

House of Commons Peak Oil

Dual fuel CNG – diesel trucks, the high pressure gas grid and shale gas

Reducing oil imports and helping the UK to meet 2020 renewable energy targets

17th January 2012

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The challenge of this presentation

Typical comments from UK Energy Companies:

“I'm not sure encouraging the use of imported gas to replace imported oil is the best line”

“Policy in this area is dominated by the green agenda and the government is promoting electric vehicles as the way to reduce carbon from road transport”

Dual fuel CNG – diesel trucks, the high pressure gas grid and shale gas

- CNG Services Ltd
- History of support for vehicle fuels (2000 – 2011)
- NGV briefing
- Dual fuel trucks
- Use of LTS to supply gas to CNG stations
- EU 2020 targets and CO₂ reduction
- Oil and gas imports by 2020
- Shale gas
- Benefits of shale gas and dual fuel trucks supplied by LTS
 - Saving in oil imports
 - Reduction in CO₂
 - Jobs
 - Supporting Renewables
- Vision for 2020

CNG SERVICES LTD

CNG Services Ltd

- Supports projects to inject biomethane into the gas grid
 - Developer of Didcot project for Thames Water, SGN and Centrica
 - Consultant on Adnams Project
 - Working on 20 further biomethane injection projects in UK
- CNG as a fuel for trucks
 - Owner of UK's largest CNG station in Crewe
 - Developing CNG stations to fuel HGVs
- Supporting development of onshore gas fields and gas storage projects
 - Ryedale Gas Project
 - Wingas Saltfleetby
 - Halite Preesall

We are independent from all makers of plant, vehicles, clean-up, compression....we help clients get the best solution for their projects

BG Group Kazakhstan

- In July 2010 we commissioned the first CNG filling station in Kazakhstan
- 200 buses ordered for Asian games
- CNG is the solution to air quality

(no CNG buses in UK due to Bus Service Operators Grant (BSOG) which makes CNG uneconomic)



Most major cities have air quality problems and so make CNG the fuel of choice for buses.....we should have CNG buses in London, we have none

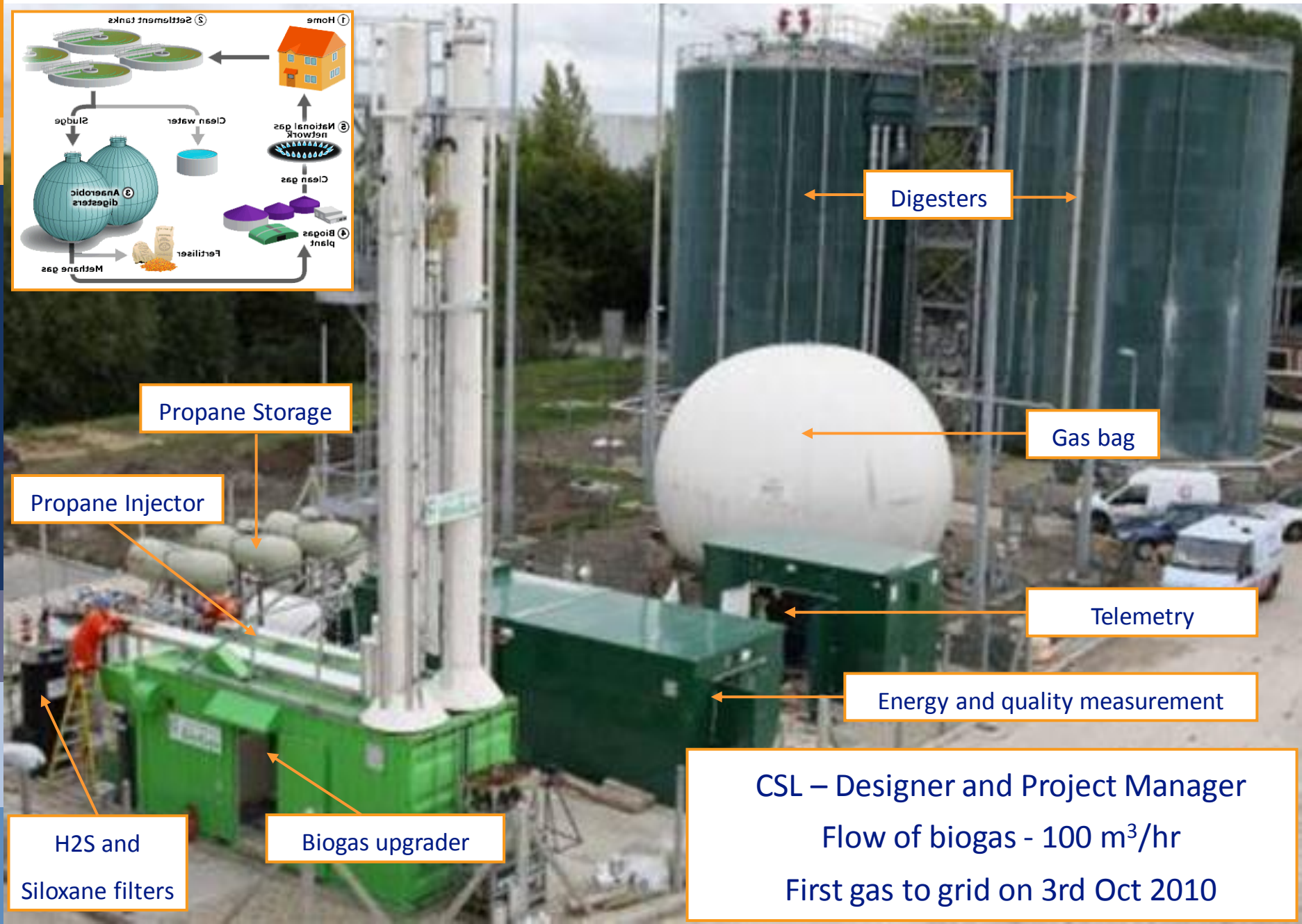
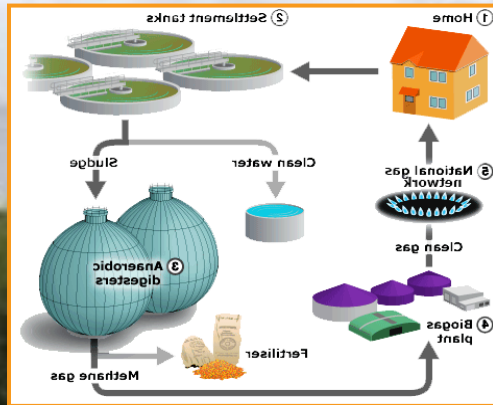
Crewe CNG Station

- We re-opened our Crewe CNG filling station in August
- Filling 5 CNG dual fuel trucks for GIST/M&S
- <http://www.youtube.com/watch?v=orxBtoXyjos>



Largest grid supplied CNG station in UK – takes gas from 4 bar grid and so uses 20% less electricity compared to 0.2 bar grid

Didcot – UK's First BtG Project



CSL – Designer and Project Manager
Flow of biogas - 100 m³/hr
First gas to grid on 3rd Oct 2010

HISTORY OF SUPPORT FOR VEHICLE FUELS (2000 – 2011)

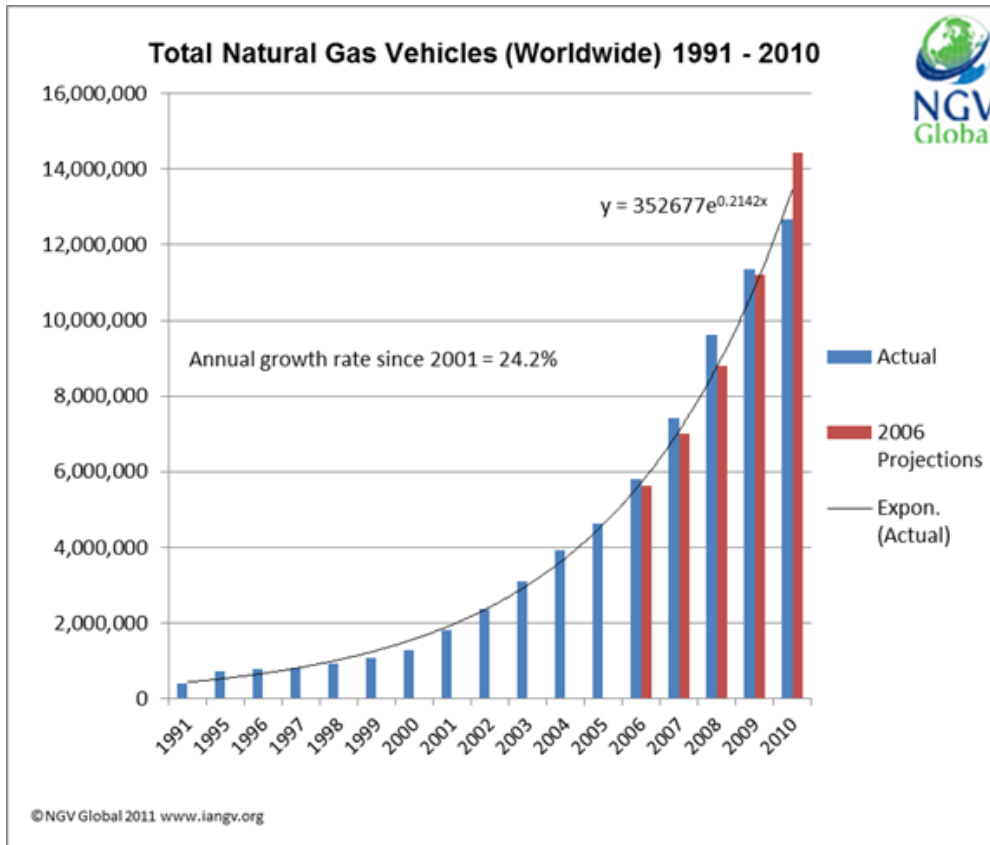
Government support for alternative fuels

- LPG (2000)
 - Problem with conversions of petrol cars - support reduced
- Biodiesel and bioethanol (2003)
 - Problem with orangutans etc - support reduced
- Hydrogen (2006)
 - Problem with laws of physics - support reduced
- Electric (2009)
 - Still supported but problems with lack of consumer demand and some stubbornly residual fossil fuel used to generate electricity

The last Government was very good at making decisions as to which fuel we should use...

NATURAL GAS VEHICLE BRIEFING

NGV Worldwide



NGV POPULATION: TOP TEN COUNTRIES

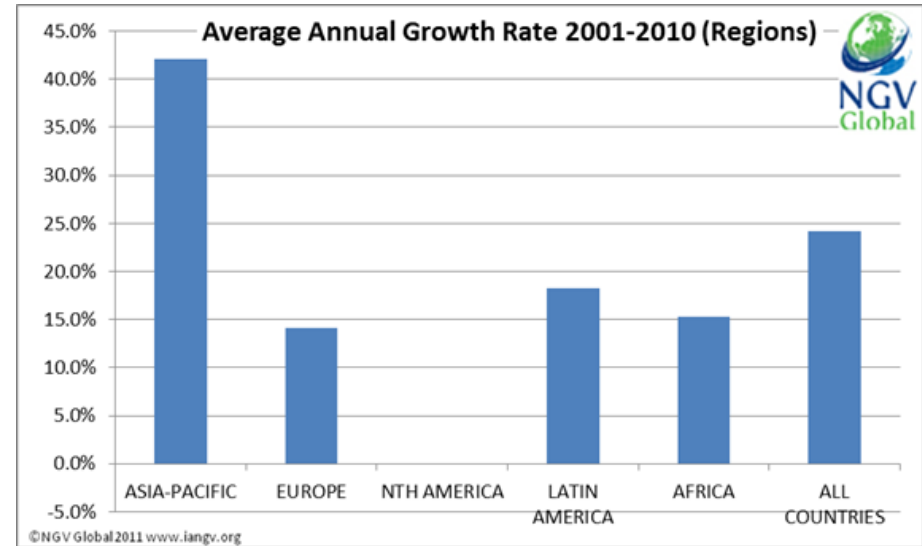
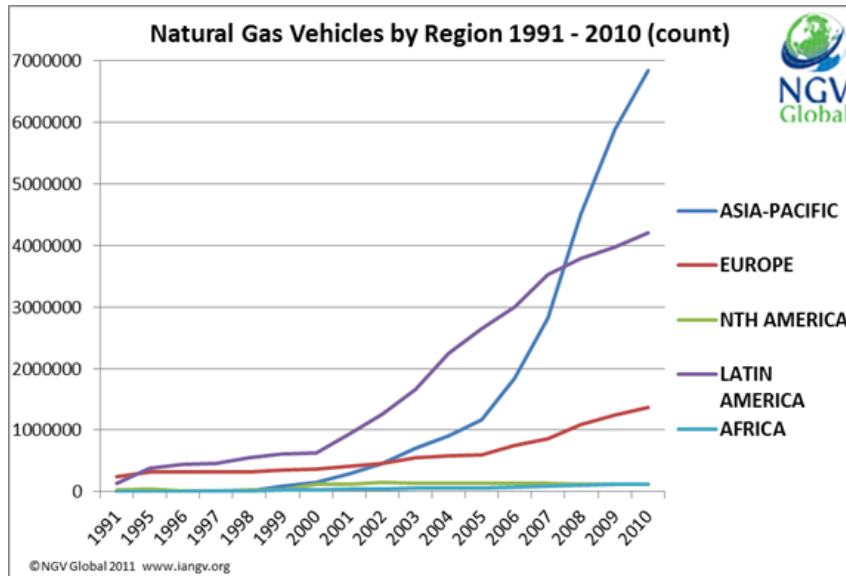
COUNTRY	NGV Population	% all NGVs in world
Pakistan	2,740,000	21.60%
Iran	1,954,925	15.40%
Argentina	1,901,116	15.00%
Brazil	1,664,847	13.10%
India	1,080,000	8.50%
Italy	730,000	5.80%
China	450,000	3.60%
Colombia	340,000	2.70%
Thailand	218,459	1.70%
Ukraine	200,000	1.60%

NGV SATURATION: TOP TEN COUNTRIES

COUNTRY	NGV Population	Saturation in Country
Pakistan	2,740,000	61.14%
Armenia	101,352	32.13%
Bolivia	140,400	20.48%
Bangladesh	193,521	16.75%
Argentina	1,901,116	15.33%
Iran	1,954,925	12.64%
Colombia	340,000	6.92%
Peru	103,712	6.56%
Tajikistan	10,600	3.95%
Brazil	1,664,847	3.40%

This has been seen as a 'developing world' fuel...but US shale gas is changing that

NGV Growth



North America has been bottom of league...before shale

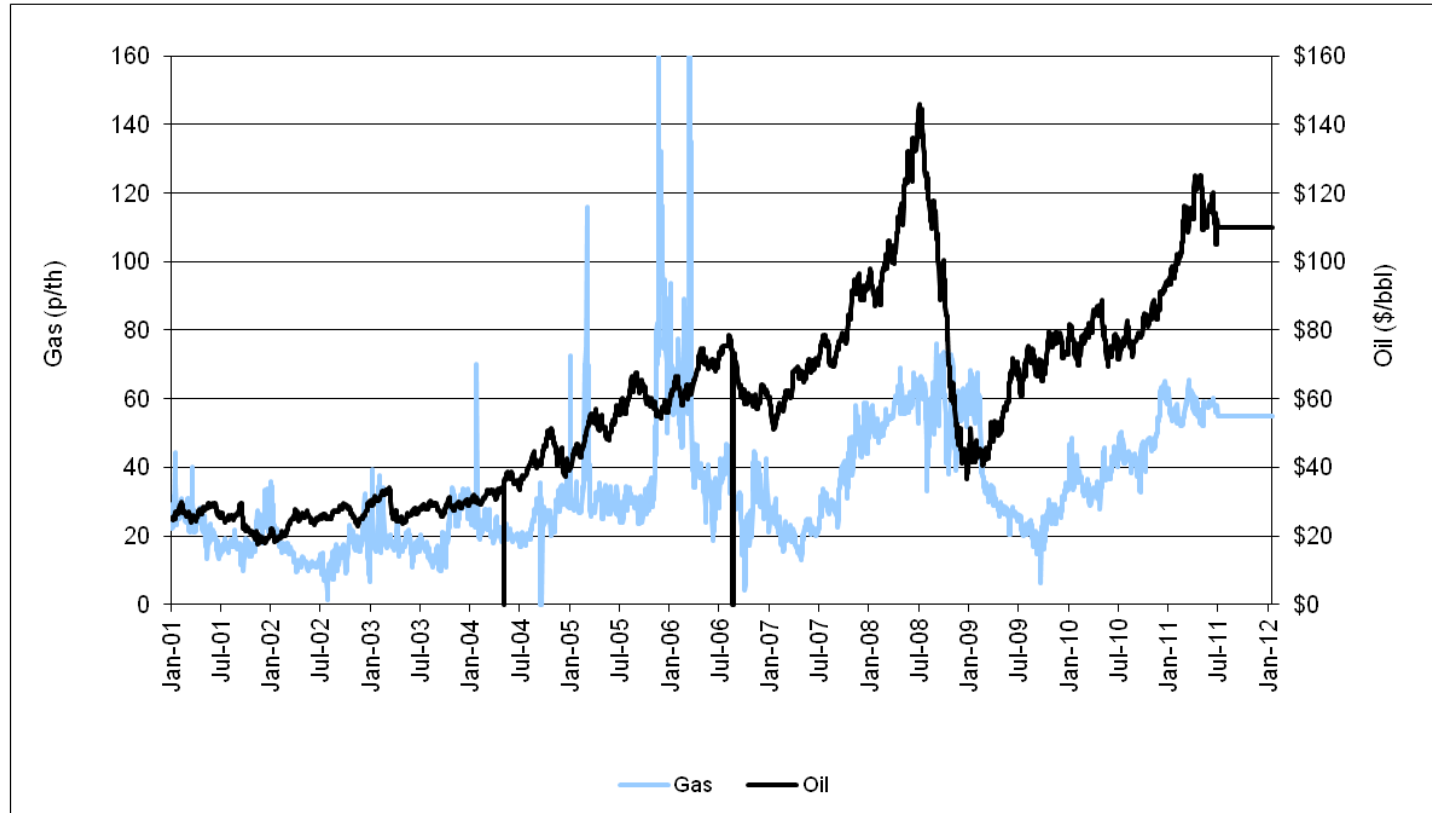
Drivers for NGVs

- Oil price increase with natural gas as a commodity generally cheaper than oil (diesel/gasoline) on a cost per unit of energy basis (Pakistan, Brazil)
- Anti-pollution measure in heavily populated cities (US, India)
- Development of piped natural gas grid (India and Iran)
- Countries that produce oil and gas are recognising benefit of a shift in transportation to gas to allow more oil exports and/or reduced diesel imports (Egypt, Iran, UAE)
- Growth in car ownership with CNG taking greater share of growth (India)
- Development of biomethane supplies (Sweden)

The big driver today is cost of natural gas compared to cost of oil

Fundamental Economics of NGVs

Natural gas v Oil



Natural gas has diverged from Oil price due to world-wide LNG trade and US Shale gas production

EU NGV Market (1) - vehicles

Country	Natural Gas Vehicles					
	Total NGVs	Total CNG vehicles	CNG Cars and Vans	HGVs and Buses	% of total vehicles in the country	% of total NGVs in Europe
France	13,500	13,500	10,200	0	0.04%	0.96%
Germany	94,890	94,890	92,100	2,790	0.21%	6.75%
Italy	761,340	761,340	757,840	3,500	1.86%	54.15%
Russia	86,000	85,140	54,180	30,960	0.24%	6.12%
Sweden	36,380	36,380	33,575	2,805	0.76%	2.59%
Switzerland	9,494	9,434	9,195	239	0.21%	0.68%
Ukraine	200,019	200,000	10,000	190,000	2.65%	14.23%
United Kingdom	220	170	20	150	0.00%	0.02%
European NGV countries	1,405,913	1,402,214	1,131,151	3,699	0.42%	100.00%

The UK is close to bottom of the league

EU NGV Market (2) – CNG stations

Country	Refuelling stations				
	Total	Public	Private	Under construction	% of total CNG fuelling stations in Europe
France	300	32	268	0	7.5%
Germany	900	720	180	150	22.6%
Italy	858	811	47	38	21.5%
Russia	244	204	40	26	6.1%
Sweden	166	130	36	0	4.2%
Switzerland	129	126	3	6	3.2%
Ukraine	294	102	192	0	7.4%
United Kingdom	5	2	3	5	0.1%
European NGV countries	3,989	2,713	1,276	328	100.0%

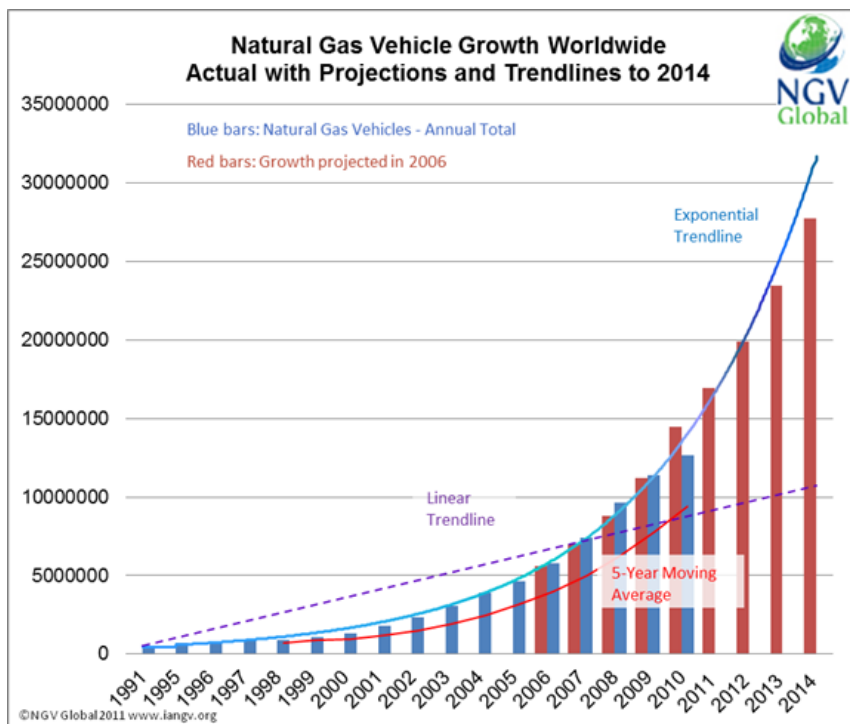
The German experience is important

NGV in Germany

- In 2000, German Govt tri-partite deal:
 - Govt would fix CNG duty at EU minimum for 20 years
 - Car OEMs would make CNG cars
 - German gas industry would install 1000 CNG stations
- In 2012:
 - 900 CNG stations
 - 92,000 CNG cars
 - Great vehicles such as Passat Ecofuel
- But 92,000 cars at 90 stations means only 100 at each or around 15 per day
- Project has failed to date because diesel vehicles are now so good

Lesson here for electric vehicles – internal combustion technology is very good and getting better

Future Growth



- North America is now considered a buoyant CNG market due to very low gas prices compared to oil caused by the development of shale gas production
- Growth in Brazil and Argentina is expected to be significant due to abundant domestic natural gas prices and the fundamental economics of reduced oil imports or oil exports
- Far east growth is lower due to high far east LNG prices which are still linked to oil
- Nigerian CNG growth expected to be significant due to increase in domestic petrol prices (reduction of subsidy)
- Iranian CNG market expected to be largest in the world by 2020 due to drive to reduce petrol imports and because of fundamentally higher value of oil as an export product compared to use for domestic road transport

North America starting to see dramatic growth in truck sector

US Market

- Shale gas and low gas prices driving growth
- LNG and CNG



Scheduled for completion during 2012 and 2013, the 150 first-phase stations coincide with the expected arrival of new natural gas truck engines well suited for heavy-duty, over-the-road trucking. Engine manufacturers and original equipment truck manufacturers such as Cummins-Westport, Kenworth, Peterbilt, Navistar, Freightliner and Caterpillar are expected to have big trucks available in engine sizes allowing for varied road and driving requirements

NGV Conclusions

- Very high growth driven by oil – gas differential
 - It happened with heating and electricity
 - Gas grid = gas for heating (UK 1970-90)
 - Gas = gas for electricity (UK 1992 - 2012, 50% switch)
- Gas stored on vehicle as CNG and LNG
- Truck sector in North America
- OEMs now making NGVs
 - This is the key development

DUAL FUEL TRUCKS

Dual fuel trucks

- A diesel-fossil CNG/LNG tractor will save 15% - 25% CO₂ on a 'tank to wheels' basis compared to diesel alone
 - Because CH₄ contains less carbon than C12 diesel
- 2 OEMs in UK supported by 2 UK companies who are world leaders in dual fuel technology:
 - Mercedes Benz supported by Hardstaff Group (Nottingham)
 - Volvo supported by Clean Air Power (Leyland)
- See next slides

Dual fuel trucks are a game changer

GIST/M&S Crewe - 5 Axor Dual Fuel



Initial feedback is good – drivers say they are just same as diesel

Tenens – 12 Actros, 2 Axor Dual Fuel

- HT carried out 6 month trial on trunking & multi-drop routes from Andover resulting in investment:
- 12 x Actros tractor unit converted running from Andover
- 2 x Axor tractor units converted running from London
- CNG station London M25/A13



Warburtons – 6 Axor Dual Fuel



These vehicles are transformational – benefit of diesel efficiency but
with natural gas – 15% lower CO₂
Range is 400 Miles, substitution is 60%

Dual Fuel Tractors – Volvo

VOLVO TRUCKS



Press release, published: 31/05/2011

Volvo Trucks first to market gas-powered truck for long-haul operations

Volvo Trucks is enhancing its focus on alternative fuels with the launch of the new Volvo FM MethaneDiesel. This truck is powered by up to 75 percent gas. Thanks to its fuel-efficient technology – which extends the vehicle's operating range – it can considerably reduce CO₂ emissions from heavy and long-distance transport operations.

Better exhaust filtration technology and lower emissions

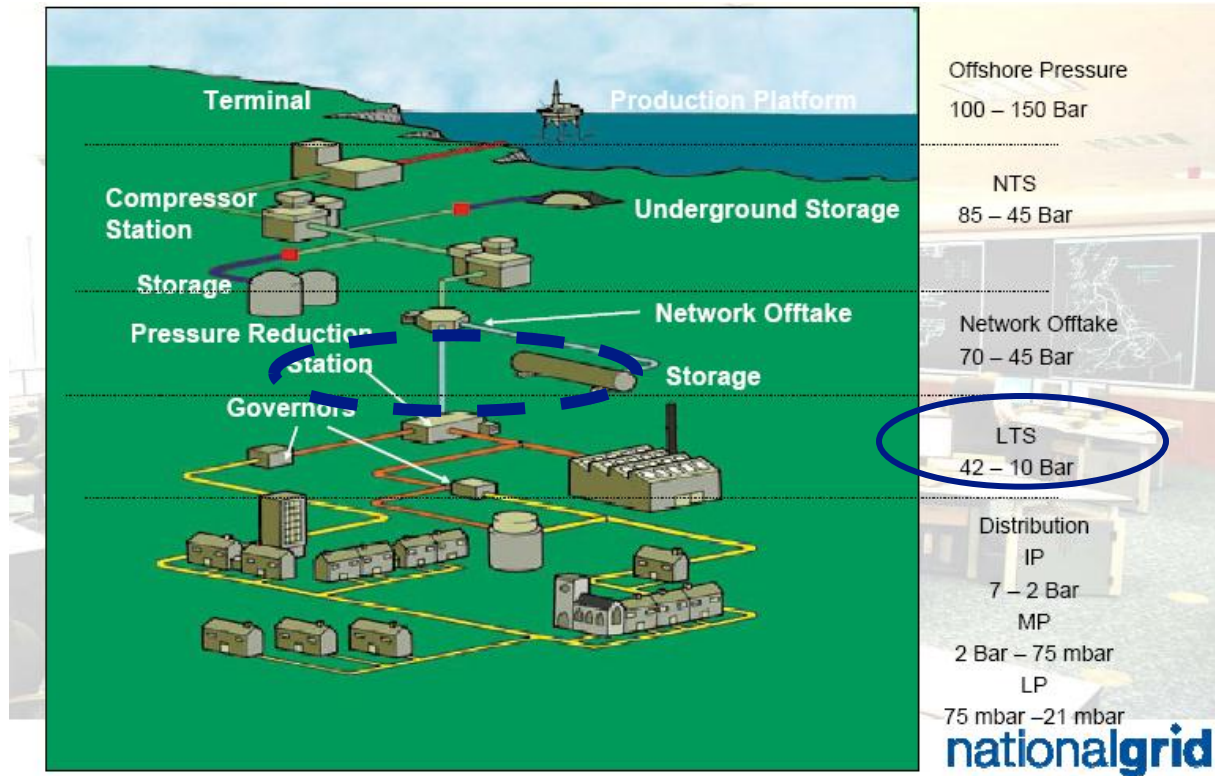
Compared with conventional gas-powered spark-plug engines, Volvo's gas technology offers 30 to 40 percent higher efficiency, and this in turn cuts fuel consumption by 25 percent. This means that if a Volvo gas-powered truck is run on biogas, emissions of carbon dioxide would be able to be cut by up to 70 percent compared with a conventional diesel engine.

Since the price of natural gas is often significantly lower than that of diesel, financial savings are also possible; this is often a necessary precondition for widespread acceptance of new technology.



USE OF LTS TO SUPPLY GAS FOR CNG STATIONS

UK gas system – Local Transmission System



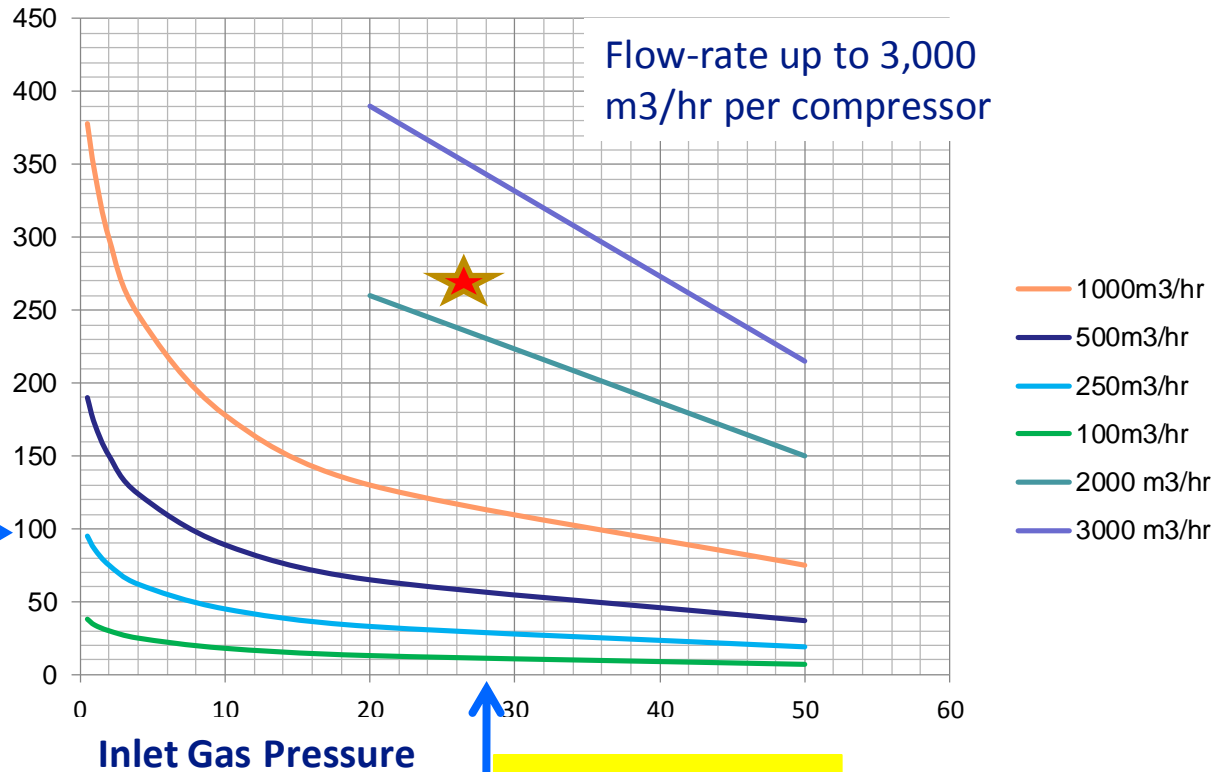
LTS is a vital national asset - ideal for CNG – it would cost >£15 billion to build NTS/LTS – these assets can help reduce diesel demand and reduce CO₂ from trucks

Compressor Power

Electricity kWh

Lower pressure grid cannot in practice flow above 500 m³/hr per compressor

Less than 100 kWh – around 25% of electricity required at 0.5 bar MP



Typical LTS site

UK is better placed than many countries in having LTS – located close to more than 100 major distribution centres

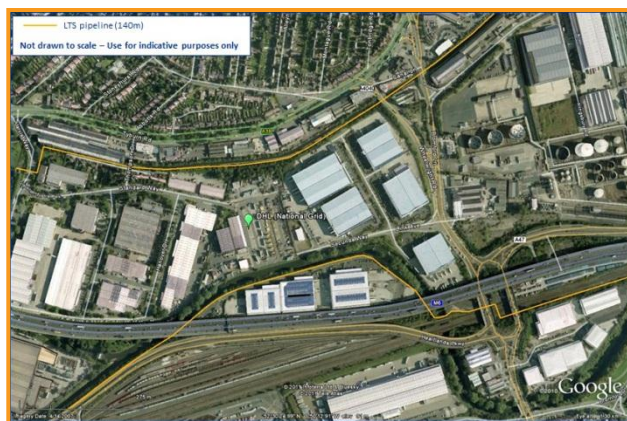
Advantages of CNG from LTS Supply

- 80% less energy for compression
 - Only 2 stages of compression, not 5, so lower capex
 - Less than 2% of the energy in the gas used for compression
- Very high flow-rates possible
 - Typical CNG compressor flow rate is 300 m³/hr
 - LTS CNG flow-rate can be 3,000m³/hr per compressor
 - This means smaller sites, less CNG Storage
 - Very low maintenance cost due to low running hours
- LTS gas is very dry so no need for gas driers
 - Saves Capex/Opex and gives very good CO₂ outcome
- No gas leakage from LTS
 - If CNG taken from Medium Pressure/Low Pressure then approx. 0.5% of the gas in these mains leaks out (hence £750 million per annum pipeline replacement)
 - Methane approx. 23 times worse as GHG so this leakage adds around 11.5% to well to wheel CO₂

National Grid LTS Location Review

We were commissioned by National Grid to undertake a review of location of distribution depots next to the National Grid LTS (who own around 50% of the UK LTS network)

- 113 haulage companies contacted
- 28 responses received
 - 23 agreed to take part and provided details of depots
 - 5 declined the request
- Total of 132 depot locations were found to be within 2km of an LTS pipeline



	A	B	C	D	E	F	G	H
1	Company	Contact Name	Position	Email	Request Sent	Response Received	Notes	
12	Johns	John Jones	Managing Director	john@johns.co.uk	12/07/2013	Viewing Response		
13	Asa Building Transport	Peter Lennex	Managing Director	pete.lennex@asa-building.co.uk	04/08/2013	Viewing Response		
14	Kymene			info@kymene.co.uk	04/08/2013	Viewing Response		
15	Kellogg Logistics Services (Europe) Ltd	Steven Poole		steven.poole@kellogg.co.uk	02/08/2013	Viewing Response	Not interested	
16	Kingsley of Old			info@kingsleyofold.co.uk	04/08/2013	Viewing Response		
17	Kingsley & Nigal Ltd	Andrew Kins	Investment Relations	andrew.kins@kingsley-nigal.co.uk	04/08/2013	Viewing Response	Deposit at Minworth's DM, Not final decision	
18	Lyvel Freight (Supply Chain) Ltd	Matthew Preston	Innovation Centre General Manager	matthew.preston@lyvel.co.uk	01/08/2013	Viewing Response	See sheet 2	
19	London City Group			info@londoncitygroup.co.uk	04/08/2013	Viewing Response		
20	London Metals	Peter Lander	Waste & Logistics Manager	info.lander@londonmetals.co.uk	01/08/2013	Viewing Response	See sheet 2	
21	London Metals	Derek Daulty	Fuel Manager	derek.daulty@londonmetals.co.uk	04/08/2013	Viewing Response	See sheet 2	
22	London Transport			info@londontransport.co.uk	04/08/2013	Viewing Response	See sheet 2	
23	Marx Wiggins			info@marxwiggins.co.uk	04/08/2013	Viewing Response	List of depots available online	
24	Marx Wiggins	John Ward	Head of Vehicle Maintenance	john.ward@marxwiggins.co.uk	04/08/2013	Viewing Response	See sheet 2	
25	Marx Wiggins Processors Ltd			info@marxwiggins.co.uk	04/08/2013	Viewing Response	See sheet 2	
26	NET RETAIL LTD	Mervyn McIntyre	Distribution Support Manager	mervyn.mcintyre@netretail.co.uk	02/08/2013	Viewing Response	See sheet 2	
27	NP T Distribution	John Gaulton	Customer Services Manager	john.gaulton@np.co.uk	04/08/2013	Viewing Response	See sheet 2	
28	Napier-Hughes Ltd			info@napier-hughes.co.uk	04/08/2013	Viewing Response		
29	Napier-Hughes Ltd			info@napier-hughes.co.uk	02/08/2013	Viewing Response		
30	Navigation Europe Group	Martin Wallingham		info.wallingham@navigation.co.uk	04/08/2013	Viewing Response		
31	Navigation Europe Group	John Matthews	Head of IT Fleet	john.matthews@navigation.co.uk	04/08/2013	Viewing Response		
32	Nine Logistics	John Tate	Fleet Engineer	john.tate@nine.co.uk	04/08/2013	Viewing Response	Not interested	
33	Nine Logistics			info@nine.co.uk	04/08/2013	Viewing Response		
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158	Nine Logistics							

How many trucks can be filled with CNG at an LTS station?

- Flow-rates of, say, 2,500 m³/hr from a single compressor
 - 1,900 kg/hr
- 1 truck doing 100,000 miles per annum will use 50 kg of CNG per day
- So 1 hour compression = 38 trucks per compressor
 - 1,824 trucks per day (assuming 4 compressors running for 50% each)
 - In practice, say 1,500 trucks at each station

How much diesel saved?

- For 1 CNG Station, annual CNG = 20 million KG
 - 10 million therms
 - Cost of LNG around £6 million at 55 p/therm for gas
 - This money goes overseas
- Equivalent to around 27 million litres of diesel
 - Cost around £16 million at 60 p/litre (duty free)
 - This money goes overseas
- 1 CNG station will save around £10 M per annum
 - We can use this money to insulate homes and build renewable generation
- Cost is £2.5 M for CNG station plus estimated £15k per truck for CNG conversion

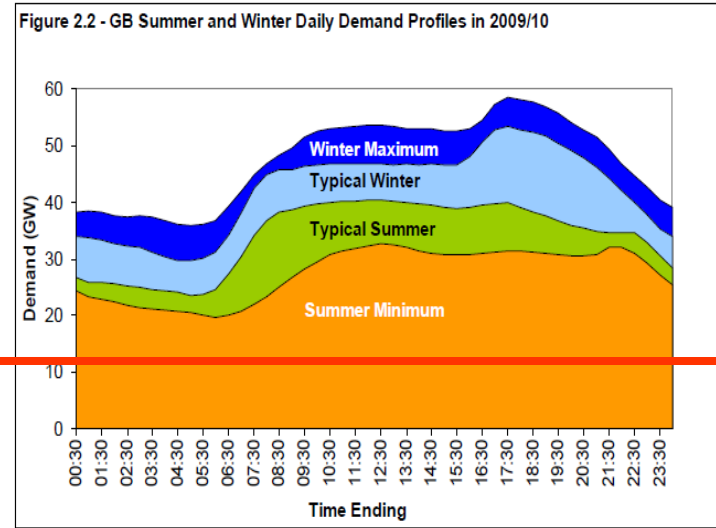
Cost to Govt save this much diesel?

- CNG duty is less than diesel duty
 - Saving of £16 million diesel duty but paying £5 million CNG duty
 - £11 million per annum net duty reduction
 - (likely to be much less due to foreign driver effect)
- Saving 27 million litres = 6 million gallons
 - Cost is **£1.80 per gallon**
- Note – estimated saving to UK balance of payments from importing gas instead of diesel is £10 million

As a hedge against peak oil and rising oil prices this looks a good idea...but
what about investing in EVs instead?

How many Electric cars to save this much diesel?

- Assume 5,000 miles and replacing diesel car with mpg 50
 - 100 gallons of diesel saved
- £5k per EV subsidy
 - £1k per annum
- No road tax and no fuel duty (and VAT), saving of 70 p/litre
 - £250
- Cost to save 100 gallons a year is around £1,250 = £12.50/gallon
- To save 6 million gallons needs a total of 60,000 EVs



EVs for cars may be a good idea once we have surplus electricity from nuclear and renewables but that is post 2030 and not the most efficient use of limited resources before then

National CNG Network

- 50 CNG stations on LTS/M'way junctions
- Each will cost around £3 Million for 4 compressors at each site (assuming £1 Million land costs)
- Each site can fill around 1,000 trucks per day
- 50,000 trucks per day
- Total CNG use of 1 billion kg = 500 million therms per annum
- Saving 60 litres diesel per day per truck = 3 million litres per day = around 1 billion litres of diesel per annum
- CO₂ saving of around 30-40% which is 10 – 15 tonnes per truck = around 1 million tonnes/annum

This is a good use of existing assets and UK technology
- saves imports, saves CO₂

LNG

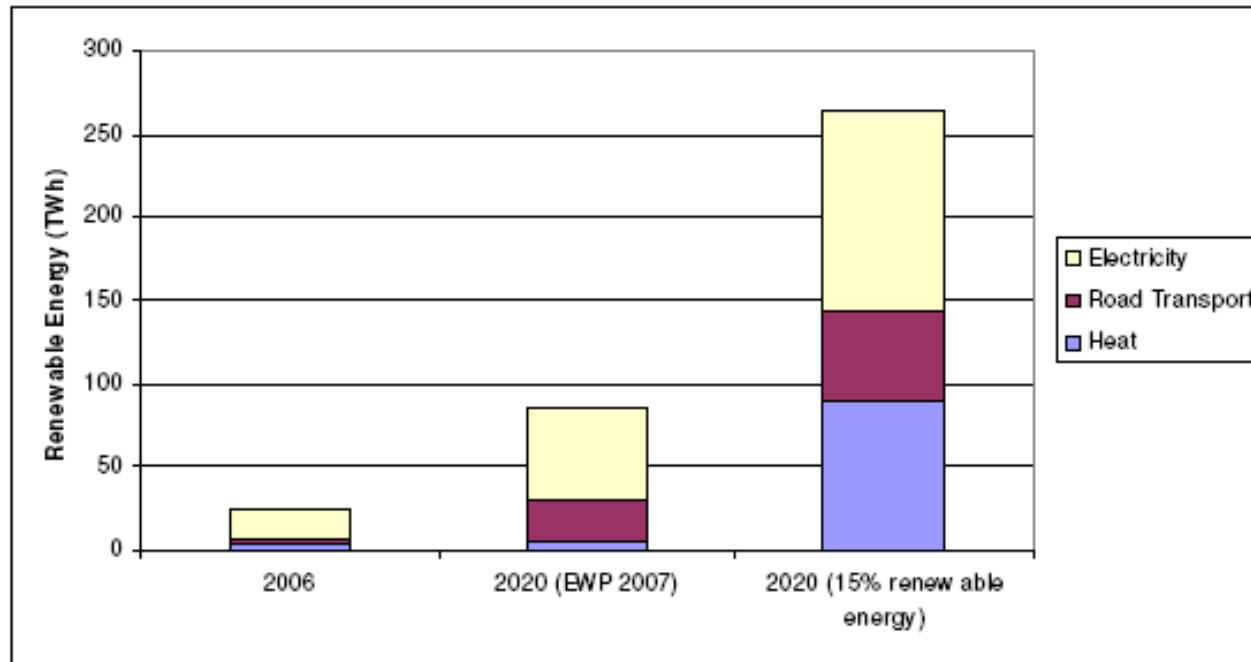
- LNG dual fuel means the natural gas is stored on the truck as cold liquid instead of compressed gas
- LNG good for heavier trucks, longer range
- Currently only 1 facility to fill with LNG (Avonmouth)
 - 30 years old, single plant, could close any day
 - 3 similar plants have closed in last 3 years
 - Not good for CO₂ as made from re-gasified Milford Haven LNG
- The new LNG importation terminals at Isle of Grain and Milford Haven have no ability to fuel LNG tankers
 - If these facilities had an LNG road tanker loading bay then the 50 LTS CNG Stations could be combined LNG-CNG

LNG road tanker loading capability at our LNG importation terminals is important

EU 2020 TARGETS AND CO₂ REDUCTION

UK 2020 Target – 15% renewables

10 fold increase in renewables by 2020



Difficult targets to meet – road transport and heat in particular...

2020 Targets - what about the 85% that is not renewable?

- Nuclear stations closing down, new ones delayed
- Coal plant closing down
 - CCS may not be viable due to cost and delayed post 2015
- So, electricity will be gas with some nuclear and some coal with CCS and a lot of wind
 - No realistic alternative to lots of gas fired CCGTs
- Heating will be gas
- Cars will be diesel-petrol with some electricity (i.e. from gas)
- Trucks can be diesel and natural gas

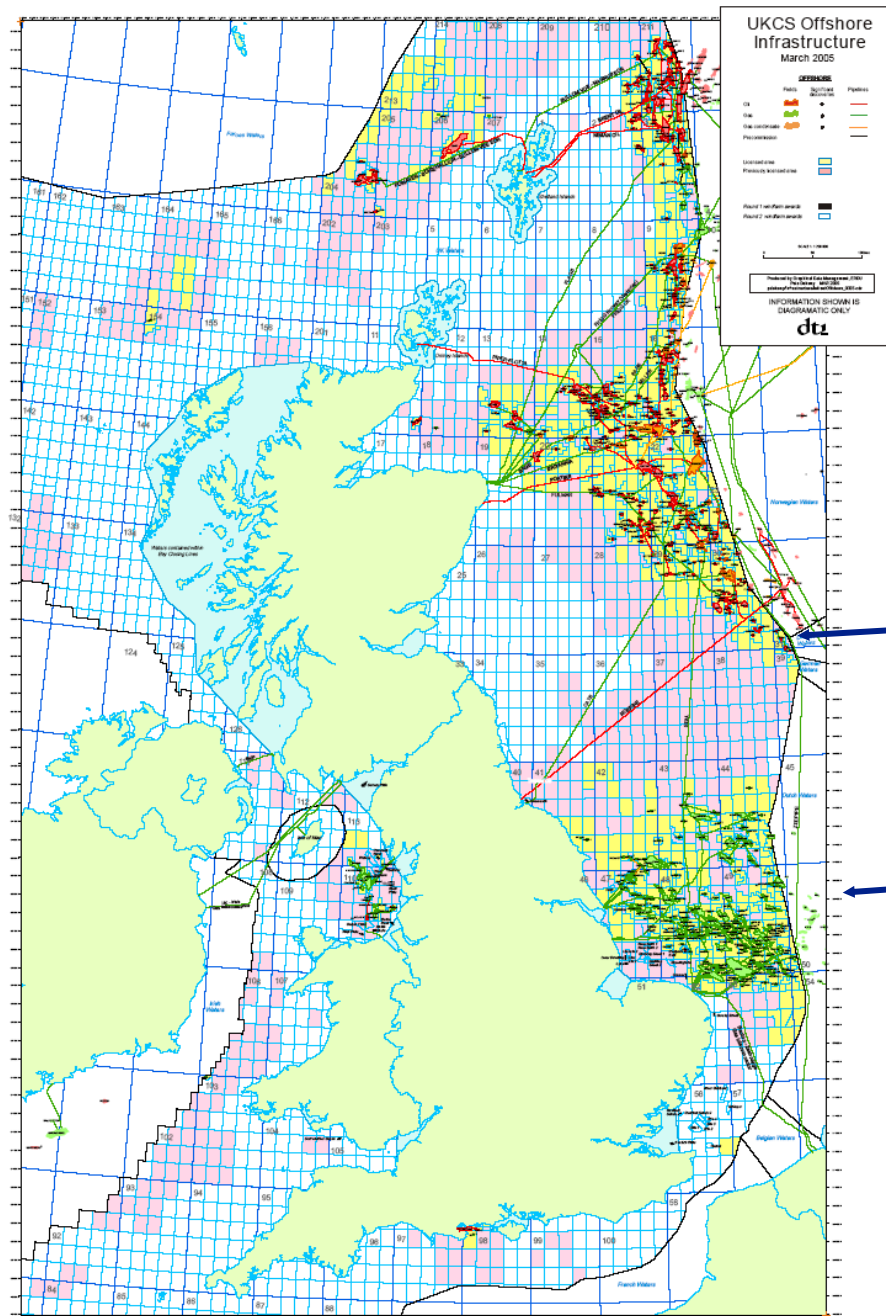
What CO₂ reduction can be made by using the LTS and dual fuel trucks?

Estimated CO₂ savings from Dual Fuel supplied via LTS

- This assumes normal fossil natural gas (not biomethane)
- Tail-pipe CO₂ saving = 15% CO₂
 - This is based on 55% CNG, 45% Diesel
 - On 75% CNG, 25% diesel, CO₂ saving 20 – 25%
- Saving from LTS = 18% CO₂
 - No leakage of methane to get gas to the supply point = 11.5%
 - 80% less electricity for compression = 6%
 - No need for drier = 1%
- Total CO₂ reduction from Dual Fuel trucks supplied via LTS is around 30 - 40%
 - More if gas comes from Lancashire

OIL AND GAS IMPORTS BY 2020

UK offshore oil and gas



Mostly oil - red

Mostly oil with associated gas

Mostly gas - green

And now, mostly gone....

Morecambe Gas

- In 1973, Gulf (now part of Chevron) drilled through the South Morecambe gas field
 - They said it was dry....
- John Bains of British Gas looked at the logs and identified 600 feet of gas bearing rock!
 - Clever chap
- Probably the single most important event in the history of Centrica, BG Group and National Grid
- 172 BCM of gas = 69 billion therms
- Worth £50 Billion at today's gas prices

I was graduate trainee on South Morecambe commissioning – Cuadrilla may have a few South Morecambes....

Centrica and GDF mull new UK offshore gas storage

Thu Mar 27, 2008 7:26am GMT

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MARKET NEWS

[Those behind mkt crisis must help solve it-Germany](#)

[European shares slide, led by banks and commodities](#)

[Hypo has liquidity problem, business sound-Germany](#)

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LONDON (Reuters) - Centrica (CNA.L: [Quote](#), [Profile](#), [Research](#)) and Gaz de France GAZ.PA are studying building the UK's first offshore gas storage facility for over 25 years, the owner of British Gas said on Thursday.

Centrica, which owns the UK's only existing offshore gas storage site, Rough, located under the North Sea, is looking at converting the Bains gas field in the East Irish Sea into a seasonal storage facility about a fifth of the size of Rough.

The partnership with GDF and UK independent First Oil plc has been announced ahead of an Anglo-French summit in London aimed at closer cooperation between the two countries, particularly on energy security.

"We believe Bains has real potential as a new gas storage facility," Centrica Chief

Executive Sam Laidlaw said.

"As the UK becomes increasingly reliant on imported gas and flexibility from North Sea fields declines in the coming years, investing in much-needed storage facilities, which will boost this country's security of supply, forms part of Centrica's long-term programme of investing," he said in a statement.

If built, the facility could be ready to top up British gas supplies for the winter of 2011/12 and would have a storage capacity of up to 20 billion cubic feet.

The final investment decision will not be taken until 2009, and Centrica gave no indication of the costs involved. But industry sources said such a facility would likely cost over 300 million pounds.

Centrica, which operates the Bains gas field, will manage the development with a 52.8 percent stake in the project, while GDF has a 34 percent share and First Oil 13.2 percent.

John Bains

So, if you discover a £50 billion gas field you get a gas storage reservoir named after you!

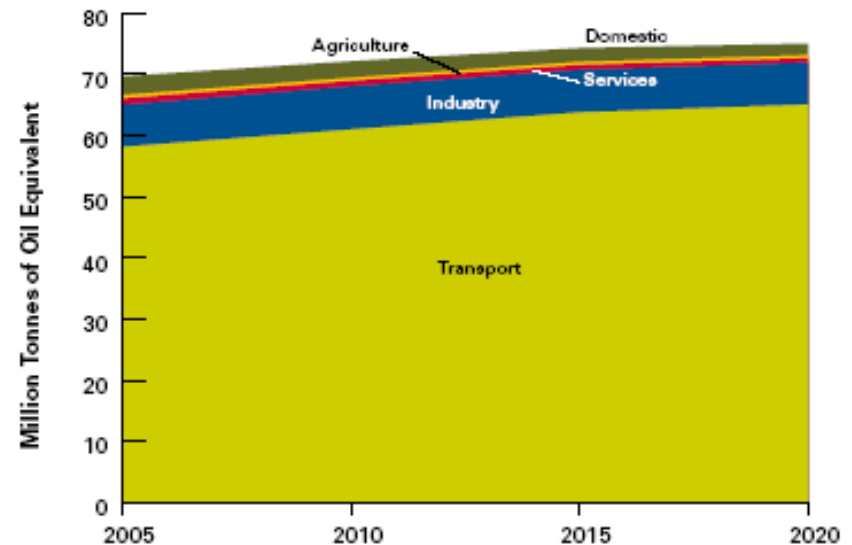
UK oil production and demand 1990 - 2020

UK oil production



Source: BERR

UK oil demand



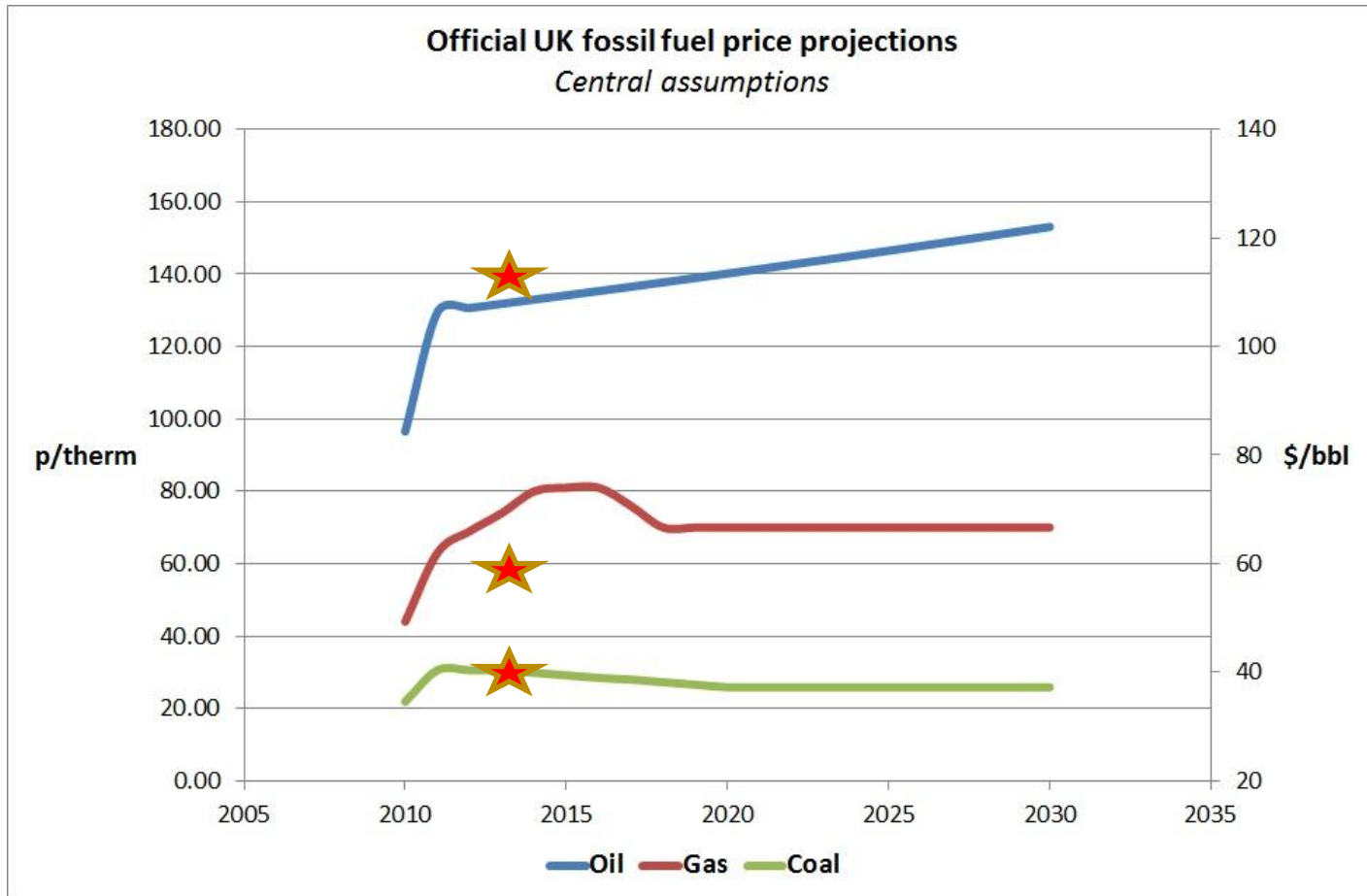
Source: BERR forecast model

DECC forecasts that by 2020, UK will be importing around 1 million bbls of oil per day, almost all for road transport

This is the Elephant in the room.....how do we afford this then?

DECC energy price forecasts

★
Prices
today

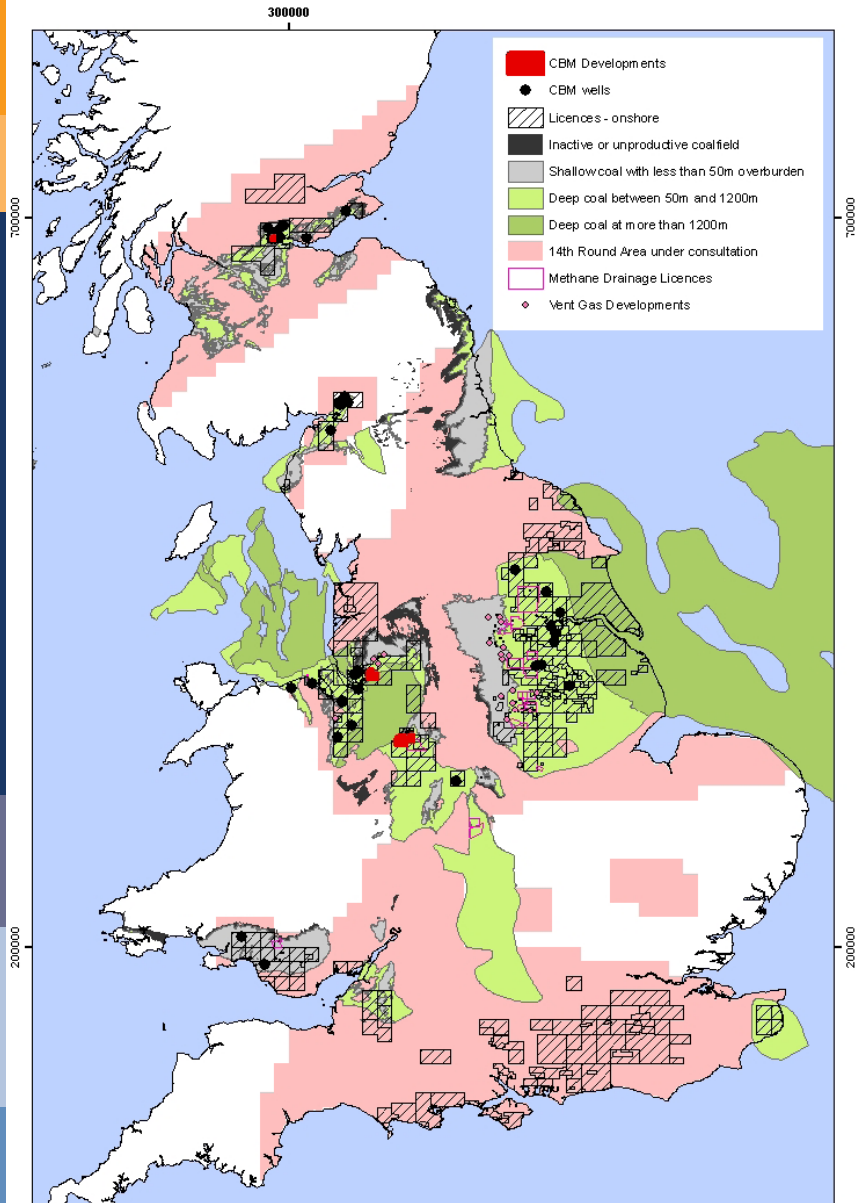


At \$150/bbl, 1 million bbls/day will cost $365 \times \$150$ million = \$54 billion per annum = £3 billion per month

Can UK plc fund this and have funds to finance renewables, nuclear etc?

SHALE GAS

Coal Bed Methane and Shale Gas Outlook in the UK



Companies pursuing CBM and shale gas in the UK:

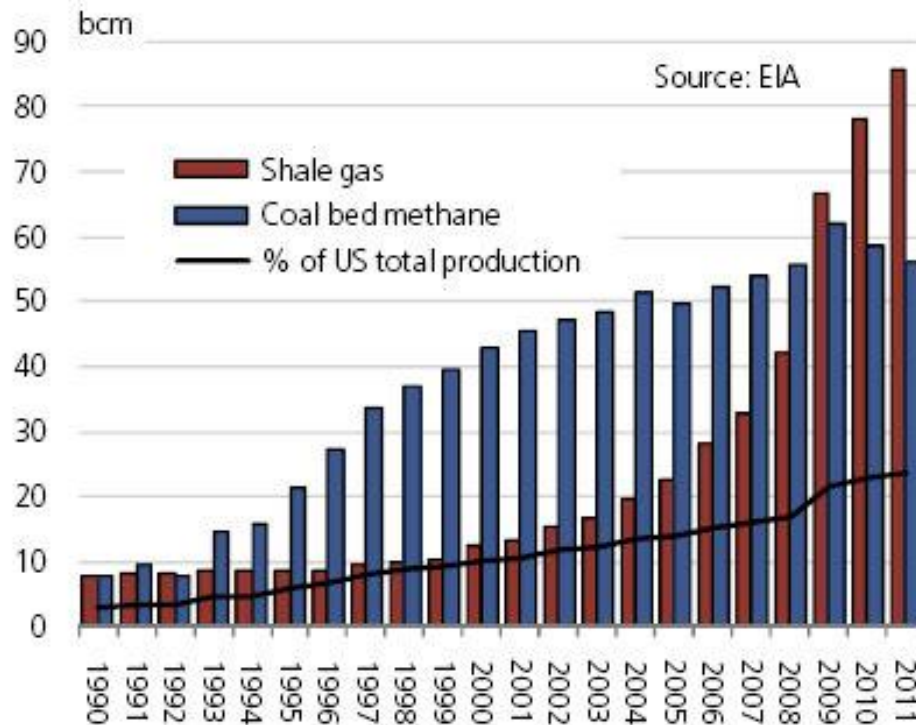
- **I Gas** CBM & shale gas & conventional onshore Oil & Gas
- **Cuadrilla** shale gas
- **Dart Energy** CBM & shale gas
- **Coastal Energy & Eden Energy (Adamo)** CBM & shale gas
- **Reach Coal Seam Gas** CBM & shale gas
- **BG** shale gas
- **Centrica** CBM but withdrawing
- **Alkane** AMM & CBM & shale gas
- **Egdon** Conventional & shale gas
- **eCorp** shale gas

Other Licence holders – Conventional & shale gas

US Shale Gas Production

1990 – 2011

Figure 3: US production of shale gas and coal bed methane



Massive growth since 2006 – all us LNG importation projects cancelled, chemical and steel industries relocating back to US

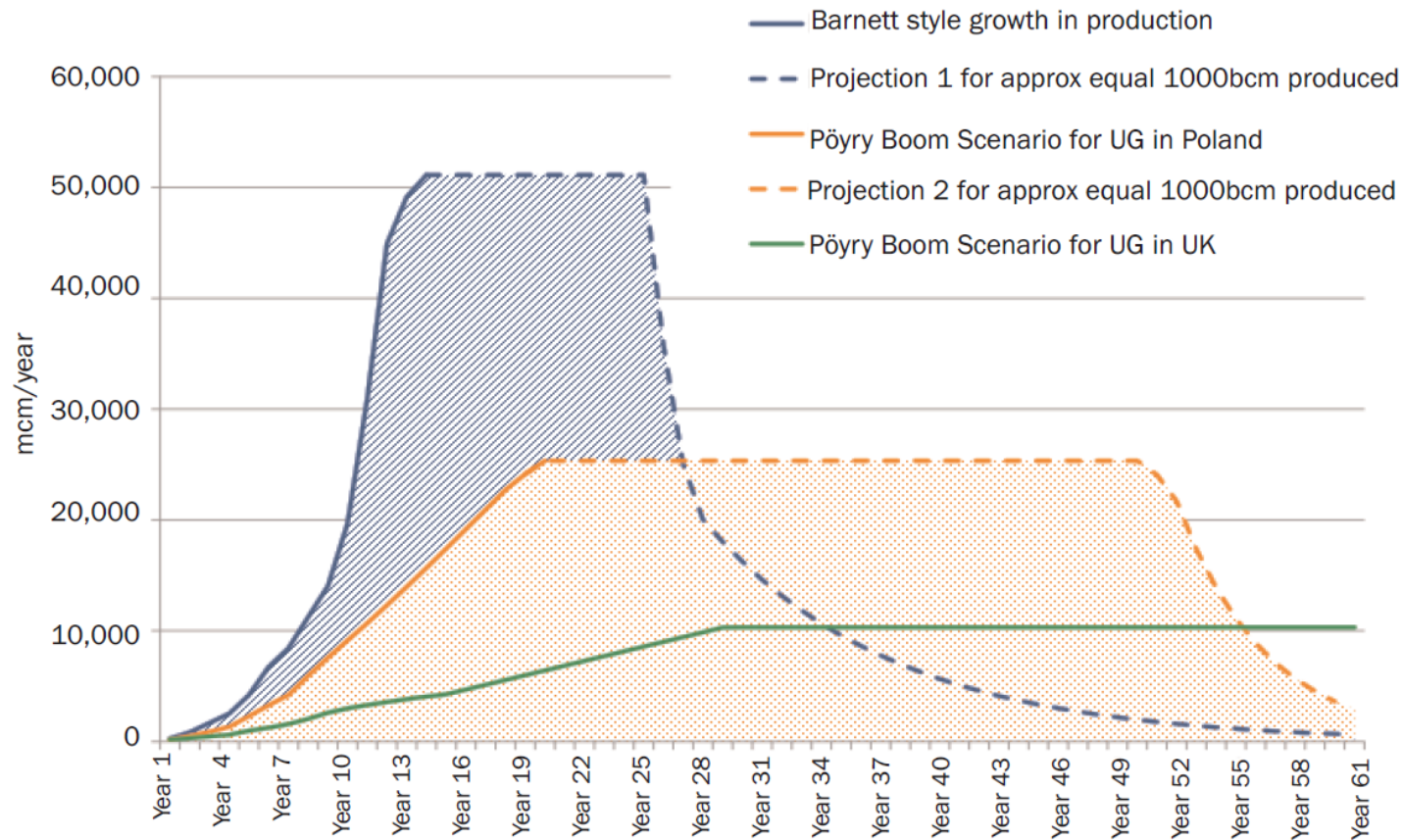
Cuadrilla Production Estimates

- Cuadrilla's 200TCF is a huge gas reserve
- 20% recovery is 40 TCF = 7 South Morecambe fields
 - Each worth £50 billion in today's money so around £350 billion (that would be paid to buy gas from abroad)
 - Even 5% recovery is OK
- Many other good prospects for shale gas in UK
- Shale gas is transformational, we need to recognise its value to UK plc and use it to fund insulation and renewables

200TCF x 20% recoverable = 1 TCF (28 BCM) per year for 40 years

Although production could be even higher at full throttle about 2019

Unconventional Gas Production Profiles



Source: Pöyry

This shows three production profiles. The 'Pöyry Boom Scenario for UG in the UK' is Pöyry's current most optimistic view of UG production in the UK, which is currently assumed to begin in 2016, at the earliest. These profiles underplay the potential based on Cuadrilla

Wider implications of shale gas

- Shale has reversed the decline in gas production in the US
 - The development of technology (e.g. fracking) and high oil prices means the US will produce more gas and oil in 2020 than at any time previously
- The same recovery could apply to Bowland shale
 - Gas prices are now at their lowest ever in comparison to oil. At current prices maybe only 5% of Bowlands 200 tcf will be recovered. If prices rise in the future then the gas is still in the shale and can be recovered then
 - As long as gas recovered exceeds cost of the well (and it probably will for many decades) the gas never goes away
- Security of supply
 - The UK consumes approx. 90 - 95 BCM per annum, so South Morecambe = 2 years worth demand
 - 200 tcf in Bowland, 20% recoverable (40 tcf) = 1150 BCM = around 25 years of domestic customer demand
 - Any gas from Lancashire saves imports from Qatar (so on days of no wind Lancashire gas is used, not Qatar LNG)
 - Use the £350 billion saved to fund the insulation of all our solid wall homes, then making a transition to wind, biomethane, Bio-SNG etc.

**BENEFITS OF SHALE GAS AND DUAL FUEL TRUCKS
SUPPLIED BY LTS
OIL IMPORTS, CO₂ REDUCTION, PROVIDING JOBS AND
SUPPORTING RENEWABLES**

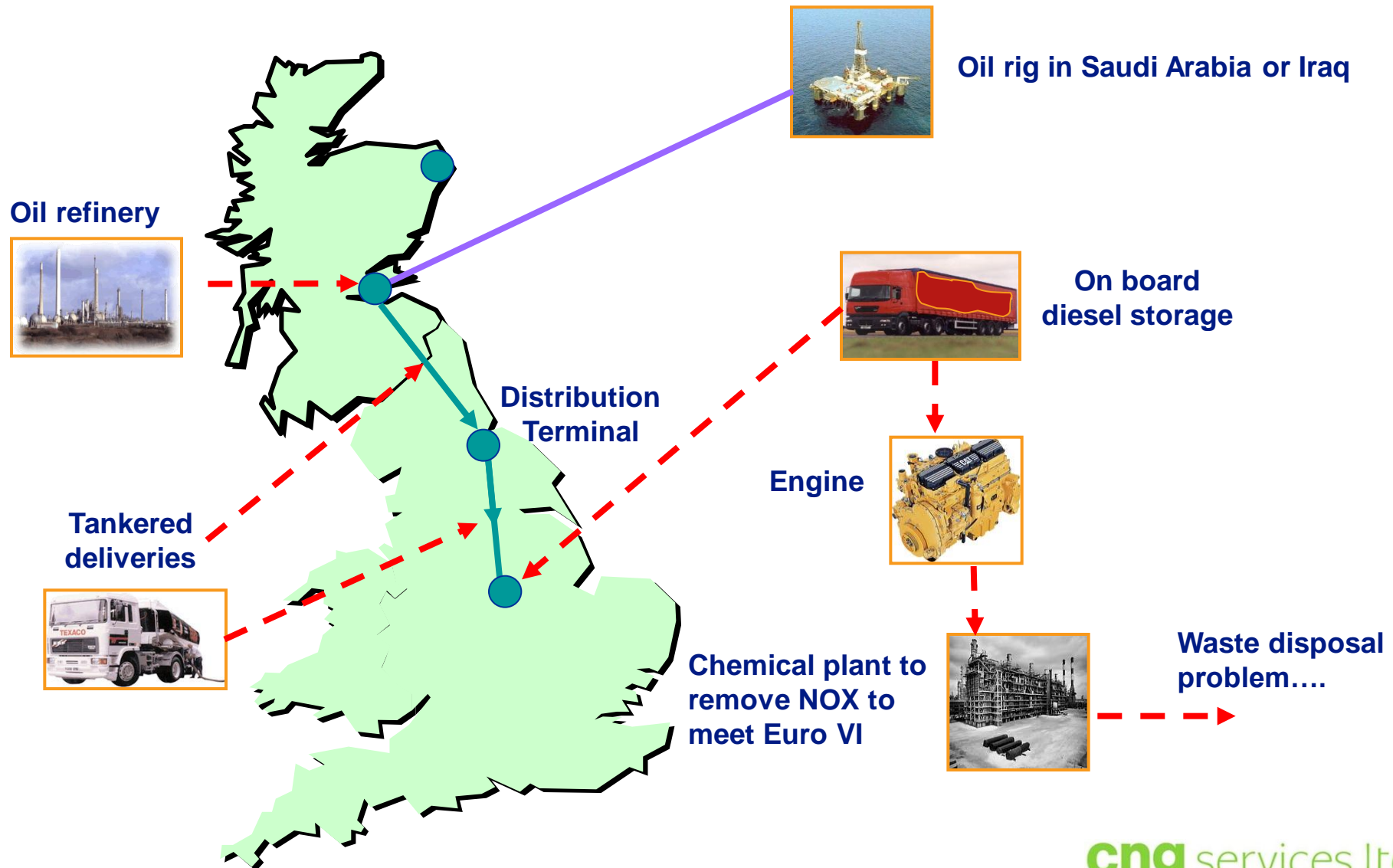
Benefits Galore

- LTS CNG and dual fuel trucks can save 1 billion litres of diesel per annum
- Provide jobs in UK manufacturing (e.g. Hardstaff Group)
- Support investment in CNG/LNG stations
- Reduce haulage costs to UK truckers (the foreign lorry loaded with diesel issue)
- Reduce CO₂ from trucks by 20 – 30%
- Provides gas to back-up wind generation (which only generates around 30% of the time)
- If shale gas comes through offers further CO₂ reduction and more jobs and more wealth that can remain in UK to fund insulation and offshore wind etc.

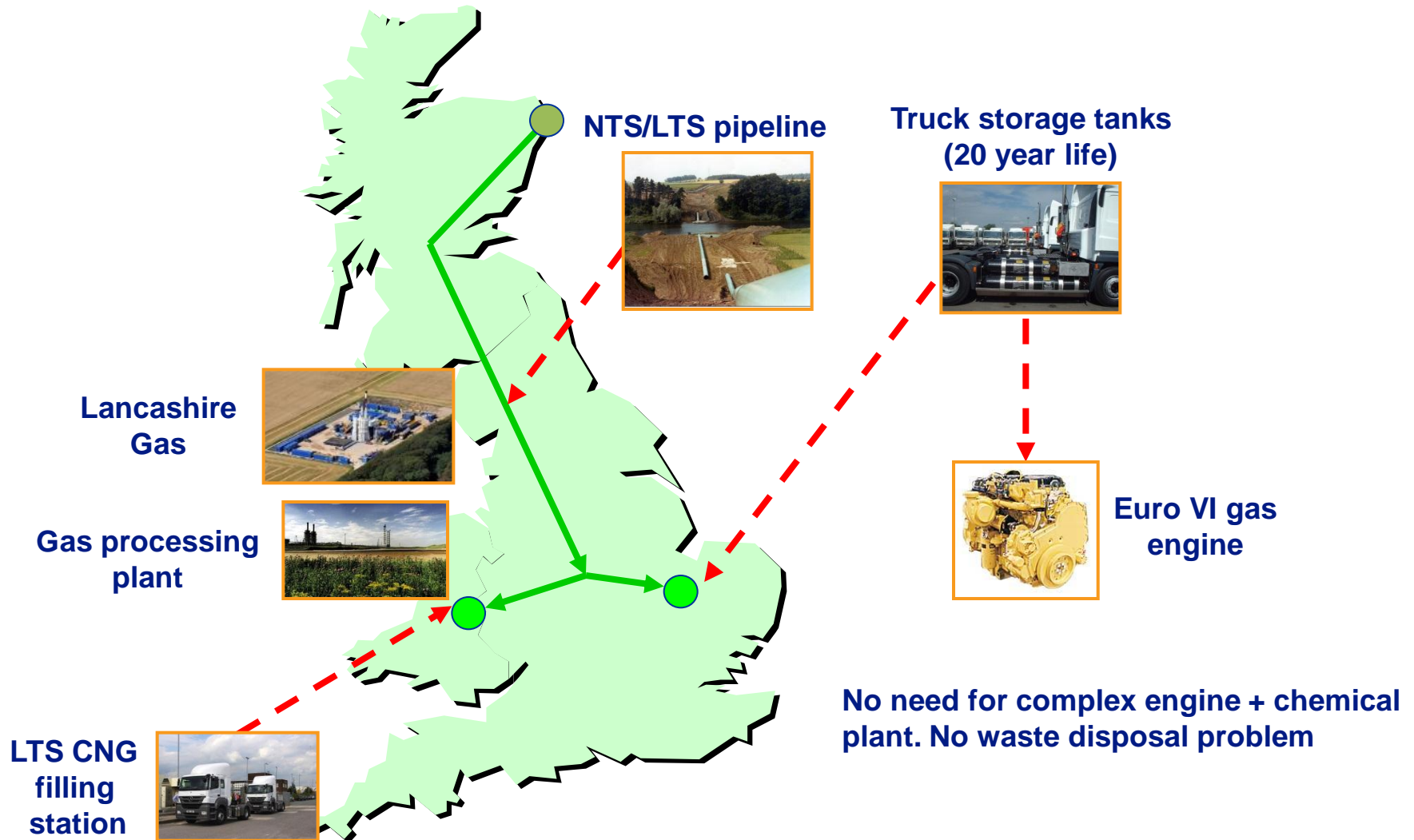
VISION FOR 2020

2020 Well to wheel - Euro VI diesel

"do nothing scenario"



Vision for 2020 Well to wheel - Euro VI natural gas



Vision On

- Technically achievable and credible
 - For vehicles – best way to meet NOX targets
 - Use LTS grid to supply filling stations
- Financially makes sense
 - UK cannot afford to import so much oil in 2020
- Very good for CO₂
 - With imported gas it is very good, with Lancashire shale it would be great
 - Estimated 40% reduction in CO₂ using Lancashire gas + dual fuel + LTS compared to LNG imports
- Let's do it

What do we need?

- Tax breaks needed to help fund filling stations and vehicle gas storage tanks
 - Natural gas – diesel duty differential fixed for 10 years is main requirement
- Political engagement
 - So that gas suppliers consider this market
 - Acknowledgement that a 44 tonne truck would need 40 tonnes of batteries and so electricity is not an option
- Support to our world class companies that can manufacture dual fuel trucks
- Gas Distribution Networks to reform their LTS connection policies to bring down time to connect to LTS and associated costs