspitarini, 2022). However, this strategy must be aligned with the skills and interests of each worker and thus the interests mapping for workers must be carried out. IESR (2022b) presents several categories that can be used for creating this interests mapping (Figure 63).

Figure 63. **Strategies on workers transition in the coal phase out plan**
Source: IESR (2022b)



UU no. 3/2022 clearly states that all mining industries are required to develop the program community development and empowerment. However, there are no clear provisions on the obligation to prepare workers for the mine closure.

The contribution of coal industry to the local, regional, provincial, to national incomes as stated in UU no. 1/2022 causes that local authorities are not always in line with the coal phase-out. In terms of reputation and the public, people employed in the coal sector, such as coal mining and CFPP engineers, can get a monthly salary of at least IDR15 million. These workers live in the heart of the cities (Hilmawan et al., 2016) and the idea of trickledown development and corporate responsibility schemes give the idea that the coal sector can be sustainable particularly to people involved in it, so overall, the sector still retains a good reputation.

Surprisingly, not all citizens are necessarily more prosperous from coal mining sector, as found in East Kalimantan by Haug et al. (2016). Social jealousy from local people often happens because most workers in coal mining in East Kalimantan and CFPP in Java are highly educated and trained, and frequently come from other provinces or other parts of Java (Hilmawan et al., 2016). Moreover, there are more local people feeling the negative impacts from coal industry on a daily basis, especially from the early 2000s (i.e., Muhdar et al., 2019 and Weber, 2009). Most complaints are related to environmental justice aspects due to the ecological impacts. There are three highlighted recommendations from Hilmawan et al. (2016) to diminish the development asymmetries between rural and urban areas, which are: a. creating a long-term plan to optimise other sectors especially agriculture, trade, and service, b. emphasizing the potential of agroindustry to control the trade-offs from human's development and environmental protection, and c. welcoming more investment to improve local people's capacity.

On the cultural side, Brown & Spiegel (2017) have described changes in the coal regions' political, demographic and economic structure. This indirectly affects indigenous communities in Kalimantan, among them, the Dayak, because of the land clearance process. This community originally lives in the deep forest of Kalimantan and agriculture is their main activity. The spread of coal mining areas is forcing the Dayak to relocate and accommodate to this new reality.

The voices of labour unions are rarely heard in the media. Among coal employees, there is still a perception that the coal industry is sustainable. Although there are many accidents that happen in the coal mines, protests are commonly coming from local communities, not the workers. Moreover, there is no information on demands or any sort of protests from the workers unions expressing their support on the energy transition. In short, the narrative of energy transition addressing the climate change may be in the plans of Indonesia's government, companies, and other stakeholders, but not yet in most citizens, especially people who benefit from the coal sector itself.

Jakarta, Indonesia **Source: Afif Ramdhasuma for Unsplash**

2.3.3 Mozambique

The coal sector in Mozambique has suffered from high volatility, with much attrition seen among its primary investors. There has been a peculiar mix of state-owned companies like Brazil's Vale or India's ICVL that simultaneously post losses and retain interest, and other big business ventures that reach modest success (i.e.: JSPL including its Vulcan Resources). Over time, the smaller, speculative investors have decreased to leave a monopoly of large Indian-backed firms, namely Jindal Steel & Power Ltd (JSPL), which controls Jindal Africa and Vulcan Resources, and ICVL. In this highly competitive environment, labour has been a crucial resource, with production capacity being vastly underutilised before and during the COVID-19 pandemic (IEA, 2020: 50), leading to increased pressures on labour and various grievances expressed by coal miners (Mucari, 2022) within the current coal price and demand boom. Most recently, Vieira's study (2021: 391-411), has shown how production techniques have generated overproduction; accentuating expropriation of residents and the labour crisis. In these conditions, pressures on labour are likely to intensify and require the improved regulation and protection that has been promised in the proposed changes to Mozambique's Labour Law.

The most relevant laws and regulations on labour in the coal mining sector is provided in the Table 38.

Table 38 Table Most relevant laws/regulations of labour in the coal sector of Mozambique

REGULATION NUMBER AND DATE	NAME
Decree No. 61/2006, 26 December 2006	Reglamento de Seguridad Técnica y de Salud para las Actividades Geológico-Mineras [Technical Safety and Health Regulations for Geological and Mining Activities]
Decree No. 62/2013, 4 December 2013	Regulation Establishing the Legal Framework for Accidents at Work and Occupational Diseases
Decree No. 13/2015, 3 July 2015	Work Regulations for the Mining and Petroleum Sectors
Decree No. 63/2011, 7 December 2011	Hiring of Expatriates for the Petroleum and Mining Sectors

The Mozambican government has proposed that changes to Mozambique's Labour Law be submitted to Parliament in late 2022 - the third round of significant reforms to industrial relations relevant to mining within two decades. Such reforms had been proposed as early as 2017, when the government recognised an "urgent need to align the national legal system" with international conventions, such as the those on forced labour, health and safety in mines, and child labour (Lusa, 2019). These changes have been made in consultation with the Labour Consultative Council (CCT), social partners, employers, and unions, and have promised crucial reforms both for labour standards, and in ensuring the country remains attractive to foreign investment (360 Mozambique, 2022). These legislative developments indicate the growing recognition by the State of the need to improve regulations in this sector.

The Ministry of Labour is the main regulator for mine workers. In addition, there is a tripartite body between the State, employers' organisations, and trade unions to discuss and coordinate industrial matters, called the Labour Advisory Committee (Comissão Consultiva do Trabalho). The most relevant union for miners is, arguably, the National Union of Construction Industry, Wood, and Mine Workers of Mozambique (SINTCIM), which is still relatively weak. In Tête, most mining groups are localised. The current rate of unionisation is very low (estimated to be 2.5% of the labour force). As such, although there has been some institutionalisation of dialogue inclusive of workers, their independence and organisation must be considered vulnerable in comparison to the relative power of the State and companies; limiting their effective bargaining power for pay and conditions.

Occupational Health and Safety (OHS) and labour are mainly regulated by the Labour Law (2007) and ancillary regulations (Decree No. 13/2015, Decree No. 61/2006, Decree no. 62/2013. This regulatory framework provides for three broad goals related to OHS:

1. **OHS plans must be included before any mining activity**
2. **Mining plans (including explorations) must include the best OHS practices for mining activities, including services and organisation**
3. **Employees must be trained in OHS in the context of mining operations**

This range of specific OHS measures is crucial to ensure safety standards across the diverse array of activities that take place within mining activities, and the principle should be to broaden such safety requirements and increase monitoring processes, such as inspections.

Of the inspections carried out by the General Inspector of Mineral Resources -IGREME, which is the governmental body to ensure best OHS practices- on the coal mining concessions, no health, safety and environment, notices, suspensions, or embargoes were instituted. However, several recommendations for strengthening existing air particles measurement, training workers on safety, and health aspects were made. Inspection actions were intensified in 2020, with 170 inspections having been carried out by the third quarter, against the 97 inspections carried out during 2019. This demonstrates a level of success in the monitoring system and ensures incremental improvements over time.

Ascertaining precise employment figures for each mining activity, or the mining sector, is impossible due to lack of verified data. Moreover, employment estimates are clouded by the expectations and promises typically made at the start of a mining project to gain community and/or government support, or to attract further investment, and should not be trusted.

For example, initial promises at Moatize Mine by Vale suggested 15,000 workers would be employed, yet despite expansions, current employment estimates show this to be far lower, with some 5,300 workers at the mine (Reuters, 2022). Similarly, over at Chirodzi mine, only 1,000 were employed by the end of 2014 - around 20% less than was promised at its inception in 2013. Some, like Riversdale (when it was responsible for the Benga mine operations), inflated numbers by including indirect jobs in their employment expectations, promising 4500 jobs by 2015. Others, like the proposed Revuboè Coal Mine, gave a more accurate figure by dividing this between employment during mine construction (estimated at 300) and when the mine was operational (estimated at 700). Such adjustments on expected employment figures should be made central to all mine plans, so that a reasonable gauge of employment can be determined.

According to Statista (2022), the mining and quarrying industry employed nearly 71,000 people in Mozambique as of 2019, showing an increase in employment across the mining industry, of over 20,000 people. However, the statistics do not specify for the coal sector, and the timeframe ends at the onset of the pandemic when employment in coal was reported to have fallen.

2.3.4 South Africa

The Congress of South African Trade Unions (COSATU) -the largest trade federation in South Africa- first recognised the just transition in 2011, with its Climate Change policy paper released a call for a just transition to a low carbon economy with a focus on mitigating impacts on workers, communities, and small businesses (COSATU, 2011). The coal value chain employs over 120,000 with direct and indirect benefits to communities and businesses - particularly in Mpumalanga (Minerals Council, 2021; NBI, 2021). Due to international pressure on the country to reduce Green House Gases, and the ageing of coal mines and power plants, the transition is inevitable. Research findings from various authors support the challenge of unemployment in the coal value chain in transitioning from the coal sector (Burton et al., 2019; Makgetla et al., 2019; Strambo et al., 2019).

The social dialogues have acknowledged the need for a just transition, with occasionally clashing views as to how it should be attained. A misconception noted is the trade-off between the coal sector and renewable energy. Renewable energy is anticipated to contribute to easing coal-related job losses but cannot replace the many jobs lost from the coal value chain. The transition will affect workers and communities differently, and therefore, it is important to support the process while considering the unique perspectives of those affected.

A proposal was put forward to improve the social security and retirement provisions (Maseko, 2021) while the Revitalisation of Distressed Mining Communities Programme is another government initiative aimed at improving socio-economic challenges in mining towns. The programme forms part of the Special Presidential Package (SPP) Social Accord signed between government, businesses, and labour in October 2012 (PMG, 2019), and is implemented in nineteen mining areas across six provinces, including Mpumalanga. The programme focuses on:

1. **Integrated and sustainable human settlements, led by the Department of Human Settlements and supported by its agencies**
2. **Improved socio-economic conditions, led by the Department of Trade and Industry, the Department of Co-operative Governance, the Department of Traditional affairs, and the Department Rural Development and Land Reform**
3. **Improved working conditions of mine workers, led by the Department of Labour**
4. **Decent living conditions for mine workers and meaningful contribution to the development trajectory of mining towns and labour sending areas, led by Department of Mineral Resources**

Mining companies in South Africa are required to plan for downscaling and promoting alternative livelihoods for workers during, and after, mine closure. The Social Labour Plans (SLPs) are usually seen as a minimum requirement for compliance with mine closure, but these are unfortunately not overly sustainable, as they provide only a short-term measure to service the local municipalities and cease after mine closure. Also, mine closure has historically focused on environmental rehabilitation to meet the minimum environmental requirements.

A shift to repurpose mining land for agriculture provides a potential opportunity that is gaining recognition. For example, the winter wheat crop project cultivated on rehabilitated mine land using mine water was successful, with a good yield (Mining Weekly, 2021). The pilot project was undertaken by Glencore and its partners, International Council for Mining and Minerals (ICMM), Mine Water Coordinating Body (MWCB), and Impact Catalyst at Wonderfonte, in Colliery in Mpumalanga. The quality of the crop for heavy metals was tested by the Agriculture Research Council (ARC), with heavy metal results being below the maximum threshold. However, the results of one planting season may not be sufficient to label the entire project a success.

Thus, there is a need to investigate the various planting seasons, and the changes in temperature, which impact soil properties. Even so, the project offers a significant potential, and other rehabilitated mine land must be tested for comparison. Such projects are usually Special Purpose Vehicles (SPVs) from the mining companies and have been classified as cluster 3 projects[33]. They are usually developed around land and water rehabilitation and provide an opportunity for investment at a large scale (Lowitt, 2021).

Various research institutions such as Centre for Scientific Industrial Research (CSIR), and the University of Cape Town (UCT) have undertaken research on alternative low-cost renewable energy sources. Moreover, the employment projections in relation to renewables have been provided. For example, the co-benefit study analysed the employment effects and opportunities for local value creation, skills requirements, and gender inclusiveness in the context of transferring from coal to renewables in Mpumalanga. The study projected job losses (direct and induced) under Eskom and compared the results with the updated IPR 2019, depending on the speed of decommissioning and repurposing of power plants.

Some of the key findings from this study included the possibility of Mpumalanga creating up to 79,000 clean energy jobs by 2030, including 25,000 direct jobs, 26,000 indirect jobs and 28,000 induced jobs. The value creation was also estimated to reach R340 billion (USD22 billion) for the period of 2019 to 2030 at higher local content levels (IASS et al., 2022). However, most of these studies have been based on theoretical models. In some instances, direct employment linked to renewables was reported. For example, the IPP office reported 60,517 direct jobs created from REIPPP projects by June 2021, of which 78% were from the construction sector, and 22% from operation and maintenance (IPPO, 2021)

The MPRDA regulations 41 and 28 (2002) make provisions for social and labour plans (SLP) with which the holder of a mining right must comply. The objectives of the SLP are to promote employment and advance social and economic welfare. In response to the just transition in the coal and energy sector, the National Employment Vulnerability Assessment (TIPS, 2020) was carried out to provide a detailed analysis of the capacity of vulnerable communities, workers, and businesses in the coal region. The assessment was undertaken across the 4 municipalities anticipated to be most affected in the coal transitional process. These are eMalahleni (Witbank), Steve Tshwete (Middelburg), Govan Mbeki, and Msukaligwa (Ermelo) - accounting for about 76% of overall coal employment (Makgetla et al., 2019). The findings were then used to inform the Sector Job Resilience Plan (SJRP), a study by TIPS on behalf of DFFE (TIPs, 2020). The SJRP suggests further development is needed for the renewable energy value chain to enable the vulnerable adjacent municipalities to benefit from the sector - for example, the manufacture and supply of renewable

[33] These are small-scale projects with ticket prices ranging from R1.5 million to R20 million but with high just transition ambitions.

energy components, operation, and maintenance of the renewable energy infrastructure. The implementation plans are guided by five principal interventions provided under the SJRP:

1. **Allocation of responsibility for driving the SJRP to monitor impacts on the coal value chain as well as the implementation of the SJRP itself.**
2. **Improve the effectiveness of existing Social and Labour Plans (SLPs), which are a prerequisite for acquiring mining and production rights. Critically, the SLPs need to be more accountable to workers and coal towns that are affected by mine downsizing and closure.**
3. **Additional support in plans developing to diversify the economies of coal municipalities over the longer run. The proposal indicates potential areas for economic diversification for illustration, with the caveat that far more in-depth studies on feasibility are required.**
4. **Active labour market measures must be strengthened and adjusted to serve potential future downsizing in coal.**
5. **Strengthening income support and social protection for workers and communities, including through an extension of public employment schemes.**

South Africa's largest, as well as one of the most powerful, trade unions is the Congress of South African Trade Unions (COSATU), the objective of which is to fight for worker rights by securing social and economic justice for all. Other key trade unions in the mining sector include the National Union of Metalworkers of South Africa (NUMSA), the National Union of Mineworkers (NUM), and Solidarity (Kalt, 2022). The trade unions support the country's overall objective of transitioning to a low carbon economy but emphasise the need for a fair process. Within their mandate, these federations educate their members on the importance of the just transition and the linkages with environmental sustainability (COSATU, 2011; Kalt, 2022). The trade unions' main concern in relation to the coal transition is the loss of jobs once the coal mines close and power stations are decommissioned. The unions have increasingly become fragmented with each prioritising their own challenges, for example, in 2018, NUMSA protested to prevent the minister from signing the renewable energy contracts -a move considered radical (Ward, 2018). NUMSA supports a socially owned and locally-focussed renewable energy programme (Winkler 2020).

COSATU released a blueprint on the just transition (COSATU, 2022), which highlights the key risks of unjust transition; these include:

1. **Retrenchment due to businesses closing and power stations being decommissioned.**
2. **Small businesses in the coal mining communities will also lose their source of income and livelihoods if this transition is not managed and if their perspectives and needs are not considered.**
3. **Support industries such as logistics, railways, port, and shipping companies and their workers, are also put at risk.**
4. **The loss of value if mining towns become ghost towns and infrastructure from decommissioned coal-fired power plants is left unused.**
5. **Migration of workers and communities into the nearest urban centres, which would be unprepared for the influx and struggle to provide housing and basic services. An unjust transition represents a lost opportunity to democratise ownership within the energy sector.**

Machinery in CFPP

Source: iStock.com/ArturNyk

Maputo, Mozambique

Source: iStock.com/Jacek.Sopotnicki

3. Lessons (to be) learned

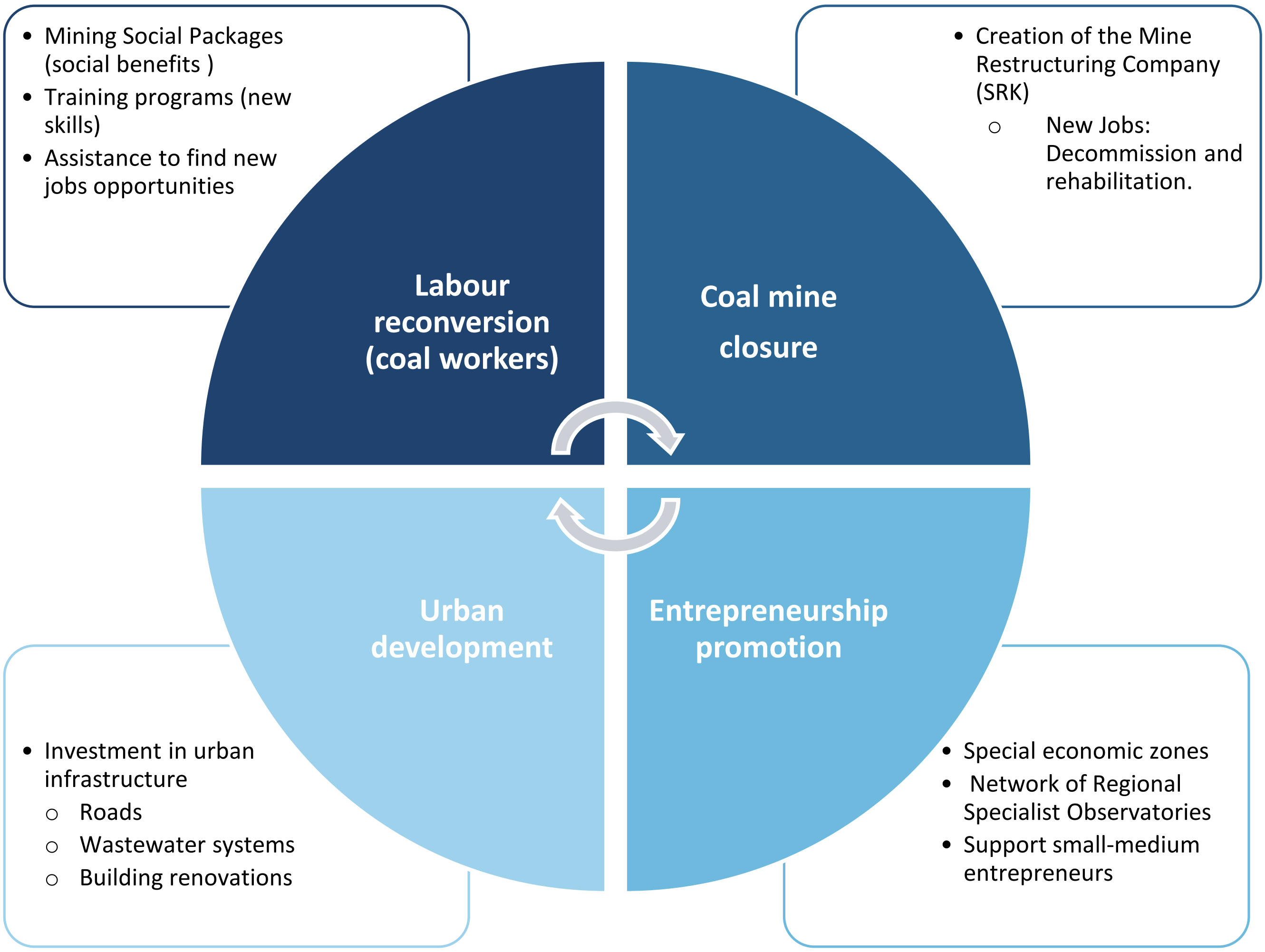
The objective of this section is to highlight examples to follow, or practices to avoid, in the context of the coal phase-out (CPO) and the just energy transition (JET) from selected countries. These recommendations, however, are not intended to be prescriptive, or to suggest that these paths alone should be followed, or that the same reactions to similar challenges are appropriate. Rather, the reader is provided with information from a range of contexts, and some observations from the NEXtra Core team as to how the study case countries may benefit from them.

Of course, the most prominent lessons learned (to be learned, or to be avoided) were extracted from the case studies themselves. To that end, the NEXtra Core team held a series of knowledge sharing sessions between themselves, after which, key lessons from Colombia, Indonesia, Mozambique and South Africa were discussed and then countries with relevant coal value chains were selected (Australia, Germany, Poland, USA and China) to determine whether their experiences could be applied to the study cases. As the histories of these additionally-selected countries are complex, a brief overview of them shall be presented below.

General context

Poland took action to stimulate an energy transition with the objective of a coal phase-out (CPO) from the early 1990s. These actions involved approximately 70 coal mines, with an employment base of 390.000 workers in Upper Silesia, from which about 147Mton were extracted (Exa et al., 2022). Through diverse measures on economic reorientation, environmental rehabilitation, and labour reconversion, the coal sector was reduced to 80.000 workers, and 54Mton being extracted in 2020 (Exa et al., 2022). Figure 64 shows a summary of the main policies and strategies applied in Poland.

Figure 64. **Main strategies applied in Poland for the energy transition and coal phase-out**
Source of data: Exa et al. (2022)



For Australia, conversely, coal forms a significant part of the electricity mix (51% in 2021) (Department of Climate Change, Energy and the Environment and Water, 2022), while CPO has been a hotly debated issue in the country's energy sector for decades. The country is also heavily threatened by the climate crisis, particularly in terms of food production and the impact of extreme weather events. Australia is also the world's biggest exporter of coal (Murray, 2020), with the current price boom taking Newcastle thermal coal into record high prices of up to US$180/ton, as a result of increased electricity demands in India, China, and other Asian countries (Mercer, 2021). Moreover, Australian coal is set to become the second commodity ever to crack $100 billion in annual exports in 2022 (Beavan, 2022).

The third country studied, the United States (US), has relied on coal for electricity generation since the oil embargo of 1973, where coal was determined to be a replacement for oil, resulting in government support for the construction of more CFPPs (Jordan et al 2021, Popa et al 2016). The main coal basins of the US include the Powder River, Illinois, Uinta, the Appalachian, and other Western and interior basins (Popa, 2016). Coal consumption had declined to almost 50% by 2019, from approximately 943,5Mton to 489,3Mton in a matter of years (Finkelman et al, 2021).

President Biden established an Interagency Working Group on Coal and Power Plant Communities and Economic Revitalization on January 27th 2021. The President is committed to robust federal leadership in direct partnership with energy communities with the aim of fostering investment and economic revitalisation, ensuring the creation of good-paying jobs that provide employees with the option of joining a union, remediating mining and drilling lands and plant sites to address environmental degradation, and securing the benefits earned by workers (The White House, 2021).

Germany transitioned from operating one of the world's largest hard coal extractions in the beginning of the 20th century (after the US and UK), to closing the last mine in 2018, following a long process during which subsidies for the sector were removed[34]. From 1958 to the mid-1980s, lignite extraction increased steadily -from just over 300Mton to about 410Mton- while hard coal decreased from about 150Mton to less than 100Mton. After that, extraction of both types of coal declined sharply. As of the early 2000s, lignite has stabilised, and hard coal gradually decreased to 0 in 2018 (Furnaro, et al., 2021); the same year, the German Federal Cabinet established the Coal Commission to a) Propose measures for the energy sector to meet the 55% emissions reduction goal by 2030 and b) Develop plans for the CFPP phase-out (Agora Energiewende, 2022).

Like Australia, coal also dominates China's energy sector, supplying 54.7% or 43,791TWh of the total in 2021 for a market of over 1.4 billion people (Ritchie & Roser, 2022). China is the largest coal extractor and consumer in the world (World Economic Forum, 2018; Worldometer, 2022), with the four sectors consuming the most coal being power generation, iron and steel, construction materials, and the chemical industry.

Teng Fei (2018) highlights several problems stemming from the dominance of CFPPs. For example, most air pollutants come from the coal value chain. It contributes 91% of the total SO2, 69% of the total NOx, and 52% of the total PM2.5 and it is estimated that in 2012, PM2.5 from the coal sector was responsible for 670,000 premature deaths. Environmental damages in water quantity, soil erosion, vegetation degradation, and desertification are very difficult to prevent, due to the insufficient current coal pricing mechanisms. Currently, this value is around 30-50 yuan/ton.

[34] Hard coal regions in Germany are concentrated in the west (Southwest Saarland, Ruhr area and Ibbenbüren) while lignite is distributed in an East-West belt (Lusatia, South and East of Leipzig, Helmstedt and the westernmost parts of North Rhine-Westphalia and Rhineland-Palatinate).

Global events

A lesson that can now be learned from the events in 2020 (COVID-19 Pandemic) and 2022 (War in Ukraine) is that global events impose relevant, and even decisive, impacts on CPO and JET plans, and on the coal market itself. Coal prices reached historically low levels in September 2020, leading to the forced closure of some projects in the NEXtra Core countries (El Espectador, 2022).

This correlation between coal price and historical events is evident from examples from a range of countries and has also been true in other moments of history and examples from other countries show it clearly. In the US, for example, the decline of coal has mostly been attributed to the market competitiveness of shale gas and technological advances in NCRE deployment (World Bank Group, 2018, Popa, 2016). Even so, most of the US' aging coal plants have very limited prospects beyond decommissioning. The shift in markets from coal to shale gas, has meant the region has become more vulnerable. The Appalachian Regional Commission was formed in 1965 to address issues related to the coal transition (World Bank, 2021).

Political Will

Much like the other case study countries, CPO/coal phase-down (CPD) totally depends on Australia's political will (Quiggin, 2021), with successive conservative governments ensuring that ongoing subsidies are awarded to the sector. At COP26, the Australian government said it would not commit to a coal phase-out (Morton, 2021) and reiterated that it would continue to export coal beyond 2030 (Regan & Dewan, 2021). However, following a landslide victory in 2022, the new Labour government has already discussed coal-phase out[35]. A very similar situation took place in Colombia, with the new Government reiterating its intention to halt coal exports based on sustainability claims (Pacto Histórico, 2022). Another common element between Australia and several other case studies is the great potential for NCRE. In terms of availability, current usages of solar and wind generation could be multiplied, provided that political will and financial resources are available.

Autonomy and decentralisation may, in some cases, be advantageous to promote CPO and JET. As a federal system, some Australian states are already initiating coal phase-down processes. An example of this activity is that of New South Wales, which, in the absence of policy at the federal level, anticipated the closure of four of its five CFPPs by 2030; other states have since implemented similar measures. Queensland announced in 2022 that it intends to source 70% of its energy needs from renewables by 2032 and 80% by 2035, with a new installed capacity of 22GW based

[35] With Teal candidates (a new independent group of conservative businesswomen that won against the LNP, and who are pro-climate action) winning seats, Green seats growing slowly in inner cities, and the ALP forced to move on climate, there might be a good opportunity in the next 3 years for Australia to progress nationally.

on hydro, pumped hydro, solar, wind, and hydrogen projects (Jackson, 2022). Another valuable experience may be Western Australia's 'Royalties for Regions' programme, which sought to use mining revenue to support communities. These initiatives could be tailored to fit a JET-COP programme. It has been shown that if the states promote solar use – whether collectively or individually - the potential for JET success is significant (Nelsen & Gilmore, 2021).

Unfortunately, these advantages largely depend on the local political and social views surrounding the topic of coal, as has been seen in the US, where some states have openly opposed JET and CPO policies. For example, In West Virginia, the Renewable Energy Portfolio Act of 2009 still includes the caveat of some 'types of alternative coal'. The Act required utilities to supply 25 % from renewable energy sources by 2025. The broad definition of 'alternative' energy sources – of which, coal is included - has made it easy for utilities to comply with the Act; despite this, state legislature repealed the Act in 2015 (Thombs and Jorgenson, 2020; POWER, 2015).

A key factor in a country's ability to initiate a successful CPO and Just Energy Transition is that of the national political forces agreeing. This consensus is invaribly achieved through long and open discussions between stakeholders. In Germany, sectors such as political foundations, civil society organisations, public institutions, and academia have played central roles in this process. Indeed subsidies to the hard coal sector (amounting to between €289 to 331 billion from 1950 to 2018) ceased due to their incompatibility with EU regulations, as confirmed by law (Herpich, Brauers, & Oie, 2018).

To control emissions, China's government announced a 'before 2060' net zero emission target at the end of 2021, following the completion of their NDCs. China stated that the emissions peak must be reached before 2030. The reduction target has been set for between 13.4 and 14.7 GtCO2eq by 2030, and 5.6 to 5.8 GtCO2eq by 2050. However, Climate Action Tracker (2022) values this target to be 'highly insufficient' as the increases in global temperature could fall within the range of 3oC to 4oC if all countries adhere to China's target. China also has a carbon pricing mechanism to compensate damage to climate and the environment caused by the coal industry. However, this pricing mechanism amounts to only 51.23 yuan per tonne of carbon (USD7.27), although the Ministry of Ecology and Environment (MEE), and the Ministry of Natural Resources (MNR) used the concept of natural-based solutions to determine this value. This concept claims to be a good methodology for policy-making processes in relation to mitigating climate change without forgetting biodiversity loss. In the context of carbon pricing, the 'penalty' amount is determined based on the biodiversity loss, ecosystem changes, and climate change mitigation actions needed – serving as an efficient method of linking global impacts to local impacts.

Aside from the emission targets and the pricing mechanism, some recent regulations have also affected the Chinese coal industry, for example, a regulation passed in order to close 4,300 small coal mining areas (about 90,000 tonnes per year), starting in 2016 (Dasgupta, 2016; Teng Fei, 2018). This decision also imposed the risk of job losses for 1.3 million workers; thus, the government allocated 100 billion yuan for workers' training and relocation (The Guardian, 2016). After months of efforts to reduce environmental damages from small coal mining, some of them were re-opened following increased global demand in 2020 (Carbon Brief, 2021). The Renewable Energy Law, created in 2006 and amended in 2009, contains provisions for increasing renewable energy share, but it does not contain clear indications for a coal phase out and/or moratorium. Finally, there has been a recent announcement regarding halting investments in the newly built CFPP abroad, and supporting low-carbon projects in low- and middle-income countries. This announcement caused distress for the recipients of some of the largest investments, such as Bangladesh, Indonesia, Pakistan, South Africa, and Vietnam (Global Energy Monitor, 2022). Indonesia received USD91,093 million in 2021, placing it in the first rank of recipients.

China is also a global leader in energy transition project investments, allocating USD266 billion for domestic and international use in 2021, 60% higher than that 2020 (BloombergNEF, 2022). Most of these investments were intended for renewable energy and electric transport. Moreover, China is well-known as a global supplier of low-cost solar panels. The growth of PV cells and arrays manufacturers began in 2002, when the government started encouraging solar projects to increase renewable energy share. China's government intends to facilitate an additional 1,200GW from new solar and wind power by 2030.

Financial Mechanisms

From the perspective of the Global South, one of the most complex challenges to be faced is that of financing the JET. In that sense, the Just Energy Transition Partnership (JETP) could serve as a model to be replicated in other countries. It may also be negotiated not only by individual countries, but by regional blocks of countries with a vested interest in addressing the JET, that may share sections of their coal value chains, as in the cases of Mozambique and South Africa. However, the achievement of this may be difficult at present, due to undisclosed details and a lack of implementation. For countries in the Global South, the loan mechanisms that are sometimes included in these alternatives may be challenging to navigate.

For example, Mozambique already faces significant debt repayment limitations, compounded by even worse crediting issues. Rather than increasing dependency, any climate funding to be provided, should be done so as a grant with concrete goals, and transparency and oversight mechanisms. Although South Africa has promoted the JET Fund, it is also true that it has sought a coal phase-down, rather than a CPO, which has raised questions in relation to the use of loans in this context. Eskom will decommission coal power stations, but it is also permitted to build new ones; this is a contradictory 'right to pollute' model, like that of the EU carbon credit scheme.

Financing such a transition may either imply monetary compensations to the stakeholders of the coal value chain by the government -a measure also applied in Germany- or ever-increasing operation charges or taxes to incentivise expedited closure. These measures might not be sufficient for all the stages of the coal value chain, especially for countries like Colombia or Mozambique, which export most of their coal, and whose energy mix is not based on it.

An alternative could be the Energy Transition Mechanism (ETM) of the Asian Development Bank (in Indonesia, the Philippines, and Vietnam) (ADB, 2022), which uses public finance to reduce those coal obligations that could be designated as export substitutes and promotes low-cost renewables and local grid solutions. On the one hand, such a model could allow funding to be used to offset the losses made to state revenue during the phase-down of coal mining, as is the case for Colombia and Mozambique. On the other, funding could potentially bridge public sector utilities/infrastructure and private sector operators, to define pathways to clean energy via off-grid solar projects.

Moreover, despite the many benefits of strengthening private investment in renewables and increasing their participation/competition, the dominance of private interests may come at the expense of domestic needs/interests. This is particularly worrisome for Mozambique - a country whose influence of civil society is not particularly decisive, and in which public oversight mechanisms are far from appropriate.

The Climate Investment Funds' Accelerating Coal Transition (ACT) programme offers resources at scale to countries that face competing pressures on their public finances (CIF, 2020). To mitigate this, rather than repurposing existing infrastructure, which in countries like Mozambique and Colombia, is very poorly developed, international funds could be channelled into export substitution, revenue compensation, and supporting the expansion of microgeneration projects.

In any case, if such mechanisms are to be available for other countries in the future, it must incorporate appropriate provisions to manage the legacy impacts of coal mining at the local scale and not only at the global scale; this means that, although climate action is pivotal in the CPO discussion, overseeing the impacts of the coal value chain at the local level is indispensable for the JET.

Labour policies and other regulations

A report for the Australia Institute found that the country could successfully transition its coal-associated workforce through a range of measures including early retirement, retraining, and investments in renewable energy resources for coal-dependent regions, with a cost of around AUD50 million a year over ten years (Quiggin, 2020), which is a relatively modest cost for an economy like Australia's. These processes would be arguably cheaper still in cases like Colombia and Mozambique, where the coal sector is concentrated in specific regions; therefore, International Cooperation has an opportunity to produce considerable positive impacts if the right conditions (efficiency, effectiveness, opportunity, etc.) are achieved. It is also relevant to mention that, under their current financial situations, countries like Mozambique will have extreme difficulties in allocating even minimal resources to this objective.

In Poland, the installation of labour reconversion programmes that consider reskilling according to the market needs is both a point to stress, and a valuable lesson to be learned. Another example worth mentioning is the entrepreneurship support packages, which are designed to revitalise the coal regions with new business ideas. From an environmental perspective, a specific organisation, or set of organisations responsible for controlling, monitoring, and maintaining the closed infrastructure is indispensable to ensure that local impacts will not severely impair the JET goals. Finally, other types of transition management institutions have proven to be useful in countries like Australia, with the LaTrobe Valley Authority (LVA) -an independent and publicly constituted authority- to help manage the transition involving community-bodies.

According to Exa et al. (2022), during the course of the Mining Social Packages (MSP) programme and the Assistance for Restructuring Economies (PHARE) programme -both of which were implemented with the objective of creating jobs and economic development in Poland- Upper Silesia showed a considerable increase in unemployment. By the end of PHARE, the unemployment figure was around 49% due to difficulties in employment generation, a lack of entrepreneurial experience, and in some cases, because the skills offered by the transition programmes did not match the needs of the labour market.

The difficulties experienced by PHARE in this regard may not be shared by Mozambique, as the sector is quite small. For example, the largest mine -located in Moatize and now owned by Vulcan- employees just under 6000 workers. For countries such as South Africa or Indonesia, however, the challenge might be more prevalent.

An antecedent that can be considered in this context is that of the central Appalachian region in the US. This region saw the most job losses at over 42%, with 51 out of 78 counties being classified as economically distressed (Debolt, 2021, Chesmore 2021). Job losses occurred more at the coal mines than for the CFPPs (Jordan et al 2021). Moreover, the region has historically been poor in comparison to others, with the lowest per capita income levels in the US, despite being the main coal basin of the country. Many of the state-level policies that tackle the coal phase out with NCRE have not fully considered the financial burden to be borne by the communities in the coal mining regions (Chesmore et al, 2021).

For communities that have faced job losses in coal mining areas, overcoming challenges such as reskilling are key to successful implementation (Hess et al 2021) and in general, coal employees have expressed excitement at these new opportunities. Some states in the US have created permanent funds with money from severance taxes for future economic development in the coal region. Severance tax depends on the coal production -which has seen a downward turn due to competition, particularly from shale gas. States such as Alaska, Montana, Wyoming, and New Mexico have had a long-standing permanent fund. Many companies have filed for bankruptcy due to overinvestment in coal assets over the high peak season of coal prices, which with time, has led to high interest rates (Popa, 2016).

Efforts to rejuvenate the JET in the US can be tracked across the different administrations, with occasionally deviating commitments. For example, a Partnerships for Opportunity and Workforce and Economic Revitalization Plus Plan (POWER+) under the Obama Administration made efforts to financially support communities but was never able to be fully realised due to partial funding. Under the Trump Administration, a deregulated market was supported, with natural gas competing more favourably. Additionally, under the same Administration, (POWER+) was changed to the Economic Adjustment Assistance Program in 2017, with about US $30 million being set aside for the coal communities. The funds went to manufacturing jobs and infrastructure development, with minimum priority afforded to renewable energy transition projects. (Chesmore, 2021).

A common element between Australia, Mozambique, and to a certain extent, the rest of the case study countries, is their need for more robust national plans for a JET, to be understood as a general and overarching policy framework that includes CFPP phase-out, CPO, a series of measures that are conciliatory to the private sector, and a process that meets international climate commitments. All these plans must be oriented not only to domestic coal consumption, but also to export and revenue substitution.

One of the most important lessons to be learned with regards to labour -and other social policies- for the NEXtra Core study case countries, is the sheer importance of baseline policies; understood as all those systems that constitute the backbone of the State-society dynamics in a country. For Germany, Furnaro et al. (2021) recognise three major points: the social security system, the labour system, and the equalisation system. In countries of the Global South, it is not infrequent for such policies to be flawed from their design, suffer from weak implementation, or lack the coverage or tools for their realisation.

Countries that seek inspiration from others, especially in the classic Global South-Global North sense, must understand that the existence and implementation of these baseline policies make a vastly different scenario for the 'example' countries that consider them. Therefore, decision-makers should be realistic with the limitations and potential hurdles that may appear in their own contexts, and plan for them accordingly. For example, if no unemployment insurance exists in a country, the JET policy must carry the entire burden of such a situation in a phased-out coal value chain, and hence, they must be even more robust in comparison.

As it will be discussed later in this section, collaboration between institutions across different levels, themes, and scales (local, national and regional) is challenging, because some of the coal regions themselves (most notably in Colombia and Indonesia) expand over the subnational borders, and therefore require special coordination. The bodies appointed to manage the transition should have both the capacity and autonomy to implement strategies in the coal regions. They must consider, but not be limited by, national or subnational constraints, or differing practices on each side of a border. Administrative institutions must strive to facilitate their work. Although evaluations and actions may be carried out by each subnational entity, the scale of analysis and action for a CPO must always be the coal value chain. Subnational entities must prioritise the success of the body created, and not their regulations or policies, although a harmonisation process and open communication channels are essential.

New Markets

Diversification has its own challenges, especially for companies with coal at the core of their businesses. Investors may not be willing to take the risk of investing funds beyond a transition period, but coal companies that have been successful in transitioning to other business models have already diversified revenues as a long-term strategy, for example, CONSOL energy, in the US, maintained utilities for coal in close vicinity to the natural gas reservoirs, making it easier to shift to a natural gas focus. (Popa, 2016).

Strategies in Poland that are also mentioned by Exa et al. (2022) include the Katowice Special Economic Zone, the Regional Agencies for Enterprise Development, and the Network of Regional Specialist Observatories (NRSO). The Katowice Special Economic Zone is an area for which investors receive tax reliefs. The Regional Agencies support small and medium entrepreneurs (SMEs) and assist their growth and competitiveness by providing investment and start-up loans, training and auditing services, and business consulting. Lastly, the NRSO analyses the region's economic sectors and identifies key areas to drive development, led by academia and research institutions.

In the US, one of the aspects that influences the energy sector is, again, the regulated and deregulated markets. In regulated markets, utility companies own power generation assets and can recover the costs of new investment, such as natural gas and renewables from taxpayers. In deregulated markets, utilities are often responsible for the transmission and distribution of electricity and have divested from electricity generation. The deregulated market enables market competitiveness through a bidding process for the power generation. For example, one of the largest utilities, American Electric Power, operates in 9 states under a regulated market at about 46.3%, and for 2 states, in deregulated markets at 73.9% (Popa, 2016). Coal still dominates in the competitive/deregulated markets, but the market overall is also influenced by emissions reduction policies and lower prices for renewable energy.

Infrastructure

Programmes for economic development at the local level, such as the Programme for Alleviating Effects of Employment Restructuring (2003-2006) and the EU-funded Regional Operational Programmes (2007), have played a major role in Poland. The main objective of these specific programmes was to improve infrastructure, promote urban development (roads, wastewater systems, building renovations, etc.), and support small and medium enterprises with loans (Exa et al., 2022). These programmes were financed by the Polish Government, with loans from the Council of Europe Development Bank and the European Just Transition Funds, while EU-funded Regional Operational Programmes function throughout 2014 to 2020 also financed social and environmental projects.

A very important point to mention in regard to the recommendations posed for this section is that coal regions are geographically delimited; they are not only conditioned by different factors like politics and the economy (meaning: making the decision of extracting the coal or not, when and how to do it, at what scale and by whom), but also through the existence and characteristics of the deposits themselves. To that end, it is pertinent to keep in mind that coal regions may occupy different states or provinces in the same country or may even occupy different parts of neighbouring countries. This is the case for Saarland, the westernmost regions of North Rhein-Westphalia, Rhineland-Palatinate, and Lusatia and therefore, coordination efforts are undertaken not only at the local scale (between municipalities or provinces of the same country, e.g.: Brandenburg and Saxony), but between institutions from different countries, followed by multilevel agreements with all involved.

These liaison activities can create another level of challenges to be addressed, however, for the NEXtra Core countries, that situation does not seem to be the case, except perhaps for some of the parts of the coal value chains of South Africa and Mozambique (transport and export).

The Australian Labour Party promised a AUD20 billion 'Rewiring the Nation' Plan if it won the federal election, among other policies (Crowe, 2022)[36]. This includes the establishment of mechanisms to oversee the updating and change of the National Energy Market (the grid). This plan assumes that Australia will be transitioning to renewable energy, based on its economic efficiency, although the timeline presented is very minimal and unclear.

Another lesson still to be learned regarding the complexity of CPO and JET processes is the need for grid flexibility to support renewable energies, and an emphasis in decentralised microgeneration systems. In some cases, like that of the Hazelwood closure, although the generation capacity for substitution was available, storage capacity lacked (McConnell, 2017).

In the United States, the energy transition from coal to natural gas has experienced its challenges, mostly in relation to the insufficient utilities. This is especially true for the inadequate pipeline infrastructure for gas storage sites, which impedes transitional processes. Moreover, the transition of coal plants from base load to intermittent load requires frequent ramping, which affects the operating life of the plants (Popa et al 2016). In the Appalachian counties, the transitional efforts are hampered by limited access to labour markets. This is mainly due to insufficient infrastructure, such as road networks to facilitate access to other job opportunities (World Bank Group, 2021).

China's transition into a free-coal energy sector is not an easy task, due the historic role of this commodity. One of these issues is the intensive use of low-quality coal for heating houses and stoves owned by the less privileged and small industries, without complementing it with proper air quality control equipment. Thus, the changing of heating systems to electric, and traditional coal stove into gas, will increase the monthly energy expenses of that group (Teng Fei, 2018). To successfully transform these activities, China's government needs to provide electric heating and gas systems in the residential areas for this population well before totally ceasing coal use (Hao, 2018).

Stakeholders' inclusion processes

Poland CPO process has showed many relevant aspects to serve as lessons learned. One positive aspect is the inclusion of different stakeholders and the political will to carry out the process, which has been pivotal in the design of policies and plans around CPO. Early retirement and welfare allowances for coal workers emerged in 1993 as the first relevant policy. In 1998, the Act of

[36] An ALP policy stated in April 2022 showed that coal mining companies would have to pay just $1.20 per tonne of coal to offset some of their carbon under a Labor policy to meet a United Nations target of net zero emissions by 2050. The Grattan Institute study showed the mining industry would face a "pretty modest" cost burden under Labor's Safeguard Mechanism to require the gradual cuts to emissions." (https://www.smh.com.au/politics/federal/labor-s-climate-plan-would-have-little-financial-impact-on-coal-grattan-20220427-p5aghx.html)

the Adaptation of Hard Coal Mining to Functioning in Market Economy Conditions and Special Rights and Tasks of Mining Communities was released, featuring a programme called Mining Social Packages (MSP). One of the important characteristics of this process that served to prevent conflicts, was the participation of unions in drafting activities.

New Gliwice, in Poland, can be considered a successful case of cooperation between municipalities, mining companies, and the national government. The project revitalized former coal mining sites by reusing industrial buildings and preserving cultural heritage (Paul Baker et al., 2021). Currently, New Gliwice is home to several technology companies and a functional urban space that attracts residents with cultural and sports events. A general observation that can be made in terms of participation is to the importance of accommodating, but not subsuming, the interests of the private sector in JET and CPO procedures.

The Australian example shows that letting the market solely control the pace of CFPP closure has been disastrous for community and workers, and evidence suggests that the same applies for CFPP and mine closures in the case study countries. An important risk associated with CFPP closure for those countries where coal is the primary electricity source -like South Africa and Indonesia- is price spikes. In Australia, the poorly planned and expedited closure of Hazelwood CFPP in the state of Victoria resulted in an increase from AUD60 to AUD100 per megawatt hour (MWh) (D'Hotman & Hamilton, 2021).

Regarding community participation, the LVA provides a good institutional framework to be modelled. This body has been made a permanent statutory authority, allowing it to support the transition in the Latrobe Valley over the long-term while the remaining three CFPPs in the area are phased out, and new industries, employers, and opportunities are embedded in the region (see State Government of Victoria, 2022). It retains a focus on JET and works collaboratively across communities, councils, industry, education providers, and government.

Another advantage for countries like Mozambique is the relatively low community support for the coal mines, given the lack of revenue or other benefits being transmitted back to the communities. Ongoing compensation issues for relocated communities also detracts from positive attitudes towards the coal sector in Mozambique, at least from a local standpoint. Therefore, decarbonising value chains is likely to find more support in Mozambique, although qualitative research would need to be carried out on the workforce and community perceptions to confirm this.

The Australian Council of Trade Unions called for an independent 'energy transition authority' to manage the transition. A Senate Report was made in 2017 (Commonwealth of Australia, 2017) and it called for an orderly closure process to encourage price stability and investment certainty, the need for a national transition plan, and a ‚just transition' for workers and communities.

The US coal energy decommissioning process does not fully engage communities in planning and decision making due to an unstructured governance system (Tarekegne et al 2022); the decommissioning decisions are instead carried out on a plant-by-plant basis. In such instances, the CFPP owners make decisions on whether to continue operation until the end of life of the plant or return to active production during peak periods. The communities are usually the most affected by such decisions and the process may not fully meet the standards of the energy transition.

Differences between study cases and selected countries

A key difference between the Australian case and the NEXtra Core study cases is the availability of resources, both at the national and the regional level. Again, the Hazelwood case is a good example of this. The Victorian government introduced a AUD266 million transition package and authorised the LVA to coordinate transition and economic development in the area (State Government of Victoria, ND). The federal government also provided a AUD40 million support package (Minister's Media Centre, 2016); at over AUD300 million in total, this is the largest-ever transition package provided by an Australian government in response to a CFPP closure.

South Africa's electricity generation mainly relies on coal, with most of the mining sites and the coal powered plants being in the same region. This allows for the easier repurposing of coal mining sites and plants to renewable energies. In Colombia and Mozambique, on the other hand, coal extraction is mainly intended for export, and in most instances, the CFPPs are located far from the mining sites. One aspect that is evident in the study cases of the Global South is the political influence and conflicting interests surrounding either phasing out, or phasing down coal to renewables.

South Africa is seen as one of the model countries for the energy transition in the Global South, which has qualified the country for ambitious transition support funds, and therefore, it continues to receive decommissioning funds and assistance for socio-economic transformation, for which results are yet to be seen.

Germany has a very large capacity to allocate resources to planned transitions and has carried out a gradual process for its coal sector. It has also designed independent processes for hard coal and lignite, for example, providing tailored answers for each study case/commodity/area. Even within the country, different coal regions face significantly different challenges; to alleviate this, international events such as the Forum of Mayors on Just Transition has been used to reflect upon and share assessments of weaknesses, strengths, risks, and opportunities.

It is important, however, to understand that although no country can successfully prevent all the negative effects that come with such transition, management will be more effective if a transition plan is accepted and implemented. It is important to understand that a faster phase-out will result in a faster recovery (Oei, et al., 2020), and that negative impacts must be acknowledged, rather than hidden or denied.

Regions like Lusatia have drafted expansive Development Strategies to involve areas such as infrastructure, innovation, and research (attracting research institutions and researchers), economic support, development of the work force, culture, art and tourism, and others via a participatory process involving almost 50 authors (Wirtschaftsregion Lausitz GmbH, 2020). One very positive takeaway from this process is the multistakeholder and multicultural approach utilised. The reports and other materials have been written using inputs from different actors and are available not only in German, but in Sorbian and Polish, which is a lesson to be learned for the NEXtra Core countries.

Fohnsdorf Mine, Austria **Source: Ándres Ángel**

Mine closures

In Poland, the Mine Restructuring Company (SRK) was created in 2002 to aid in mine closures. SRK created new job openings for employees, assisted departing workers in seeking new opportunities, and provided support to them during their transition to new jobs. From 2015 to 2018, SRK assumed 16 mines and about 13,000 additional employees (Exa et al., 2022), and was charged with environmental tasks like protection against fires, water treatment management and control, and sales of methane emissions, and restoring post-mining areas (SRK, 2022).

In 2021, Australia became concerned by significant risks to supply and prices as CFPPs began to decommission. Closures of South Australia's Northern and Playford B CFPPs in Port Augusta (in 2016), and Victoria's Hazelwood power station in the Latrobe Valley (in 2017), highlighted these issues. The Hazelwood closure (2016-2017) and other current closures in the Latrobe Valley, have since pushed the arguments surrounding JT to the forefront of policy and public debate.

The Australian case highlights that such closure plans must be agreed upon by all parties; they must include robust environmental information, close monitoring processes, and periodic and frequent reviews of the bond paid in securities to account for any changes to the closure plans.

In the US, some of the challenges faced during the transition referred to the long-term contracts held by many power generation utilities with coal suppliers; thus, limiting the energy mix. Nonetheless, companies continue to renegotiate these contracts based on changes in policies and the low cost of renewable energies. Many coal companies also filed for bankruptcy, leading to devastation for both the environment and employment. Many employees were laid off, and no funding was available for environmental rehabilitation. For example, Walter Energy was granted approval by the Federal Judge to reject its labour agreements and put a stop to retiree benefits (Popa, 2016).

A more positive legal antecedent was set by the Mercury and Air Toxic Standards (MATS) rule implemented in 2015, which contributed to a decline in CFPPs (Bowen, 2020); proving once again that in general, strict environmental standards and regulatory frameworks have a positive impact on transition efforts.

Even with the continued efforts to rehabilitate land disturbed by surface mining in some sites in the US, the rehabilitation of ecosystems has often failed. Revegetation of surface mines also tends to fail due to soil chemistry (Bolan et al, 2017), while low water quality has persisted, or even worsened. These environmental effects are associated with extreme disruptions to the hydrological and ecological systems, loss of soil nutrients, and contamination in general (Lima, et al 2016). These effects may persist for several decades, centuries or even millennia after closure. From existing research, topsoil replacement is apparently the best approach to re-establish plant communities. In Appalachia, many mines use rock spoil, especially in steep slopes (Zipper, et al 2020) and soils with excessive compaction (Bolan et al 2017).

Additionally, US researchers have developed a methodological approach to reclaim mined land. This approach, known as the ‘Forest Reclamation Approach (FRA)’ is designed based on site conditions that favour forest vegetation. The FRA is a 5-step process involving: a) the creation of a suitable rooting medium (topsoil for tree growth), b. Grading the topsoil loosely to create a non-compact growth medium, c) using underground plants that do not compete with trees for water, light, and space, d) planting commercially valuable crop trees and succession species for wildlife, and e) using correct planting techniques.

In Germany, organisations like the RAG Foundation and Wismut GmbH work to mitigate the impacts, and design alternatives for former mining sites. The activities, most of which must be carried out in perpetuity, are also supported by academic organisations such as the Georg Agricola Technical College. Despite these being good examples of undertaking the necessary activities to benefit former mining regions, they also act as a warning for future expansion of the coal sector in other countries, as the costs associated with the mitigation may be extremely high. For this report, the three organisations were contacted, although no satisfactory answers were obtained.

Fohnsdorf, Austria, coal mine and overburden material **Source: Ándres Ángel**

Fohnsdorf Mine, Austria

Source: Ándres Ángel

4. Recommendations

This final section will apply the knowledge garnered during this study to the context presented in Chapter 1, the challenges and opportunities described in Chapter 2, as well as the lessons learned, and to be learned, from other perspectives – all of which have been drawn upon to create recommendations relevant to all stakeholders from the case study regions and beyond. The purpose of these recommendations is to point out the pivotal issues that, if addressed, will help to foster both a Just Energy Transition (JET), and a Coal Phase-out (CPO) that consider global sustainability goals in the light on of their local implementation, including environmental benefits but also socio-economic opportunity costs and challenges. In this context, the relevance of a resource nexus approach for managing synergies and trade-offs between different environmental and regional development objectives is discussed.

The recommendations presented here have been shared and discussed with some of the stakeholders interviewed for this report for the purpose of relaying feedback; indeed, certain common elements could be identified across different coal regions and countries. These common elements specifically include: The recognition of the current context of high coal demand and prices as both a challenge, and an opportunity to reorient extra taxes and royalty resources to JET and CPO initiatives; The advocation for more transparency regarding the coal value chain information, and the recognition of the need for binding community participation in decision-making. Moreover, gaps in the EIA process -such as deficiencies in environmental quality estimations in the long-term- that effectively compromise the social, economic, and environmental sustainability of the coal regions, were determined. In relation to this issue, the responsibility regimes for post-closure were deemed unclear and, in some cases, not even developed. At the essence of all examined cases was a need to improve the current conditions of communities living in the coal regions, including access to health infrastructure and pilot programmes of renewable energy deployment. These points are presented in more detail below:

4.1 Colombia

This report was produced just before, during and just after a very sharp turn in national politics in Colombia that arose from a government change and complete re-orientation of national energy and environmental policies. However, previous chapters and these recommendations alike have been heavily influenced by the challenges and opportunities that are long-term and which persist to constitute development challenges for coal regions across the country. An assessment as to how these challenges can be best overcome in this new scenario was made, resulting in the following:

- **Promoting Non-Conventional Renewable Energy Access -particularly in rural communities located in the influence areas of coal mining projects- as a key aspect of the Just Energy Transition**

NCRE access is a key aspect for JET in Colombia, with the potential to significantly improve the living conditions of people in rural areas, especially those in the coal regions. Micro-, small-, and medium-scale community-managed generation projects (including off-grid energy communities) would help to address equity issues. NCRE electrification also has the potential to solve other equity issues, such as drinking water access, thanks to the installation of specialised procurement systems.

Community-managed generation projects should be articulated with legal incentives, economic benefits, and technical operational know-how. Financial and technical cooperation from international organisations, cooperations, and academia, could have a massively positive impact on proceedings. Finally, the political will at the time of writing is favourable; it stands to reason that these initiatives will be able to gather significant support.

- **Adjusting regulatory and policy instruments to clearly define the Coal Phase-Out as an essential factor in the country's Just Energy Transition**

As has been previously shown in this report, the current regulations and policies (Energy Transition Law (2099/2021), CONPES Document 4075/2022, and others) have intentionally left the door open for continued extraction, and instead propose technological solutions (e.g.: CCS) or compensation measures (e.g.: reforestation) to deal with emissions, following the logic of a Coal Phase-Down (CPD) and not a Coal Phase-Out (CPO). If a JET is to be truly achieved across all levels, CPO must form the cornerstone of all measures. A rigorous analysis on the feasibility of CCS facilities as a strategy to reduce CO_2 emissions[37] should also be carried out. Adjustments to Law 2177 (Congreso de la República, 2021b) are urgently needed to prevent new coal value chain projects from being granted with lines of credit from public funds, which is a major component of this regulatory piece, and thus prevents the appearance of new stranded assets.

[37] Considering uncertainties about the coal market, energy consumption, efficiencies, emission rates, and capture rates.

Although the country already considers relevant information-access mechanisms under Art. 23 of the Constitution, there is still a lack of clear and binding consultation and decision-making mechanisms for communities, and a lack of protection measures for the lives of environmental leaders - especially in rural areas. Access to information and security are *sine qua non* conditions for a Just Energy Transition. To that end, it is necessary that the recently approved Regional Agreement on Access to Information, Public Participation and Justice in Environmental Matters in Latin America and the Caribbean (Escazú Agreement) is enforced.

The provision of support to, and the endorsement of Environmental Due Diligence and Supply Chain regulations -especially during environmental licensing and in oversight processes- at the European and National level (for example the German Lieferkettengesetz) is important on the European end. In terms of Colombian regulations, however, it is crucial that modifications are made to the Environmental Offset Manual for the Biotic Component (Resolution 256 of 2018 (MADS, 2018)) to clearly define the offset typologies and transfer its management to ANLA. Updating the National Air Quality Standards to meet the international recommendations set by WHO is another key aspect for health, safety, and fairness.

Finally, it is vital that specific Environmental Licence Terms of Reference (ToR) for offshore wind projects are created, and those for onshore wind and solar projects are updated.

- **Accounting for trade-offs between different resources at a regional level is essential**

Both CPO and JET require an integrative and holistic approach to better understand and respond to the complexities of ecological and social systems, and their interactions. So far, most studies that have dealt with the impacts of coal mining on water resources, land-use, food production; have focused on either specific projects, distinct sections of the coal regions (municipalities, f.ex.), or segments of the coal value chain (extraction, rail transport, ship transport). More comprehensive studies are required fully understand the local cumulative and synergic impacts of the coal value chain on these resources.

Regional hydrogeochemical investigations and modelling are needed to identify water dynamics and sources of pollution. A good starting point for this is the modelling study carried out by ANLA in Cesar (ANLA, 2021a), although results should be oriented to make regulatory decisions, while considering the variables that quantify water access (scarcity, human and agricultural consumption, etc.). This type of modelling should include assessments on the impacts of land use changes on water and incorporate regional climate change scenarios.

Regional air quality modelling must also be conducted - specifically, that which quantifies emission sources and assesses the air quality impacts on local communities, with a focus on the places where no monitoring equipment is installed. This modelling should be supported by epidemiological studies to foster a better understanding of the impact of air quality on the health of local communities, which can then form the basis for the implementation of updated and targeted health programmes in these communities.

- **Collecting more (independent) data to understand the full extent of the impacts and determine appropriate management alternatives**

The installation of an updated and enlarged network of sensors for monitoring is indispensable, as some of the data series available in the regions studied currently lack adequate spatial and temporal resolutions. The regular use of surveillance drones, for example, may offer a low-cost alternative for the monitoring, control, and even measurement of biophysical parameters. Moreover, independent community monitoring (citizen science) initiatives have the potential to contribute relevant sources of reliable environmental information if appointees are properly trained. Ideally, this information -both raw data and processed- should be available for all stakeholders, in real-time, or near real-time, to facilitate timely reactions.

- **Mine closure and post-closure management are integral to the Just Energy Transition**

It is of the utmost importance that the terms of reference for mine closure are updated, and that a clear post-closure responsibility framework is established to consider the Resource Nexus Approach, the costs in perpetuity, and the financial mechanisms to manage them. Mine closure plans must also incorporate climate change provisions.

Large-scale open-pit coal mines in the Caribbean region will leave permanent infrastructure that will require monitoring and management in perpetuity. To that end, all rehabilitation and compensation processes must align with future land uses and territorial plans. To avoid future issues in geochemical stability and water quality, the EIA processes must encompass clear decision-making criteria to either accept or reject projects, based on the evidence they provide in these topics.

- **Building the technical capacities of public institutions to implement the RNA as a tool to account for all impacts**

The capacity gaps that currently impede the ability to conduct holistic analyses must be resolved. To provide integrative responses and to fully consider trade-offs among resources, public officers must be trained to transition from case-by-case decision-making (e.g.: Environmental Licencing) to a more systemic analysis (e.g.: Strategic Environmental Evaluations); building familiarity with the concept of the Resource Nexus Approach will no doubt aid in these efforts. As such, strengthened institutional frameworks are a necessary condition to deliver this, and initiatives such as the ‚regionalisation process' of ANLA provide a good place to start (ANLA, 2019).

Regarding the topic of the environmental licencing process, rather noticeable shortcomings of staff have already been acknowledged by the institutions and indicated by members of civil society (Razon Pública, 2020). These shortcomings must be resolved if those institutions are to contribute effectively to the CPO and the JET. International cooperation in the form of partnerships, and exchanges between agencies and ministries, would act as valuable tools to improve this exercise.

In linking with international initiatives that promote the decarbonisation of electricity grids, such as the No New Coal Energy Compact (UN Energy, 2021), and the Powering Past Coal Alliance (Powering Past Coal Alliance, 2022) better access to technical expertise is facilitated, as well as providing an opportunity to learn from the experiences of others.

- **Aligning land planning instruments is essential for territories to be managed sustainably**

The institutions responsible for land use planning across all levels should strive to harmonise and simplify instruments (POTs, POMCAs, PIDERETs, etc.). The incorporation of the RNA into environmental policy thinking can support the articulation of diverse approaches, and aid in unifying the current instruments. In that sense, for example, POTs can be contrasted with the environmental zoning included in POMCAs; the subsequent definition of the land use will consider the water availability to further define the activities that can be permitted without endangering water resources.

- **Reorienting local economies away from coal to reduce, and ultimately eliminate, dependence**

The year in which this report was compiled -2022- has seen both internal and external significant economic, political, and sectorial events, such as a new tax reform (MinHacienda, 2022), increased coal prices due to global events (such as the war in Ukraine), and the first ever relinquishment of large-scale coal mines concessions in the country. A diagnosis of these new conditions is recommended to better define the impact of these factors on future events, and to posit case-specific, appropriate response strategies.

Among the alternatives considered for the post-mining era for the coal regions, two sectors -tourism and agriculture- have both been repeatedly stressed by the stakeholders and can be found in other case studies. Evidence-based estimations as to how these sectors might absorb former mining workers, and how much revenue can be generated for the municipalities impacted by the transition, will be required. Other requisites such as security, sufficient infrastructure (especially transport), and a strong regional innovation system will be indispensable in fortifying these alternative industries, along with a Workers' Transition Centre[38] to provide people with direct support as they change occupation.

[38] Based on the experience developed by Australia (CASE for Southeast Asia, 2021) .

The creation of a consortium of universities either located, or conducting work in the coal mining regions, and that can align their educational programmes with these sectors in need of strengthening for the energy transition, would facilitate JET enormously.

To increase competitiveness and innovation in the coal mining regions, it is suggested that the relationship between the public and private sectors should be reinforced by bolstering existing institutions, such as the Regional Competitiveness and Innovation Commissions (SNCI, 2022), and garnering their contributions to JET and CPO.

Additionally, the generation of special economic zones to offer tax relief for companies in the coal mining regions will attract investors whose core work and missions are aligned with sustainability activities. These zones can focus on the key indicators for reorientation like number of jobs created, women employed, amount invested, etc.

Currently, the mining companies are also the owners of the railroads that connect the mines in both Cesar and La Guajira to the respective coal terminals in the Caribbean Sea. Some of these companies have already expressed their intent to diversify their portfolios and lease the infrastructure to transport other products. These, and any other initiatives that may have the potential to switch economic activity away from coal extraction and export, should be supported and seen as a substitute, rather than as complementary.

A Just Energy Transition Commission led by the MME, with the potential to be responsible for public policy about economic reorientation, labour reconversion, and financing strategies for the JET, would be an interesting initiative. In addition, the JET Commission could act as the scenario that promotes the articulation and alignment of institutions like ANM, DNP, ANLA, MME, MADS, and UPME.

Due to the unique aspect of the presence of Afro-Colombian and Indigenous communities in the coal mining areas, the financial sector should incorporate finance products tailored to the needs of these specific communities; considering their traditions and ways of life, and the economic sectors that need to be, or stand to be boosted.

- **Promoting the use of unusually high royalties and taxes to finance economic reorientation and labour reconversion programmes.**

Strategies such as earmarking the taxes levied from the coal industry -including those described in the 2022 tax reform- for the purpose of strengthening the JET could act as valuable financing mechanisms. These should also include a specific typology of the projects that contribute to the JET, in order to prevent resource losses in the projects that have little or no marginal impact. Utilising the high revenue observed at the time of writing will require modifications to the SGR to include the explicit funding of JET initiatives. Intensified audit and control processes for institutions like CGR will also be needed to prevent corruption.

- **Facilitating national and international strategies for financing economic reorientation**

The effective designation of funds from the different ministerial portfolios to specifically deal with labour reconversion is a must. FENOGE funds could be expanded to include the social, environmental, and economic needs of those in the coal mining regions, and not only those associated with non-conventional renewable energy. Royalties could also be used to promote labour reconversion.

Moreover, aligning economic reorientation plans in the coal regions with the pillars of the new National Development Plan (referencing land-use planning, human security -investment in education and health-, food security -increasing of national food production-, energy matrix transformation, and regional convergence) (Valora Analitik, 2022) is key to ensure support and financing from the national government.

The new government's initiative to exchange external debt for climate actions could also serve as a valuable resource to keep coal underground.

For economic reorientation at the municipal level, the local administrations in the coal regions should strengthen collaborations with FONTUR and FINAGRO (institutions for the financing and promotion of the tourism and agricultural sectors, respectively) – both of which have agreements with territorial entities through special lines of credit, and offer financial support for touristic projects across three strategic lines, those being the improvement of tourism competitiveness, tourist infrastructure construction, and the promotion of the tourism market (FONTUR, 2020). These partnerships can also be supported by international cooperation to promote the development of alternative sectors in the coal regions.

Finally, the country should strive to request mechanisms like the fund promised to South Africa in the context of COP26 for the Just Energy Transition. Climate Investment Funds (CIF) are an example of an alternative avenue to operationalise this.

4.2 Indonesia

The improvement of social-environmental impacts management is crucial for the case of Indonesia; efforts must be instigated by the country's government, with the participation of all stakeholders. In enhancing these management actions, climate change targets can be achieved without neglecting other aspects of sustainability, particularly at the local level in terms of the impact on water, food, energy, land and other elements of the resource nexus. For the coal value chain in Indonesia, the recommendations include:

- **Improving EIA conditions, oversight provisions, and regulations**

A reform in environmental regulations must be carried out - particularly regarding EIA standards, for the purpose of making them more specific and less prone to interpretation. The limitations of UU 11/2020, which were intended to be addressed by PP 22/2021, mean that the importance of EIA assessment for conducting economic activities cannot be fully emphasised, especially in relation to the coal value chain. Thus, more derivative regulations that clearly define all measures for EIAs (AMDAL), and in EIAs for small businesses (UKP-UPL), are needed.

The public must be involved in the drafting of AMDAL and UKL-UPL documents to accurately analyse all the possible social-economic issues that could occur before and after extraction along the coal value chain. The current UU 11/2020 has restricted many opportunities to debate the social and environmental feasibility of coal-related activities, and as such, a comprehensive social study must be undertaken to address concerns raised by local communities. Moreover, the relevant EIA documents must be made available for the public in their entirety to allow for the evaluation of any disruptions both during and after the mining process.

The frequency of monitoring procedures and evaluations carried out by experts for all mining activities, as stated in MEMR's Decree 77/2022 (Keputusan Menteri ESDM 77.K/MB.01/MEM.B/2022), must be well-documented. By upholding detailed regulations and their effective enforcement, the quality of social, economic, and environmental conditions surrounding the coal industry can be maintained during the final years of coal mining and CFPP operations. Furthermore, in the event of changing conditions (such as mine exploitation plans, frequency, schedule, or volume transported, amount of coal to be processed in a CFPP per unit of time, etc.) monitoring and evaluation rates, and the communication of these activities, must immediately change accordingly.

Regular updates on the environmental conditions and evolution of coal value chain projects must be periodically shared -ideally on a monthly basis- to increase public awareness of these changes. Any situations emerging that may compromise health, livelihoods, or other conditions for the surrounding communities or ecosystems, must be communicated as soon as the operator becomes aware of their existence. Furthermore, there must be forums provided for the public to discuss any concerns they may have regarding these changes.

A real-time database to communicate coal value chain updates from each company (e.g., extraction rates, export rates, transportation modes, employment figures, environmental information on the elements of the resource nexus, and sales target locations, to name a few) must be made available to the public. Additionally, to the accessibility of MEMR's OneMap website must be improved by allowing the public to download raw data. There will be more opportunities for research, outreach to the public, and collaboration between stakeholders if these conditions are met.

The government must establish a regulation to manage standards for the coal transportation process in relation to water and other environmental elements and conditions that have the potential to be affected. This regulation may have a positive effect in mitigating the current impacts on the rivers and lands over which coal is transported from the mine to CFPPs or other destinations.

To maintain the health of local people living around coal mines and CFPPs, health facilities must be provided by local governments using revenue from the coal sector derived from the provincial or local budget. Such facilities can help to treat coal-related illnesses but should also serve as a contribution from the private sector to the well-being of the communities in general and therefore, the quality of the infrastructure and equipment should also be of a high standard to treat more complex conditions. If only coal-related conditions are treated in such facilities, no net social health benefit can be claimed.

In general, and considering the examples above, the current regulations pertaining to the coal value chain must be reformed to avoid ambiguity and to open opportunities to discuss contradictory interpretations. Such clear regulations can improve the effectiveness of implementation and reduce risks of corruption.

- **Assisting in the improvement of mine closure processes and valuing post-closure costs**

Clear standards for the required procedures, and the essential parameters of the reclamation monitoring process (UU 11/2022) need to be explicitly and precisely defined. Experts from a range of relevant fields must also be involved in the monitoring and evaluation processes pertaining to the reclamation. The frequencies of these processes must be also determined by a derivative regulation of UU 11/2020 and PP 96/2021.

The reclamation process must be monitored not only from an implementational stance, but also from a financial perspective; the available and guaranteed budgets from the coal companies must also be monitored. According to PP no. 96/2021, coal companies must budget for any post-mining activities, including reclamation. However, as it remains unclear as to how this secured allocation will behave in the future, considering factors like inflation, a public investment fund could be established. This alternative, like the U.S. superfund, may solve the issue, or at least offer a lower degree of uncertainty. It is also recommended that a multi-stakeholder dialogue on the financing of, and responsibility framework for, the environmental liabilities of existing projects and the costs of future ones is initiated.

- **Conducting studies to update existing knowledge, and exploring alternatives to promote JET and CPO**

With a current carbon tax of IDR 30,000 per tonne of CO2eq (around USD2), Indonesia is viewed as being unlikely to discourage coal extraction and use. A comprehensive study to redefine this price must be conducted using several methodologies, such as nature-based solutions and economic models. Trade-offs between economic impacts, and local and global environmental welfare must be considered.

To execute better socioecological management, the ministries should conduct a joint study for the creation of a fact-based policymaking process to legislate around these issues in general. For instance, the determination of a carbon tax should not solely be made by the Ministry of Finance. Rather, this tax must also be able to account for economic, environmental, and energy supply problems, and hence requires coordination between the Ministry of Environment and Forestry, the Ministry of Energy and Mineral Resources, and the Ministry of National Development Planning, at the least. By fostering strong coordination between government institutions, gaps in policies and regulations can be minimised, thus halting opportunities for corruption and inequality.

Public surveys to determine the state of the public's understanding of the impact of the coal sector must be regularly conducted. The results can be used periodically in decision-making processes, including the creation of new regulations to consider the views of the public. These surveys should be carried out using community science-based methodologies, through which public opinion can be gathered in the form of questionnaires or stories.

- **Creating strategic collaborations to pass reforms and seize opportunities**

There are numerous potential collaborations that can be established to pursue coal transition in Indonesia, such as:

The provision of research funding for universities and private organisations that focus on those elements of the resource nexus impacted by the coal industry.

Collaboration between international institutions, the Indonesian government, academia, and local organisations to create a comprehensive CPO roadmap, which then provide a foundation to update/reform RUPTL, RUEN, RPJP, and RPJMN. The implementation of this roadmap must be monitored and evaluated. If anomalies are encountered, such as an unforeseen economic crisis, a revaluation must be carried out. Such collaboration can be considered as a long-term iterative process since Indonesia has a net zero target for 2060 or sooner.

Indonesia's new capital city, Nusantara, is intended for inauguration in 2024. Since it is in the heart of the coal mining area, this event is an opportunity for international and local organisations to publicise the importance of coal transition, which will also benefit from the ambition of the new capital to be the first capital city to be surrounded by forests, and entirely supplied by renewable energy.

- **Minding the pitfalls of sectorial substitution**

There are many studies on the use of alternative fuels, including palm oil substituting coal in the energy sector. Although there is a great potential of palm oil for the domestic use and/or export, studies on the side effects of it to other elements of the resource nexus are often neglected. These include water use and land use change. For Indonesia, impacts associated with intrusion in indigenuos territories is also relevant. Therefore it is important, when drafting transition strategies to consider the local trade-offs resulting from the strengthening of other sectors.

4.3 Mozambique

Coal extraction is increasing in Mozambique. Recent figures of Vale, the country's largest producer, have indicated massive expansion (see Lusa, 2021), and JSPL increasing production from its Moatize operation, as well as massive increased tonnage being transported through the Maputo Corridor, are just some examples of this growth. A high international demand for coal, particularly from India, East Asia, and Europe, is expected to generate exceptionally high tax revenue for the country, especially with the windfall tax now in operation. All these factors, compounded by the ongoing force majeure on gas projects in Cabo Delgado, makes coal highly appealing for the Mozambican government (UNU-WIDER, 2018).

In this context, the main recommendations for promoting a just energy transition and securing a coal phase-out in Mozambique are:

- **Actively supporting information dissemination and transparency initiatives**

Access to information in Mozambique is still a challenge, especially in terms of the environmental and economic data related to the extractive sector. Despite the few exceptions touched upon in Chapters 1 and 2, independent studies are urgently needed for sound decision-making. The shortcomings in public information (access to public reports on mining sites, private sector contracts, etc.) are of particular concern. Issues surrounding confidentiality, and/or a lack of proactive publication efforts not only impairs the ability of the country's different stakeholders to participate in the processes, but also makes research exceedingly difficult. National and international efforts to foster transparency are recommended, and support to build data management and publication strategies are indispensable.

One of the perennial issues noted by many commentators is the problem of elite capture of extractives in Mozambique (examined by Burr, 2014; Mondjane, 2019). Initiatives appear to be supported in accordance with the priority of the ruling party (Oxford Analytics, 2015). The publication of the results for all environmental studies required during the licencing process, all economic estimations for each project (employment and revenue figures), and instances of binding participation, must be guaranteed.

Actions in this regard include allocating fixed budgets for medium-term research projects, building institutional capacity to gather independent unbiased data, opening channels to openly disseminate findings, and promoting the accurate and timely sharing of data (see African Population Health Research Center, 2016). Another crucial reform is the standardisation of mining contracts to prevent deviations from the general taxation scheme, or other duties in specific cases. Castel-Branco and Cavadias (2009) exposed the fiscal benefits granted to some mining companies, which greatly reduced the economic benefits to the country.

Mozambique had previously been declared to be EITI compliant in 2012 but was briefly suspended for failing to publish its 2017 EITI Report – although the government's attempt to meet this commitment was acknowledged. Moreover, while EITI provides a base standard of practice, their proximity to government institutions warrants the installation of additional independent transparency mechanisms.

Furthermore, existing transparency and accountability systems should be fully operationalised; those institutions that are already legislated for, need to come into being. An example of this is the High Authority for the Extractive Industry, created under Article 25 of the Mining Law, which the Tribunal Administrativo (TA) (2021: v-33) reported was still waiting for approval from the Council of Ministers. In addition, the existing monitoring bodies like the TA, which are currently authorised to audit a range of ministries and obtain data from the bureaucracy, should be strengthened.

More transparency in the process of revenue collection and allocation is needed. CPI (2020) and Valoi (2022) have reported on this issue, stating that revenue is largely "invisible". Its recommendations remain applicable to the coal sector, especially when revising the local remuneration rate of 5.75%. Previous suggestions by SIPA (2013: 15ff) to address legislative deficiencies in fairer revenue sharing provisions, such as a Sovereign Wealth Fund and one third of mining profits (SIPA, 2013: 16), remain workable options.

- **Assisting the elaboration of independent studies on the socioecological impacts of the coal value chain in Mozambique from a resource nexus perspective**

In specific reference to the coal value chain, independent field assessments on the environmental impacts of coal mining, processing, and transportation in Tête are urgently needed to provide knowledge on the context-specific interlinkages between coal and other natural resources, and to identify potential opportunities for pollution prevention, mitigation, and remediation. This will assist Mozambique in better managing these resources, and optimising SDG implementation (see Bleischwitz et al, 2018). Similar studies should be undertaken at the coal ports in Beira, Nacala, and Maputo. Given the lack of capacity and the potential for politicisation, it is recommended that these assessments are conducted by an independent research institute such as the Centre for Environmental Policy and Advocacy (CEPA), which operates across Southern Africa from Malawi.

An important component of the previous studies is a sector-wide monetary and non-monetary economic valuation of the benefits and costs of the coal value chain. As was shown by the TA (2020, 2021), there is a lack of accurate information regarding pricing, export, and revenue rates, which renders any knowledge of the cost/benefit of the coal sector dubious at best. Public participation in these processes is key, with grassroots organisations and advocacy groups like the National Union of Peasants (União Nacional dos Camponeses, UNAC), the Rural Women‘s Assembly and Justiça Ambiental (JA) being, among many others, stakeholders that should take part in the discussions. Academia, especially economists and anthropologists from the Universidade Eduardo Mondlane in Maputo, have also been identified as key actors. The informing and educating of stakeholders from plural sources is, of course, a pre-requisite for this, and efforts to achieve this should always be supported.

It appears that Tête is currently suffering under a particular form of Dutch disease in that the increase in foreign exchange, alongside the loss of arable lands and resettlements, has reduced the competitiveness of its agricultural sector in a clear manifestation of impacts between two elements of the resource nexus. It is therefore important that this evidence is continued to be studied, and that light is shed on the drivers responsible for this phenomenon, as well as potential solutions to this impediment.

A crucial element pertaining to environmental studies is the comprehension of the post-closure costs of mining; environmental monitoring, infrastructure maintenance, risks mitigation, among others, do not seem to be adequately considered in the current legislation. A detailed framework is not present and therefore, supporting any efforts in this direction may prevent unsustainable new projects, negative ecological, social, and economic impacts, and even conflicts that may rise because of them.

- **Investing in institutional capacities improvement for the public sector**

As the TA has become more empowered to use its powers of recommendation, it therefore stands to reason that affording it enforcement mechanisms to ensure that its recommendations are followed through in a timely manner also holds the potential to increase accountability in the sector. Similarly, the environmental reports and EIAs produced on mines that are held by INAMI and MIREME should be made accessible to the public, instead of the current method of facilitating access only for potential investors. Considering the contracts held with the different companies and given the potential impacts of the coal sector in particular, the threshold for what is considered private contractual knowledge should be very high in this context.

- **Considering the effects of the consumer countries' decisions**

Messages from the international community must be coherent. As previously shown, the EU has supported some of the projects linked to the development of coal infrastructure, such as that of the Beira railway. Even if this contribution ensured more transparency being afforded to the process in terms of public information, it seems contradictory that the EU is financing such efforts while simultaneously emphasising how negative coal expansion is. In this case, the EU saw that the rail component would likely fall outside the scope of the typical EIA, thereby requiring less monitoring. Similar projects such as NLC, Maputo, and Biera have been celebrated solely based on their increased export capacities, with no mention of environmental and/or social benefits (e.g.: SADC, 2021: 14). Resources allocated to these could instead be used to finance export substitution projects, for example.

Another consideration pertains to the potential effect of some EU policies on Mozambique's economy. In particular, the Carbon Border Adjustment Mechanism (CBAM), has the potential to further reduce revenue from exports - for example, aluminium stands to be affected by up to 60%, which will lead to a 2.5% decrease in the country's GDP (see Tas, De Clercq, & Buvane, 2022). Measures to help lower emissions from these carbon-intensive sectors through technological transfer, for example, might help preserving this source of revenue and consequently prevent the government from resorting to coal expansion.

- **Fostering legal reform, policy reform, regulatory changes, and correct implementation**

Mozambican law surrounding extractives is complex and inefficient, hindering industry and socio-environmental needs. All efforts to incrementally modernise and facilitate legislative/regulative functions in the coal sector should be supported. A key priority is the generation of a price mechanism for coal to produce reliable revenue figures, including verification of transactions, incomes, and control of quantities exported. Without this, the relation between revenue and volume exported is unknown and therefore, the environmental and social costs may be neither offset, nor justifiable.

Vagaries in the existing legislation, specifically the Mining Law (2014), should be redrafted and developed over time as part of an ongoing statutory process to ensure relevance. Concretely, tensions between the definition of 'public interest' and its apparent subordination to the 'national priority principle', need to be resolved. Redrafting is recommended across levels (policies, laws, and regulations) to improve coordination.

Another vagary to resolve is the amount of mining revenue allocated to communities in Art. 20 of the Mining Law, which was only determined after much advocacy from the civil society years later. This fixed amount is derived from the 'expected revenue for mining activities', which leads to imprecisions and/or interpretations, and increases the risk of exports under-reporting. This, and the continuous delays, must be addressed by the incumbent institutions.

Mine closure planning must be improved to include community needs in a national mine closure policy, as well as through stringent standards and regulations. The continuous monitoring, revision, and renewal of these, based on emerging evidence, is of the essence. Each must also convey realistic post-mining scenarios tailored to the needs of local communities, while preserving ecological and social sustainability, and therefore, must be constructed with community involvement. The provision of adequate financial assurances for all aspects of mine closure processes -whether after licence expiry, resource exhaustion, or unforeseen events- is crucial. The current two-year revision of the bonds should also be conditioned to relevant findings (mine construction changes, reserves estimations uncertainty, geochemical variations, etc.).

- **Ensuring community participation in environmental and development decisions**

Empowering communities to defend their interests and to keep the government accountable is key to addressing the issues that come with the gendered nature of mining. The correct representation of the interests of the civil society requires institutionalisation, with the support of both the state and the private sector. The relative weaknesses of trade unions or worker groups in the coal sector is keenly observed, and their development should be promoted. Tighter regulations and oversight must be afforded to policing and security instruments, as tactics to repress community and labour disputes too often involve heavy-handedness and violence -sometimes to a severe extent- which has been long documented (see Amnesty, 2009). As many of the companies use private security, changes to the Regulation of the Activity of Private Security, proposed in 2022, must be made to ensure that community action is permitted, guaranteed, and rendered safe under these regulations.

The establishment of a dialogue instances between public institutions, the companies, and the communities in a coherent fashion, as promised or intended within the Mining Law (2014) itself, is urgently needed. Providing a regular, properly constituted public forum in which individuals, families, and civil society groups can have meaningful input in the direction of their communities is essential for democracy and social justice in the mining sector, and in Mozambique as a whole.

- **Facilitating Non-Conventional Renewable Energy sourcing**

Mozambique has tremendous potential for non-conventional renewable energy capture, particularly solar (2,7GW/year potential) (see MIREME (2020) and Cruz, Mendes & Cardoso, (2022)). The country's electrification programme (see National Electricity Program of Mozambique) set a 100% electrification target by 2030, which is consistent with the UN 2030 Agenda in Universal Access to Electricity. As such, this endeavour should be supported as a matter of social and environmental justice, as well as a source for economic development. Increased hydropower seems unfeasible, since the Master Plan for Electrical Infrastructure (Plano Diretor de Infraestruturas Elétricas 2018-2043) projects a significant decline by 2043, and the socioecological costs such as those associated with the reemergent Mphanda Mkuwa dam (relocation of 1,400 households, damages to irrigation systems, impacts on key ecosystems downstream) (Morrissey, 2013; Isaacman and Sneddon, 2003; Kirshner & Power, 2015: 71), seem far greater than installing further PV and/or wind turbines. Although hydropower is viewed as a source of revenue from energy sales to South Africa, it does not mean that this cannot be replaced for NCRE exports.

It is essential that Mozambican policy on energy, electricity, mining, and private investments cooperate to promote universal electrification via NCRE. To achieve this, integrating The National Directorate of New and Renewable Energy with policymakers in mining and electricity is a strategic way forward. One of the key challenges, however, is capital investment to increase renewables in Mozambique. The NCRE sector in Mozambique should be actively supported by the international community via financing options backed by donor grants, high concessional loans, multilateral and regional funding, and free knowledge/technology transfer. Already, the World Bank, the European Union, Sweden, and Norway have promised over USD200 million (EnerData, 2019) in support, but this figure should still be increased.

Solar micro and mini grids are a cost-effective, energy efficient, and locally responsive option (AfDB, 2016; AFDB, 2017; ODI, 2016), with many recent studies confirming the convenience of decentralised systems - particularly for rural communities (see Gebreslassie, Cuvilas, Zalengera, et al. 2022). Therefore, initiatives promoting the installation of new such projects should be endorsed. This requires tacking market barriers, which seem to be the most relevant limitation, (Economic Consulting Associates GreenLight, 2018) and to support the enforcement of quality standards on solar products, the increase of skilled labour through training programmes, and to expand donor funding and consumer financing.

- **Advocating for revenue substitution**

The primary motivation for state support of the coal sector is the government's reliance on it for revenue and foreign currency. To that end, it is crucial to focus on supporting revenue substitution. Two options for this are compensatory mechanisms for revenue loss from coal and substituting coal exports for other products. Regarding the latter, international donor aid or debt service reductions (like the G20 debt moratorium), could be deployed to offset the loss in tax revenue from the coal transition.

There is already good evidence to suggest that the Mozambican government would welcome such international initiatives, were they to observe a specific pay-off that would accrue to the state budget. For example, Mozambique has been a fervent supporter of REDD+ initiatives and has undergone concerted reforestation efforts, in part, because of the promise of financial reward.

It should be noted that this recommendation is caveated by a cautionary tale of previous international interference in the Mozambican economy. Recent studies have postulated that the 'shock therapy' imposed by the IMF and The World Bank (WB) contributed significantly to specific features of Mozambique's resource curse, such as the rise of oligarchs, corruption, inequality, and poverty (see Hanlon, 2022).

4.4 South Africa

For South Africa, the recommendations for a sustainable and just energy transition away from coal are divided into four categories, those being Regulatory, Socio-economic, Financial and Technical-Environmental aspects, which are as follows:

- **Changes to regulatory frameworks and building an enabling environment**

Considering the planned extension and improvement of the transmission and distribution network in South Africa, renewable energies should arguably be afforded a fair chance to compete. However, this requires the amendment of the existing energy policies to support deregulated markets as an incentive to increase renewable energy supply.

The government should consider further amendments to the recently adjusted Schedule 2 of the Electricity Regulation Act 4 (of 2006; amended in August 2021). At present, embedded electricity generation of less than 100MW requires registration with NERSA and is exempt from generation licence requirements. Increasing the threshold for licencing driven by demand, and its eventual removal, could increase private investment in generation.

The One Environmental System (OES) mandate affords the DMRE authorisation for the mining rights of prospection. However, there is need to harmonise stakeholder integrated decisions to avoid overlooking the interests of different parties. More robust mechanisms of participation, and engagement with environmental and other key interest groups are needed to improve the quality of the permit decisions review. This would improve the transparency and efficiency of meeting the requirements for environmental regulation compliance. In addition, this would help align mining permits with other relevant licences, such as the water use licence.

As the energy policies are still largely influenced by the few powerful energy-intensive industries, the government should facilitate networks for interested parties in academia, civil society, and grassroots communities to be involved in the design and reform of such policies; thereby ensuring compliance throughout the transitional phase. It is advisable that the reformed policies strengthen not only the social viability and economic diversification of the renewable energy sector, but the manufacturing and food processing sectors, for example, as potential alternative sectors for the coal mining regions.

Energy policies and plans should accurately describe the interdependence between all resources, with particular consideration given to developing a deeper understanding of the resource nexus. As such, all sectors are equally considered, and opportunity costs are minimised.

Finally, carbon tax allowances should be minimised as they enable carbon lock-ins, thus preventing a smooth and just energy transition, as well as hindering sustainable financing for alternative projects.

- **Increased resilience of the communities experiencing the effects of the transition**

Most coal-dependent communities in South Africa are impoverished, either without access to electricity, or being unable to afford grid-connected electricity. Even in 2022, these communities still depend on rudimentary energy sources such as paraffin, candles, and wood (Baker & Phillips, 2019; Tait, 2016), and also coal - all of which compromises their personal health and safety. As the country transitions from a coal-based matrix to a renewable matrix, tailored projects should be considered in those areas lacking access to electricity.

One way to empower these communities is through subsidies for NCRE sources as alternatives to those currently used. For example, subsidised rooftop solar panels, micro hydro, and run-of-the-river hydro could be used to provide energy to rural communities. These sources are also key to tackling the country's dependence on centralised coal energy, and to foster environmental and social justice.

Providing information on, and educating about, NCRE in communities is urgently needed. Enhancing civil understanding of co-ownership models and the advantages of renewable energy projects will further bolster the acceptability and applicability of the JET and render communities independent from coal projects.

A participatory approach that correctly considers the differing gender impacts, and other demographic groups like the youth and senior citizens, must be included in all efforts. In South Africa, men dominate the mining workforce in the coal regions, but women also play very important roles in contributing to livelihoods. It is therefore of critical importance to understand, act upon, and communicate the challenges faced by different demographic groups to accelerate the just transition.

A reskilling/upskilling framework to mitigate disruptions in the employment/livelihoods of workers affected by the energy transition is of the essence. For instance, skills and capacity building programmes for JET jobs, jobs in prioritised sectors, and small-scale businesses will increase market demand and reduce emigration from the coal regions. In addition, other programmes on health and safety for coal mining communities, including artisanal miners, should be designed. On the issue of land use after mine rehabilitation, partnering with communities to identify the best options forward will prove beneficial and avoid environmental conflicts.

- **Providing financial support and creating instruments for the transition**

The social labour plans that form part of the requirements for prospecting mining companies usually elapse after mine closure, which poses significant challenges to local governments' abilities to plan for the transition and set priorities, due to insufficient funds. Empowering local governments with fiscal autonomy is indispensable to allow for the establishment of investment funds aimed to cover these deficiencies – such as through a permanent transition fund for coal-dependent communities payable by all mining companies and other carbon-emitting companies. The funds can then be used for locally driven transition plans. To safeguard and improve the transparency of the permanent fund, a trust board including community representatives as part of the committee, or similar institutions with a representation of local stakeholders, must be installed. Investments could, for example, be directed to local institutional capacity and local business or organisations.

Other challenges to be overcome include the initiation of innovative debt financing mechanisms for energy transition technologies and projects to maximise the utilisation of stranded assets, to consider redirecting future energy funds by the state to assist in the transitional process and, to generate advanced decision support systems for optimal investments in the energy transition, and for the sectors that directly or indirectly depend on coal mining, such as the steel industry and textile manufacturing. Finally, and very importantly, financing the health externalities related to coal mining and CFPPs is another issue of social and environmental justice that cannot be overlooked.

- **Mitigating technical and environmental impacts, while involving communities**

South Africa's potential for NCRE is significant, with wind and solar resources being the most available, most abundant, and economically feasible energy options. Due to the intermittent nature of these resources, battery and other storage technologies remain a major hurdle in the development of renewable energy technologies. One of the options are Vanadium reflux flow batteries, or VRFB, which do not only have significant potential for large-scale energy storage, but which are locally produced and have the advantages of not being easily flammable and being recyclable.

The transition from grey hydrogen to green hydrogen is envisioned as a contribution to economic diversification. Infrastructure used to produce grey hydrogen can be repurposed for this new venture. Nonetheless, investment is required to further advance research in fuel cells using platinum group metal-based components. This technology has the potential to create job opportunities through the re-skilling of workers already employed in the production of grey hydrogen.

Carbon capture and storage (CCS) in South Africa is still in its infancy, and mostly constituting of ongoing pilot projects. There is, therefore, necessary that CCS evaluates the feasibility of transitioning from pilot to mainstream use to effectively enable the reduction of GHGs from those energy-intensive industries that are still intended for long-term operation. The initial high costs of CCS render it prohibitive in some cases, however, if proven useful, government legislation should also fully consider the environmental and safety aspects of this technology from a resource perspective, especially regarding water use.

The implementation of the carbon tax without further extensions and/or exemptions would stimulate the uptake of such technologies or lead to additional efforts to prevent emissions. To that end, carbon offset allowances should be clear and effective as an incentive to boost the reduction of carbon emissions. There is also a need to invest in carbon utilisation, especially due to the potential presence of carbon dioxide reservoirs in the coal region of Mpumalanga. Consequently, this investment could benefit other sectors, such as the water sector, through carbon dioxide mineralisation to treat acid mine drainage, and to produce fertilisers for the agriculture sector.

Revegetation efforts should be directed towards commercial crops following reclamation of abandoned mines; using proper planting techniques if the reclaimed land it is deemed suitable. Land that is not viable could be redirected into commercial forestry, or even biofuel crops as an energy substitute. Biomass crops for bioenergy can be used as a fuel for heating generation systems; switch grass is a promising example of a biofuel crop, though it does require more research. As reclamation practices influence the productivity and diversity of vegetation on the surface of coal mines, it is crucial to recreate the mine soil properties of the site before revegetation. This will improve the vegetation cover and sustain the local ecosystems. Regional communities must be engaged in the repurposing plans, with employment opportunities offered to these communities to manage the revegetation processes.

To conclude, three points should be noted: a. In addition to the provided environmental pollution parameters, most of the toxic metals should be detailed, with information regarding their presence being shared with the public in the interest of transparency and accountability; b. Post-mining environmental and social impacts are critical in guiding the repurpose of land after the rehabilitation of abandoned mines, and in determining the closure and post-closure responsibility frameworks and costs; c. Partnerships with research institutes to offset insufficient capacity to effectively monitor environmental pollution is necessary for communities, local authorities, and even national institutions.

View of Maputo, Mozambique **Source: Rohan Reddy for Unsplash**

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