



A Generator-Retailer View of the Market

2017 Wind Energy Conference

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Accommodating views of the future

1987:

- School C
- I had hair



A lot can happen in 30 years!

Why does Meridian care?

- Planning for the future effectively
- Asset lifetime & the role of 'big kit'
- Inability to hedge long-term risk

So how does Meridian cope?

- Focus on the fundamentals of supply and demand
- But try not to turn a blind eye to future risks and opportunities
- Test the future through an envelope of possible scenarios
- Be credible but push things a little
- Scenarios are not forecasts of certainty but are tools of exploration

Meridian creates coherent and complete scenario based stories of how we and the industry might evolve over the next few decades

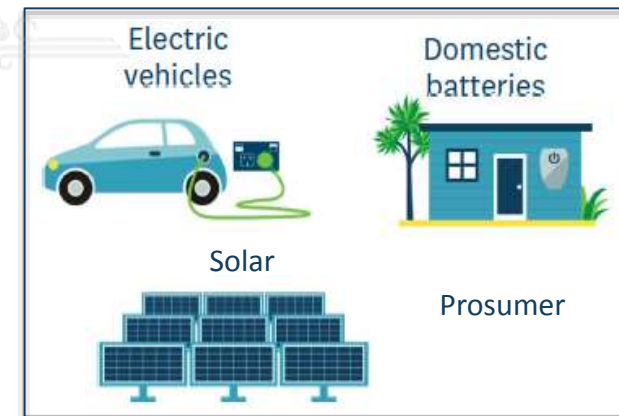
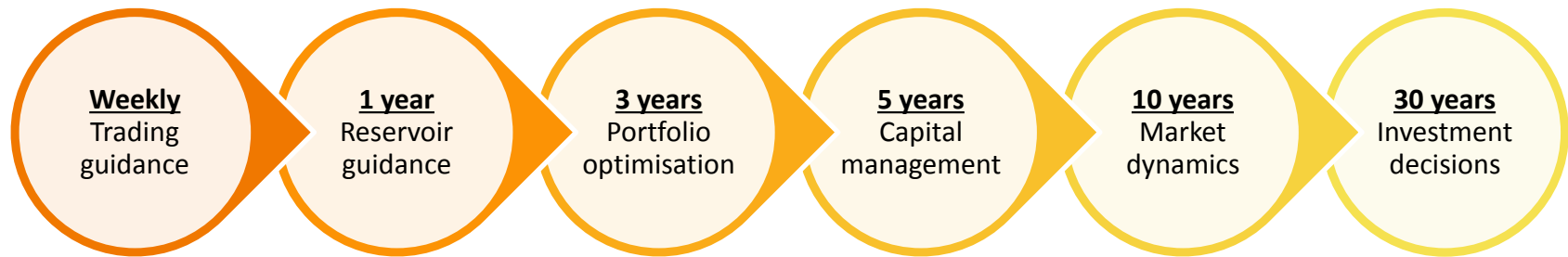
2017:

- Engagement surveys
- No hair



Common analytical framework

Meridian uses a consistent and integrated analytical framework to explore different time horizons and areas of both operational and strategic focus



Global drivers & context for the NZ market

International
prices

Global economy

Energy security

Markets &
re-regulation

Climate change

Disruptive
technology

Consumers

Renewables

America 1st!

Local drivers & context for the NZ market

Thermal closures

NZAS

Economic growth

Thermal fuel
landscape

New generation
options

Disruptive
technology

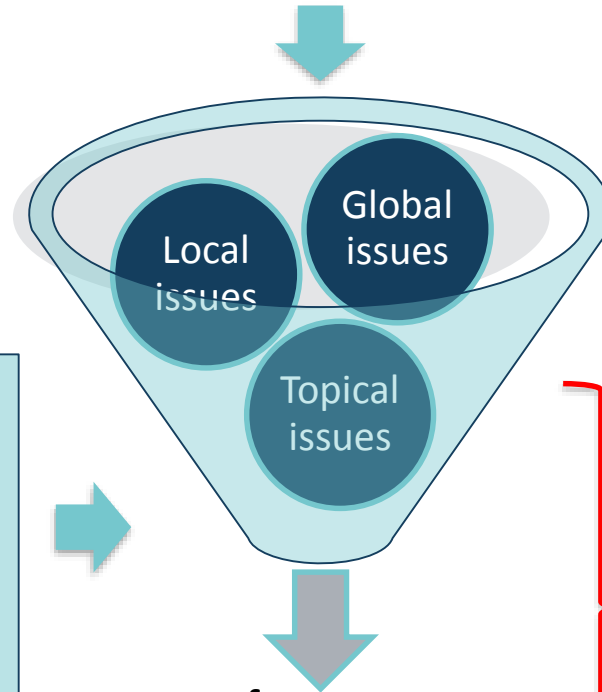
Regulation

Climate change

New Zealand 2nd!

Key issues: so what really matters?

A huge range of potential areas to look at and stories to tell ... many of them fascinating – but too many to cover in full detail



Narrow it down and focus on a key handful of issues that are of most immediate relevance to:

- consumers,
- the power sector,
- Meridian

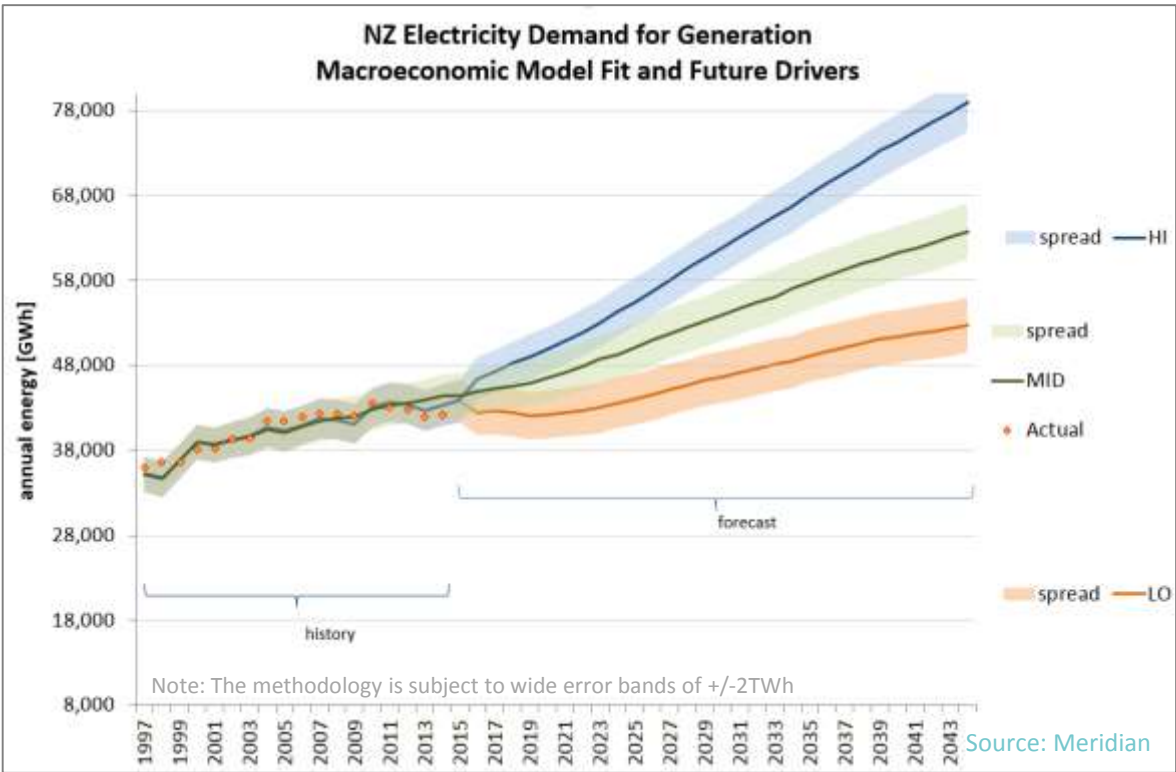
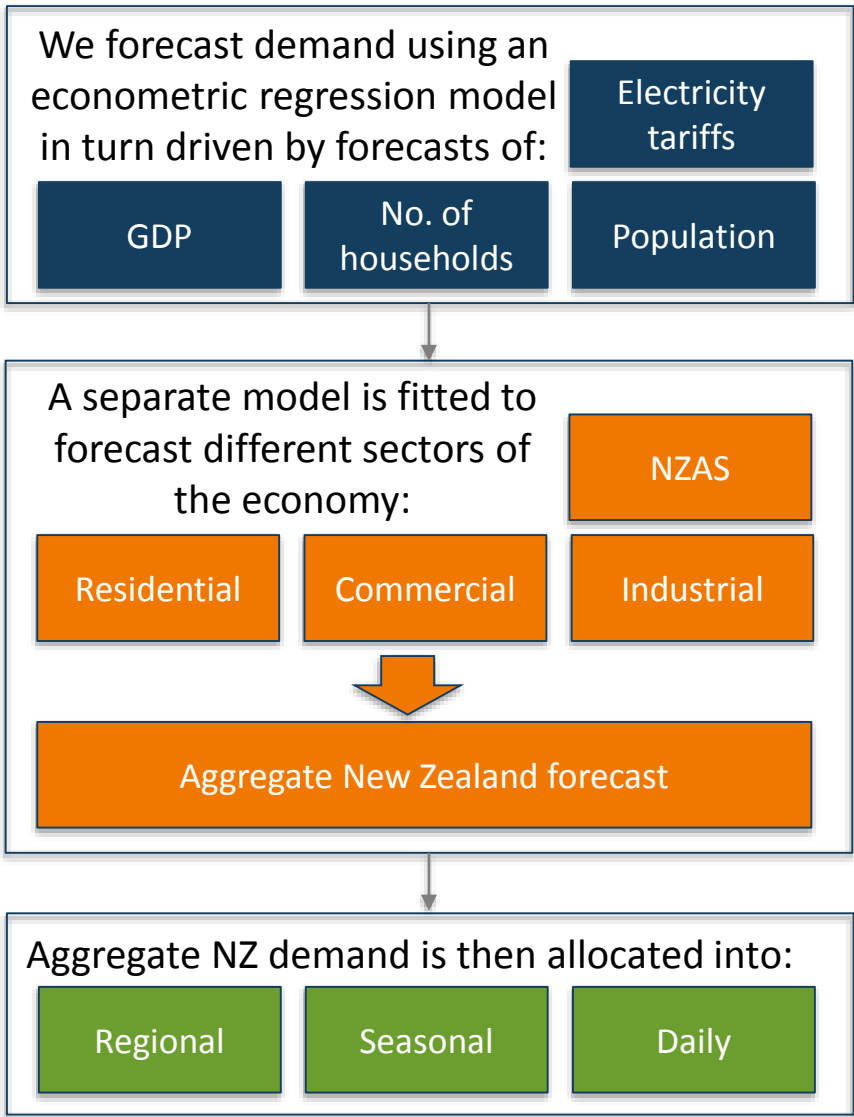
Key focus areas:

- Demand growth
- Thermal closures
- Cost of new generation
- Security
- New technology

Finally, we ask ourselves the question:

Is the NZ power system facing an evolution or is it a revolution?

Demand forecasting: old school 101



- Key takeouts:**
- Population and economic growth are unavoidable
 - Improvements in energy efficiency will continue
 - Uncertainties abound: recent demand growth, new tech, ...
 - Growth in demand for electricity seems largely inevitable:
 - But, how much is less clear!

Thermal plant retirement: nothing lasts forever

	Thermal closures		New thermal build	
Total over 2008 – 2012	New Plymouth (2008) 1 x Rankine units (2012)	300MW 250 MW	Stratford GT/Ahuroa (2011) McKee GT (2012)	210MW 100 MW 310MW
Total over 2008 – 2015	1 x Rankine units (2015) Southdown CCGT (2015) Otahuhu B (2015)	250 MW 180 MW 390 MW 820 MW 1,370 MW		
Potential by 2025-2035	TCC (1998) 2 x Rankine units (1973-85) E3p (2007) Whirinaki (2004)	370MW 500 MW 400MW 155MW 1,425 MW	Should expect significant new investment, if only to replace retired existing thermal plant baseload energy delivery, fast-start peaking capability, and dry-year backup cover	

Source: Meridian

Key takeouts:

- Significant thermal closures over last 10 years, especially last 2 years
- Limited new build has occurred over same period
- Future closures are inevitable, simply a matter of when:
 - The lifetime of renewable generation technologies is another factor to consider
- Therefore new build will be required, if only to replace future end of life plant

Costs of new build: now and (back to) the future

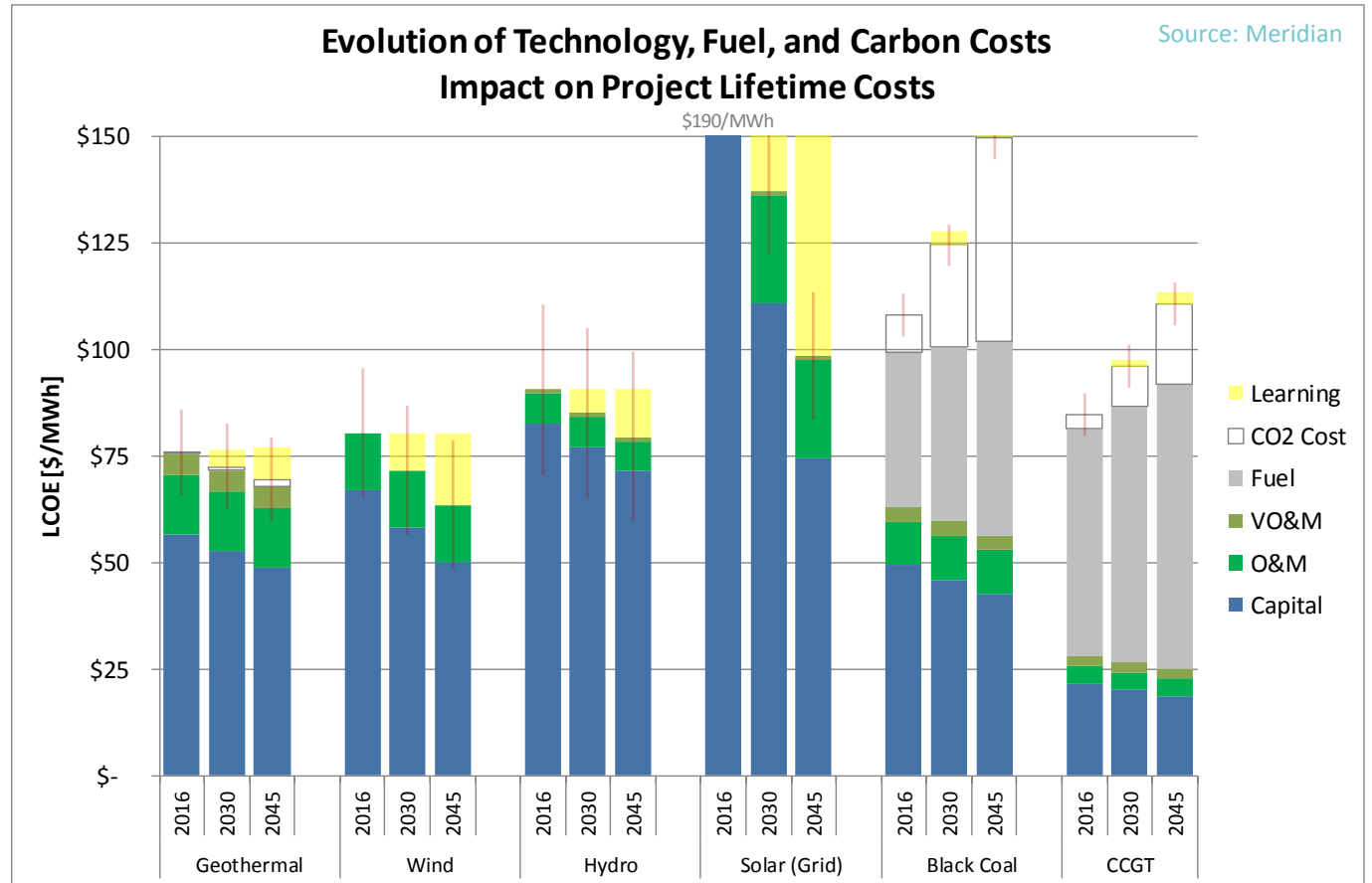
**Now vs the future:
Lifetime cost of energy**

Costs vary by technology
\$80-100/MWh

Experience will drive savings in capital costs, O&M and performance

Thermal fuel cost increase likely

Carbon acceptability & cost increase likely



Key takeouts:	Range of renewables \$80-\$100/MWh	Costs likely to fall over time	Baseload thermal challenging
	Need to secure public support and consents	Need to secure finance	Need to fit in the market
			Need to fit in a company's strategy

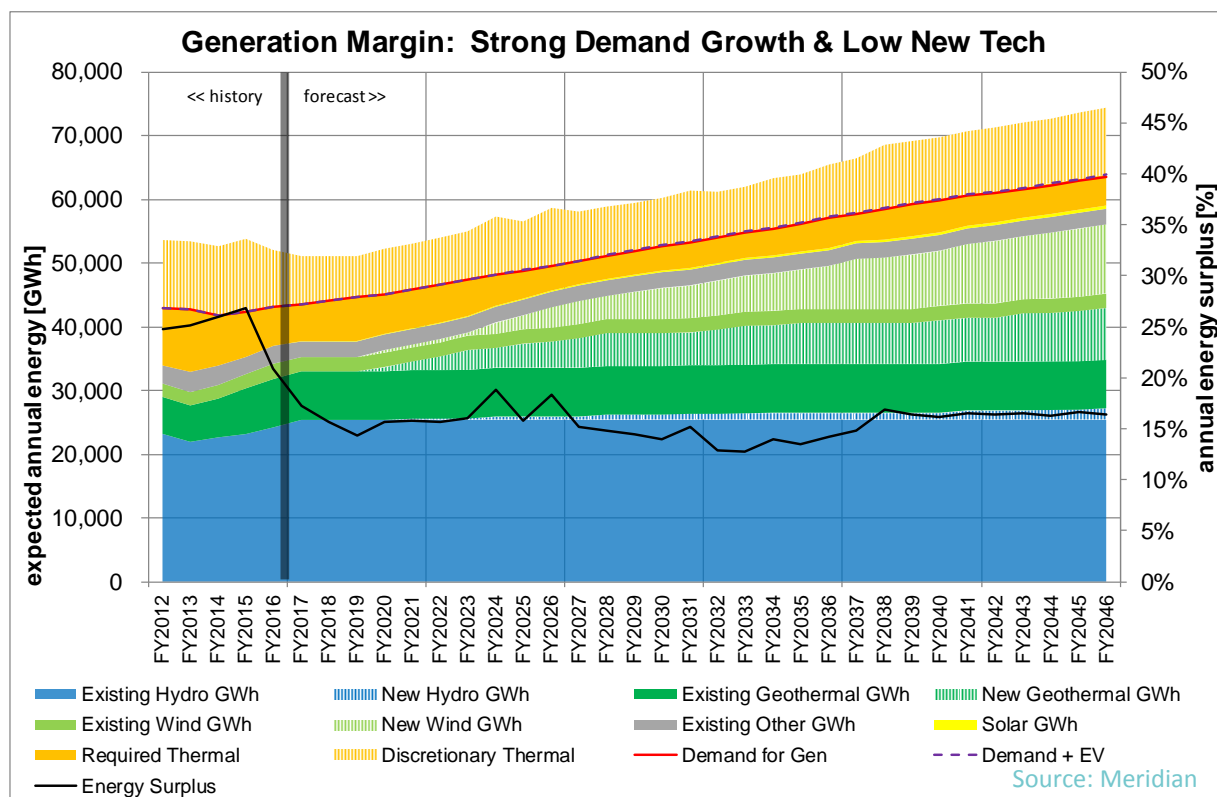
Security margins: keeping the lights on & people happy

System Security energy margins:

- **Pre 2015:** margins were at historically high levels: 25-30%
- **Post 2015:** margins have fallen to <17%
- **Looking forward:** margins will continue to fall towards 15%

Concern (but no mandated action) mounts when margins fall below:

- 15-17% of energy (in winter)
- 800MW at periods of peak demand (NI)



Key takeouts:

- NZ's energy-only market does not rely on any security standard per se
- It is driven by an appropriate return (WACC+) on investment for all new generation technologies
- Investment revenue adequacy assumed by Meridian is consistent with a 15-17% annual energy margin

New technologies: living in interesting times

Headline numbers as at 2017 suggest some distance until there is parity for new technologies:

- **Rooftop solar:** 3kW system ~\$10K
- **Residential batteries:** \$12K for 13kWh
- **EVs:** Low carbon works of art at ~\$60K+

Costs will continue to fall for some time – but exactly how much and by when?

However, consumers investing in demand side technologies respond to a wide range of incentives beyond pure cost:

- Increased utility of consumption
- Independence
- Contribution to a cause
- Novelty

Becomes yet another planning uncertainty

Potential new technology scenarios

	Low steady but modest increase from today	High persistent & strong increase from today	Steady cost decline expected
Solar (residential)	125,000	1,500,000	falling from 30c to <12c/kWh
EV (passenger)	150,000	1,000,000	falling from \$60K to <\$25K
Domestic batteries	50,000	250,000	falling to <\$100/MWh

Source: Meridian

Key takeouts:

- Consumer led new technologies will continue to develop and be deployed
- Unclear as to what, when, or how much
- It is largely out of our hands
- So instead focus on how much it matters

Final Insights: so ... ?

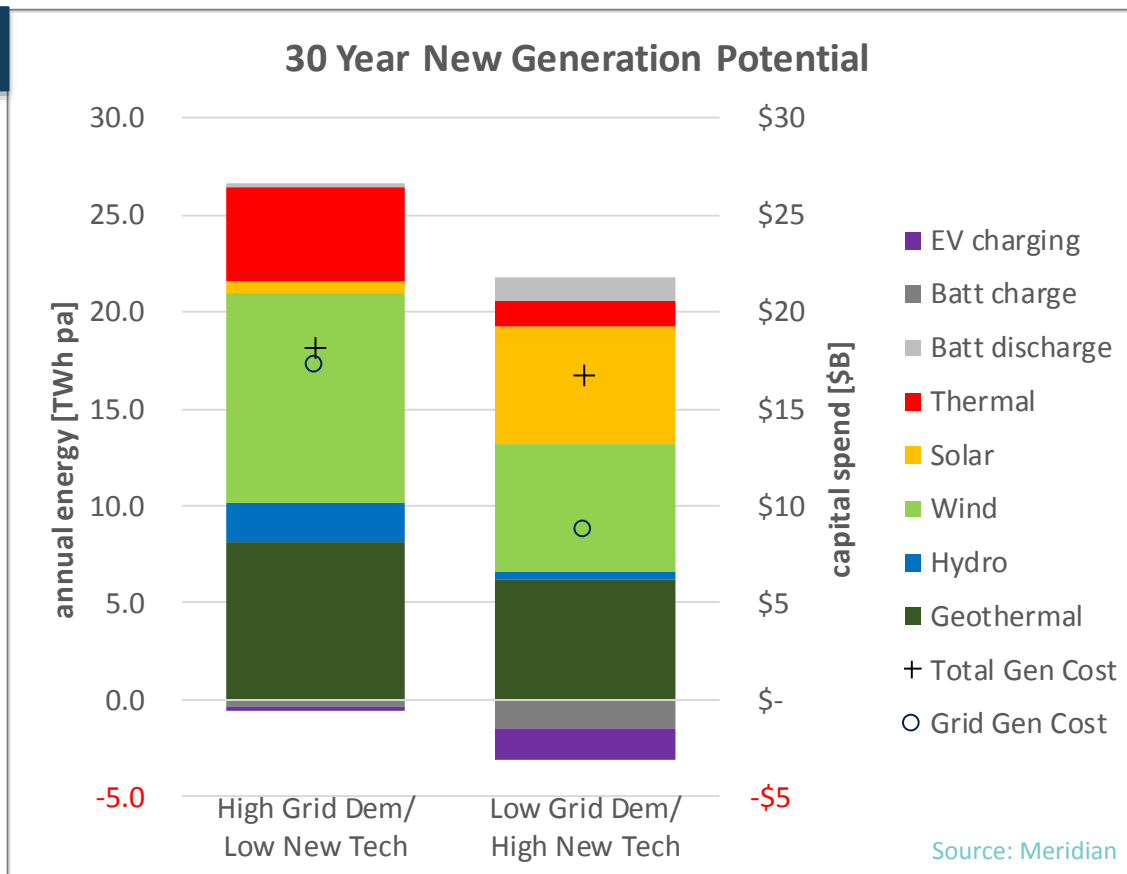
Q) Evolution or revolution?

A) A bit of both!

New Generation

New grid scale generation build and capital commitment seem inevitable:

- Dominated by renewables
- Supported by thermal gas peakers
- New technologies accommodated within existing (grid) infrastructure



Cost & Prices

Generation capital spend is similar regardless:

- \$17-18B
- But rooftop solar remains expensive

Prices rise towards levels required for new grid investment:

- \$70-80/MWh today rise towards >\$100/MWh

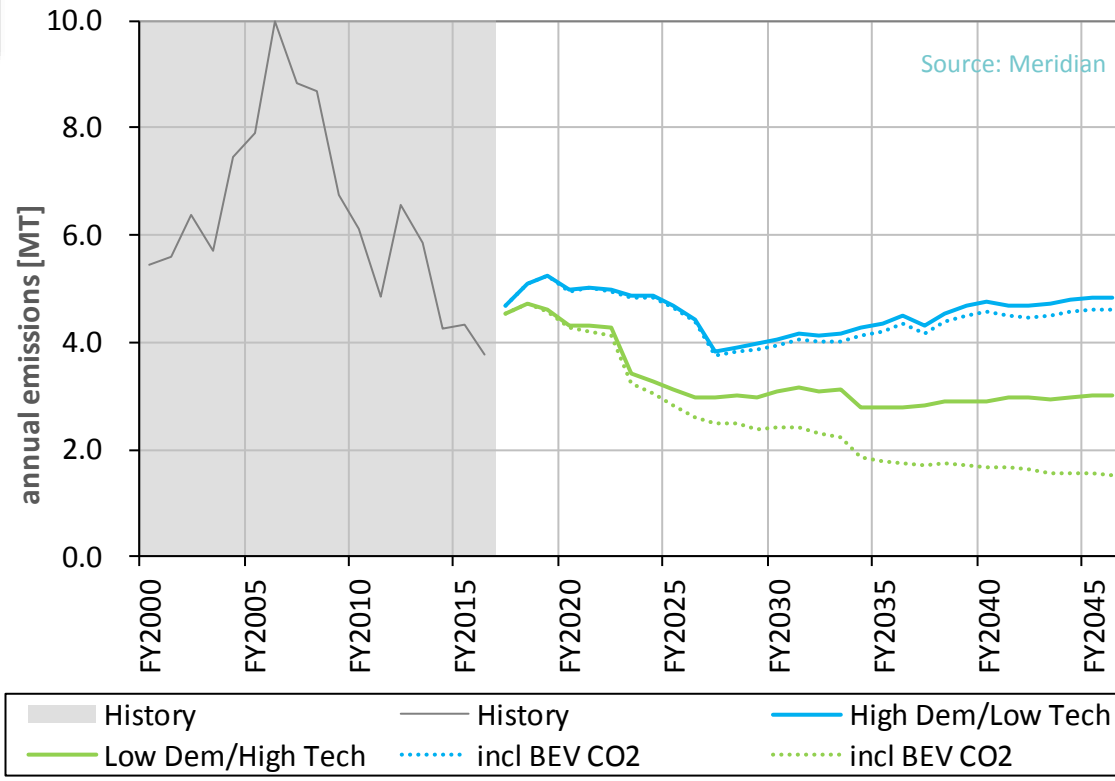
Final Insights: wait there's more...?

Renewable share of generation

Rises as thermals retire & replaced by renewables & new cleaner GTs:

- A 90% renewable share achievable within 10 years
- Beyond 90% relies on large thermal plant retiring
- CO₂ emissions fall following thermal retirement
- EVs allow a greater reduction in wider energy system emissions

Electricity Generation Carbon Emissions



Consumers & New Tech

Consumers will continue to invest in new technologies:

- By how much and by when difficult to pick
- What is the role of conventional gentailers?

Summary

- We are never going to predict the future correctly
- Instead we look at what we have now, what might change, and at what is new and emerging
- We test resilience, scale of impact, and challenge our thinking:
“Are we missing something?”
- The future for grid scale electricity – both old and new – and especially renewables seems robust
- Hard to see an industry ‘Kodak moment’ emerging ... Yet!
- But we don’t know what we don’t know ... so we test the boundaries as much as we credibly can
- We engage with and invest in new ideas as and when they make sense

Gently does it and don’t drink too much of the Kool-Aid 😊