Seminar on the Future of Road Transport - 27th October, London

The transformational impact of abundant shale gas on the road fuel market

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The transformational impact of abundant shale gas on the road fuel market

- CNG Services Ltd
- Impacts of Shale
  1. Morecambe Gas
  2. UK Oil and Gas Decline
  3. Renewable targets 2020
  4. The 85% Not Renewable
  5. CNG for Trucks from High Pressure Grid
  6. Gas versus electric
  7. Conclusions

The UK can adopt a gas based strategy

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CNG Services Ltd

- Cleaning bio-gas and injecting biomethane into the gas grid
  - Creator of the UU Davyhulme BtG and CBM Project
  - Developer of Didcot project for Thames Water, SGN and Centrica
  - Consultant on Adnams Project
  - Working on 8 further biomethane to grid projects in UK

- CNG Filling Stations
  - CNG for trucks

- Supporting development of onshore gas and storage projects
  - Ryedale Gas Project
  - Wingas Saltfleetby Storage Facility
  - Halite Preesall Storage Facility

We are independent from all makers of plant, vehicles, clean-up, compression....our aim is to support developers in projects which are gas engineering based but a bit complicated.....

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BG Group Kazakhstan

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

Most major cities have air quality problems and so make CNG the fuel of choice for buses.....we should have CNG buses in UK, we have very few

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Crewe CNG Station

- We have re-opened our Crewe CNG 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 0.5 bar grid

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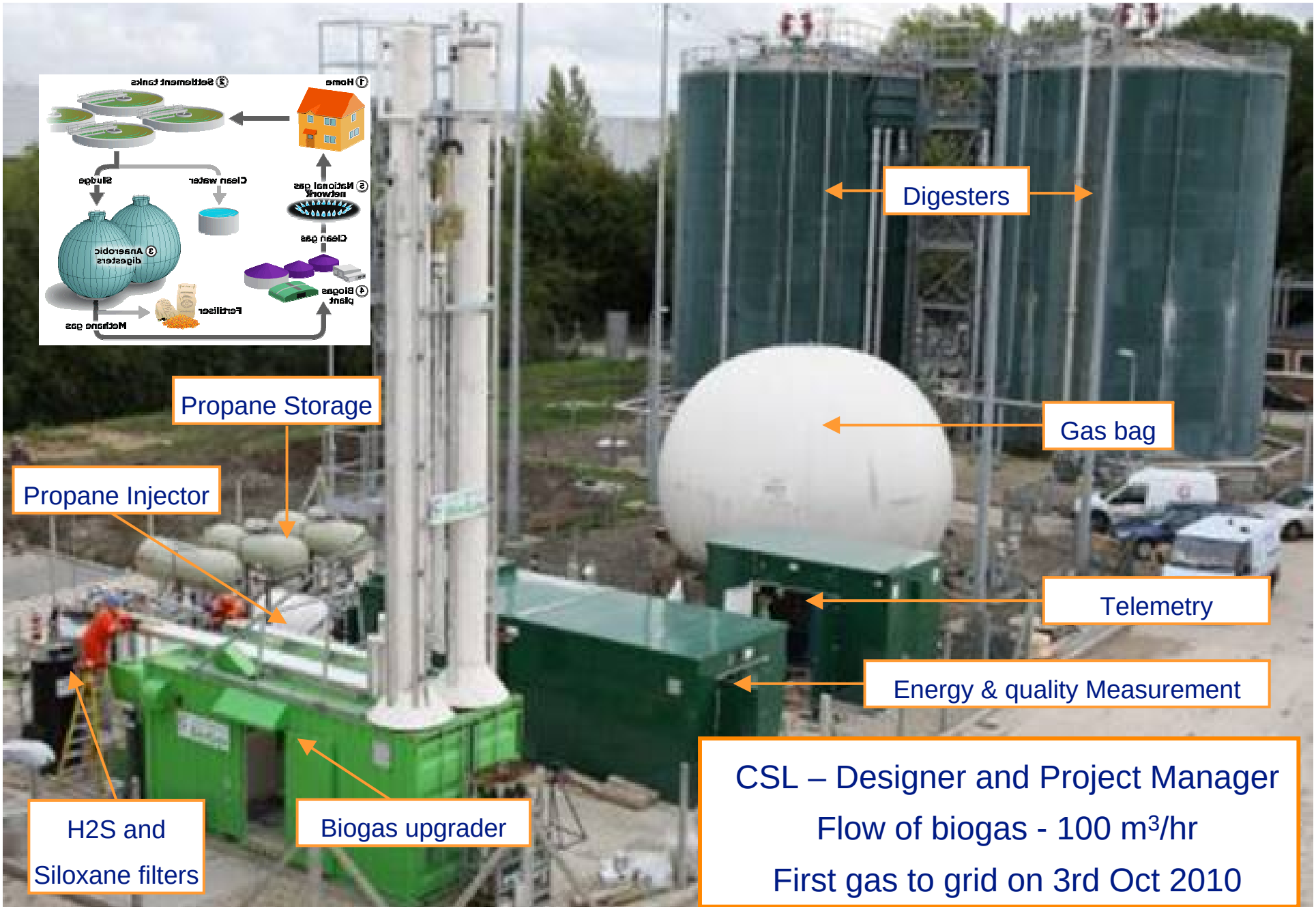
Didcot – UK's First BtG Project



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 pay!
  - 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 found a few South Morecambe's....and Lancashire won the County Championship!

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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
- More Business & Investing News...

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.

Bains

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

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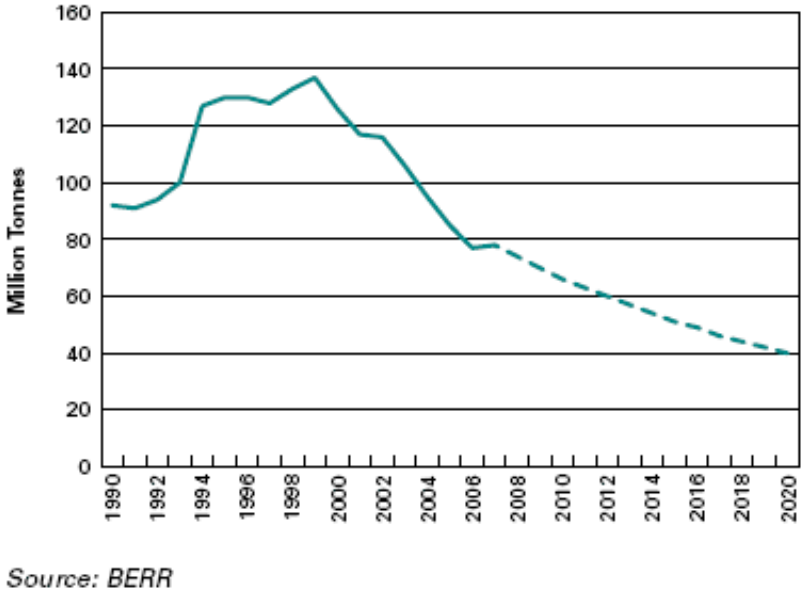
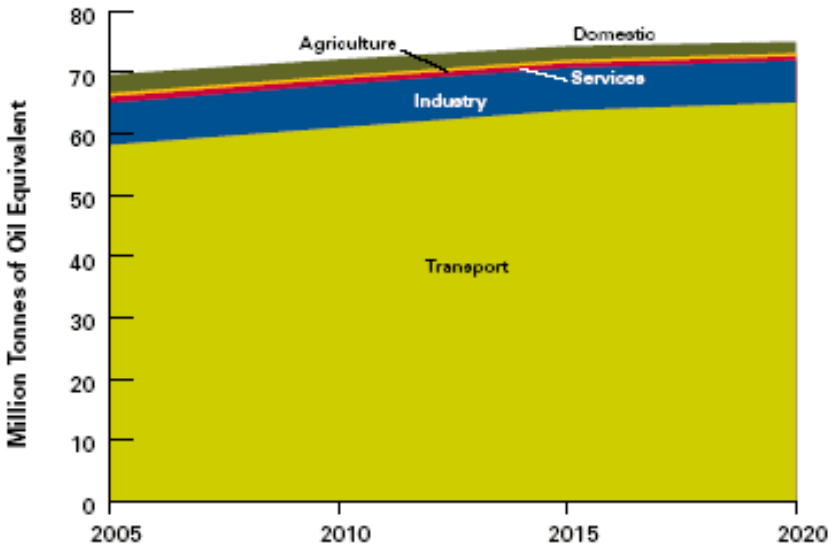
UK oil production and demand 1990 - 2020

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

At $150/bbl this will cost 365 x $150 million = $54 billion per annum = £3 billion per month…..

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

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

- Nuclear stations closing down and may not build new ones
- Coal plant closing down
- CCS may not be viable due to cost
- So, electricity will be gas with some nuclear and some coal with CCS and a lot of wind (when its windy)
- Transport will be diesel-petrol with some electricity (ie from gas)
- No realistic alternative to lots of gas fired CCGTs
- Heating will be gas

Thanks goodness for shale gas – what to do with it?

1970 – 90:	UK converts heating to gas
1990- 2010:	UK converts 50% of electricity to gas
2010 – 2025:	UK to convert trucks to gas…see next slides

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Dual Fuel Trucks and use of High Pressure Gas Grid for CNG

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Dual fuel trucks

- A diesel-fossil CNG tractor will save 15% - 25% CO2 compared to diesel alone
- 2 OEMs:
  - Mercedes Benz
  - Volvo
- See next slides Tenens/Warburtons/GIST

Dual fuel trucks are a game changer

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Tenens – 12 Actros, 2 Axor Dual Fuel

- Tenens carried out 6 month trial on trunking & multidrop routes from Andover resulting in investment:
  - 12 x Actros tractor units converted running from Andover
  - 2 x Axor tractor units converted running from London
- CNG stations in Andover, London M25/A13 and Boston

Warburtons – 6 Axor Dual Fuel

These vehicles are transformational – benefit of diesel efficiency but with natural gas – 15% lower CO2.....with the world full of abundant shale gas we can now start to shift trucks to dual fuel CNG diesel

Range is 400 Miles

Substitution is 60%

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GIST/M&S Crewe - 5 Axor Dual Fuel

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

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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.

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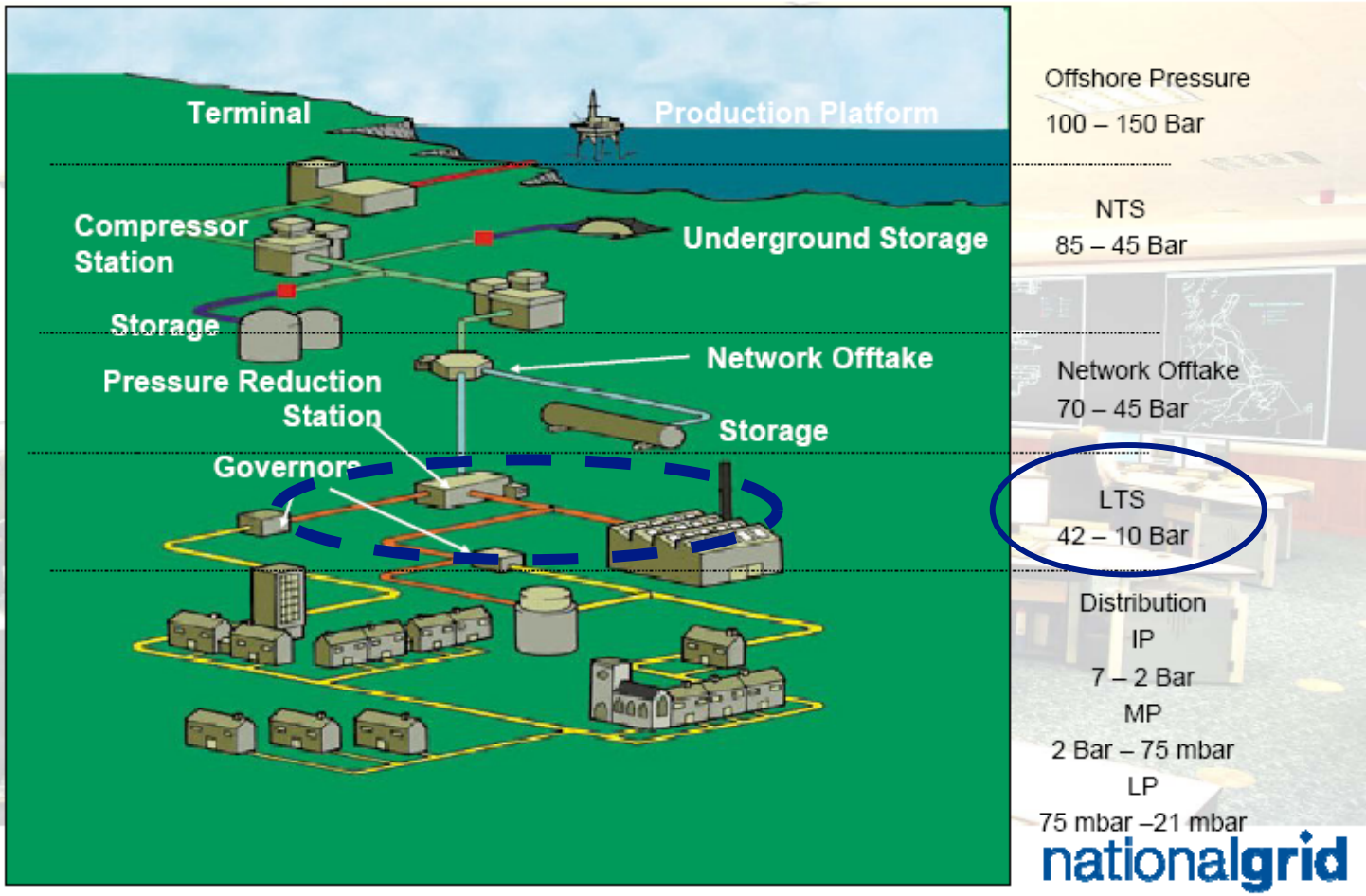
UK gas system



LTS is ideal for CNG

UK can run most trucks on CNG from high pressure gas grid

- 80% less energy for compression (see next slide)
- Only 2 stages of compression not 5, so lower capex
- Very high flow-rates possible
  - Typical CNG station flow rate is 300 m3/hr (eg Tenens, Warburtons)
  - LTS CNG flow-rate 2,000 – 3,000 m3/hr per compressor
  - This means smaller sites, much less CNG Storage
- LTS gas is very dry so no need for gas driers
  - Saves Capex/Opex and better CO2 outcome
- There is 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 pounds per annum pipeline replacement)
  - Methane approx 23 times worse as GHG so this leakage adds around 11.5% to well to wheel CO2
  - For LTS no leakage

UK can focus on high pressure grid as source of CNG

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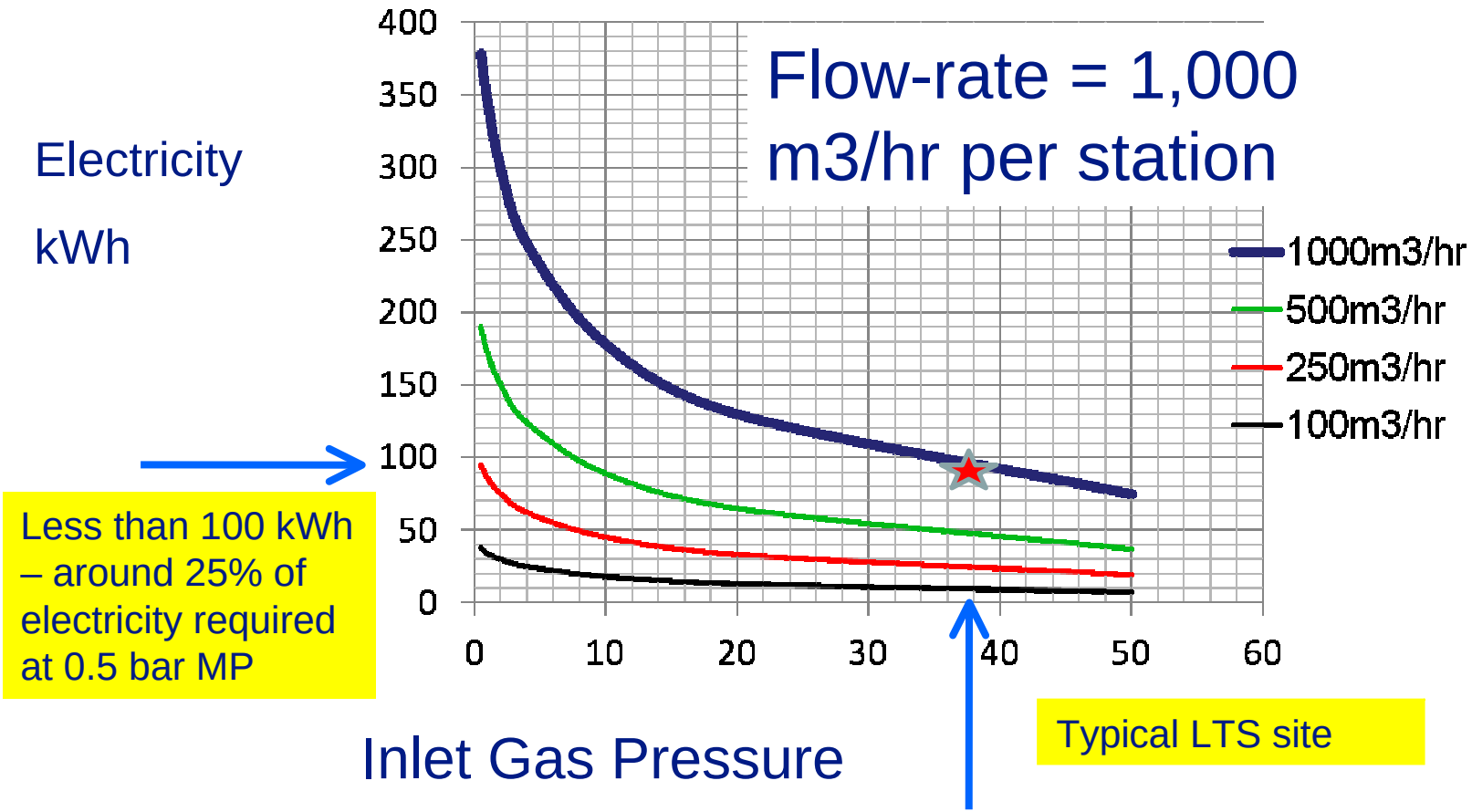
Compressor Power



Flow-rates of 3,000 m3/hr from a single compressor = 2,300 kg/hr
1 truck doing 100,000 miles per annum will use 50 kg /day
So 1 hour compression = 46 trucks = 1,100 trucks per day (assuming 2 compressors at 50%)

Estimated CO2 savings from Dual Fuel supplied via LTS

- This assumes normal fossil natural gas (not biomethane)
- Tail-pipe saving = 15%
  - This is based on the Axor dual fuel operations underway and also theoretical saving
  - This is based on 55% CNG, 45% Diesel
  - On 75% CNG, 25% diesel saving 20 – 25% (Volvo OEM Product)
- Saving from LTS = 17%
  - No leakage of methane to get gas to the supply point = 10%
  - 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%
- Nothing else offers this saving

Germany has gone down CNG for cars path – we think CNG for trucks is the way to go – saves oil imports, saves CO2

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National CNG Network

- 50 CNG stations on LTS/M'way junctions
- Each costs around £ 2 Million for 3 compressors at each site
- Each site can fill 1,500 trucks per day
- 75,000 trucks per day
- Total CNG use of 3.75 million kg = 1.8 million therms/day = 5 MCMD = 684 million therms per annum
- Saving 72 litres diesel per day per truck = 5.4 million litres per day = around 2 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 shale gas - saves imports, saves CO2

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EV CO2

- UK Govt gives £5,000 subsidy for an EV
- My wife has Smart Petrol - 50 gallons petrol pa = 250 gal / 5 years
- Petrol to EV = 250 gallons saving or 1,100 litres or 2.9 tonnes of CO2 saved (from not burning petrol)
- But gas (or coal) is burnt to make electricity, so saving in CO2 is around 1.5 tonnes
  - Cost of subsidy = £6,000 (EV + fuel tax + road tax)
  - Around £4,000 / tonne of CO2 'saved'
- Dual fuel truck on LTS supply saves 30% CO2, equates to 30% diesel or 12,600 gallons (41,400 litres) equates to 147 tonnes of CO2 emissions
  - There is no subsidy
  - To match EV subsidy per tonne of CO2 saved, a subsidy could be £588,000 per vehicle

Funding for EVs cannot be justified on CO2 grounds – low emission diesel and petrol hybrid cars are just too good (which is why CNG in Germany has failed) …if we have spare electricity, use it to make CNG for trucks. Focus on best outcome - the Olympic Athlete point

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Conclusions

- Shale gas creates the opportunity to move towards a lower CO2 future
- There are no material issues with shale gas, its a very low CO2 fuel
  - Low CO2 natural gas compared to LNG
- Allows trucks to run on natural gas
  - 30% CO2 reduction for dual fuel
- Saves UK plc the cost of imports so the money can be invested in renewables such as offshore wind
- Need to focus support on best outcomes

There is a highly coherent gas based strategy to support economic growth, reduce CO2 emissions and support growth in renewables...surely, it is only a matter of time before this strategy is adopted and trucks switch to dual fuel natural gas-diesel

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