ENA

# INCREASING INTEGRATION OF RENEWABLES INTO THE ELECTRICITY GRID

## ALL ENERGY CONFERENCE

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# Focus

1. What lessons should COAG Energy Council's crisis meeting take from South Australia?

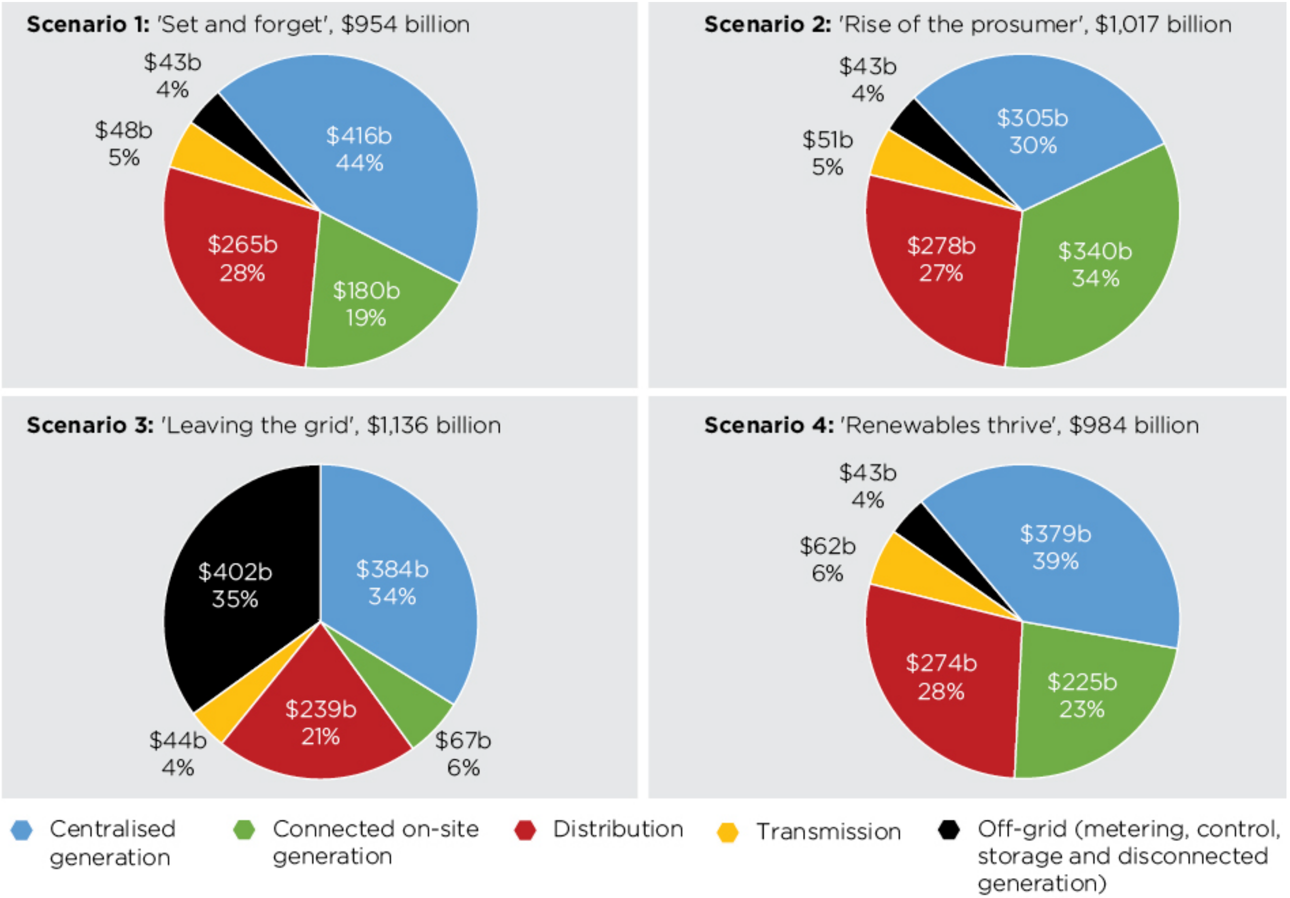
2. How can we achieve current and future carbon targets at least cost to customers?

3. How will the Grid transform itself to achieve greater Integration of Renewables?

4. How can incentives help Australia unlock the full potential of its Distributed Energy Resources?

# CSIRO - Scenarios for future system expenditure

Customers or their agents will make **25% to 40% of all investment decisions** in the energy supply system out to 2050 - up to $400 billion.

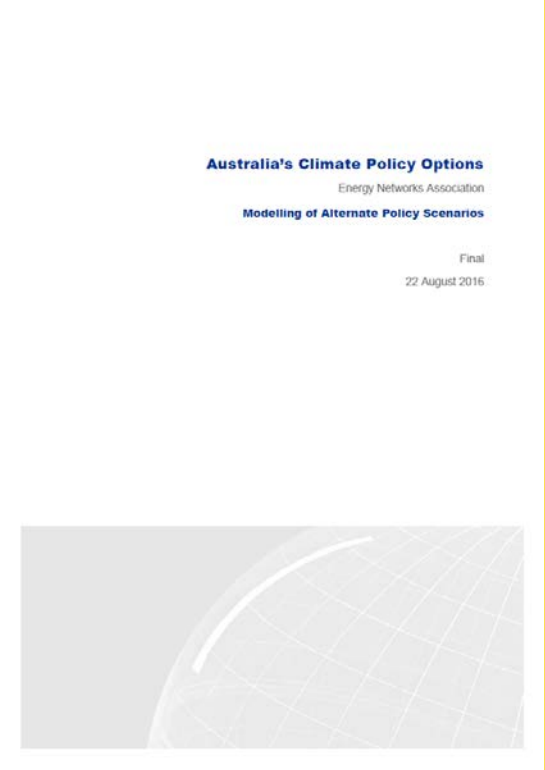



*CSIRO & ENA – Network Transformation Roadmap Interim Program Report*

# 1. What lessons should COAG Energy Council's crisis meeting take from South Australia?

# 2. How do we secure the achievement of current and future carbon targets at least cost to customers?

- Jacobs commissioned to model different policy options to meet Australia’s 2030 abatement target.
  1. **Business-As-Usual**: extend current government policies & absolute baseline mechanism.
  2. **Technology-Neutral:** current State & Federal polices transition to become technology neutral & ‘Baseline and Credit’ Scheme.
  3. **Carbon-Price-Mechanism** –all policies replaced by a Carbon Price on emissions.
- Two targets were considered:
  - **26 to 28%** below 2005 levels by 2030
  - **45%** below 2005 levels by 2030.

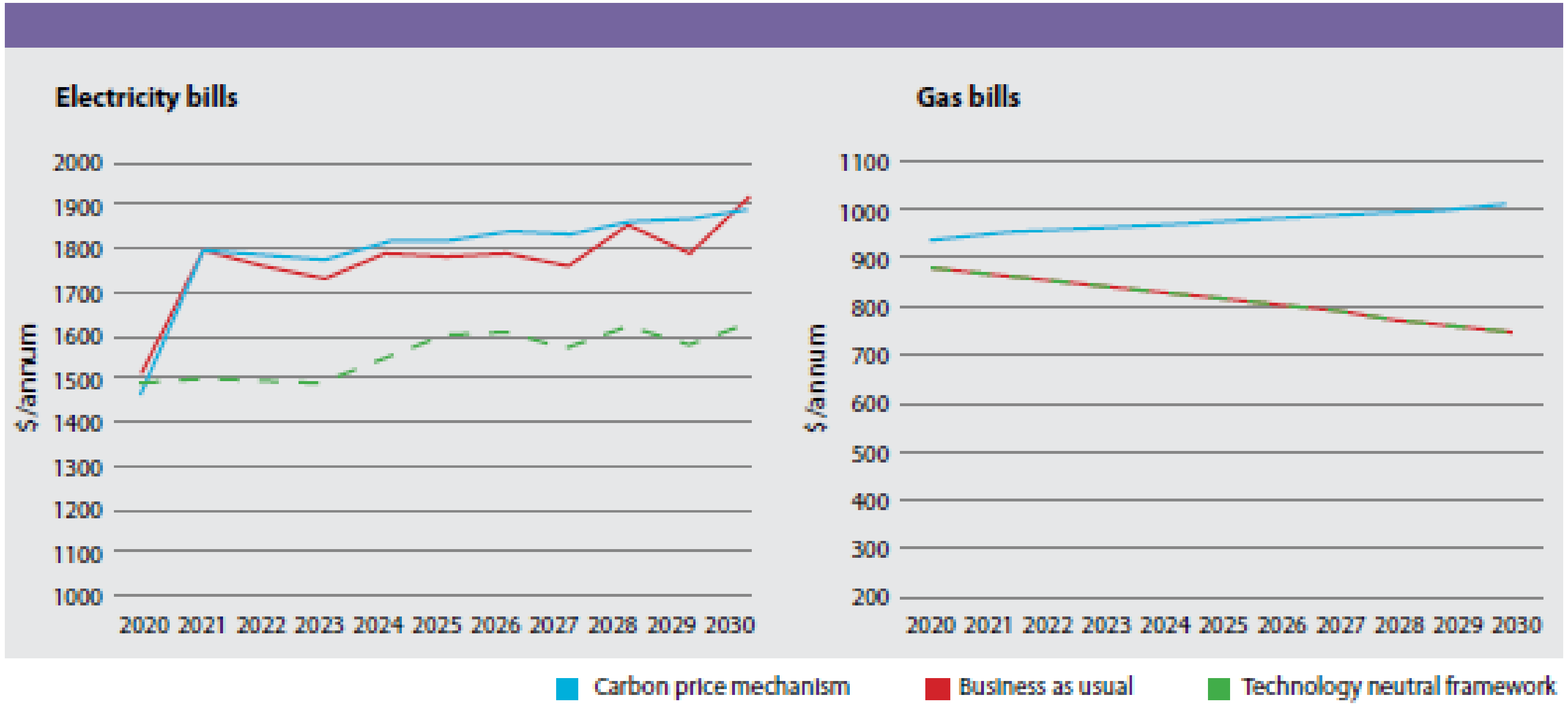

Australia’s Climate Policy Options
Energy Networks Association
Modelling of Alternate Policy Scenarios

Final
22 August 2016

# Key Results – Jacobs analysis of Carbon Policy

1. Carbon abatement targets achieved in all scenarios
2. Household bills could be $216 per year lower

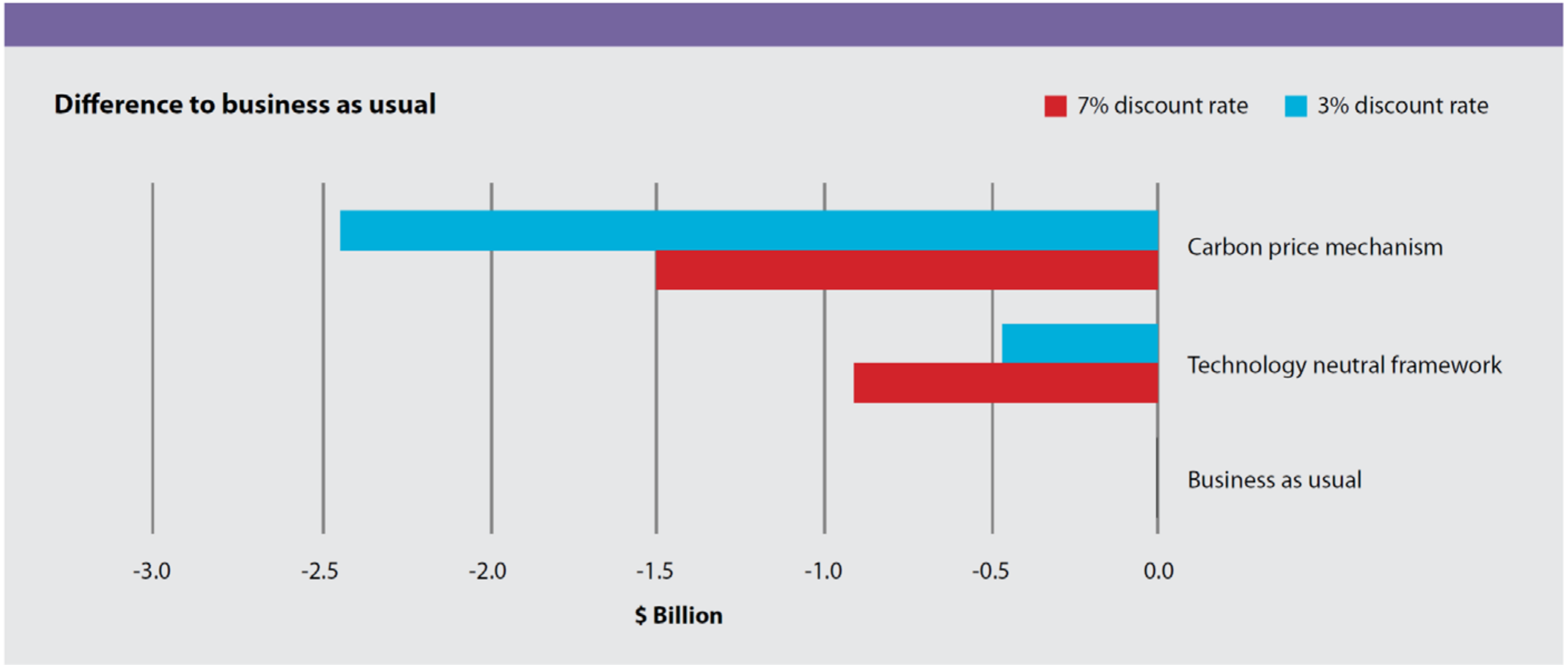
**Figure 1:** Policy scenario impacts on electricity and gas bills



# Key Results – Jacobs analysis of Carbon Policy

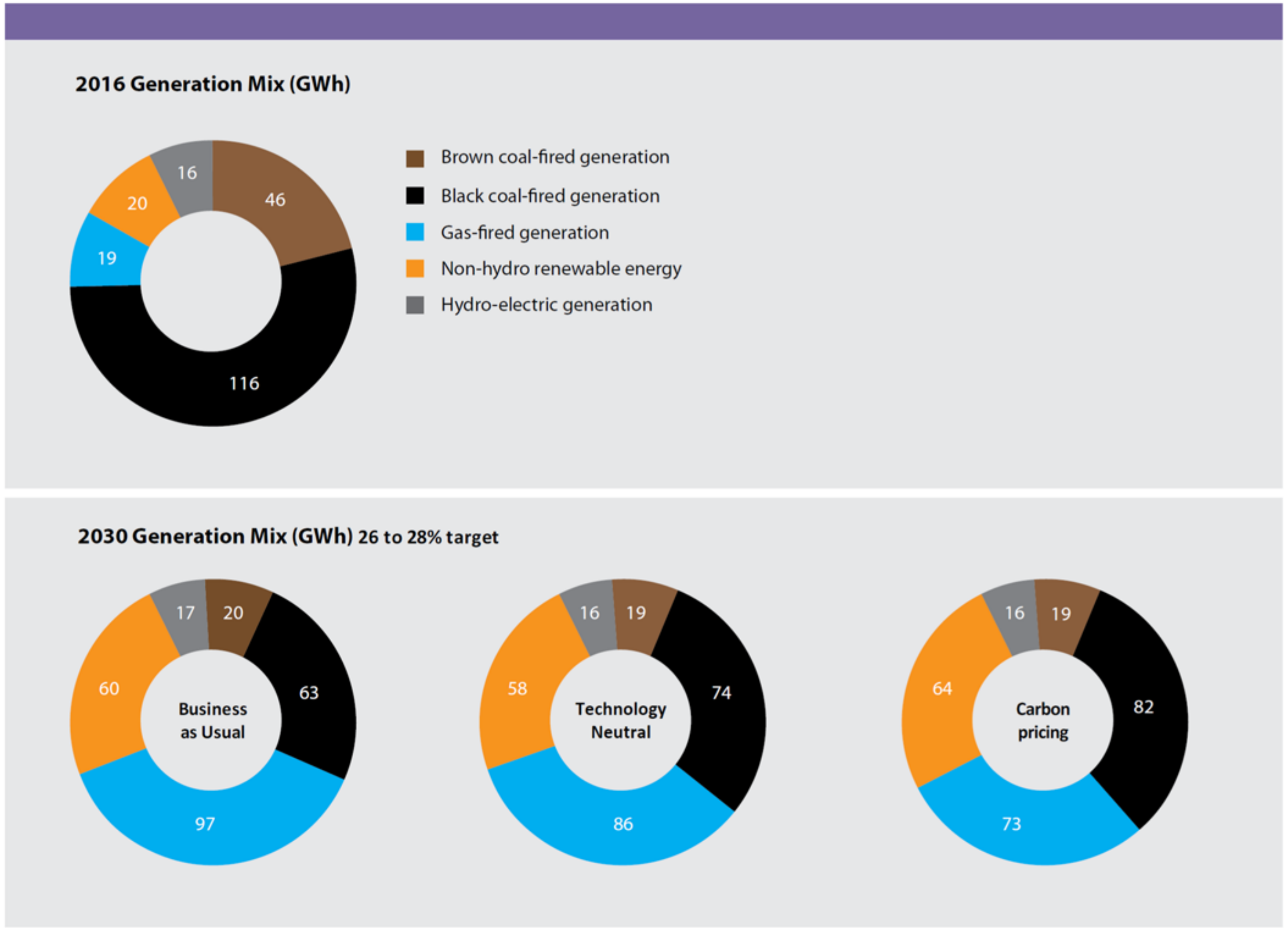
3. Potential economic benefits between $0.9 and $1.5 billion

**Figure 2:** Potential Economic Benefits from efficient Carbon Policy

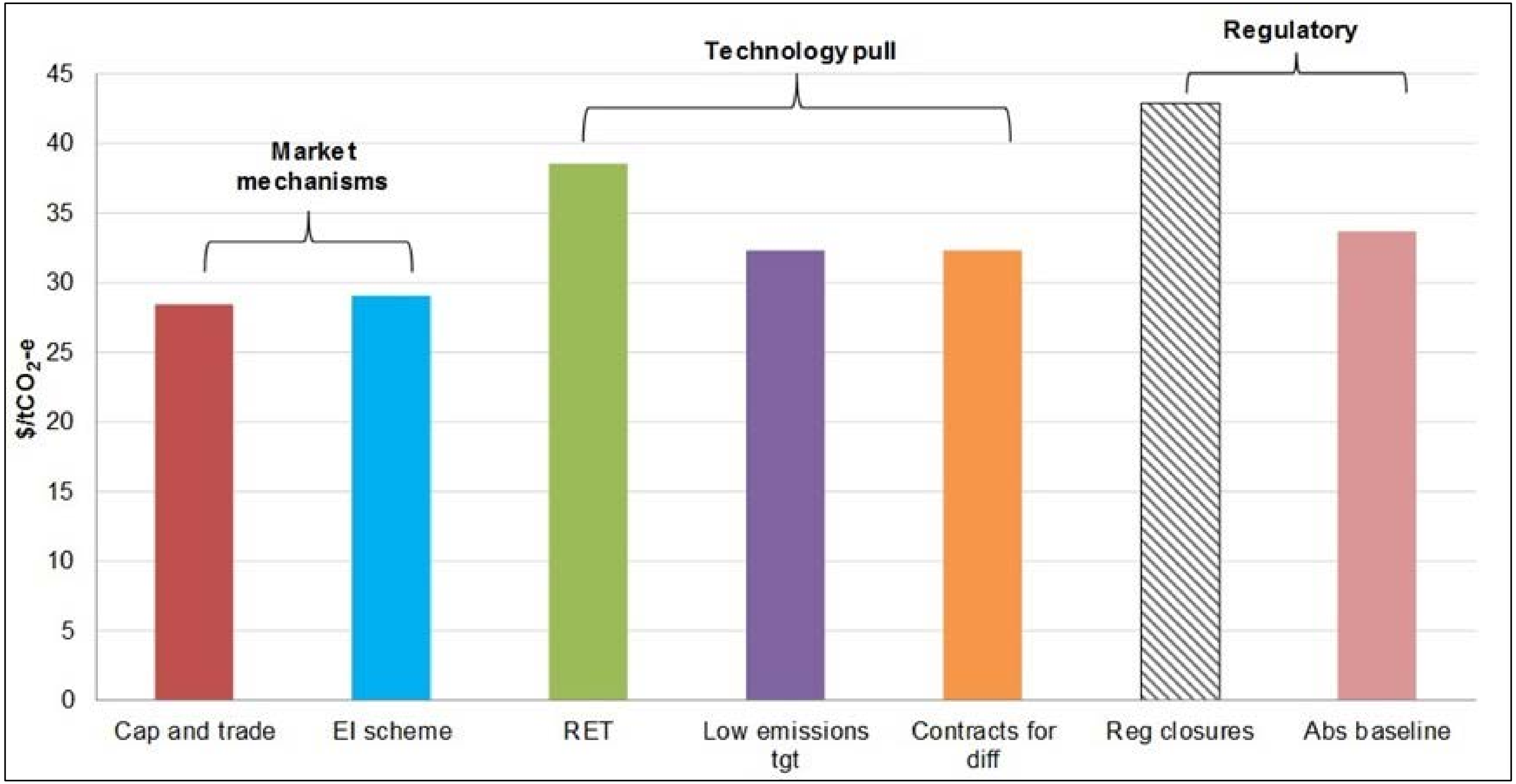


# Key Results – Jacobs analysis of Carbon Policy

**Figure 3:** Change in Generation Mix from 2016 to 2030 under Carbon Policy Scenarios



# Climate Change Authority (2016)



# Steps to smarter carbon policy

1. Pursue an enduring, stable and nationally integrated carbon policy framework based on consensus.
2. Introduce a 'Baseline and Credit' Scheme leveraging the current legislative architecture of the Emissions Reduction Fund Safeguard Mechanism.
3. Over time, consider options to increase economic efficiency by moving to a Carbon Price mechanism, with appropriate financial transfers and household support and without risking subsequent policy 'churn'.
4. If governments maintain direct incentive programs, transition Commonwealth and State programs to focus on least cost abatement outcomes, which are scale neutral and technology neutral.
5. Continue to review Australia's abatement targets (in the form of Intended Nationally Determined Contributions or INDCs), within the 5 yearly cycle proposed following the COP21 Agreement in Paris.
6. Incorporate an explicit, independent assessment of national energy market implications when developing jurisdiction initiatives on carbon and renewables policy.
7. Ongoing support for research, development and demonstration on a diverse range of low emission technologies.

# 3. How will the Grid transform to achieve greater Integration of Renewables?

*Table 4: Scenarios of RE generation share in the future according to different studies*

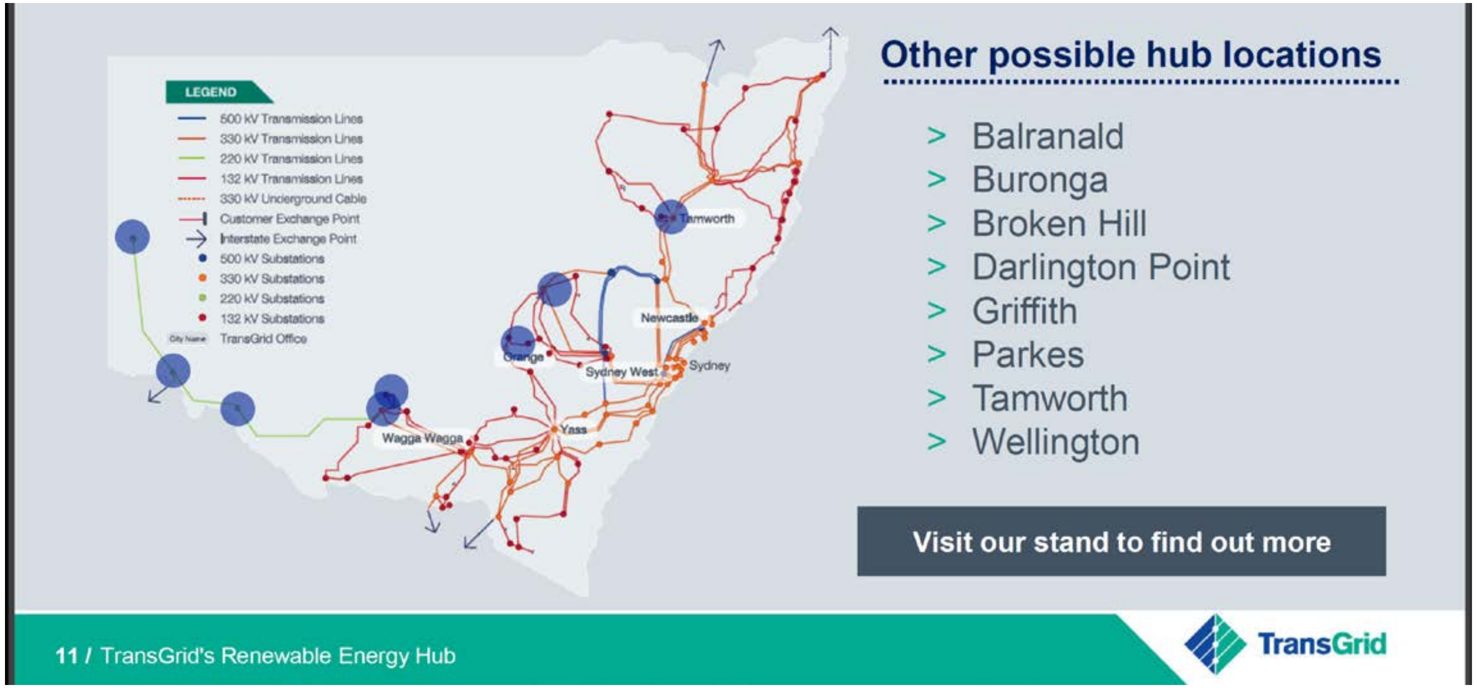
| Technology | REmap 2030[1] | New Policies 2030[2] | Blue Map 2050[3] |
|---|---|---|---|
| Nuclear | 11% | 11.9% | 23.9% |
| Natural Gas | 17% | 23.2% | 15.2% |
| Oil | 1% | 1.7% | 0.6% |
| Coal | 27% | 33.0% | 12.4% |
| Hydro | 17.6% | 16.1% | 14.3% |
| Bioenergy | 7% | 3.4% | 6.1% |
| Wind | 12% | 7% | 12.3% |
| Solar | 6% | 2.9% | 12.4% |
| Other renewables | 1.4% | 0.7% | 2.8% |
| **Total RE** | **44%** | **30%** | **48%** |

1 IRENA, 2014
2 IEA, 2014a
3 IEA, 2010

IRENA (2015)

# Integrating Renewables at High Voltage

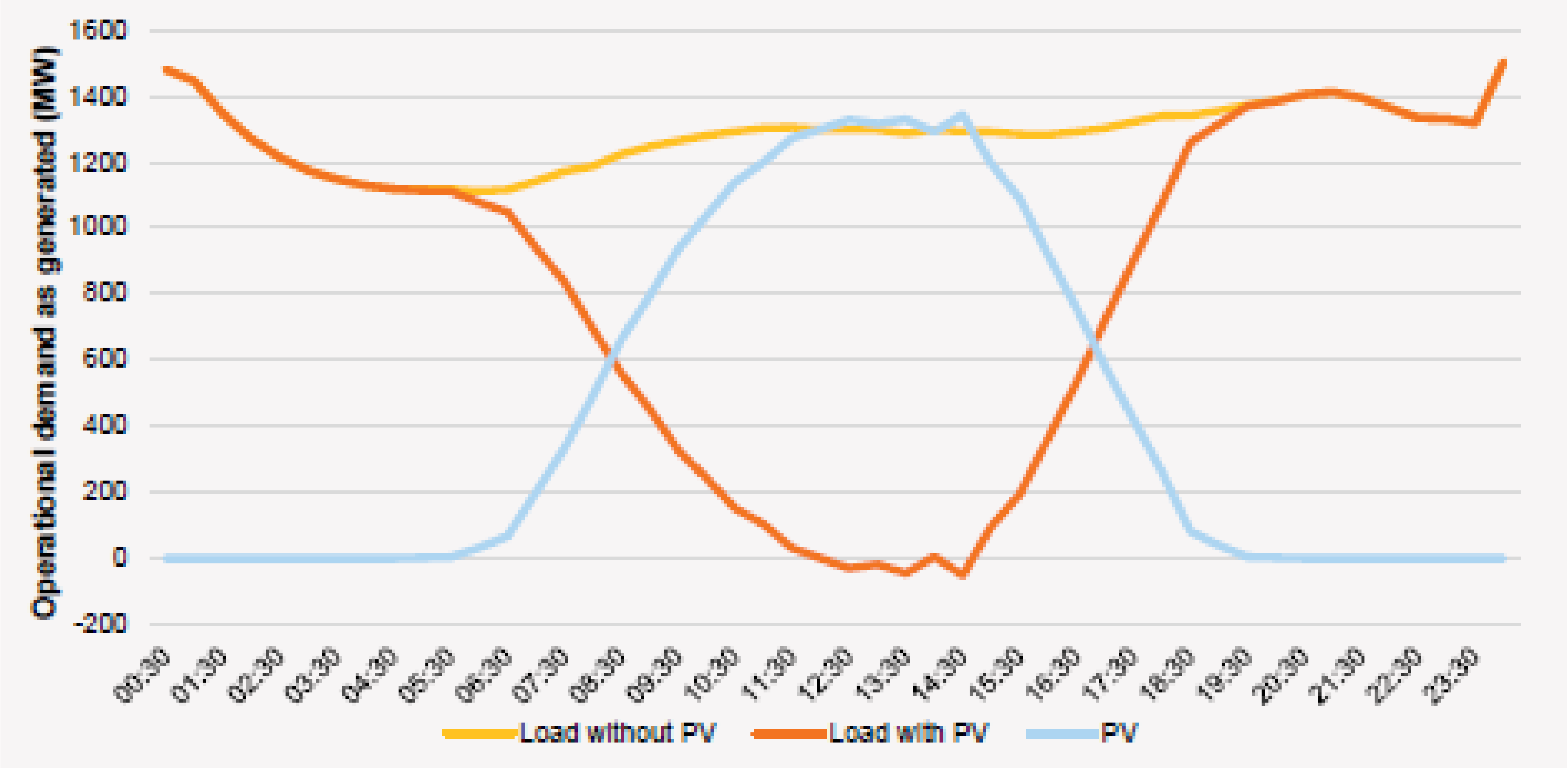
- Connection Hubs
- Interconnection Supporting Renewable Corridors
- Grid Connected Storage
- Technical Solutions




Transgrid (2015)

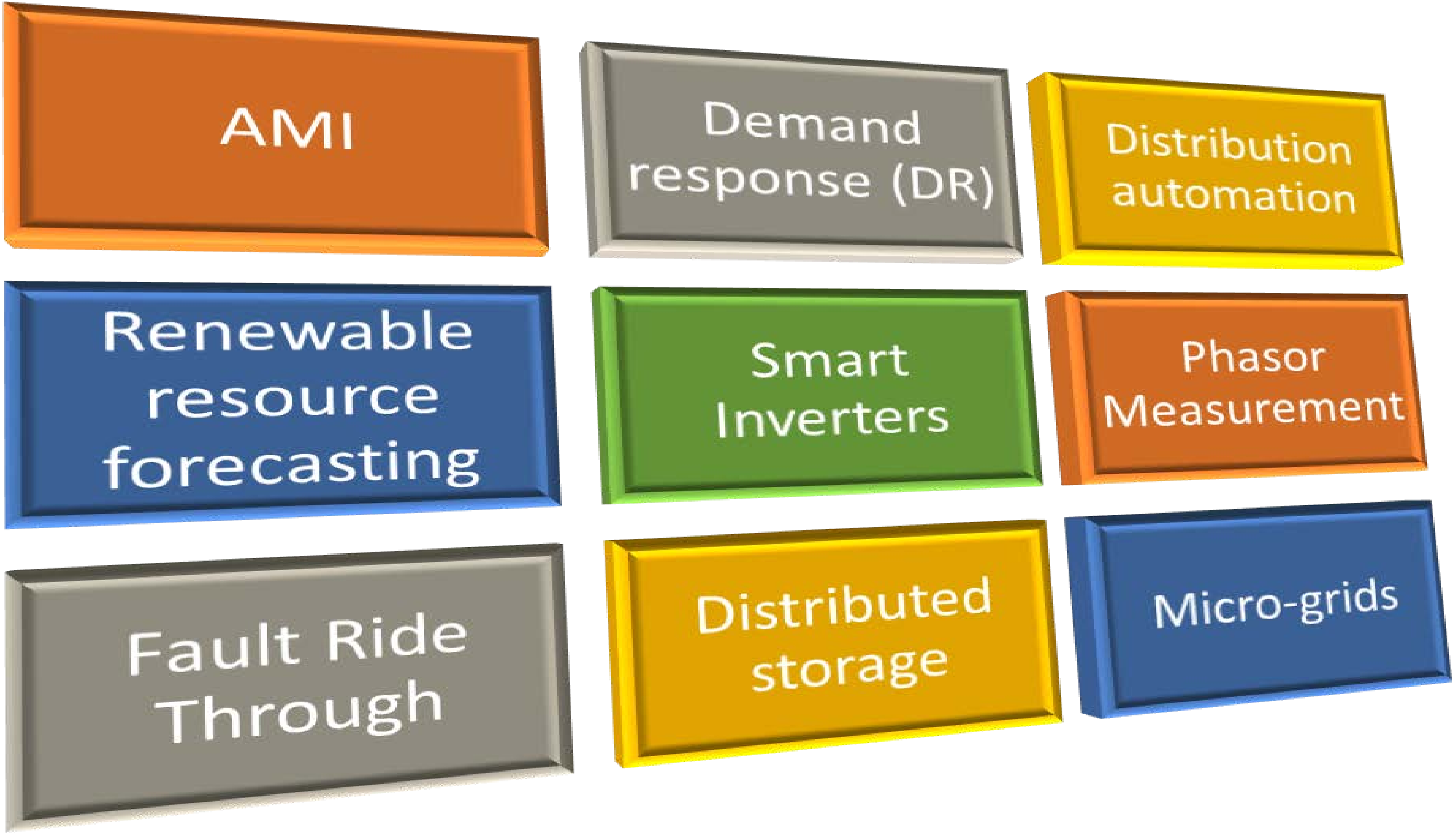
# Enabling the Two Way Grid

Figure 39 2024-25 summer 90% POE minimum demand load profile for South Australia




AEMO (2015)

# Enabling the Two Way Grid



# Battery storage can play a critical role

## Peak Load

- Charging off peak, discharging during peak

## Power Regulation

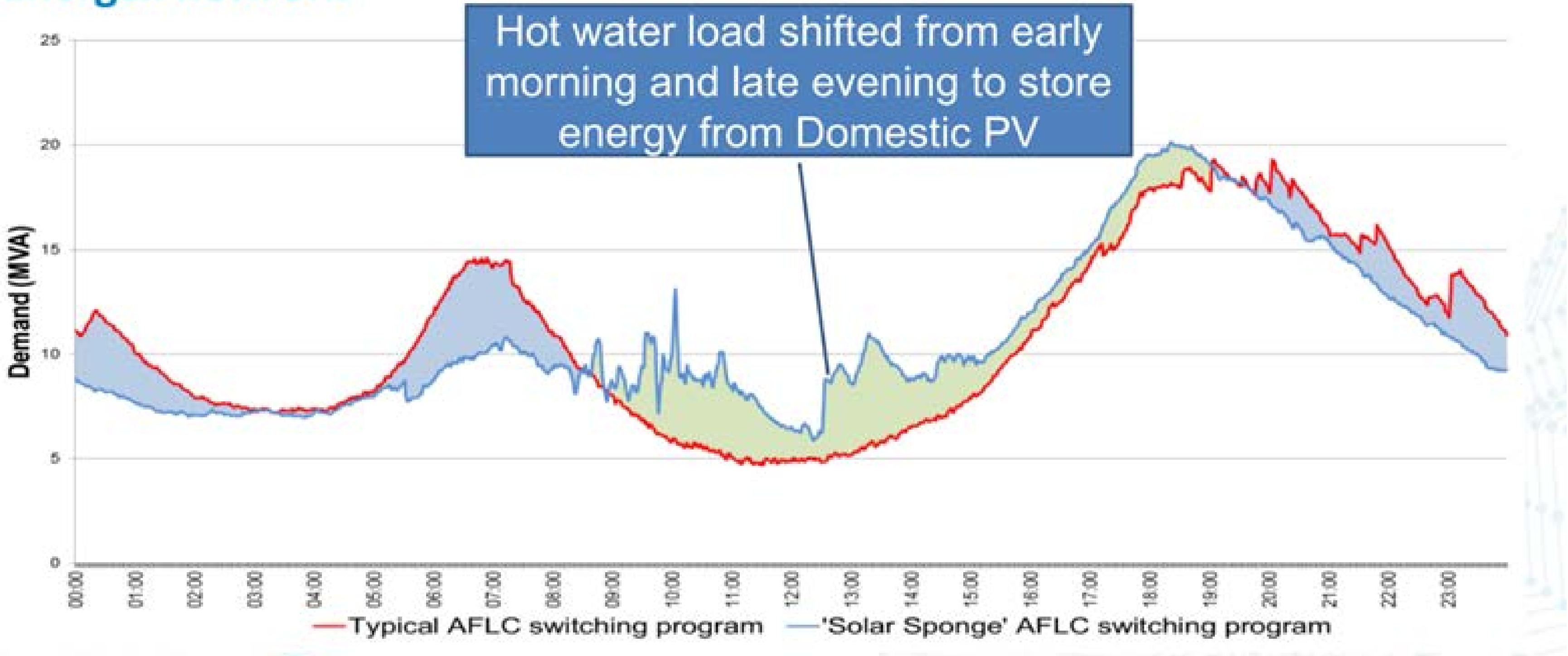
- Frequency - dispatched in response to frequency deviations to correct the load-generation imbalance
- Bi-directional power flow, balancing flows by absorbing excess energy for later dispatch.
- Power ramp-rate, acting to absorb the ramping distributed generation.
- Isolated network stability

## Power Quality

- Voltage rise, caused by uncontrolled generation like rooftop solar PV.
- Voltage imbalance, redistributing power flows across electrical phases.
- Voltage flicker smoothing out power flows due to fast variations.

# New Tricks for Old Dogs

**Using our Distribution Management System Software we can now use existing hot water load control as low cost option to integrate PV into the Energex network**




Energex (2016)

# 4. How can incentives help unlock the full potential of Distributed Energy Resources?

> CSIRO & ENA ***Network Transformation Roadmap Project***

> Energeia assessed 6 scenarios for managing pricing and incentives reform in electricity networks exploring:

- **'First Wave' tariff reform:** replacing current volume-focused tariffs with demand based tariffs;
- **Options to transition customers** to demand-based tariffs enabled by smart meters, while enabling choice;
- **Second Wave Incentives**: customers to sell DER services to networks; and
- New network products like a **Stand Alone Power System (SAPS) tariff**, for customers capable of self-supply.

# Key Findings – 'First Wave' reforms

1. An earlier transition to demand based tariffs could save customers over 10% per year on average network bills by 2026 and achieve economic benefits of $1.8 billion.
2. Consistent with international studies, waiting for customers to "Opt In" to new network tariffs fails to achieve timely take up of fair and efficient tariffs, with 70% of customers remaining on legacy tariffs in 2026 (Figure 1).
3. By contrast, customers can be assigned to demand tariffs, with a choice to "Opt Out" while achieving effective reform – less than 10% choose to return to legacy tariffs.

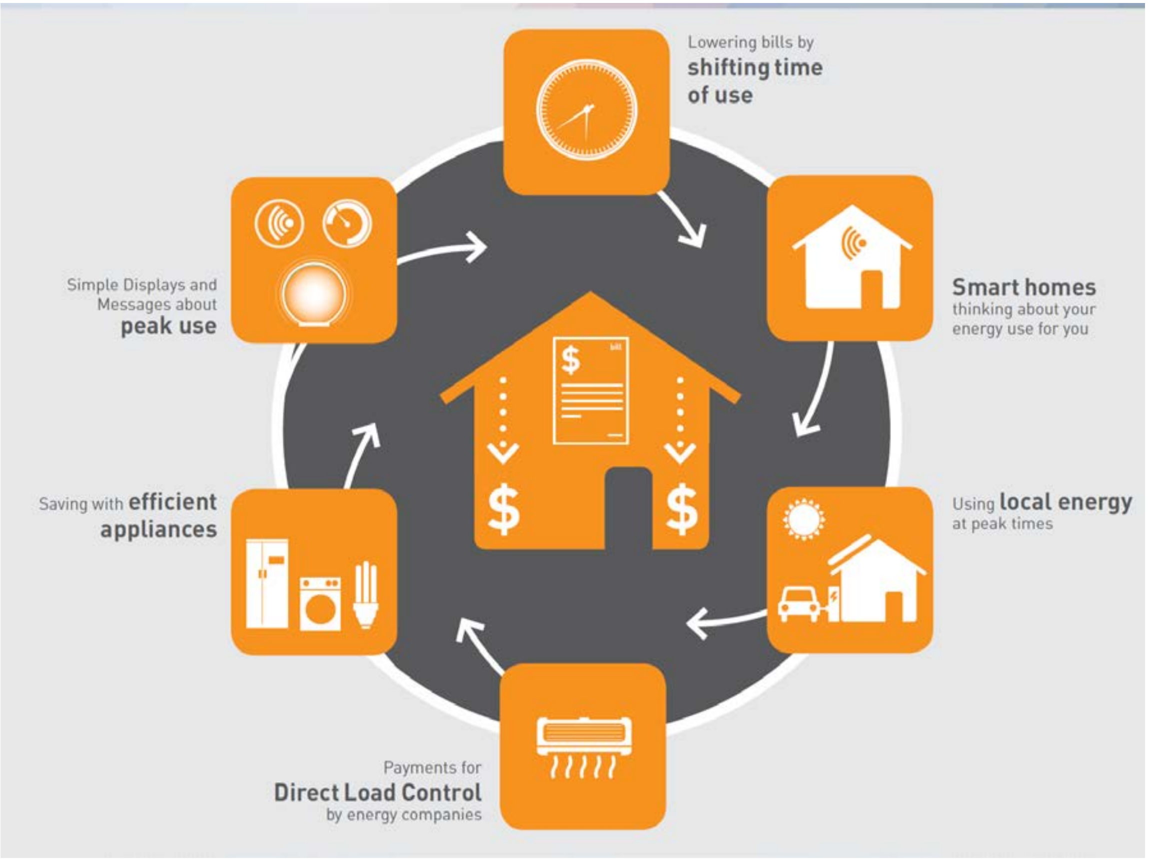


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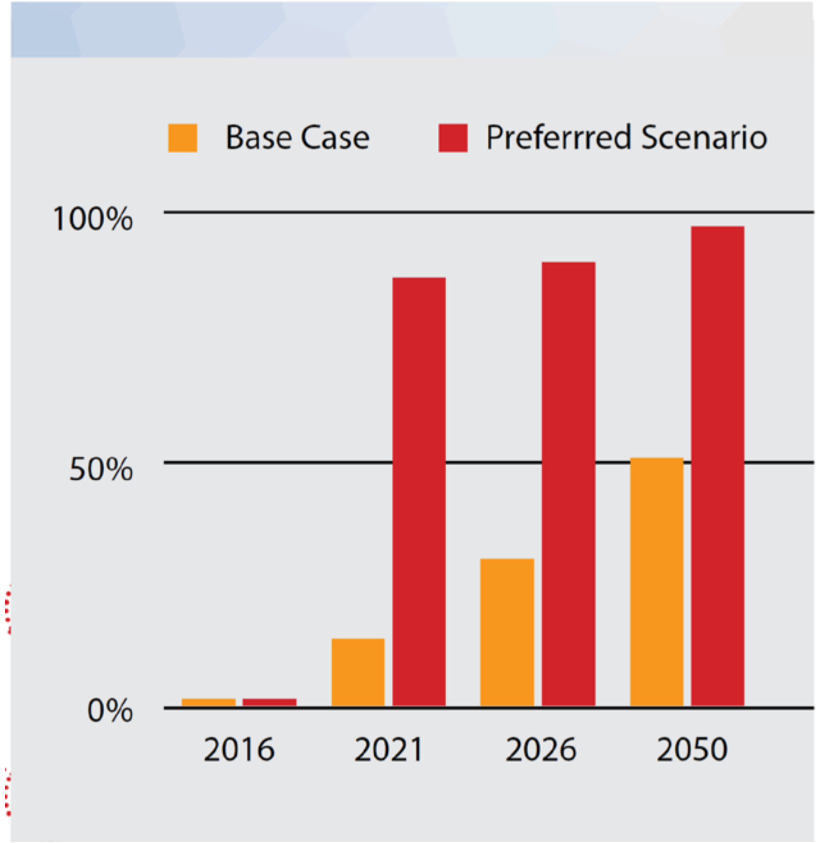
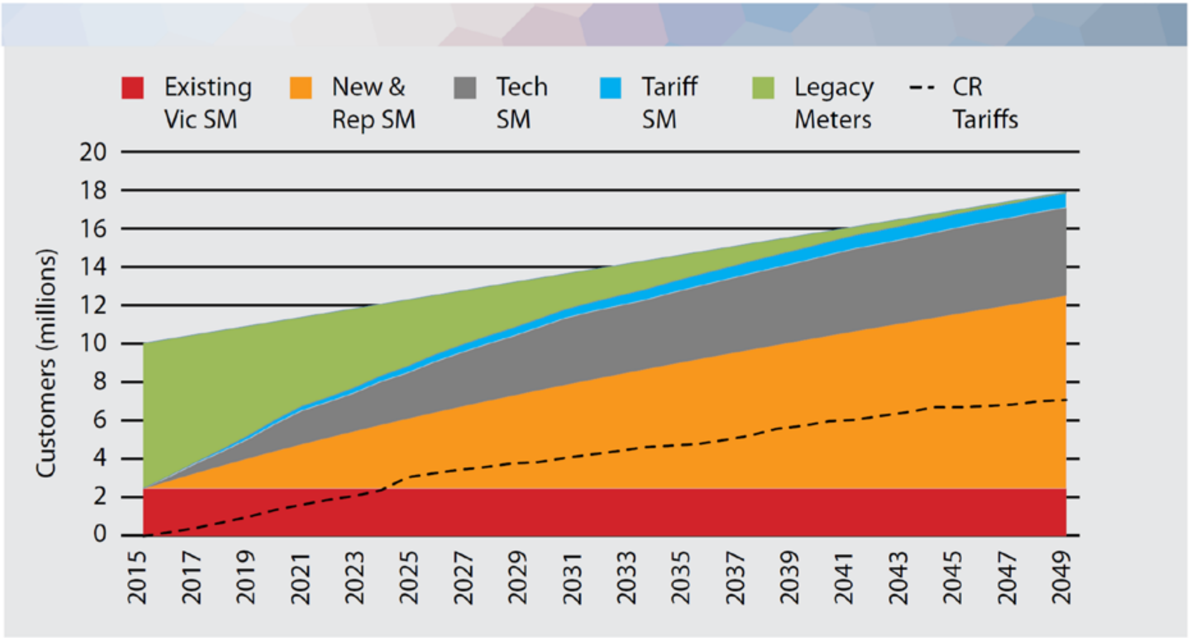
**Figure 1:** Customers on more cost reflective tariffs



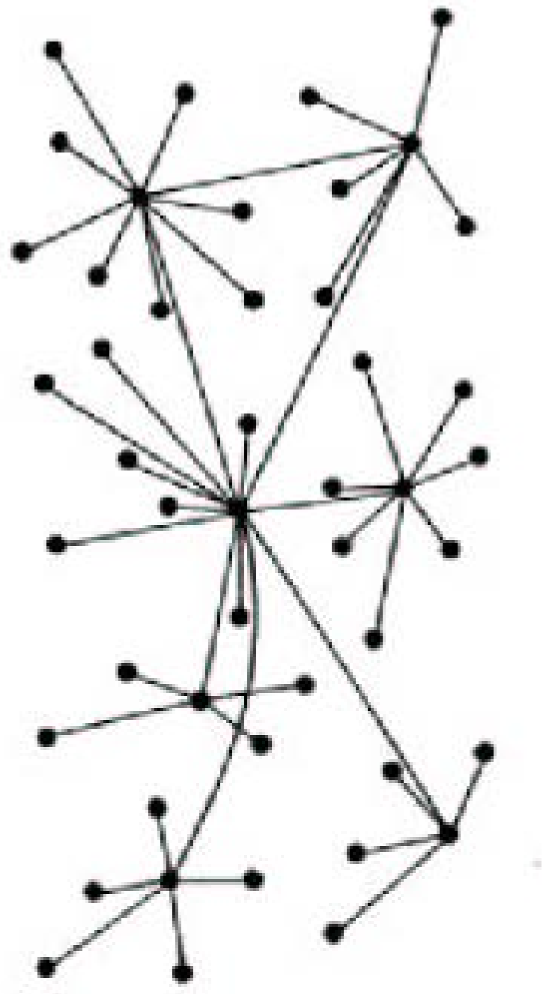
# Key Findings –First Wave Reforms

4. Smart meters are essential to enabling demand-based tariffs and will require close monitoring by policy makers to ensure market-led deployments are effective.
5. Without actively assigning customers to demand-tariffs, 60% of forecast smart meters will remain unused for cost-reflective tariffs in 2050, resulting in $2.4 billion in under-utilised investment

**Figure 2:** Cost Reflective (CR) Tariff Uptake and Smart Meter (SM) uptake (Base Case)



# Key Findings – ‘Second Wave’ incentives

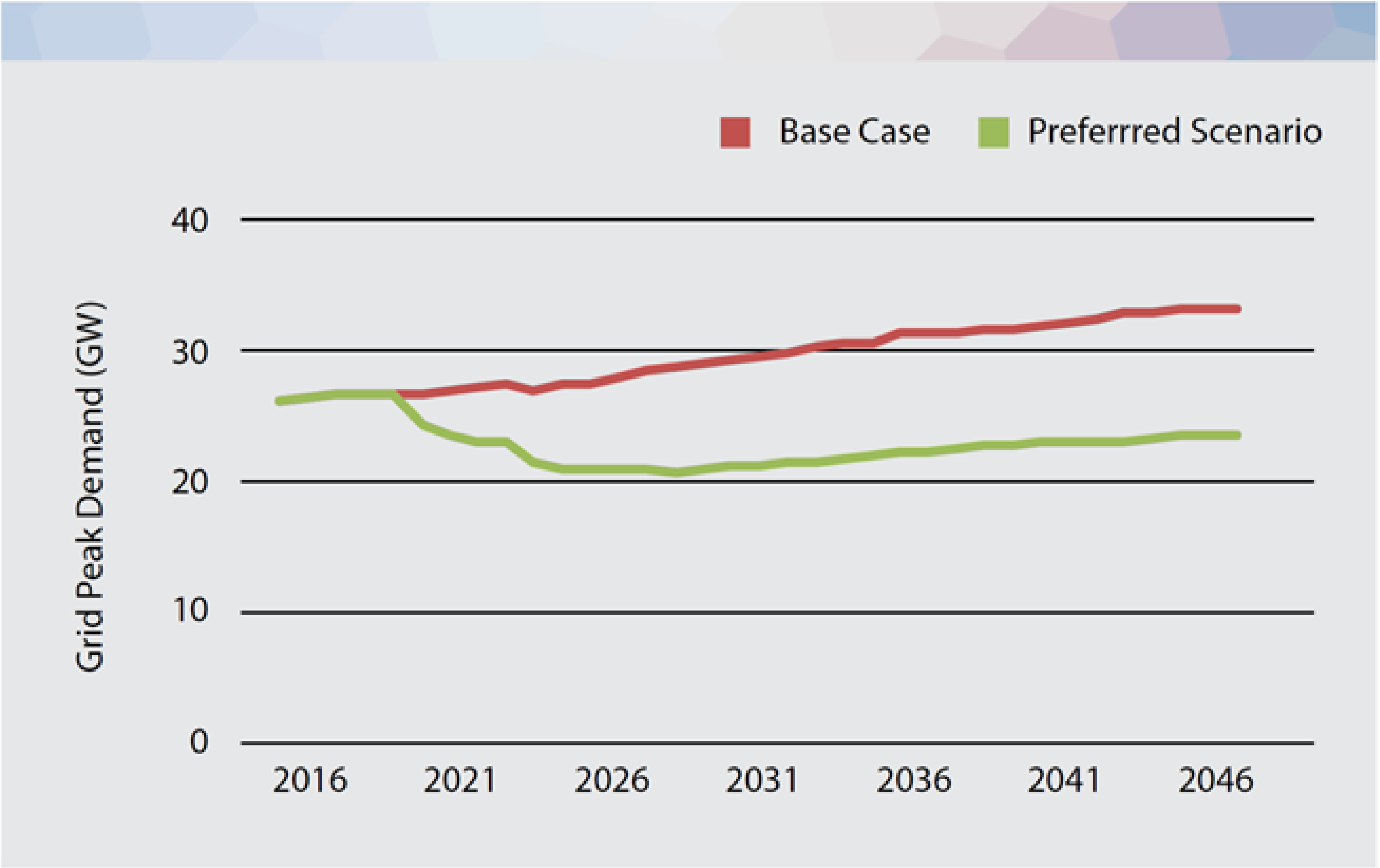


> Customers (or agents) could choose to ‘opt in’ to rewards for grid support in the ***right place*** at the ***right time***:

- **Incentive Payments for ‘orchestration’ of DER** (eg. battery discharge; smart inverters; load control; HEMs platforms);
- **Advanced Network Tariffs for Behavioural Response** *(eg. Critical Peak Price; Peak Time Rebates; Nodal Pricing)*;
- **Transactive Energy:** (eg. real time pricing in future in distributed markets).

# Key Findings – ‘Second Wave’ incentives

**Figure 3:** Total Network Non-Coincident Peak Demand (GW)



# Key Findings –Second Wave Incentives

7. If Networks buy grid services from DER Customers, this 'orchestration' could replace the need for $16.2 billion in network investment, avoid cross subsidies, and lower average network bills by around 30% compared to today.

75GW solar, 90GWh batteries

61% customers with DER

<3% residential customers on legacy tariff

Average network charge of $429 represents 23% of the average amount spent by customers on electricity

**2050 Benefit**

- The majority of customers are subject to dynamic, locational incentives or standalone power system integration
- 31% of customers with SAPS enjoy benefits of being on grid but with lower prices
- Non-coincident zone substation demand is below 2016 levels

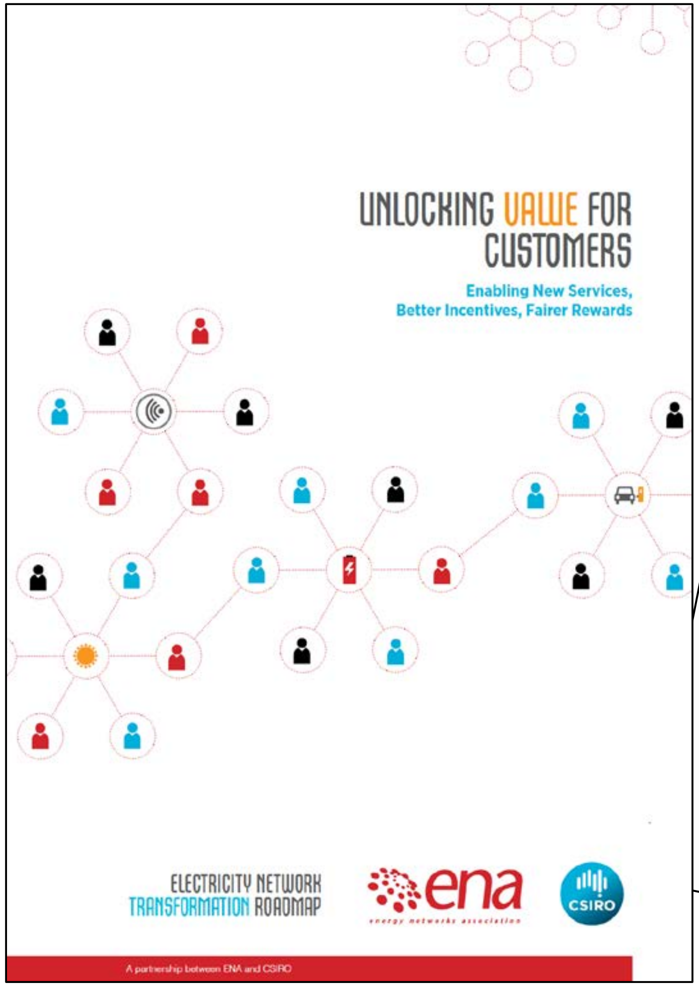
# Key Findings –Second Wave Incentives

- Smart Incentives avoid significant cross-subsidies and inequity between **active** and **passive** customers

**Figure 4:** Outcomes for different customer types

| | Base Case | | | Preferred Scenario | | |
|---|---|---|---|---|---|---|
| | **Active $** | **Passive $** | **The Gap $** | **Active $** | **Passive $** | **The Gap $** |
| Working Couple | 1,387 | 1,900 | **513** | 1,303 | 1,552 | **248** |
| Medium Family | 1,584 | 2,761 | **1,177** | 1,577 | 2,119 | **542** |
| Large Family | 2,722 | 4,339 | **1,617** | 2,655 | 3,206 | **552** |
| Single, Retired | 1,059 | 1,792 | **733** | 1,076 | 1,445 | **370** |

# For More Information: www.ena.asn.au


UNLOCKING VALUE FOR CUSTOMERS

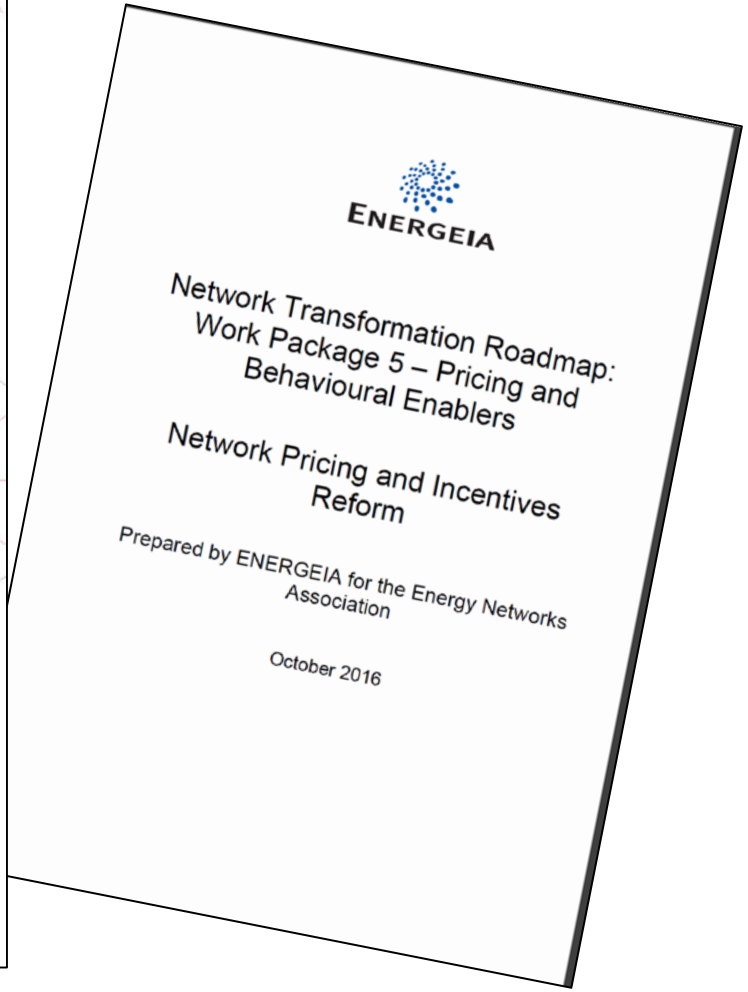
Enabling New Services,
Better Incentives, Fairer Rewards

ELECTRICITY NETWORK TRANSFORMATION ROADMAP

ena energy networks association

CSIRO

A partnership between ENA and CSIRO


ENERGEIA

Network Transformation Roadmap:
Work Package 5 – Pricing and
Behavioural Enablers

Network Pricing and Incentives
Reform

Prepared by ENERGEIA for the Energy Networks
Association

October 2016