Stand Alone Power Systems as an alternative to grid connection at the fringe of the grid

February, 2012

SAPS at Fringe of Grid

- Electricity Market funded research:
  - Consumer Advocacy Panel
  - response to research for rural consumers
- Project team:
  - SKM MMA – energy market consultants
  - Sun, Wind and Power – SAPS installer
  - ATA Energy Team (Craig Memery, Damien Moyse)

SAPS at Fringe of Grid

- Research Objectives:
  - Understand ‘levellised’ energy cost of SAPS
    - average cost over 20 years
    - appropriate discount rates
    - range of SAPS designs (solar, wind based)
  - Understand / compare with grid connection costs
    - cost to the customer
    - cost to the network (i.e. all electricity consumers)
      - expensive for the customer might be cheap for the network (and all electricity consumers)

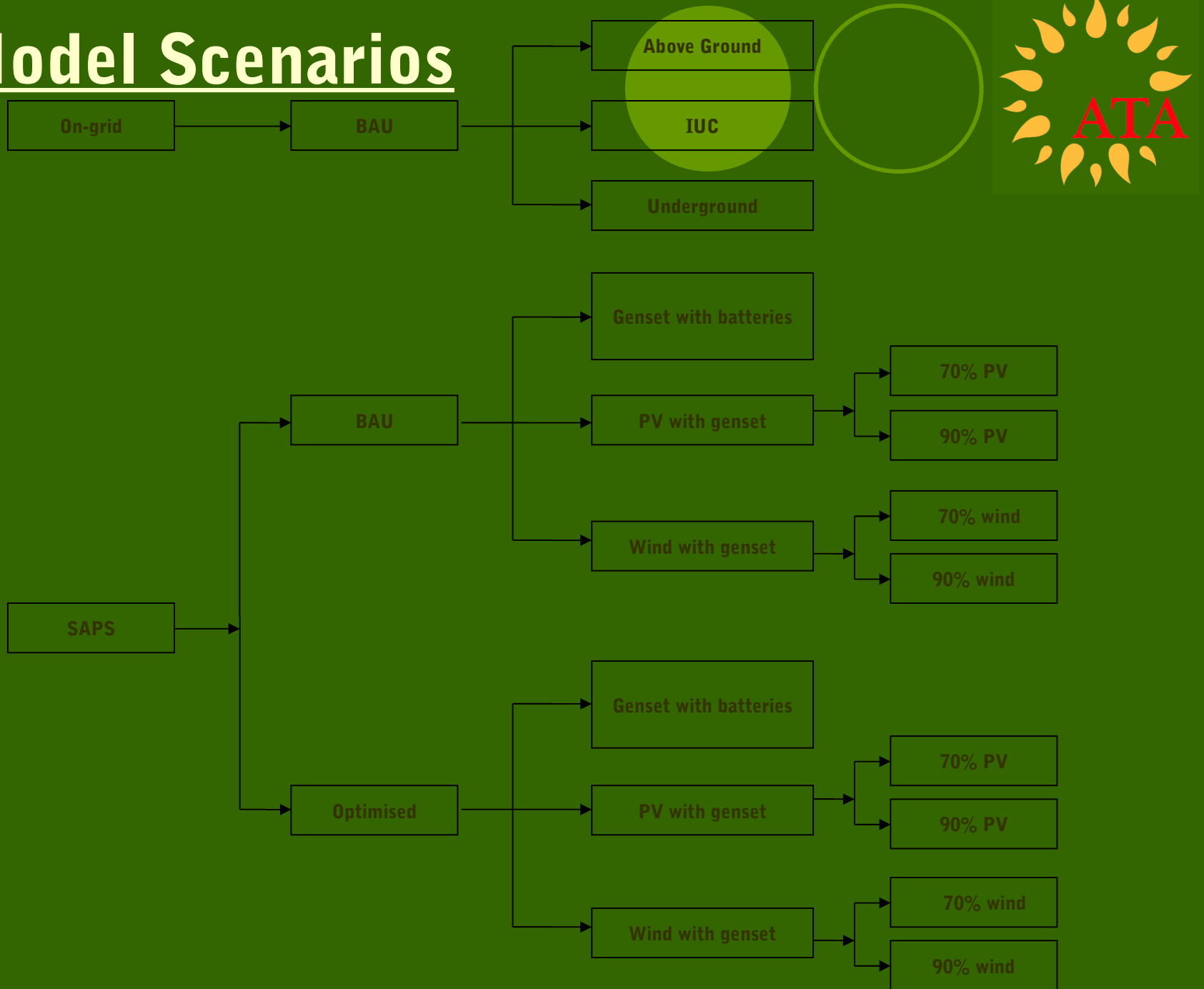
SAPS at Fringe of Grid

- Project Context:
  - Bushfire Mitigation – Vic Government response
  - Rising electricity prices – when will it be cheaper to go ‘off-grid’?
  - Falling costs of renewables (e.g. solar)
  - Energy efficiency opportunities
  - ATA member experience of off-grid

SAPS at Fringe of Grid

- Project Methodology – 4 approaches:
  1. Survey of rural ATA members:
     - consumption and appliance use data
     - potential for efficiency and fuel switching
     - understand price consumers prepared to pay
  2. SAPS specs & costings – SWAP
  3. Modelling of levellised energy cost
  4. Modelling of distribution network upgrade costs

Model Scenarios



BAU v Optimised

- BAU – Business as Usual:
  - On-grid or SAPS
  - BAU load requirement – 13.7 kWh per day
  - mean of ATA member respondents
- 'Optimised':
  - based on potential of ee & fuel switching
    - efficient appliance swaps
    - fridge, wash mach, dishwasher, water heating
    - no 'building fabric' improvements
  - Optimised load requirement – 12.1 kWh per day
    - ATA members already had high efficiency & wood
    - potential greater load reductions (e.g. 5-10 kWh day)

Assumptions

- Batteries:
  - ‘Hoppecke’ sealed gel
  - 50% depth of discharge
  - 1, 2 (70%) & 3 (90%) days of autonomy
  - no maintenance
- Wind:
  - 22 metre tower
  - skilled maintenance - $200 / yr
  - overhaul – 10th year @ 50% capex

Assumptions

- Gensets:
  - 13 KVA JCB generator
  - 3.5 Litres per hour
  - overhaul at 20,000 hrs
  - no scenario required overhaul in 20 yrs
  - routine maintenance in opex
- Inverter:
  - ‘Selectronic’ 7kW interactive inverter
  - no maintenance
- ✓ No residual value any components at 20 yrs

Fixed Parameters

Parameter	Values
Diesel price	$1.50/L
Discount rate	10%
Genset capex	$14,355
Genset opex, excluding fuel	$1.50/hour
Inverter capex	$9,290
Inverter opex	$100/year
Battery opex	$0/year
Wind turbine maintenance cost	$200/year
PV maintenance cost	$0/year
STC price	$35

Solar PV

Scenario	Installed Capacity	PV Capex ($)
SAPS BAU PV 70%	2.63	$14,700
SAPS BAU PV 90%	3.60	$20,160
SAPS Optimised PV 70%	2.63	$14,700
SAPS Optimised PV 90%	3.15	$17,640

Gensets & Wind

Scenario	Daily electricity use	Generator size (kVA)	Generator use (h/year)	Size of wind generator (kW)
1. On grid BAU	13.7	N/A	N/A	N/A
2. SAPS BAU Genset w Batteries	13.7	13	1,004	N/A
3. SAPS BAU PV 70%	13.7	13	302	N/A
4. SAPS BAU PV 90%	13.7	13	57	N/A
5. SAPS BAU Wind 70%	13.7	13	300	5
6. SAPS BAU Wind 90%	13.7	13	75	5
7. SAPS Optimised Genset with Batteries	12.1	13	877	N/A
8. SAPS Optimised PV 70%	12.1	13	252	N/A
9. SAPS Optimised PV 90%	12.1	13	77	N/A
10. SAPS Optimised Wind 70%	12.1	13	220	5
11. SAPS Optimised Wind 90%	12.1	13	100	5

Batteries

Scenario	Capacity (Amp hours)	Capex ($)
On-grid BAU	N/A	N/A
SAPS BAU Genset w Batteries	1,000	$21,120
SAPS BAU PV 70%	1,250	$22,440
SAPS BAU PV 90%	1,700	$33,792
SAPS BAU Wind 70%	1,250	$22,440
SAPS BAU Wind 90%	1,700	$33,792
SAPS Optimised Genset w Batteries	750	$15,312
SAPS Optimised PV 70%	1,000	$21,120
SAPS Optimised PV 90%	1,250	$22,440
SAPS Optimised Wind 70%	1,000	$21,120
SAPS Optimised Wind 90%	1,250	$22,440

Price Sensitivity Results

Point	Definition	Value
Indifference pricing point	Typically the current average market price	$18,000
Optimal pricing point	Least number of respondents reject because too expensive or too inexpensive	$20,000
Point of marginal inexpensiveness	Lower limit of acceptable prices	$13,000
Point of marginal expensiveness	Upper limit of acceptable prices	$28,000

Indicative Capex - $20,000

Indicative Opex - $580 per year

First Year Capital Costs

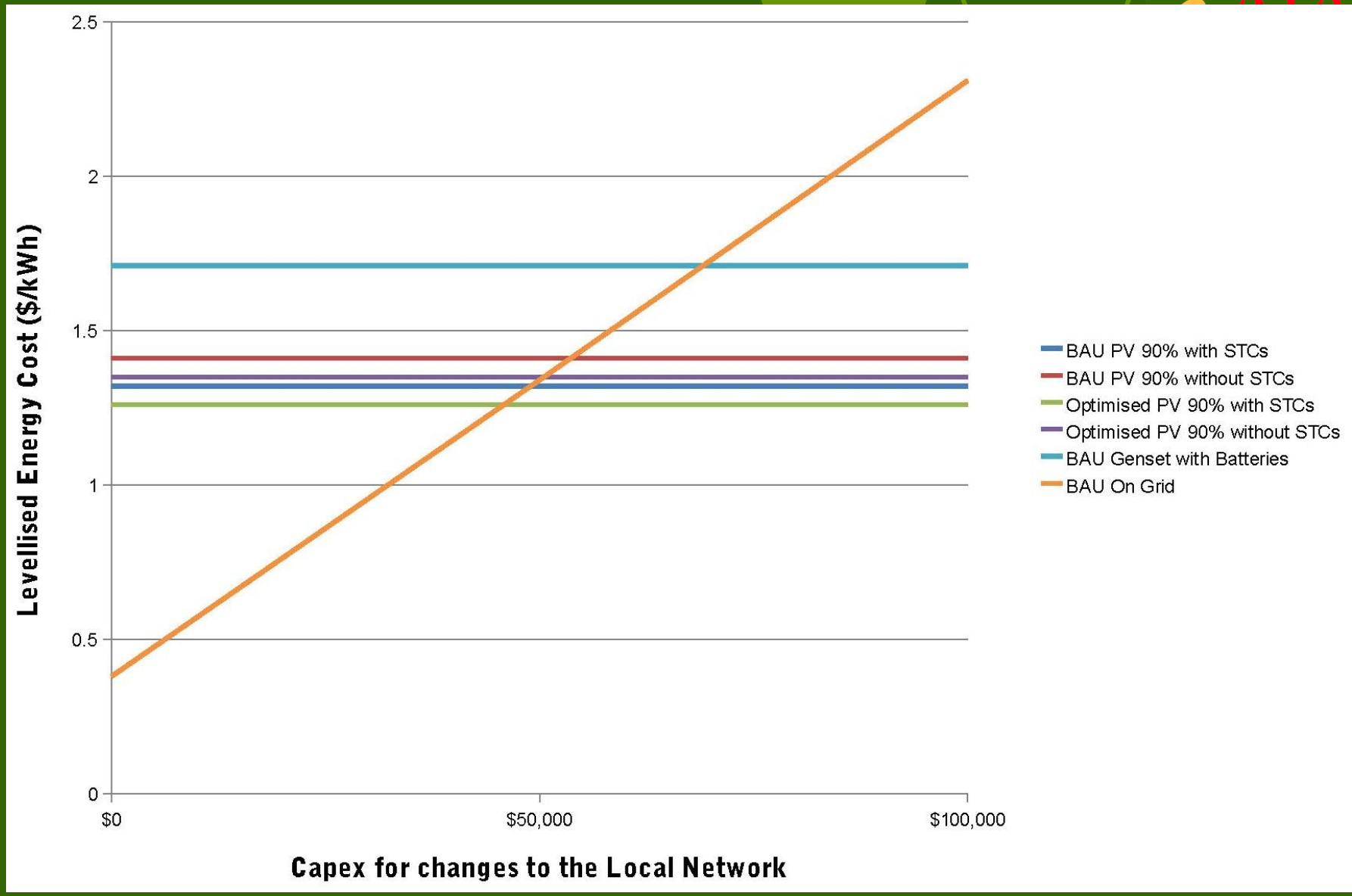
Scenario	Capital Cost ($)	Daily Electricity Load (kWh)
BAU genset with batteries	$49,242	13.7
BAU PV 70%	$60,744	13.7
BAU PV 90%	$78,557	13.7
BAU Wind 70%	$96,716	13.7
BAU Wind 90%	$109,203	13.7
Optimised genset with batteries	$45,061	12.1
Optimised PV 70%	$61,500	12.1
Optimised PV 90%	$65,826	12.1
Optimised Wind 70%	$97,472	12.1
Optimised Wind 90%	$98,924	12.1

Levellised Energy Cost

Scenario	Levellised Energy Cost ($/kWh)
On grid	$0.38
On grid at $50,000 network upgrade1	$1.34
On grid at $100,000 network upgrade1	$2.31
SAPS BAU Genset with batteries2	$1.71
SAPS BAU PV 70%2	$1.25
SAPS BAU PV 90%2	$1.32
SAPS BAU Wind 70%2	$1.85
SAPS BAU Wind 90%2	$1.90
SAPS Optimised Genset with Batteries2	$1.81
SAPS Optimised PV 70%2	$1.35
SAPS Optimised PV 90%2	$1.26
SAPS Optimised Wind 70%2	$1.96
SAPS Optimised Wind 90%2	$2.21

[1] 10% discount rate
[2] 5% discount rate

SAPS v Grid Augmentation



Discussion Points

- SAPS can be economic at around $50k-$70k of network capex
  - charged to all electricity consumers

But is the current cross over point lower?

- Energy efficiency – essential part of policy mix
- Constantly changing parameters
  - installed costs
  - incentives (STCs): on-grid or off-grid incentive?
  - distance / capital cost from grid (e.g. < $30k?)

Discussion Points

- Installed costs as at early 2010
  - solar $5.50 - $6 per watt (pre STCs)
  - 2012 - $4 - $4.50 per watt (pre STCs) – 33% reduction
- Batteries cost reduction?
  - mixed views
  - Renault-Nissan CEO – claim ‘Li-On’ battery (for solar PV) could be $190 / kWh by 2014
- Electricity prices
  - rising? – no question
  - how much?

Discussion Points

- BAU on-grid = $0.38c / kWh:
  - ‘averaged’ 11 retailer energy and fixed (supply) charges
  - energy charge - $0.21c / kWh
  - fixed (supply) charge - $0.69c per day (inc GST)
  - assumed 5% annual increase to 2030

  - Jan – July 2012 - most retailers up to $0.80c per day (fixed)
  - research tested flat rate only
  - Time of Use Tariffs exist, likely greater prevalence
  - grid-connect PV owners reassigned to ToU
  - case by case
  - test price rise scenarios – future research

Further Info

- For data / assumptions / design elements of SAPS – 3 docs in ATA Melb office:
  - ‘Preliminary assessment of stand alone power systems as an alternative to grid connections at the fringe of the grid’
  - ‘Supplementary modelling on stand alone power systems as an alternative to grid connection at the fringe of the grid’
  - ‘Summary for Policy Makers’
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