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The role of Gas in a low emissions future

Date: August 2017

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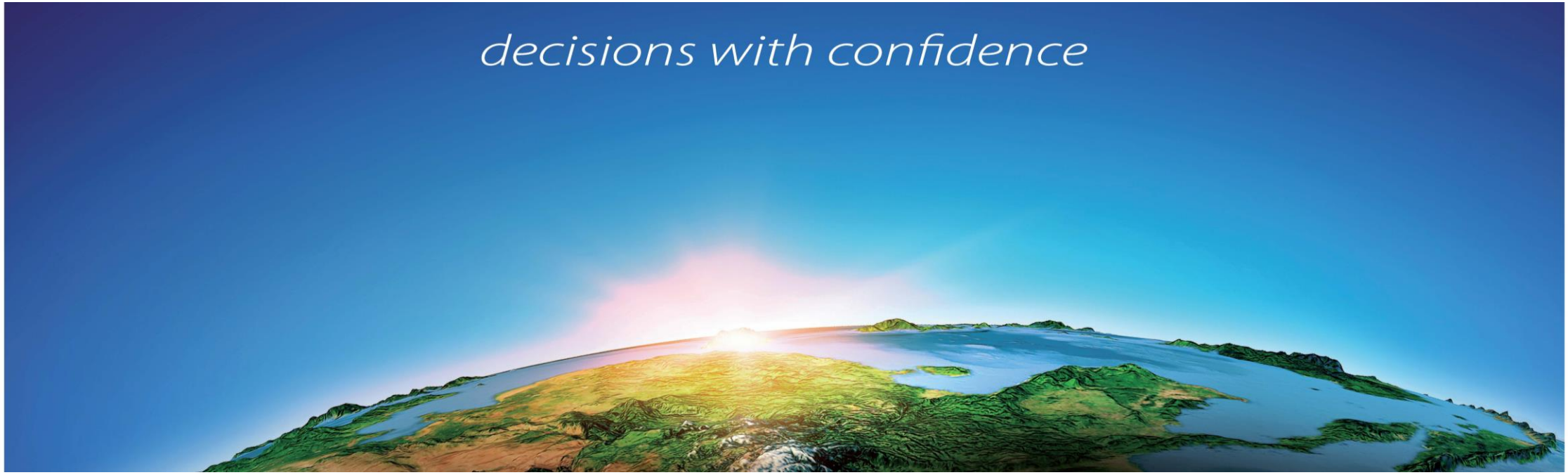


Global Energy Use projections from 2006

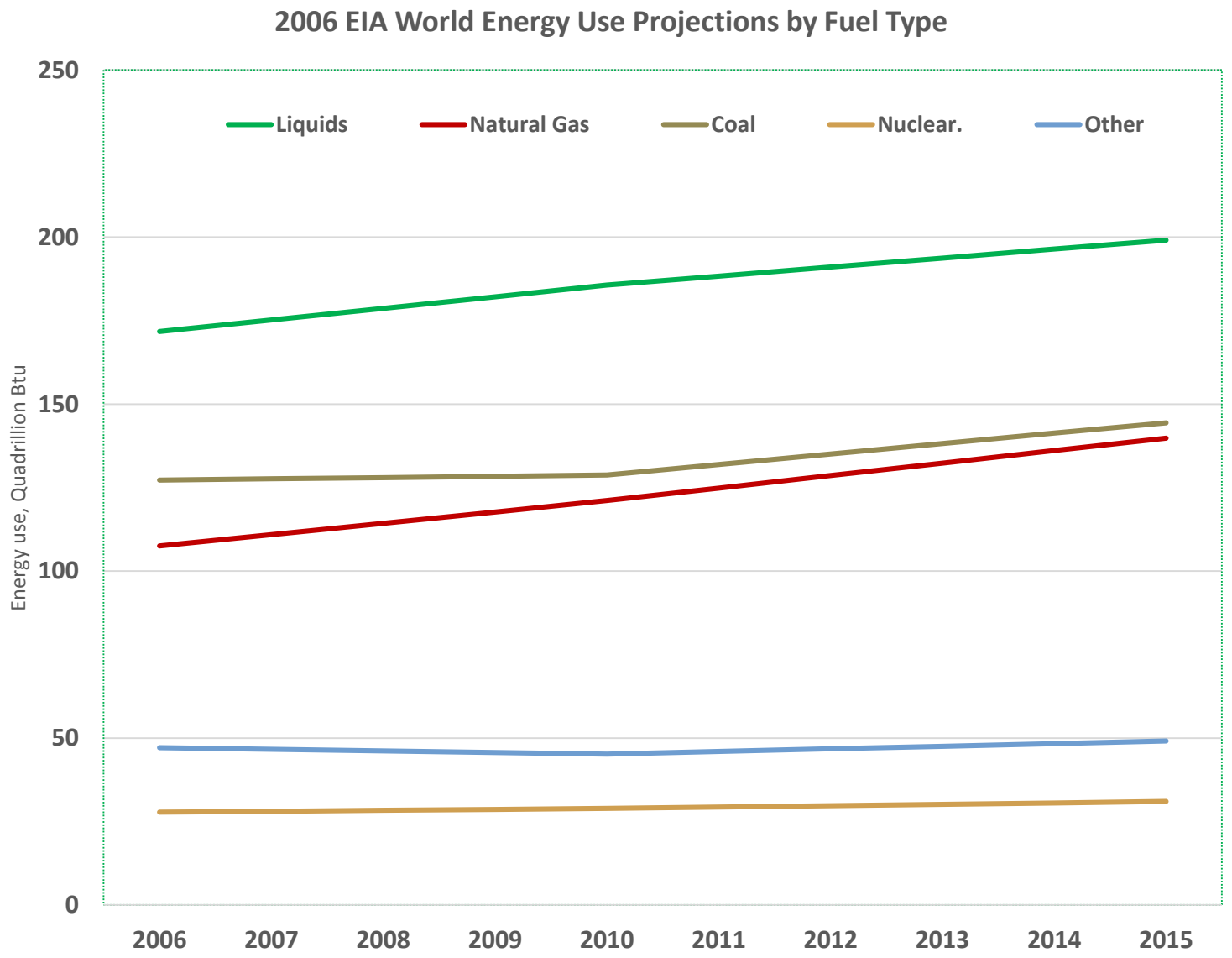
In 2006 Global Warming was firmly on the Map (later to become Climate Change), and as a result it was anticipated that:

- Coal use would rise more slowly than other fuels
- Gas would be the highest growing fossil fuel as it is the “cleanest”
- 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)



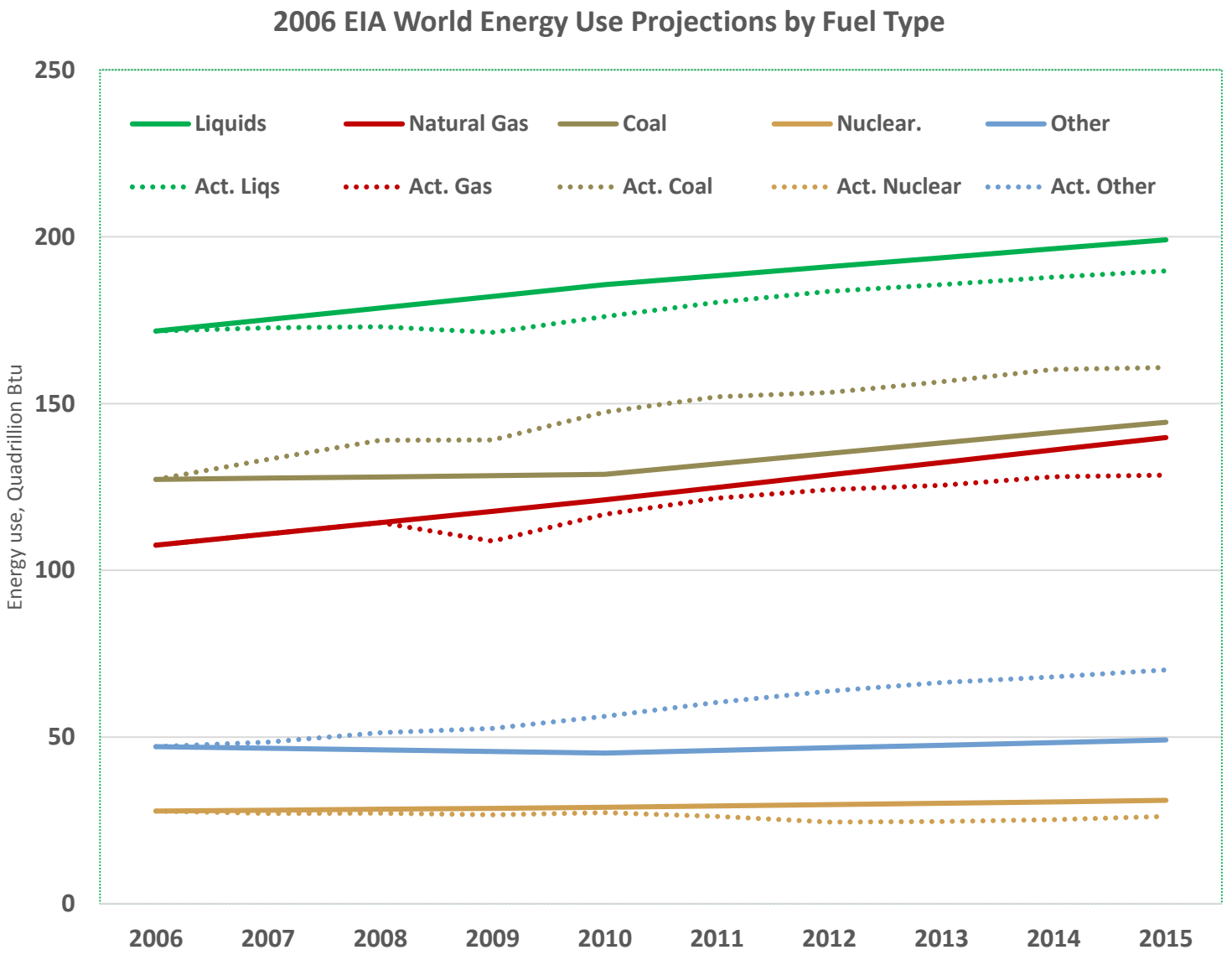
Global Energy Use projections from 2006, actual outcomes

What actually happened:

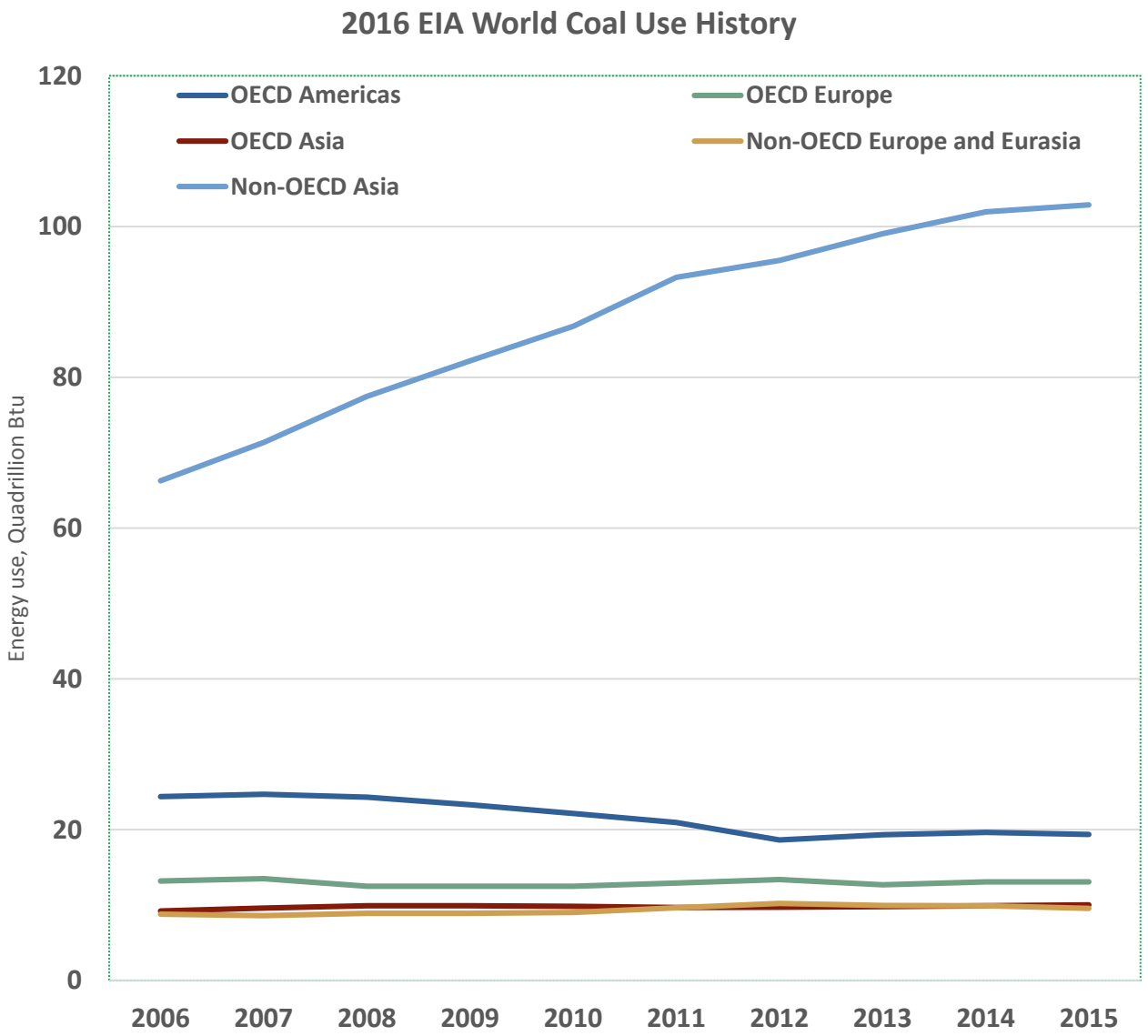
- Growth in renewables has been dominated by wind and solar in developed countries, and has grown much more strongly than anticipated
- Oil and gas were both significantly impacted by the GFC
- Gas use has grown in step with renewables growth

…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



Coal use increased in Asia, and only decreased in N. America



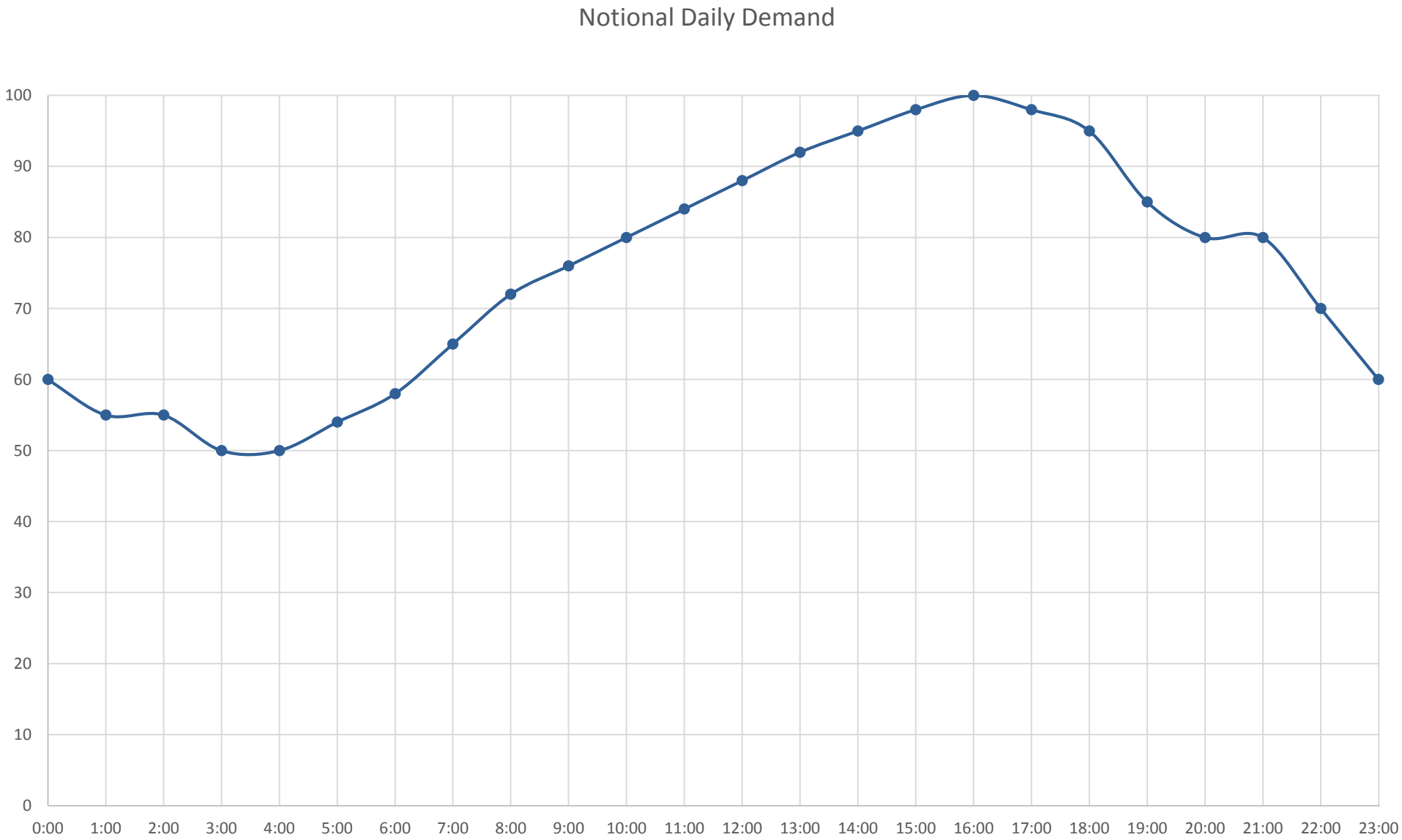
Between 2006 and 2016

- 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

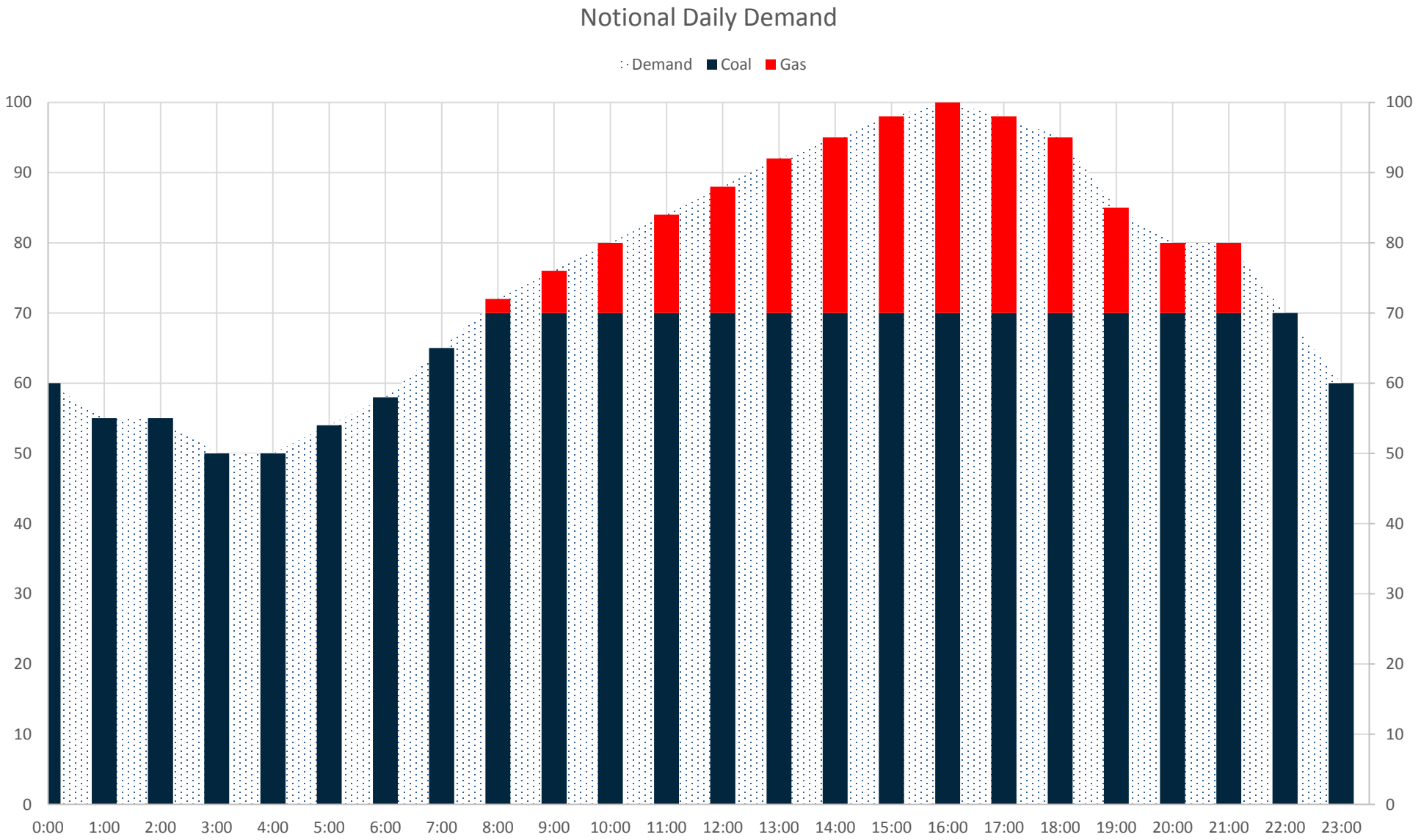
- US emissions have reduced by ~12%
- German emissions have reduced by ~10%

Gas clearly has a role in helping reduce emissions whilst maintaining security of supply

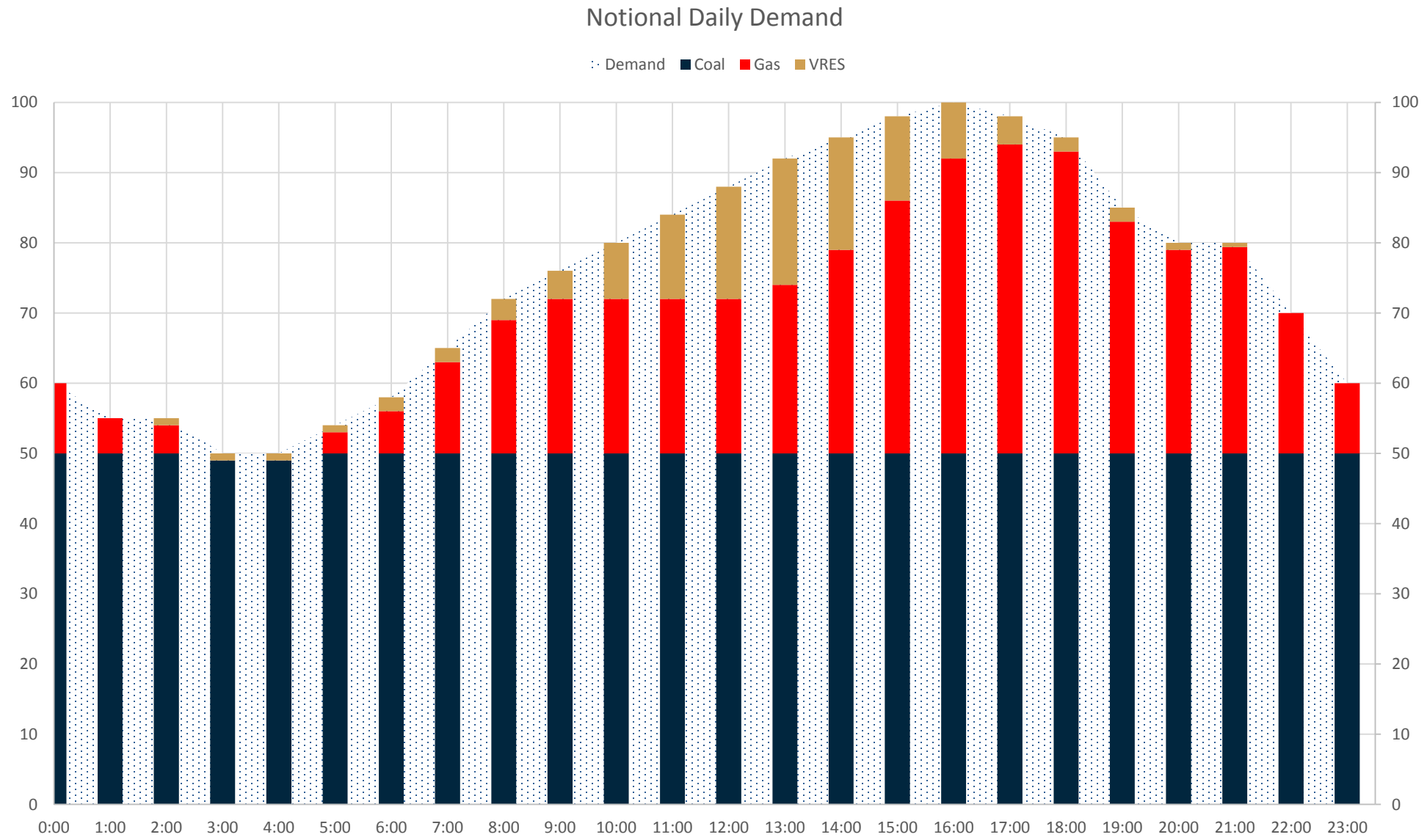
Typical diurnal demand for power generation



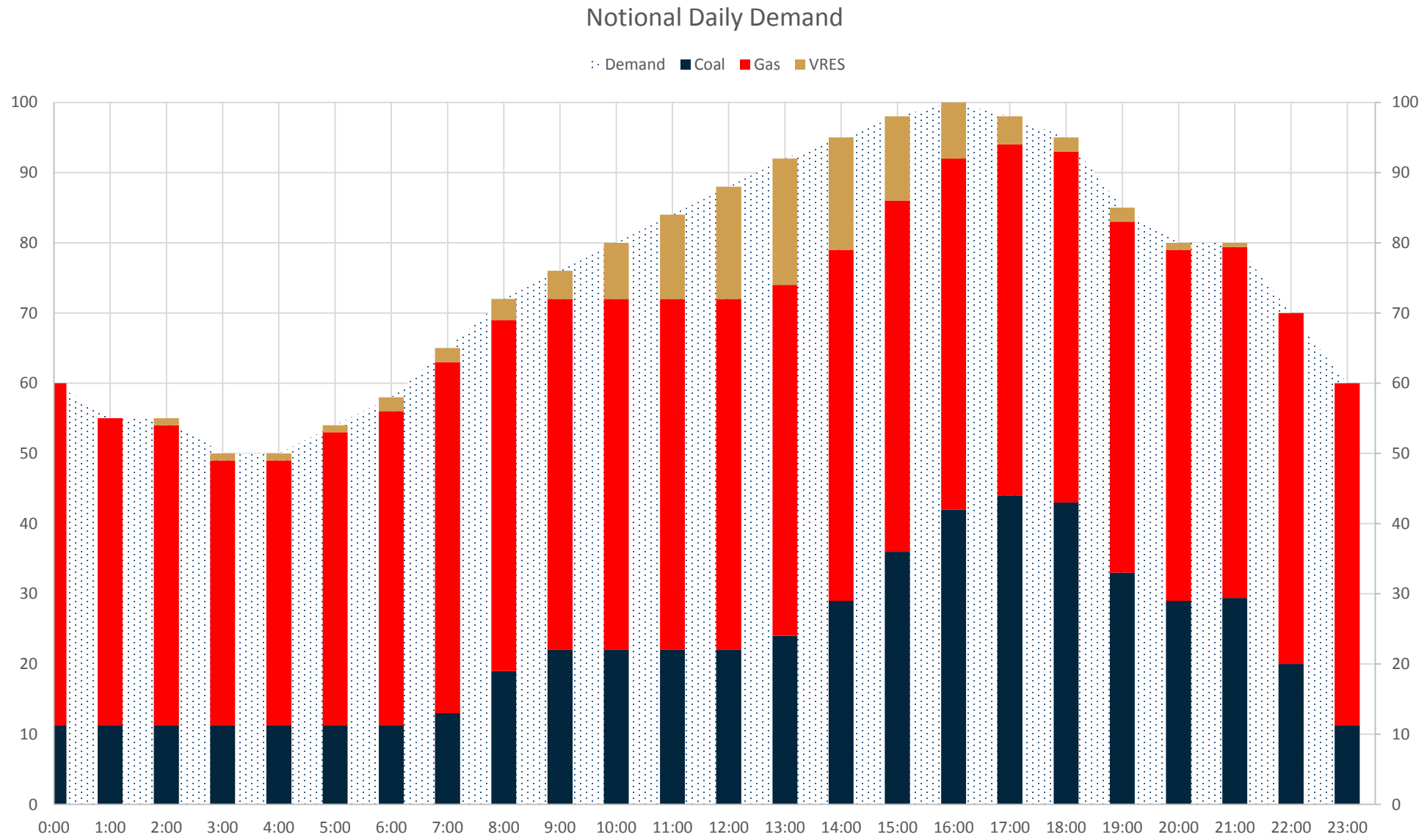
How to meet the demand: 1 Coal dominated Fossil fuels



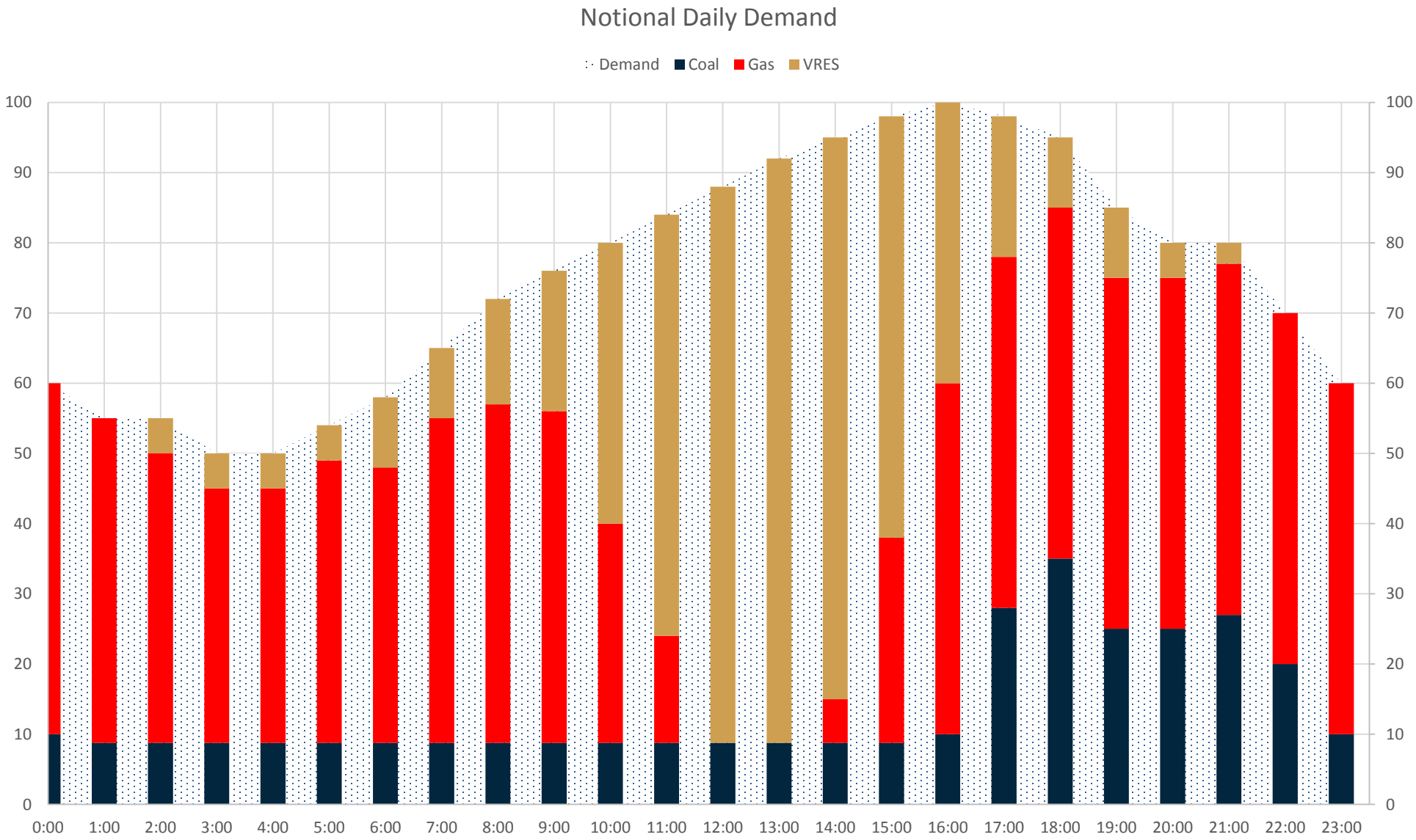
How to meet the demand: 2 Fossil fuels + VRES



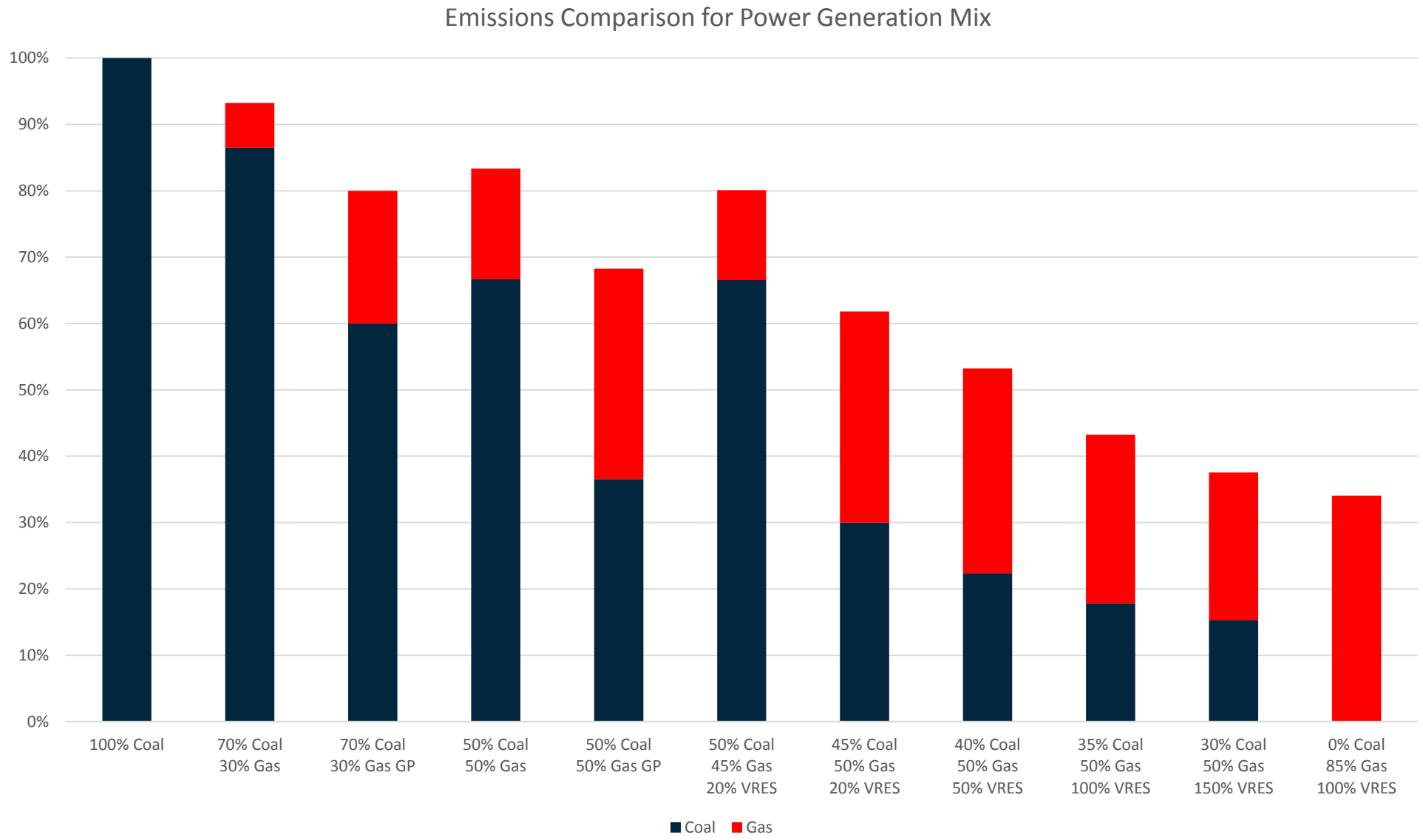
How to meet the demand: 2 Gas dominated + VRES



How to meet the demand: VRES dominated

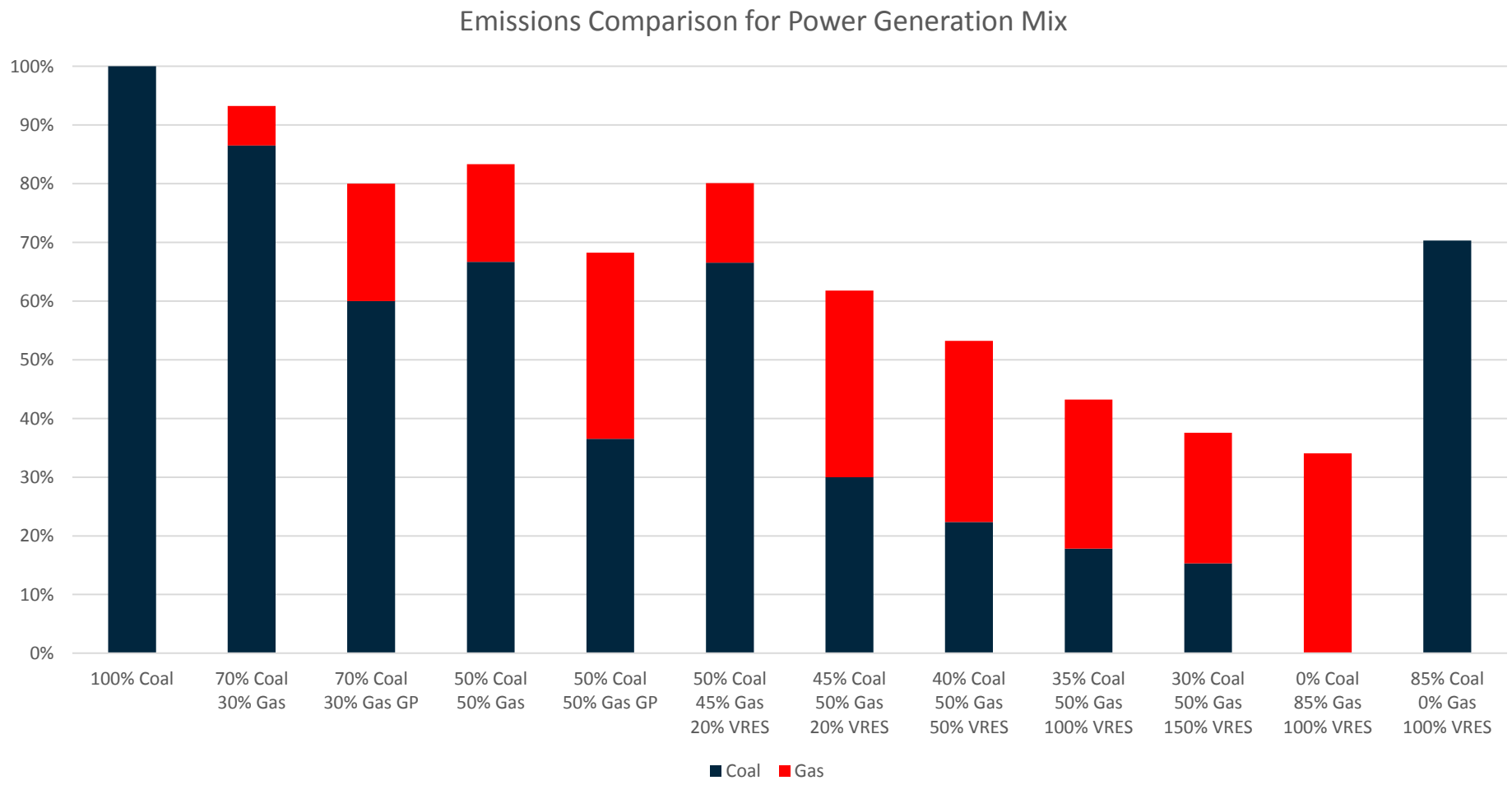


Energy mix has a significant impact on built capacity and emissions



The Green Cheap Squeeze

- Gas is not as green as renewables
- Gas is not as cheap as coal
  - Countries/states move to a mix of renewables and coal for power generation

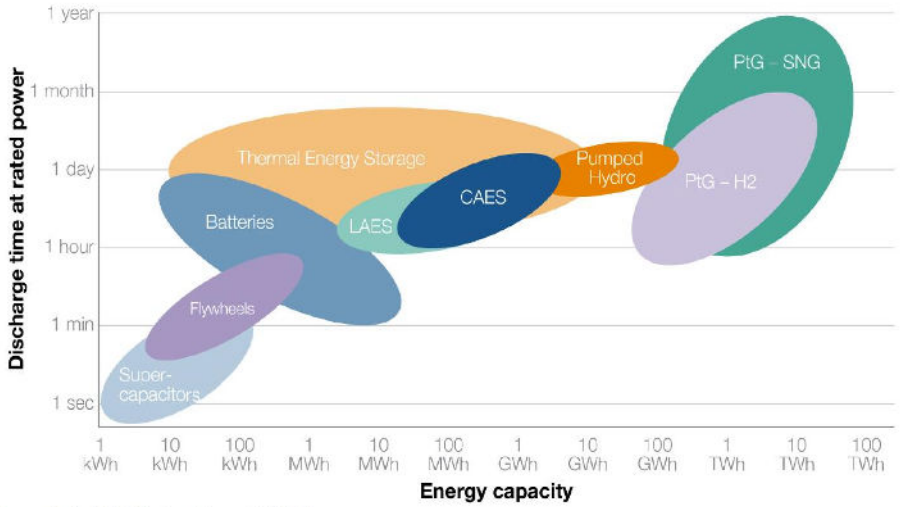


Power Storage for renewables

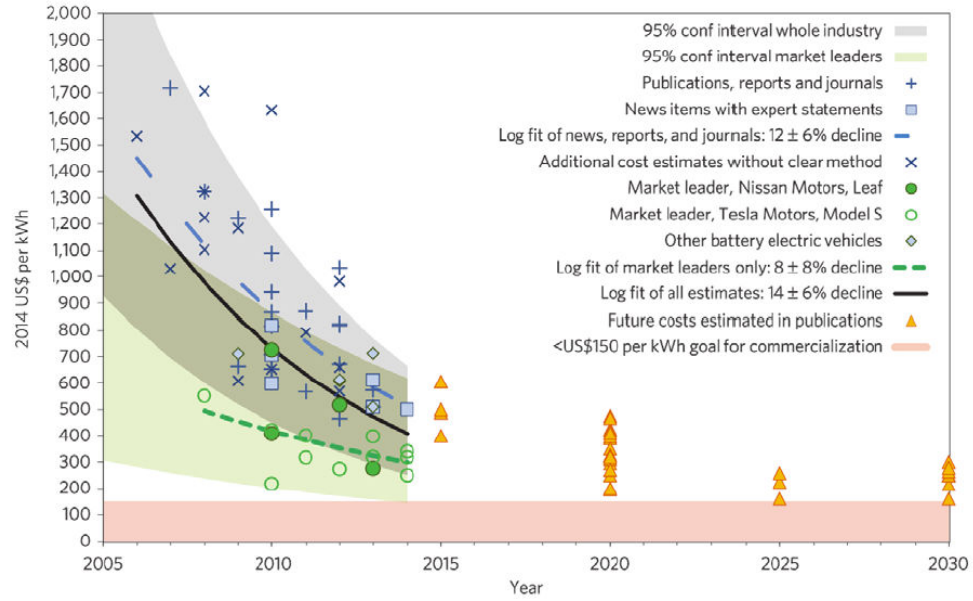
- Wind and solar are the most cost-competitive VRES solutions, but they are intermittent and non-dispatchable.
  - Peak supply is not coincidental with peak demand
  - Require significant back-up

- 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 100MW battery July 2017

- Li-ion batteries costs decreasing rapidly
  - but commercial application still years away?



Source: PwC, 2015, following Sterner et al. 2014



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 an 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 CO_2 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

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Devils Creek Gas Plant

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