Centre for Energy and Environmental Markets

UNSW THE UNIVERSITY OF NEW SOUTH WALES SYDNEY • AUSTRALIA



Energy-only markets with high renewables

Can they work? Models for resource adequacy

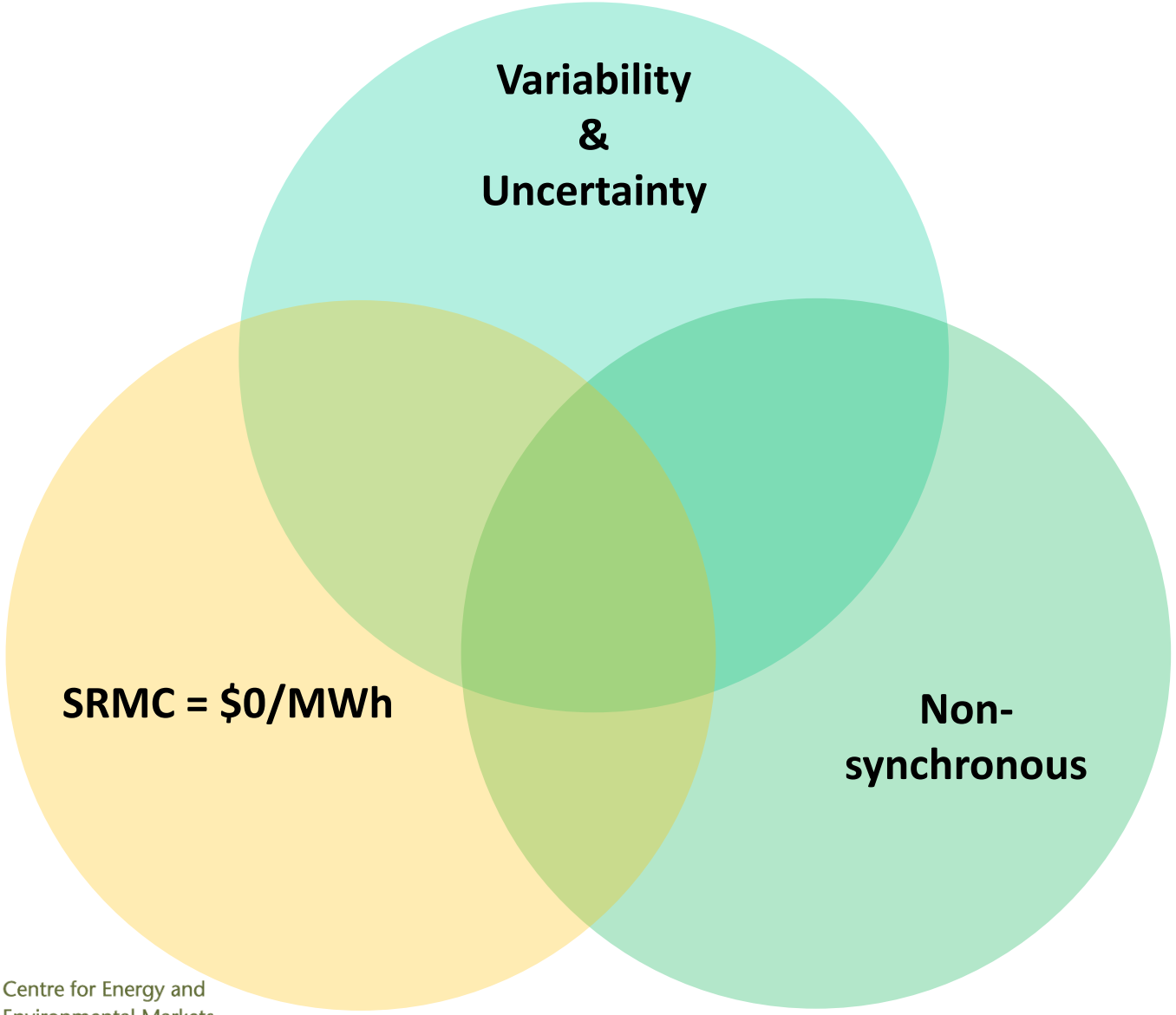
Dr Jenny Riesz

Friday 29th May 2015

Electricity Markets with a High Share of Renewables – Experiences and Future Challenges

Winterthur, Switzerland

What makes renewables different?



Reasonable evidence that 100% renewable systems are technically and economically viable.

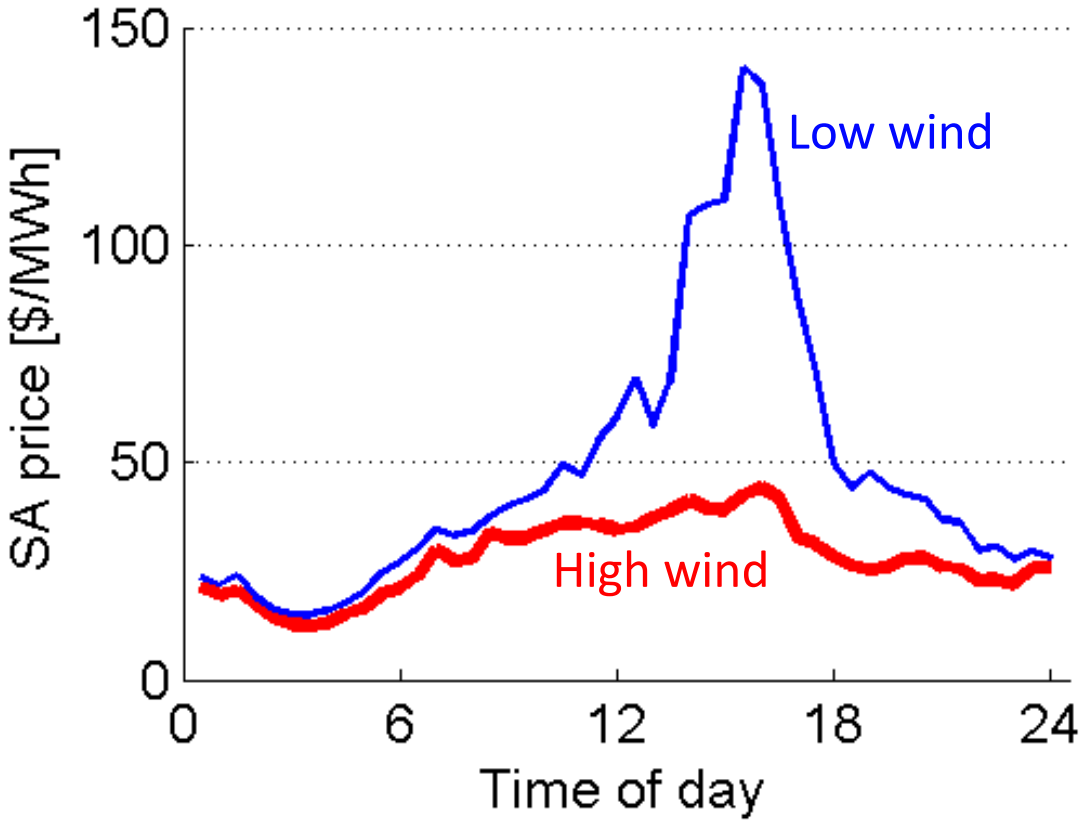
But what about the *market?*

How do generators recover costs?

How do we maintain accurate investment incentives?

SYSTEM ADEQUACY

Merit Order Effect - Observed



- Also in international markets
  - Texas (ERCOT), Denmark, Spain, Ireland

UNSW THE UNIVERSITY OF NEW SOUTH WALES

Centre for Energy and Environmental Markets

Cutler NJ, Boerema N, MacGill IF, and Outhred HR, (2011). High penetration wind generation impacts on spot prices in the Australian national electricity market, Energy Policy 39, 5939-5949.

Australian National Electricity Market (NEM)

- A useful case study?
- 15% RE at present (target 20% by 2020)
- Special market design features for integrating renewables
- Focus here on resource adequacy mechanisms (Energy-only Market)
- Will it be necessary to introduce a capacity market?

27% wind
4% rooftop PV

More than 85% instantaneous penetration

Managing resource adequacy in the Australian NEM

- Energy-only market
- Market Price Cap (MPC) = $13,500 AUD (9,800 CHF)
- Strategic offers are permitted (few limits on exercise of market power)

Determine Market Price Cap (MPC)

Simulate future market → adjust installed capacity to meet 0.002% USE → Adjust MPC to allow last generator to meet costs

Market participants make investment decisions

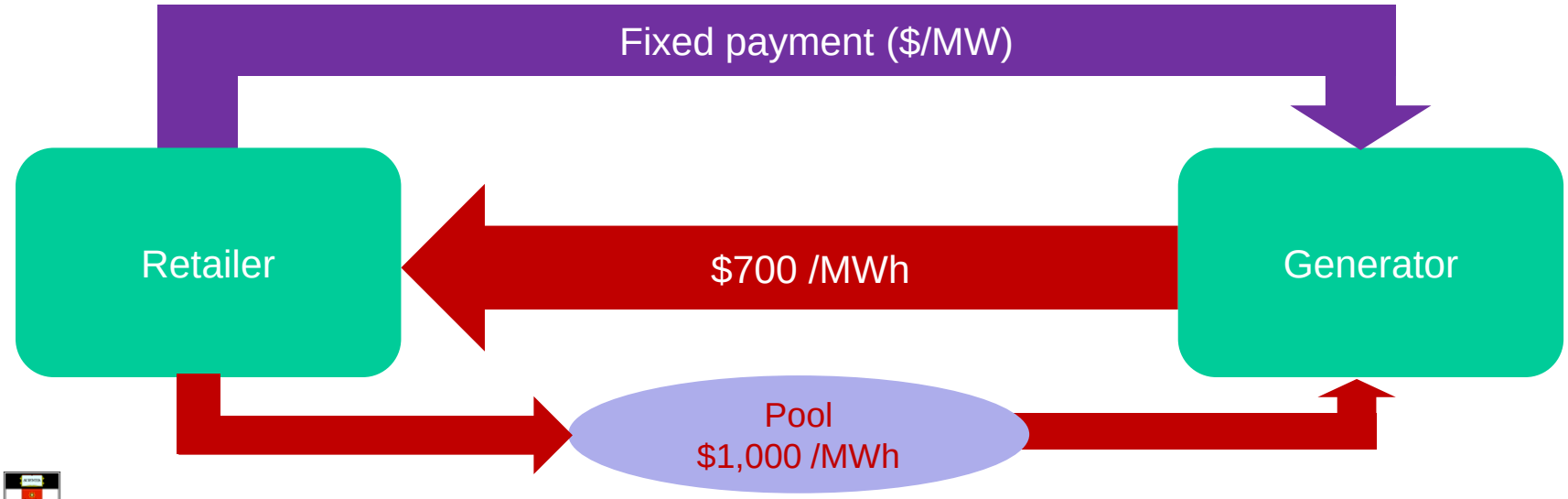
- Higher MPC rewards more investment

Managing price volatility

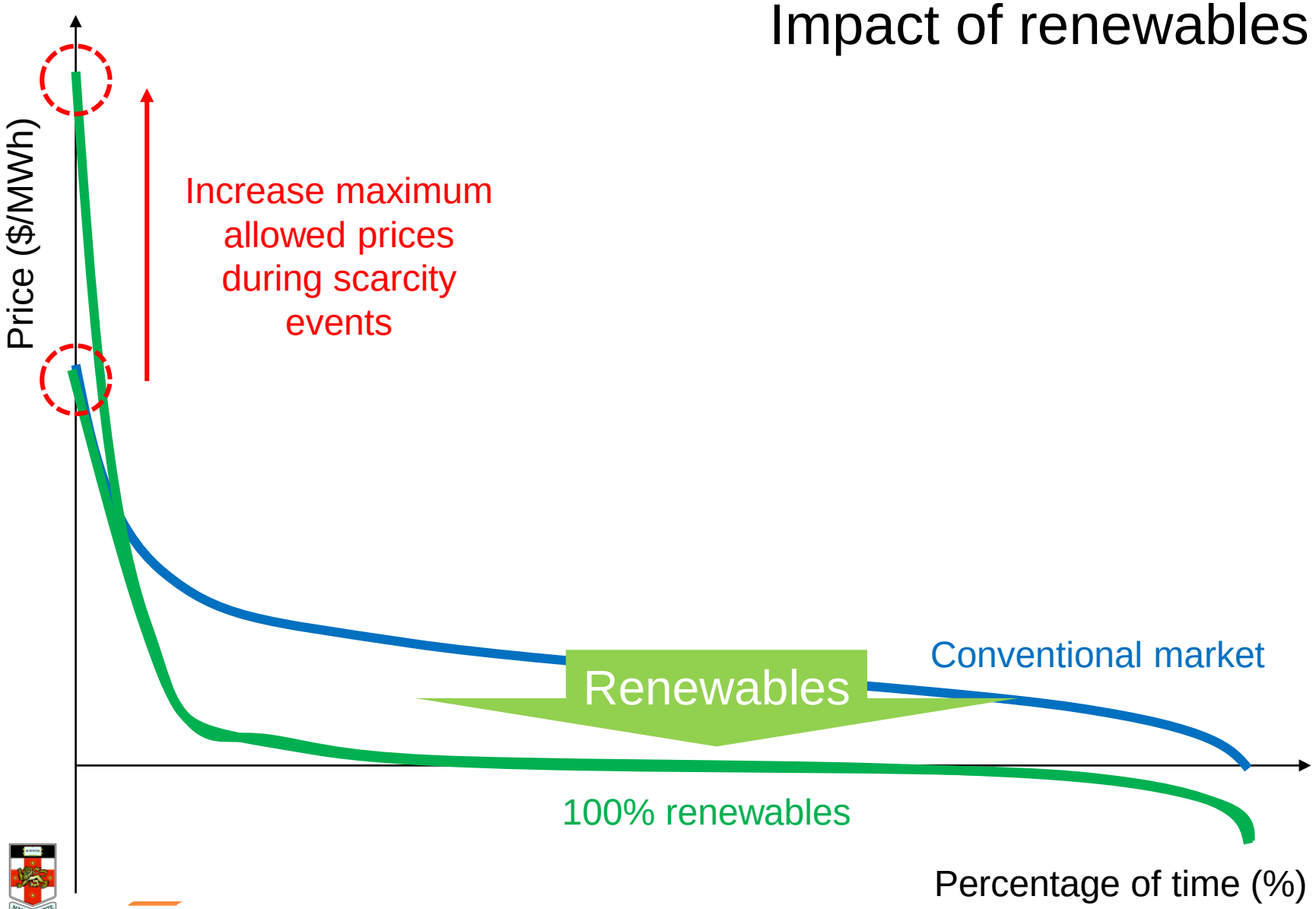
- Energy-only markets should exhibit high price volatility
  - Periods of extreme prices necessary for recovery of fixed costs
- Market participants manage price volatility via:
  - Contractual arrangements – mature derivatives market, or
  - Vertical integration

Cap contract:
($300 strike price)

Provides many of the benefits of a capacity market, but market participants retain decision making



Impact of renewables



UNSW THE UNIVERSITY OF NEW SOUTH WALES

Centre for Energy and Environmental Markets

How much would scarcity prices need to increase?

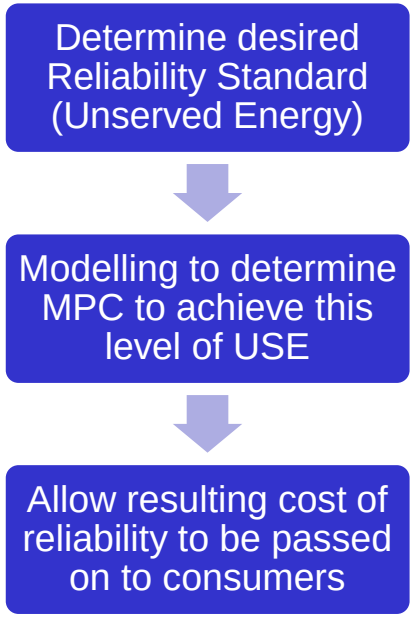
- Analysis for Australian NEM:

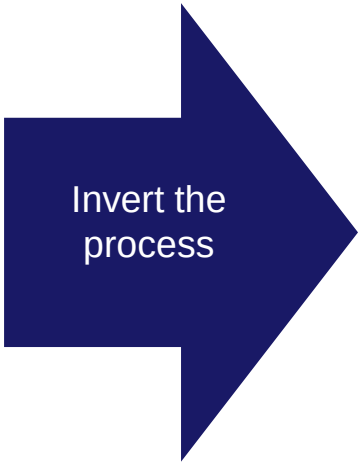
	MPC (AUD $/MWh)	MPC (CHF /MWh)
Present Market Price Cap (MPC)	$13,500	9,800
To maintain historical aggregate revenues (with move to 100% renewables)	~$30,000	~22,000
Sufficient aggregate revenues to support 100% renewables	~$60,000 to $80,000	~43,000 to 58,000

J. Riesz, Iain MacGill, "100% Renewables in Australia – Will a capacity market be required?" Proceedings of the 3rd International Workshop on the Integration of Solar Power into Power Systems, London, October 2013.

Perhaps this isn't crazy…

Process applied in the Australian NEM:





Theoretical "best practice":

Renewables don't affect VCR, so shouldn't affect MPC

	Value of Customer Reliability (AUD $/MWh)	Value of Customer Reliability (CHF /MWh)
Residential	20,710	15,000
Small business	413,120	300,000
Large business	53,300	39,000
Average	**94,990**	**69,000**

UNSW THE UNIVERSITY OF NEW SOUTH WALES

Centre for Energy and Environmental Markets

Oakley Greenwood, "NSW Value of Customer Reliability", Australian Energy Market Commission, 2012

Issues with allowing higher extreme prices

Increased costs of hedging

Increased prudential obligations

- Increased barriers to entry for retailers

Discouragement of inter-nodal contracting

- May interfere with generation locational decisions in the absence of perfect hedging with FTRs

Increasing importance of the contracts market

Consider:

- Close monitoring
- Mechanisms for increased transparency
- Disincentivise vertical integration?
  - Reduces liquidity and contracting options

Demand Side Participation

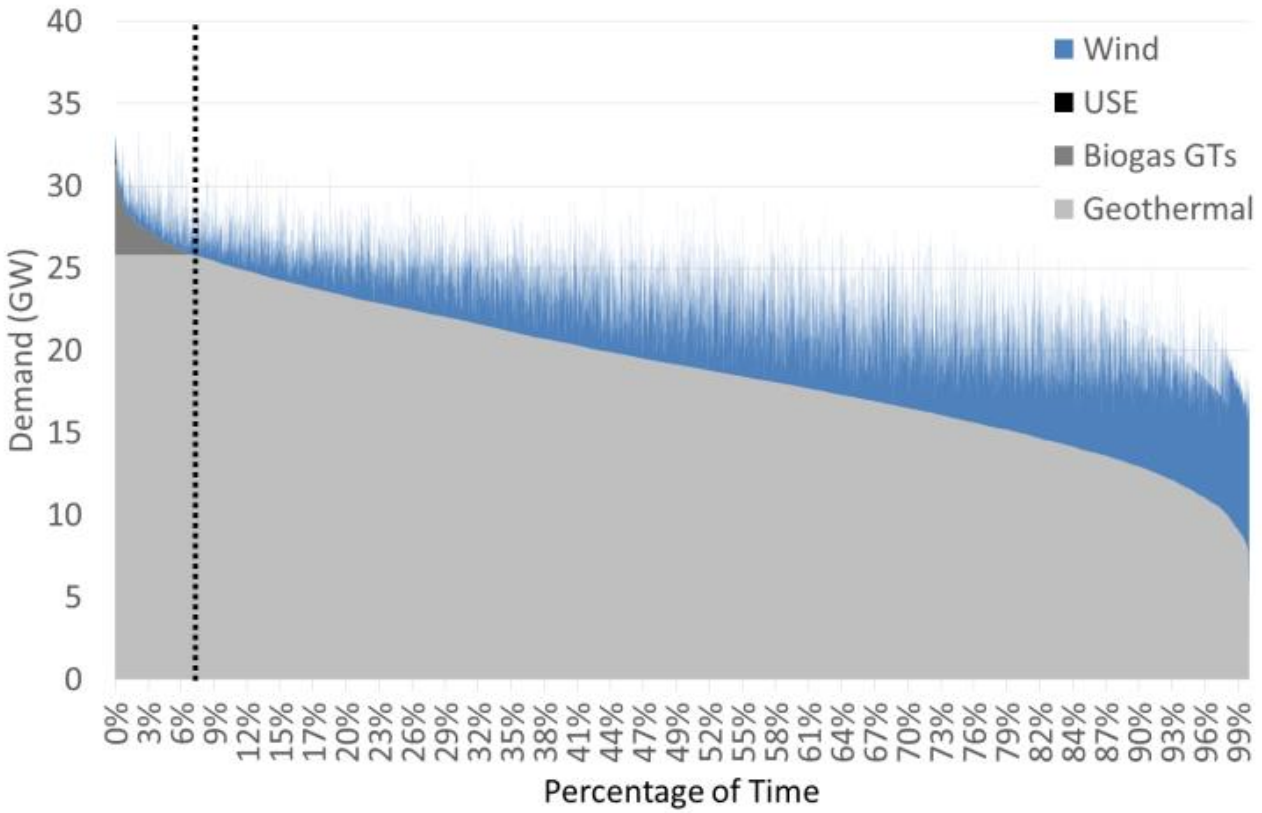
Why have a Market Price Cap?

- Demand is inelastic
- Need to protect consumers

Increase DSP sufficiently → True representation of "value of lost load" in market, for each consumer → No MPC required

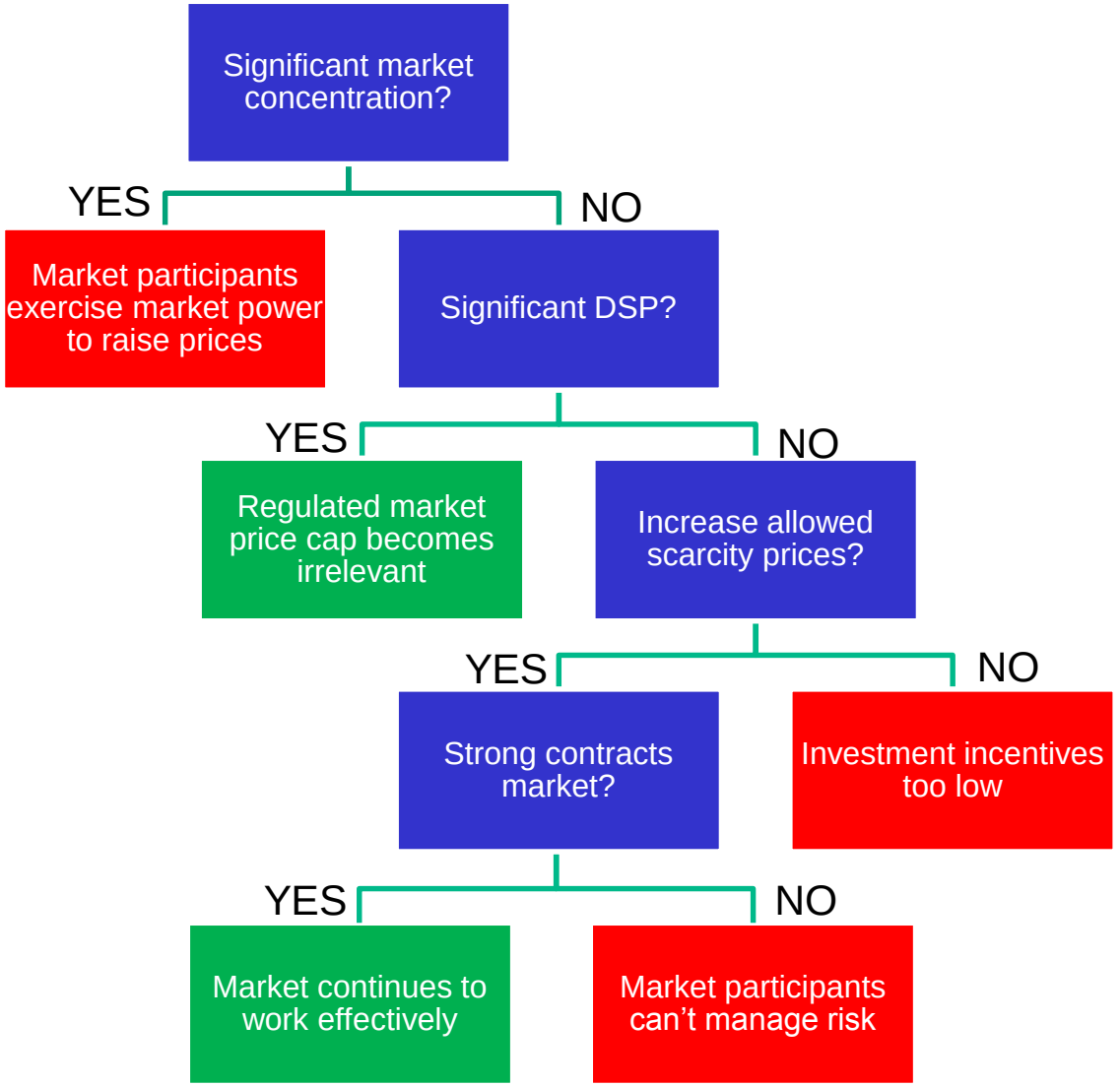
Cost recovery – variable renewables?

If generation mix is least-cost optimised, all generator types earn revenues that precisely cover costs (in theory)



J. Riesz, I. MacGill, J. Gilmore, "Examining the viability of energy-only markets with high renewable penetrations", Accepted for presentation at the IEEE Power and Energy Society meeting, Washington DC, July 2014.

Will the market work with high renewables?



Constant monitoring is wise – new issues will arise over time

Caution around introducing capacity markets?

- Capacity markets have many challenges
  - Cross-border issues (many different designs, limited compatibility, double-counting capacity?)
  - Inter-regional issues (locational requirements for capacity due to network congestion?)
- May be especially poorly suited to renewable integration
  - How should variable renewables be valued? (changes with penetration level)
  - Assessment of total capacity requirement increasingly challenging (scarcity depends upon supply and demand, not only peak demand)
  - Remove or dilute incentives for flexibility (need to introduce explicit flexibility markets?)

Centre for Energy and Environmental Markets

UNSW
THE UNIVERSITY OF NEW SOUTH WALES
SYDNEY • AUSTRALIA

Thank you

ceem.unsw.edu.au

jenny.riesz.com.au