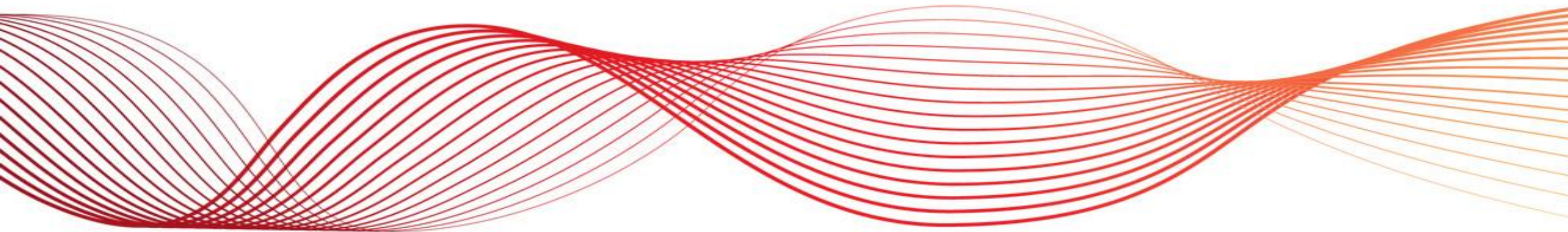


MARKET TRENDS AND OUTLOOK IN AUSTRALIA'S ELECTRICITY MARKETS

July 2016

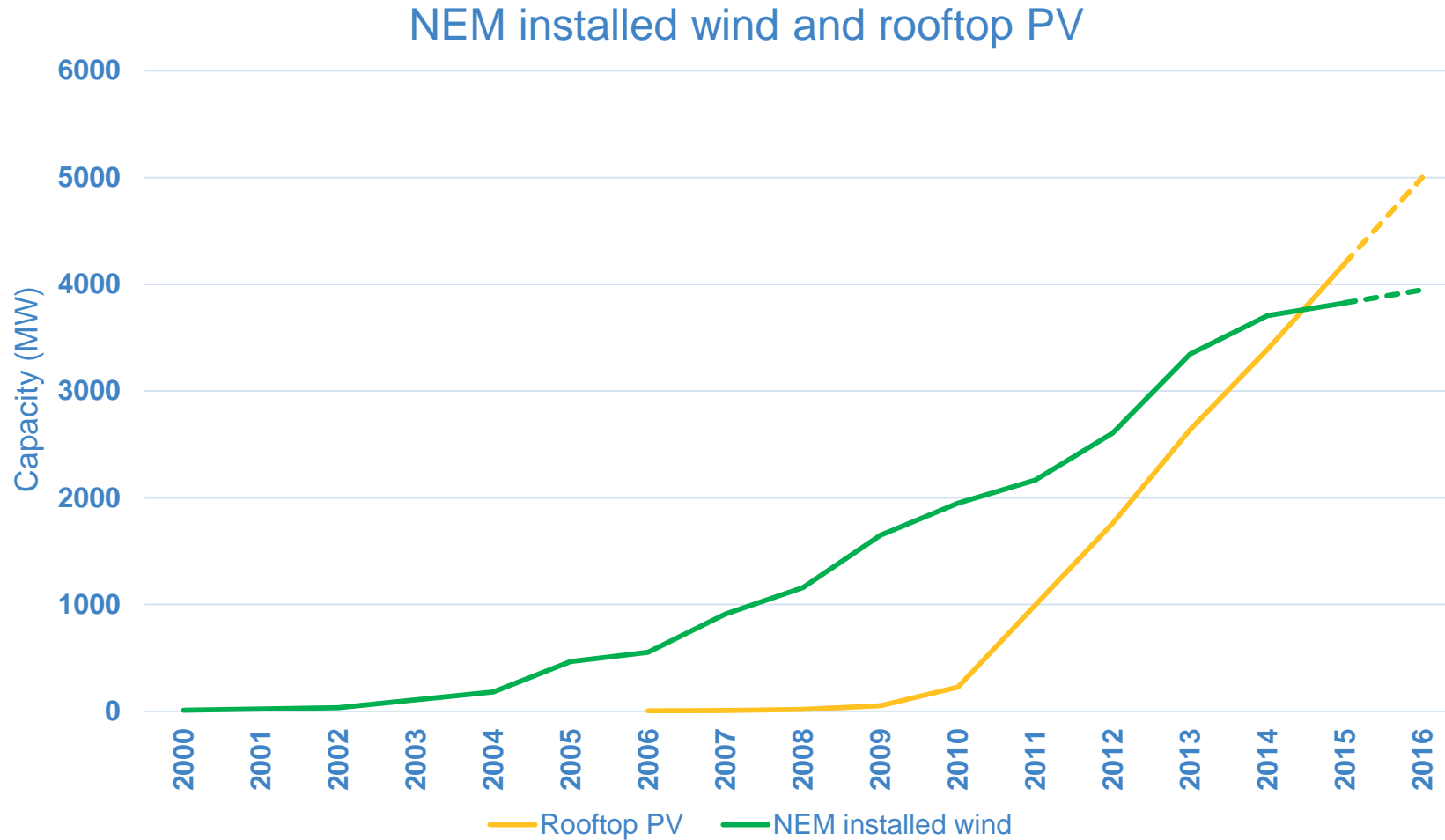


DAVID SWIFT

- Technology costs, pro-active consumers, new business models and government policies are driving the takeup of renewable energy
- This is delivering:
 - a changing generation mix
 - changing patterns of demand
 - changes in the dynamic performance of the power system
- Work is underway to determine the changes needed to rules, regulation and policies to ensure power system security is maintained
- The generators of the future need to consider the value of the generation and services they bring, not just the cost

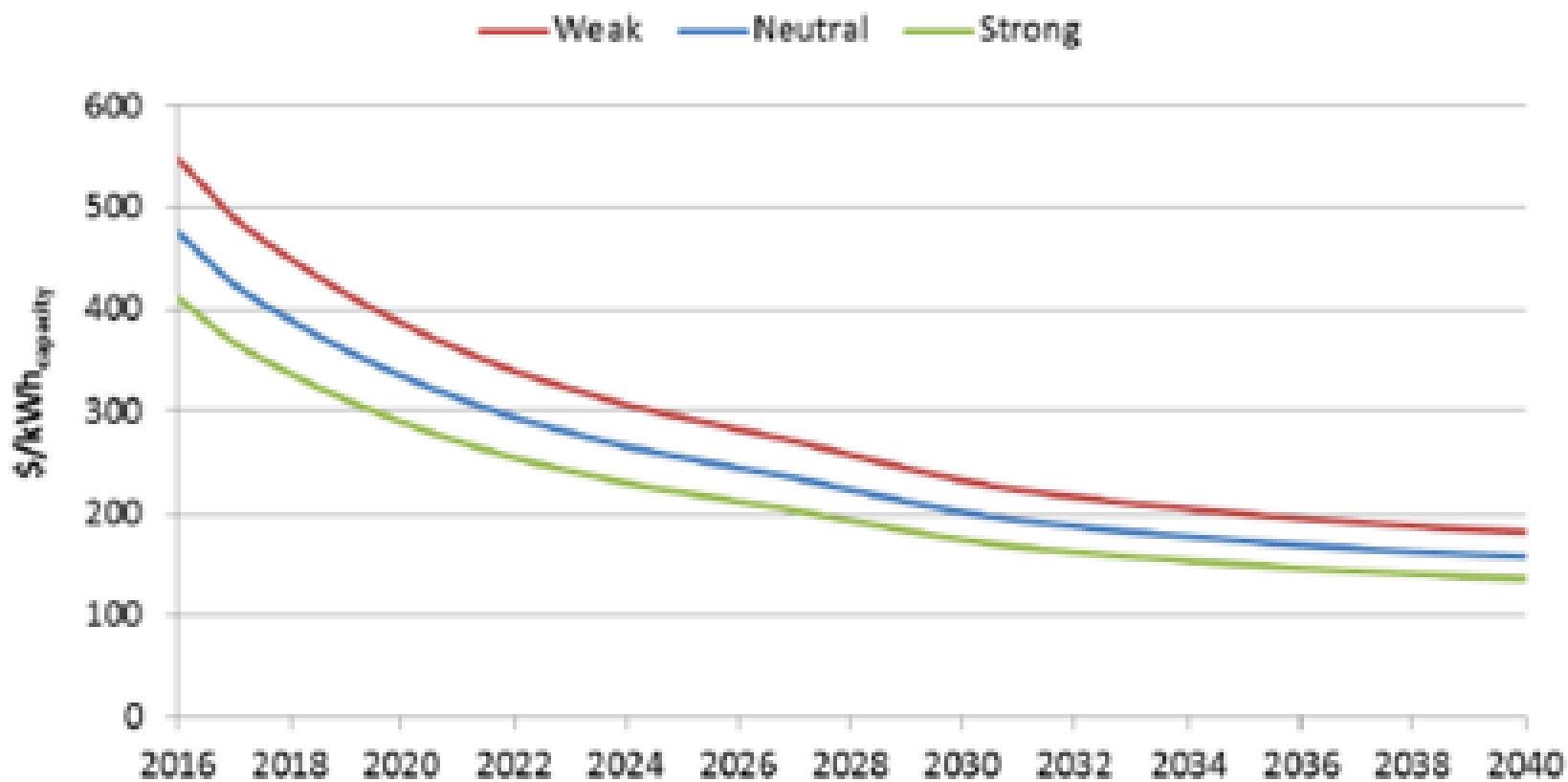
- Technology costs are generally falling faster than we previously predicted
- More pro-active consumers, new business models and government policies are adding to take-up
 - Increasing rooftop PV
 - Now considerable interest in utility scale solar PV
 - Continuing deployment of wind generation
 - Investment in battery storage has commenced and is forecast to increase
 - International experience suggests that the cost of solar thermal is falling significantly and may provide a competitive option in the future

ROOFTOP PV OUTPACING LARGE SCALE WIND

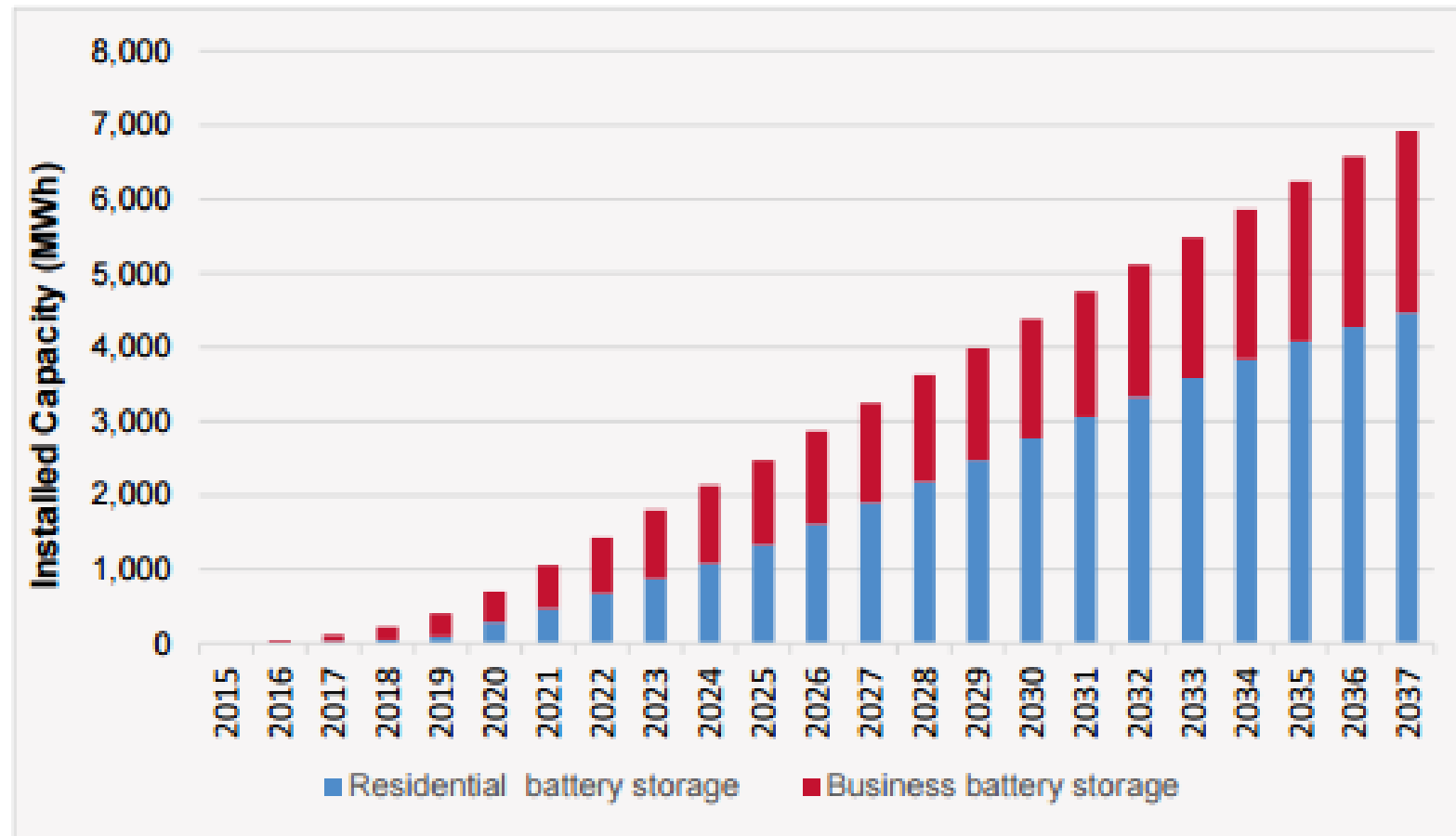


- A steady uptake in battery storage is forecast after 2021 in both the residential and the commercial sectors.
- This is expected to be driven by
 - projected retail electricity prices
 - decline in battery costs
 - transition to a time-of-use tariff structure.
- By 2035–36, 3.8 GW of rooftop PV capacity is expected to have integrated battery storage, providing 6.6 GWh of energy storage potential.
 - 3.8GW is comparable to total installed rooftop PV in 2015

PROJECTED CAPITAL COST OF BATTERIES

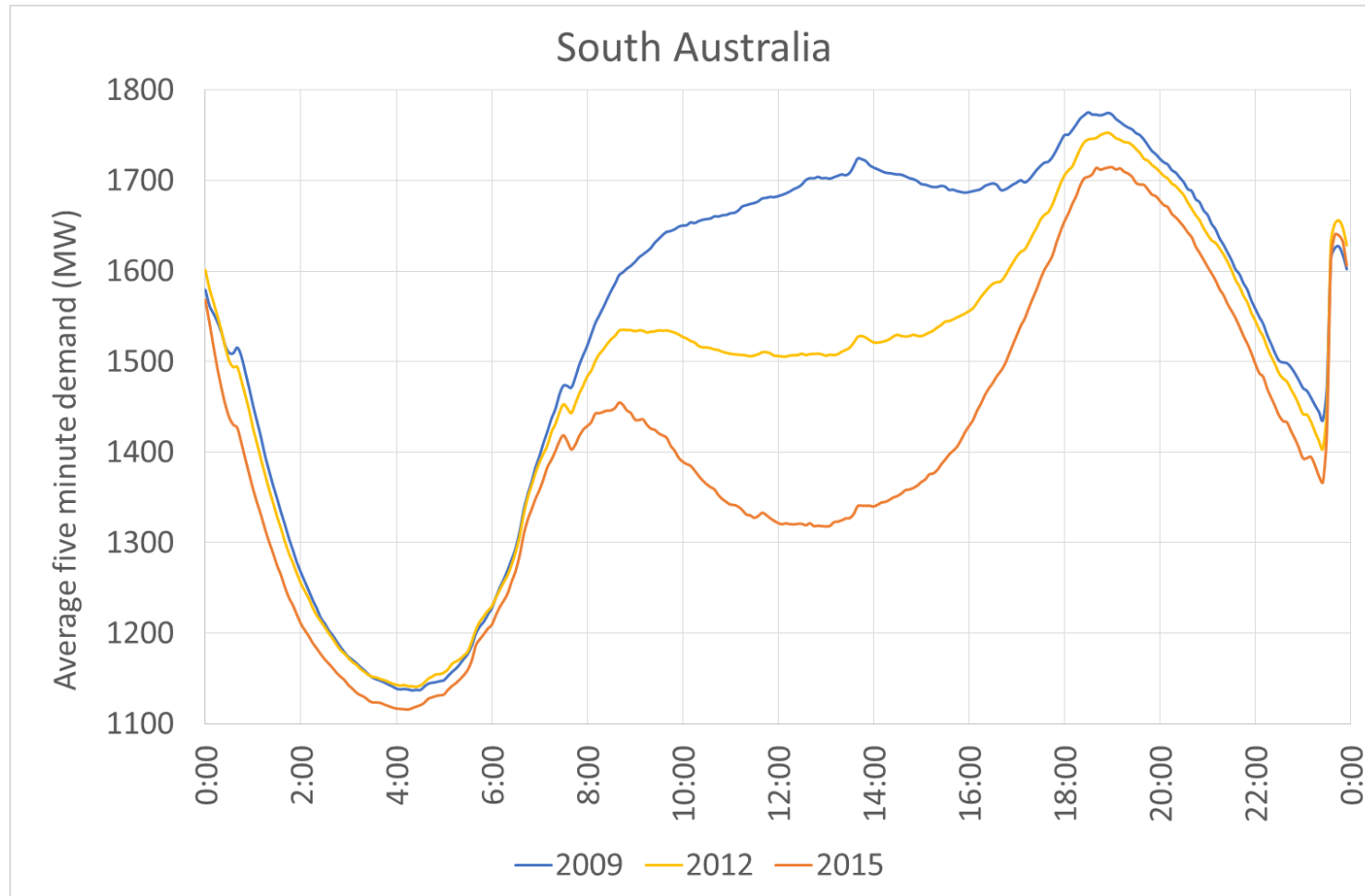


FORECAST INSTALLED CAPACITY OF BATTERY STORAGE

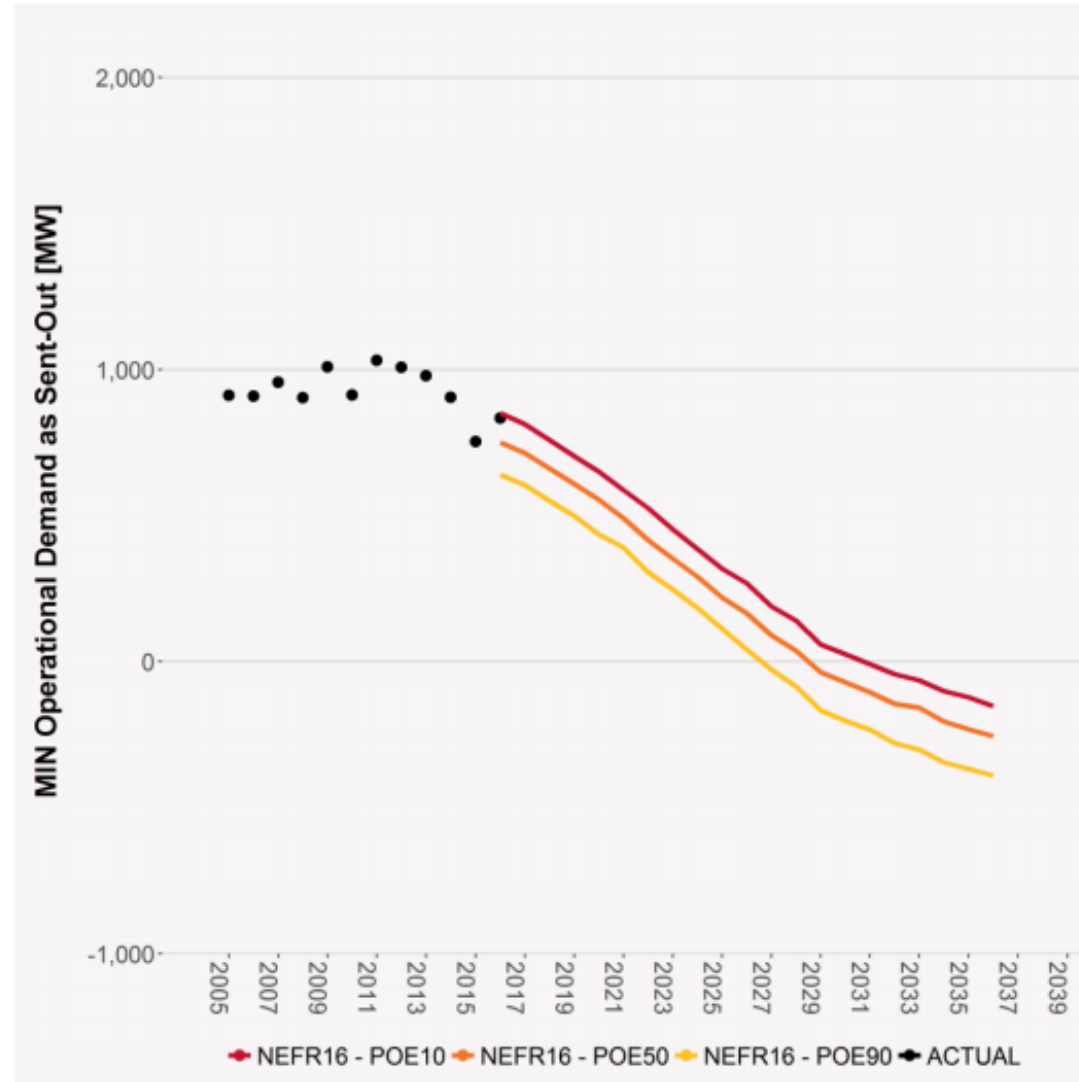


- The profile of demand is changing with changing customer mix, energy efficiency and new retail products
- The profile of demand on the grid is facing even greater change due to the strong growth in embedded generation, especially solar PV
- The growth of batteries will allow further change to load profiles

AVERAGE DEMAND PROFILE

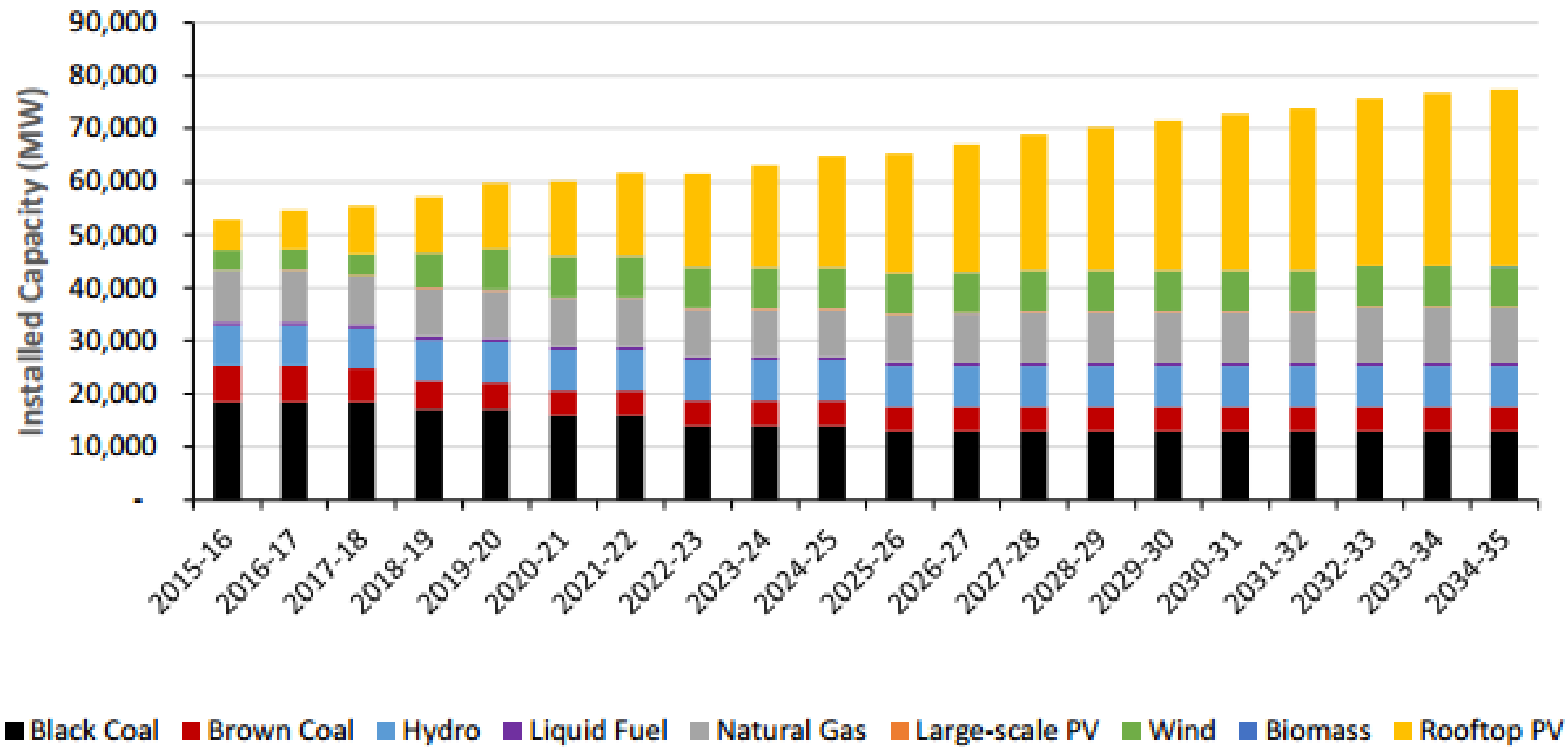


MINIMUM DEMAND IN SOUTH AUSTRALIA



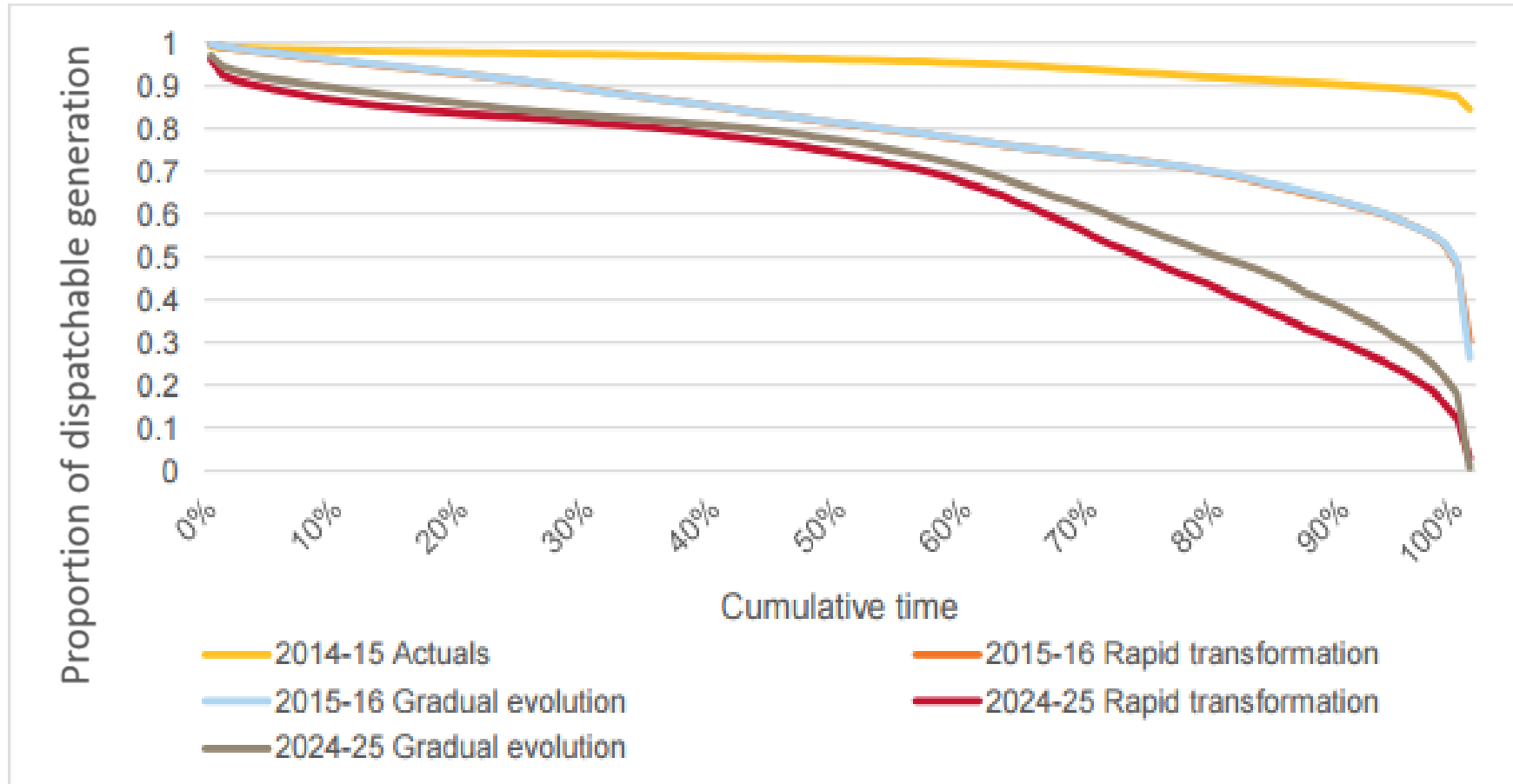
- The generation mix in the NEM is changing:
 - Retiring synchronous generation
 - Growth in asynchronous generation
 - Growth in embedded, asynchronous generation
 - Rooftop PV forecast to quadruple by 2036
 - Reduction in centrally dispatched generation

THE FUTURE OF GENERATION IN THE NEM

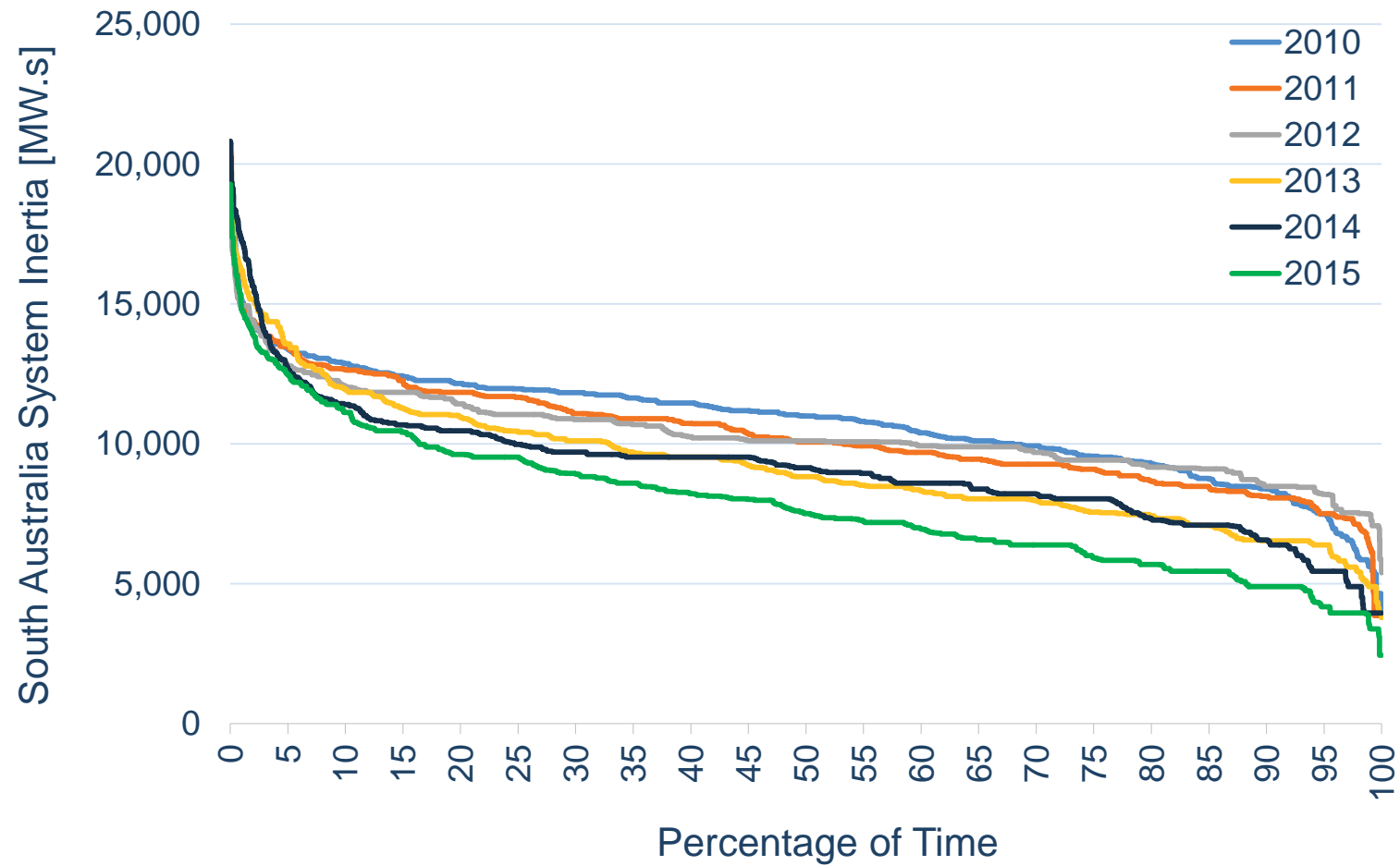


GENERATION DISPATCH

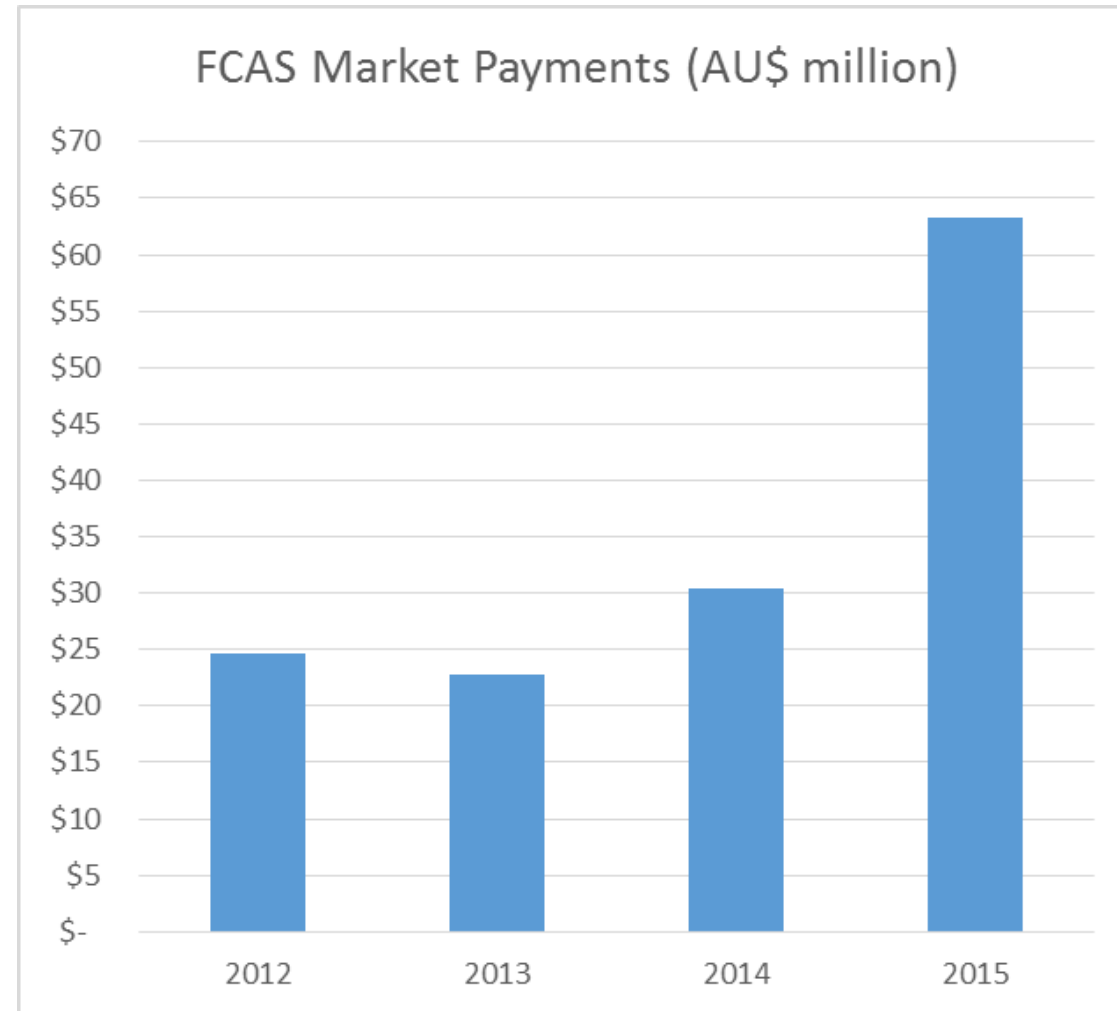
Scheduled and semi-scheduled generation compared to total generation in the SA



REDUCING SYSTEM INERTIA



FCAS MARKET PAYMENTS



- AEMO is committed to ensuring we maintain security today and in the future:
- Established a work program to give dedicated attention to the longer-term challenges
 - Identify and prioritise the issues
 - Consider potential technical solutions
 - Recommend means to deliver solutions
- Working in collaboration with others
 - Establishing an industry advisory group
 - Agreement with AEMC
 - Agreement with ENA
- COAG Energy Ministers mid year and report by end 2016

- Progress report to be released next week
 - Identifying long term challenges ✓
 - Understanding technical solutions - underway
- AEMO has identified four high priority areas
 - Frequency Control
 - Management of extreme power system conditions
 - Information, data and models
 - System Strength

While we see there are challenges in maintaining the security of the power system in the future under some operating conditions, we are confident that potential solutions abound

Solutions need to:

- be forward looking
- provide a market and regulatory environment which is adaptable to the issues in different areas of the network
- provide a flexible market and regulatory environment which is technology neutral
- use efficient markets or incentive regulation to drive optimal outcomes
 - many solutions cross the boundary between networks and markets
- incorporate regulatory arrangements that support innovation

- Fast frequency response provided by battery storage
 - PJM has battery storage participating ancillary markets.
 - Battery storage has the highest performance factors
- Synthetic inertia provided by wind farms
 - Hydro-Québec (Canada), National Grid (UK) and EirGrid (Ireland) all require connecting wind farms to include synthetic inertia capability
- Frequency control and black start services could be provided by a range of technologies
- Some renewable generators are dispatchable
 - Solar thermal provide storage capabilities as well as synchronous advantages

- Expect lowering costs and increasing deployment of both embedded and utility scale renewable generation
- In considering trends for the future it is key that investment consider not just the simple cost per unit of generation but rather the value that generation supplies to the market;
 - Generating when customers need that generation; and
 - Supplying the characteristics required to ensure system security