Repositioning Gas in the Energy Mix

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Martin Wilkes
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How to meet the demand: Coal dominated Fossil fuels

Notional Daily Demand

- Demand
- Coal
- Gas

Power required, % of daily maximum vs. Time (0:00 - 23:00)
How to meet the demand: Coal, Gas and VRES

Notional Daily Demand

- **Demand**
- **Coal**
- **Gas**
- **VRES**

Power required, %age of daily maximum

0:00 1:00 2:00 3:00 4:00 5:00 6:00 7:00 8:00 9:00 10:00 11:00 12:00 13:00 14:00 15:00 16:00 17:00 18:00 19:00 20:00 21:00 22:00 23:00

0 10 20 30 40 50 60 70 80 90 100
How to meet the demand: VRES dominated

Notional Daily Demand

- Demand
- Coal
- Gas
- VRES
In 2006 Global Warming was firmly on the Map (later to become Climate Change), and as a result it was anticipated that:

- Coal use would rise more slowly than other fuels
- Gas would be the highest growing fossil fuel as it is the “least polluting”
- Renewable growth would be slow and dominated by large scale hydro in developing countries

“North America emerges as a major importer of LNG” (IEA, IEEJ & others)

“Natural Gas prices will remain high in the US for the foreseeable future” (EIA)

“Renewables will increase share slightly, driven by large scale hydro-electric projects...non-OECD” (EIA)
Global Energy Use projections from 2006, actual outcomes

What actually happened:

- Growth in renewables has been dominated by wind and solar in developed countries, and has grown much more strongly than anticipated
- Oil and gas were both significantly impacted by the GFC
- Gas use has grown in step with renewables growth
- But...
- Coal was the fastest growing of all fuels, growing by almost 50% more than either renewables or gas
  - This presents problems for reducing emissions
The Green, Cheap Squeeze on Gas

Between 2006 and 2016

- Coal use increased significantly in developing countries
- Coal fired generation in the USA declined from >50% to ~35%
  - US renewables generate ~13% of power
  - Gas power generation has grown from 18%-30%
- Germany has installed more renewable generation than they can use on a peak day.
  - RES generate ~26% of power, but have caused instability and security of supply issues
- US emissions have reduced by ~12%
- German emissions have reduced by ~10%

Gas clearly has a role in helping reduce emissions whilst maintaining security of supply
The Energy Mix has a significant impact on emissions

Emissions Comparison for Power Generation Mix

- System emissions (%age of a purely coal based generation system)

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Coal %</th>
<th>Gas %</th>
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<tbody>
<tr>
<td>100% Coal</td>
<td>100</td>
<td>0</td>
</tr>
<tr>
<td>70% Coal, 30% Gas</td>
<td>70</td>
<td>30</td>
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<tr>
<td>50% Coal, 50% Gas</td>
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<td>50</td>
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<tr>
<td>50% Coal, 50% Gas GP</td>
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<tr>
<td>45% Coal, 50% Gas, 20% VRES</td>
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<tr>
<td>40% Coal, 50% Gas, 50% VRES</td>
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<tr>
<td>35% Coal, 50% Gas, 100% VRES</td>
<td>35</td>
<td>50</td>
</tr>
<tr>
<td>0% Coal, 85% Gas, 100% VRES</td>
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<td>85</td>
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<tr>
<td>85% Coal, 0% Gas, 100% VRES</td>
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</tbody>
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Coal - Black
Gas - Red
VRES - Blue
Power Storage for renewables

- Wind and solar are the most cost-competitive VRES solutions, but they are intermittent and non-dispatchable.
  - Peak supply is not coincidental with peak demand
  - Require significant back-up

- Currently hydro-electric storage account for over 90% of all storage capacity
  - Wide range of storage technologies under development

- No other proven large scale options currently available
  - Household scale likely to take off first
  - Victoria tender for a 20MW battery storage facility Feb 2017
  - South Australia 130MWh battery July 2017

- Li-ion batteries costs decreasing rapidly
  - but commercial application still years away?
Impact of World’s largest Battery in SA

Notional Daily Demand

- Demand
- Coal
- Gas
- VRES

Power required, % of daily maximum

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Large scale storage will require new “dedicated” generation facilities
Emissions Comparison for Power Generation Mix

System emissions (%age of a purely coal based generation system)

- 100% Coal
- 70% Coal, 30% Gas
- 50% Coal, 50% Gas
- 50% Coal, 50% Gas GP
- 45% Coal, 50% Gas, 20% VRES
- 45% Coal, 50% Gas, 20% VRES
- 40% Coal, 50% Gas, 20% VRES
- 35% Coal, 50% Gas, 50% VRES
- 0% Coal, 85% Gas, 100% VRES
- 0% Coal, 50% Gas, 50% Battery, 200% VRES
Conclusions

- Gas generation produces approximately half the emissions of coal generation, so simply switching from coal to gas generation has a material impact on emissions (as seen in the USA).
- Gas generation is a natural companion to renewables as it can be turned on and off and ramped up and down as the renewables generation changes.
- Gas generation is, and should be recognised as, an enabler for the integration of renewables into the grid.
- Gas needs to be positively promoted as a partner for renewables:
  - Maintains stability of system (intermittency of VRES)
  - Minimises emissions (Coal emits twice as much CO₂ as gas fired generation, and is not as flexible)

Promotion of a future energy mix based on renewables and gas is likely to lead to the lowest cost and least disruptive way of maximising emission reductions.