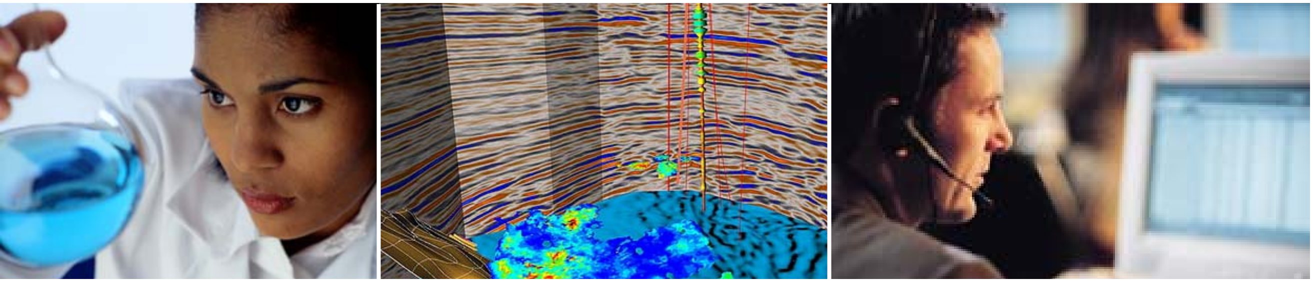
ChevronTexaco



Worldwide Power and Gasification

Clean Coal Technology Options – A Comparison of IGCC vs. Pulverized Coal Boilers

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Presentation Highlights

- ChevronTexaco
- Clean Coal Landscape
- Gasification: Current Status of Technology
- Standards Project Initiative - Reference Plant
- Comparing Coal to Power Technologies: IGCC vs. PC Boiler Plants
- Next Generation – CO_2 Capture with IGCC
- Conclusions

ChevronTexaco

ChevronTexaco

- 53,000 employees; 180 countries
- > $100 billion in annual revenues
- 3rd in global reserves of oil
- 4th in global oil and gas production
- Sasol Chevron Joint Venture on Fischer-Tropsch liquids from natural gas
- Global Market Leader in Gasification
- Montebello Technology Center (MTC)
- Pittsburgh & Midway Coal Mining Co.

ChevronTexaco Worldwide Power & Gasification

- A wholly owned subsidiary of ChevronTexaco
- Global Market leader in gasification since 1948, over 130 plants licensed in last 52 years
- Both a process licensor and project owner
- First oil gasification plant in 1956
- First coal gasification plant in 1978
- 72 commercial gasification plants now operating or under construction / in advanced development
- Nominal Syngas capacity: 5.1 billion standard cubic feet/day

ChevronTexaco Power Generation Portfolio

Name	Location	Facility Size	Type	Online Date
Sunrise Power Company	California	585 MW	Combined Cycle	2001/03
Tri-Energy Company	Thailand	700 MW	Combined Cycle	2000
North Duri Cogen	Indonesia	300 MW	Cogen (EOR)	2000
LG Power Company	Korea	950 MW	Comb. Cycle/Heat	2000
Darajat II	Indonesia	70 MW	Geothermal	2000
Black Mountain	Nevada	85 MW	Cogen (Thermal)	1992
Garnet Valley	Nevada	85 MW	Cogen (Thermal)	1992
March Point	Washington	140 MW	Cogen (Refinery)	1991, 1993
Sargent Canyon	California	36 MW	Cogen (EOR)	1991
Salinas River	California	36 MW	Cogen (EOR)	1991
Coalinga	California	36 MW	Cogen (EOR)	1991
Mid-Set	California	36 MW	Cogen (EOR)	1989
Sycamore	California	300 MW	Cogen (EOR)	1988
Kern River	California	300 MW	Cogen (EOR)	1985

Clean Coal Landscape

Clean Coal Landscape - USA

- Coal as a fuel for new power capacity in the USA is again on the table after the 1990s domination of natural gas
- All new USA coal-to-power capacity will use clean coal technology - environmental drivers will increasingly affect technology decisions
- Government incentives are increasing for clean coal technologies
- Some clean coal technology is cleaner than others
- Development of new coal plant projects must start now to be operating when the USA power capacity glut ends after mid-decade (2008 -2012)
- Recent IGCC experience has provided the foundation for the commercial reality of coal IGCC
- IGCC is a current viable choice for clean coal power capacity

Clean Coal Technology US Government Current Initiatives

- Clean Coal Power Initiative 2002: $330 Million Between A Number of Technology Demonstration Projects, selection by 1Q 2003. Expected to be a $ 2 billion program over 10 years.
- US Congress: Federal Legislation in conference between Senate and House (HR 4), offering up to $ 2 billion in tax incentives for commercial projects, up to 4,000 MW IGCC. Gasification seen as sole technology now available to help with mercury and other metals (e.g., cadmium, lead) long-term.
- States: Some states offering funding for clean coal projects using in-state coal.

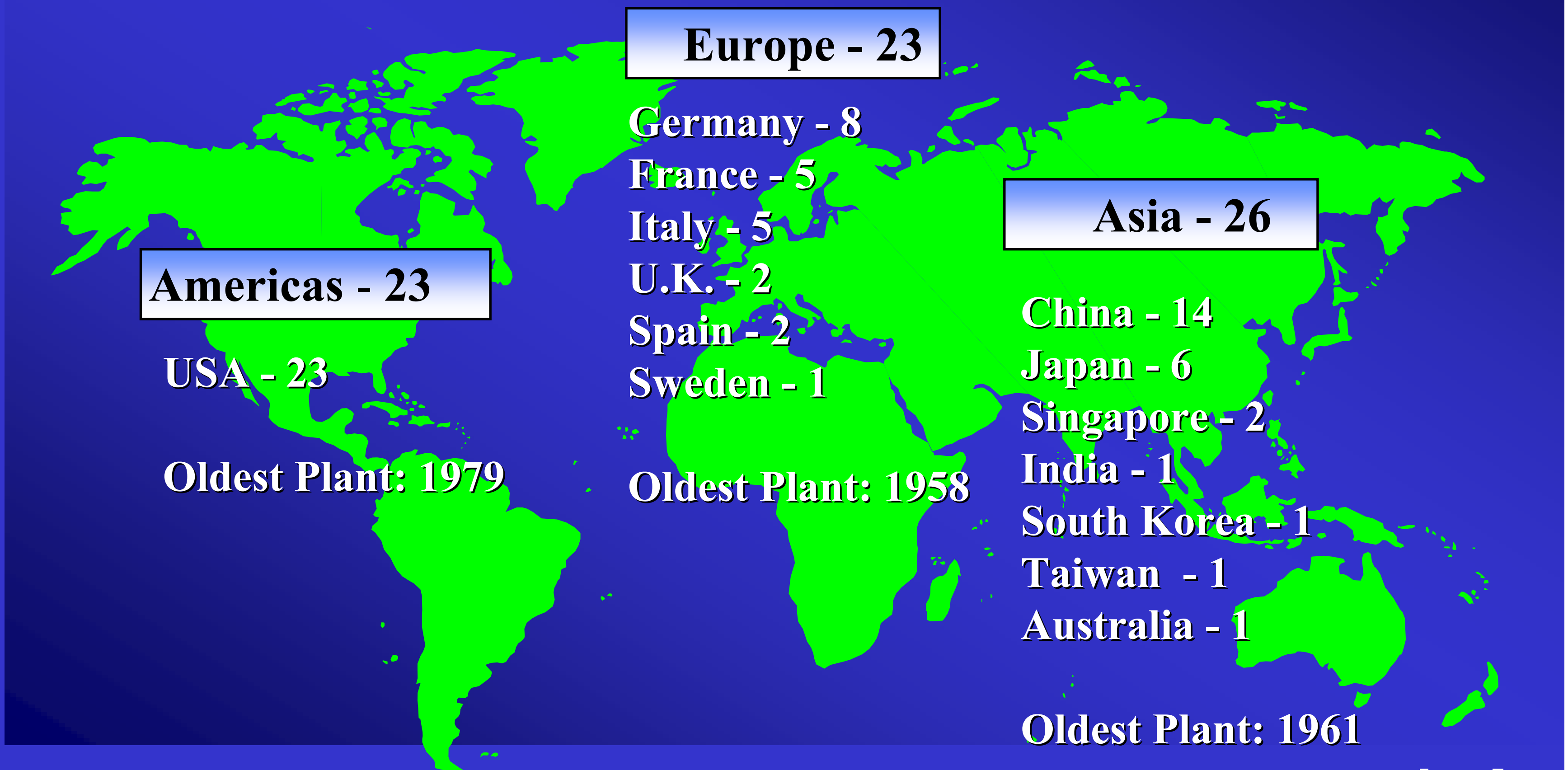
Business Environment – The Marketplace for Gasification

- Market Forces Impacting Competitiveness
- Increasingly Stringent Emission Requirements
- NO_x, SO_x, Particulates, Mercury, and emerging CO_2 Issue
- Less Pricing Volatility With IGCC vs. Natural Gas
- Increasing Hydrogen Demands of Oil Refining
- Polygeneration (Power, Hydrogen, Steam, F-T liquids) Over Steam Methane Reforming
- Sulfur Reduction Mandates for Cleaner Transport Fuels
- This Will Create the Potential for Hydrogen and Fischer-Tropsch (zero sulfur diesel) applications
- Increased Use of Lower-Quality Fuels
- Higher Levels of Sulfur, Nitrogen, and Heavy Metals

Gasification:
Current Status of Technology

ChevronTexaco Gasification Process

72 Facilities: Operating (66), Construction / Engineering (6)
125 Gasifiers: Operating (113), Construction/Engineering (12)
5.1 billion standard cubic feet/day Syngas (H_2/CO) Nominal Capacity



Americas - 23

USA - 23

Oldest Plant: 1979

Europe - 23

Germany - 8
France - 5
Italy - 5
U.K. - 2
Spain - 2
Sweden - 1

Oldest Plant: 1958

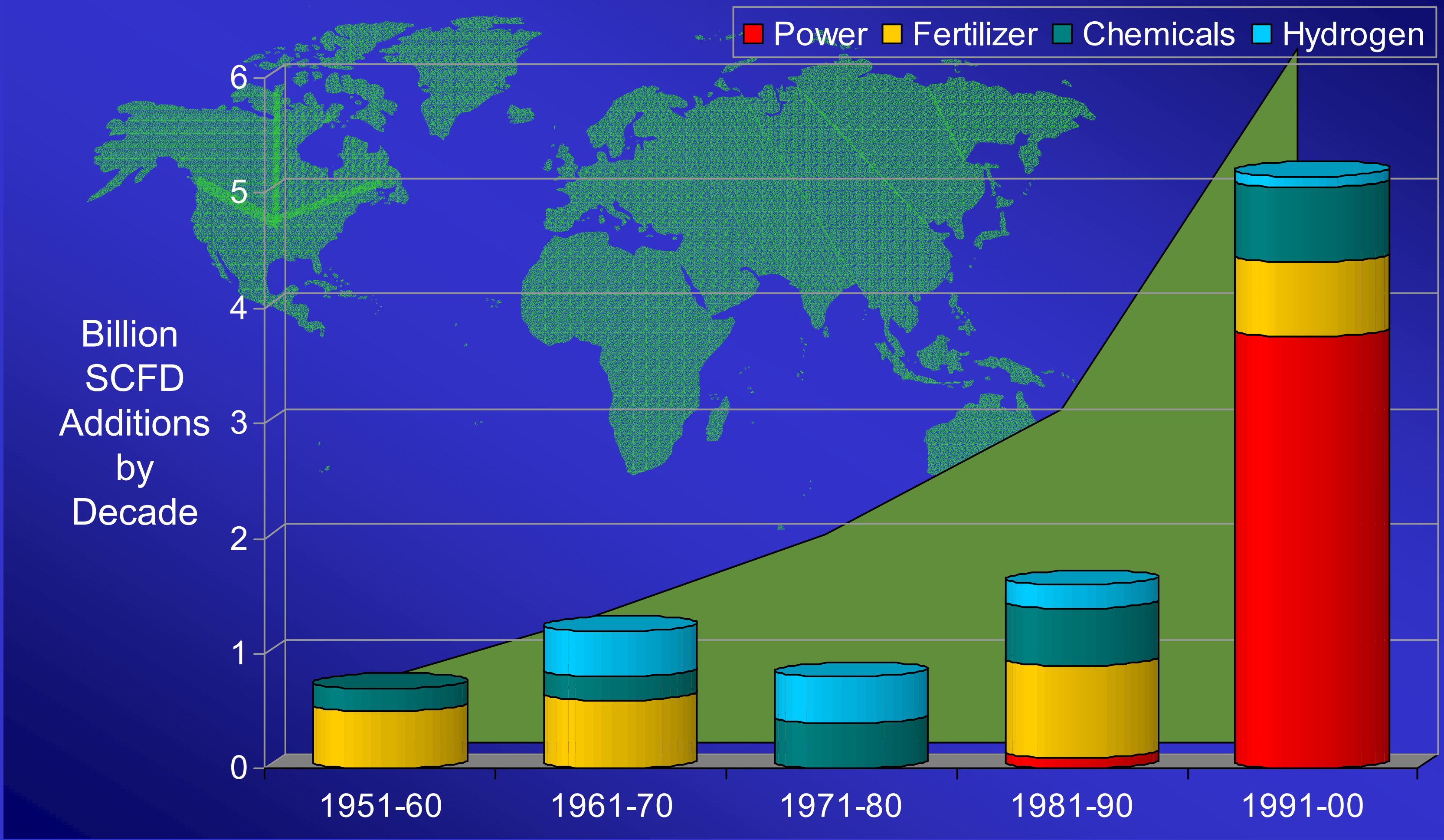
Asia - 26

China - 14
Japan - 6
Singapore - 2
India - 1
South Korea - 1
Taiwan - 1
Australia - 1

Oldest Plant: 1961

Status of the ChevronTexaco Gasification Technology

Current Licensed Syngas Capacity



ChevronTexaco IGCC Experience

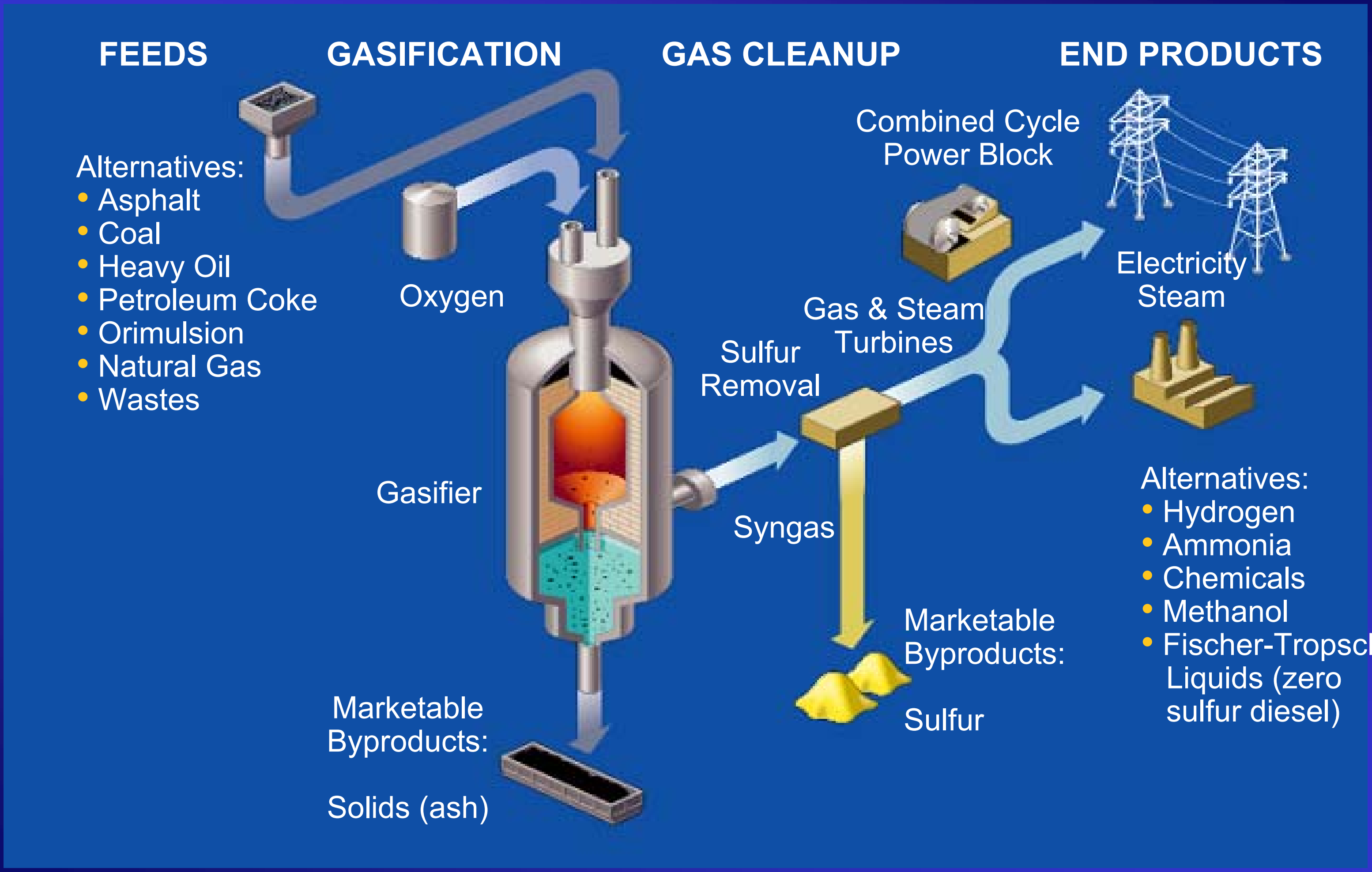
Company	Size (MW)	Feedstock	Commercial Operation
Cool Water (USA)	100	Coal	1984-1989
Tampa Electric USA)	260	Coal/Petroleum Coke	1996
El Dorado (USA)	42	Petroleum Coke	1996
SARLUX (Italy)	550	Visbreaker Tar	2001
ISAB (Italy)	510	Asphalt	2001
api Energia (Italy)	280	Visbreaker Tar	2001
ESSO Singapore	160	Cracked Tar	2001
Motiva LLC (USA)	160	Fluid Coke	2002
NMPRC (Japan)	350	Asphalt	2003
Normandie (France)	360	Visbreaker Tar	2006
PIEMSA (Spain)	800	Visbreaker Tar	2006
Citgo (USA)	680	Petroleum Coke	2006

- *Coal projects now being considered at 500 - 1,500 MW in USA*

Sarlux, Italy

- Sarroch (Cagliari), Italy
- 3771 sTPD heavy oil,
  550MW + hydrogen + steam
- Three trains, quench type
- Initial startup 4/24/00
- In full commercial operation in 2001
- One of three IGCC's in Italy now commercial, generating more than 1,300 MW power from clean syngas

Texaco Gasification Process



Evolution of Coal IGCC/Coal Gasification

Pilot → Demo → Commercial

Huainan 900sTPD (China) Coal to Ammonia / Urea

TECO (Power Services) 2000sTPD / 250MW (USA) Coal to Power

Weihe 1650sTPD (China) Coal to Ammonia / Urea

Shanghai 1800sTPD (China) Coal to Town Gas / Methanol

Lunan 550sTPD (China) Coal to Ammonia

SAR 800sTPD (W. German) Coal to Oxo-chem/H_2

UBE 1650sTPD (Japan) Coal and Petroleum Coke to Ammonia

Cool Water 1000sTPD / 120MW (USA) Coal to Power

EASTMAN 1100sTPD (USA) Coal to Methanol / Acetic Anhydride

TVA 190sTPD (USA) Coal to Ammonia

RAG/RCH 165sTPD (W. German) Coal to Oxo-chemicals

25sTPD plant at Montebello USA research lab

1970 — 1980 — 1990 — 2000

ChevronTexaco
Standards Project Initiative (SPI)
Reference Plant

IGCC Product Concept

- A "product" development process that provides a focused forum for facilitating technology deployment, and design and cost optimization
- Improves "time to market" with shorter project development schedule and lower costs
- Establishes the groundwork for potential supplier alliances
- Establishing the product as a Reference Plant:
    - Provides a baseline on which to assess and incorporate technology advances
    - Allows for a menu of plant configuration and operation options
- Provides a data-point for comparison with Pulverized Coal generation options

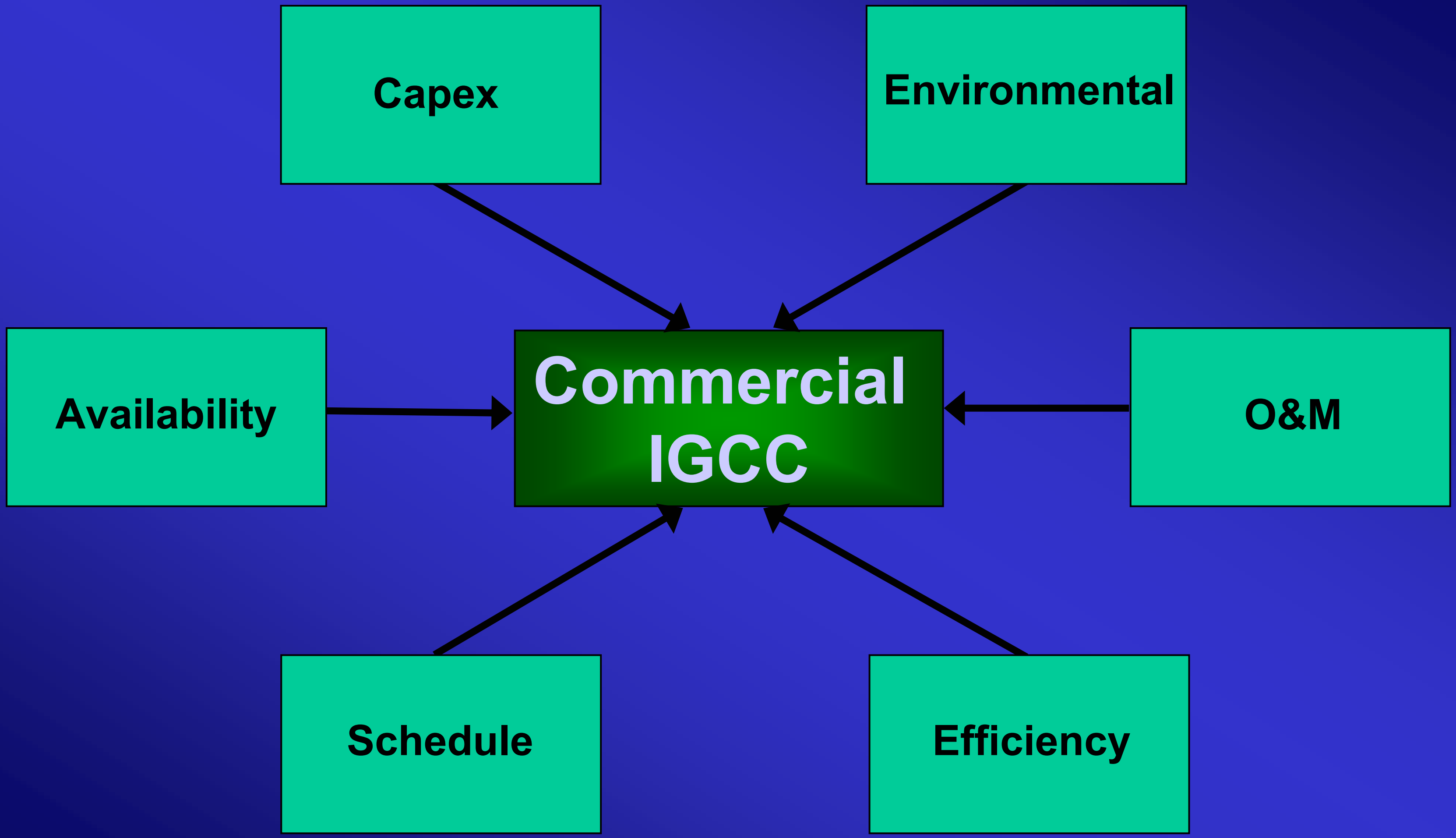
ChevronTexaco
SPI - IGCC Reference Plant "Product"

- Why: Market need for standardized IGCC plant, initially targeted for coal
- When: Begun in 1999 and continues to work on improving the Reference Plant
- Who: ChevronTexaco supported by Bechtel, General Electric, and Air Liquide
- What: Development of a standard IGCC design and project execution concept
- Status: Selected a preliminary configuration (9/02 case) - enhancement is in process

SPI Reference Plant
Frame for Current Case

- **100% coal-to-power (no petroleum coke)**
- **no poly-generation in this study**
- **USA market**
- **Capacity > 500 MW**
- **GE turbines**
- **Back-up fuel available – nat gas**
- **Equity and license projects**
- **Bituminous coal (Eastern USA)**
- **Proven technology**

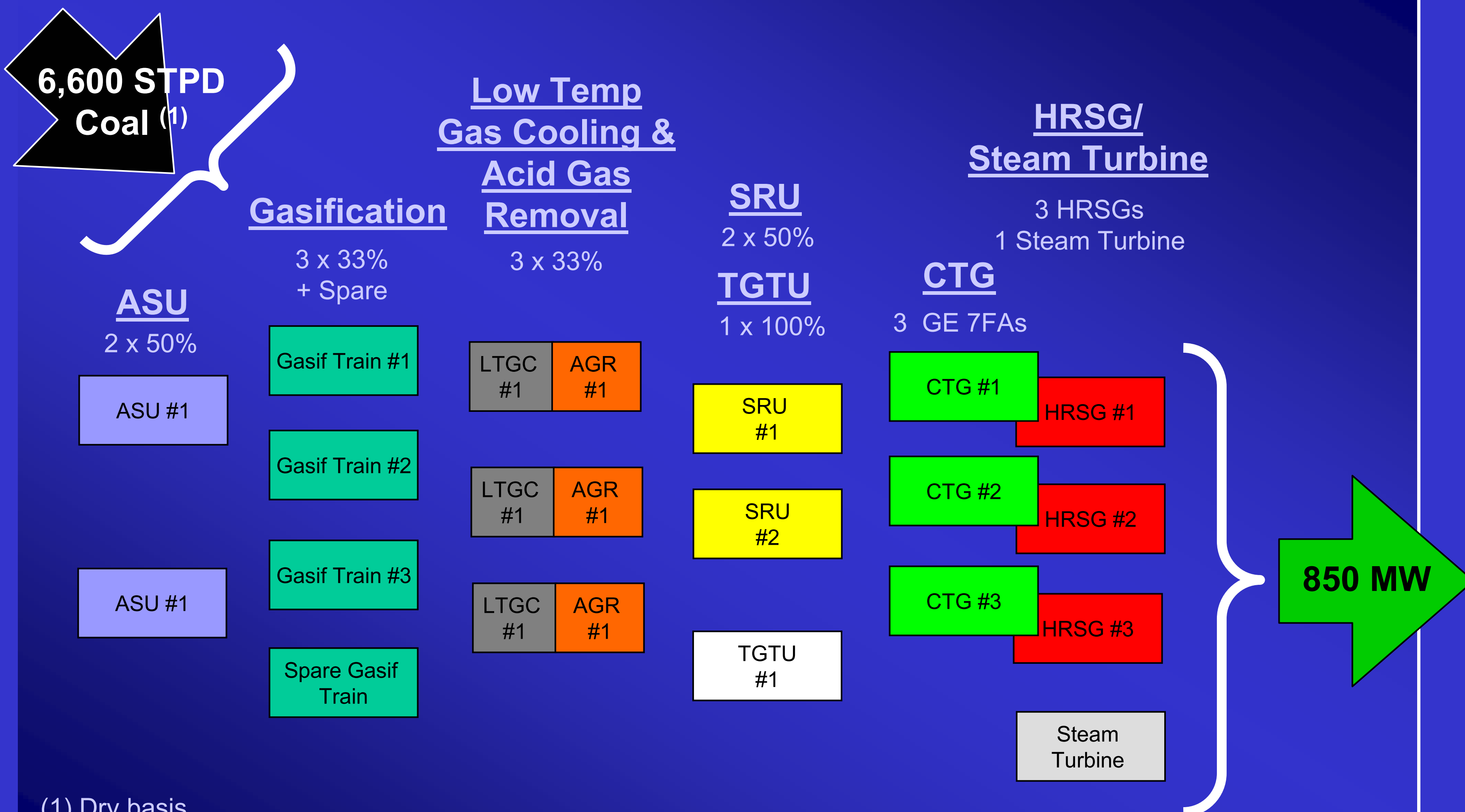
IGCC Standards Project Initiative
Enhancing Commercial Performance



IGCC Standards Project Initiative
Design concept selection - major focus areas

1. Radiant syngas cooler vs. quench gasifier design
2. Gasification pressure
3. Air integration between CTG and ASU
4. Moisturization and/or diluent of syngas feed to CTGs
5. ASU optimization
6. Spare gasification train
7. Number and size of component trains
8. Coal selection and slurry concentration
9. Acid Gas Removal (AGR) technology selection

SPI Reference Plant Configuration (current status)



(1) Dry basis

SPI Reference Plant – Current Case Overall Plant Performance

		@ 59°F	@ 90°F
Coal Feed	STPD	6594	6443
Oxygen Feed	STPD	6358	6213
Water Consumed	klb/hr	4168	4168
Net Power Output	MWe	849	799
Sulfur Byproduct	LTPD	126	123
Slag and Fines (wet basis)	STPD	1149	1123
Treated Water Discharge	klb/hr	1063	1063
Plant Heat Rate (HHV)	BTU/kWh	8849	9190
Thermal Efficiency (HHV)	%	38.6	37.1

Comparing Coal-to-Power Technologies: IGCC (Integrated Gasification Combined Cycle) vs. Supercritical Pulverized Coal (PC) Boiler Plants

Fruit-basket of variables - The “Apples and Oranges” challenge of comparing coal-to-power technologies

$/kw
- **location?**
- **Financed?**
- **Opex vs. capex**
- **Etc.**

In or Out?
Solids disposal
Coal pile
Scrubbers, FGD
Etc.

Efficiency

‘99,‘00, ‘01,‘02 ?

Hg Removed?

Different Regulations, Different Countries

Trade-offs

O&M **Capex**

Emissions Measure
Lb/hr
Lb/MWh
% removed
ppm

Union ↔ Non-union

Guarantees

LDs

Varying Regulations

HHV ↔ **LHV**

C.O.D.

Availability ↔ **Capacity Factor**

Market segment

Comparison categories – IGCC vs. State-of-art Supercritical PC Boiler plant

- Capex
- Plant availability
- O&M costs
- Plant performance - efficiency
- Implementation schedule
- Environmental
- Positioning for future - CO_2 recovery

IGCC vs. PC Boiler Plants Relative Comparison Summary

	IGCC	PC	Notes
Capital ($/kW installed)	◕	●	Both in $1,000 - $1,400 range
Regulated emissions	●	◕	Clear advantage with IGCC
Mercury emissions	●	◑	IGCC >90%, PC undetermined
O&M costs	◕	●	PCs are becoming more complex
Plant availability	◕	●	Both in 90%+ range
Schedule	◕	●	IGCC front end will improve with repeated projects
Product/Fuel flexibility	●	◔	IGCC capable of multi feeds, poly-gen
Efficiency	●	◕	Both technologies are improving
CO2 capture positioning	●	◔	IGCC pre-combustion, PC post

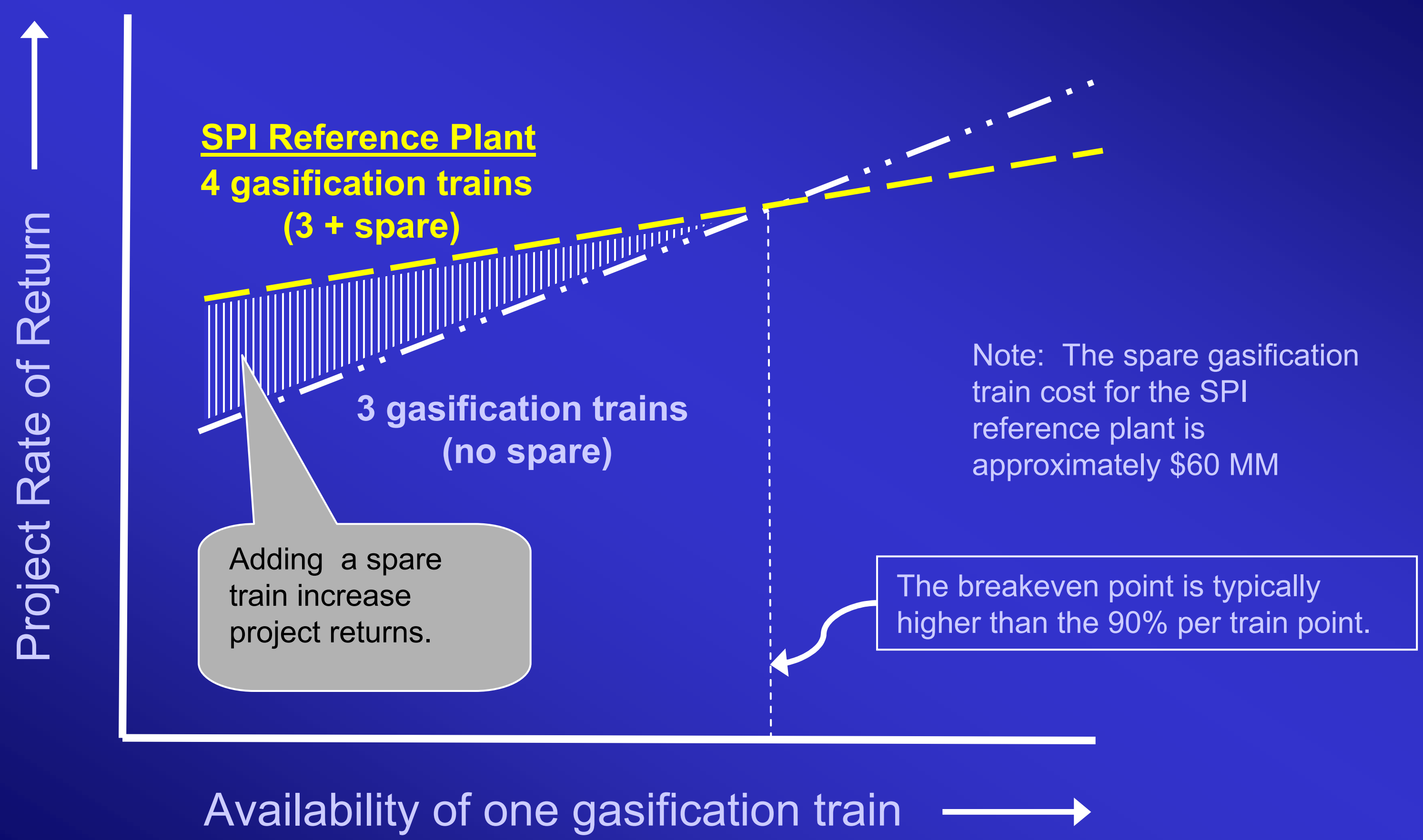
● = Category leader ◔ through ◕ = Standing relative to category leader

IGCC vs. PC Boiler Plants

	IGCC	PC	Notes
Capex ($/kW) - Power only case	1,300 – 1,400	1,100 – 1,300	Location and fuel dependent, IGCC Capex includes mercury system
Plant Availability (%)	> 90%	> 90%	IGCC includes spare gasification train
O&M costs ($/MWh)	7.00 – 9.00	3.00 – 5.00	Excludes solids disposal
Efficiency (%)	38.5 - 40.5	36.0 - 37.5	
Heat rate (HHV)	8860 - 8420	9480 - 9100	

- More work (Value Improvement Processes, etc.) planned to further reduce Capital, Heat Rate and O&M costs for IGCC

SPI IGCC Reference Plant
Spare Gasification Train Included



Note: The spare gasification train cost for the SPI reference plant is approximately $60 MM

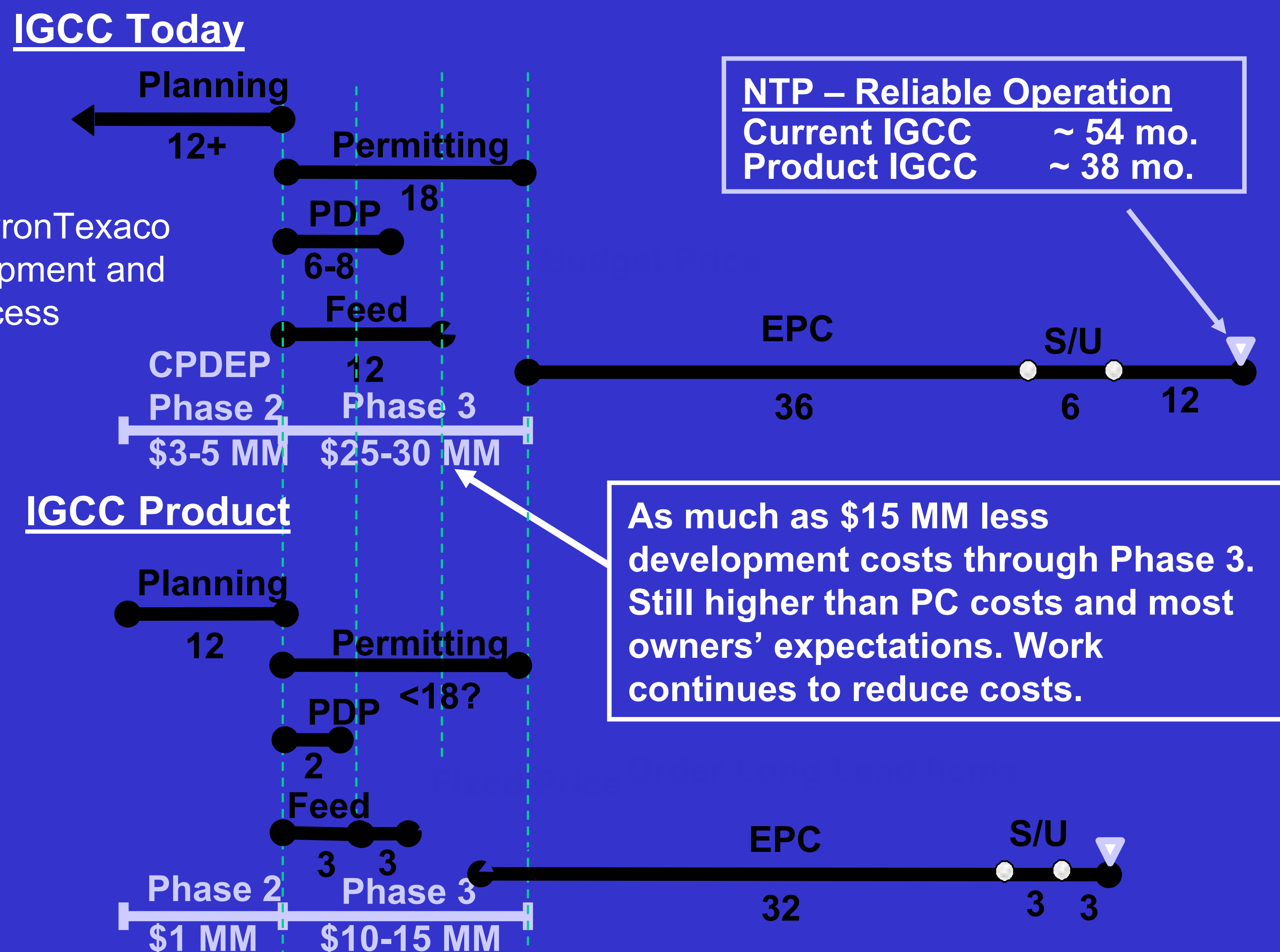
SPI IGCC Reference Plant
Plant Availability vs. PC

- The overall IGCC plant availability can match that of the PC boiler plants (>90%)
- An overall IGCC availability of >90% is reached with proven availability levels per gasification train by including a spare gasification train
- Further improvements in availability of individual gasification trains will provide additional opportunities to reduce capital costs

Why a Standard IGCC Product

IGCC Delivery: Today vs. The Product Vision

CPDEP = ChevronTexaco Project Development and Execution Process



Environmental Performance

IGCC's Proven Pre-Combustion Clean-up of Syngas Fuel to the Gas Turbine

- NOx: current level of 15 ppm (@15% O_2)

  NOx suppression in gas turbine by use of a diluent such as nitrogen or steam. No SCR required.

- SOx: Removal of 98 - 99+% S in feed
  SOx < 0.5 lb/MWh

  Conventional H_2S removal from syngas, technology practiced in chemical and refinery industries

- Particulates

  Both water and amine washing of syngas prior to gas turbine, up to 15-20 stages.

- Mercury (Hg) **

  Chemical removal from syngas through use of sulfided activated carbon bed(s). 90+% achieved.

- Carbon dioxide (CO_2)

  Separation from syngas through deep sulfur removal technology; creates a high purity CO_2 stream, proven in existing ammonia plants

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Environmental Performance – Air
Comparison with Supercritical PC Plants

	lb/MWh		lb/MMBtu		ppmv	
	IGCC	PC	IGCC	PC	IGCC	PC
SOx [1]	0.47	1.19 [3]	0.053	0.132	13	57
NOx [2]	0.50	0.72 [3]	0.057	0.08	15	48
CO	0.32	0.99	0.036	0.11	25	n/a
PM	0.06	0.16	0.007	0.018	n/a	n/a
VOC	0.01	0.04	0.001	0.004	1.4	n/a

1. Comparison assumes Eastern Bituminous Coal with 2.2 wt% sulfur
2. For IGCC, NOx is corrected to 15% O_2; For PC, NOx is corrected to 6 % O_2
3. PC Plant requires SCR and wet FGD to accomplish above emissions for NOx and SOx.

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Environmental Performance – Air (continued) [1]

Comparison with Supercritical PC Plants

Mercury Removal

	IGCC	PC
Mercury Removal	> 90 + %	~ 30 - 50%

- Proven mercury removal, at Eastman Chemical's Kingsport, Tennessee gasification facility, from the compressed syngas upstream of the gas turbine. This allows mercury removal to be less expensive, less complex and with higher reliability. Testing reproducibility still an issue.
- The cost of mercury removal for PC plants can be an order of magnitude higher than the IGCC plant, due to the much higher volume of gas to treat in a PC.
- The cost increment to add 90% removal to an IGCC plant is estimated to be less than 0.3% and the increase the cost of electricity is less than 1%.

1. Reference: The Cost of Mercury Removal in an IGCC Plant, 9/2002 prepared for DOE by Parsons Infrastructure & Technology Group, Inc.

Environmental Performance – Air (continued)
Comparison with Supercritical PC Plants

CO2 Removal

	IGCC	PC
CO_2 Production due to Relative Efficiency	Base	~ + 2 %
CO_2 Removal Incremental cost of electricity [1]	1.5 – 2 ¢/kWh	> 3 ¢/kWh

- IGCC CO_2 removal by absorption scrubber of compressed syngas. PC CO_2 removal by MEA scrubbing of flue gas.

1. Reference: "The Cost of Carbon Capture", by J. David & H. Herzog (MIT)

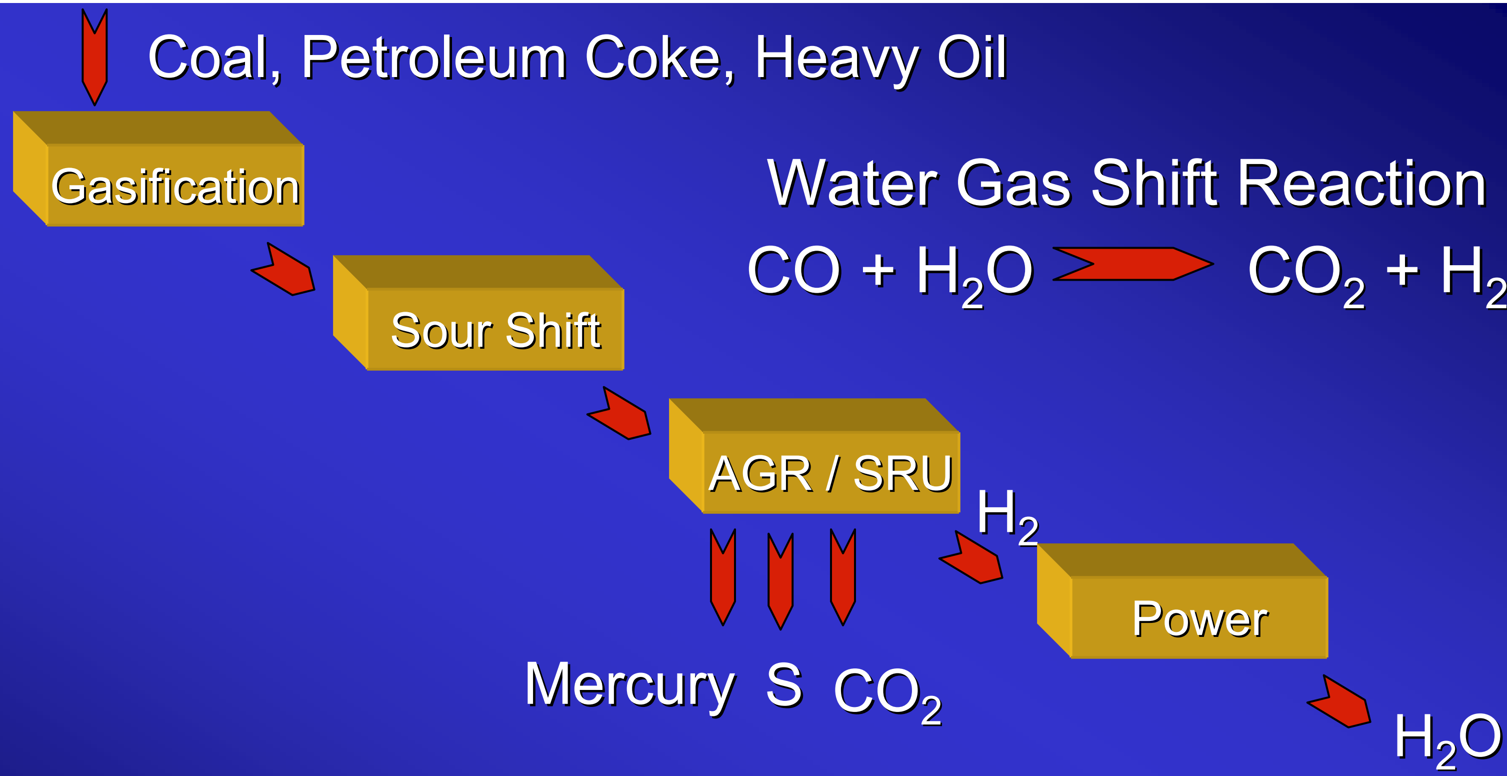
Environmental Performance - Solids
Comparison with Supercritical PC Plants

	lb/MWh		lb/MMBtu	
	IGCC	PC	IGCC	PC
Ash	0	83	0	9
Slag	113	0	13	0
FGD Sludge	0	114 [2]	0	13
Sulfur Recovered	14 [3]	0	1.5	0

1. Comparison assumes Eastern Bituminous Coal with 10 wt% ash & 2.2 wt% sulfur & based on the latest CVX Reference Plant Data
2. For IGCC, 98+% of sulfur in coal recovered as elemental sulfur while for PC, sulfur In the coal ends up in the sludge
3. IGCC recovered sulfur is a saleable product, as solid sulfur or sulfuric acid.

Next Generation:
CO2 Capture with IGCC

IGCC as a Pre-Combustion CO_2 Capture Technology – Near Future



Note: Nine ammonia projects using CVX gasification in China currently remove CO2, and recombine with Ammonia to produce Urea. Urea capacity is more than 4 million tons/year (Urea is a solid fertilizer).

Conclusions

Benefits of ChevronTexaco IGCC

- IGCC compares well with PC plants, with further cost reductions expected, and "is in the ballpark" on categories led by PC plants.

- Compared to alternative coal fossil technologies, IGCC provides:
  - Lowest NOx, SOx, Particulates and solid waste streams
  - Lower HAPS (Hazardous Air Pollutants)
  - Higher mercury removal (more than 95% expected)
  - Higher Efficiency through polygeneration

- Ready now for CO2 control scenarios: sequestration/injection for enhanced oil recovery

- Unique technology to utilize domestic energy sources (coal, pet coke) for cleaner energy, and provide future flexibility

- Provides strategic long-term options for local, regional and national energy security concerns