True integration of renewables into the Utility Network

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Overview

- What is true integration?
- Current approach & constraints
- The economic considerations
- The required approach
- Future Direction
- Questions

True integration – the Definition!

- True integration:
  1) Achieving the maximum renewable generation (no constraints)
  2) Achieving the maximum CO_2 reduction (not shifting the location)
  3) Assist with dealing with peak energy demand (major capital $)
  4) Achieving the above at least cost / most economical

- Looking at two cases:
  1) Small Scale
  2) Large scale

Small Scale – Embedded Renewables

Statistics EE

- **98,675 Connected Premises**
  - 2 Hydro – 4.2kW in total
  - 71 Wind – 573kW in total
  - 98,602 Solar – PV 364MW
- **Semi Scheduled and Non Scheduled**
  - Bagasse 68MW
  - Diesel 50MW
  - Landfill Gas 5MW
  - Natural Gas 10MW
  - Wind 144MW
  - Solar 265MW
  - Hydro 165MW
- **Total 706MW**

Indication of embedded generation in EE

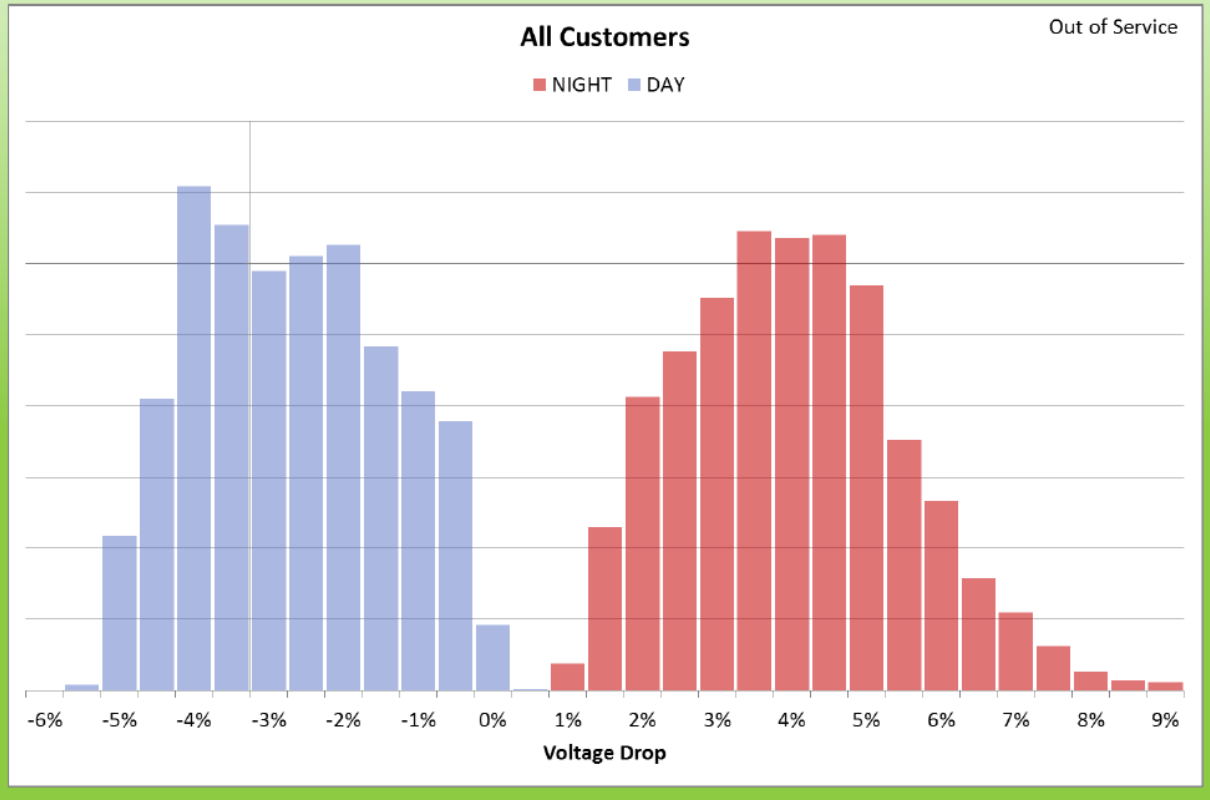
(Reference: Essential Energy – Embedded Generation Presentation)

Drake Landing
100% Solar Community

Residential Solar PV

(Reference: Essential Energy – VARMO Presentation)

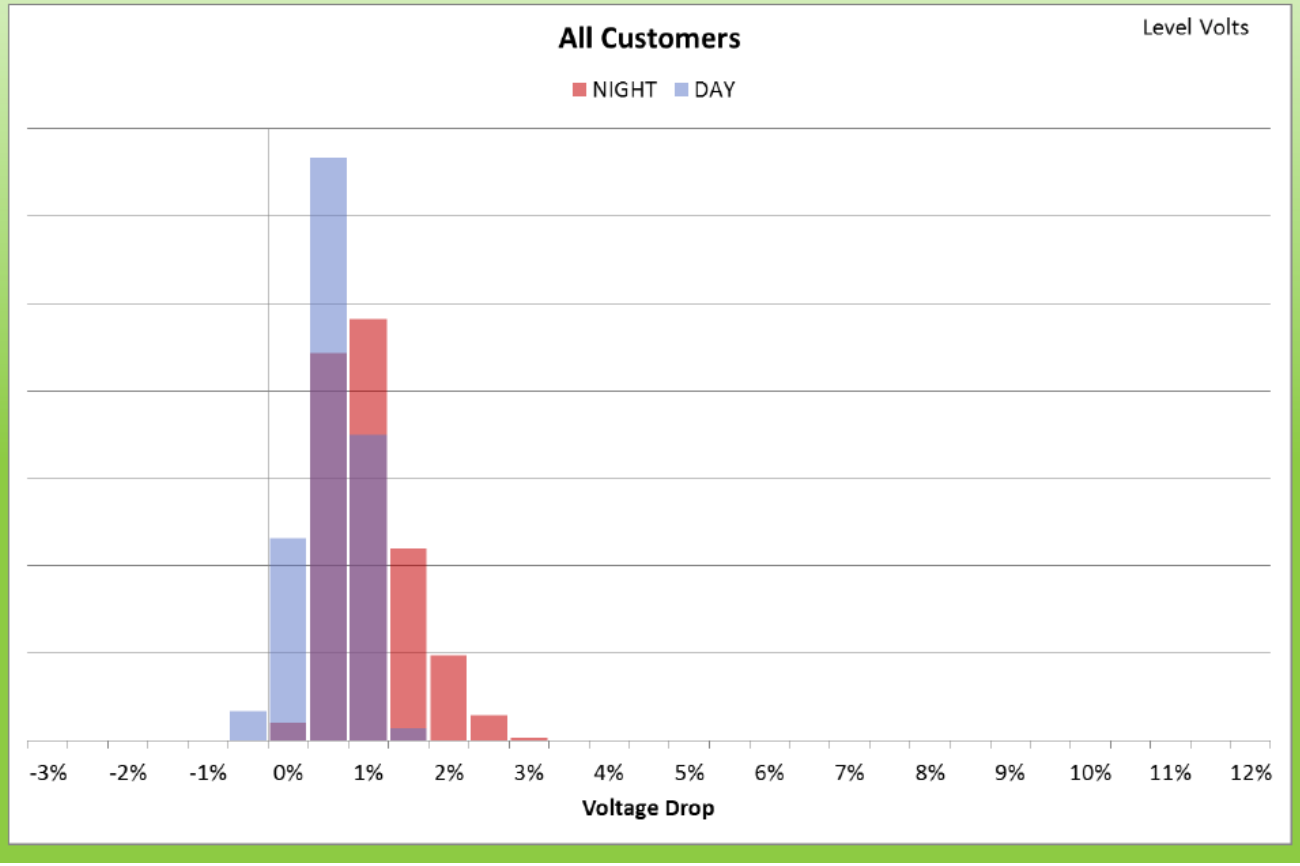
100% PV : NO COMPENSATION



Residential Solar – 100% PV – No Compensation/Limiting

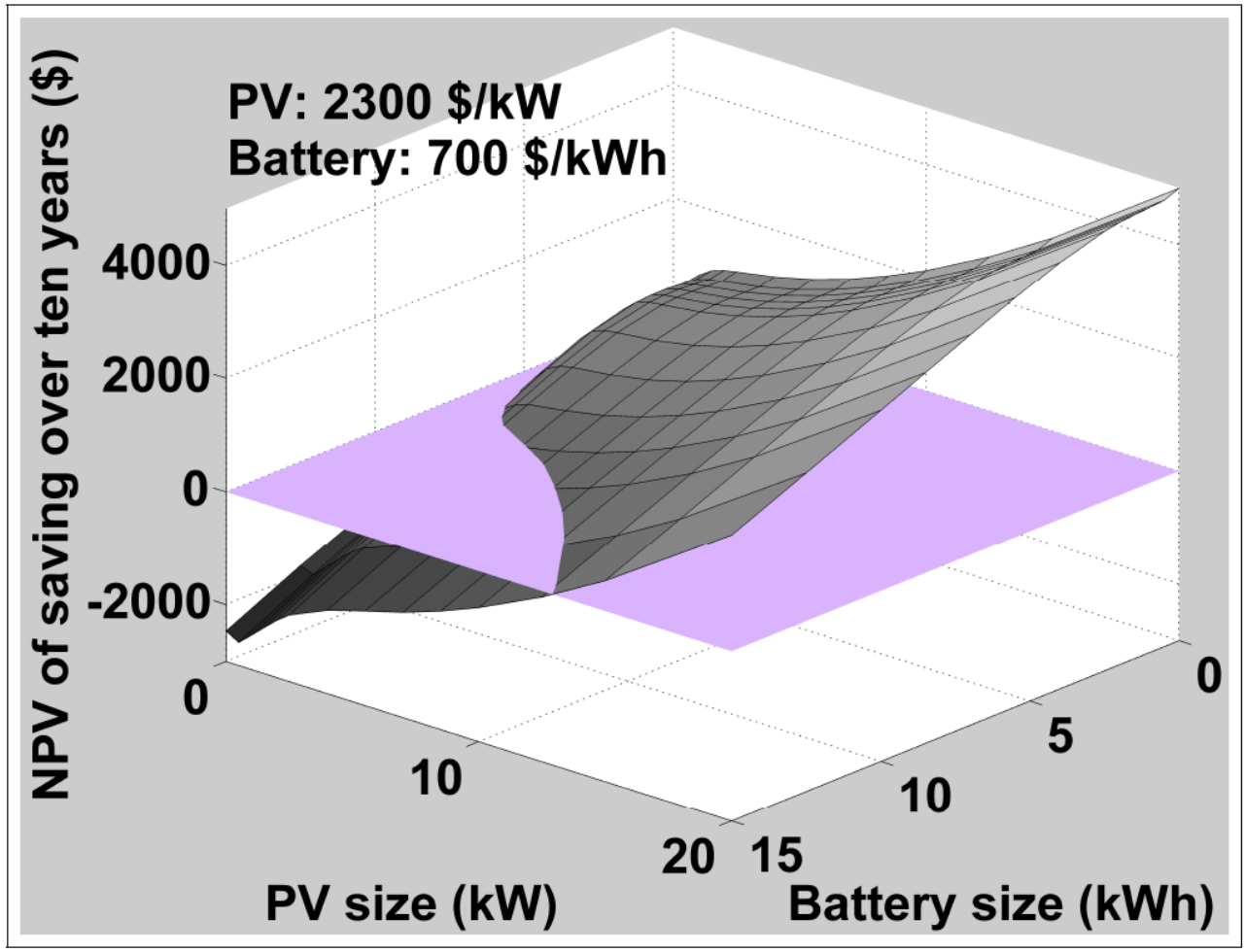
(Reference: Essential Energy – VARMO Presentation)

100% PV + VOLTAGE LEVELLING



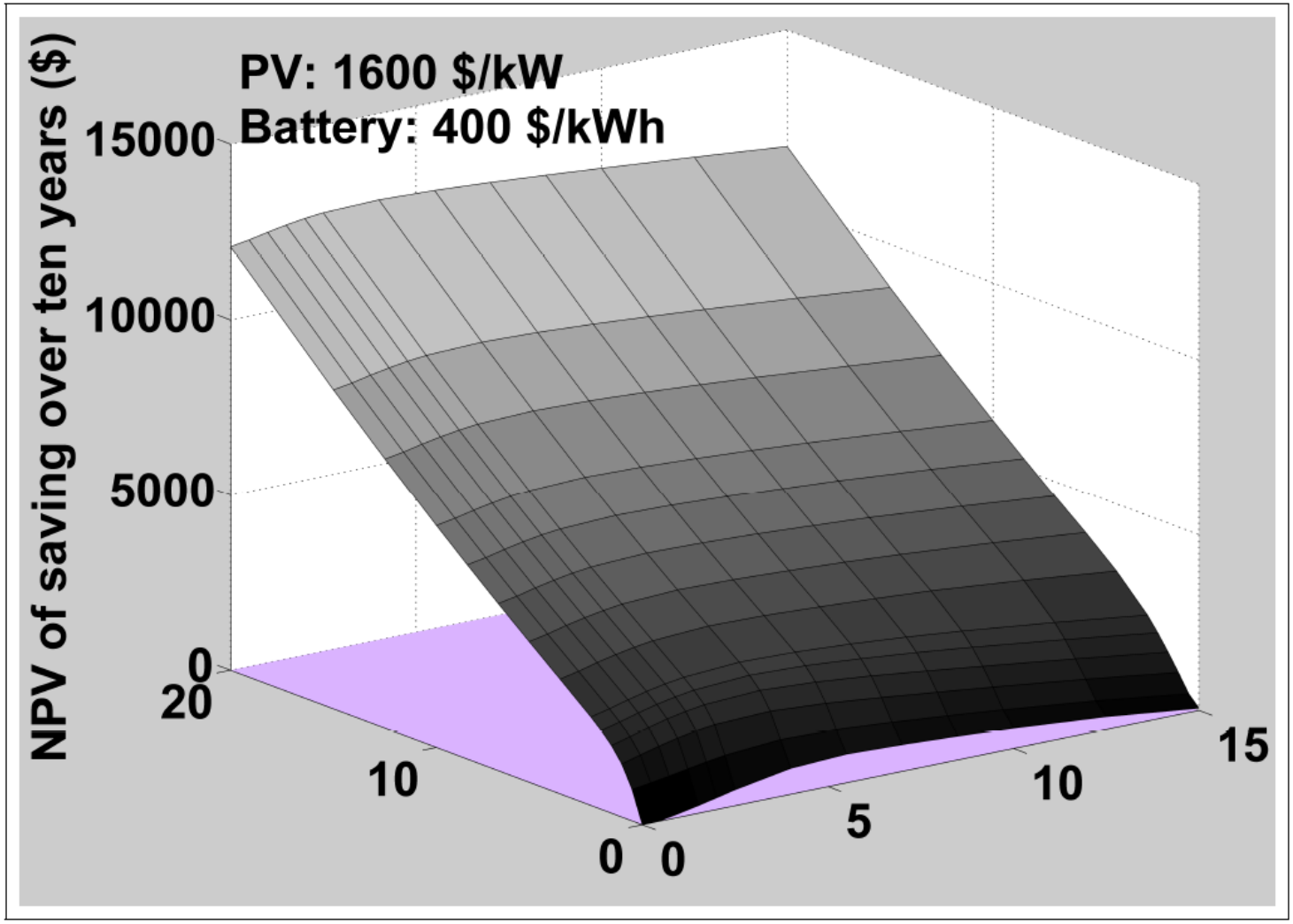
Residential Solar PV – with Compensation

(Reference: Essential Energy – VARMO Presentation)



Residential Solar PV vs Storage

(Reference: Professor Tony Vasallo – Batteries and PV's Presentation)



Residential Solar PV vs Storage

(Reference: Professor Tony Vasallo – Batteries and PV's Presentation)

Landfill Gas – Eastern Creek (>5MW)

Large Scale – Embedded Renewables

Large Scale Solar – Nyngan Solar Farm – 102MW

(Reference - Essential Energy – Nyngan Solar Farm Presentation)

- 250 Ha (1.0 km x 2.5 km)
- 1.35 Million Cells
- 152 inverters rated 0.67 MW each
- Connected in pairs to 1.5 MVA step up transformer
- 4 x 33 kV strings
- 120 MVA 132/33 kV transformer

Large Scale Solar – Nyngan Solar Farm

(Reference - Essential Energy – Nyngan Solar Farm Presentation)

Large Scale Wind – Capital Hill - 140MW
(View over Lake George)

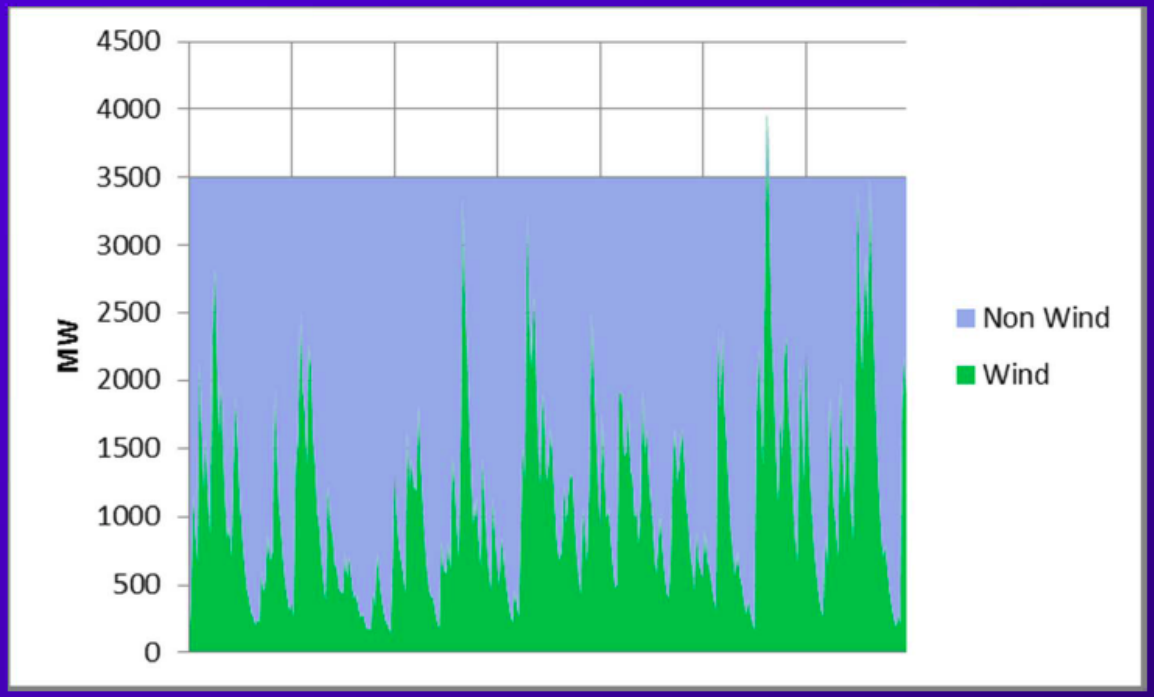
Large Scale Wind – Gullen Range, Goulburn - 165MW

Open Cycle Gas Generation – Colongra (Munmorah region – 660MW = 4x165MW)

Combined Cycle Gas Generation – Darling Downs
(630MW = 3x120MW+ 270MW)

Coal Fired Generation – Vales Point
(1320 MW = 2 x 660MW)

Modeled Large Scale Wind
Constant Load – Dancing Partner



70% of 0.65 Tonnes CO_2/MWH OCG= 0.45 Tonnes CO_2/MWH

Compare with 0.4 Tonnes CO_2/MWH for CCG

30% Wind

Reference: Dr Robert Barr – EESA National President

CO_2 Emissions

+

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Wind OCG CCG

Reference: Dr Robert Barr – EESA National President

Current Approach – Energy Blend / Portfolio

(Courtesy Dr Robert Barr – EESA National President)

Fuel	Tonnes of CO_2 /MWh	$ Capital Construction Cost/MW	Dispatch Capable	Ability to Rapidly Change Output
Brown Coal	1.4	**High**	Yes	**No**
Black Coal	0.9	**High**	Yes	**No**
Natural Gas Open Cycle Gas Turbine	0.65	**Low**	Yes	**Yes**
Natural Gas Combined Cycle Gas Turbine	0.4	**Medium**	Yes	**Moderate**
Hydro	0	**Extremely high**	Yes	**Yes**
Wind	0	**High**	No	**Nil**
Solar PV	0	**Very high**	No	**Nil**

The Required Approach for True Integration

- Small Scale
  1. Economic Battery Storage (targeting under $400 / kWh), or
  2. Economic small scale ‘Statcom’ (compensation) for voltage control
- Large Scale
  1. Large Scale Economic Storage
  2. More economic Statcom technology (compensation)
  3. Alternative Clean Energy solutions that are:
     a) Despatchable (generation when required to match load)
     b) Low CO_2 per MWh
     c) Low Capital Cost (to have competitive energy globally)
     d) Can be geographically located where required

Questions?