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1. Background
2. The Lochiel Park Green Village
3. The Green Features
4. Impacts on Energy Use, Peak Demand and GHG Emission
5. Householders' Interaction with Smart Technologies
6. Conclusions

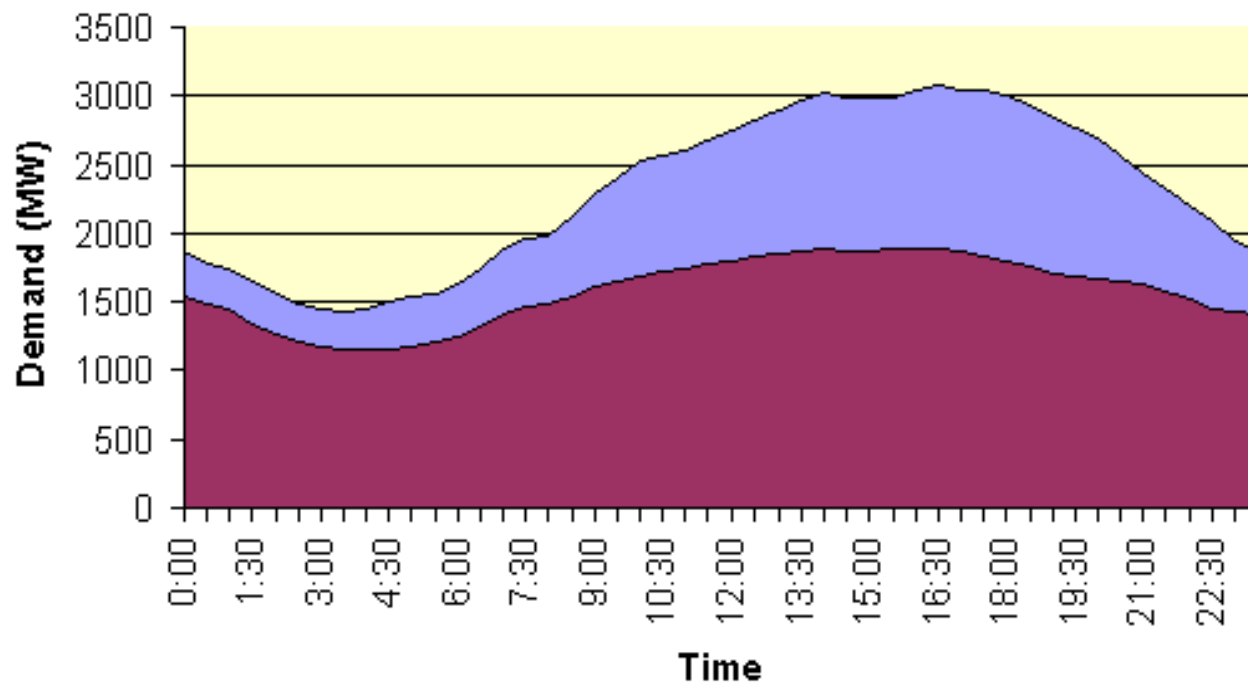
# BACKGROUND

SEC - ISST

- Residential buildings represent 20% of Australia's greenhouse gas emissions
- Residential buildings are responsible for escalating peak demand
- Lack of hard evidence of the impact of demand side management / distributed generation
- Lack of integrated technical/socioeconomic evaluation
- Australia's CSIRO Energy Flagship Clusters program
- 3 year project: July 2008 – June 2011

# BACKGROUND

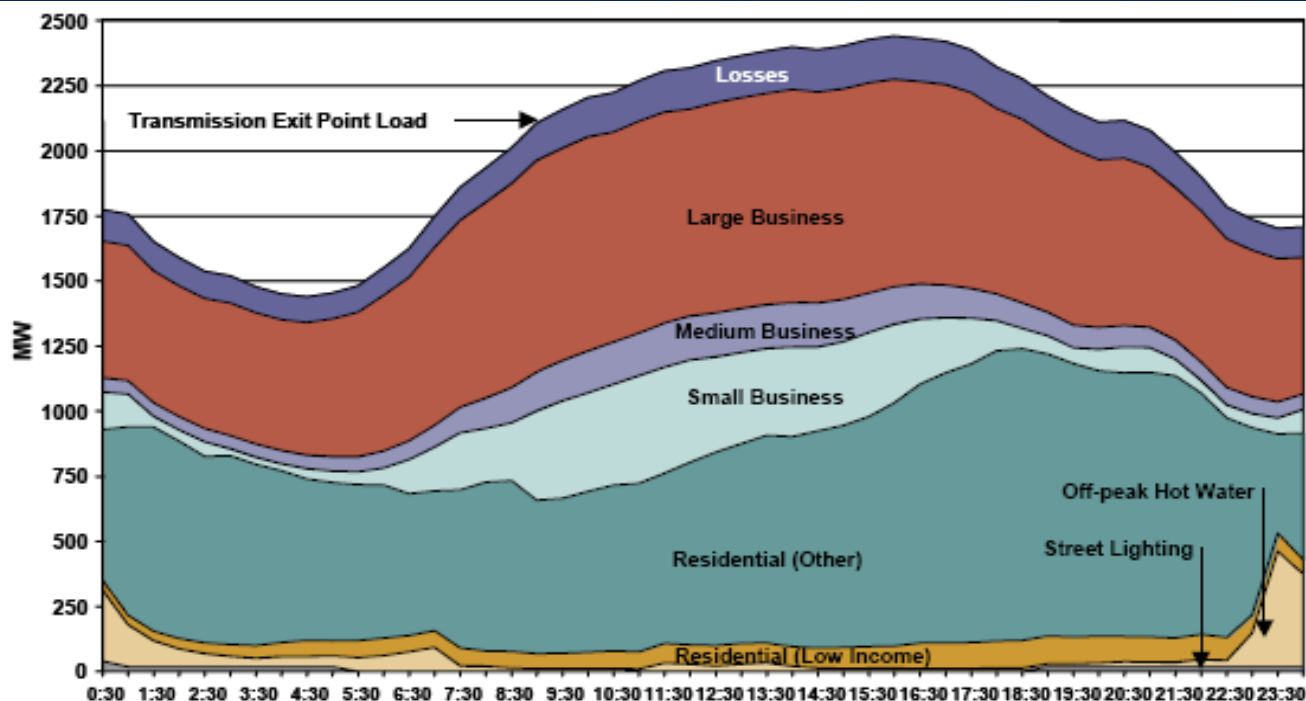
## Impact on Peak Demand



**South Australia's Total System Peak Demand and averaged across the period 1 December 2007 – 31 March 2008 (ESCOSA, 2008)**

# BACKGROUND

## Impact on Peak Demand



**Peak day load profile for the ETSA utilities system on 8 February 2001 (ESCOSA, 2007)**

# BACKGROUND

## Recent Peak Demand Related Events (Australia)

- extreme heat waves
  - dramatic increase in use of air conditioners
  - rise in state peak demand
  - load shedding (30 Jan 2009) – 90 MW power short fall
  - heat wave related deaths
- dwellings' total reliance of on air conditioners powered by conventional centralised electricity generation

# THE OBJECTIVES

- Two year monitoring program: to enable the validation of the energy, economic and social interaction models
- Hard evidence of the benefits of the greater use of smart features and distributed generation
- Developing practical experience in incorporating smart features and distributed energy
- An integrated technical, environmental, social and economic evaluation of the impact of intelligent and distributed energy features in the housing sector
- To show how well designed homes with passive design and smart features contribute to reducing energy consumption, peak demand and GHG emissions

# THE LOCHIEL PARK GREEN VILLAGE

- SA Government initiative with “a clear objective of building ecologically sustainable homes within a natural bush and parkland settings ...”
- Master plan finalised 2005
- 106 houses including social housing
- Released to market, November 06, mostly sold

## As of November 2009:

- 40 homes are being built
- 14 homes occupied – 5 detailed monitoring, 9 general monitoring





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# THE LOCHIEL PARK GREEN VILLAGE





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# THE LOCHIEL PARK GREEN VILLAGE



- Total Site Area: 14.71 Ha
- Open Space: 10.51 Ha
- Residential/Housing: 4.20 Ha

# THE GREEN FEATURES

- passive design: homes with minimum 7.5 stars (using AccuRate)
- Use low embodied energy building materials
- best available energy efficient appliances
- use of solar electricity : 1 kW/100m<sup>2</sup> of living area
- electrical load limiting devices (2, 3 or 4 kVA)
- special bundled tariff incorporating green power
- smart metering and energy usage display
- gas boosted solar hot water systems
- Day lighting, skylights and energy efficient lights

*	MJ/m <sup>2</sup> -a	*	MJ/m <sup>2</sup> -a
1	<b>480</b>	6	<b>96</b>
2	<b>325</b>	7	<b>70</b>
3	<b>227</b>	8	<b>46</b>
4	<b>165</b>	9	<b>22</b>
5	<b>125</b>	10	3

Adelaide NatHERS Star Band





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# IMPACTS ON ENERGY USE, PEAK DEMAND AND GHG EMISSIONS



2003: 2.5 stars



2008: 5 stars



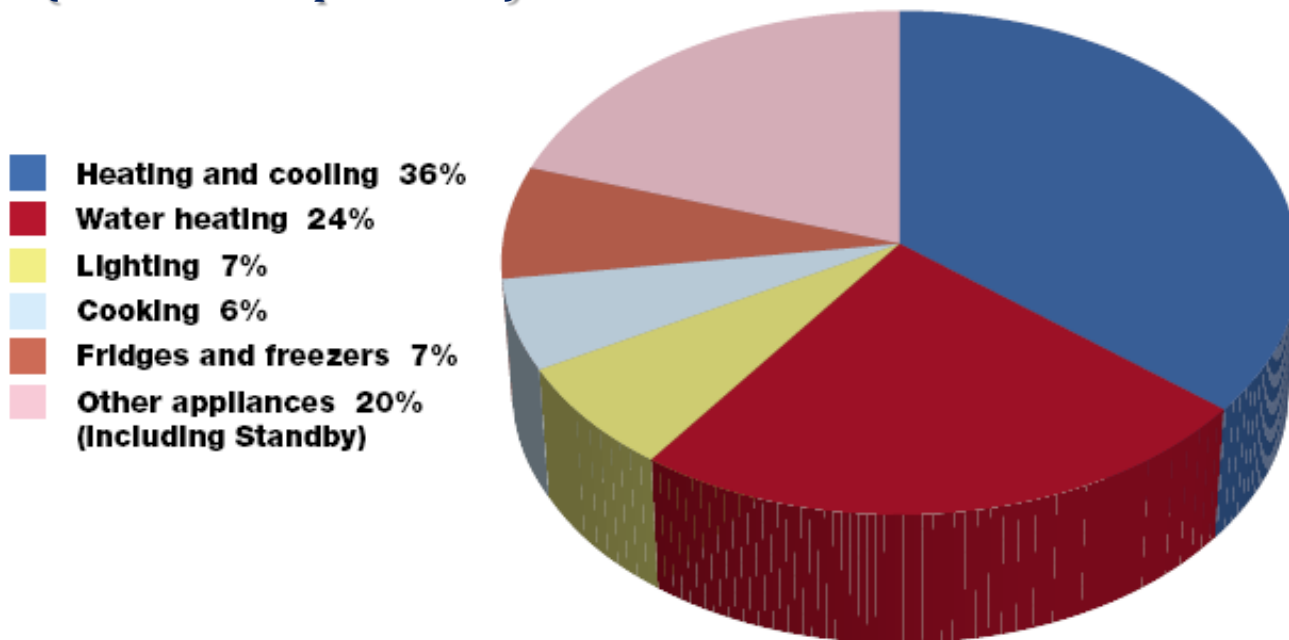
2009: 7.5 stars

# IMPACTS ON ENERGY USE, PEAK DEMAND AND GHG EMISSIONS

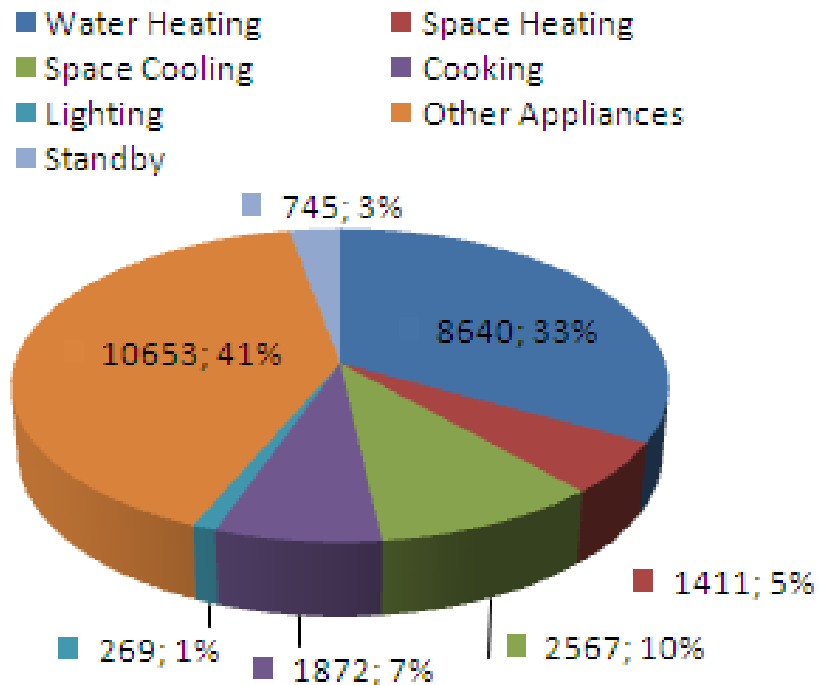
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## Typical SA House Energy Use

([www.lochielpark.com](http://www.lochielpark.com))



# IMPACTS ON ENERGY USE, PEAK DEMAND AND GHG EMISSIONS



Breakdown of energy use in the 7.5 star house

# IMPACTS ON ENERGY USE, PEAK DEMAND AND GHG EMISSIONS

## Specifications of the 7.5, 5 and 2.5 star rated houses

Item	7.5 star Home	5 star home	2.5 star Home
Floor	Standard concrete with carpet + felt underlay	Standard concrete with carpet + felt underlay	Concrete slab
Roof insulation	R4	R2.5	R2.5
Roof construction	Metal deck	Metal deck	Terracotta tiles
Ceiling	R2 insulation with ceiling fan	R2 insulation with ceiling fan	R1 insulation no ceiling fan
External wall material	Reverse brick veneer with insulation	Brick veneer un-insulated	Brick single skin
Shading devices	Holland blind	Heavy drapes only	Open weave
Windows tightness	Weather-stripped	All windows gap size set to medium	All windows gap size set to large
Door tightness	Weather-stripped	All door gap sizes set to medium	All door gap sizes set to large
Glazing	Low E double glazing	Single glazing	Single glazing

## Specifications of the 7.5 star rated house

Roof/ceiling insulation	R 4.0
External wall insulation	R 3.5
External wall	Reverse brick veneer with R 2.5 insulation
Floor	Standard concrete with carpet and felt underlay
Windows	Double glazed 4 mm clear with 12 mm argon filled and low E film.
Door	Solid construction
Area-adjusted heating requirement	15 MJ/m <sup>2</sup> -annum
Area-adjusted cooling requirement	37.5 MJ/m <sup>2</sup> -annum
Cooling / heating system	Reverse cycle (6 star)
Hot water system	Solar / gas boost
Installed PV system capacity	2.4 kW



# IMPACTS ON ENERGY USE, PEAK DEMAND AND GHG EMISSIONS

**Annual Energy (Electricity and Gas) Consumption and GHG emissions (in MJ)**

Star Rating	2.5		5		7.5	
Energy source	E	G	E	G	E	G
Water Heating	21240			22830		8640
Space Heating	4693		3137		1411	
Space Cooling	5172		3608		2567	
Cooking		2527		2246		1872
Lighting	1130		848		269	
Other Appliances	11113		10883		10653	
Standby Energy	2167		924		745	
Total energy consumption	45516	2527	19399	25076	15645	10512
Total energy generated					15552	
Total electricity consumption	45516		19399		93	
Total gas energy consumption		2527		25076		10512
Emissions - electrical, kg-CO <sub>2</sub> -e	13200		5626		27	
Emissions - gas, kg-CO <sub>2</sub> -e		186.5		1850.6		775.8
Total emissions	13386		7476		803	

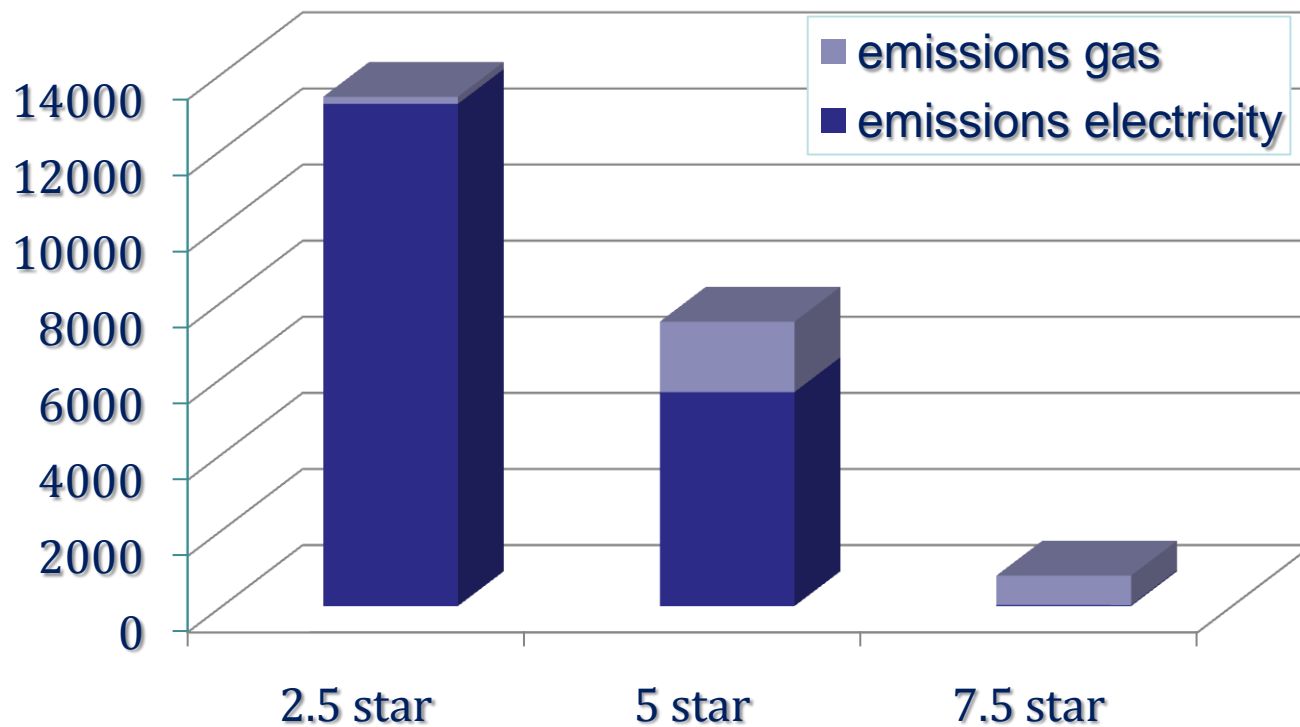
# IMPACTS ON ENERGY USE, PEAK DEMAND AND GHG EMISSIONS

## Peak Load Performance of the 2.5, 5 and 7.5 star houses

House Star Rating	2.5	5	7.5
Average Power Demand, W	1062	372	349
Load contribution from air conditioning, W	6700	3660	1430
Locally Generated Power during peak period, W	0	0	600
Peak Power Demand without LGEP <sup>*)</sup> , W	7762	4032	1779
Peak Power Demand with LGEP, W	7762	4032	1179
Peak Demand Ratio without LGEP	7.3	10.8	5.1
Peak Demand Ratio with LGEP	7.3	10.8	3.4

<sup>\*)</sup> LGP = Locally generated electrical power

# IMPACTS ON ENERGY USE, PEAK DEMAND AND GHG EMISSIONS



# IMPACTS ON ENERGY USE, PEAK DEMAND AND GHG EMISSIONS

- Combined passive design, energy efficient appliances and local solar energy use will result in:
  - **Net zero energy homes**
  - reduced peak demand
  - Reduced GHG emissions
- We are achieving this in the Lochiel Park Green village

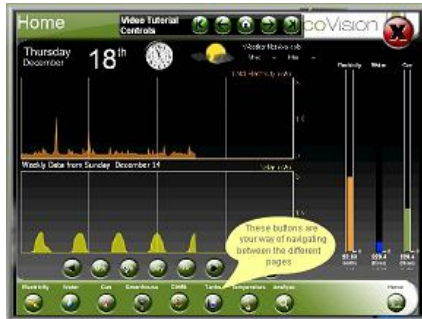




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# HOUSEHOLD INTERACTION WITH SMART TECHNOLOGIES

- Real time display and touch screen interaction & control
- Enables householders to:
  - check real time
    - use of energy, water and gas
    - energy generated by PV panels
    - cost of energy and water used
    - GHG emitted
  - program the load limiting device
- Under investigation – we are developing qualitative instruments to study related human behavior and attitude
- Preliminary observation:
  - Householders “enjoy / exited”
  - Positive impact on sustainability behavior





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# HOUSEHOLD INTERACTION WITH SMART TECHNOLOGIES

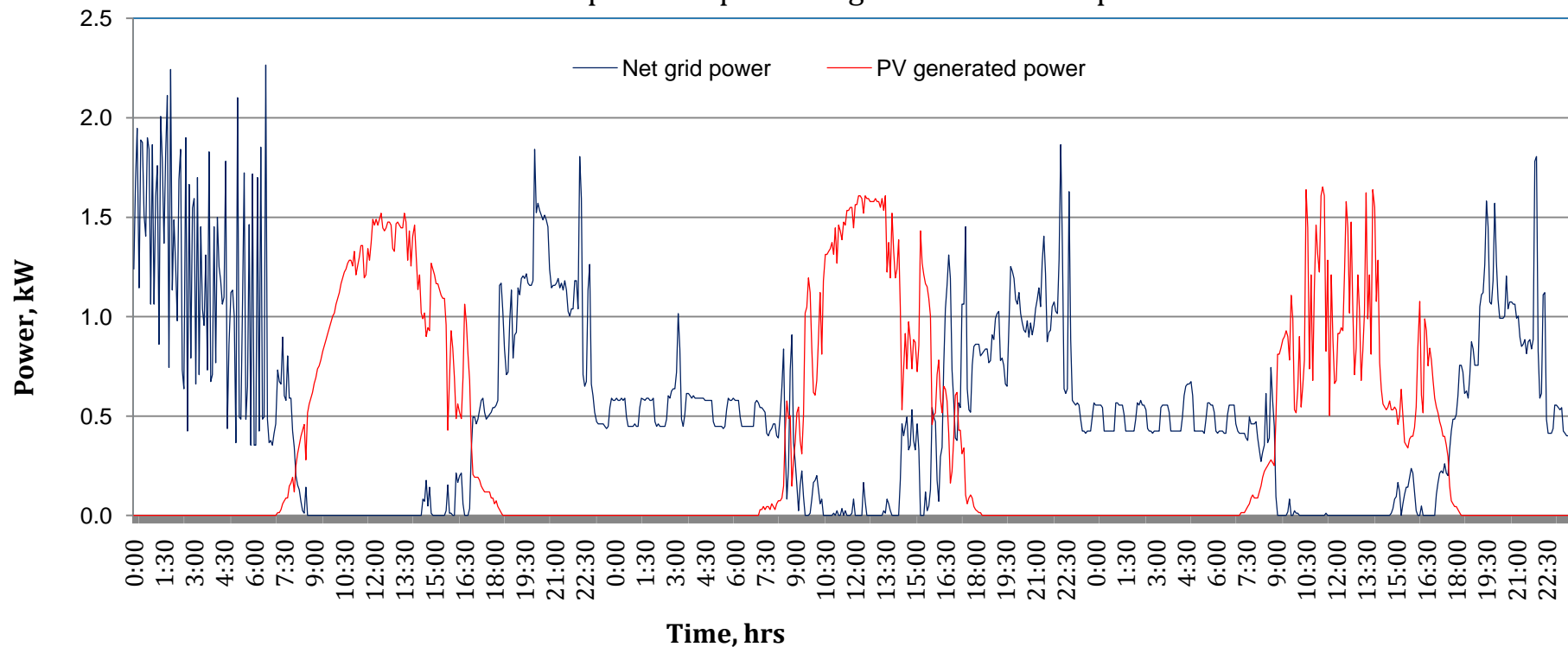
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An email message from a Lochiel Park Green Village householder (winter 2009)

*“Just thought you might be interested. It is 14 degrees outside today. In the family room of our house, it is 24 and near the main windows, it is 30 .... We are in short sleeves today”*

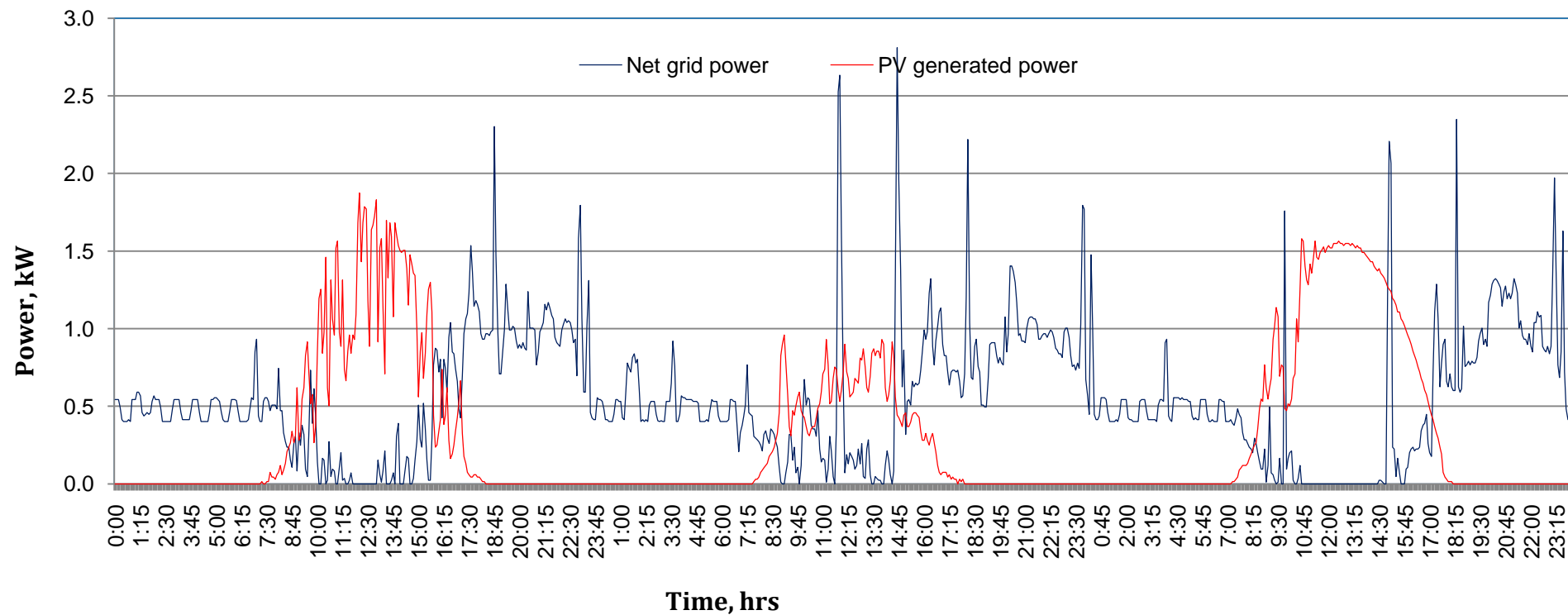
# SOME PRELIMINARY DATA

Electric power imported & generated: 1 – 3 April 2009



# SOME PRELIMINARY DATA

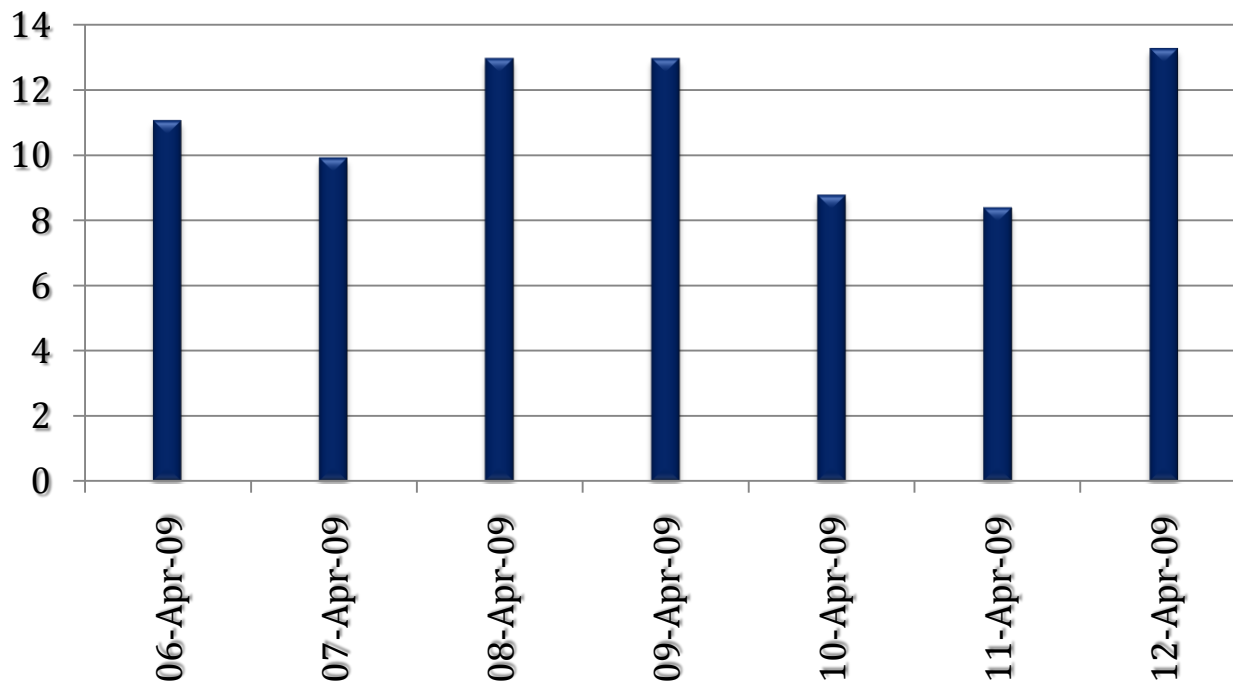
Electric power imported & generated: 4 – 6 April 2009





## SOME PRELIMINARY DATA

Daily Gas Consumption (MJ): 6 – 12 April 2009



## SOME PICTURES FROM LOCHIEL PARK GREEN VILLAGE

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SEC - ISST





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## SOME PICTURES FROM LOCHIEL PARK GREEN VILLAGE







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## SOME PICTURES FROM LOCHIEL PARK GREEN VILLAGE



# CONCLUSIONS



combined passive design, energy efficient appliances, local solar energy use and smart features will result in:

- net zero energy homes
- reduced peak demand of dwellings
- reduced GHG emissions

## USEFUL LINKS

- Lochiel Park Green Village:
  - [www.lochielpark.com.au](http://www.lochielpark.com.au)
  - [www.lochielparkonline.com.au](http://www.lochielparkonline.com.au)
- ISST-UniSA: [www.unisa.edu.au/isst/](http://www.unisa.edu.au/isst/)
- CSIRO iGrid Cluster Website: [www.igrid.com.au](http://www.igrid.com.au)
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