RESIDENTIAL ENERGY PRODUCTIVITY: IS 40% IMPROVEMENT POSSIBLE?

Australian Summer Study on Energy Productivity – Sydney 24 Feb 2016

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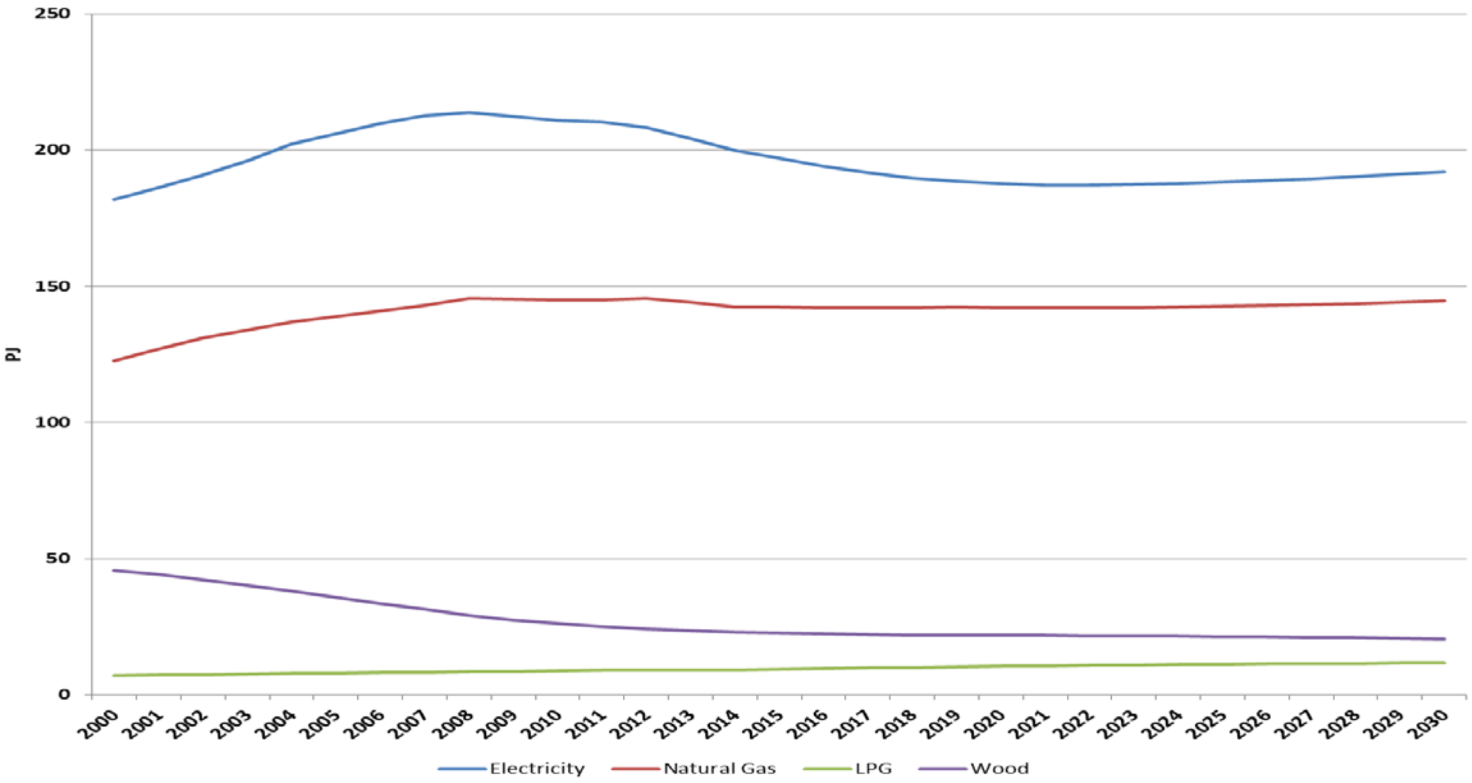
EnergyConsult Pty Ltd

Residential Consumption by Fuel



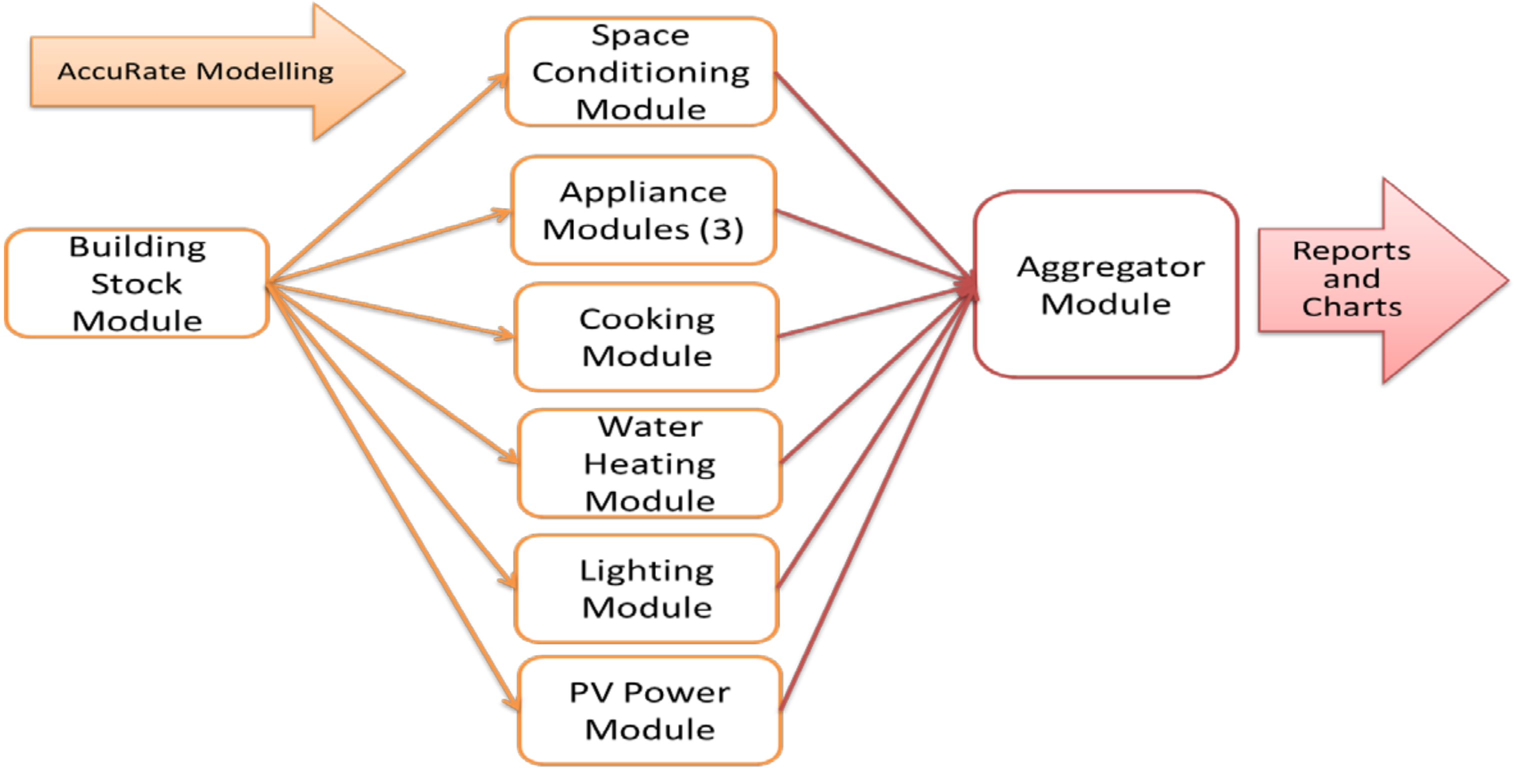
Residential Baseline Study

- Bottom up model of Australia and New Zealand residential energy use
  - All stationary fuels, end uses, and modes of operation
  - 2000 – 2030, last historical year 2013 or 2014
  - Update of 2008 study, and first study in 1999
  - For the Australian and NZ federal governments and all the 8 States/Territories
  - Aims to forecast energy use, demand, efficiency and equipment trends
  - Uses considerable data, on sales, equipment characteristics and usage (ABS)

Methodology & Data Sources

- Model attributes used/produced (by year if applicable)
  - Annual Sales
  - Life
  - Efficiency (or input power or other metric) - sales weighted
  - Size/capacity
  - Hours of operation (or uses per day) by mode of operation
  - Building thermal performance
  - Energy use /demand characteristics by year
  - Stock installed
- All attributes are potentially adjustable due to
  - Regulations, programs or market changes
  - BAU trends (natural efficiency changes)
- Fundamentally a complex stock model that includes energy related characteristics of stock

Overview of Model: Structure



Basic Energy/Demand Model Diagram

Inputs

- Hours of use
- Unit Size
- Unit Efficiency
- Sales
- Life
- Rated Power
- Peak Load Factors

Calculations of UEC, Stock & Unit Power

UEC_{yr} = Hours x Size x Efficiency

$Stock_{yr}$ = ∑ $Sales_{yr}$ - $Retirements_{yr}$

Unit $Power_{yr}$ = Rated Power x Rated Load Factor

Annual Energy Consumption

AEC =∑UEC_{yr} x $Stock_{yr}$

Max Demand

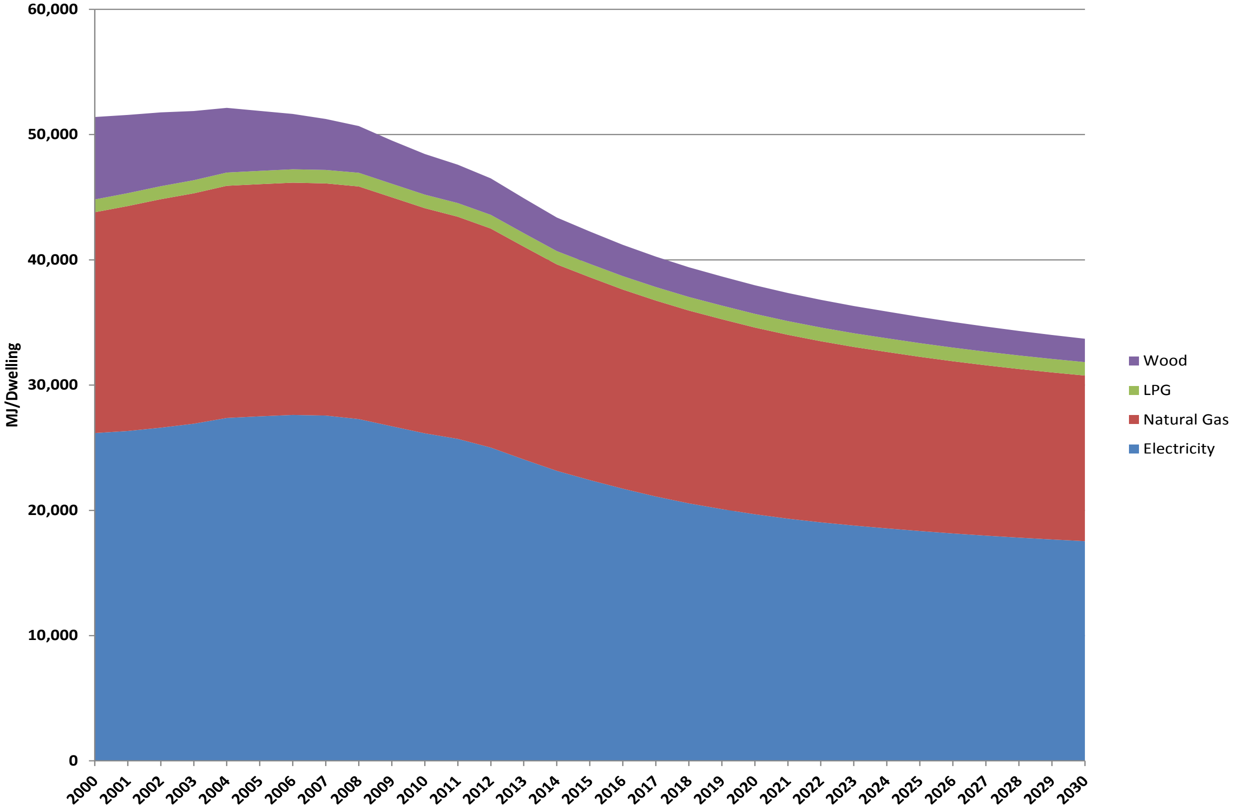
Max Demand = ∑ Rated $Power_{yr}$ x $Stock_{yr}$ x Peak Load Factors

Modes of Operation

- 130 Products classified by:
  - End-use, category, product group, product, e.g.
    - Appliances – White Goods – Refrigerators – Ref Type (1 to 7)

Mode	Description
Operation 1	Main operation mode - heating mode in space conditioning equipment.
Operation 2	Main operation mode - cooling mode in space conditioning equipment
Auxiliary	Auxiliary mode used by some appliances such as energy use by fans in gas heaters
Standby	The modes that are non-operating (standby/off), but consuming power.

Total Residential Consumption per Dwelling by Fuel



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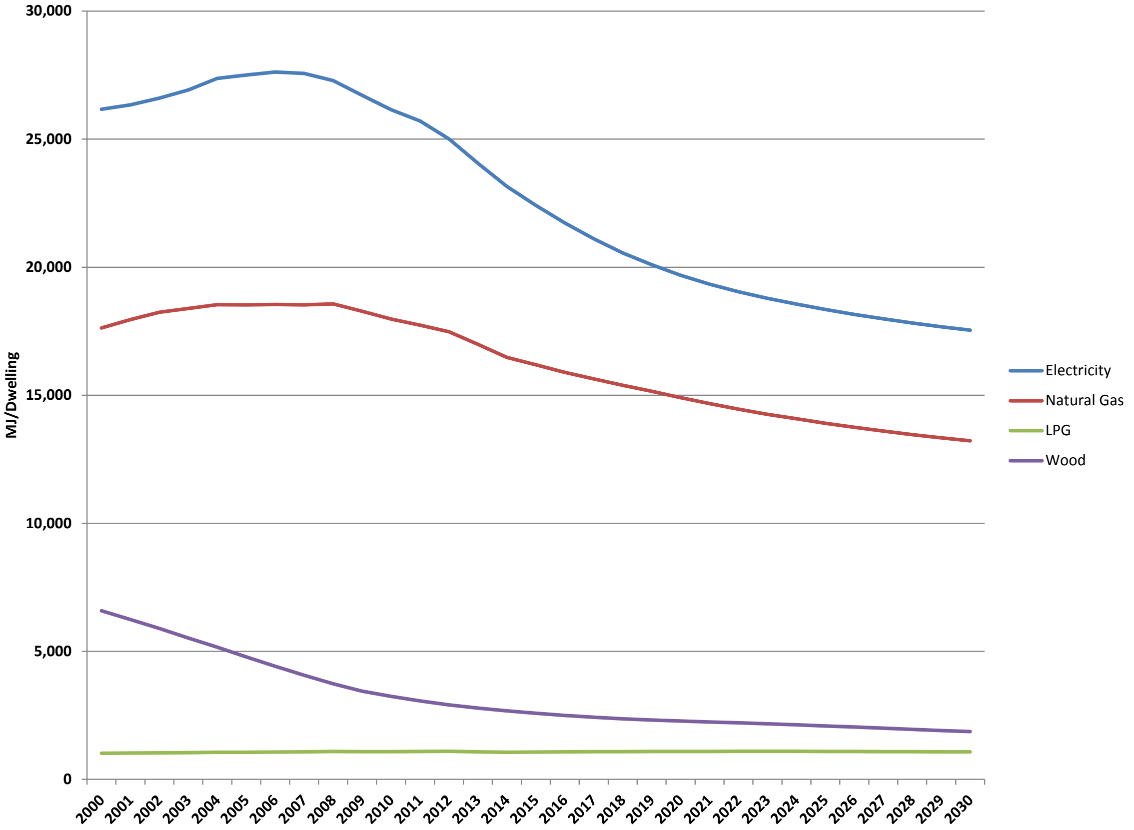
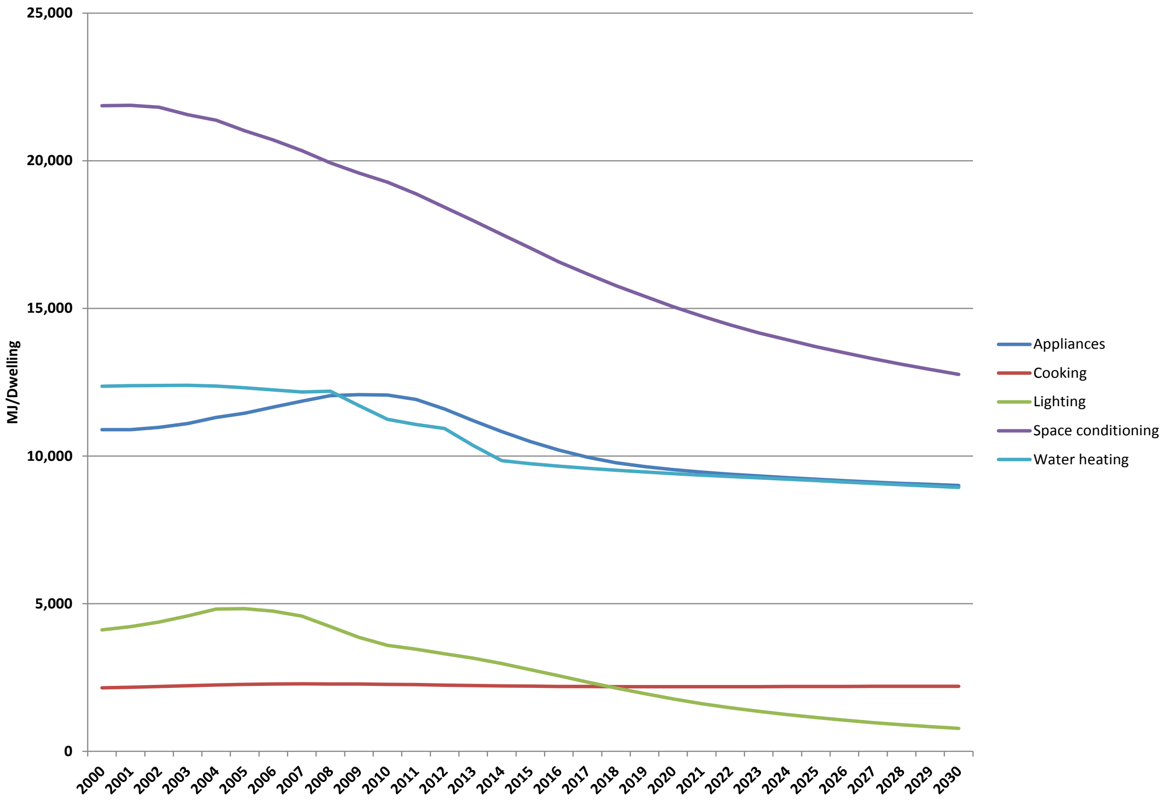
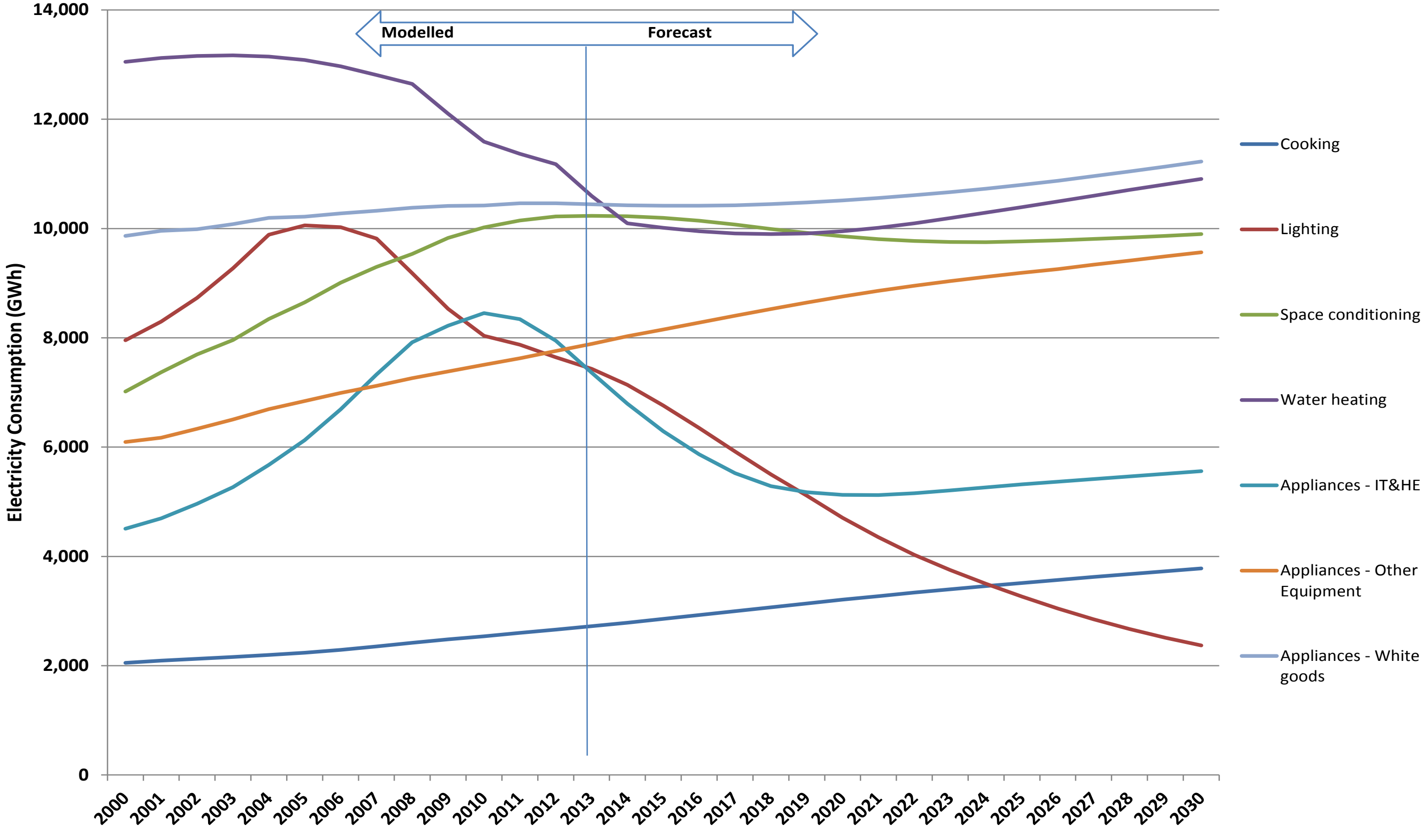


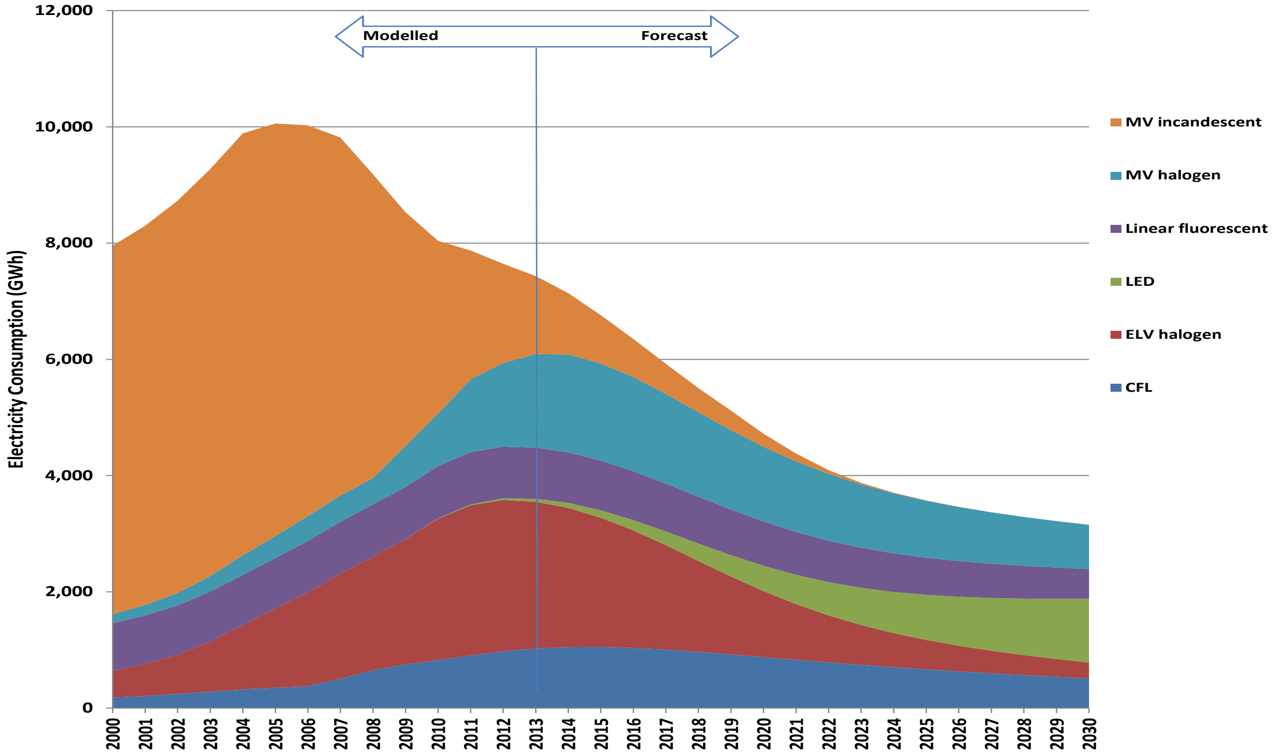
Total Residential Consumption per HH by End Use



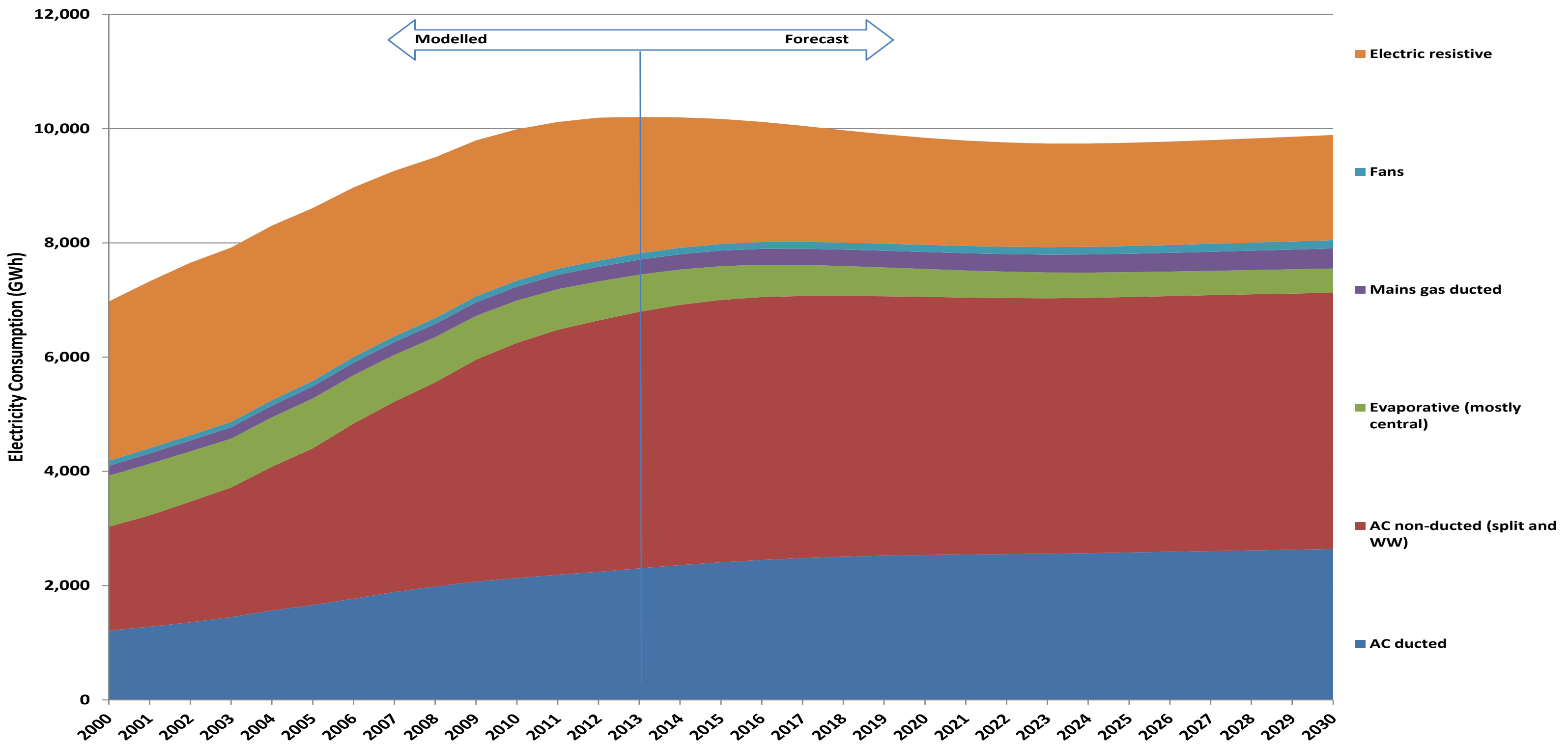
Electricity Consumption – trend lines



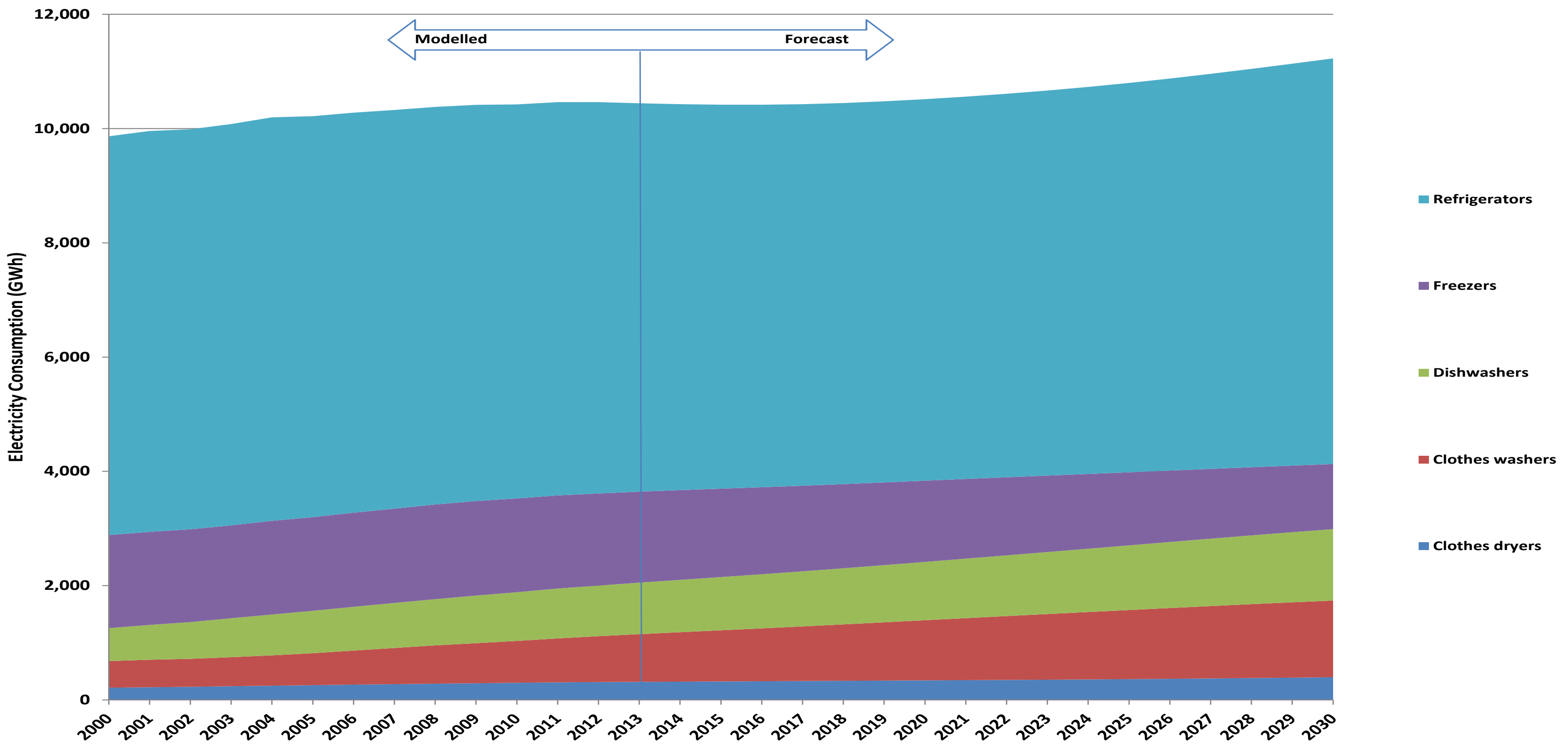
Estimated and forecast electricity consumption of lighting end-use



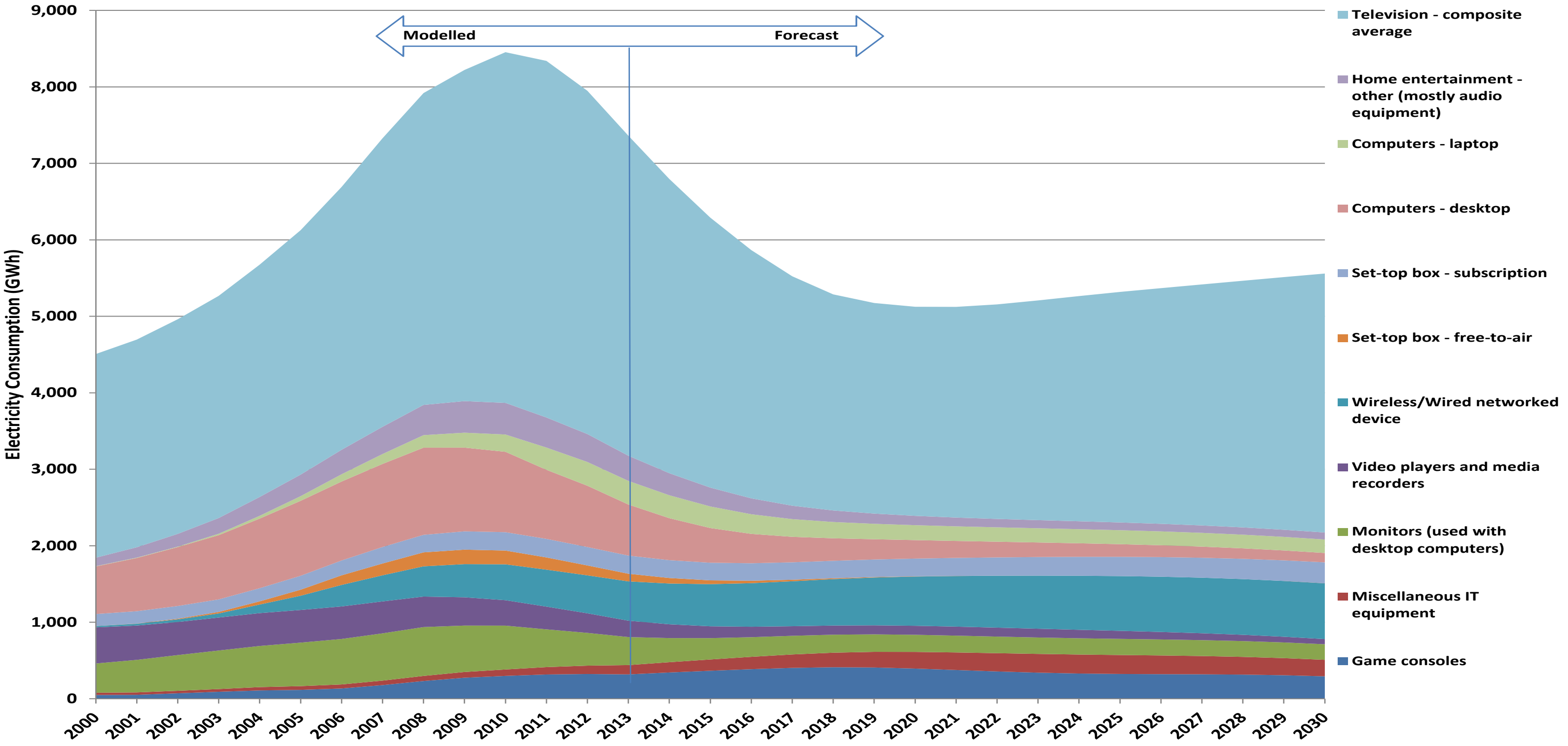
Electricity – Space Conditioning



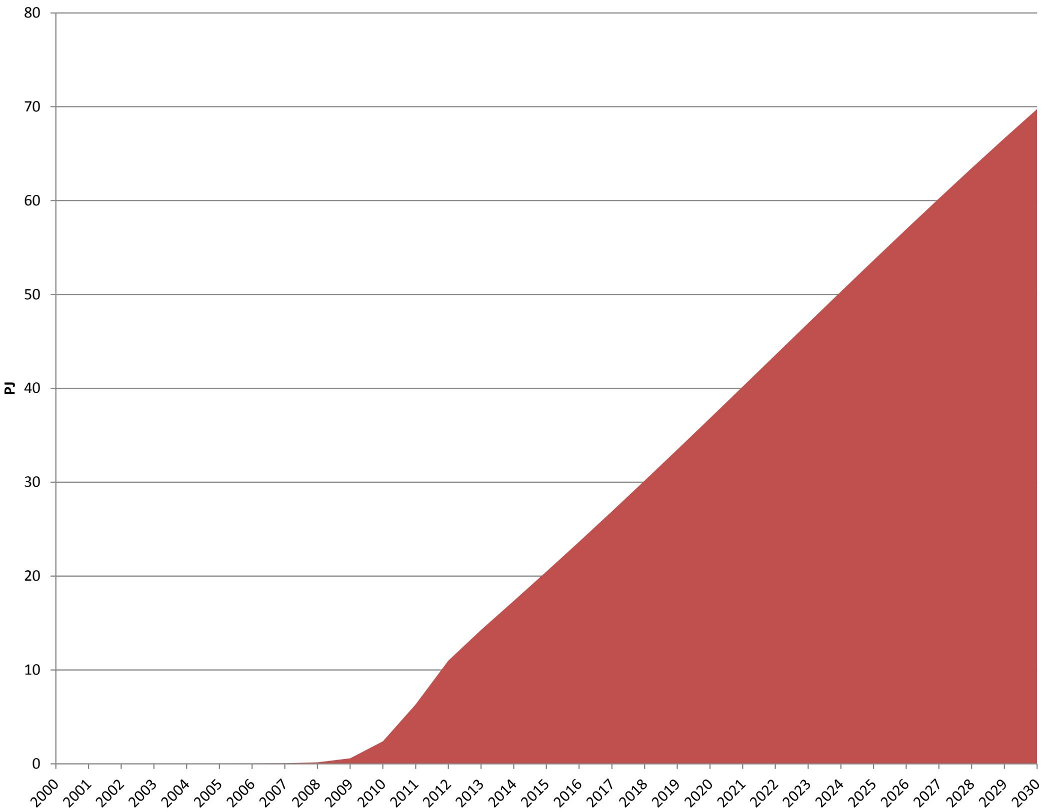
Electricity – Appliance (White Goods)



Electricity – IT & Home Entertainment



National Residential PV: Gross Annual Energy



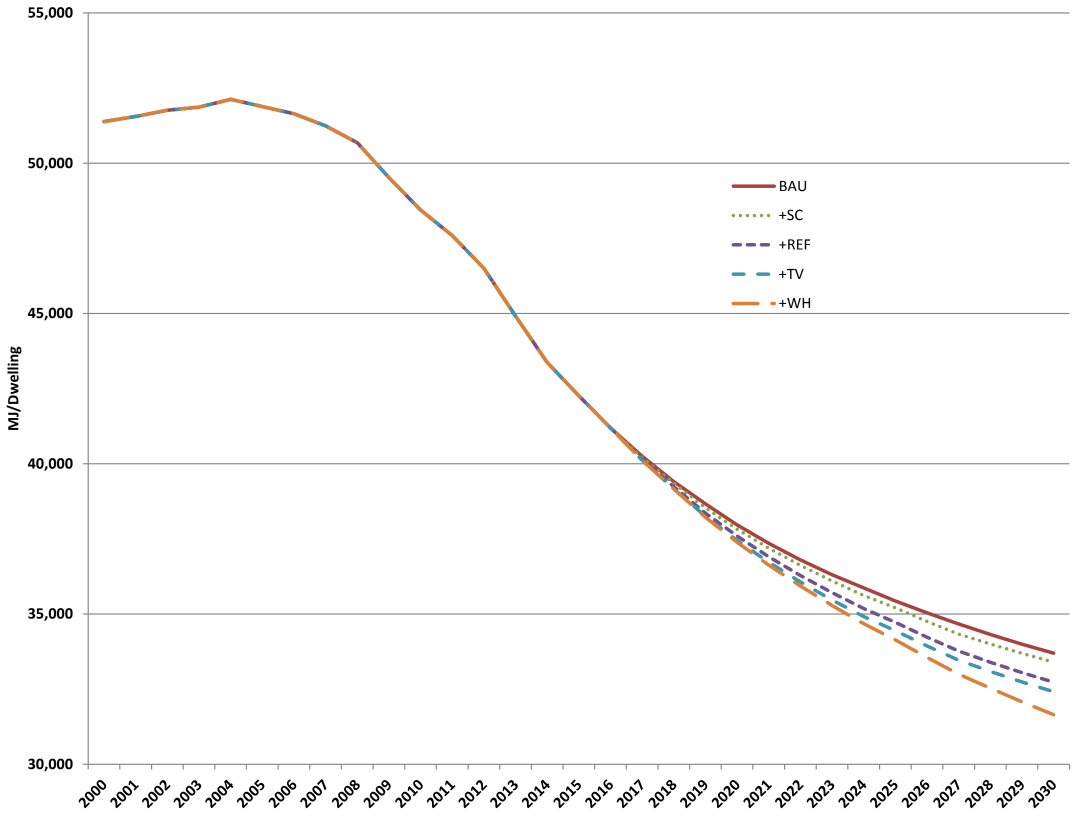
Scenarios to achieve a 40% increase in energy productivity

- A 40% increase in energy productivity as a 40% decrease in energy use per household by 2030
- Under BAU, energy use per household is projected to decrease by 20% by 2030 compared to 2015, another 20% required
- Options available
  - regulatory actions (MEPS and building codes)
  - incentives (such as state based Energy Saving Schemes)
  - information programs (Energy Rating Labels, Endorsement labels)

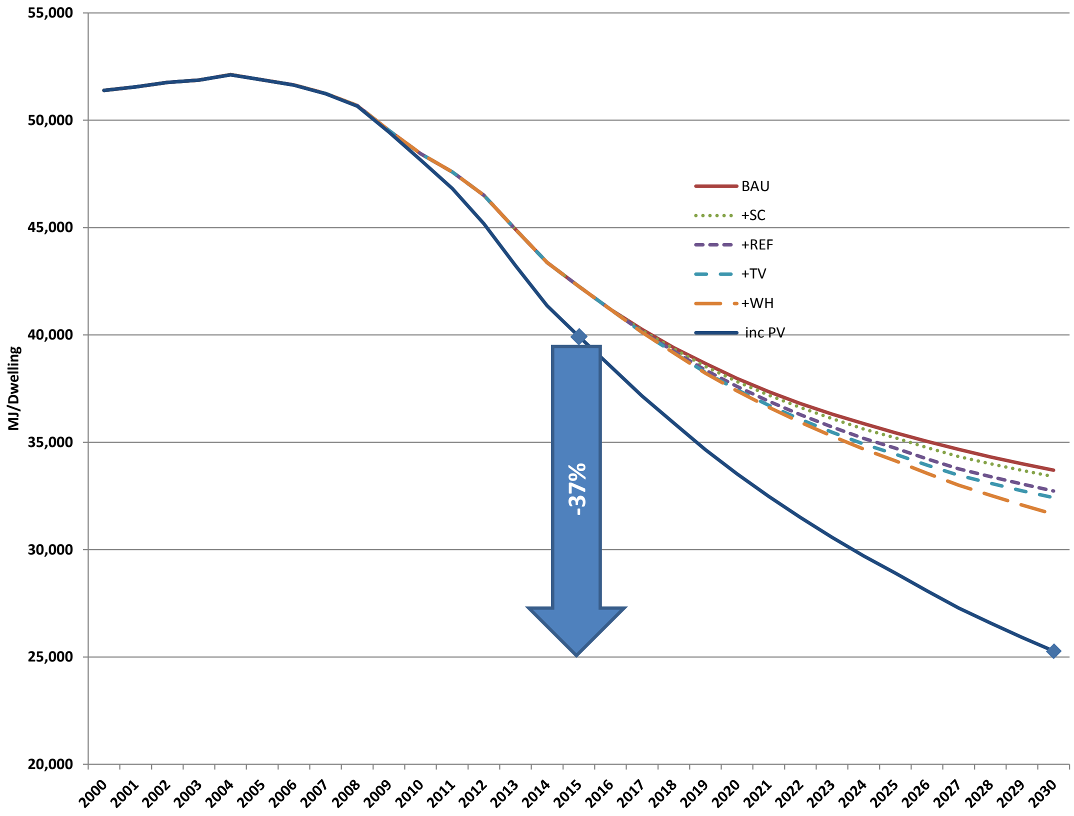
Actions examined to see what is possible

- Space Conditioning
  - Increase the thermal efficiency of new buildings by increasing the national building code energy performance requirements to 7 stars in 2017 (Shown as +SC in the following figures
- Refrigeration
  - increase the MEPS for new domestic refrigerators and freezers that is equivalent to a 30% efficiency improvement (similar to the USA standards) in 2017 (+REF)
- TVs
  - increase the MEPS for new TVs to be equivalent to a 30% efficiency improvement above BAU (similar to the USA Energy Star Specifications) in 2017 (+TV)
- Water heaters
  - phase out the installation of new medium and large electric storage water heaters in Australian households, beginning in 2017. This would increase sales of solar electric, heat pump, solar gas and gas instantaneous water heaters, while it is assumed that sales of electric storage water heaters would reduce by 80% (+WH)

Cumulative impact of various policy measures



With PV generation



Conclusions (1)

- Residential energy use in Australia increased during the 2000s but has declined in recent years since 2008
- The energy productivity of the average dwelling is expected to continue to improve to 2030
- There have been dramatic declines in the last five years in the energy consumption in some end-uses,
  - such as hot water, IT&HE and lighting,
  - but these have been masked by the increase in energy use of space conditioning and white goods

Conclusions (2)

- Energy productivity 2015 – 2030
  - 20% by 2030 under BAU
  - Extra 5% if measures modelled are implemented
  - Total of 37% if solar is included
- Total energy use forecast
  - Without further regulated improvements in the efficiency of electric water heaters, refrigeration and TVs in Australia, likely to be increasing energy use over the period 2020 to 2030
  - Continual refreshment of MEPS and energy labelling programs will be essential + State EE schemes

Further Information

www.energyrating.gov.au

Thank You

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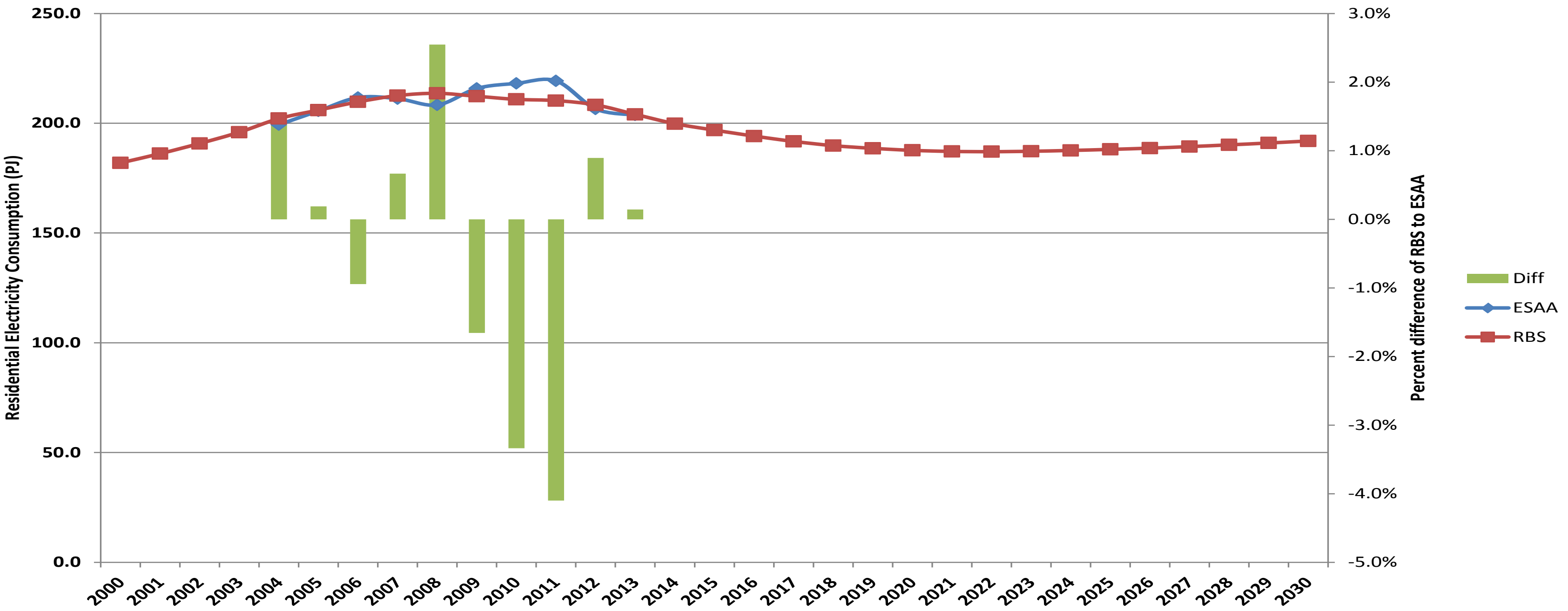
Spare Slides

RBS versus ESAA Electricity Use



Electricity – Water Heating