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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
Focus on SWIS
~1.3 million energy consumers
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.

Guide **policy, market and regulatory changes**

Guide **future investment** in the short-term (least regrets) and medium / long term (less certain)

**Inform stakeholders** (market participants, customers, future investors, regulators and Government) and help them **make informed decisions**
ROLES AND RESPONSIBILITIES

- **Energy Transformation Implementation Unit**: Project leader/manager, provider of policy development insights
- **westernpower**: Provider of network development insights and data
- **AEMO**: Provider of system / market development insights

**Market participants**
- Provide data, input and feedback

**Modelling consultant**
- Provider of external modelling expertise
PROJECT DELIVERY APPROACH

Major project deliverable phases

**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)
**MODELLING PROCESS**

- **Input assumptions**
  - 4 scenarios to capture various possible futures
  - Demand forecast (system-wide and locational/nodal)
  - Technical
  - Policy settings
  - Economics

- **Modelling**
  - System and network assessment
  - Least cost expansion model
  - Market dispatch model

- **Results**
  - Identification of risks and issues to be addressed
  - Supply, storage and network development needs and opportunities
  - Connection opportunities (zones / locations)
  - Total system cost

4 scenarios to capture various possible futures
**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

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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
Techtopia

Technological change places downward pressure on energy costs.
Medium economic growth
High de-carbonisation
High DER uptake
High utility scale renewables
Urban balanced demographic forecast

Groundhog Day

Renewables thrive, but reliance on the network remains high.
Medium economic growth
High de-carbonisation
Extremely high DER uptake
Medium utility scale renewables
Urban balanced demographic forecast

Double Bubble

Booming economy with limited global action on climate change.
High economic growth
Medium de-carbonisation
Medium DER uptake
High utility scale renewables
Extreme climate demographic forecast

Cast Away

Leaving the grid with muted economic growth.
Low economic growth
Low de-carbonisation
Low (on grid) DER uptake
Low utility scale renewables
Urban sprawl demographic forecast
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.

Population growth

Economic growth

Mining growth

Non-mining growth

Urbanisation

Ruralisation

Climate Change

Self generation

Localised generation

Centralised generation
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

Source: Western Power
ECONOMIC DRIVERS

Underlying Energy Consumption (GWh)

- Individual demand profiles
- Diversification
- Adoption of emerging tech

Consumption influences

- Population growth
- Economic growth
- Energy efficiency

Modelling includes

Source: Western Power
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

- 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 charging**
  - 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.
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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.

Source: Western Power
MAXIMUM DEMAND – FOUR SCENARIOS

Source: Western Power
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

Source: Western Power
DER thrives, but reliance on the network remains high

Source: Western Power
Technological change places downward pressure on energy costs

Source: Western Power
Booming economy with limited global action on climate change

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

Source: Western Power
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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For further information, please visit our webpage:  
Appendix

Additional information
DER TRAJECTORIES: ROOFTOP PV

Residential Rooftop PV Capacity

Capacity (MW)

2019 2020 2021 2022 2023 2024 2025 2026 2027 2028 2029 2030 2031 2032 2033 2034 2035 2036 2037 2038 2039 2040

Source: Western Power

Business Rooftop PV Capacity

Capacity (MW)

2019 2020 2021 2022 2023 2024 2025 2026 2027 2028 2029 2030 2031 2032 2033 2034 2035 2036 2037 2038 2039 2040

Source: Western Power
DER TRAJECTORIES: BATTERIES

Residential Battery Capacity

- Cast Away
- Groundhog Day
- Techtopia
- Double Bubble

Business Battery Capacity

- Cast Away
- Groundhog Day
- Techtopia
- Double Bubble

Source: Western Power
DER TRAJECTORIES: ELECTRIC VEHICLES

Residential Electric Vehicles

Business Electric Vehicles

Source: Western Power