

Prosumeration of power supply

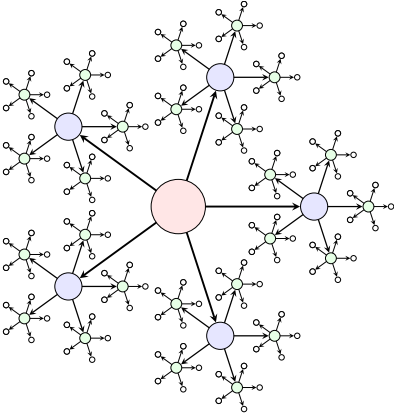
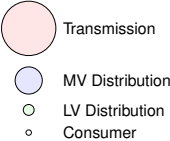
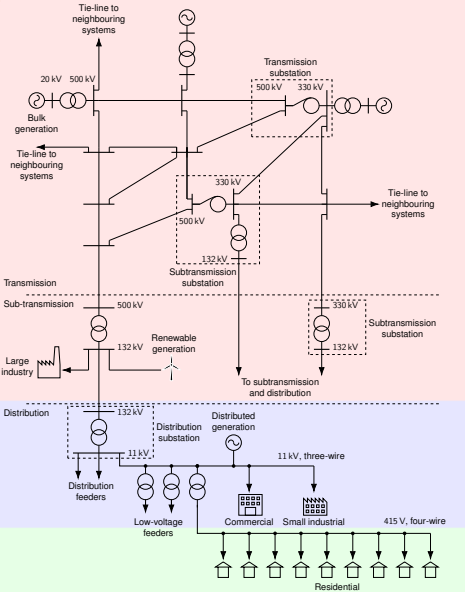
Flipping the paradigm of power system operation

A/Prof Gregor Verbič

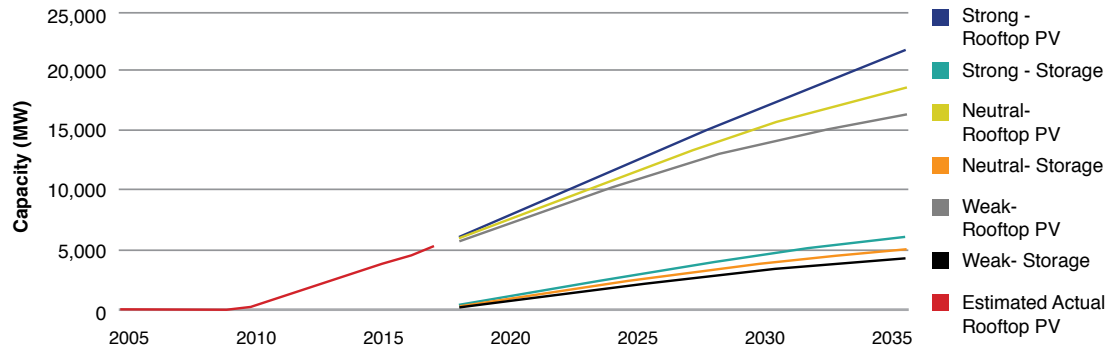
School of Electrical and Information Engineering, The University of Sydney, Australia
Centre for future energy networks

14 July 2021

Traditional electricity network

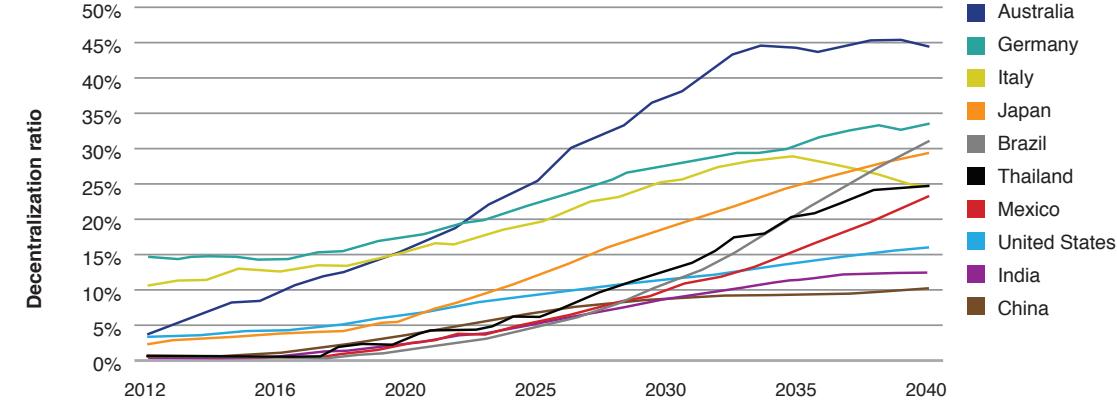


Projected installed capacity of rooftop PV and distributed battery storage in the NEM



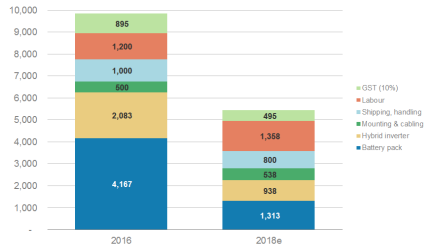
Source: AEMO ENA Open Energy Networks, 2018.

Global rate of electricity market decentralisation

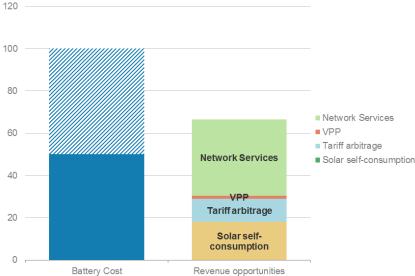


Source: AEMO ENA Open Energy Networks, 2018. (from Bloomberg New Energy Finance. 2017 New Energy Outlook.)

Cost reduction drivers



Installation costs for a generic 7 kWh battery system (A\$)



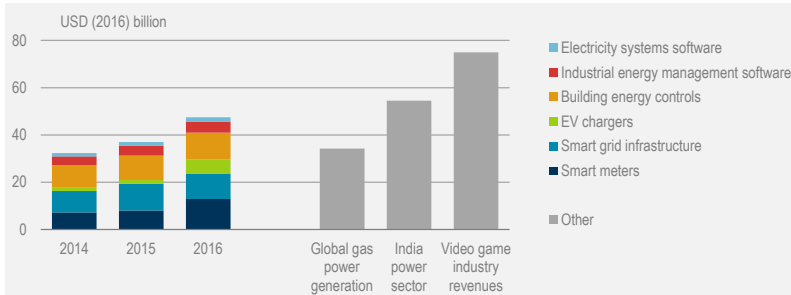
Battery cost per kWh used vs. value opportunities (c/kWh)

Morgan Stanley Research, "Australia Utilities Asia Insight: Solar & Batteries" 2016.

Digitalisation of the energy landscape

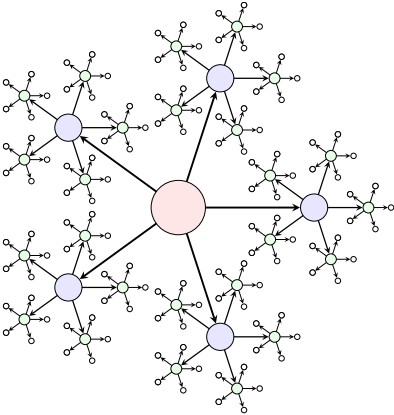
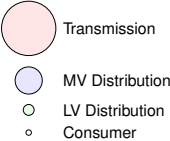
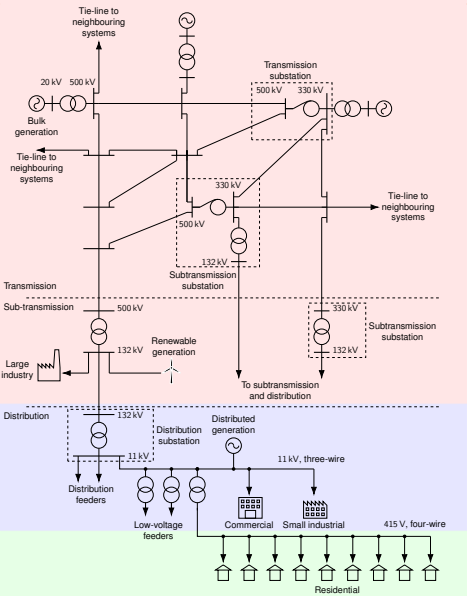
- Ubiquitous connectivity (Internet of Things)
- Artificial intelligence ('smart' devices)
- Blockchain (distributed energy marketplace)

Global investments in digital electricity infrastructure and software

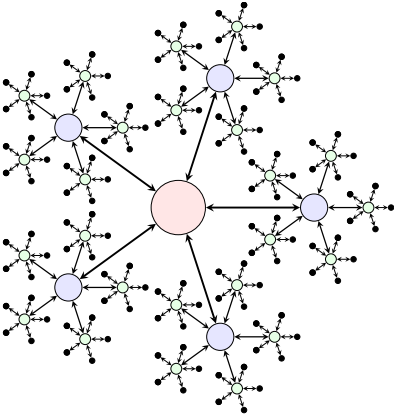
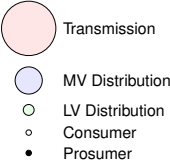
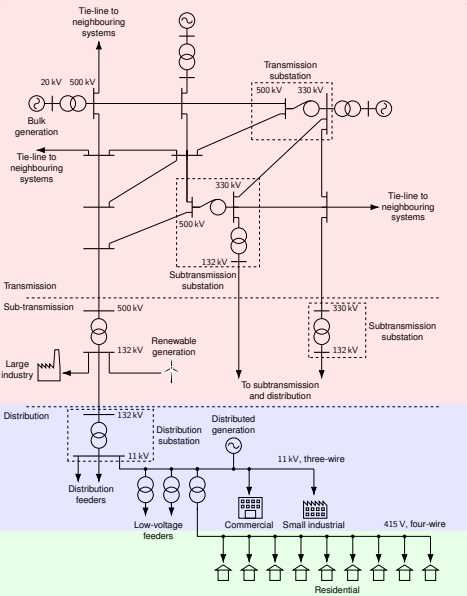


International Energy Agency (IEA), "Digitalization & Energy", 2017.

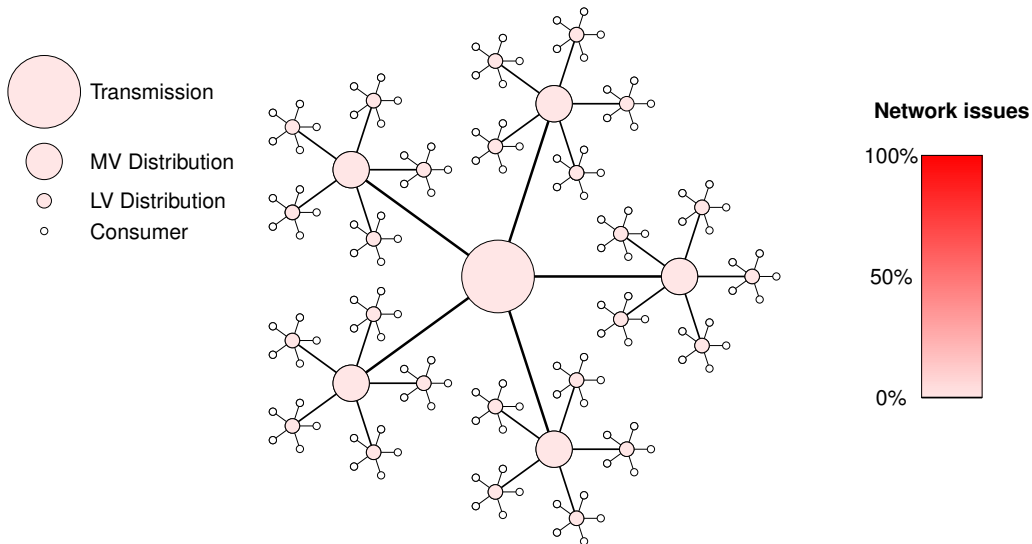
What does that mean for the electricity network?



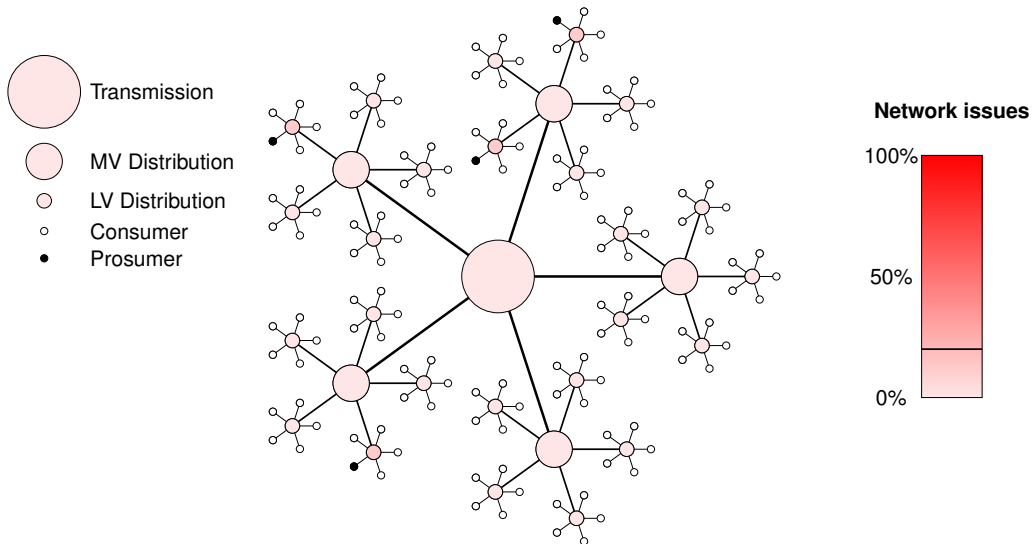
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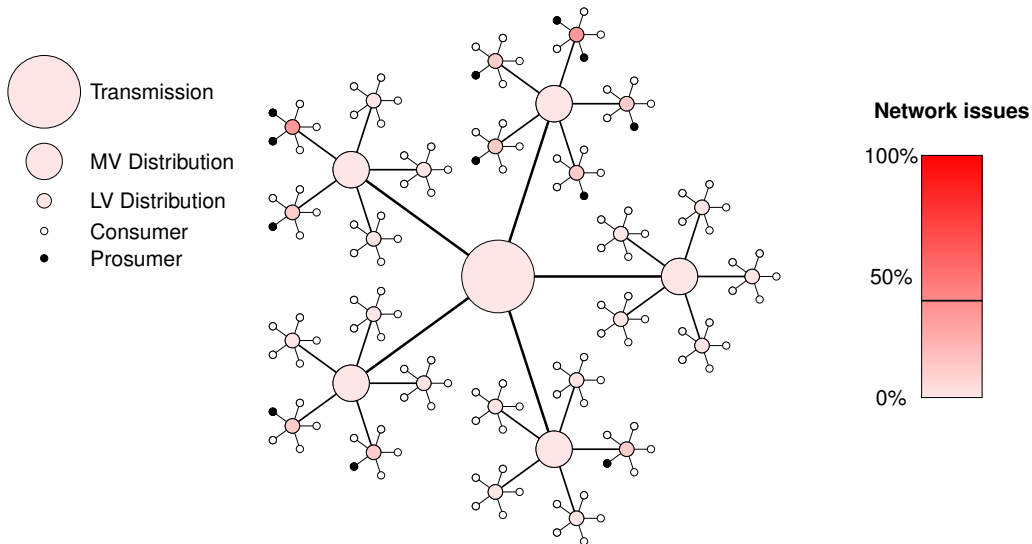
Increasing penetration of prosumers creates network problems



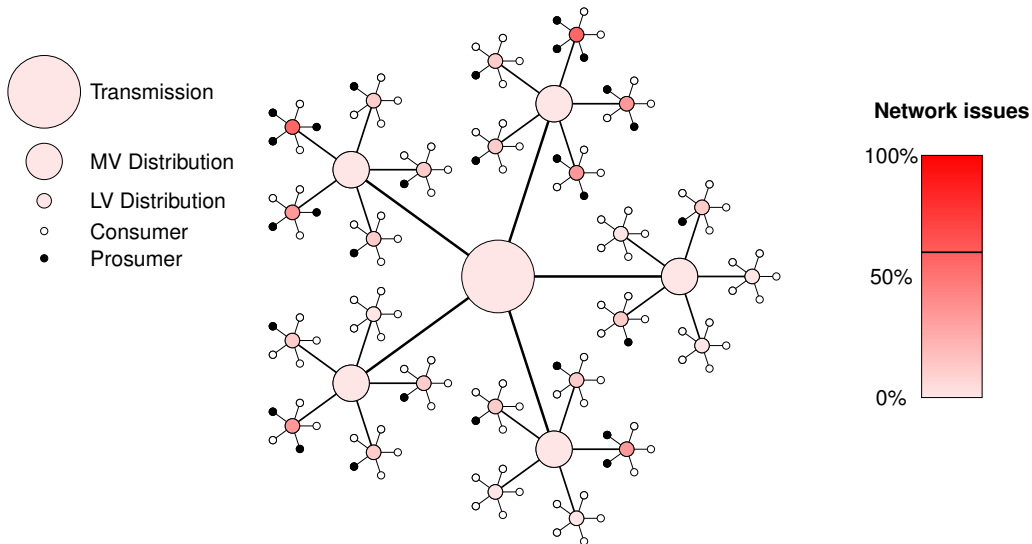
Increasing penetration of prosumers creates network problems



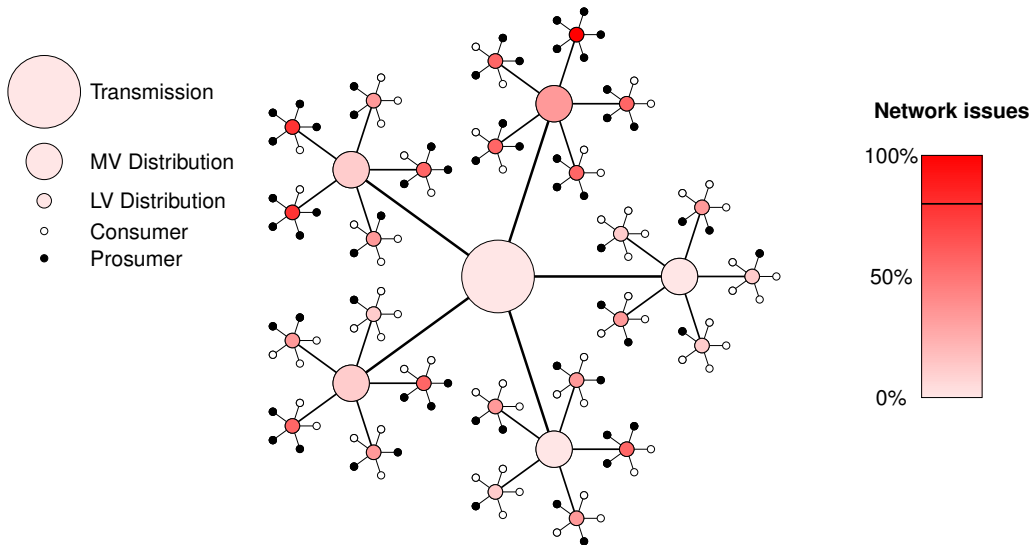
Increasing penetration of prosumers creates network problems



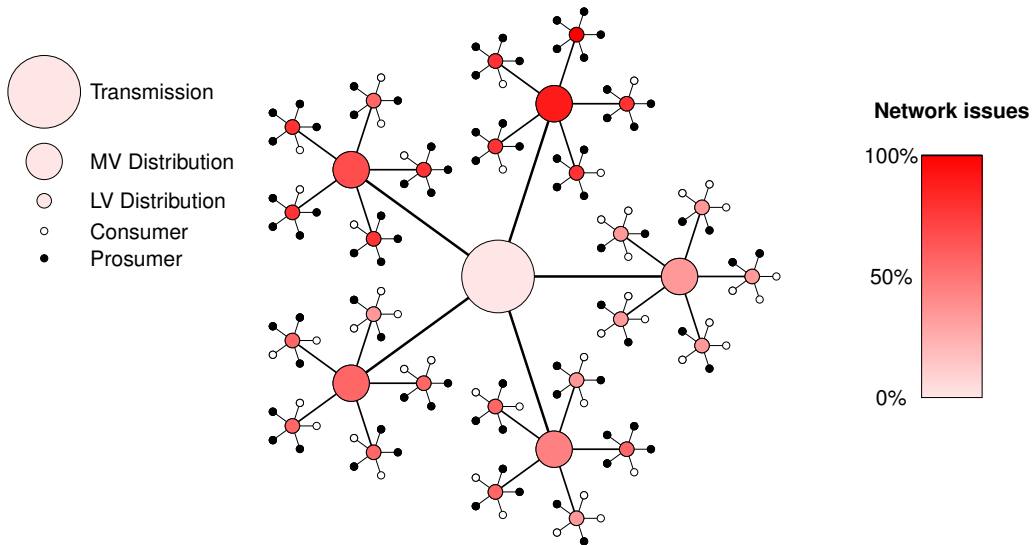
Increasing penetration of prosumers creates network problems



Increasing penetration of prosumers creates network problems



Increasing penetration of prosumers creates network problems



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Giles Parkinson 16 July 2020  0 Comments

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New plan to make room on grid for more home solar and batteries

25 March 2021

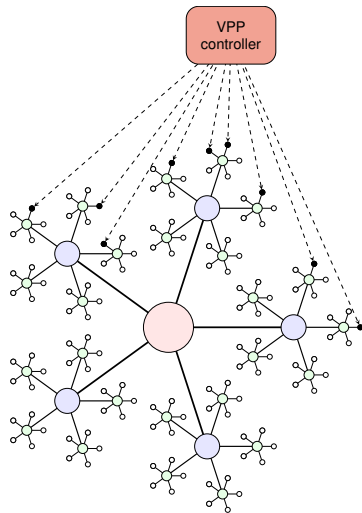


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Virtual power plants (VPP)

- DER aggregated into **single scheduled generator**
- Requires **orchestration**
- State of the art (utility VPP):
 - Batteries used to mitigate price exposure
 - **Direct load control** by a retailer (e.g. AGL Tesla VPP)
 - Users have no control over when VPP uses their batteries
 - Batteries located in different MV networks
- Demand response mechanism rule change (24 October 2021)



Challenges

- DERs are highly diffuse and their number is enormous
- DERs are connected to LV networks
- DNSPs have only partial (or no) observability of LV networks
- End-user energy usage is stochastic and inherently task-oriented
- Consumers are inherently self-interested
- Highly granular smart meter data is still scarce

1. **Operating envelopes with partial observability: Increasing hosting capacity of low-voltage distribution networks**

DNSPs don't have full observability of the system (including customer demand, PV generation, voltages and even network model, including phase connections). The project will develop algorithms to compute operating envelopes with partial system observability.

2. **Prosumer virtual power plants with strict performance bounds**

The problem with VPPs using behind-the-meter resources is their output depends on the task-oriented end-user demand. The project will address this problem by developing statistical models of prosumer behaviour to provide rigorous confidence bounds of the VPP output.

Project partners:

DNSPs (Ausgrid, Endeavour, Essential), retailers (Origin, AGL, EnergyAustralia), technology providers (Reposit Power, SwitchDin, Solar Analytics)

Questions?



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