Intelligent Grid Cluster Industry Forum

Household Monitoring and the Intelligent Grid

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Introduction

Talk discusses, with reference back to the i-grid, what household monitoring can tell us about,

- **Residential Energy Use**
- **Impact of Temperature on Load and Peak Load**
- **Impacts that PV and Electric Vehicles could make on Load Profiles**

AUSTRALIAN CONSERVATION FOUNDATION

CONSUMPTION ATLAS

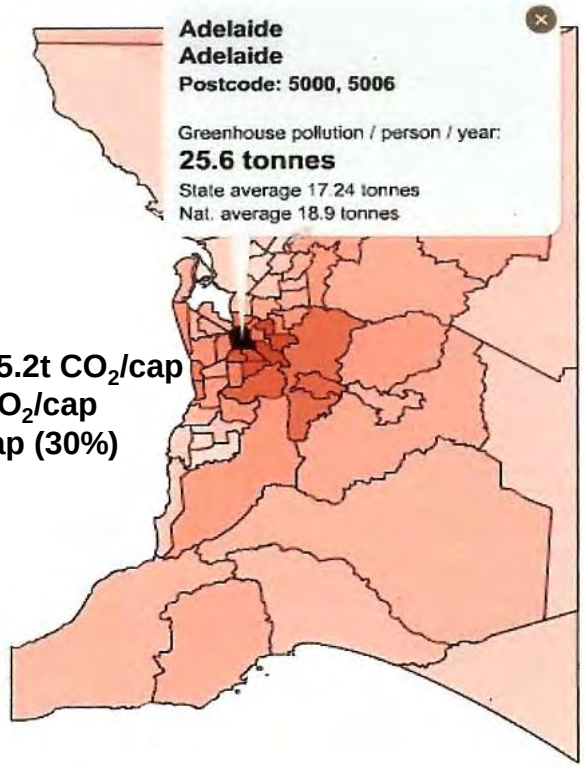
Home | Greenhouse Pollution | Water Use | Eco-footprint | postcode: 5000 GO or state

GREENHOUSE POLLUTION IN SOUTH AUSTRALIA

Burning fossil fuels for energy accounts for most greenhouse pollution. This energy is used mainly in the production, transport and retail of our goods and services. The goods and services consumed by an average Australian create a total of nearly 19 tonnes of greenhouse pollution a year. That's about the same amount created by 9 round car trips from Perth to Melbourne.

The consumption patterns of households in Adelaide and surrounding areas account for the highest greenhouse pollution levels created by South Australian residents. Other greenhouse pollution hot spots include the Barossa Valley wine region and the booming mining district of Roxby Downs. Sources of greenhouse pollution vary from region to region, depending on the dominant mode of transport, the amount of beef eaten and the carbon intensity of local electricity production. Overall, greenhouse pollution in the state is about 10% lower than the national per capita average.

HOW DO I RATE?



Electricity + gas = 5.2t CO_2/cap
Transport = 2.6 t CO_2/cap
Total = 7.8 t CO_2/cap (30%)
17.8 t left

CONSUMPTION PROFILE

SA Capital

What types of consumption are having the biggest impact in this area? Click on items below for more information.

Construction & renovations	9.1%	Food	23.3%
Electricity	17.9%	Clothing & fabrics	3.7%
Gas & firewood	2.5%	Furniture & appliances	3.2%
Other household operations	2.6%	Books & magazines	2.2%
Transport	10.0%	All other goods & services	25.0%

FAQ

- How does what I buy impact on the environment? View answer
- Which products have the most impact? View answer
- Who has the most impact? View answer
- What can I do about it? View answer
- What's the science behind the Consumption Atlas? View answer

DID YOU KNOW?

Consumption is on the rise
Consumption and environmental impacts are rising steadily with household incomes.

Previous Next

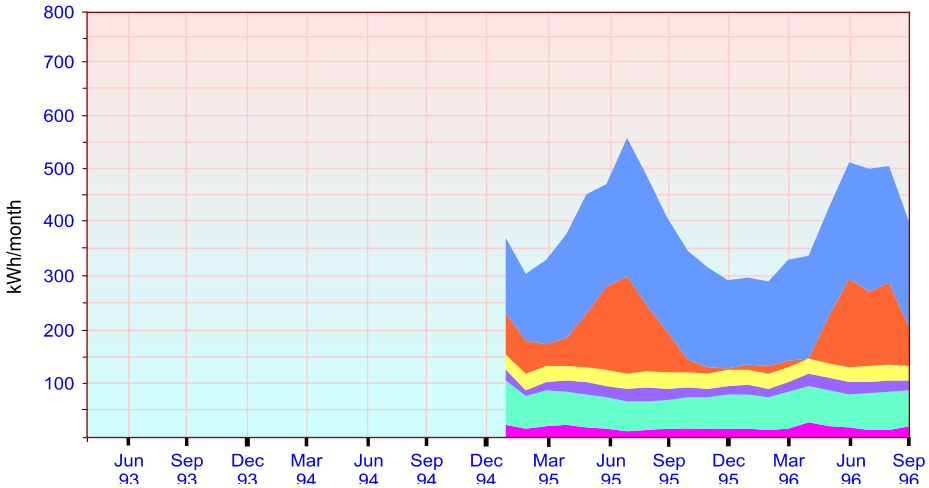
Tonnes per person per year:
<12.0 37.5>

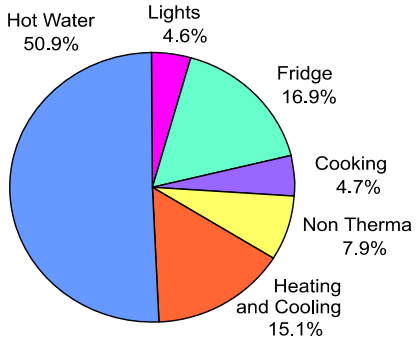
South Australia

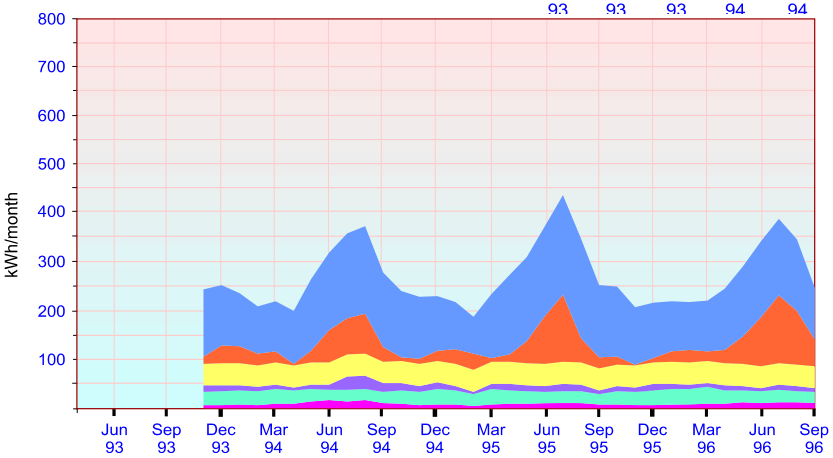
This project has been assisted by the New South Wales Government through its Environmental Trust.

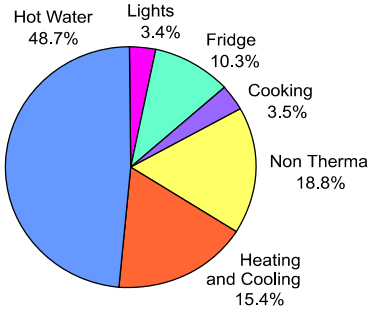
Household Energy

Control Group



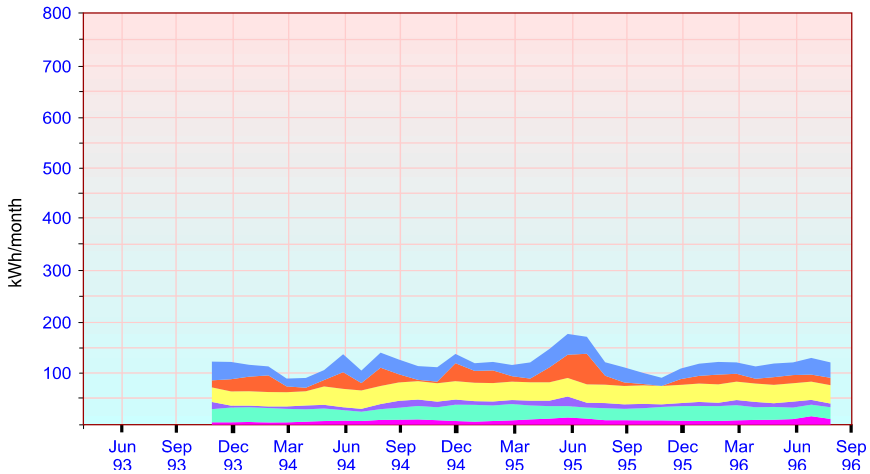


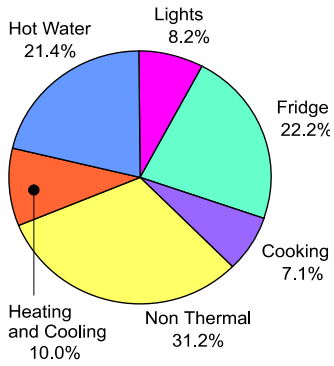




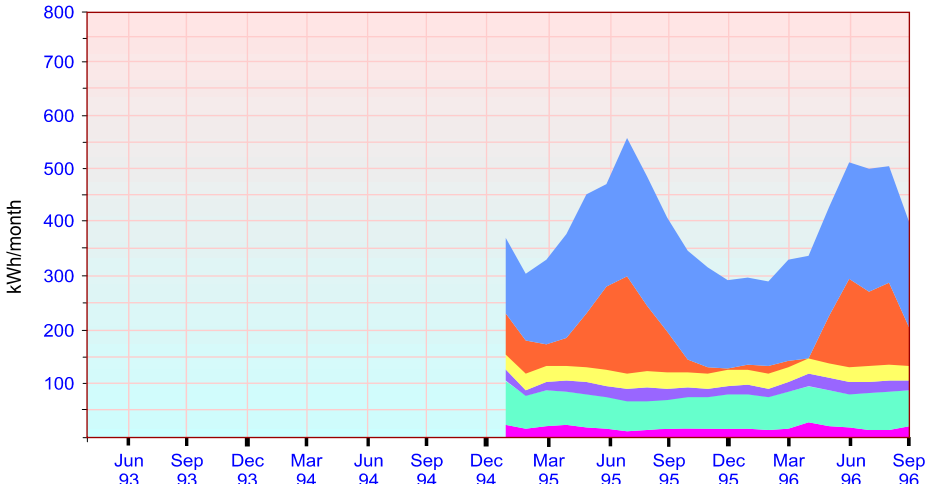
Standard Water Heater and Efficient appliances

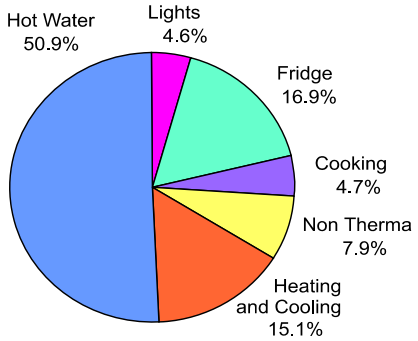
Solar Water Heater and efficient appliances and education

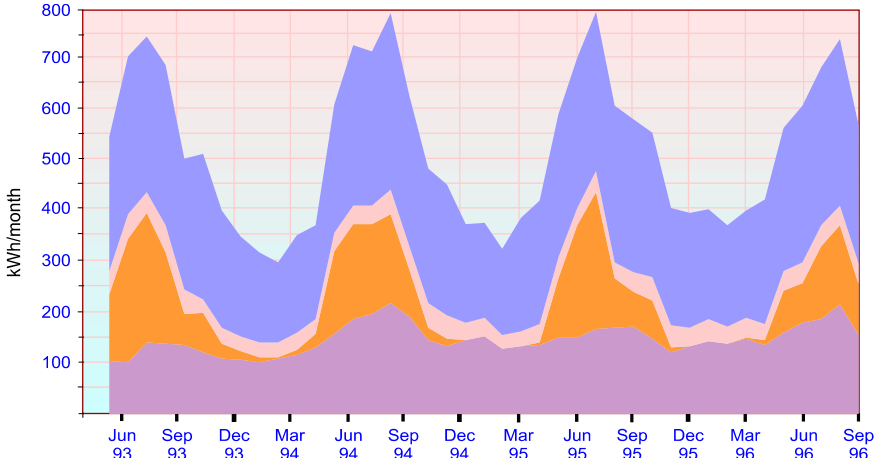


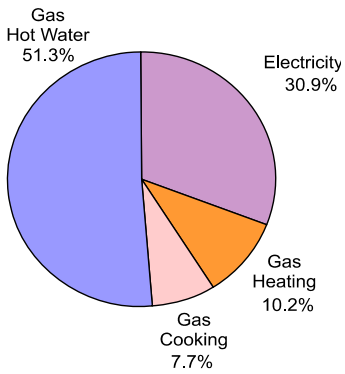


Control Group



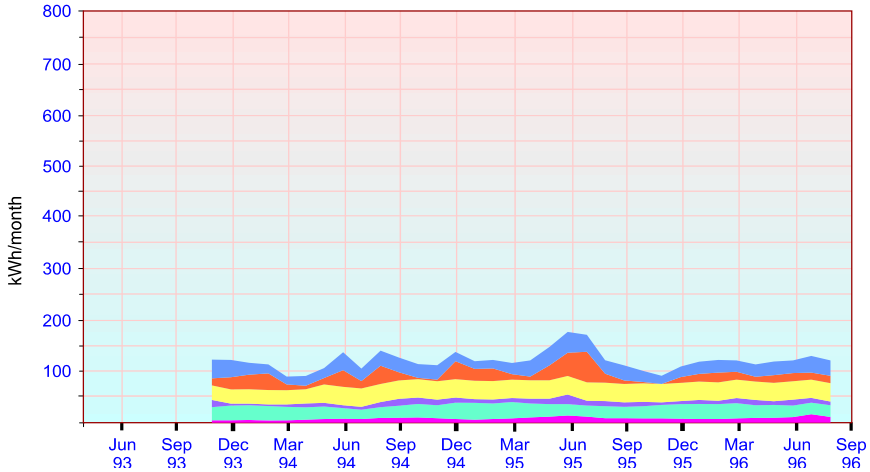


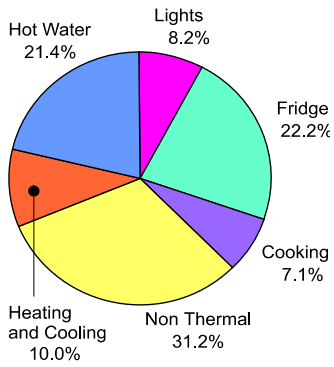




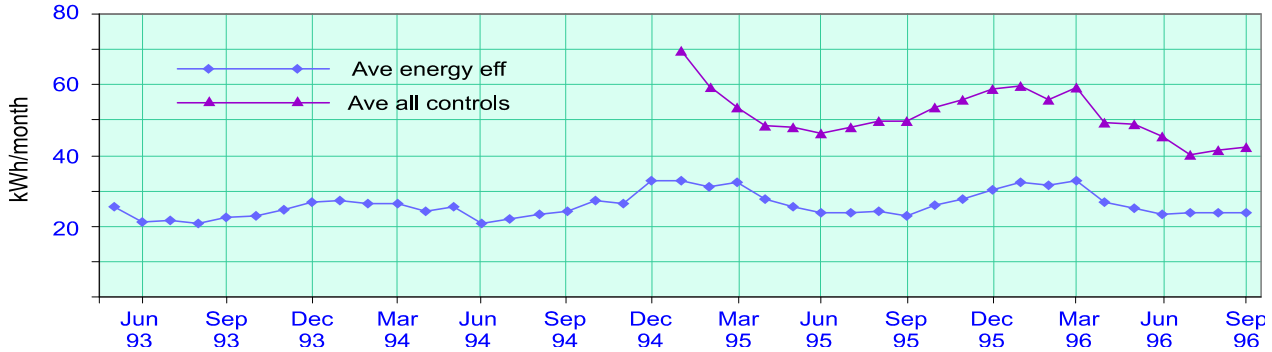
All Gas Homes with efficient electrical appliances

Solar Water Heater and efficient appliances and education

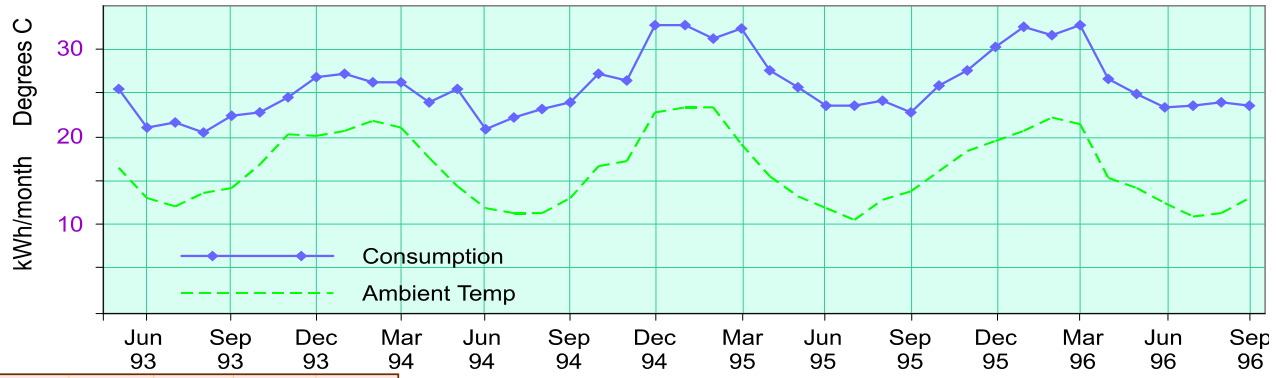




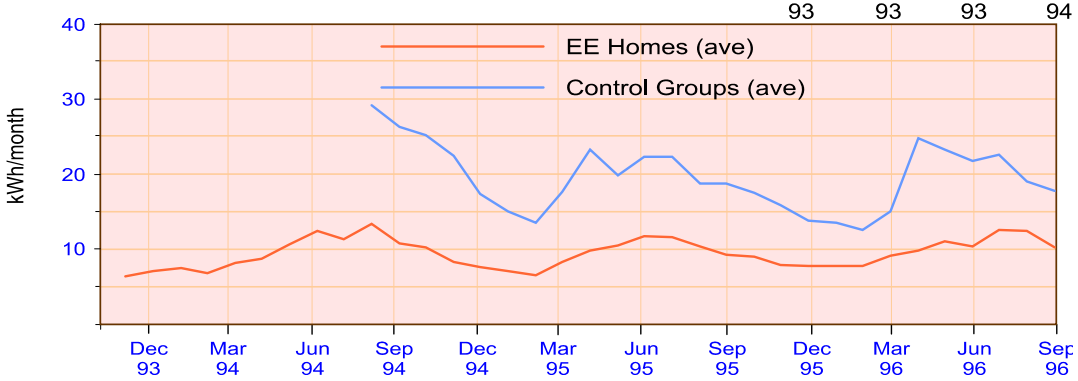
Refrigerators



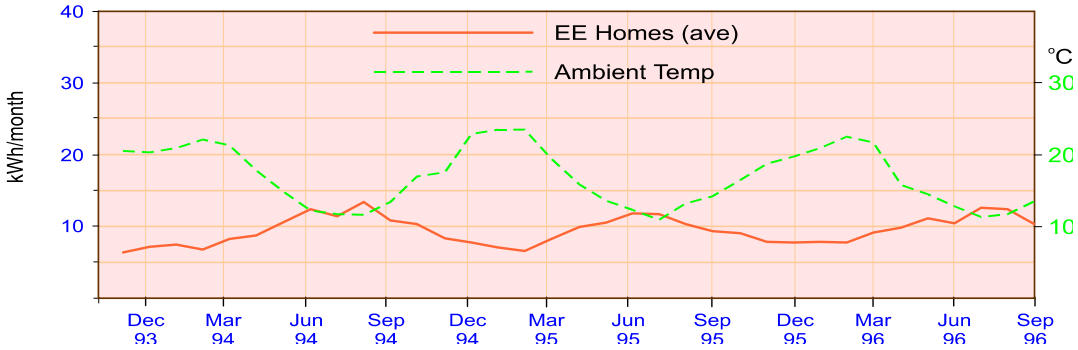
Efficient, Controls and Temperature



Lighting

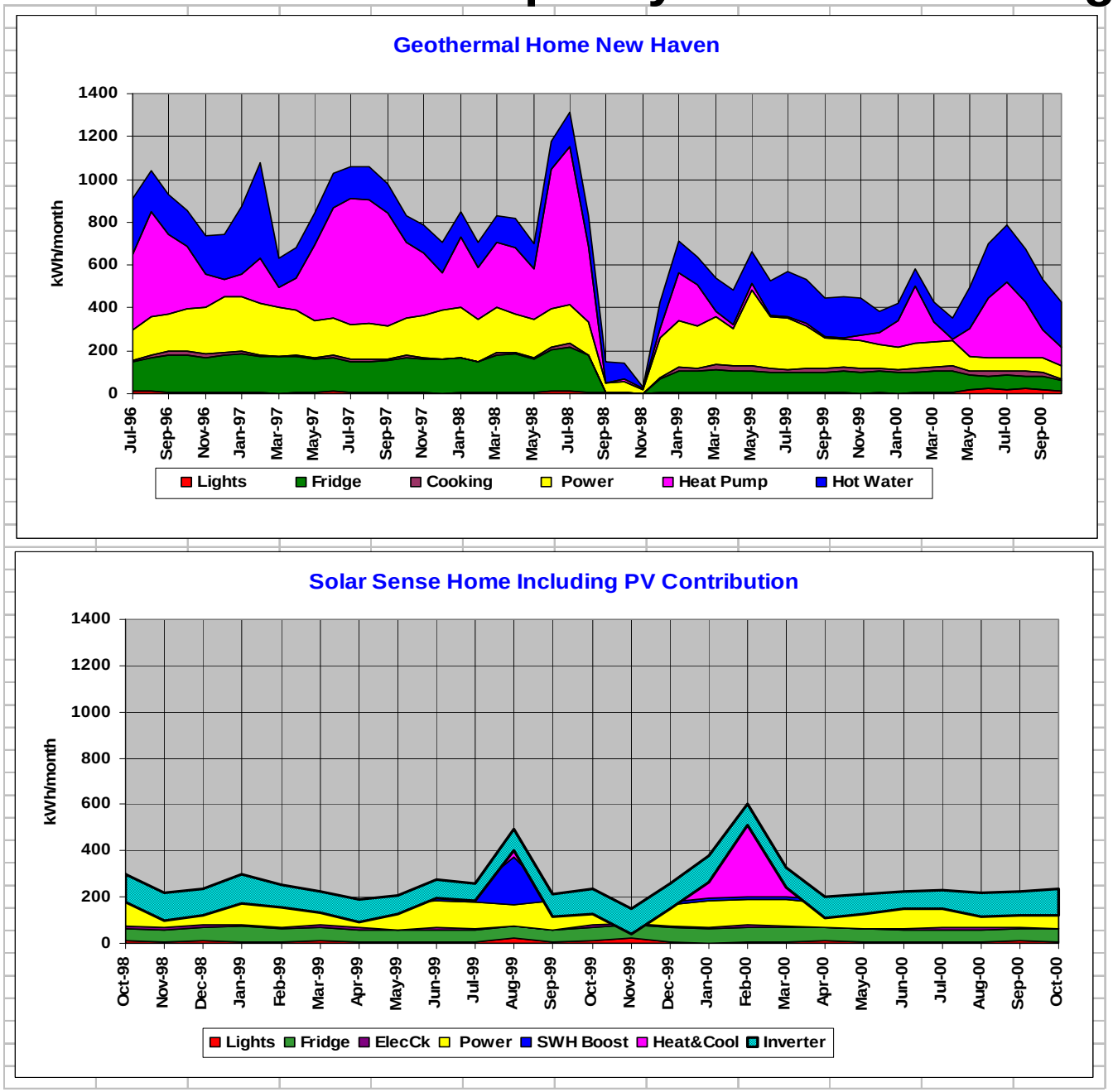


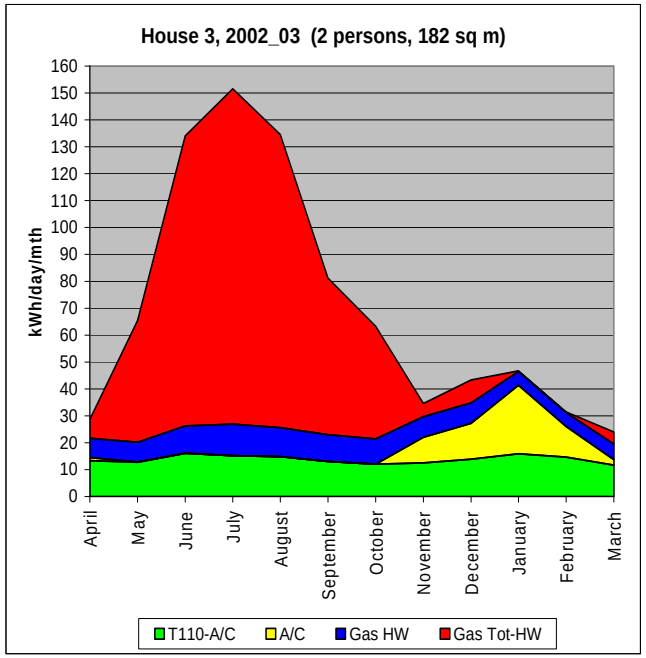
Efficient, Controls and Temperature

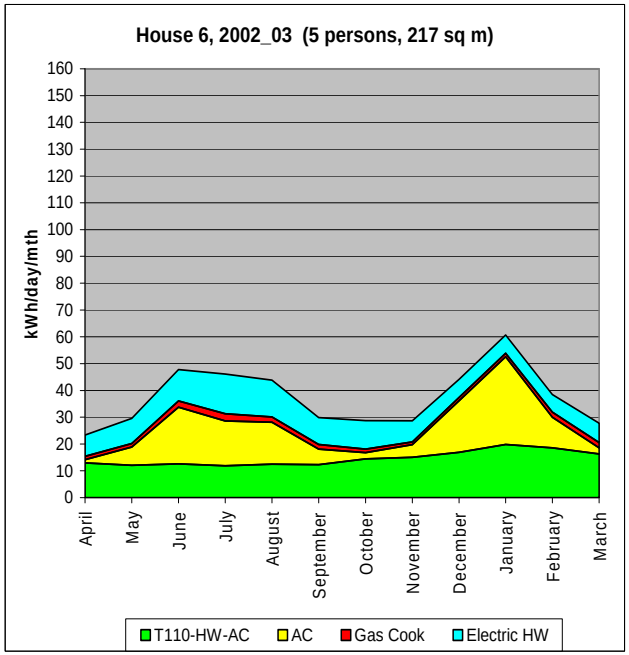


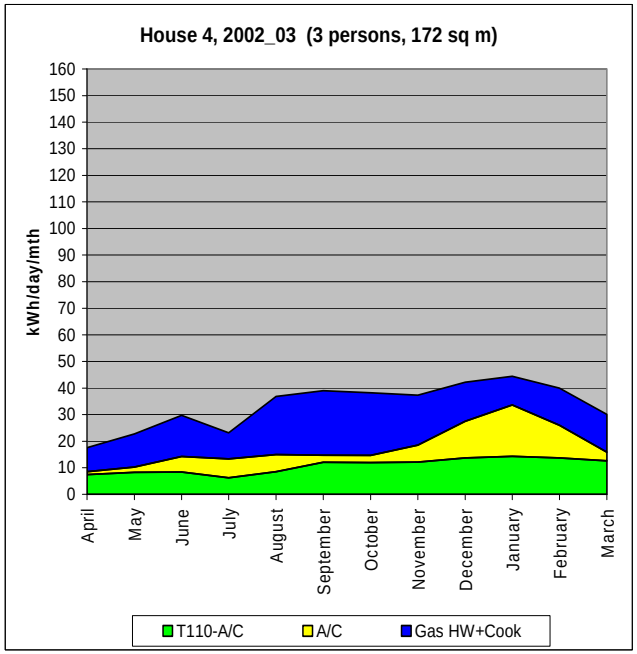
Low Mass (Rapid Wall) House with roof integrated SWH, PV and skylight plus evaporative air conditioner in ventilated roof space

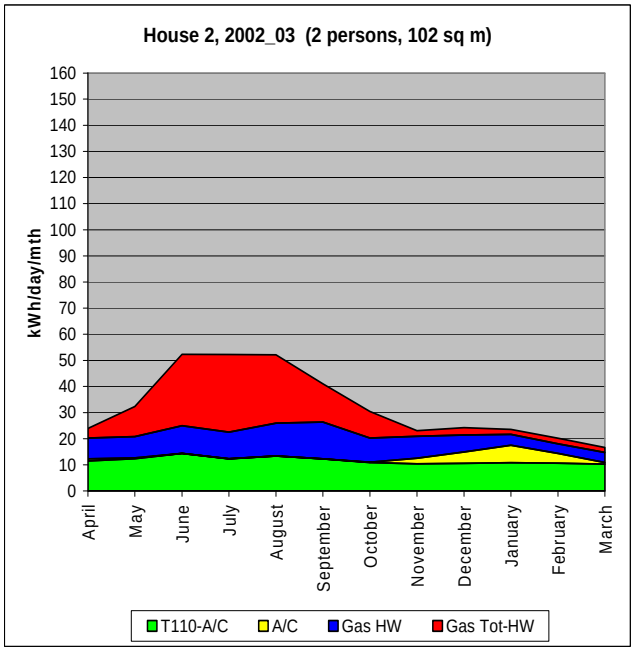
Impact of Household Occupancy and PV on Energy Use

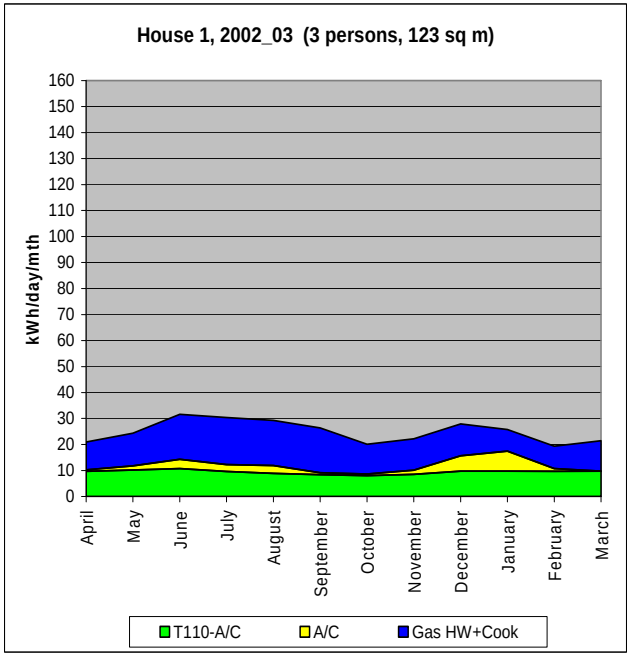


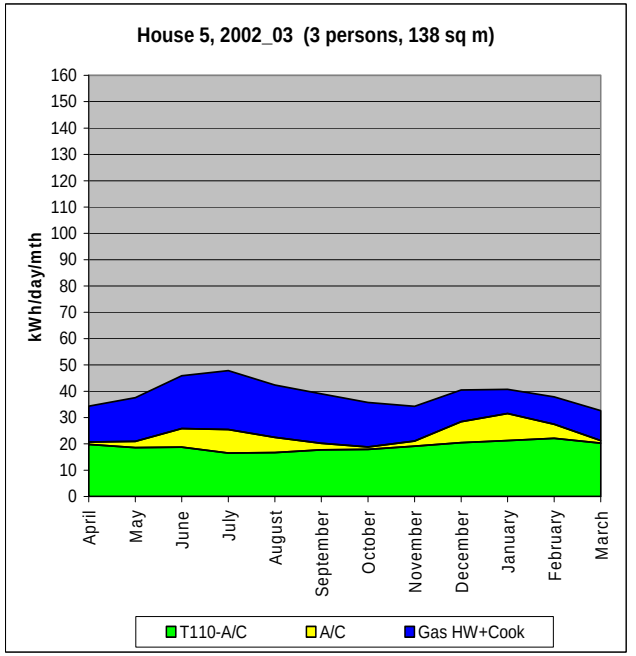

House 3, 2002_03 (2 persons, 182 sq m)
kWh/day/mth
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
April
May
June
July
August
September
October
November
December
January
February
March
T110-A/C
A/C
Gas HW
Gas Tot-HW


House 6, 2002_03 (5 persons, 217 sq m)
kWh/day/mth
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
April
May
June
July
August
September
October
November
December
January
February
March
T110-HW-AC
AC
Gas Cook
Electric HW

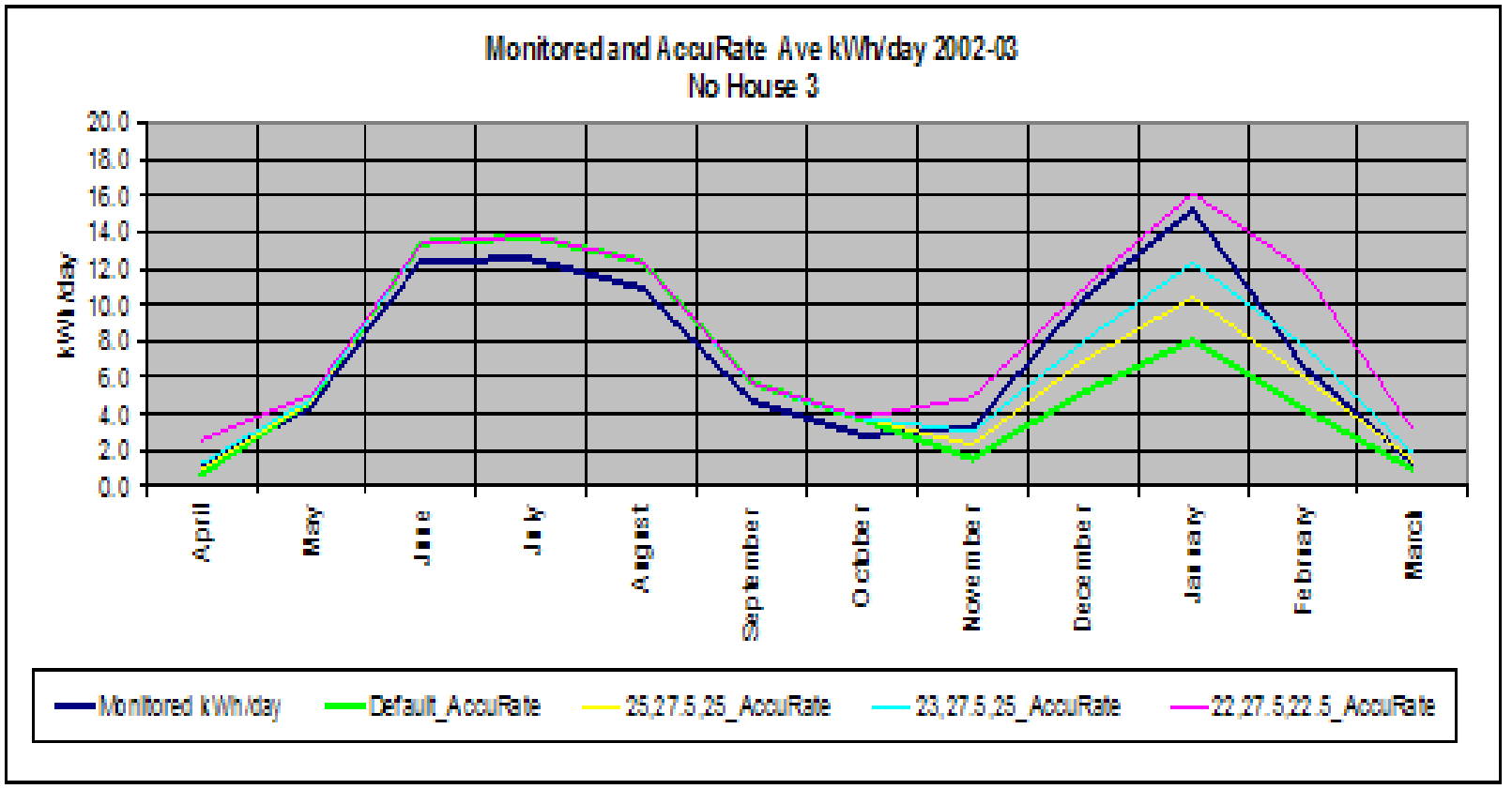

House 4, 2002_03 (3 persons, 172 sq m)
kWh/day/mth
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
April
May
June
July
August
September
October
November
December
January
February
March
T110-A/C
A/C
Gas HW+Cook


House 2, 2002_03 (2 persons, 102 sq m)
kWh/day/mth
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
April
May
June
July
August
September
October
November
December
January
February
March
T110-A/C
A/C
Gas HW
Gas Tot-HW

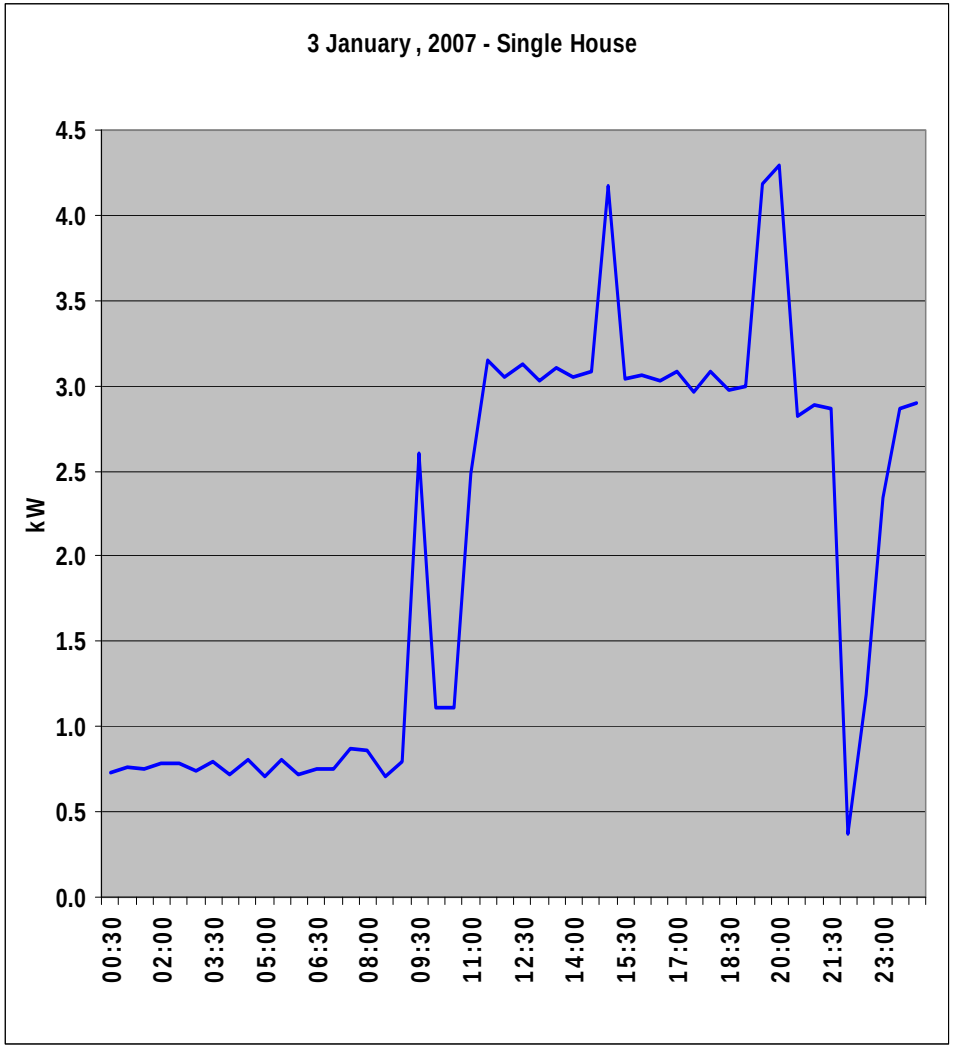

House 1, 2002_03 (3 persons, 123 sq m)
kWh/day/mth
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
April
May
June
July
August
September
October
November
December
January
February
March
T110-A/C
A/C
Gas HW+Cook

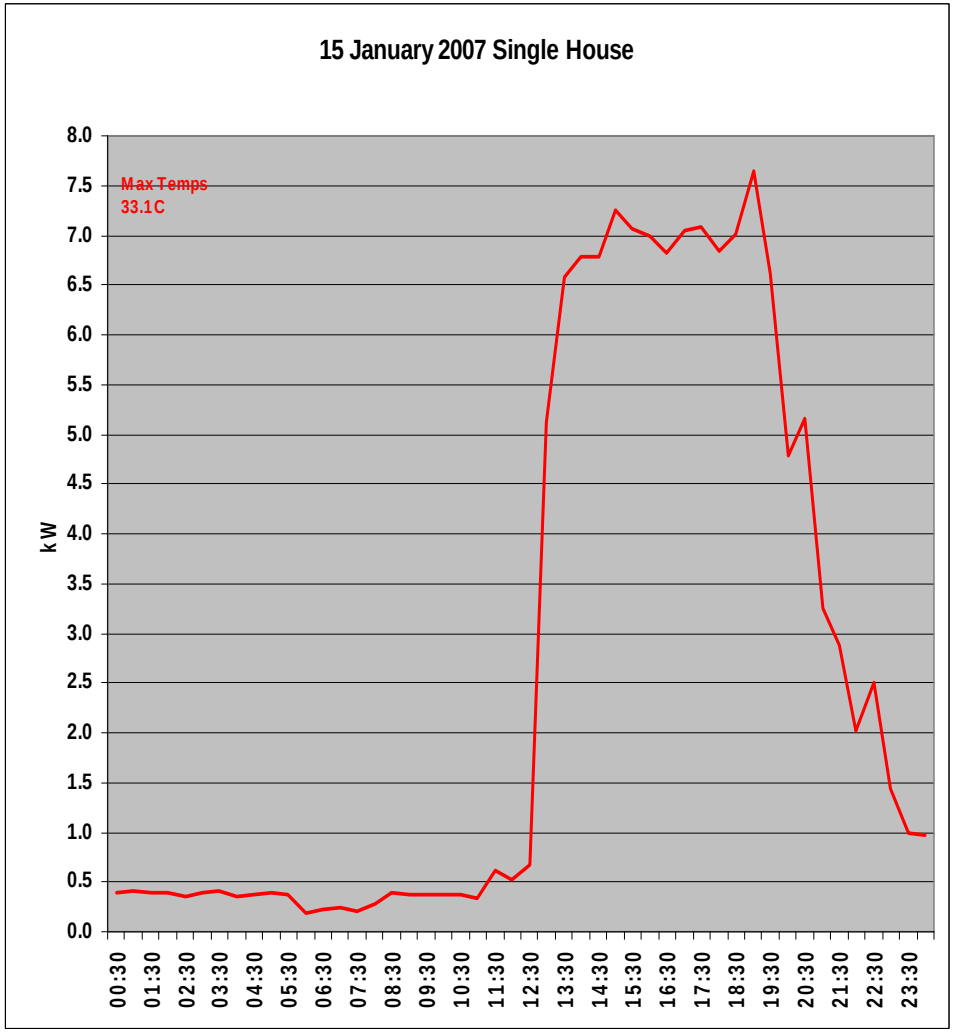

House 5, 2002_03 (3 persons, 138 sq m)
kWh/day/mth
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
April
May
June
July
August
September
October
November
December
January
February
March
T110-A/C
A/C
Gas HW+Cook

Use of Monitored data to validated AccuRate Models

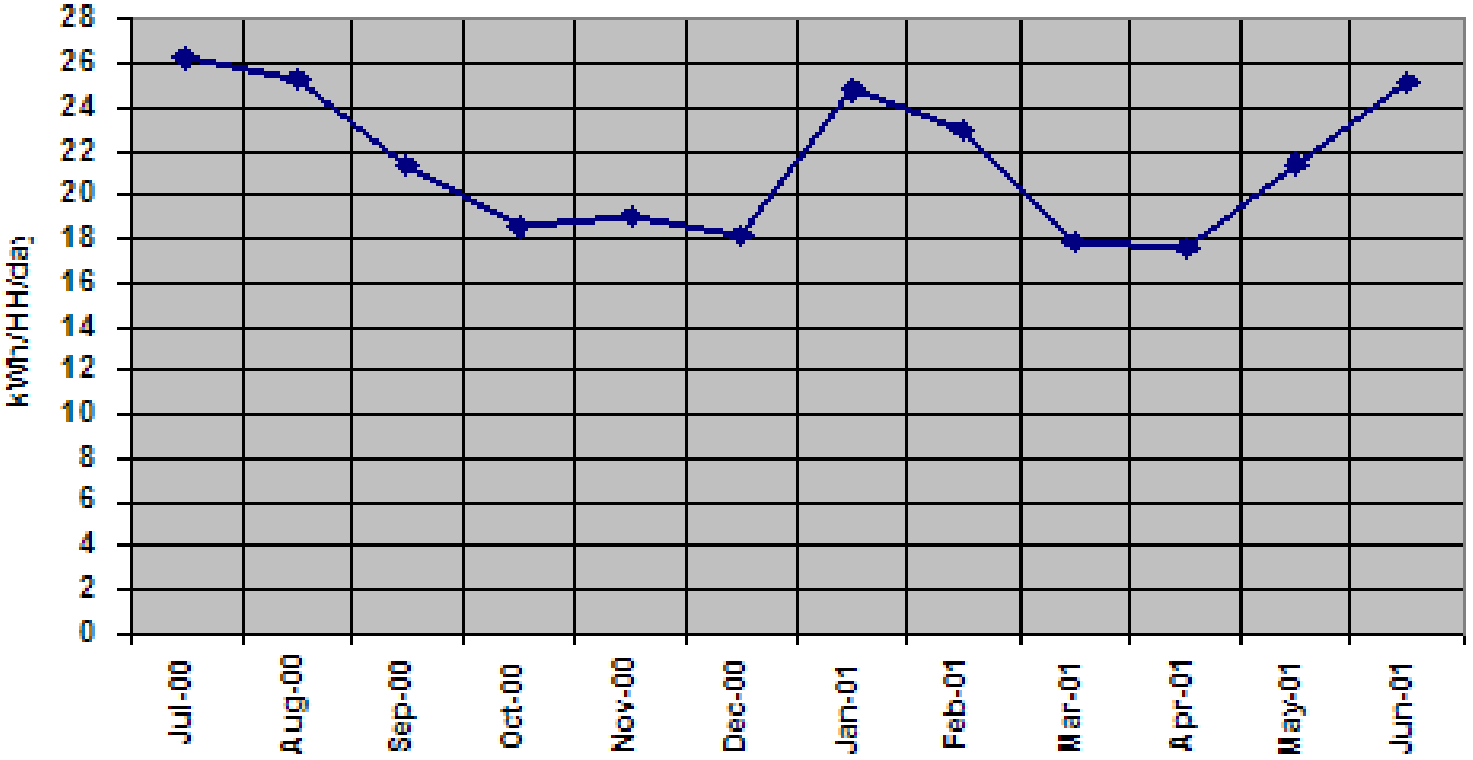


Interval Metering Data:
Air conditioning and Standby

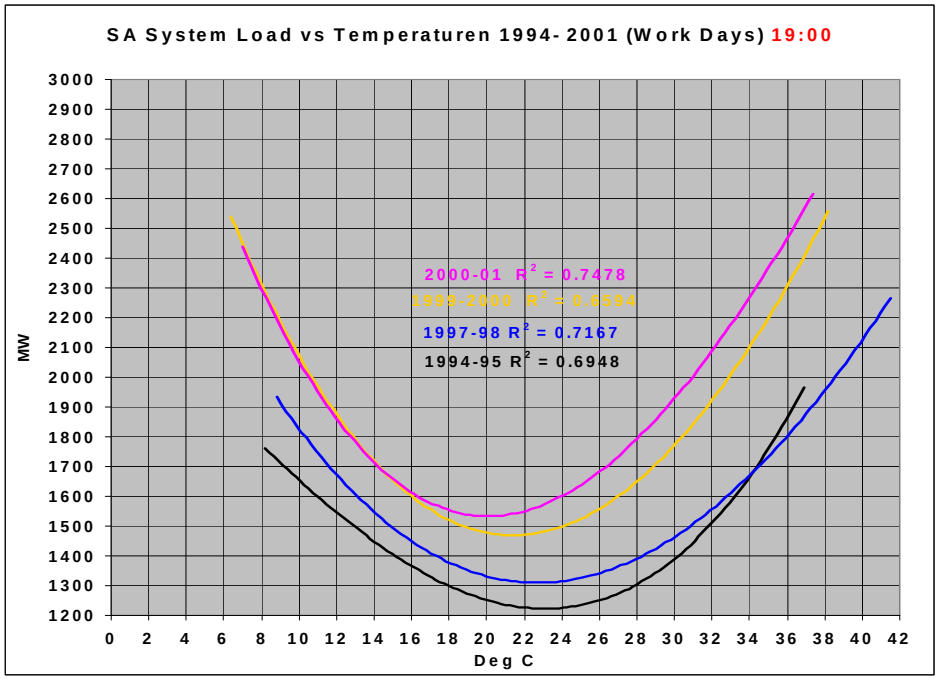




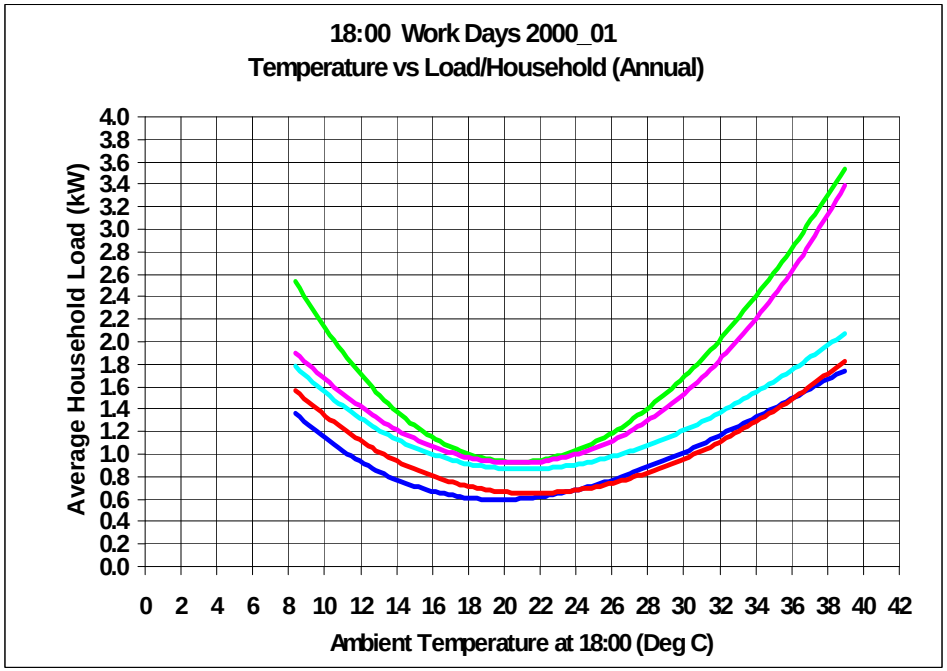
Average kWh/day/month from 18 Residential Transformers

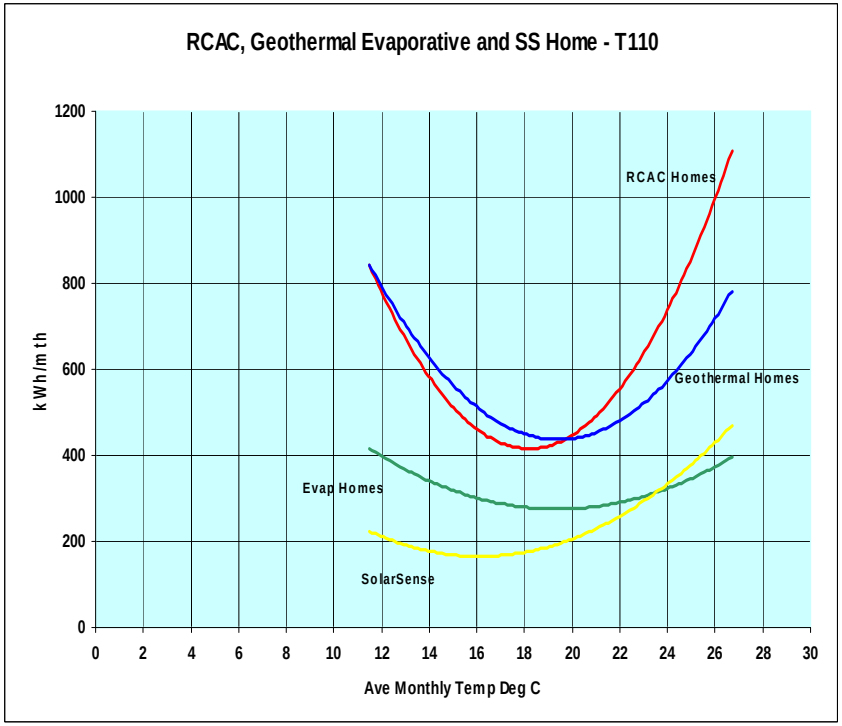


Household Temperature vs Load and Peak Load

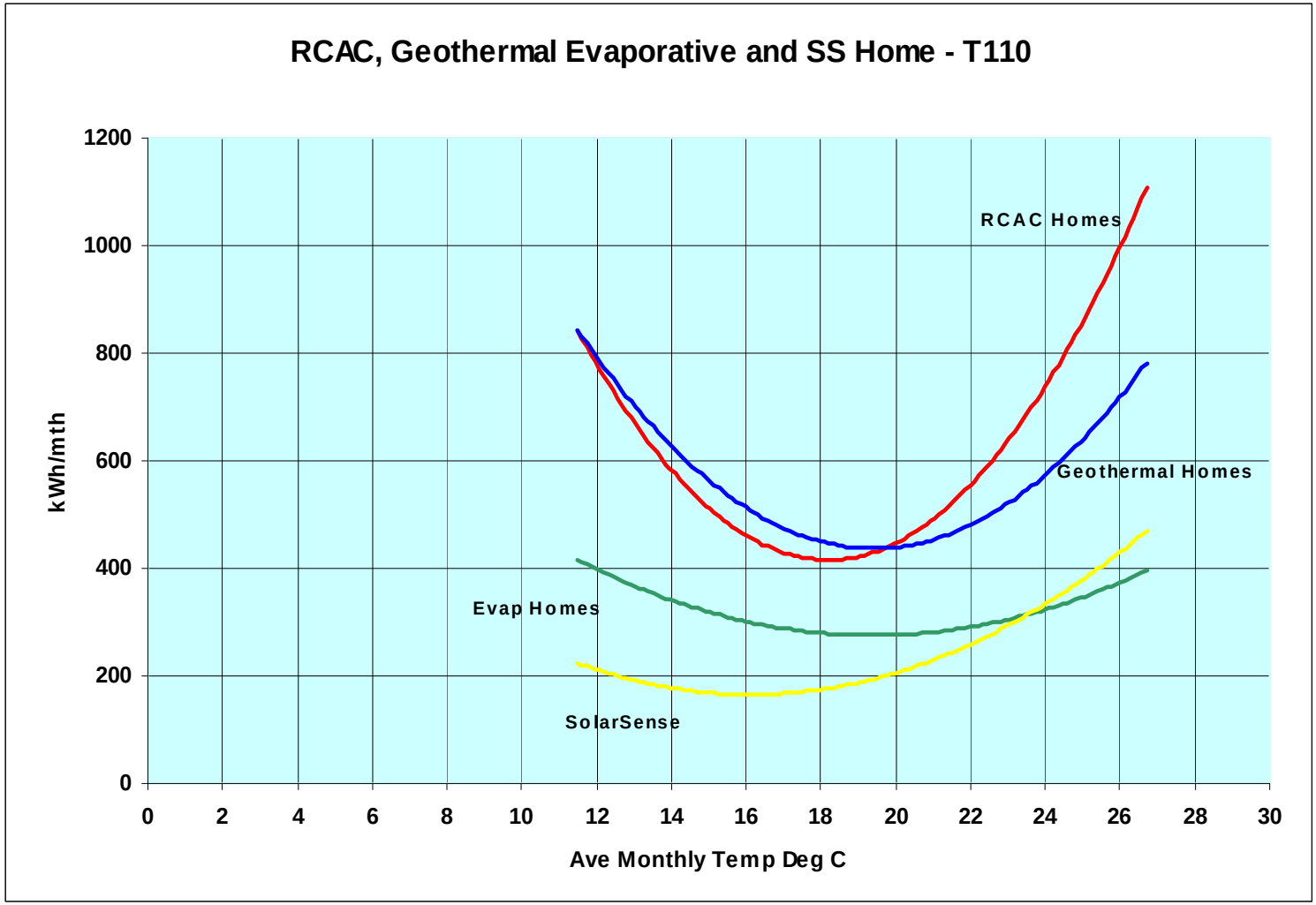


Temperature vs Load for
- SA Demand
- Residential Transformers
- Individual Homes

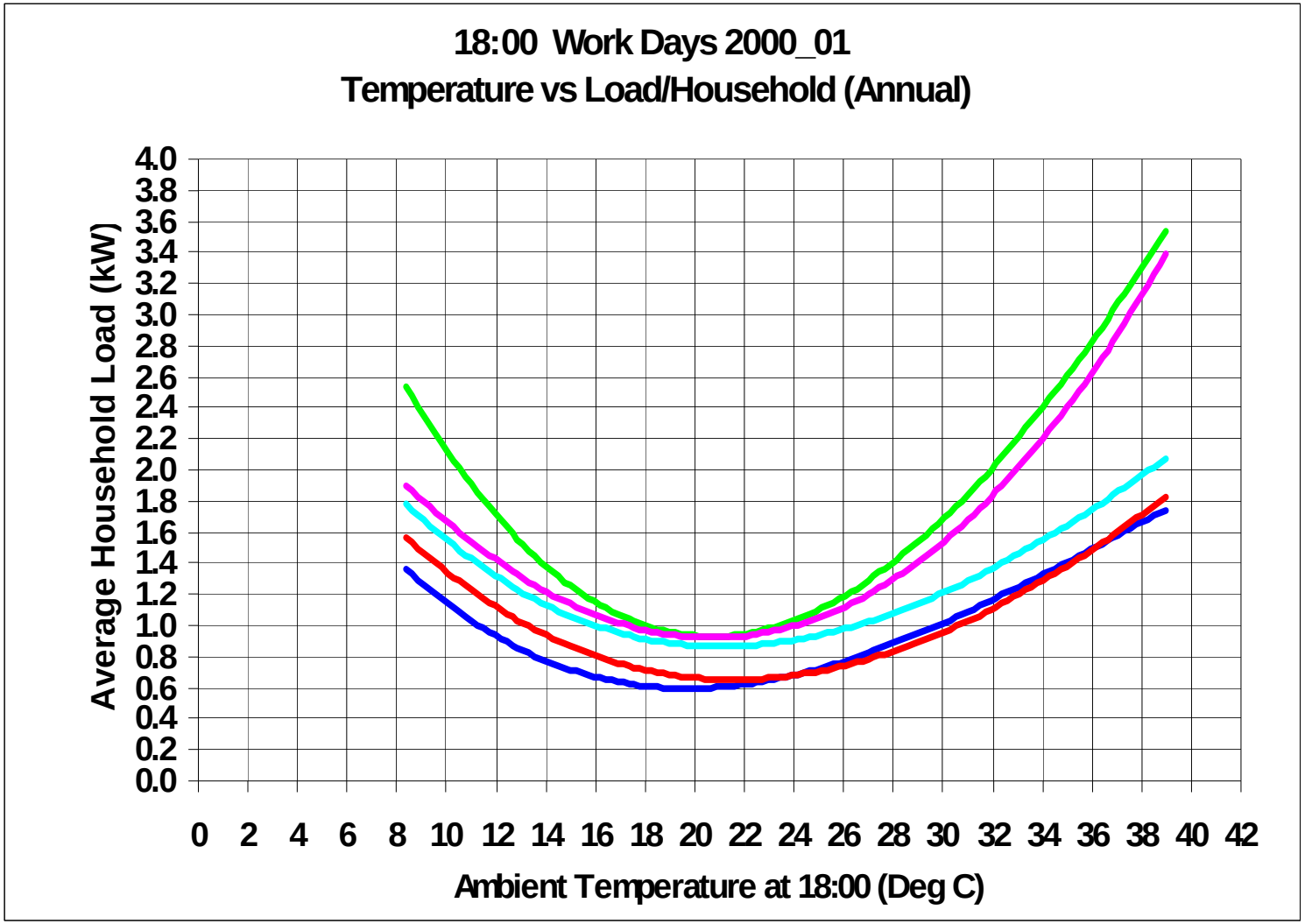




Temperature vs Load (New Haven)

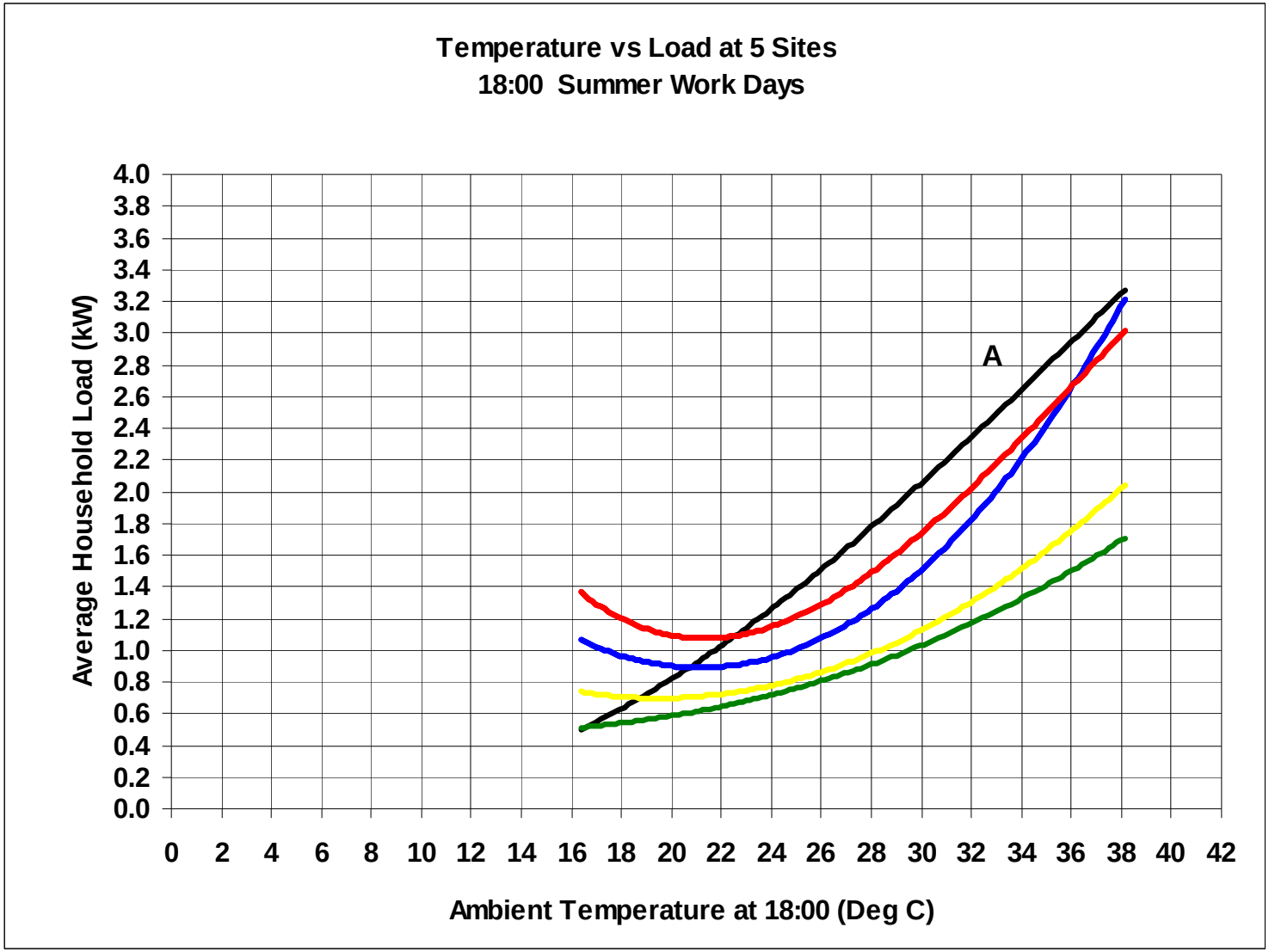


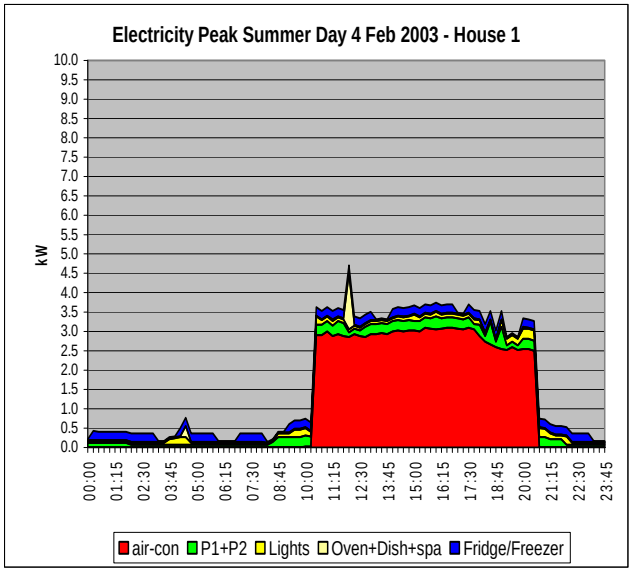
Impact of Temperature on Load on Transformers

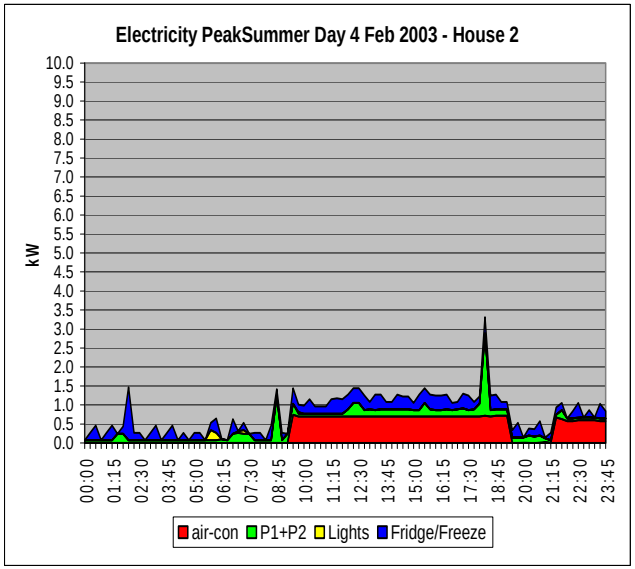


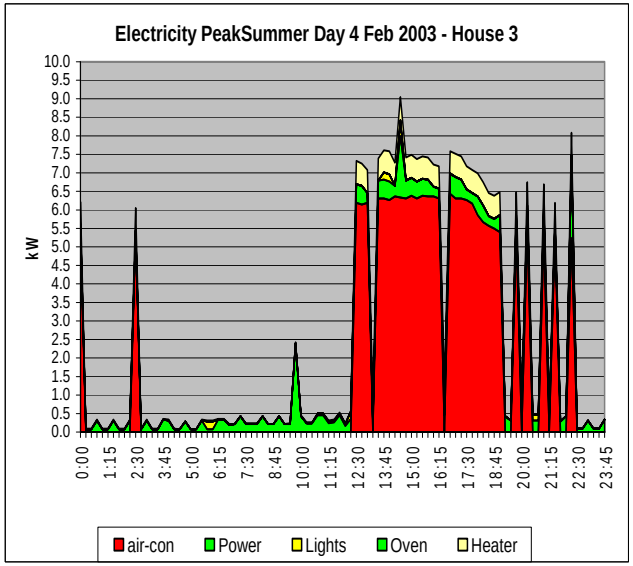
Impact of Temperature on Load – Summer

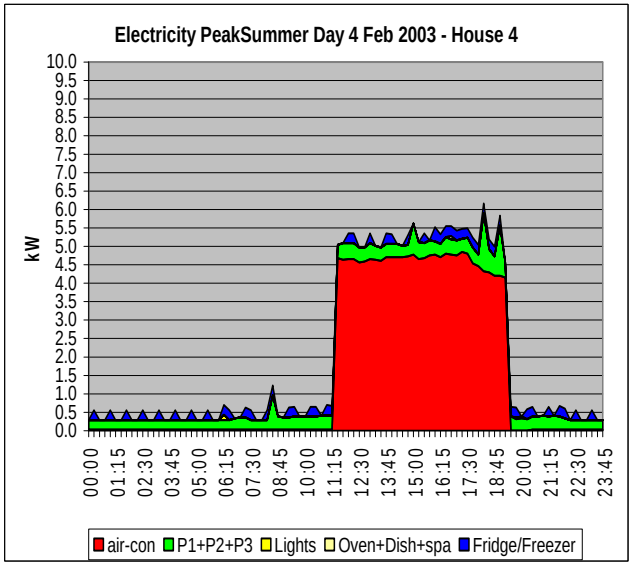
("A" is a new sub division with houses similar to those shown in next slide)

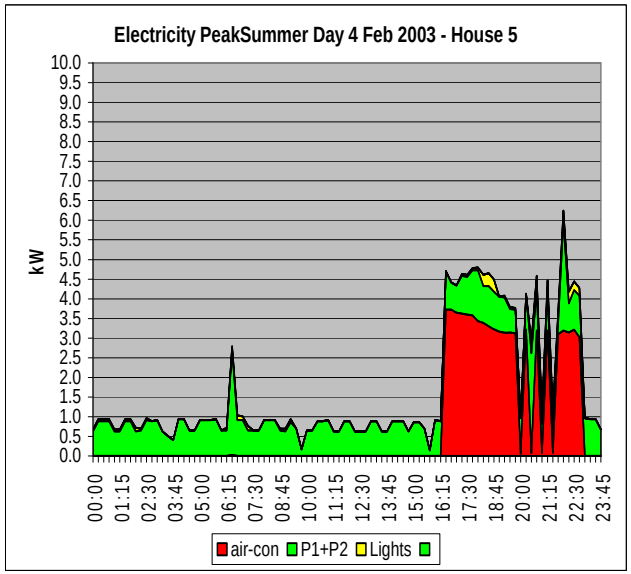


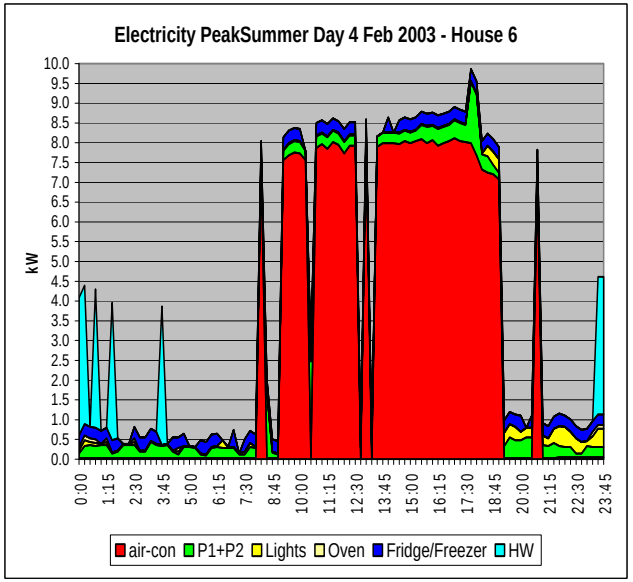

Electricity Peak Summer Day 4 Feb 2003 - House 1
kW
air-con
P1+P2
Lights
Oven+Dish+spa
Fridge/Freezer

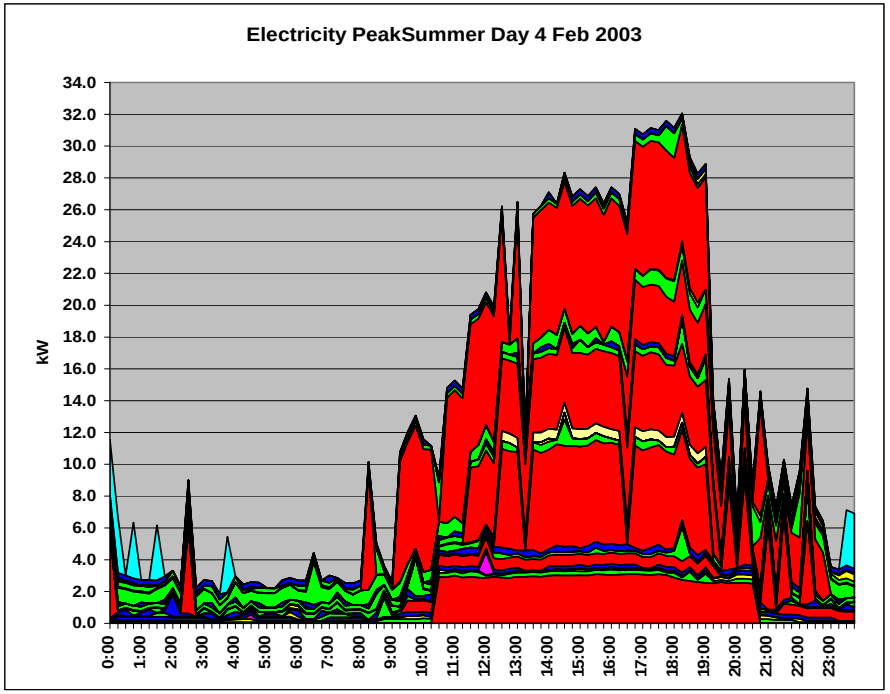

Electricity PeakSummer Day 4 Feb 2003 - House 2
kW
air-con
P1+P2
Lights
Fridge/Freeze

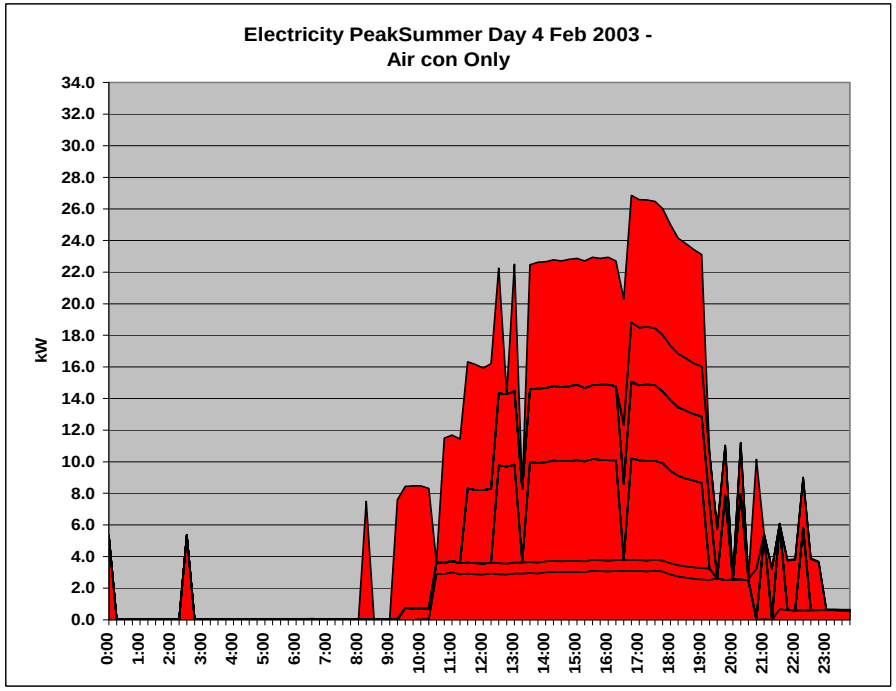

Electricity PeakSummer Day 4 Feb 2003 - House 3
kW
air-con
Power
Lights
Oven
Heater

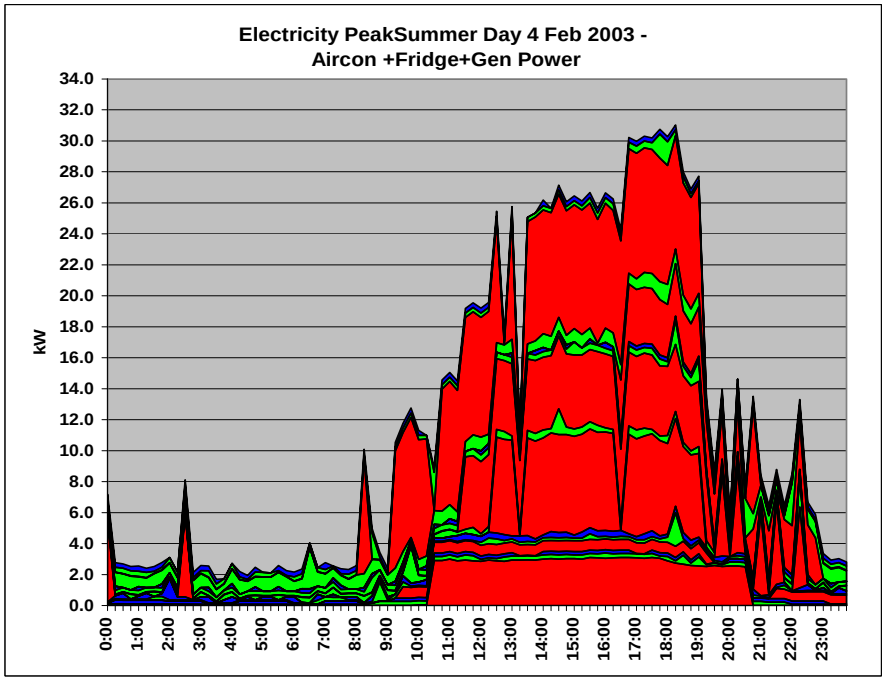

Electricity PeakSummer Day 4 Feb 2003 - House 4
kW
air-con
P1+P2+P3
Lights
Oven+Dish+spa
Fridge/Freezer


Electricity PeakSummer Day 4 Feb 2003 - House 5
kW
air-con
P1+P2
Lights


Electricity PeakSummer Day 4 Feb 2003 - House 6
kW
air-con
P1+P2
Lights
Oven
Fridge/Freezer
HW





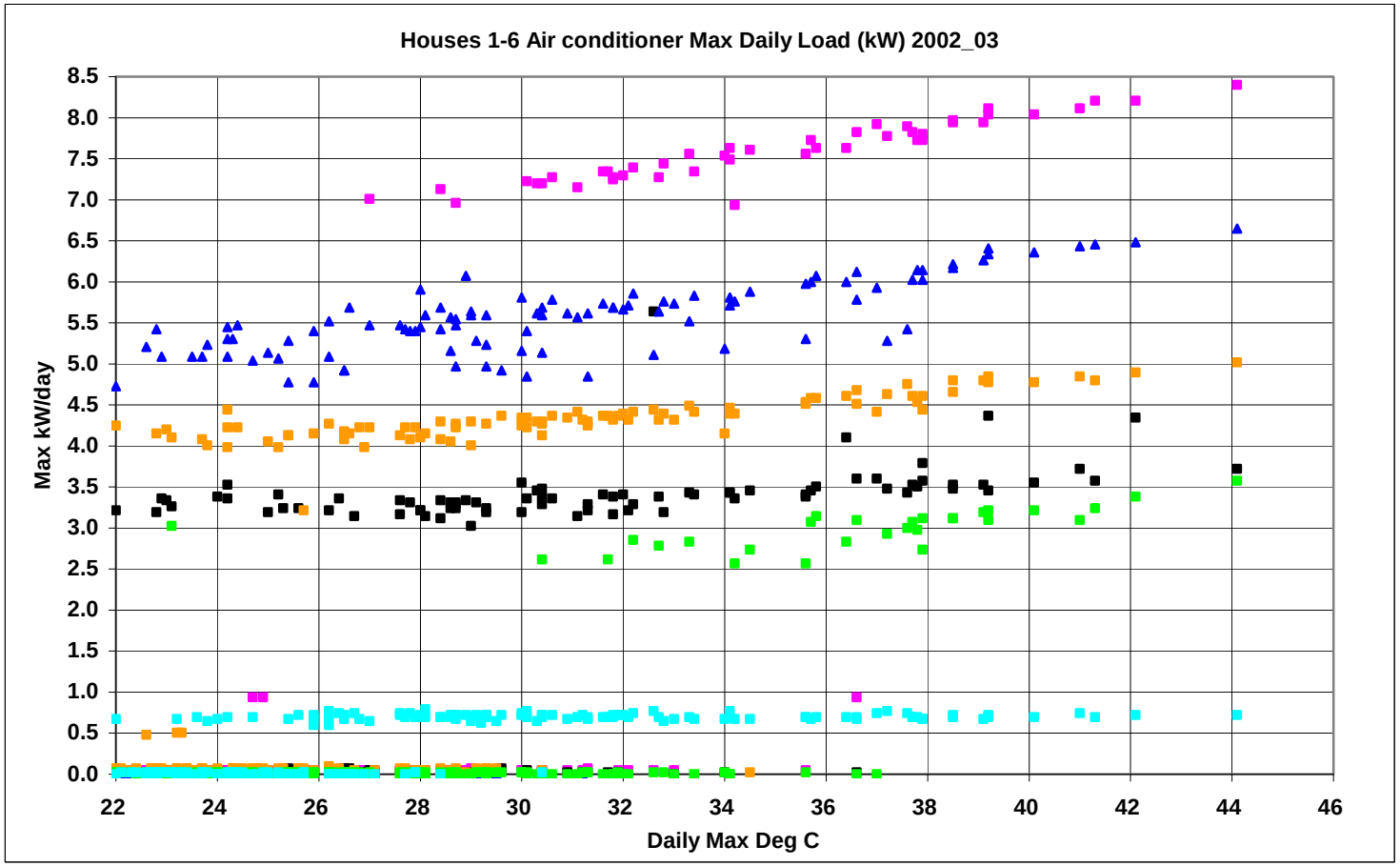


1 - Total Load = 32 kW
(Ave, 5.3 kW/home)

2- Total Air Con Load = 27 kW
(Ave, 4.5 kW/home)

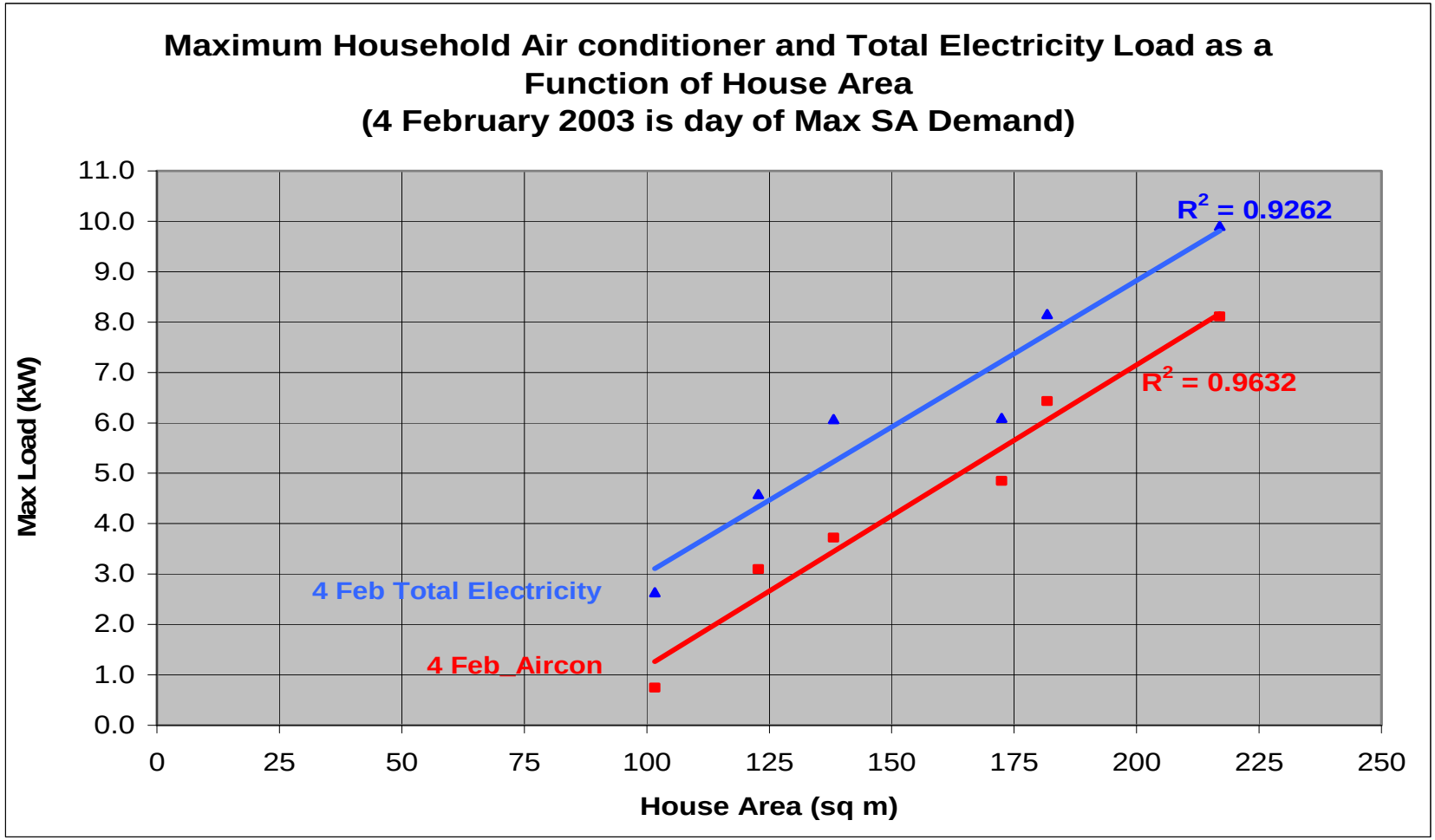
3- Total - No Lights and oven = 31 kW
(Ave, 5.2 kW/home)

Impact of Temperature on Peak Air conditioner Load (6 Homes)

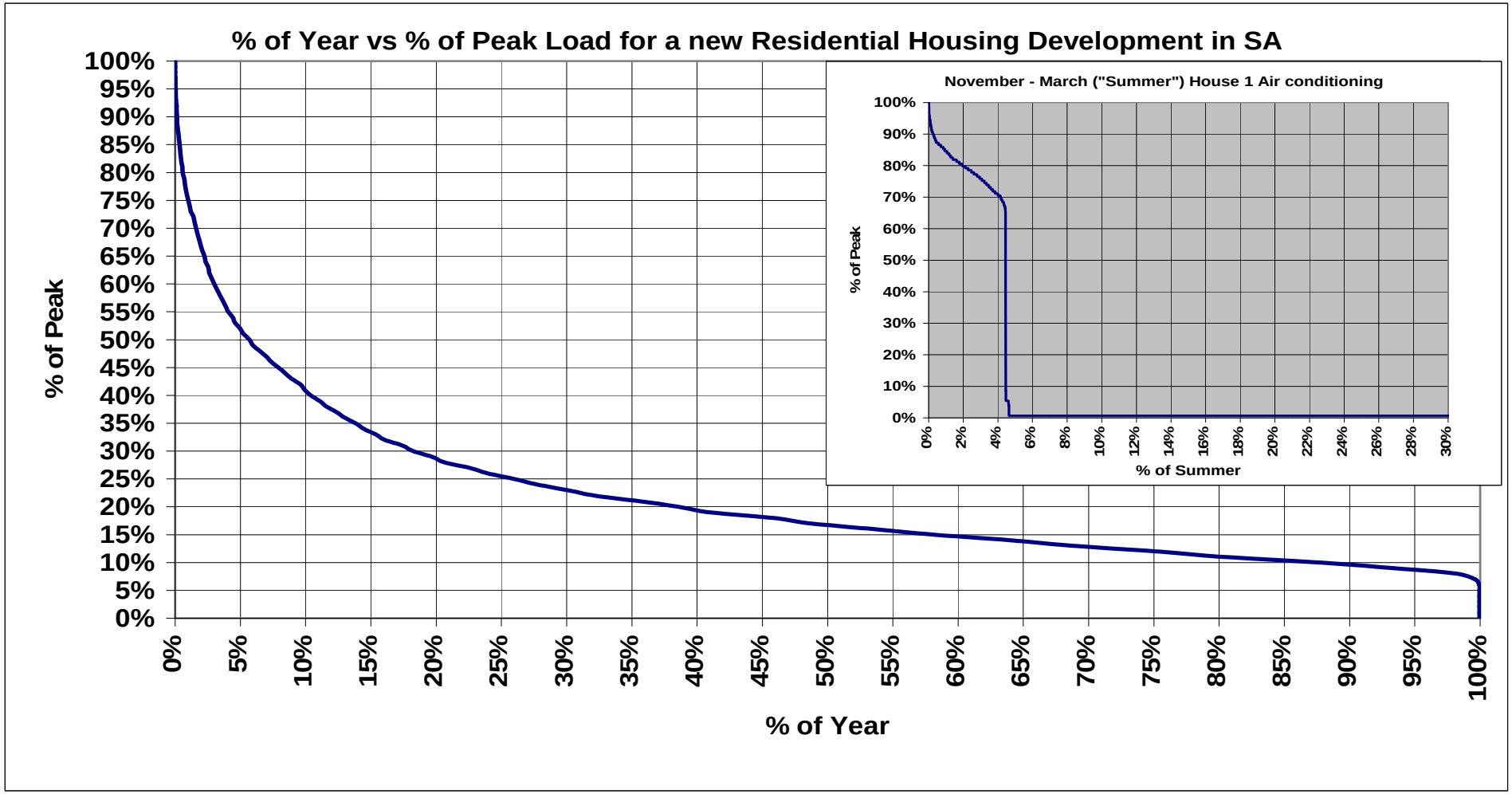


Code	House	Stars	Type	COP
	6	3.4	Ducted	2.87
	3	4.0	Ducted	3.57
	4	4.7	Ducted	2.69
	5	4.2	Split	2.45
	1	4.1	Ducted	2.58
	2	4.1	Evap	8

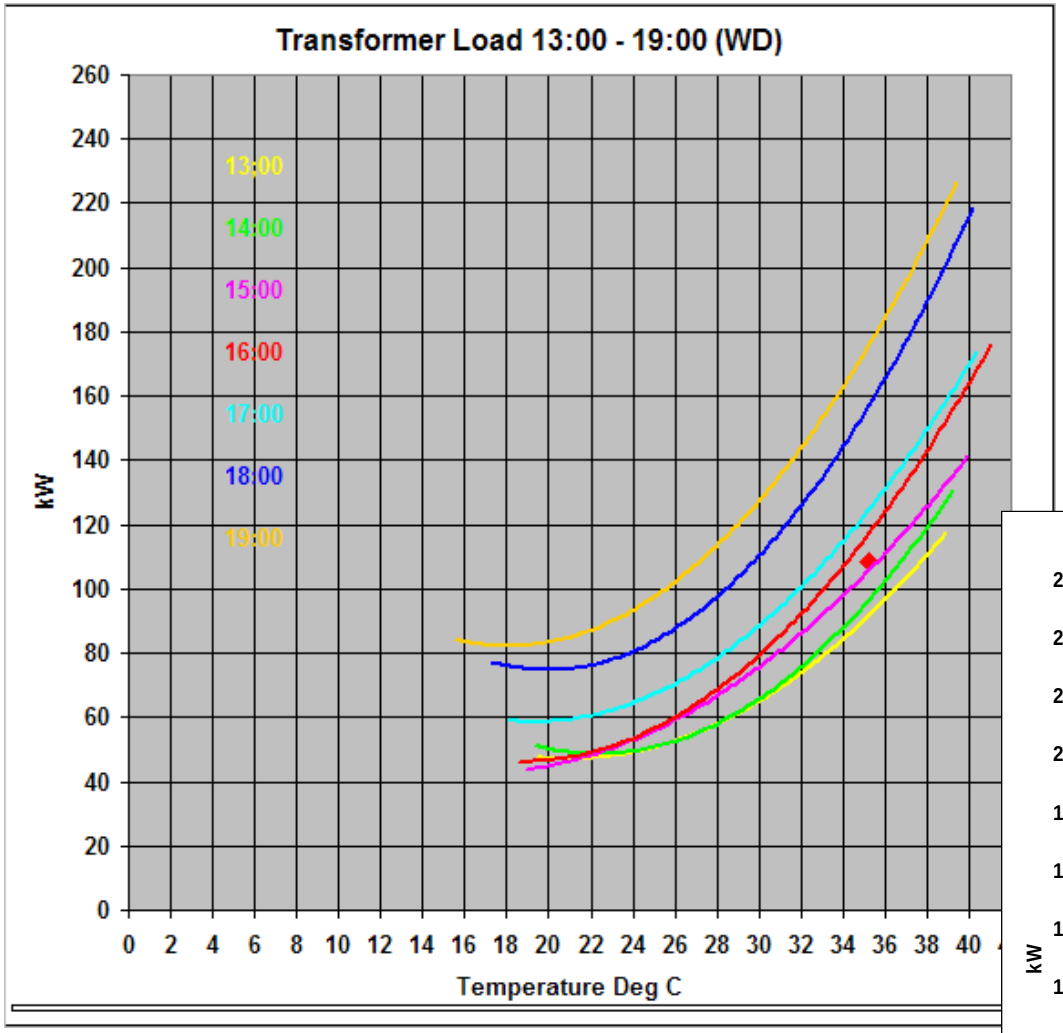
Relationship between Air conditioner Peak Load and House Area

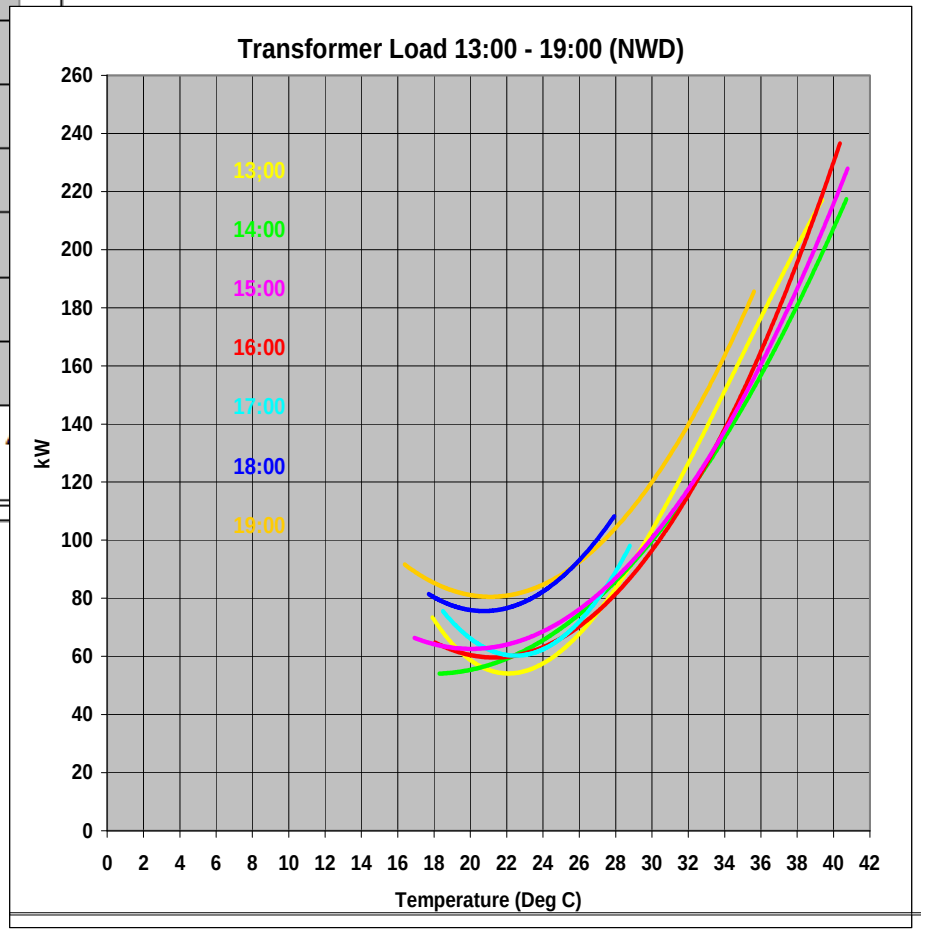


Load Duration curve for new residential development and a single air conditioner

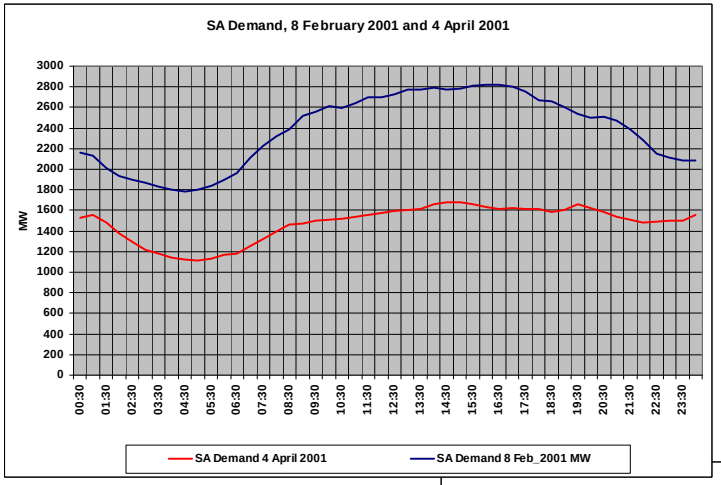


Transformer Load vs Temperature on Work Days and Non Work Days





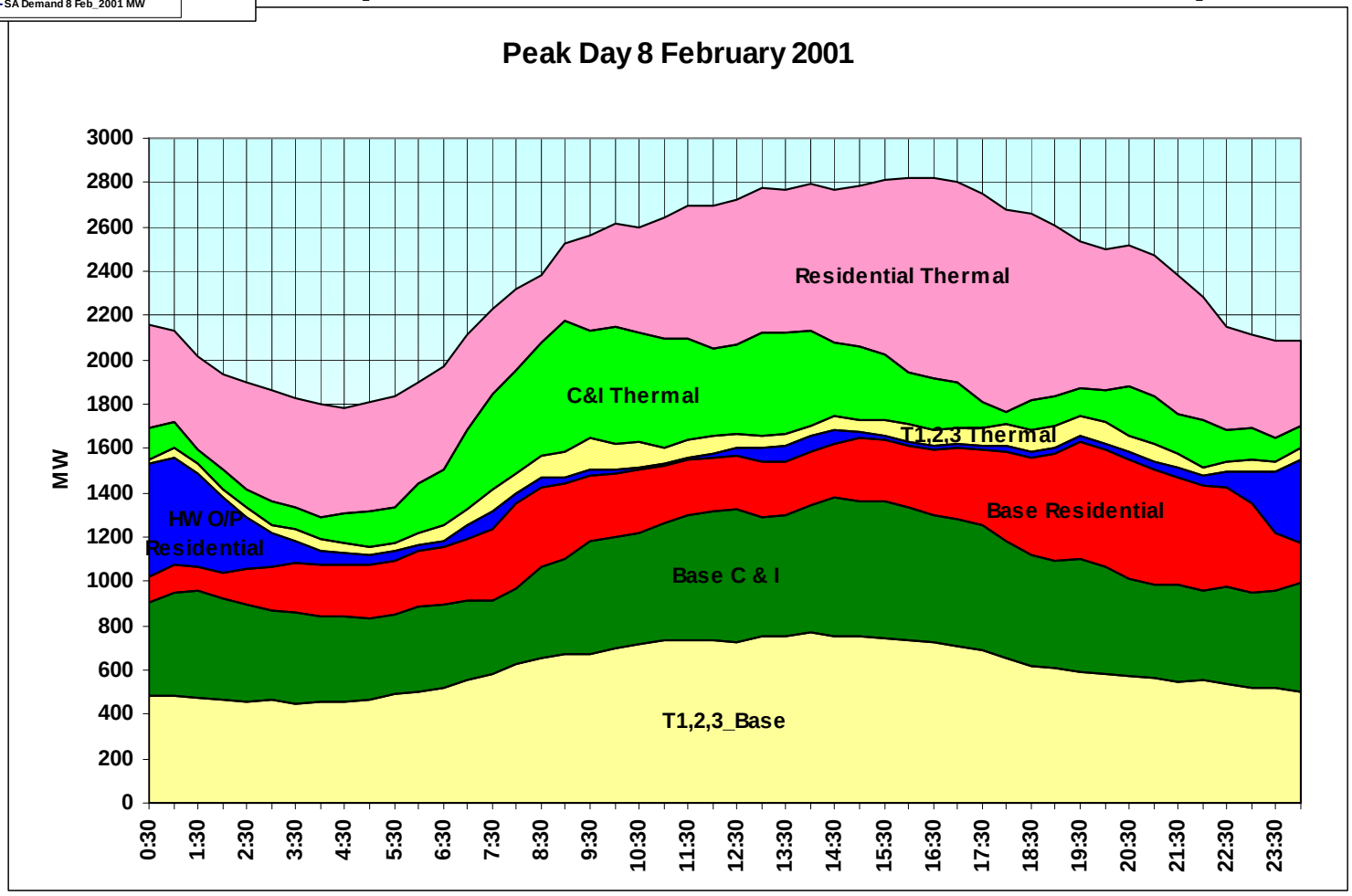
Contribution of PV and EVs to Load Profile



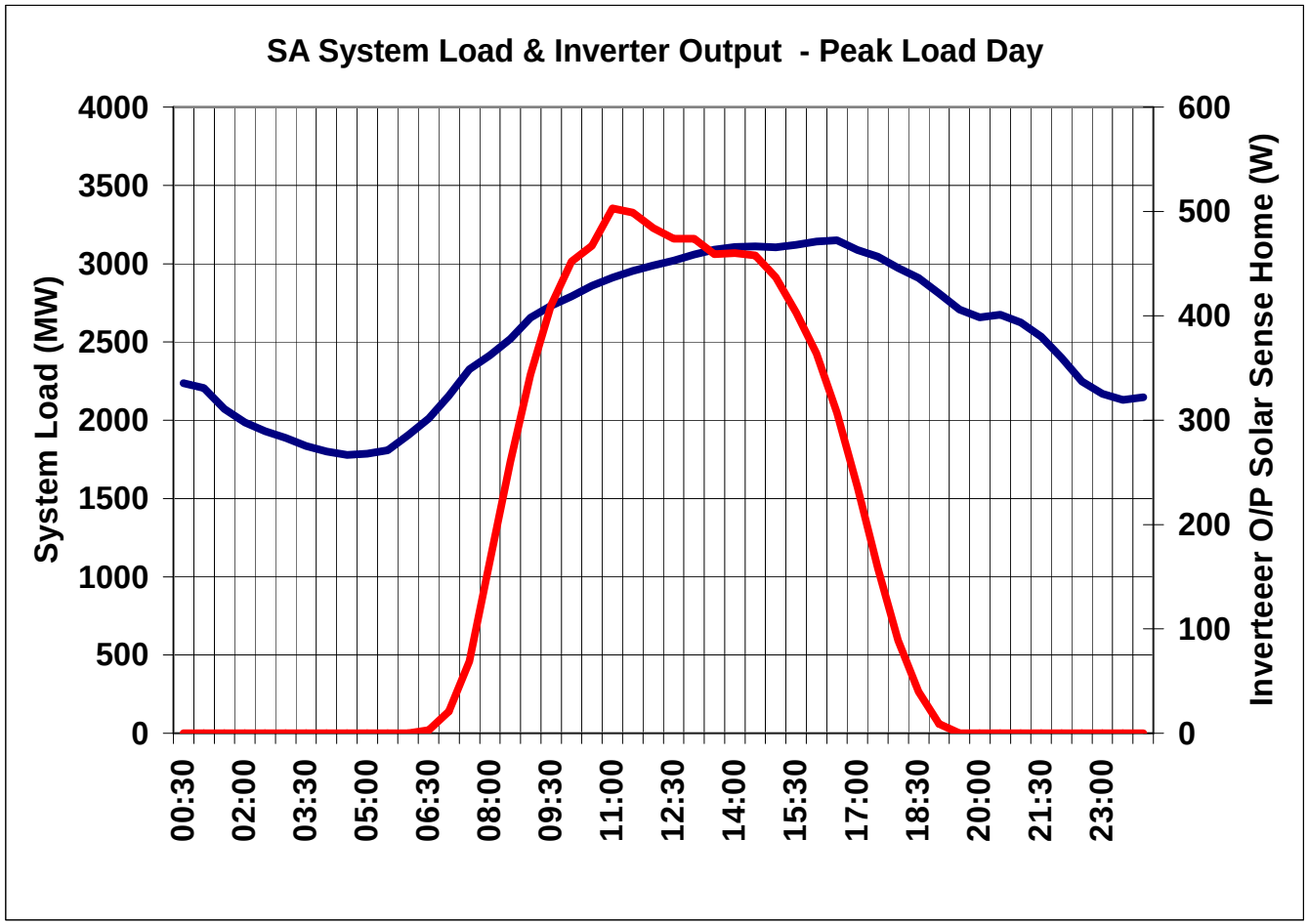
Impact of Thermal Load on SA System Demand – By Sector

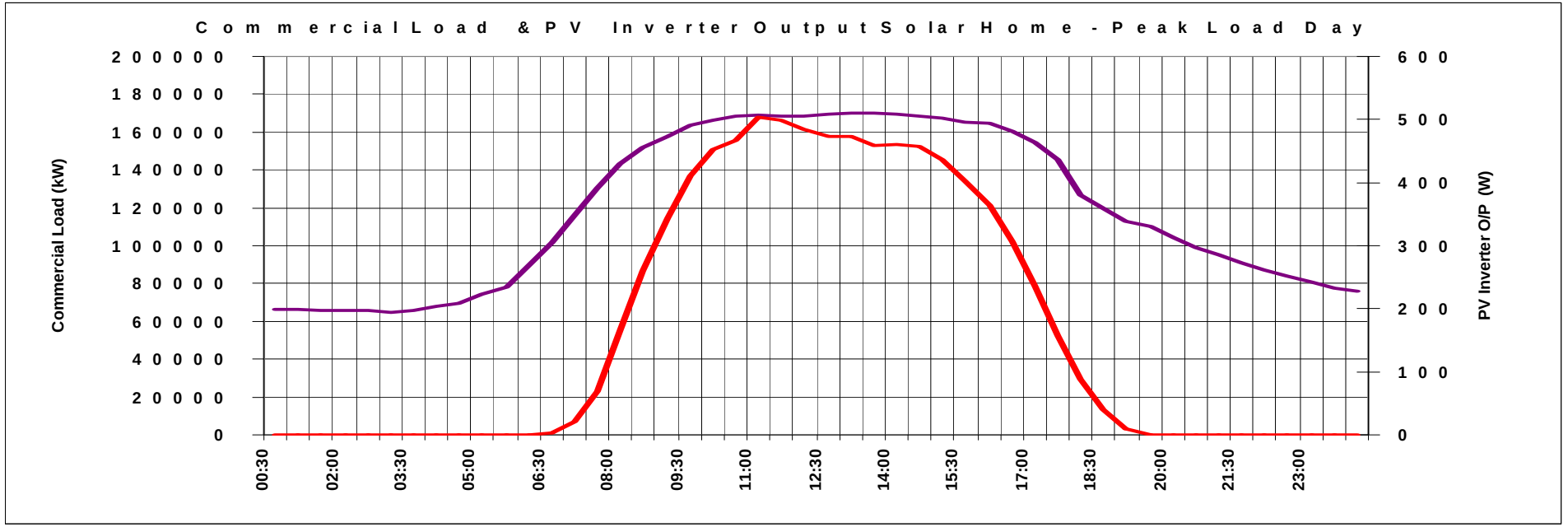
(Note: Breakdown is a very rough estimate: C&I Thermal has an anomaly round 18:00 it is suspected that graph should be smoother)

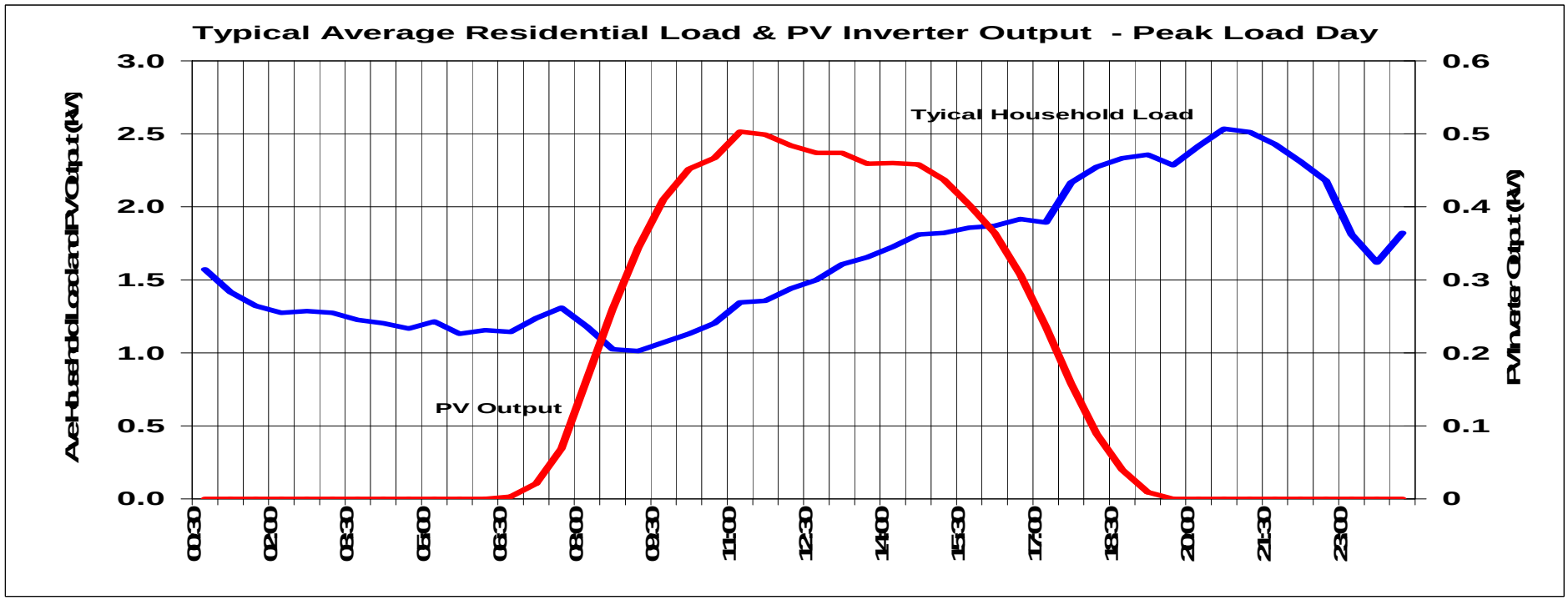
(Peak Thermal Residential ~ 800 MW)



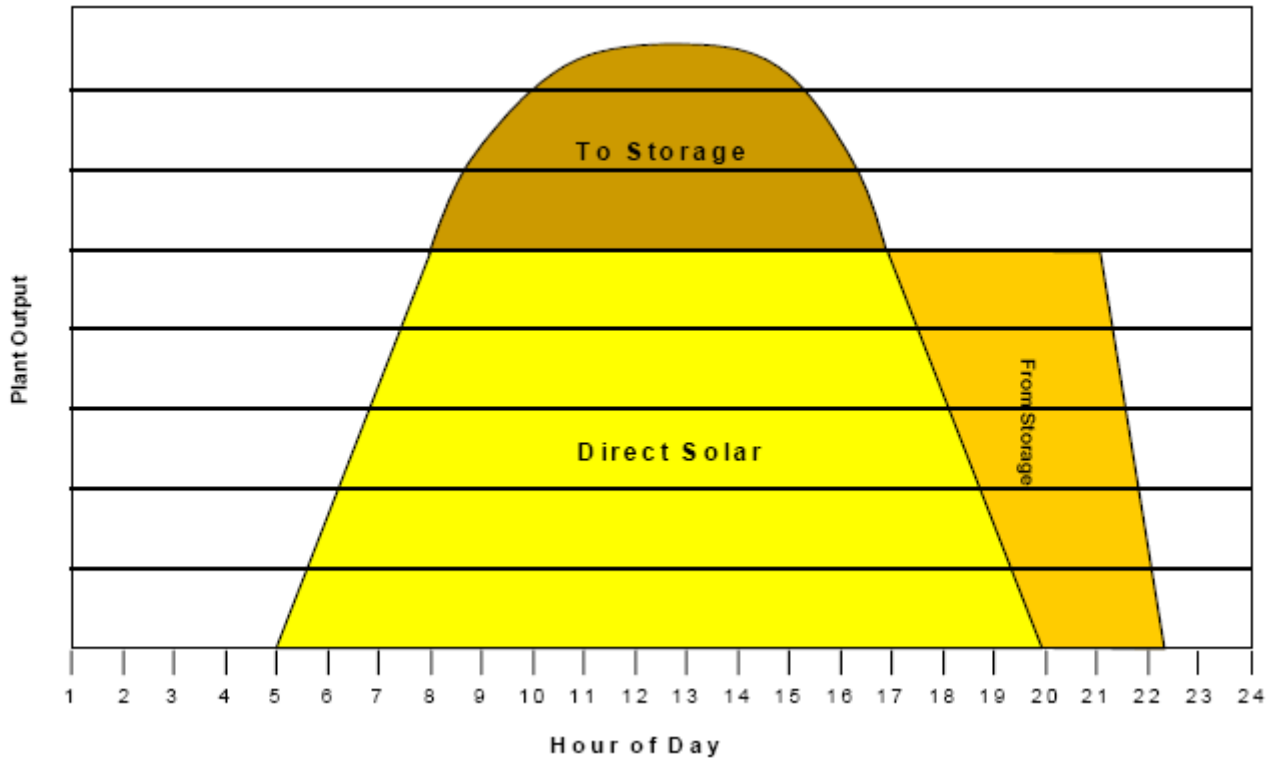
South Australian Electricity Demand on Peak Load day with PV Load curve superimposed




Commercial Load & PV Inverter Output Solar Home - Peak Load Day
Commercial Load (kW)
200000
180000
160000
140000
120000
100000
80000
60000
40000
20000
0
PV Inverter O/P (W)
600
500
400
300
200
100
0
00:30
02:00
03:30
05:00
06:30
08:00
09:30
11:00
12:30
14:00
15:30
17:00
18:30
20:00
21:30
23:00


Typical Average Residential Load & PV Inverter Output - Peak Load Day
Tyical Household Load
PV Output
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0.6
0.5
0.4
0.3
0.2
0.1
0
00:30
02:00
03:30
05:00
06:30
08:00
09:30
11:00
12:30
14:00
15:30
17:00
18:30
20:00
21:30
23:00

Conceptual Generation Scenario with Storage



Fiat Plug in EV being developed by Itaipu in Brazil

Conclusion

- **Deep cuts in emissions require a rapid transition to the use of renewable energy and more project experience is needed in integrating RE systems AND CARS into the network.**
- **Since reductions are required quickly the intelligent grid should identify large emitters and deal with them first.**
- **Base line studies are therefore required and quick and easy methods of determining target loads are needed – though we really already know them,**
  - **Water heating, heating and cooling and refrigeration**

  (Include both gas and electricity data collection.)
- **Peak load contributes to network costs rather than ghg emissions still this is a very important issue to tackle.**
- **The i-grid program provides the opportunity to develop cheaper monitoring and analysis methods so that real rather than modeled data can be used for policy decision making – which is a big advance!**

How to Increase use of Solar Energy improve Energy Efficiency and get value out of i-grids

- **Good Policies**
- **Strong Commitment from Governments**
- **Strong Commitment from Community – and a mind set of co-operation**
- **Education (all ages)**