# *Resource Adequacy in a Decarbonised Grid: An Insurance Overlay on Electricity Market Design*

BY FARHAD BILLIMORIA AND RAHMATALLAH POUDINEH

## Introduction

Energy-only market designs face renewed scrutiny in an increasingly decentralised and decarbonised electricity system. The 'missing money' challenge has been given new relevance under a dynamic which has seen the introduction of variable, intermittent and distributed forms of energy. Increasing penetrations of low marginal cost renewables could present a dynamic where it is no longer economic for flexible generation to remain in the market resulting in a disorderly withdrawal of dispatchable generation capacity (Nelson 2017). The design fails to trigger investment sufficient to meet the resource adequacy needs of the market especially when there is no forward market in which investors hedge against market risks (missing market problem).

Additionally the energy-only design has been argued to be vulnerable to distortions that arise from interactions with environmental policies (Simshauser & Tiernan 2018), illiquidity in contracts markets (Simshauser 2018; AEMO 2018) and market power (Chattopadhyay & Alpcan 2016).

In the face of challenges of energy only design under the electricity sector transition, a common option considered by policy makers is to incorporate some form of capacity mechanism with centralised decision-making. (Cramton 2017; Bushnell et al. 2017; Doorman et al. 2016). However, there are two key issues with this approach.

The first is that capacity mechanisms are often disconnected from consumer preference. With the growth of distributed energy resources (DER) consumers have increasingly elected to self-source for a portion of energy supply, rather than rely on a centralised grid.

Traditionally, electricity market frameworks have attempted to provide the same basic level of service to all consumers (Kurlinski et al. 2008). Many designs look to central agencies to make decisions on behalf of consumers relating to the reliability needs and safety margins of the system. This notion however can be challenged in an increasingly distributed and decentralised grid (Kiesling & Giberson 2004; Keay 2016; Keay & Robinson 2017). Rooftop PV, distributed storage and energy management systems have unlocked supply options for consumers. Load control and communications technology also exists to allow for differentiated tiers of reliability (Kurlinski et al. 2008; Bushnell et al. 2008). This suggests the potential for increased differentiation between consumers as to supply preferences and their value of lost load (VOLL). Some users may have high financial impacts, while others may be less sensitive to supply interruption. For example, the consumer experience of the 2016 statewide blackout in South Australia provides an indication of the differentiated economic impacts across a range of participants. It is reported that of the estimated A$367 million in total costs, almost a third was borne by four big businesses (Business SA 2016).

The second challenge with centralised capacity mechanisms is related to the incentives of the central party. In deregulated markets the central party allocated with decision rights is typically a non-commercial entity like the Independent System Operator (ISO). As a non-commercial entity, the incentives of the central party are indirect and non-pecuniary in nature. A central authority faces no financial penalties for overinvestment or underinvestment, nor is rewarded for striking the right balance. There are potentially strong political pressures to avoid under-investment and lost load events. Some argue that this leads to 'risk aversion' and a tendency to over-protect the system – to the detriment of consumer costs and efficiency (Newbery & Grubb 2014). As against this, the central party may face criticism or stakeholder pressure from energy market participants if costs are considered inordinate.

On both sides, the incentive to act is indirect – the financial implications of decisions are not directly borne by the party itself but by others, typically consumers, that face the ultimate financial brunt of either over-investment through additional energy costs, or under-investment through the financial impact of an unreliability or 'lost-load' event.

Managing reliability in electricity markets is concerned with the operational and financial management of extreme or tail-risk events. Risk transfer for tail risk events often takes place through insurance arrangements (Manove 1983).

In this article we propose a new model for electricity market design – the *insurer of last-resort* model. This model aims to overcome the challenges of centralised capacity mechanisms by introducing a financial risk and reward structure for the central authority making decisions over capacity and reserves. This serves as an overlay on existing market design with the aim of (i) aligning incentives for centralised decision making and

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See footnote at end of text.

(ii) allowing revealed consumer preferences to guide new capacity deployment.

## An ‘insurance based’ model for reliability

### *The concept*

The scheme would involve the establishment of a commercially-mandated central insurance company (“the Insurer of Last Resort” or “IOLR”). The company would offer last-resort electricity interruption insurance to electricity consumers in return payment of an insurance premium.[1]

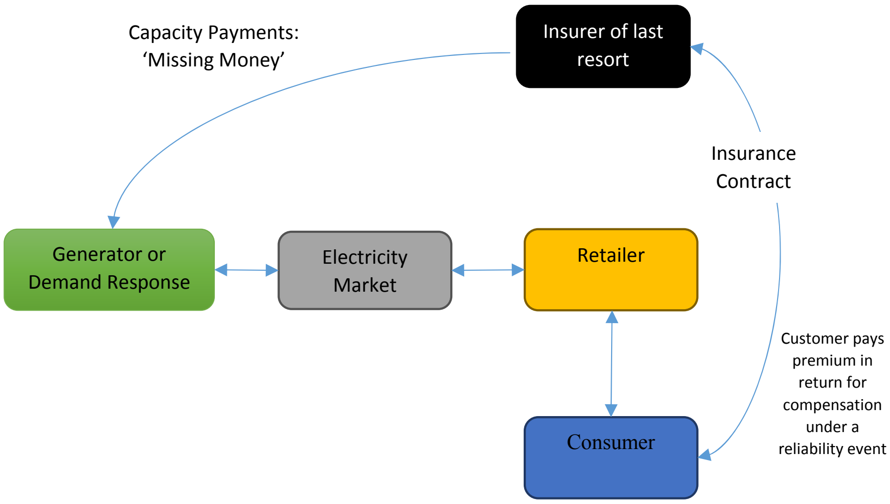


*Figure 1: Reliability Insurance Model*

The objectives of the company would be to manage the reliability compensation scheme, but also to undertake loss limiting activities with respect to reliability, where economically efficient to do so. Where it observes a resource adequacy gap, the company would be able to take steps to execute capacity contracts with new generation or demand-response resources to provide ‘missing money’. However, its commercial focus would restrict this to situations where the capacity resource can specifically improve reliability and where the all-in cost of those contracts are cheaper than the loss-adjusted risk of payout. Faced with the following question: Is it economically efficient to add capacity at a cost of $X million in order to reduce the risk of reliability lost load by Y% (or Z hours etc) – the central insurer would be required to weigh the cost of additional capacity contracting, against the benefits of reduced reliability compensation.

Importantly, the insurer model works as an overlay on top of existing market signals, rather than replacing them (see Figure 1). The insurer would be tasked with assessing the reliability gap between what the market is naturally delivering through scarcity price signals. By doing so, it provides residual or back-stop procurement, where the energy-only design does not provide the required response.

The market structure for this model might be initially in the form of a regulated monopoly (with the need for government regulation regarding setting the premiums) but over time can transition into a competitive market. This is because as it is currently done with some current business interruption insurance contracts, commercial insurance providers will also be able to offer insurance coverage to consumers (in addition to IOLR). Consumers can chose between rates and coverage offered by commercial providers, against that of the centralised IOLR. These different providers would compete to offer reliability insurance to consumers, and to deploy investment capital into new capacity. Further consideration would need to be given to the size of the market, potential for market abuse and competitive dynamics.

This model would develop an economic signal for investment in reliability driven by revealed consumer preferences. Importantly, the goal of the insurer is not to guarantee reliability, but to make economically efficient and commercially oriented decisions on resource adequacy, as it has financial exposure to lost load events.

The business model for the insurer would involve the investment of a capital base (‘the insurance capital

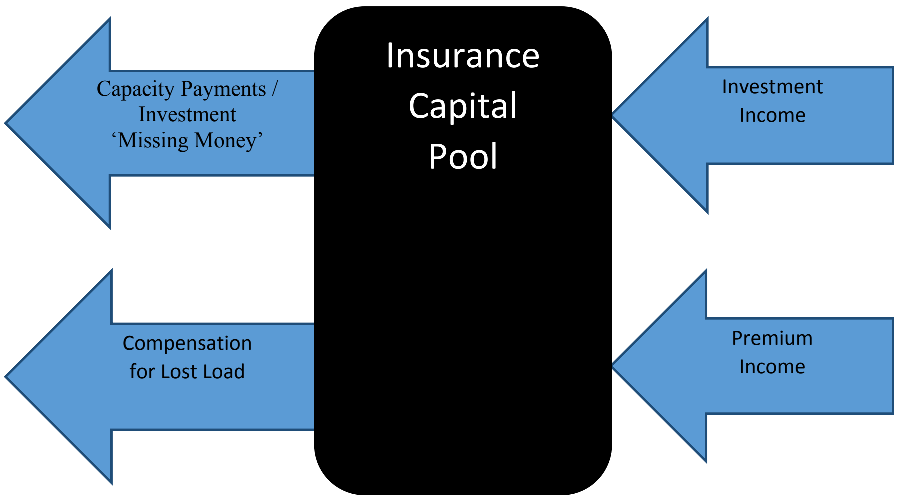


*Figure 2: Flows in to /out of Insurance Capital Pool*

pool') and management of loss events. Primary sources of cash outflows would include compensation payments, capital investments and payments for capacity contracts (see Figure 2). Primary sources of cash inflows would include premium income and investment income.

### *Implementation Considerations*

The practical implementation of such a scheme would require the consideration of a number of factors.

Customers would have the choice to elect whether to take up the insurance and the level of financial coverage required. Those customers that decline to participate would then form part of a load shedding

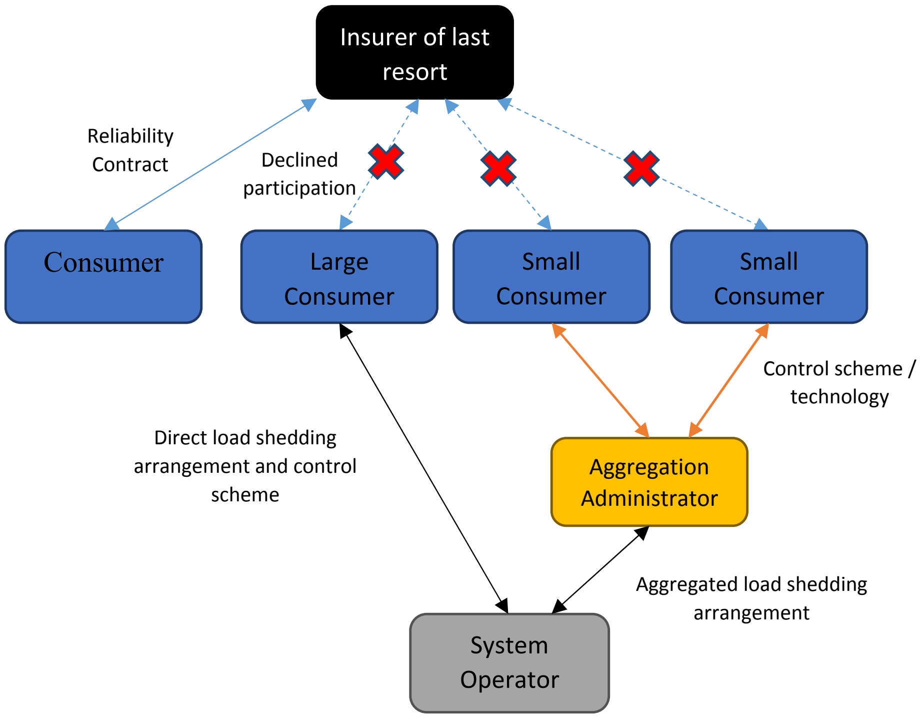


*Figure 3: Non-participating Customer Load Shedding Arrangements*

scheme and be available for disconnection by the system operator during a reliability event (see Figure 3). This mitigates the impact of 'free-riding' (Fumagalli et al. 2004; Abedi & Haghifam 2013) where consumers elect not to participate in the insurance mechanism but benefit from preventive actions by the insurer.

Consumers would need to evaluate their need for electricity during scarcity as well as the frequency of such conditions (Doorman et al. 2016). This may be politically difficult, with some research suggesting consumers don't want this level of choice (Stenner et al. 2015). As against this, it is not necessary that there be a large 'as-available' consumer base on day one – this could develop as options for consumer self-supply and backup power emerge. Nevertheless the approach to educating consumers and implementing their preferences would need careful management.

The insurer is initially funded through capital contributions from its ownership base. The determination of the ownership base is an important consideration. Any government funding must be appropriately caveated by clear governance protocols to limit the impact of political or government intervention. Commercial funding would require that a sufficient commercial rate of return is built into the financial and revenue structure.

Ensuring a sufficient competitive dynamic for provision and pricing of insurance will also need to be encouraged. The ability of the consumer to elect for coverage would mean that demand is elastic, encouraging supplier pricing discipline. Regulatory oversight and monitoring would also be important.

## Conclusion

Existing energy only market design has faced a number of conceptual and practical challenges under the recent energy transition. Increasingly, the response of many jurisdictions faced with similar challenges is to incorporate capacity mechanisms with centralised decision.

Centralised decision making puts increased focus on the efficiency of central authority decision making and the alignment of incentives. We propose an 'insurer-of-last-resort' model that would incorporate insurance-based risk management concepts and allow consumer preferences for system reliability to be directly incorporated into centralised resource adequacy decision making. This serves as an overlay on existing market design with the aim of (i) aligning incentives for centralised decision making and (ii) allowing revealed consumer preferences to guide new capacity deployment. Key issues that will require focus include the extent of coverage, regulatory model and governance. Competitive models of insurance provision may also emerge to enhance competition in prices and coverage.

## Footnote

[1] Our model builds on the previous works in this area. Fumagalli, Black and Vogelsang (2004) introduced the concept of electrical grid insurance in the context of an integrated distribution utility model, extending prior work done with respect to insurance schemes for curtailment priority (Chao & Wilson 1987; Deng & Oren 2001; Manove 1983).

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# *Bangladesh Affiliate Founded*

A new IAEE affiliate, the Bangladesh Association for Energy Economics (BDAEE), was founded in Dhaka, Bangladesh on February 1, 2018. Following the IAEE bylaws, three faculty members from North South University, Dhaka, Bangladesh and one leading energy entrepreneur from ME SOLshare Ltd. were elected to run the BDAEE for two years. Dr. Sakib Bin Amin, an Assistant Professor at North South University, Bangladesh and a visiting Commonwealth scholar at Durham University Business School is president of BDAEE. Sakib's research mainly focuses on Energy Sector Reform and Energy Policy in Developing Countries, and he has a long-term research record with Bangladesh Energy Regulatory Commission (BERC). Dr. Sebastian Groh, an Assistant Professor at North South University, is the vice-president of BDAEE. Sebastian is also the Managing Director of ME SOLshare Ltd. and on behalf of ME SOLshare, he received the Microsoft Airband Grant 2018, Intersolar Award for Outstanding Solar Businesses, the UN Momentum for Change Award, both in 2016, as well the 2017 Start-Up Energy Transition Award by the German Energy Agency (DENA) and the 2017 UN DESA Powering the Future. The BDAEE Secretary Mr. Daniel Ciganovic is also the Co-Founder and Director of Business Development of ME SOLshare Ltd. Ms. Mahjabeen Ahmed, a senior lecturer in the School of Business and Economics at North South University (NSU), is the treasurer at BDAEE. She has been teaching at NSU since 2013, and her research mainly focuses on energy economics.

The inaugural Energy Lecture of BDAEE was held on 6th September, at North South University. This event was held in amalgamation with the inauguration of the energy hackathon, as part of the "Power & Energy Week 2018", organized by the Ministry of Power, Energy, and Mineral Resources of Bangladesh. The Vice President of BDAEE, Dr. Sebastian Groh inaugurated the event with a formal introduction of BDAEE to the audience. The keynote speaker of this lecture was Bangabandhu Chair Professor Joyashree Roy from the Asian Institute of Technology (AIT). Professor Roy has also been among the network of scientists of the IPCC-2007 Nobel Peace Prize-winning panel, has been a chapter author of Global Energy Assessment. The Honorable Secretary of Power Division, Ministry of Power, Energy and Mineral Resources Government of Bangladesh, Dr. Ahmad Kaikaus, graced the event as the chief guest. Professor Dr. G. U. Ahsan, Pro Vice-Chancellor (Designate), North South University, Bangladesh and Professor Dr. Mahboob Rahman, Dean of the School of Business and Economics, North South University, Bangladesh also attended the event, along with other distinguished guests. Also present at the event where over 500 students from different universities in Bangladesh, highly motivated and keen on solving Bangladesh's energy challenges, as participants of the hackathon, 2018.