RENEWABLE GENERATION IN THE NEM Towards 100% (or less)

CITIES Consortium Meeting - 31 May 2017



PRESENTED BY MAGNUS HINDSBERGER



SLIDE 2

AUSTRALIAN ENERGY MARKET OPERATOR (AEMO)

- AEMO's core functions are within:
 - NEM and WEM
 - System Operator
 - Market Operator
 - o Transmission Services
 - o National Transmission Planner
 - o Gas Markets Operator
 - o Energy Market Development
- Governance:
 - Joint government (60%) and industry (40%) ownership
 - Not for profit
 - o Funded by Market Participants





NATIONAL ELECTRICITY MARKET





CURRENT RENEWABLE PENETRATION: SOME INTERNATIONAL COMPARISONS









Balancing Area	Peak Demand	Annual Energy	Installed Wind (% peak)	Installed PV (% peak)
Texas	68,000 MW	340 TWh	12,400 MW (18%)	300 MW (0.4%)
NEM	35,000 MW	194 TWh	3,600 MW (10%)	3,440 MW (10%)
Ireland (all island)	6,600 MW	35.4 TWh	2,325 MW (35%)	1 MW (0%)
South Australia	3,400 MW	13.2 TWh	1,475 MW (43%)	565 MW (17%)
Hawaii (Oahu)	1,140 MW	7.0 TWh	99 MW (9%)	221 MW (19%)

Source: ERCOT, EirGrid, SONI, HECO

DISTRIBUTED ENERGY RESOURCES



• Strong growth in DER

State/territory	Total installed capacity (systems under 100kW)	Penetration among dwellings	New installations (as of April 2017)	Same time April 2016	Rate of increase
ACT	59,000	13%	2024	1841	10%
NSW	1,216,000	14%	51,096	34,956	46%
NT	41,000	10%	2777	1871	48%
QLD	1,718,000	31%	61,581	39,823	55%
SA	727,000	32%	22,618	15,482	46%
TAS	105,000	15%	3155	2596	22%
VIC	1,060,000	15%	41,021	32,878	25%
WA	706,000	15%	43,515	25,422	71%
Total	5,633,000			-	

• <u>http://reneweconomy.com.au/australian-solar-capacity-now-6gw-to-double-again-by-2020-2020/</u>

SOUTH AUSTRALIA: SOLAR PV





GROWTH IN RENEWABLES WHILE THERMAL PLANT RETIRE





GROWTH OF SOLAR AND BATTERY STORAGE



- Expected 20 GW of rooftop PV by 2037.
- Fast growth driven by increasing costs and reliability concerns.
 THE NATIONAL PICTURE
- Battery storage seen as the next big thing. More than 5000 MW forecast by 2037.
- Huge variations in estimates.



 Little growth in Electric Vehicle demand. No major uptake expected till after 2020.

GRID SCALE STORAGE



- Revival of pumped hydro
 - Kidston (330 MW in disused gold mine)
 - Snowy 2.0 and Tasmanian pumped hydro (1000s of MW)
 - South Australia proposals (Turkey Nest)
- Overshadowed by interest in battery storage proposals
 - o Multiple proposed solar farms to include battery storage
 - > 330 MW solar farm in SA with 100MW/400MWh storage
 - SA government tender for 100MW/100MWh 90 proposals
 - VIC battery storage EOI for 20MW/80MWh 110 proposals
- Potential role for batteries in providing fast frequency response (FFR). Similar service in UK (1 second FCAS) is almost entirely supplied by batteries.

100% RENEWABLE ELECTRICITY SUPPLY IN AUSTRALIA

- 100% renewable Electricity supply in Australia:
 - o Is it possible?
 - o What would it look like?
- In 2012, AEMO was commissioned to undertake such as study.
- Part of the previous Government's Clean Energy Future Plan.
- Scenario 1 by 2030 and 2050

 Moderate economic growth, fast transformation
- Scenario 2 by 2030 and 2050

 High economic growth, moderate transformation







- Renewable potential 50 times what's needed to meet demand.
- A wide range of technologies and locations can help to lower costs over systems relying on single technologies.
- More capacity relative to maximum demand is likely to be required (200%) compared with today (130%)
- The high level operational review found that operational issues appear manageable
- Considerable solar PV generation in all four cases drives demand and load pattern changes
- Considerable bioenergy could be required, however this may present some challenges with competing land uses.

FUTURE POWER SYSTEM

• The power system is changing



- What challenges will we encounter?
- How do we ensure we can maintain power system security in future?
- Must identify necessary interventions early



PERFORMANCE OF GENERATORS



Synchronous Generation **Non-Synchronous Generation** Voltage control Energy Voltage control Energy Frequency control Dispatchability Semi-dispatch Inertia Governor response Fault level contribution

Problems to solve here and now!



- Accurate forecasts for demand is important for both system and market
- Demand is changing rapidly
- AEMO need to address this:
 - Solar forecasting system stage 2 (rooftop PV)
 - Improved forecast of DSP
 - Battery usage forecasting system next?
 - How will consumers act in the future?
- Forecasting annual energy consumption is "relatively" easy.
- Forecasting max demand (for grid supplied electricity) is hard.
 - What will the future load shape look like?

DEMAND SIDE PARTICIPATION



- Difficult to estimate new rules allow AEMO to collect more information from later this year. Need methodologies that allow DSP to be estimated without double counting impact on forecast max demand.
- Current estimates:
 - o 600 MW Industrial/Comm (2%)
 - o 1200 MW Hot Water (3%)
- Future target/hope?
 - Cap market best practice:
 - ▶ 8-10%
 - o Is 15% achievable?
 - o 5500 MW battery storage?
 - o What about EVs?



Audrey Zibelman, new AEMO CEO

CHANGING CONSUMER





CONSUMER BEHAVIOUR – THREE POTENTIAL FUTURES

- Continuation
 - o Offering through retailers
 - Little product innovation (technology/tariffs)
 - Moderate voluntary uptake of products
- Commodification of energy services
 - Retailer/aggregator led "smart future"
 - Major product innovation pushed by industry:
 - Bundling of services
 - Contracts when buying appliances
 - Leasing arrangements
- Consumer led "smart future"
 - o Active buying, selling, adapting
 - Pull from individuals and communities
 - Accept longer payback period (wider motivation for change)









CHANGE IN ENERGY SERVICES DELIVERED BY APPLIANCE TYPES





SLIDE 18

DEMAND FOR ENERGY SERVICES VS ACTUAL CONSUMPTION





SLIDE 19

PUTTING SMART METER DATA TO USE



- VIC Government led mandatory smart meter rollout. Caused a number of controversies, but has reached a penetration of around 97%.
- Other states have lower penetration and little activity in terms of roll outs
- Can we use existing data from VIC to better understand consumers?
 - Coupling of (very large) data:
 - Meter data
 - Building data
 - PV and storage installation data
 - ANZIC code data
 - o Clustering of meter data identifying:
 - Households with PV, pools, electric hot water, air conditioning, etc.
 - Use data to understand changes in consumption following "interventions/actions":
 - Energy efficiency schemes (pink batt insulation, low flow shower heads)
 - Purchase of PV systems
- What is the rebound effect of energy efficiency measures?
- What is the rebound effect when installing PV?

QUESTIONS?

