

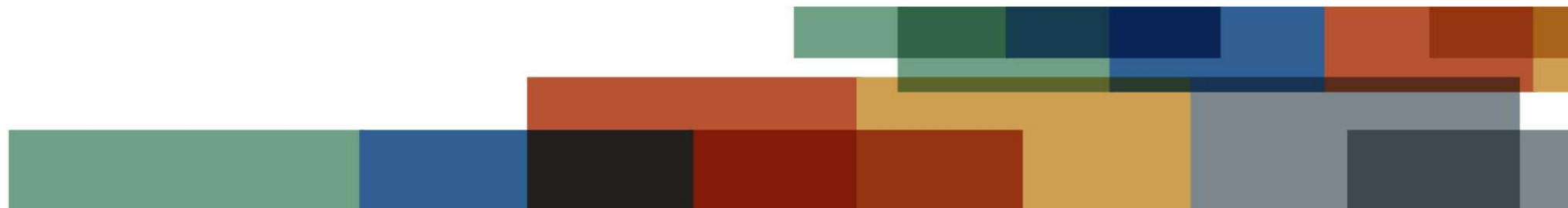


decisions with confidence

Repositioning Gas in the Energy Mix

May 2018

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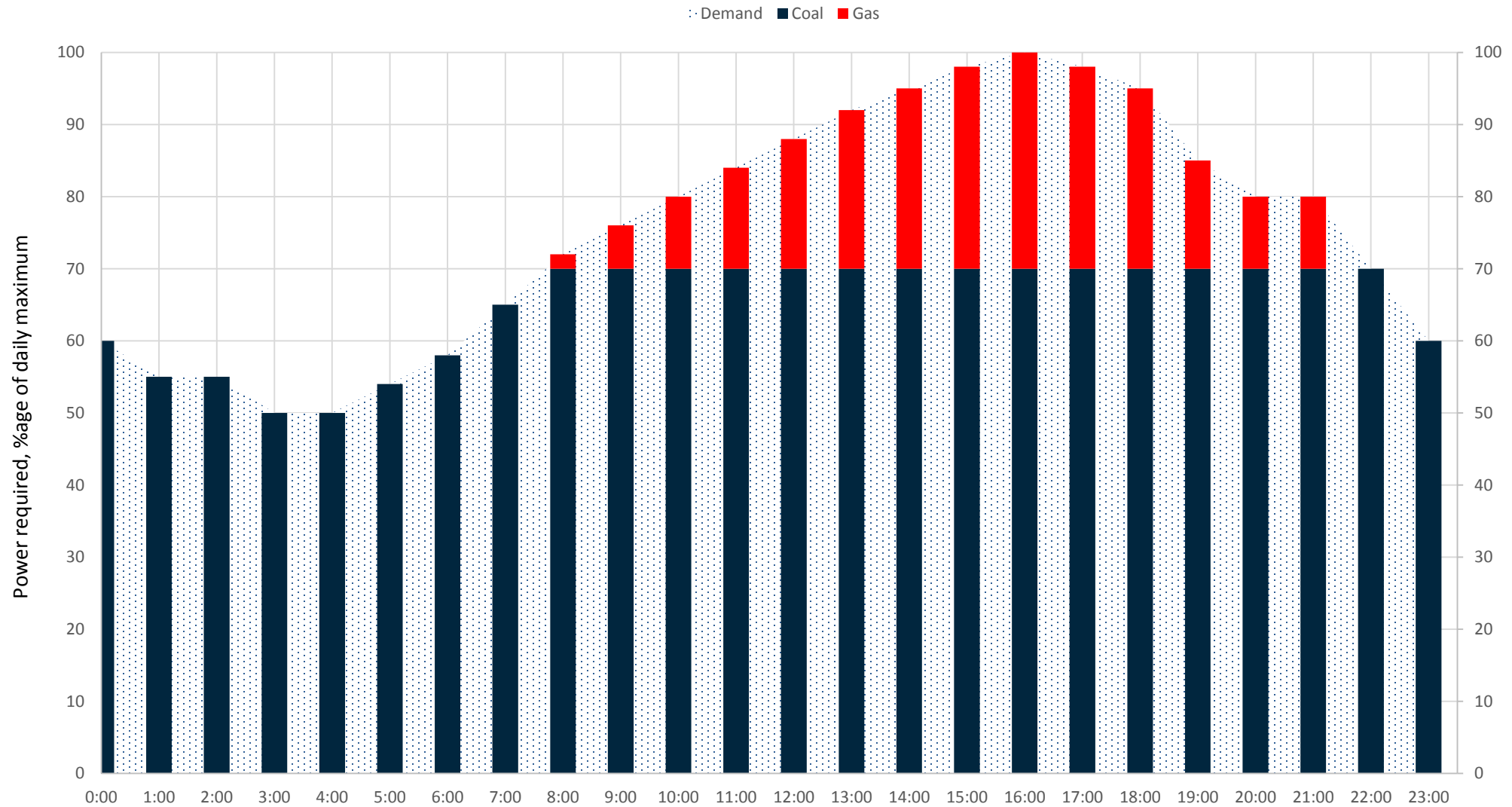
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A wide-angle landscape photograph showing a bright sun rising over a body of water, with green hills in the foreground and a clear blue sky. The text "decisions with confidence" is overlaid in a white, italicized font.

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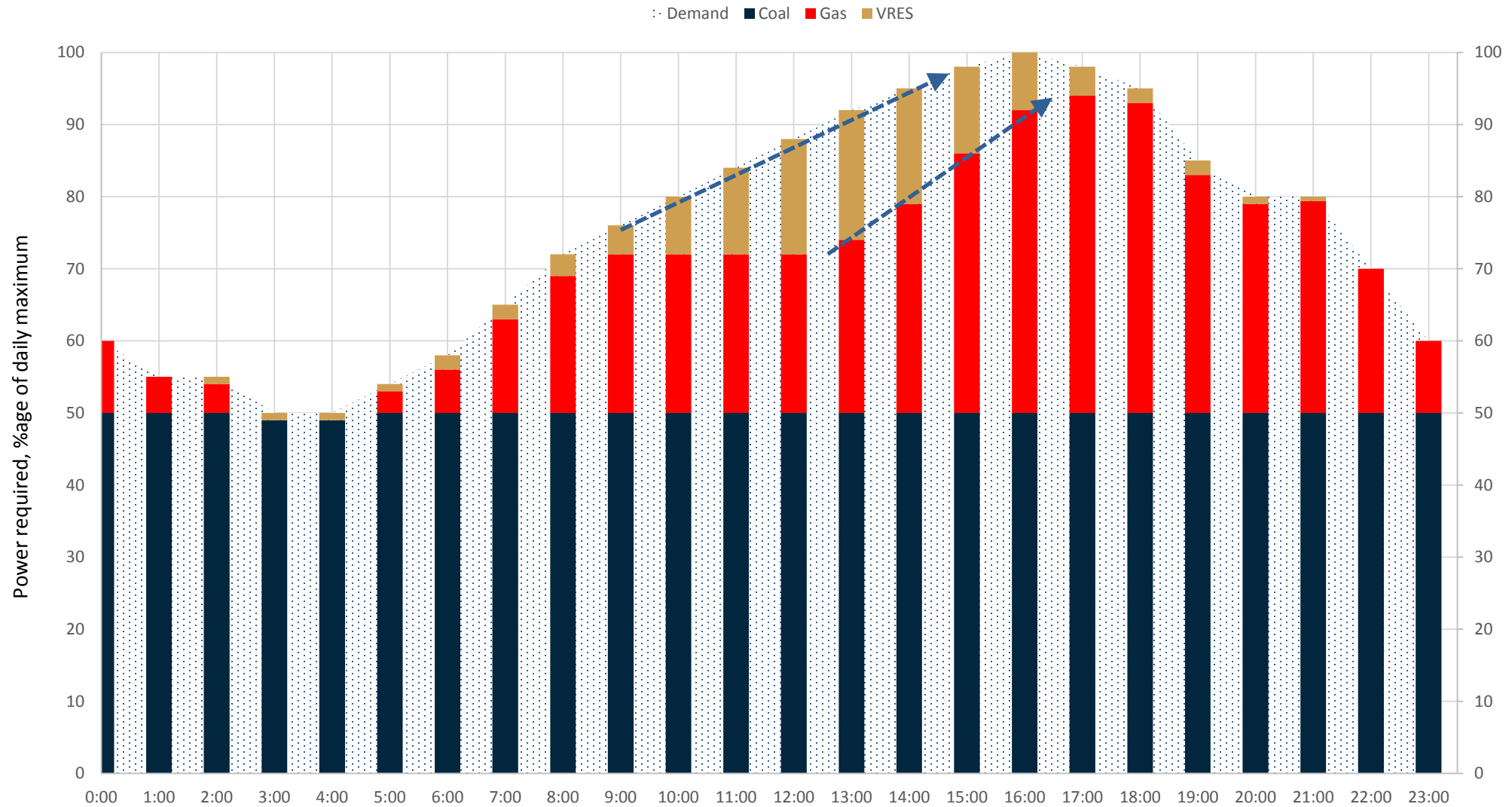
How to meet the demand: Coal dominated Fossil fuels

Notional Daily Demand

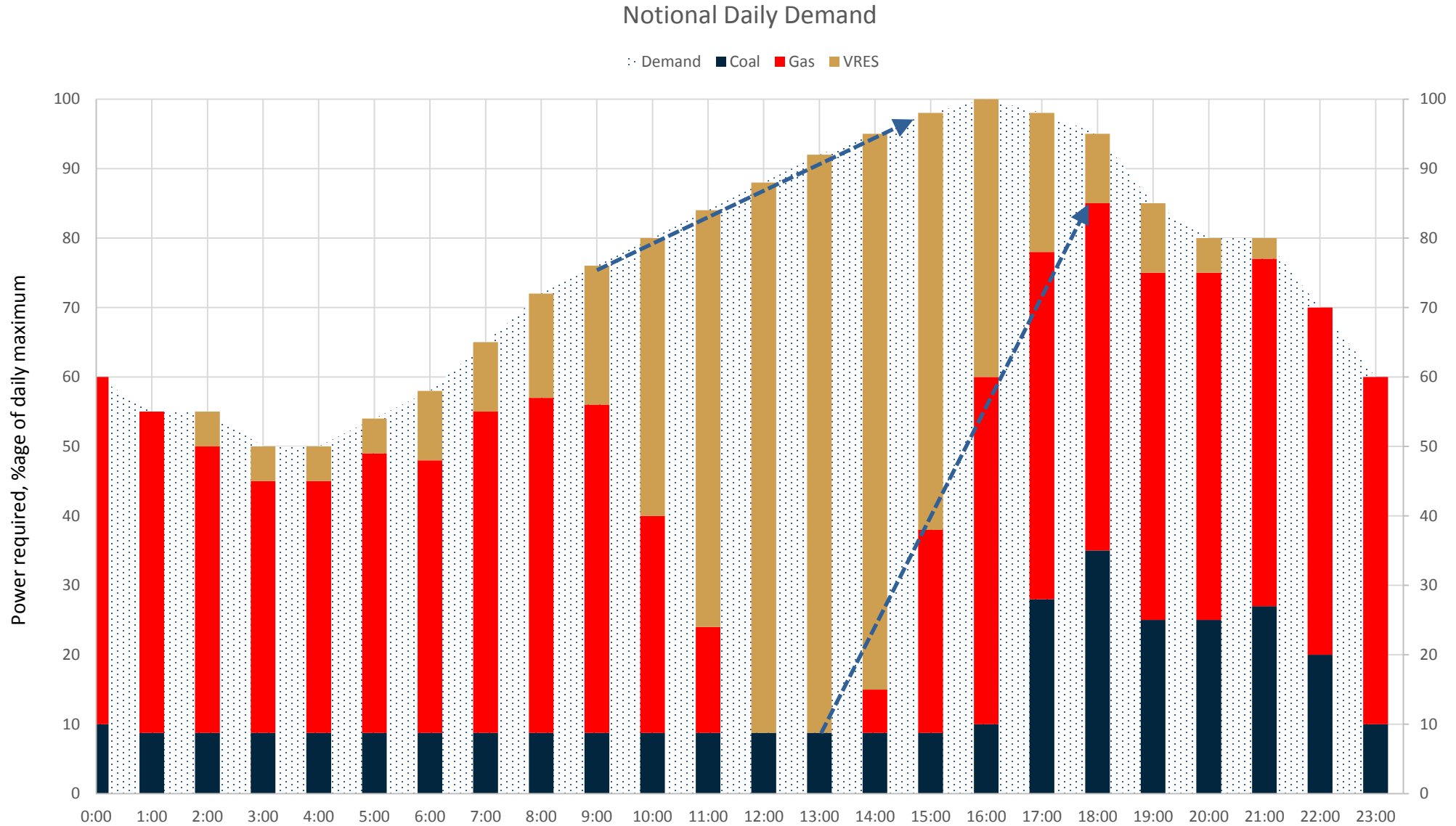


How to meet the demand: Coal, Gas and VRES

Notional Daily Demand



How to meet the demand: VRES dominated



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:

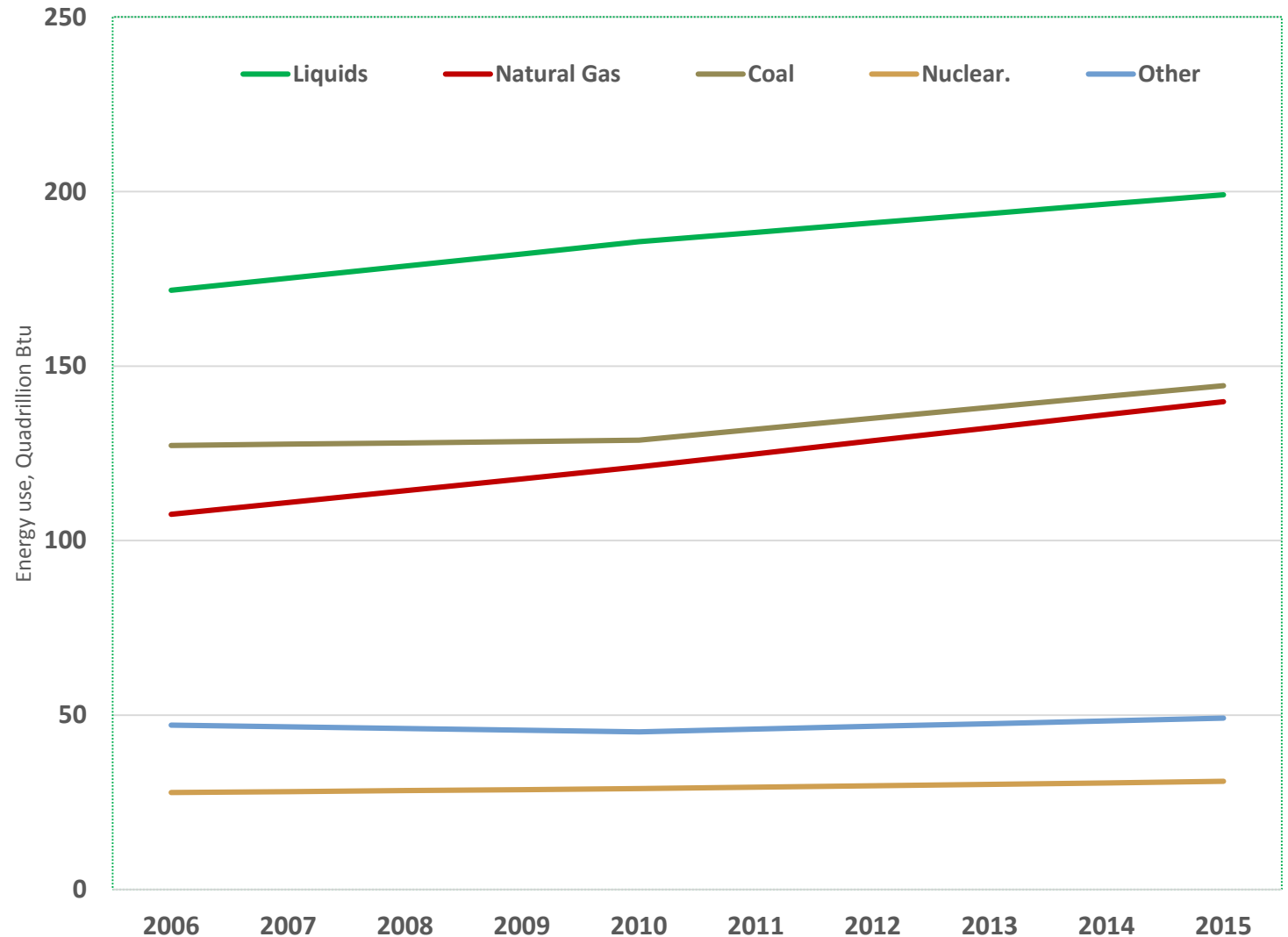
- Coal use would rise more slowly than other fuels
- Gas would be the highest growing fossil fuel as it is the “least polluting”
- Renewable growth would be slow and dominated by large scale hydro in developing countries

“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)

2006 EIA World Energy Use Projections by Fuel Type



Global Energy Use projections from 2006, actual outcomes

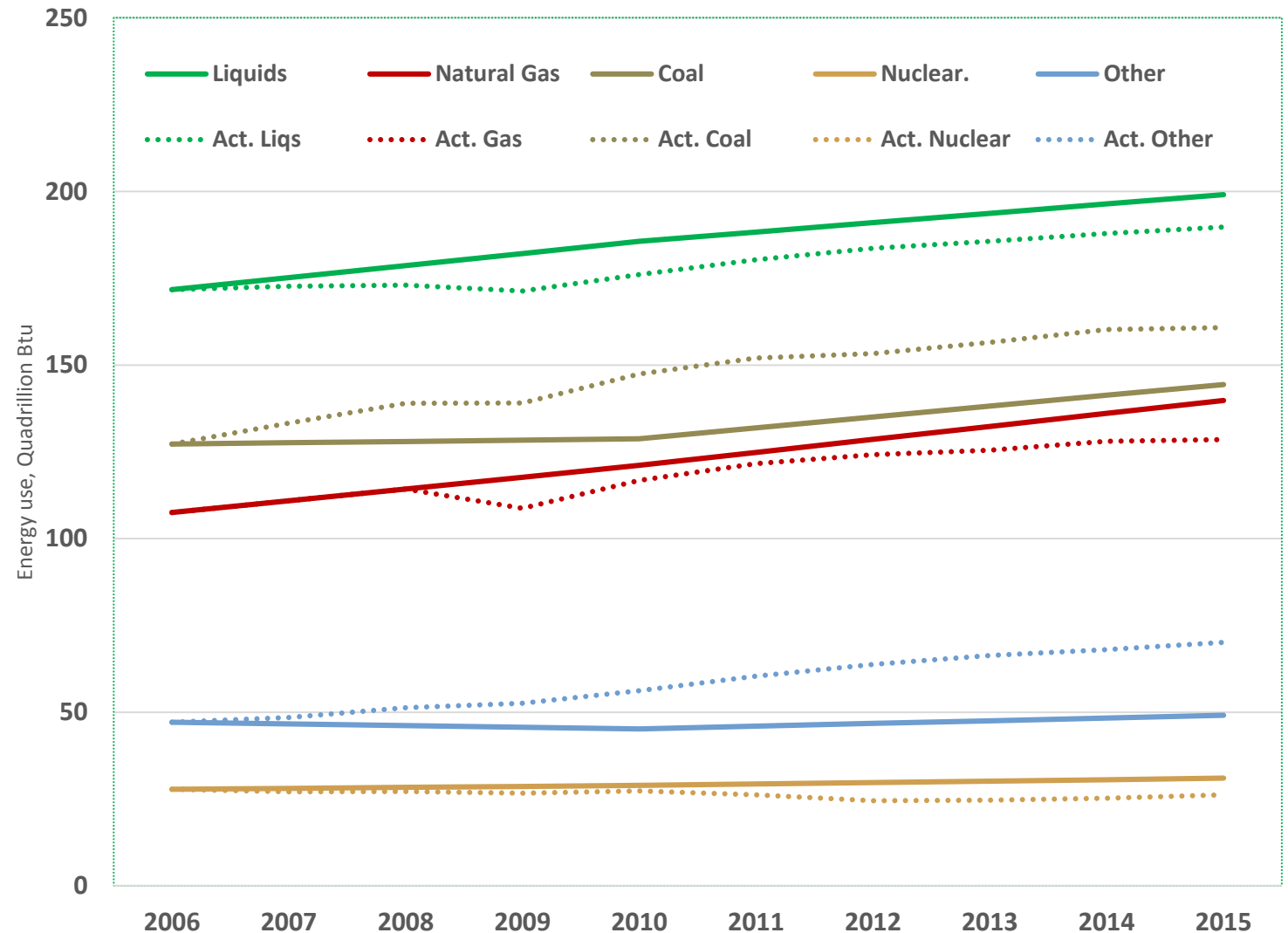
What actually happened:

- 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

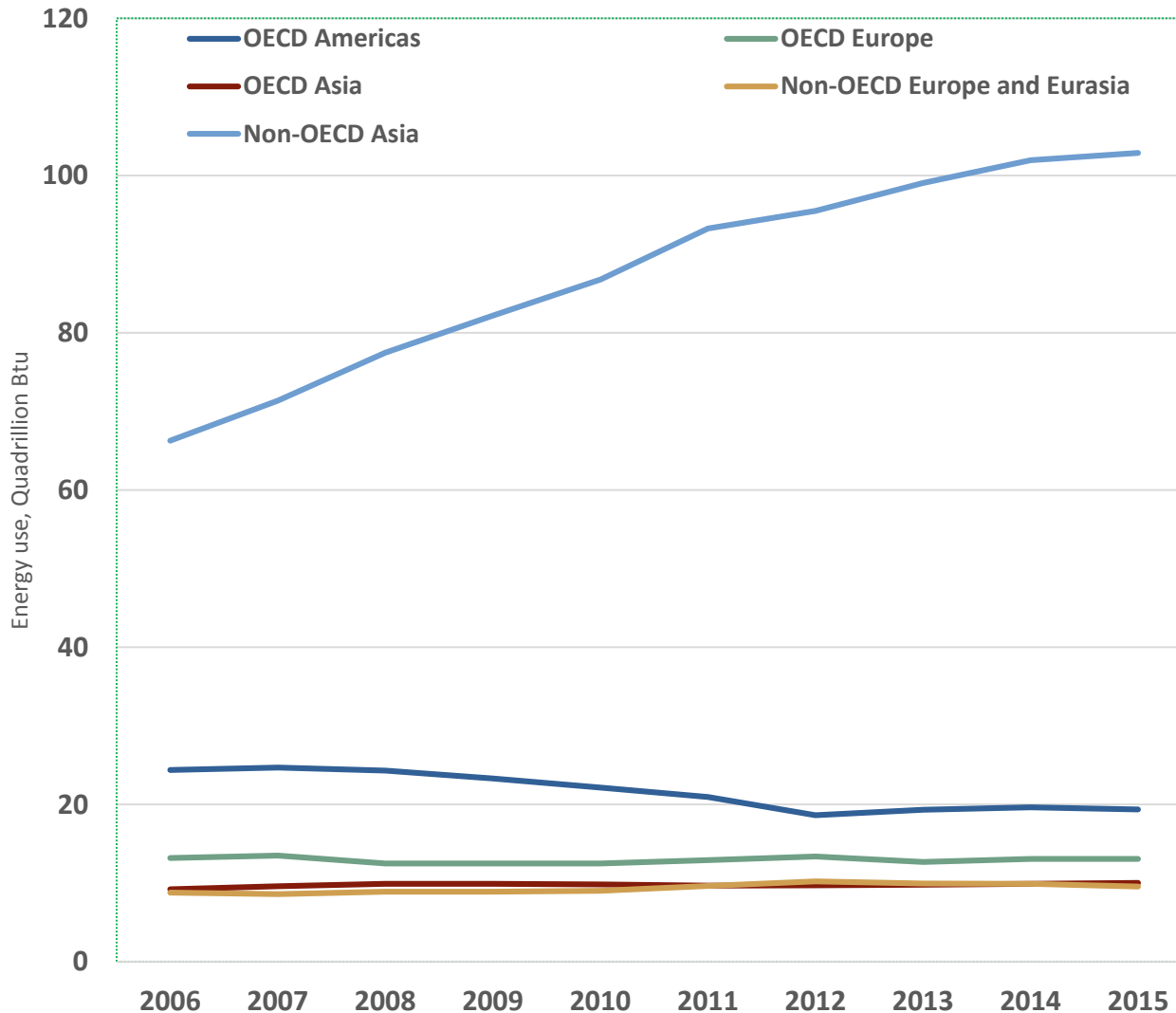
...but...

- Coal was the fastest growing of all fuels, growing by almost 50% more than either renewables or gas
 - This presents problems for reducing emissions

2006 EIA World Energy Use Projections by Fuel Type



2016 EIA World Coal Use History



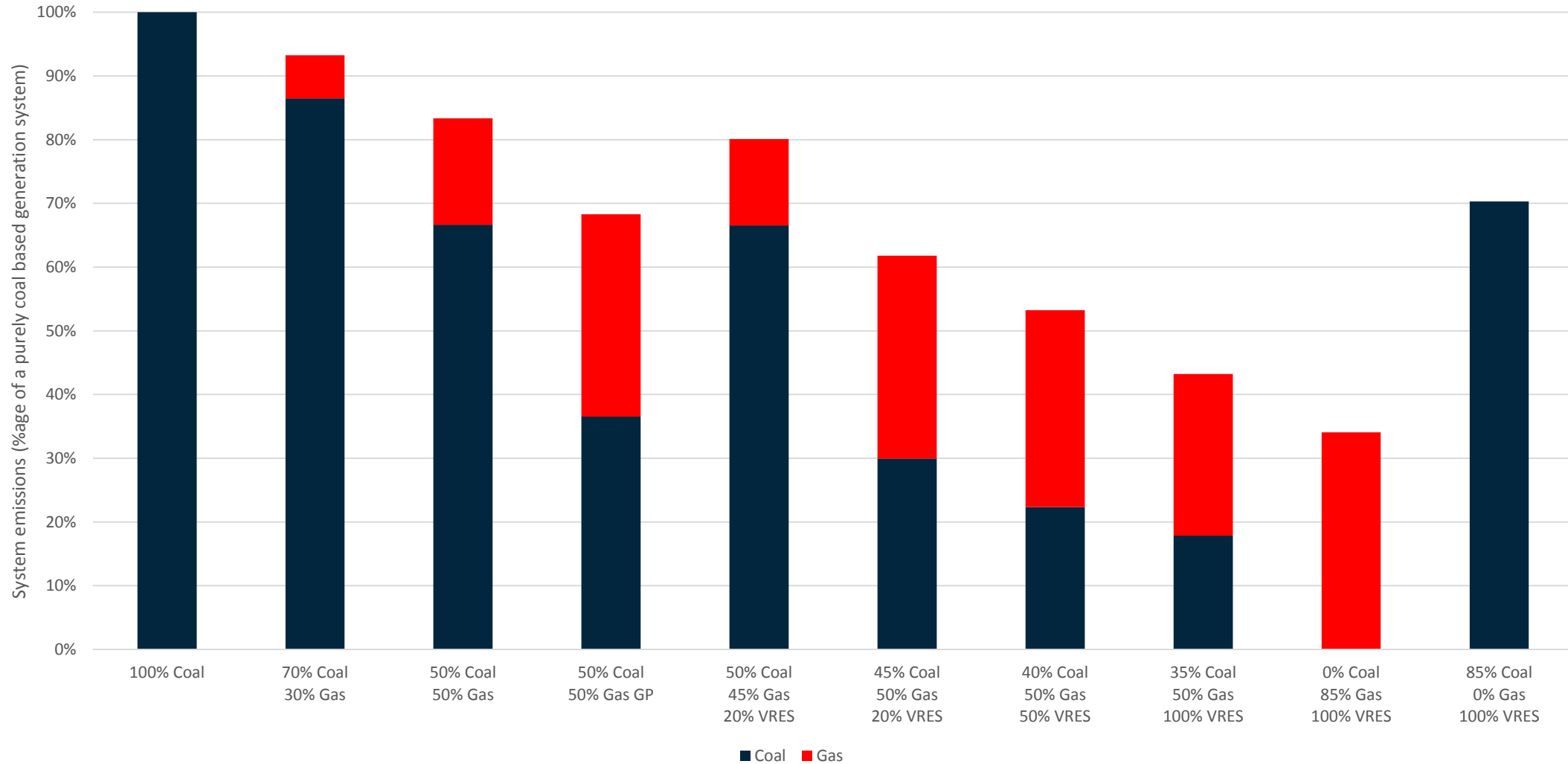
Between 2006 and 2016

- 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



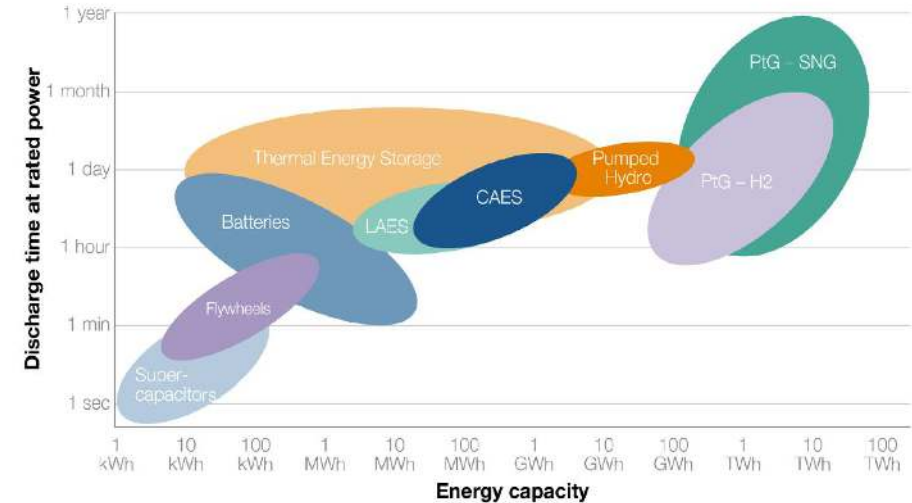
Power Storage for renewables

- 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

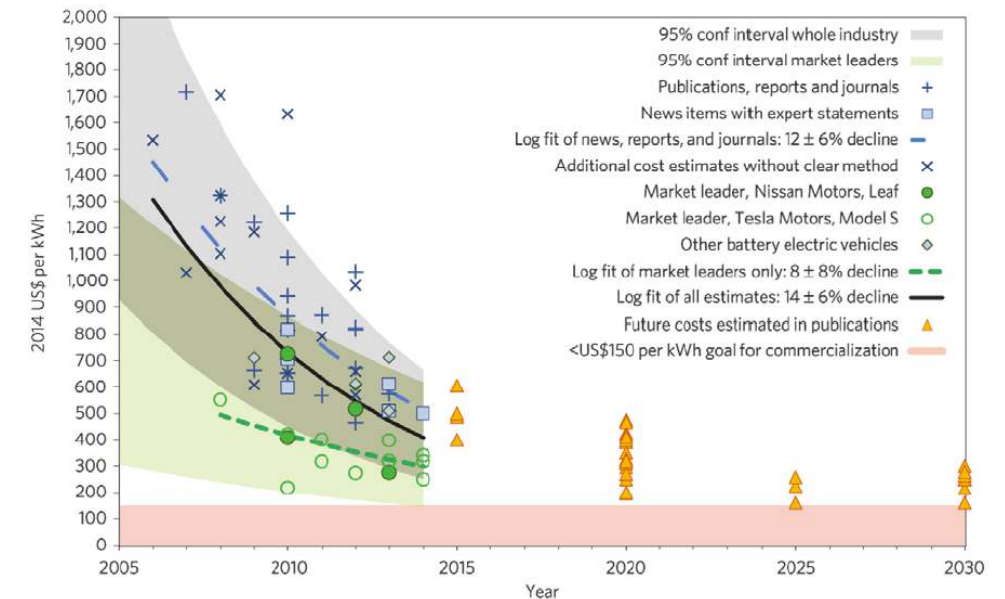
- Currently hydro-electric storage account for over 90% of all storage capacity
 - Wide range of storage technologies under development

- 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?

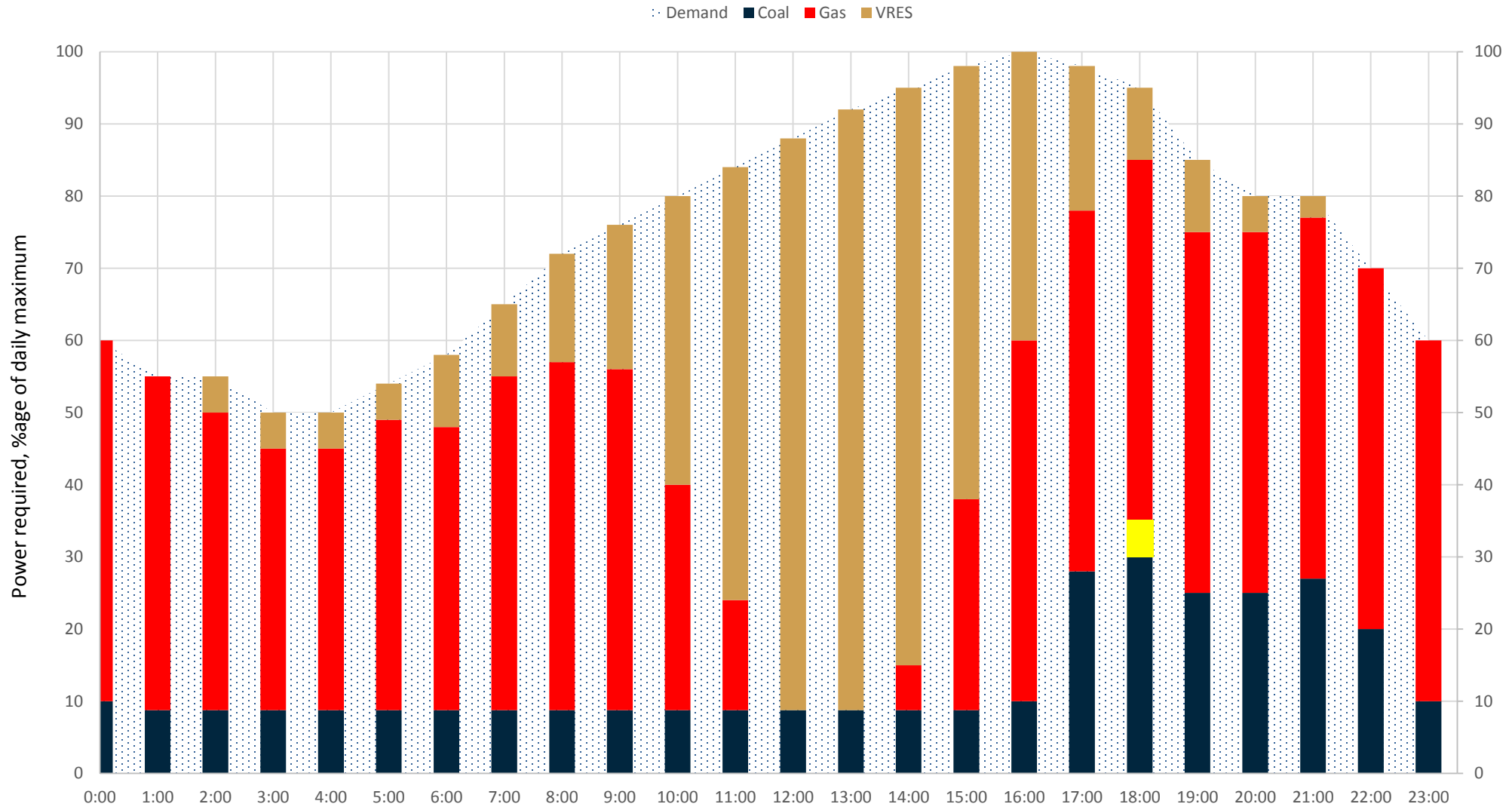


Source: PwC, 2015, following Sterner et al. 2014

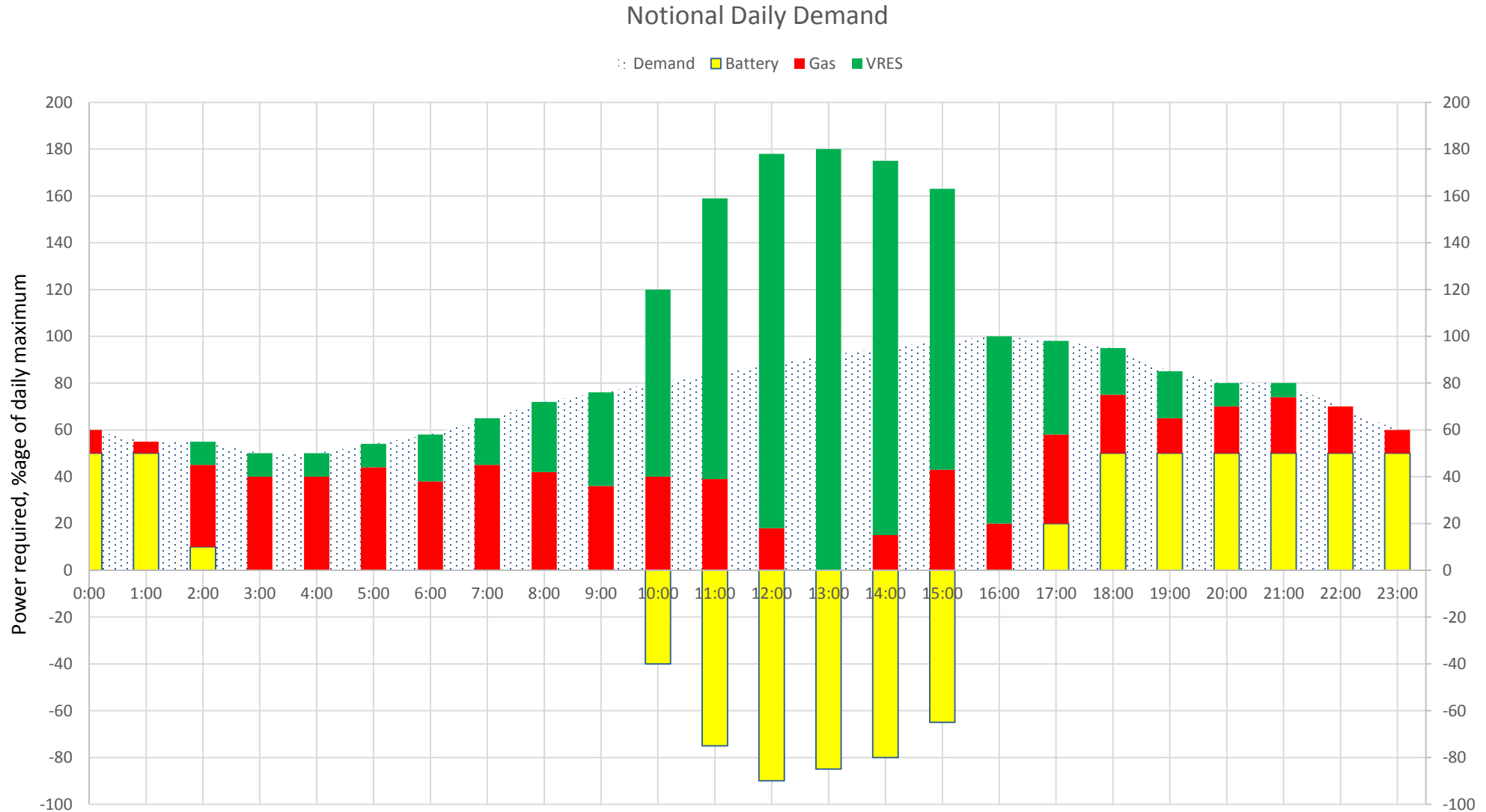


Impact of World's largest Battery in SA

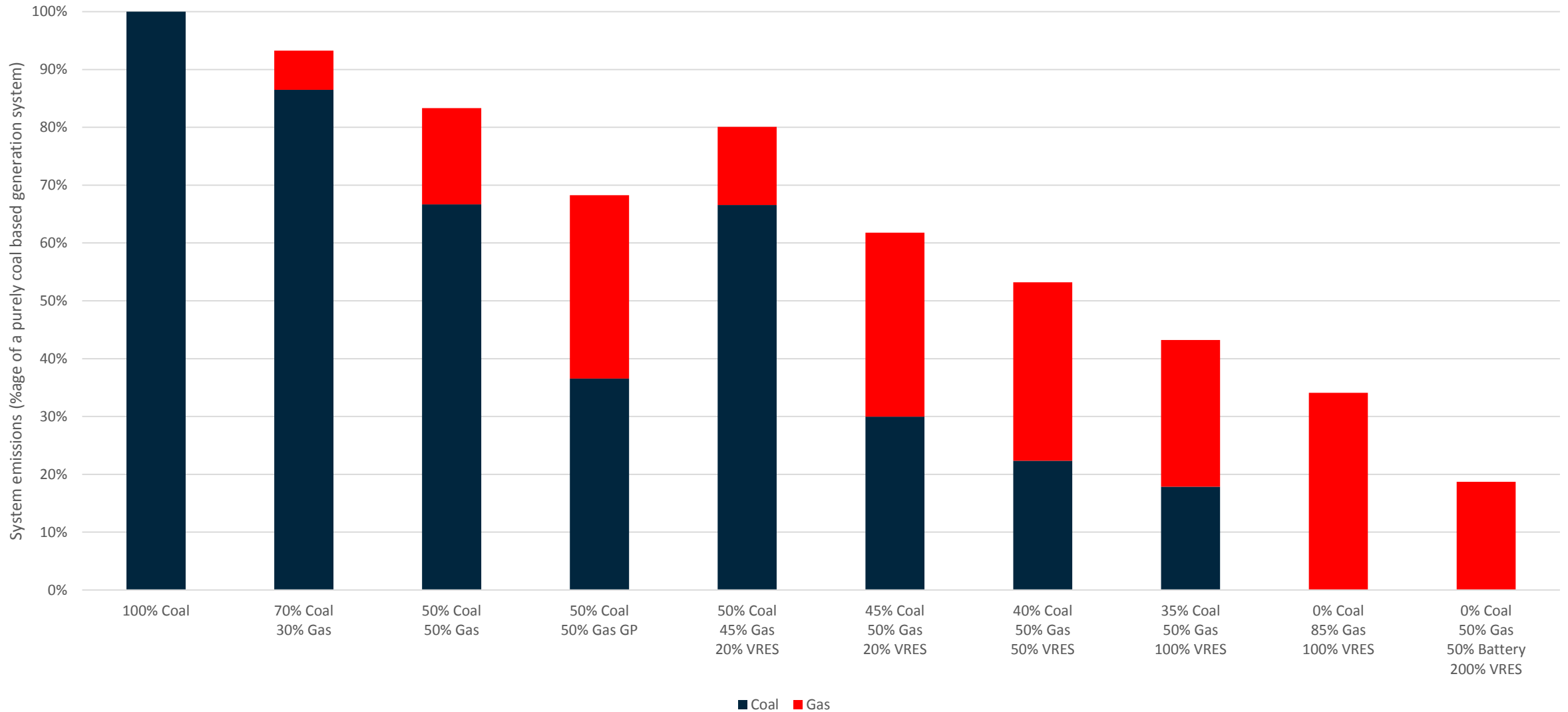
Notional Daily Demand



Large scale storage will require new “dedicated” generation facilities



Emissions Comparison for Power Generation Mix



-
- 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



Mt Marion Lithium Mine



Devils Creek Gas Plant



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