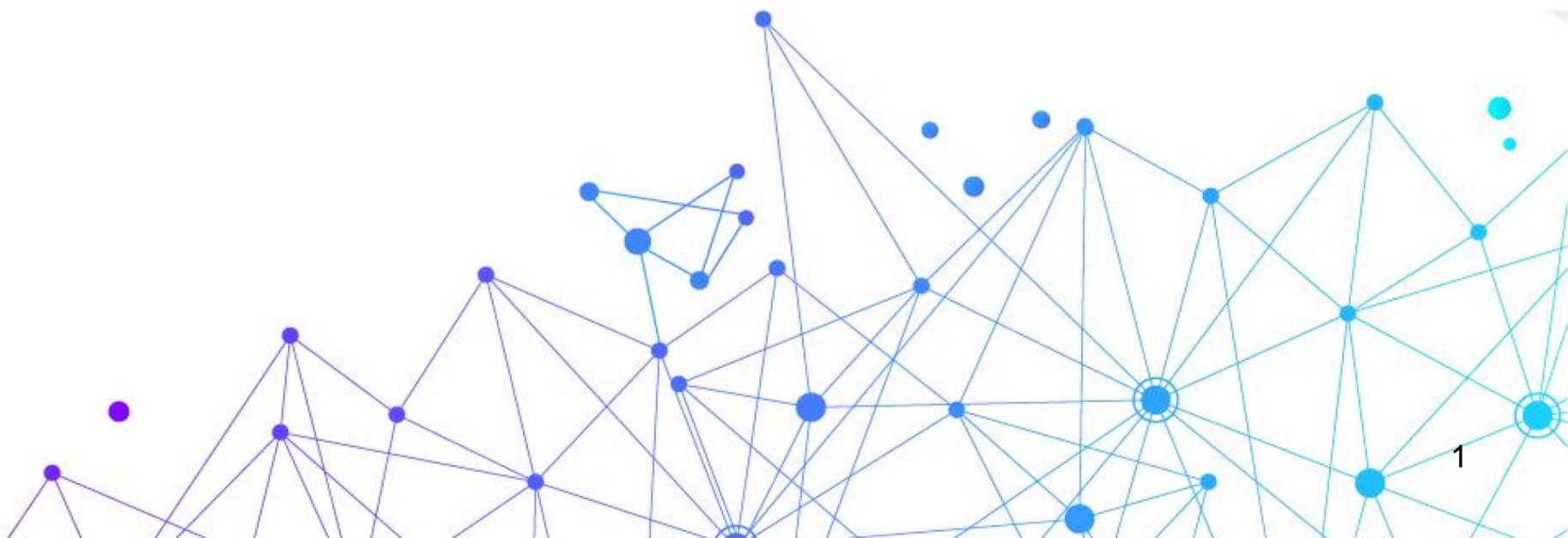


Whole of System Plan

Industry Forum

12 July 2019



DISCLAIMER

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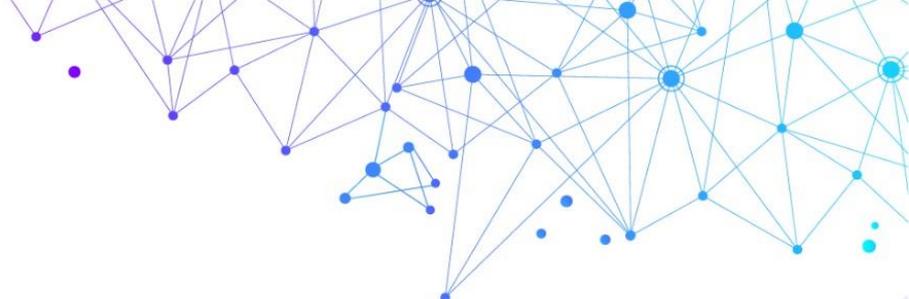
The information, representations and statements contained in this presentation have been prepared by the Department of Treasury, Energy Transformation Implementation Unit. It is provided to assist in obtaining public comment on, and contains only a general discussion of issues relating to, the inaugural Whole of System Plan.

The issues discussed in this presentation are under consideration by the Energy Transformation Implementation Unit and may be modified, discarded or supplemented by other issues during the course of the project. The proposed modelling scenarios do not necessarily reflect government policy.

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Agenda

9.35 am

Opening remarks

Stephen Edwell | Independent Chair, Energy Transformation Taskforce

9.40 am

Part 1 – WOSP objectives, process and methodology

Noel Ryan | Project Lead, Whole of System Plan, Energy Transformation

10.15 am

Morning tea

10.40 am

Part 2 – Modelling scenarios, inputs and assumptions

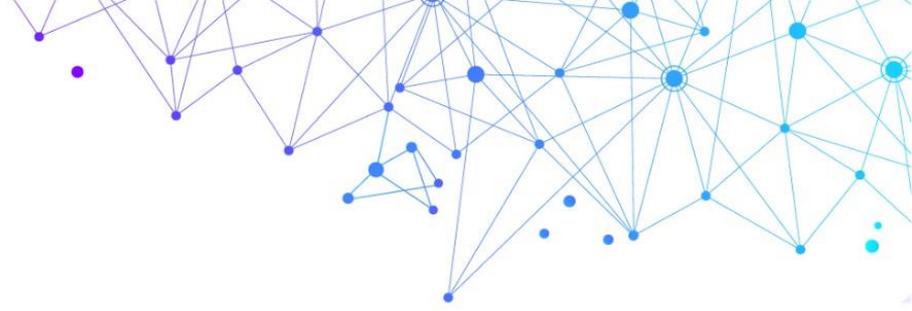
Peter Condon | Forecasting & Modelling Team Leader, Western Power

11.35 am

Discussion – Q&A

12.20 pm

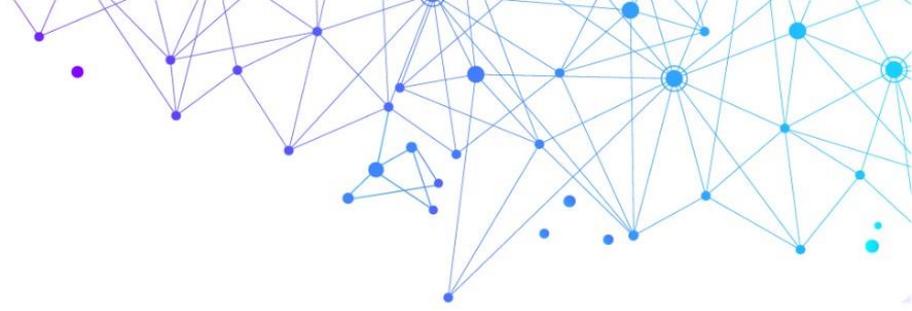
Next steps



Opening Remarks

Stephen Edwell

Independent Chair, Energy
Transformation Taskforce

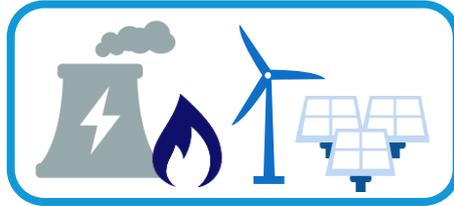


Part One

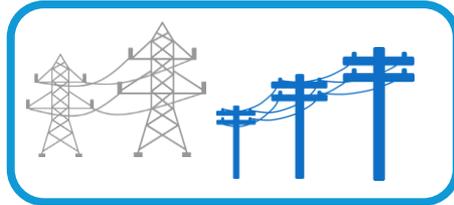
**Whole of System Plan objectives,
process and methodology**

CONTEXT

Generation mix
and location



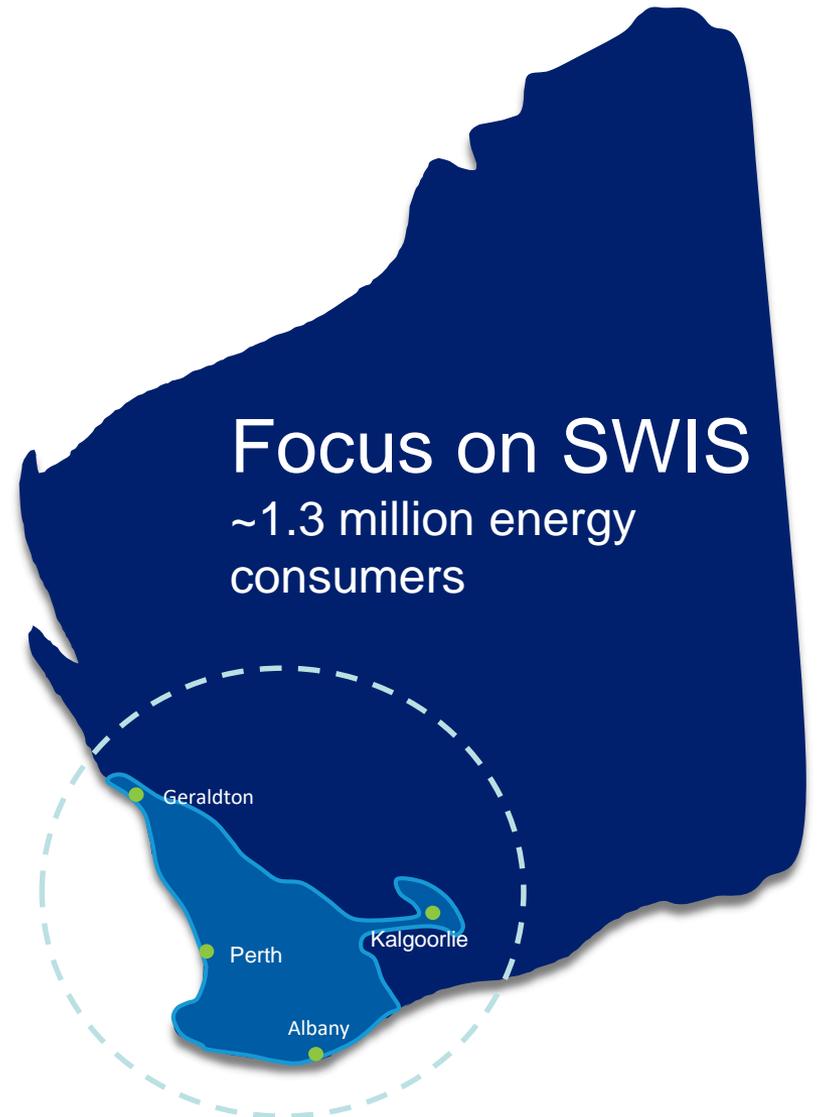
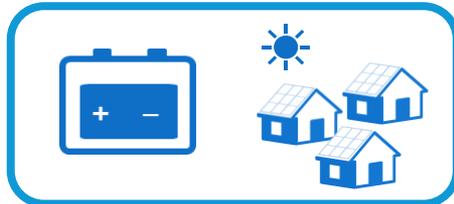
Network
configuration and
investment



Regulation,
dispatch and
essential system
services

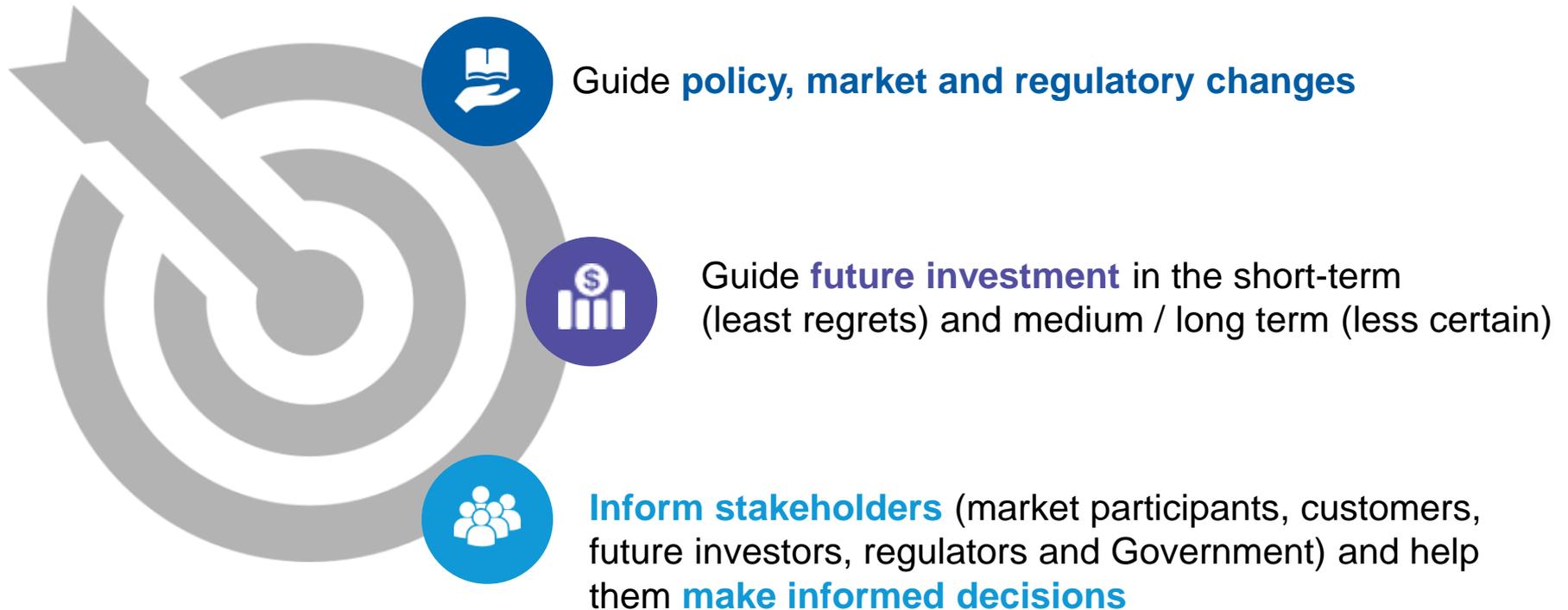


Integration of
distributed energy
resources

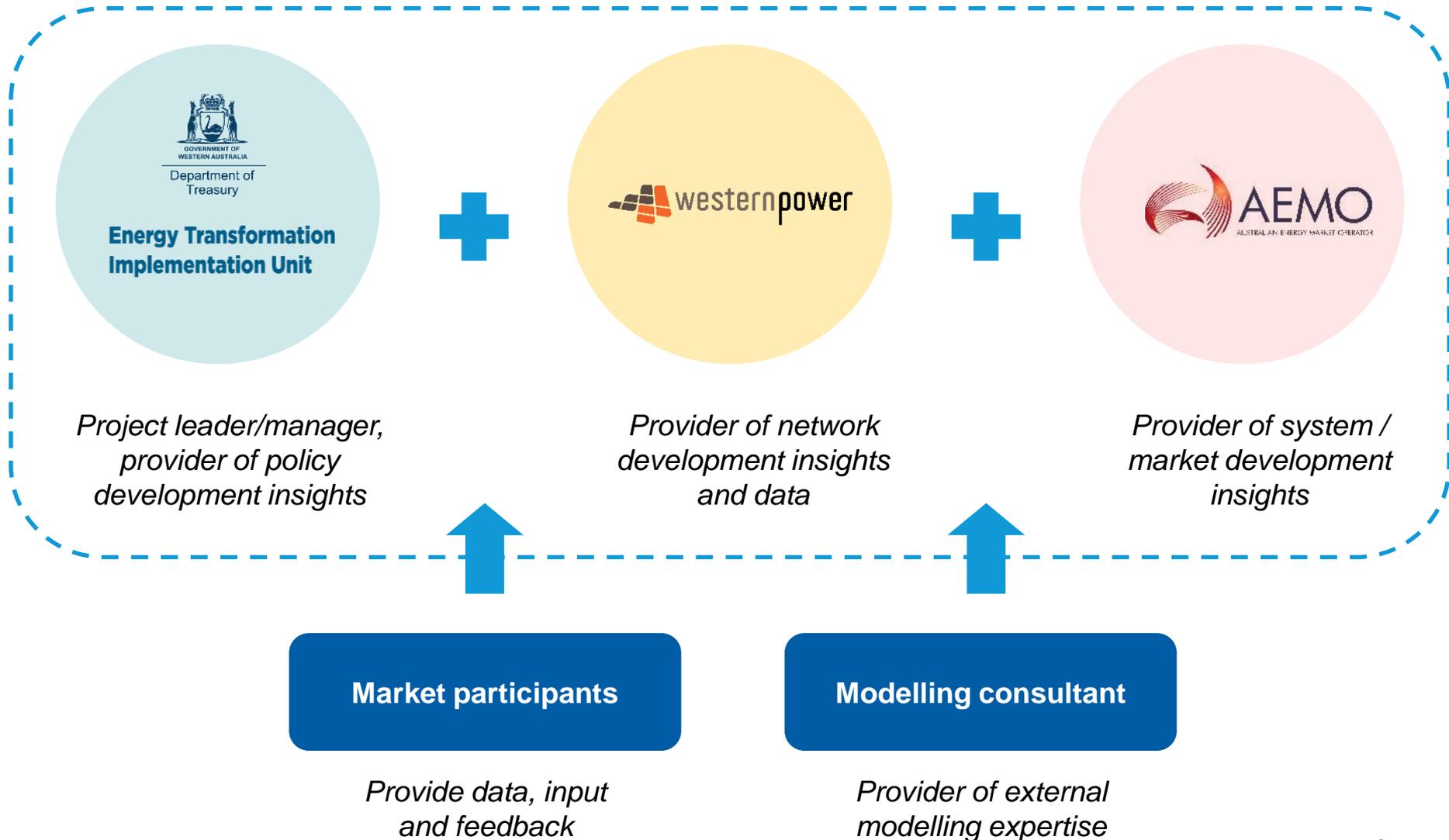


PURPOSE OF THE WOSP

WOSP should demonstrate how to deliver electricity supplies at lowest sustainable cost within the reliability and security standards over a 20 year period.

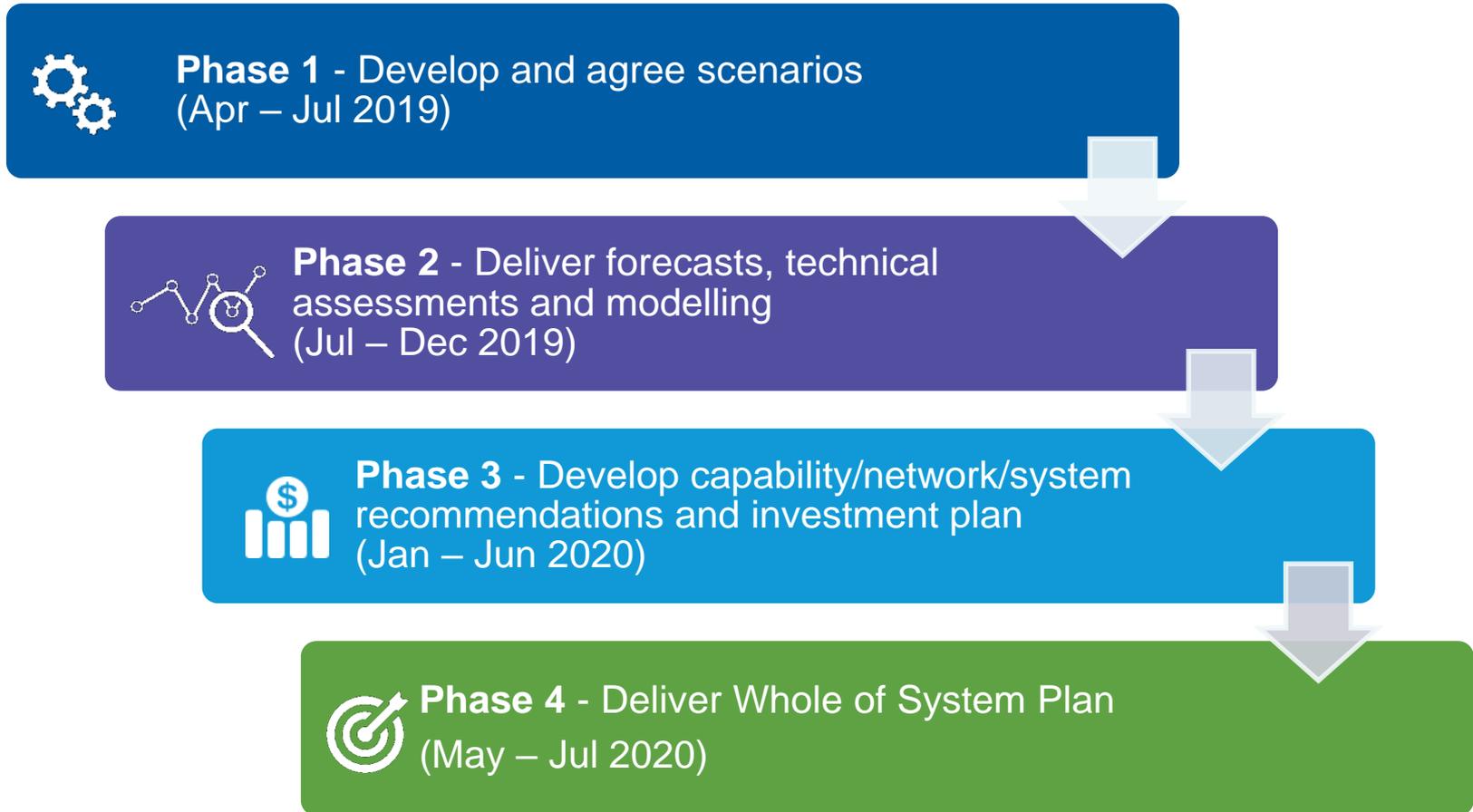


ROLES AND RESPONSIBILITIES

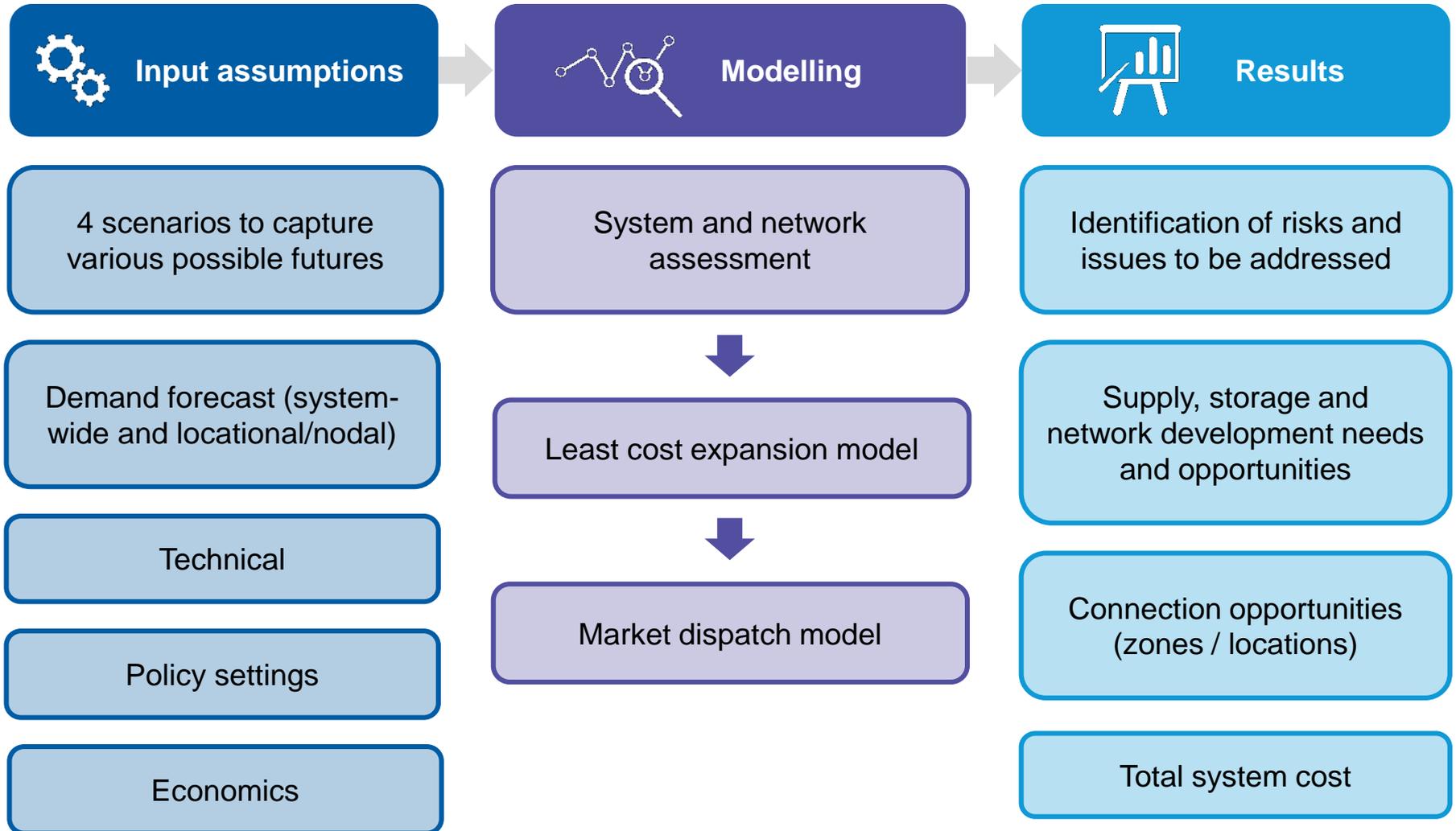


PROJECT DELIVERY APPROACH

Major project deliverable phases



MODELLING PROCESS



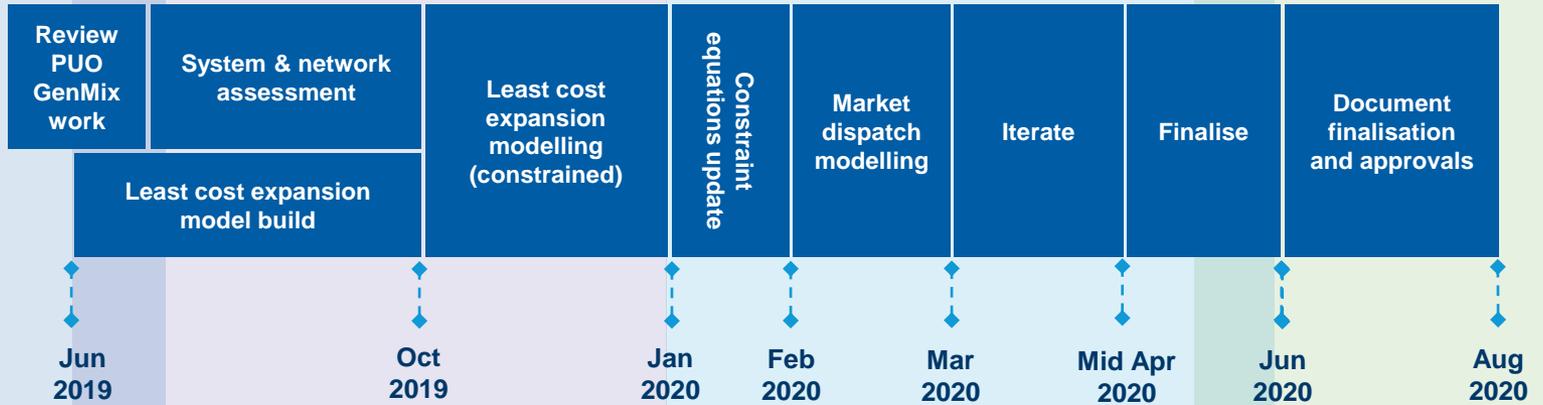
TIMEFRAMES

PHASE 1
Develop and agree scenarios
 Apr – Jul 2019

PHASE 2
Deliver forecasts, technical assessments and modelling
 Jul – Dec 2019

PHASE 3
Develop capability/network /system recommendations and investment plan
 Jan – Jun 2020

PHASE 4
Deliver Whole of System Plan
 May – Jul 2020



Q2 2019

Q3 2019

Q4 2019

Q1 2020

Q2 2020

Q3 2020

Jul 2019

- Industry forum on scenarios
- 1:1 meetings with stakeholders
- Present to MAC on scenarios
- Finalise scenarios

Sep 2019
 Present to MAC on final scenarios, inputs and assumptions

Dec 2019
 Present to MAC on technical assessment

Mar 2020
 Present to MAC on preliminary generation and network plans

Jun 2020
 • Present to MAC on SWIS/network investment plan
 • Industry forum on preliminary findings

Aug 2020
 Government approval to publish WOSP

SCENARIOS

The following scenarios have been developed in close collaboration between the Energy Transformation Implementation Unit, Western Power and Australian Energy Market Operator.

1

Cast Away

Leaving the grid with muted economic growth.

2

Groundhog Day

Renewables thrive, but reliance on the network remains high.

3

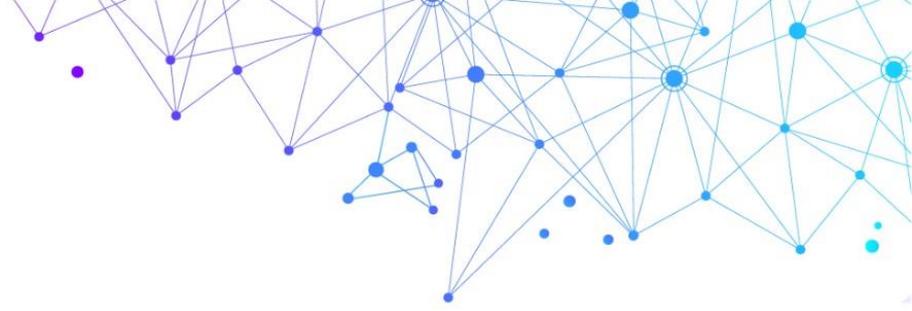
Techtopia

Technological change places downward pressure on energy costs.

4

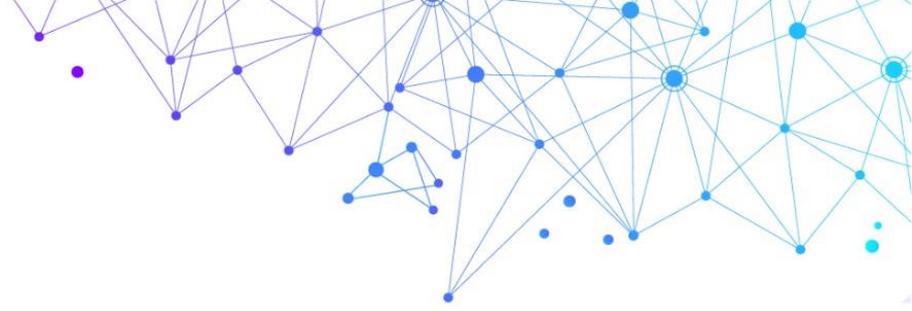
Double Bubble

Booming economy with limited global action on climate change.



Morning Tea

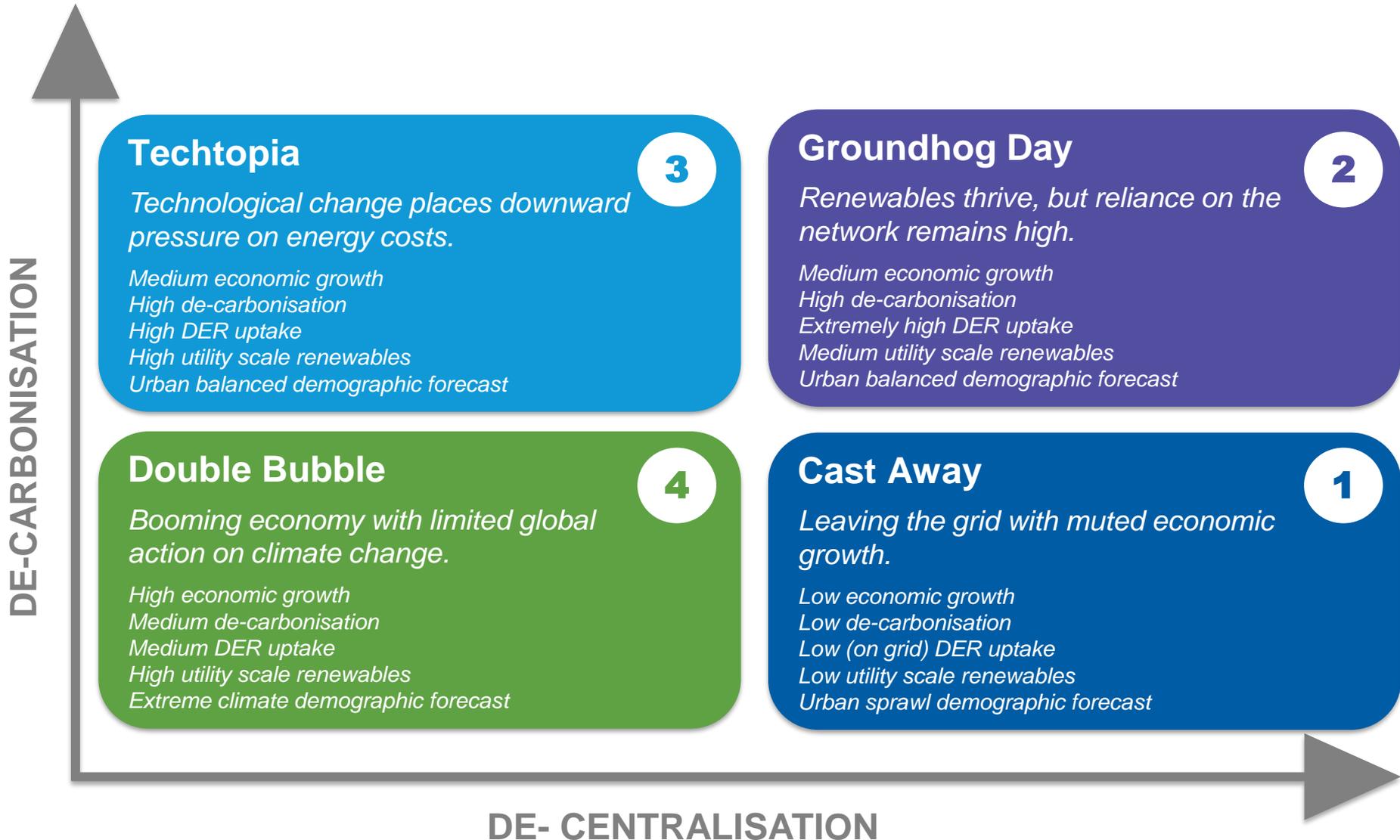
We will recommence at 10.40 am



Part Two

Modelling scenarios, inputs and assumptions

DE-CARBONISATION VS DE-CENTRALISATION



KEY DRIVERS – HOW, WHERE, SOURCE

1

How much energy?

At the most fundamental level, how much energy used in the SWIS is determined by the number of people here and the strength of the economy

2

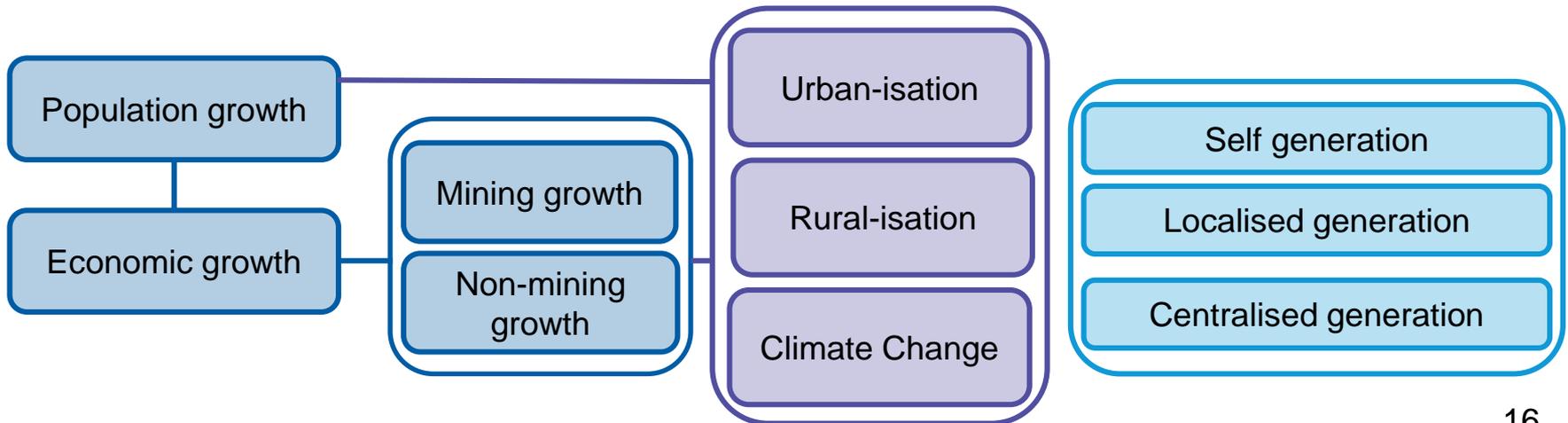
Where is the energy?

Where the energy needs to be at any given time is driven by two patterns, the relative strength of mining and non-mining industries (i.e. the economy) and demographic trends in how people like to live.

3

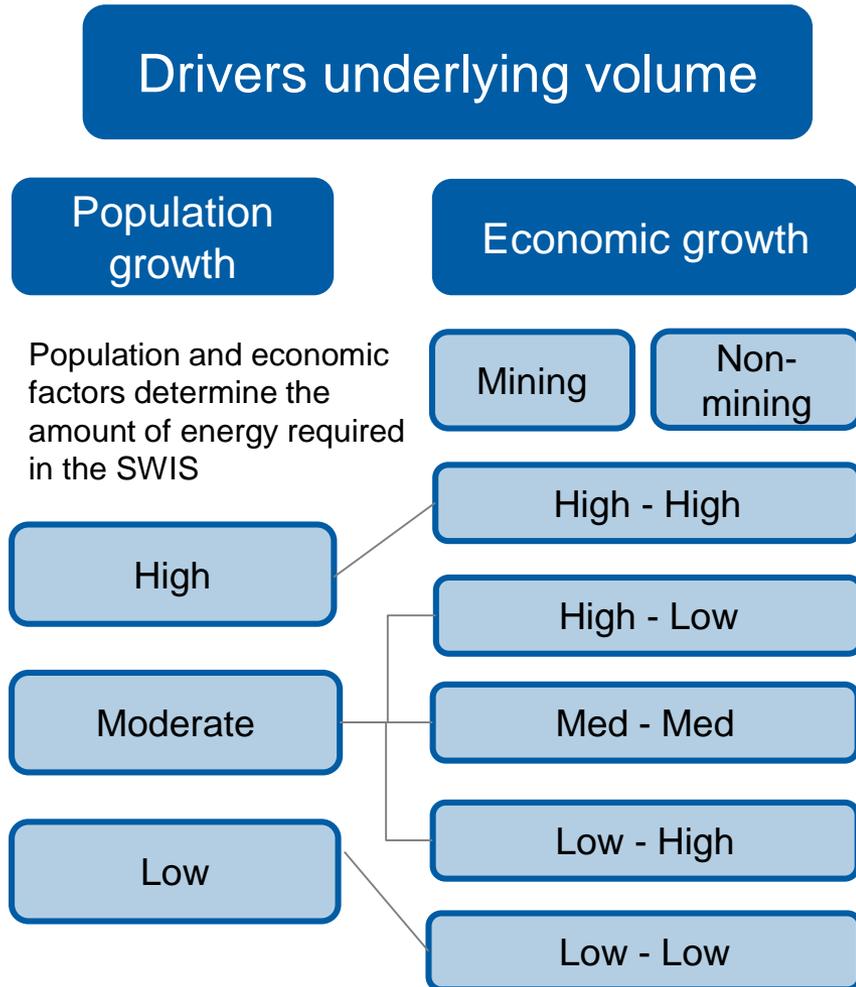
Source of energy?

The source of energy, whether it is self supplied or centrally generated and transported depends on an interaction between price, technology and socio-political trends.



ECONOMIC DRIVERS

How the economy affects total electricity demand



- Five scenarios of Mining and Non-mining economic growth
- Each side of the economy can be high, medium, or low
- Econometric modelling based:
 - WA Tomorrow (DPLH)
 - Economic modelling (BIS Oxford)
 - Potential mine sites (DMP)
 - Potential industrial sites (various)
 - Potential infrastructure sites (various)

ECONOMIC DRIVERS

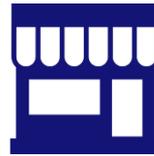
The economy is split into five segments:



Residential



Mining



Commercial



Industrial



Infrastructure

Each segment has two key outputs:

Potential network connections

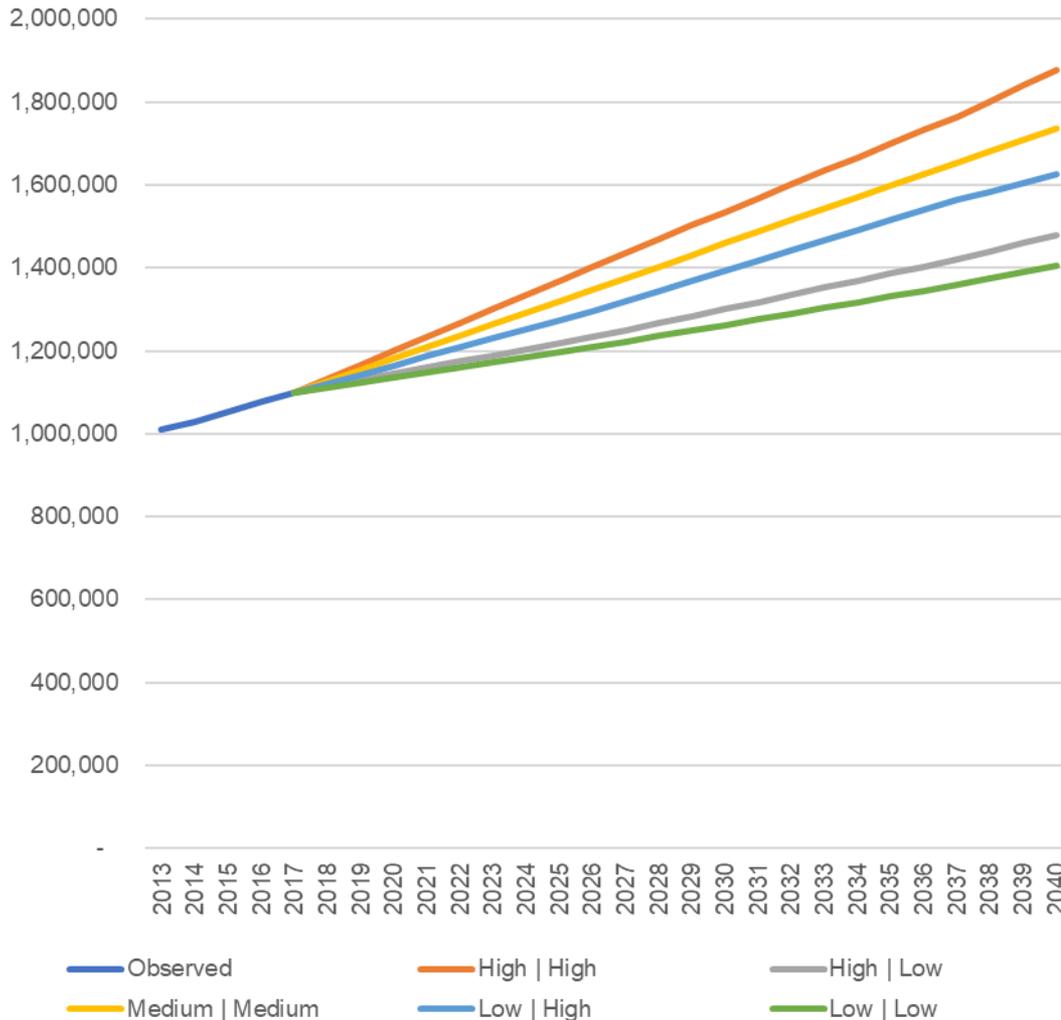
Models the number of sites (connection point) that consume electricity in the SWIS catchment regardless of whether they are connected

Underlying energy consumption

Models total electricity consumption regardless of source

ECONOMIC DRIVERS

Potential Network Connections



Connection growth influences

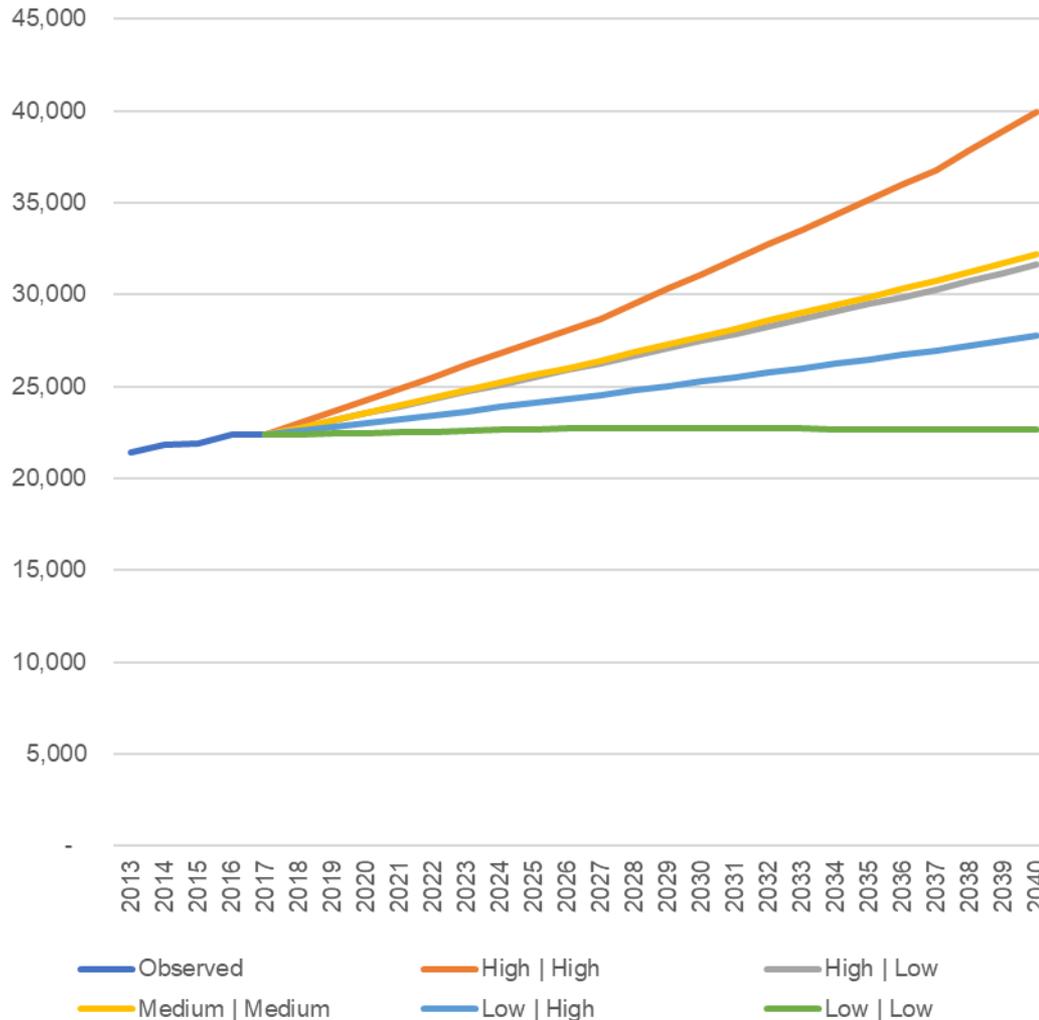
- Base load
- Adoption of emerging tech
- Energy per customer

Modelling includes

- Population growth
- People per household
- Economic growth

ECONOMIC DRIVERS

Underlying Energy Consumption (GWh)



Source: Western Power

Consumption influences

- Individual demand profiles
- Diversification
- Adoption of emerging tech

Modelling includes

- Population growth
- Economic growth
- Energy efficiency

DEMOGRAPHIC DRIVERS

Where people choose to live and work

Drivers underlying demand/location

'Where' is determined differently. Growth in:

- business tends to result in intensity in small locations,
- residential and commercial business is differentiated by spread.

Demographic sprawl

Urban sprawl

More growth on the fringes

Urban balance

WAPC base case

Urban infill

More growth in the inner city

Regional growth

More growth in the regional centres

Climate change

Population shifts south

- Five scenarios shifting population and economic activity
- Focusses on consumption that grows and spreads
- Influences
 - Experienced weather
 - Technology preferences
 - Density related demand profile characteristics
 - Transport related demand profile characteristics
- Spatial modelling based on:
 - WA Tomorrow (DPLH)
 - Perth and Peel @ 3.5 million (WAPC)
 - Census (ABS)
 - Transport corridors (DoT)
 - Climate modelling (IPCC)
 - Topographical models (Landgate)

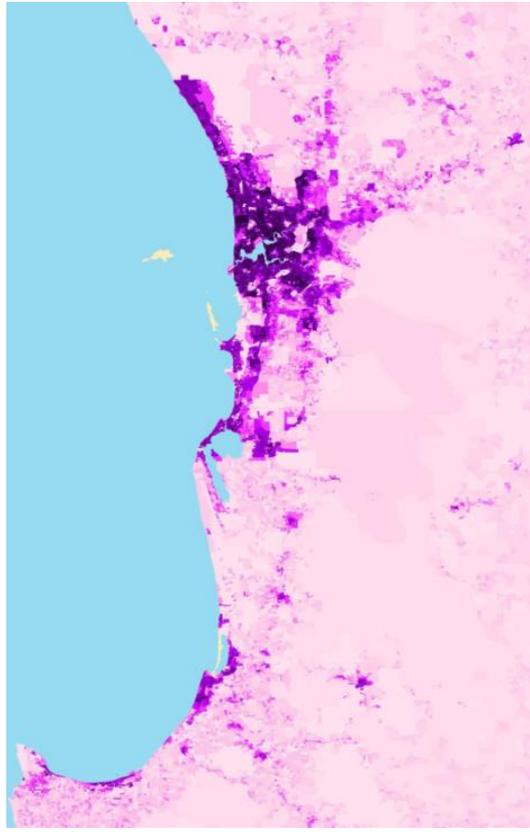
DEMOGRAPHIC DRIVERS

Absolute differences between scenarios can be subtle

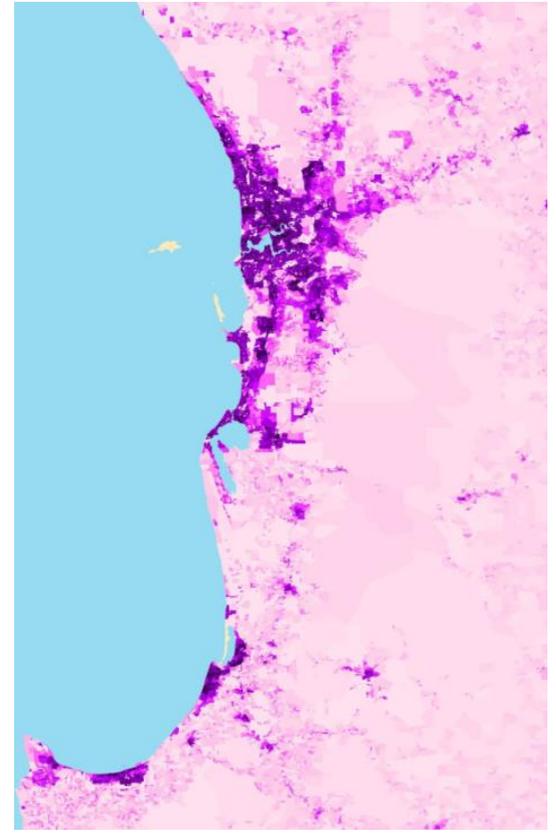
Urban sprawl



Urban infill



Regional growth



TECHNOLOGY DRIVERS

How technology may change consumers' use of electricity

Source drivers

Set and forget

Rise of the prosumer

Leaving the grid

Renewables thrive

Minimal change

High demand

Low demand

- Seven scenarios derived from the Future Grid Forum (CSIRO)
- Influences
 - Individual underlying demand profile
 - How consumers interact with the network
 - Diversification
- Agent-based simulation modelling based on:
 - Emerging technology forecast (BNEF)
 - Observed individual demand profiles (Western Power)
 - Consumer preference profiling (Forethought)
 - Alternative product trials (Synergy)
 - Electric vehicle studies (UK & Norway)
 - Battery studies (Energex)

Source: CSIRO, 2013, Change and Choice, The Future Grid Forum's analysis of Australia's potential electricity pathways to 2050

ELECTRIC VEHICLE DRIVERS

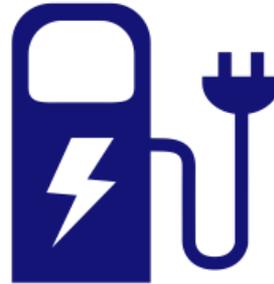
There are many ways that electric vehicles may materialise

Behind the meter
charging



*Low voltage (wall socket),
high voltage (dedicated
charger)*

Front of meter
charging



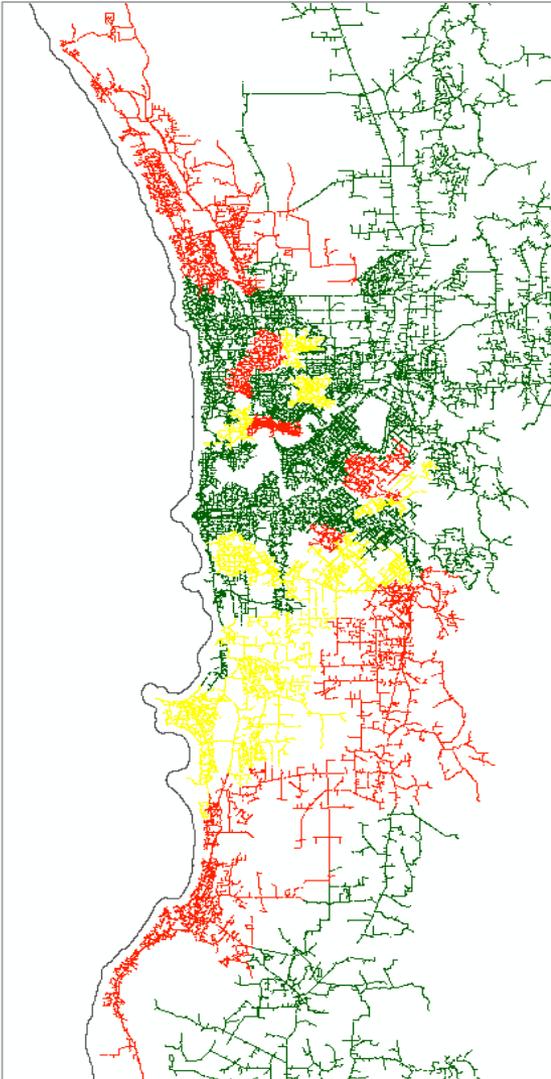
*Charging station, battery
swap, electric highway*

Non-network



*Disconnected charging
station, hydrogen*

POINT LOAD DRIVERS



The largest consumers on the network do not grow and spread

- Mines set up where there are deposits
- Refineries set up where there is space
- Desalination plants set up near the sea

24 industries were studied to identify future block loads

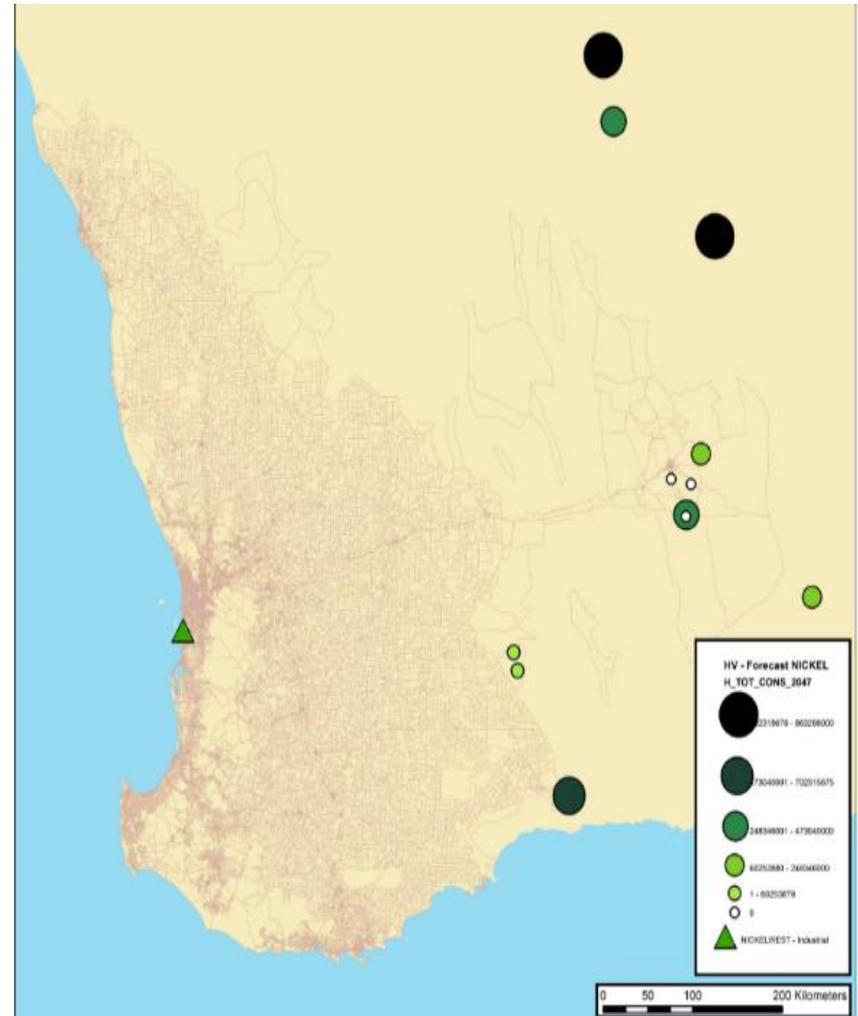
- Mining: gold, nickel, bauxite, lithium, iron, coal, etc
- Industrial: mineral processing, agriculture, petrochemical, etc
- Infrastructure: water, education, health, transport, etc

POINT LOAD DRIVERS

Each potential block load study identifies:

- Potential consumption and peak demand
- Likely operating lifecycle
- Conditions that would influence operations (e.g. mineral price)

Each industry is evaluated for low, central, and high cases and the likely demand at each site



SCENARIOS

The following scenarios have been developed in close collaboration between the Energy Transformation Implementation Unit, Western Power and Australian Energy Market Operator.

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Leaving the grid with muted economic growth.

2

Groundhog Day

Renewables thrive, but reliance on the network remains high.

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Techtopia

Technological change places downward pressure on energy costs.

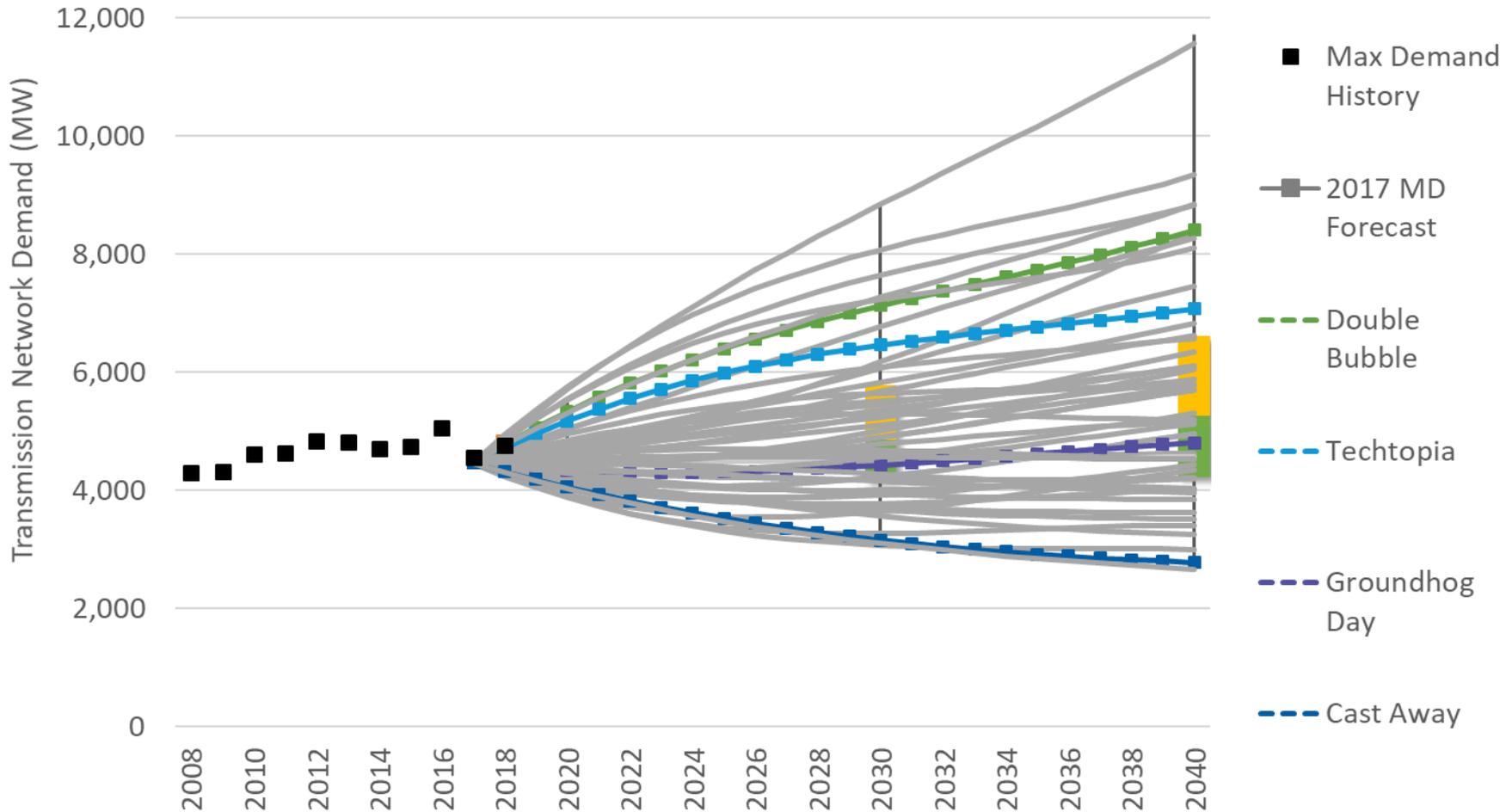
4

Double Bubble

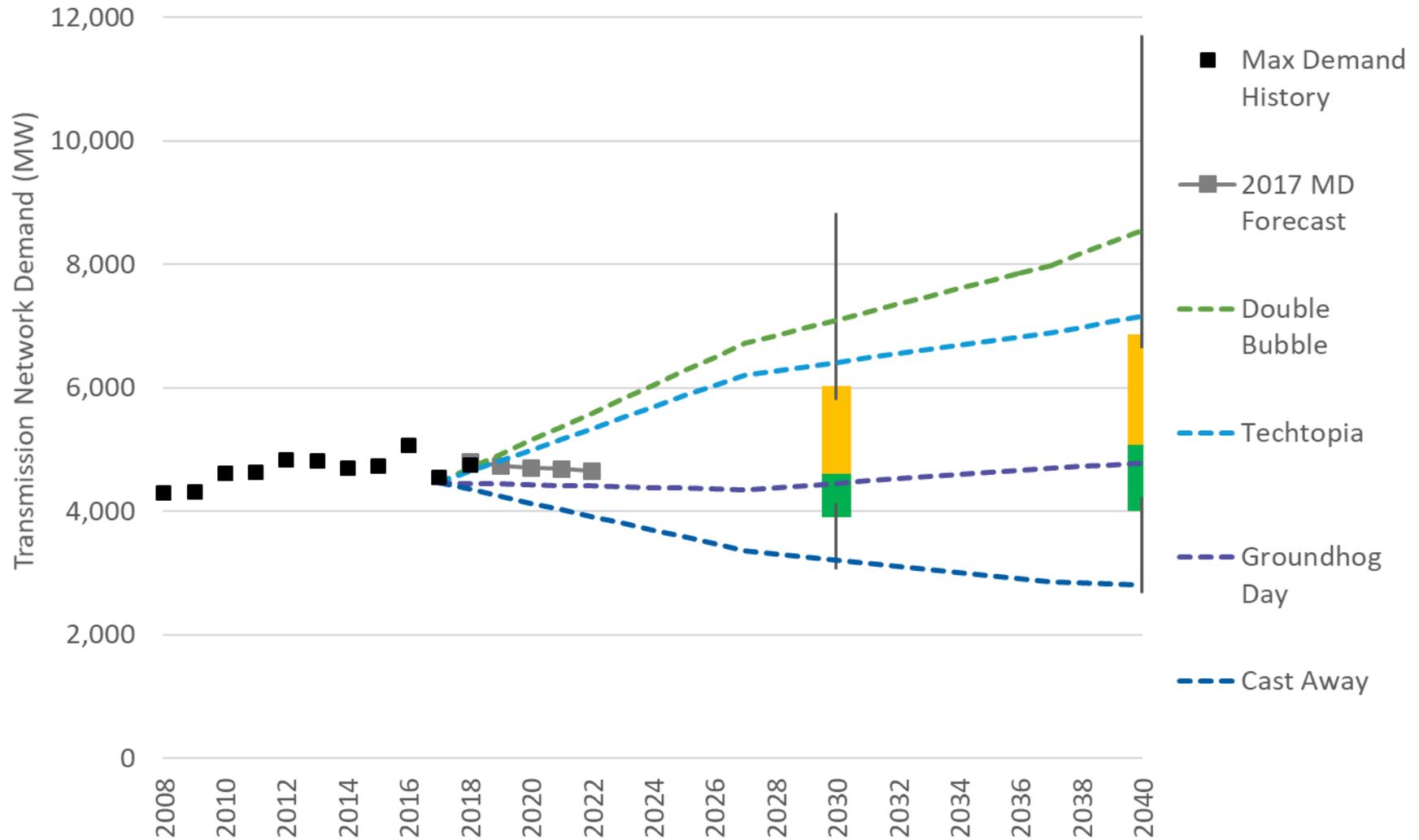
Booming economy with limited global action on climate change.

MAXIMUM DEMAND – 50 SCENARIOS

There are 50 energy forecasts generated based on the different permutations of key drivers.

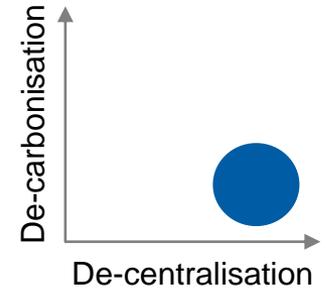
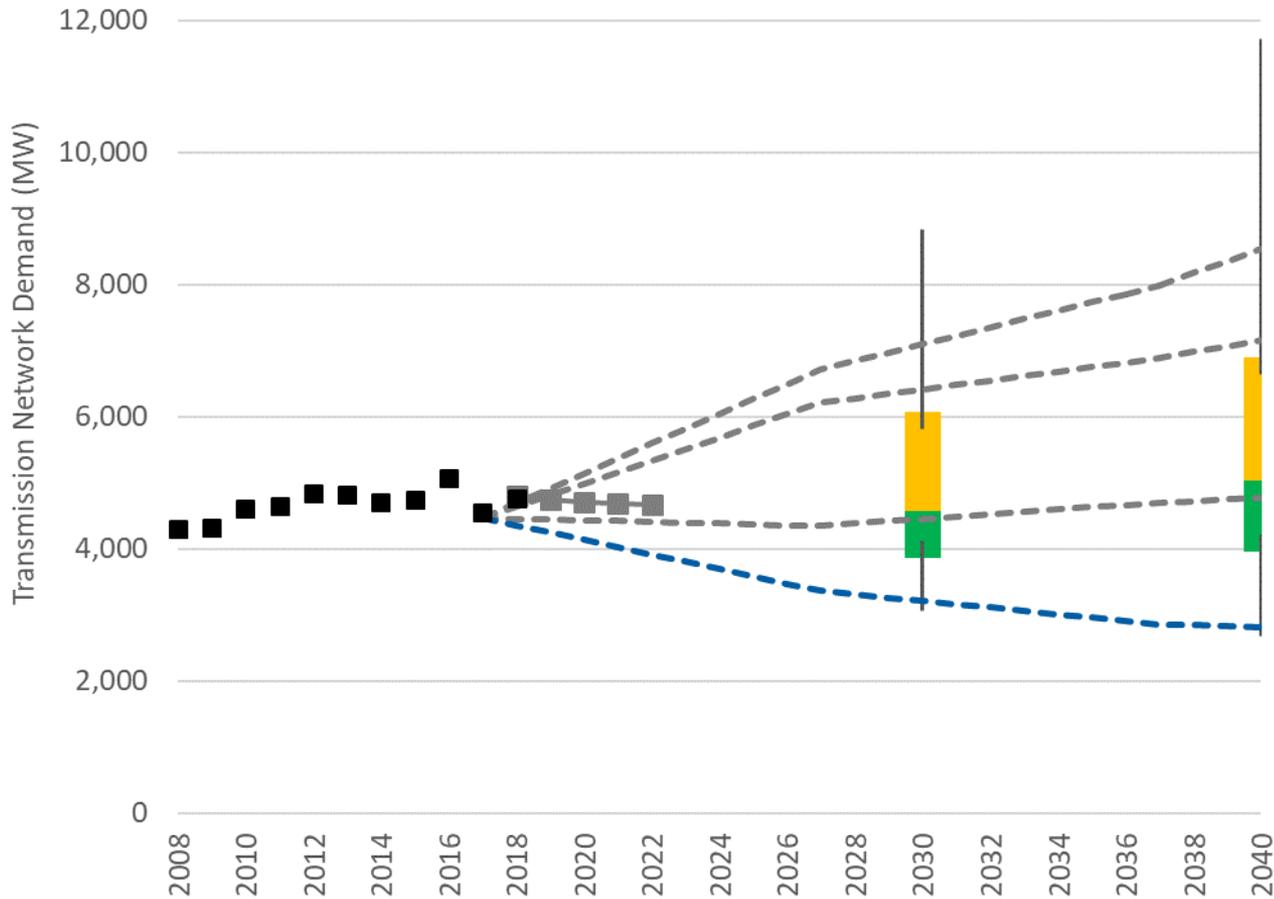


MAXIMUM DEMAND – FOUR SCENARIOS



1 CAST AWAY

Leaving the grid with muted economic growth



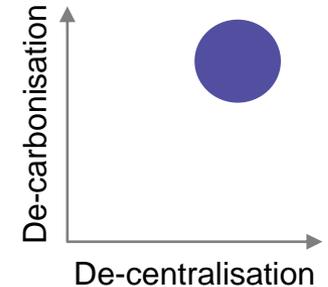
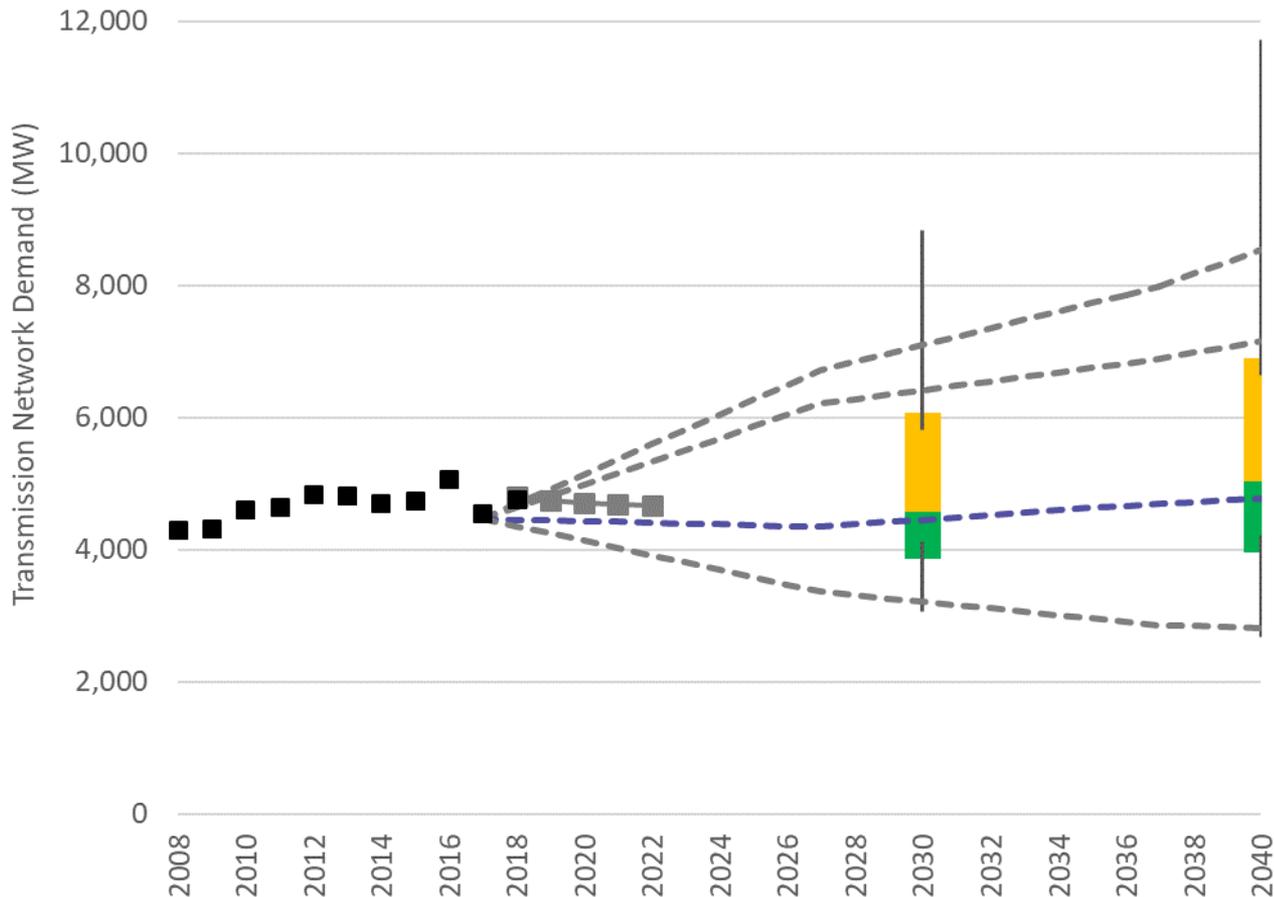
PROFILE

- Low economic growth
- Low de-carbonisation
- Low (on grid) DER uptake
- Low utility scale renewables

2

GROUNDHOG DAY

DER thrives, but reliance on the network remains high



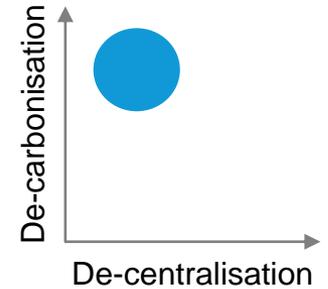
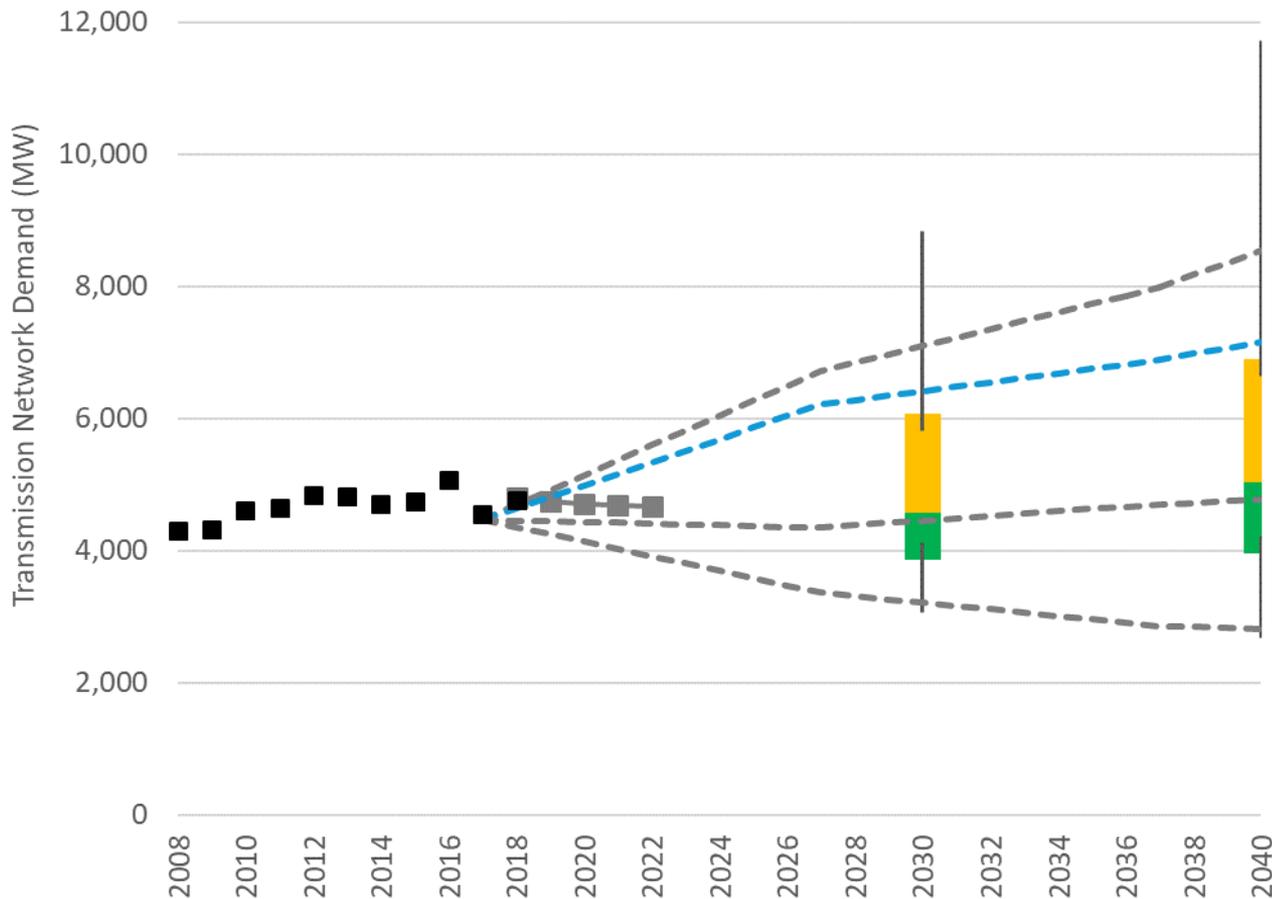
PROFILE

- Medium economic growth
- High de-carbonisation
- Extremely high DER uptake
- Medium utility scale renewables

3

TECHTOPIA

Technological change places downward pressure on energy costs

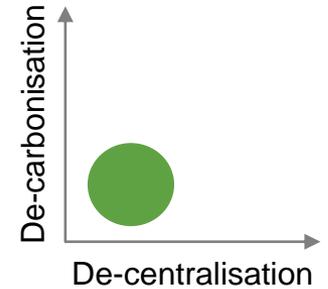
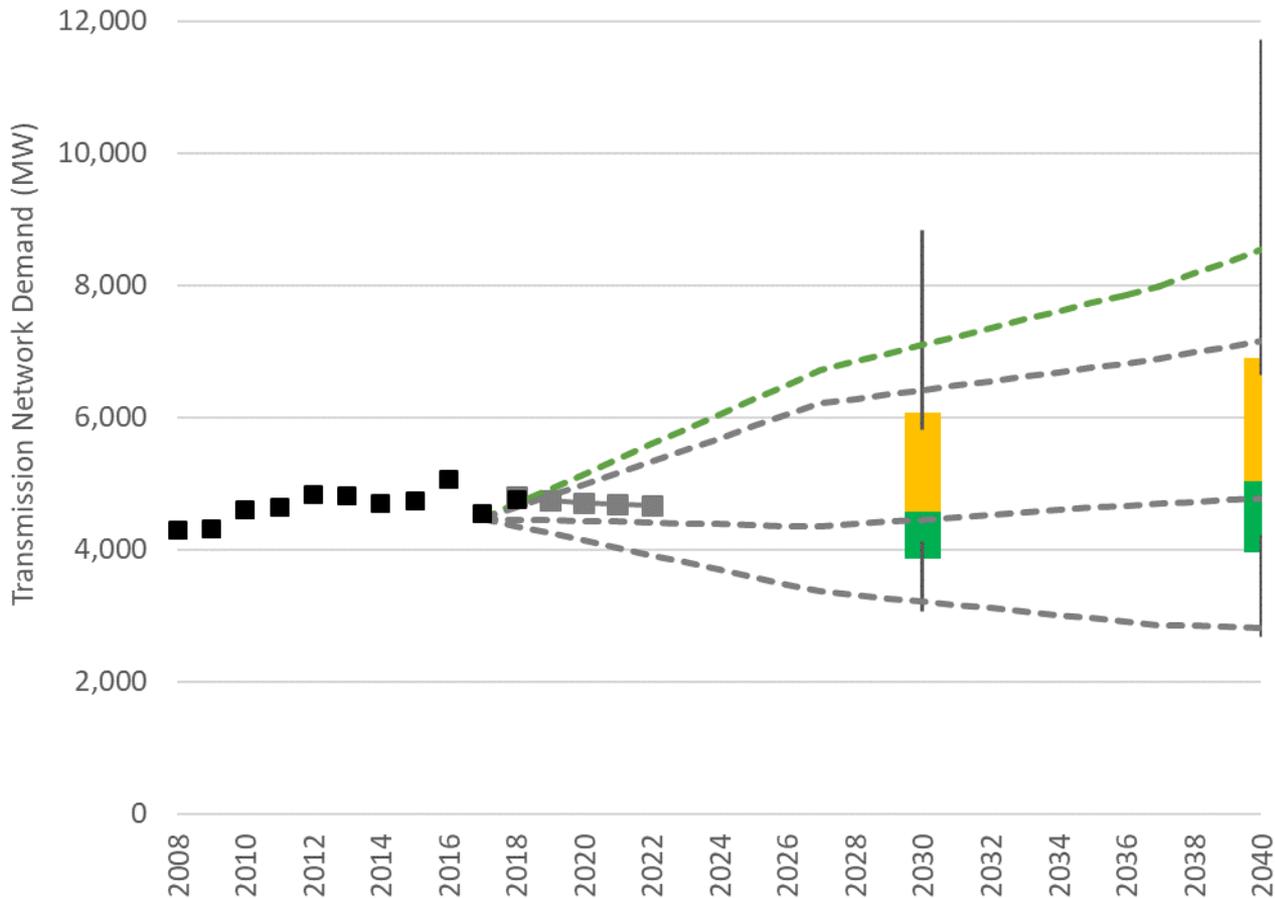


PROFILE

- Medium economic growth
- High de-carbonisation
- High DER uptake
- High utility scale renewables

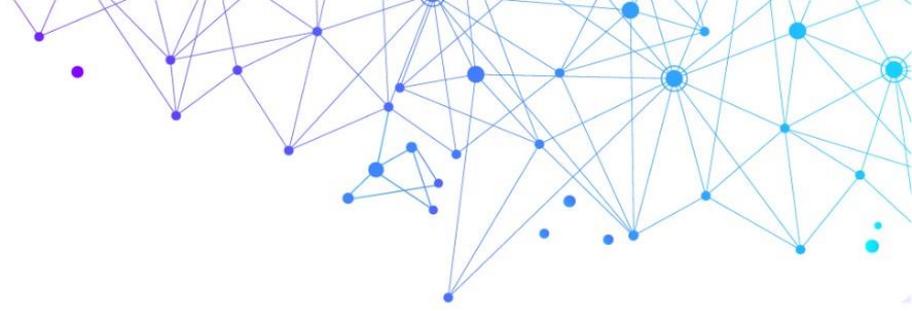
4 DOUBLE BUBBLE

Booming economy with limited global action on climate change



PROFILE

- High economic growth
- Medium de-carbonisation
- Medium DER uptake
- High utility scale renewables



Discussion

Question Time

NEXT STEPS



Industry forum on modelling scenarios

12 July 2019, 9.30am – 12.30pm



1:1 meetings with industry

15 – 26 July 2019



Stakeholder feedback due

26 July 2019



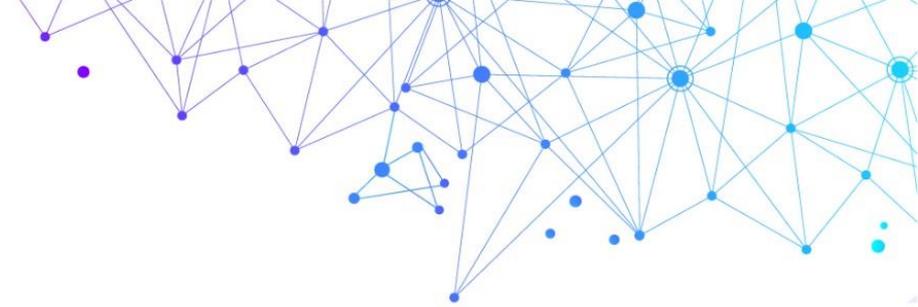
Update MAC on final modelling scenarios

30 July 2019



Finalise modelling scenarios

31 July 2019



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Miles Jupp

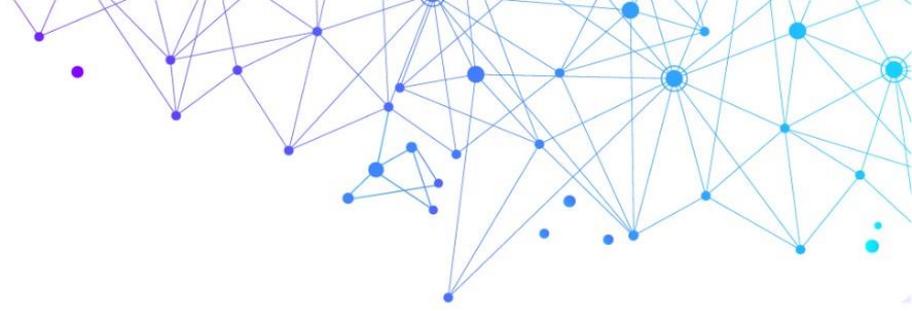
Principal Adviser, Whole of System Plan

miles.jupp@treasury.wa.gov.au

+61 8 6551 2777

For further information, please visit our webpage:

<http://www.treasury.wa.gov.au/Energy-Transformation/Whole-of-System-Planning/>

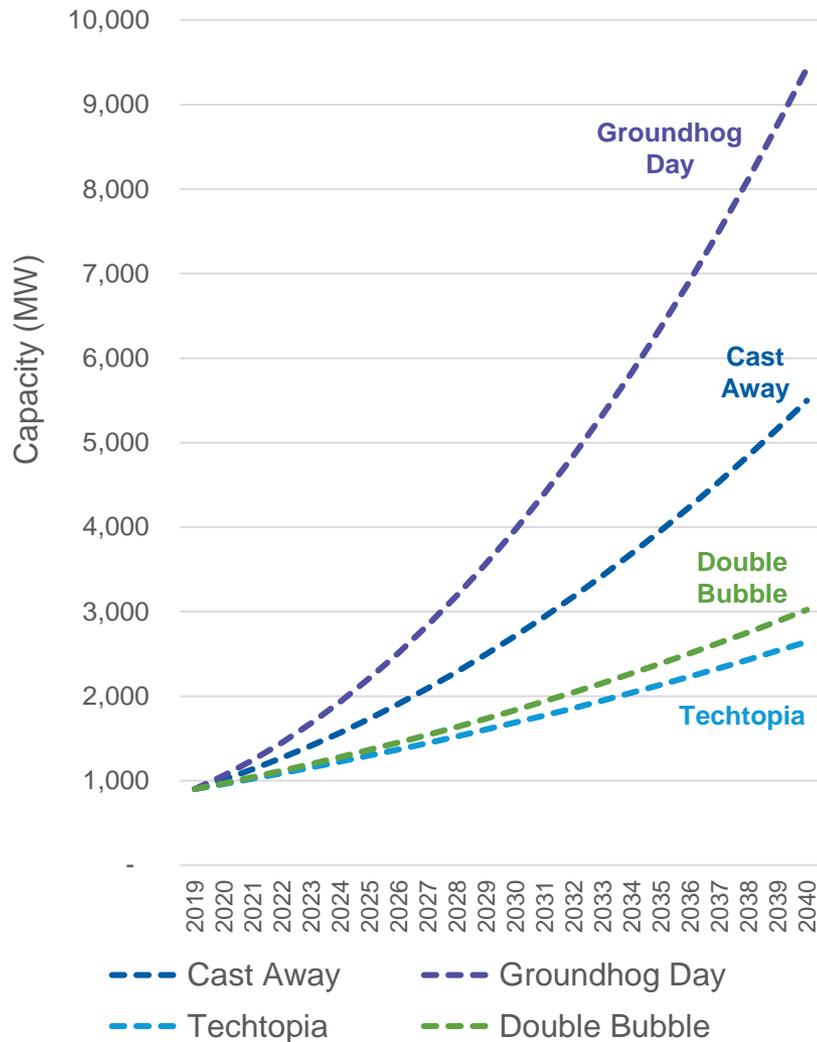


Appendix

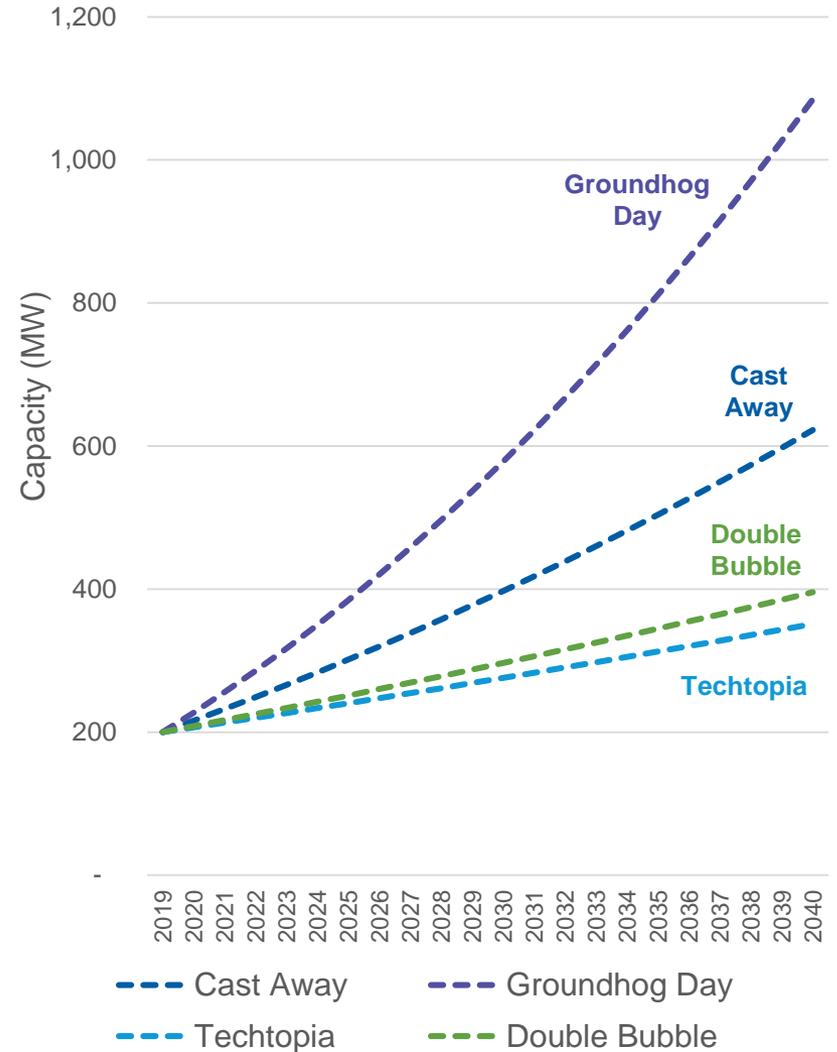
Additional information

DER TRAJECTORIES: ROOFTOP PV

Residential Rooftop PV Capacity

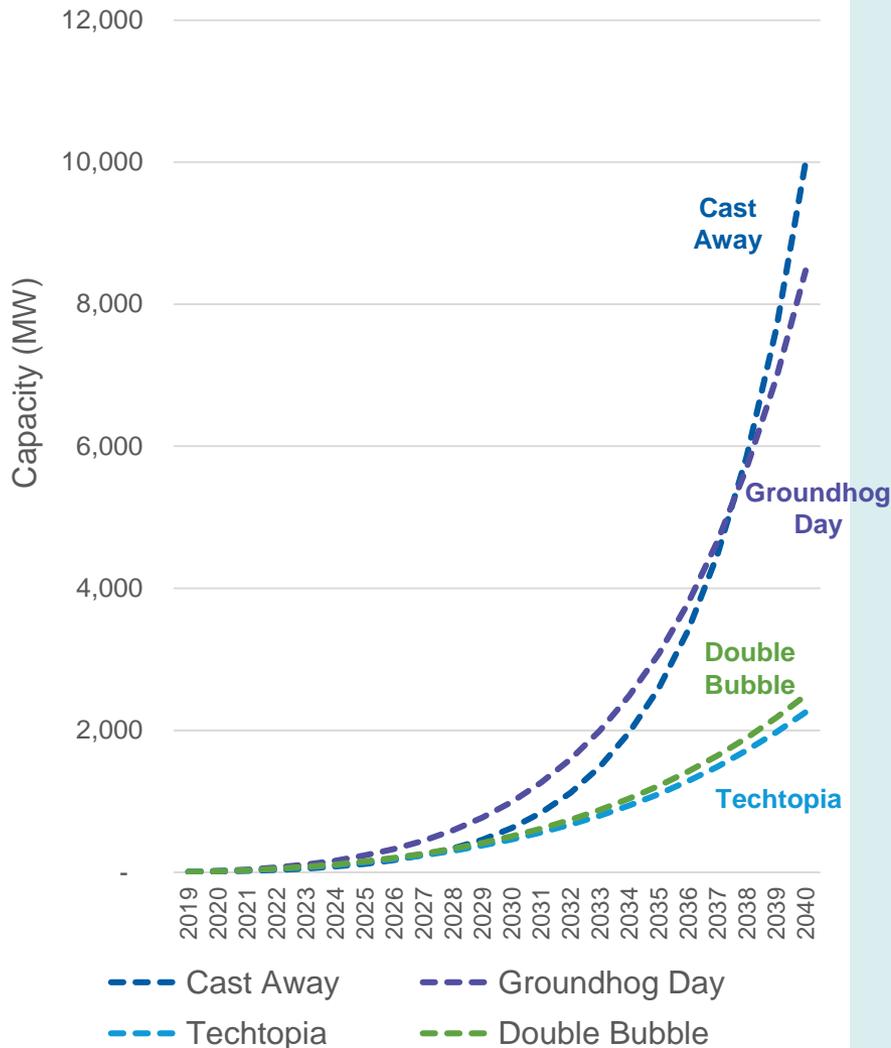


Business Rooftop PV Capacity

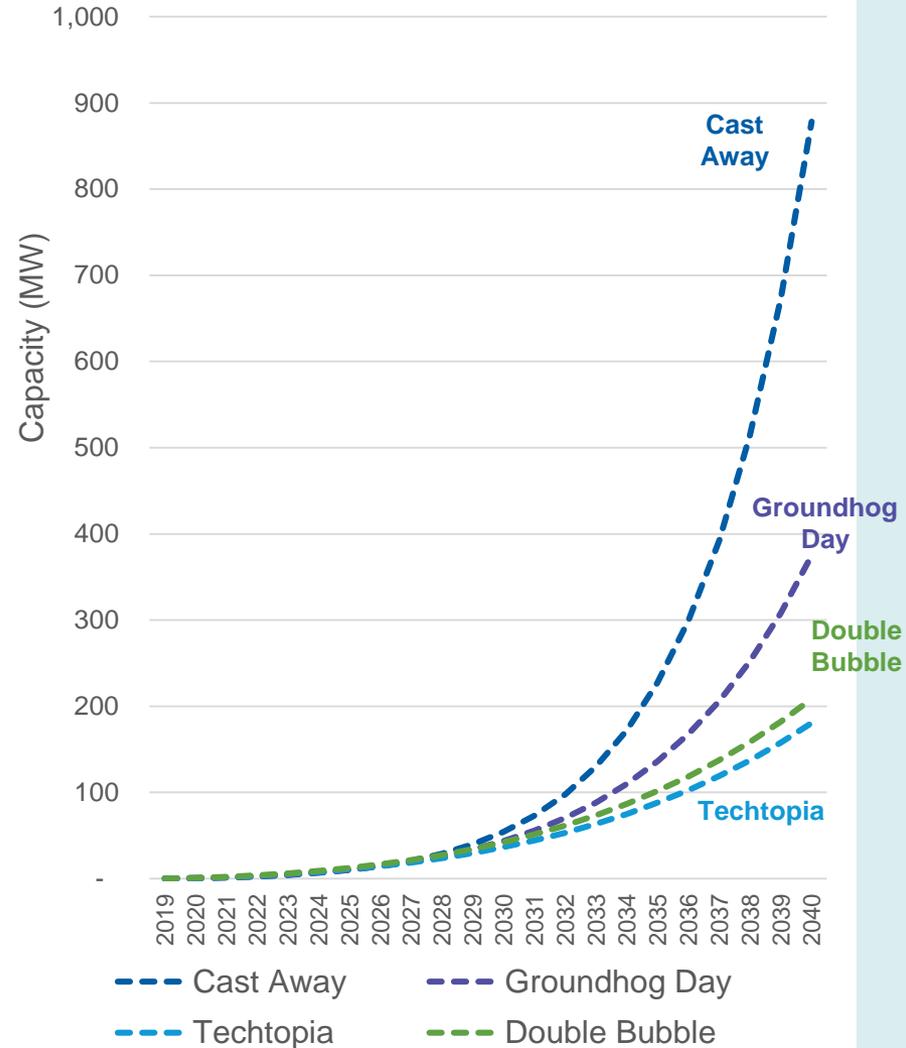


DER TRAJECTORIES: BATTERIES

Residential Battery Capacity

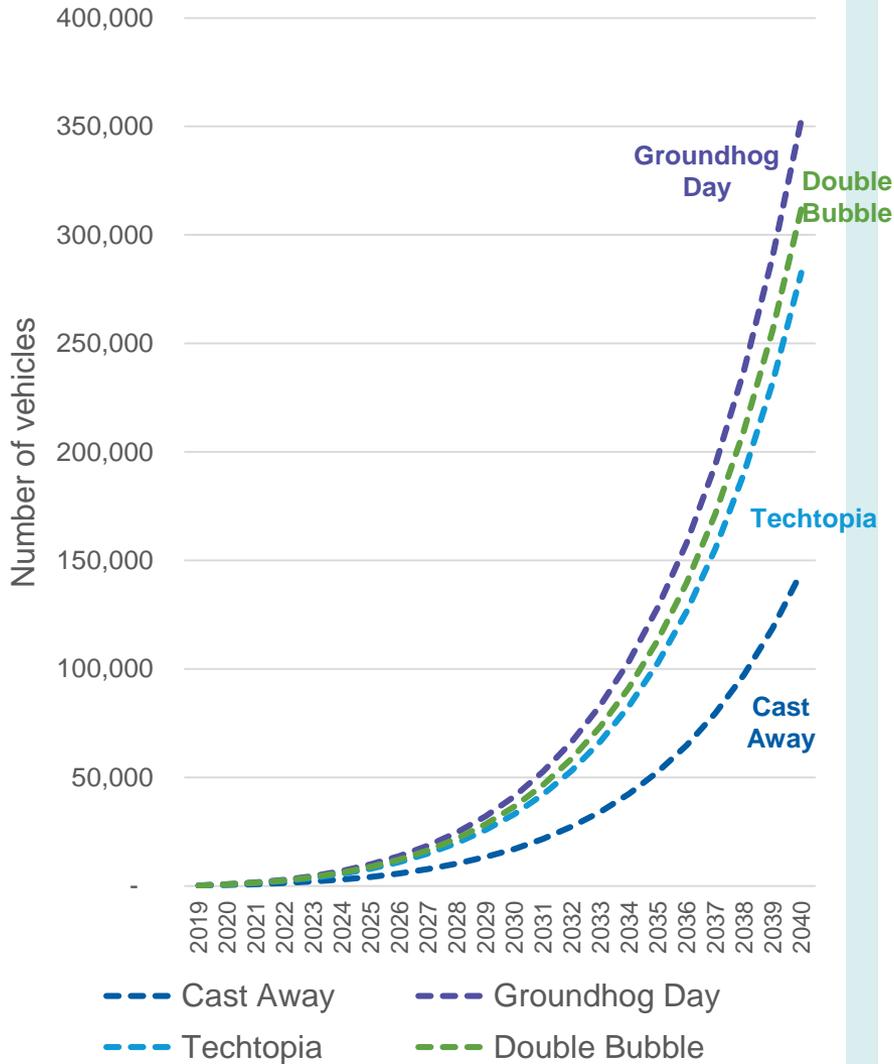


Business Battery Capacity



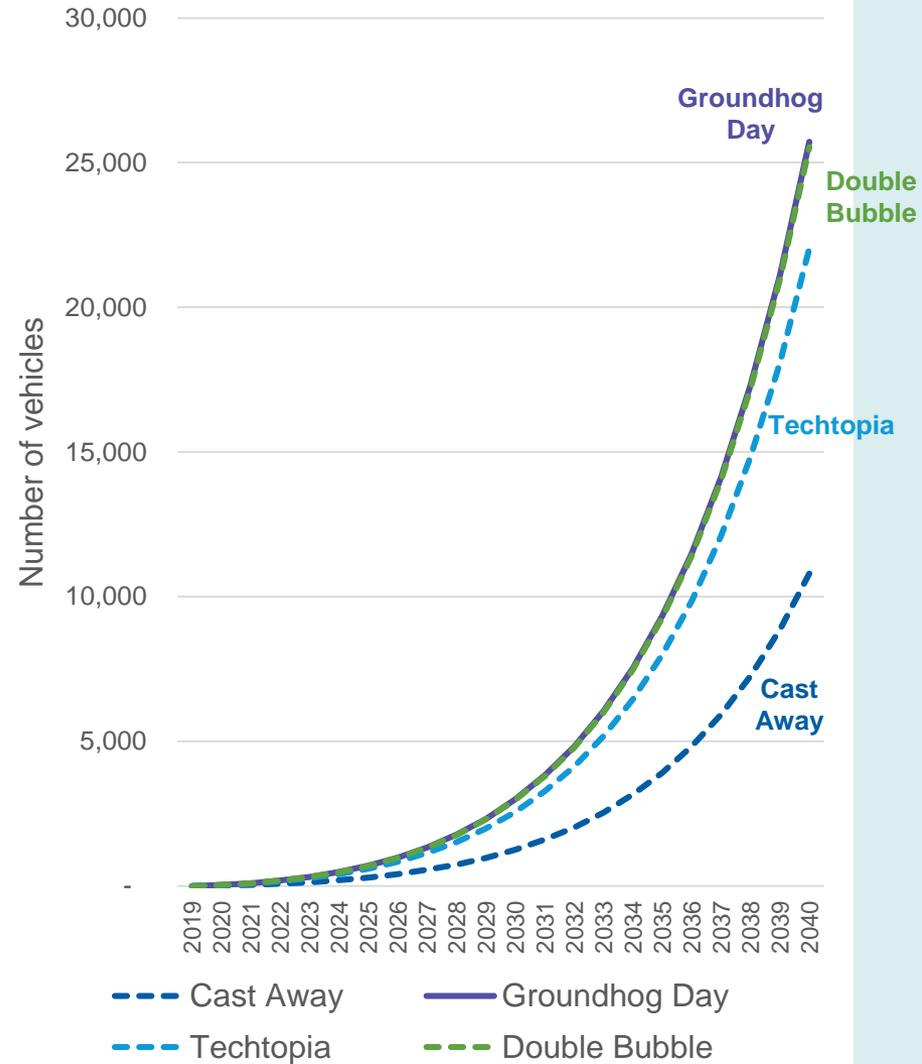
DER TRAJECTORIES: ELECTRIC VEHICLES

Residential Electric Vehicles



Source: Western Power

Business Electric Vehicles



Department of Treasury