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# AusZEH – A Systems Approach to GHG Emissions Reduction in Housing

Energy Transformed Flagship

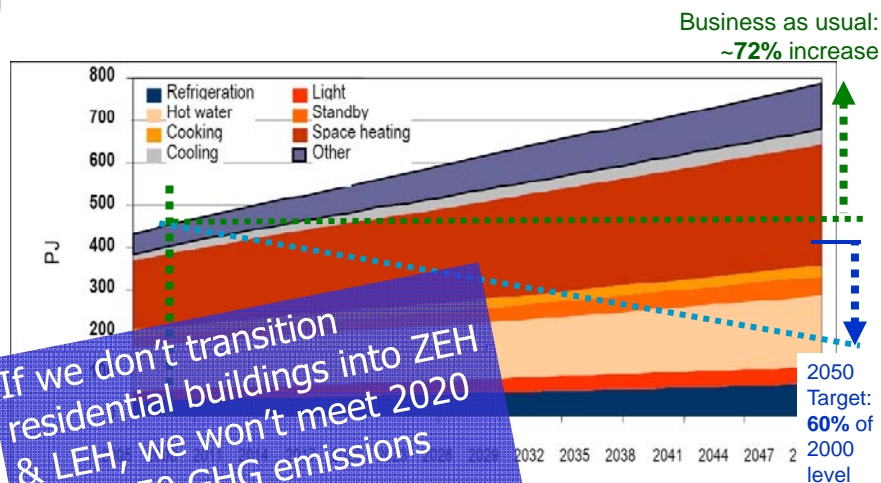
Greg Foliente *for the AusZEH Team*  
CSIRO Ecosystem Sciences, Melbourne, Australia

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**FLAGSHIPS** CSIRO

# AusZEH

Context | Systems Approach | Conclusions

## Sector projected residential energy use by activity – assuming no action (from CIE 2007)



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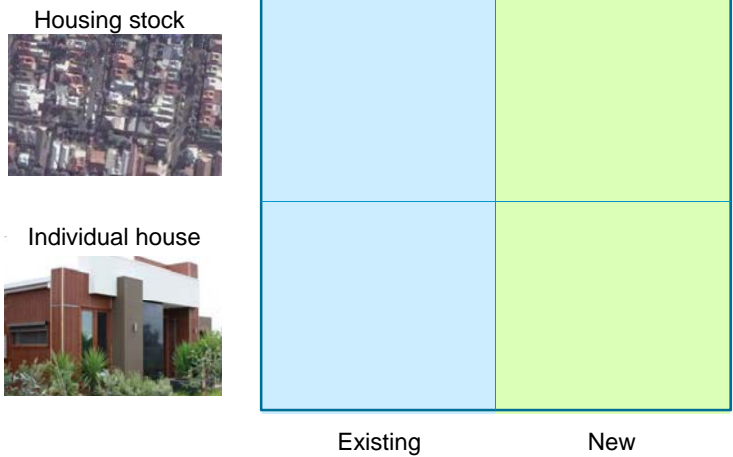
# AusZEH

## Goal

To facilitate significant GHG emissions reduction in Australian housing through:

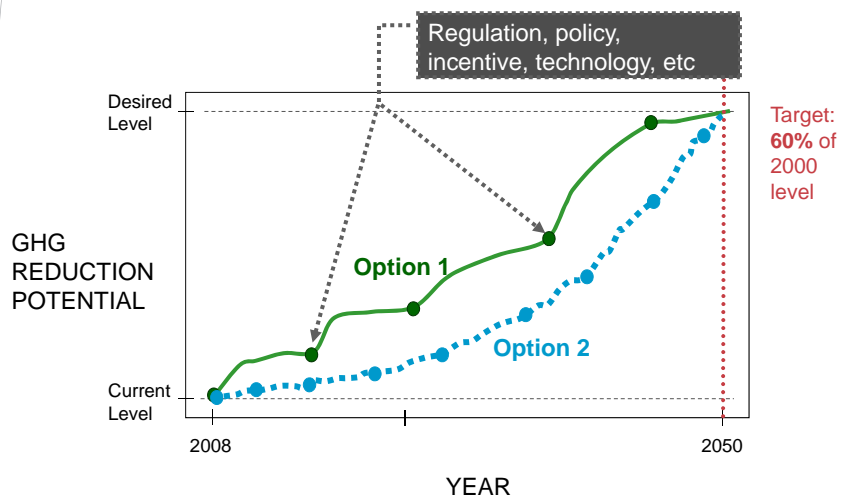
- demonstration and capability development
- development of design, decision support & scenarios analysis tools for pathways planning & assessment

## Housing Sector Framework & Scope



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## GHG reduction pathways & scenarios – Residential housing stock



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# AusZEH

Context | **Systems Approach** | Conclusions

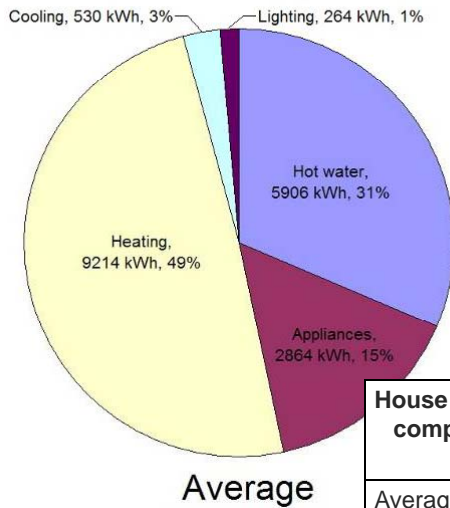
- Individual house
- Housing stock

## **New Housing**

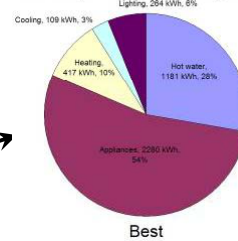
*Integrated Demonstration & Capability  
Development*

## Potential energy demand & GHG emissions reduction of a typical house in Melbourne – now!

Total: 18,779 kWh (7,908 kg CO<sub>2</sub>)



Total: 4,251 kWh (4,265 kg CO<sub>2</sub>)



House scenario comparisons	% Energy Demand Reduction	% CO <sub>2</sub> Emission Reduction
Average to Best	77%	46%

## ZEH Demo House One Laurimar Development, Melbourne

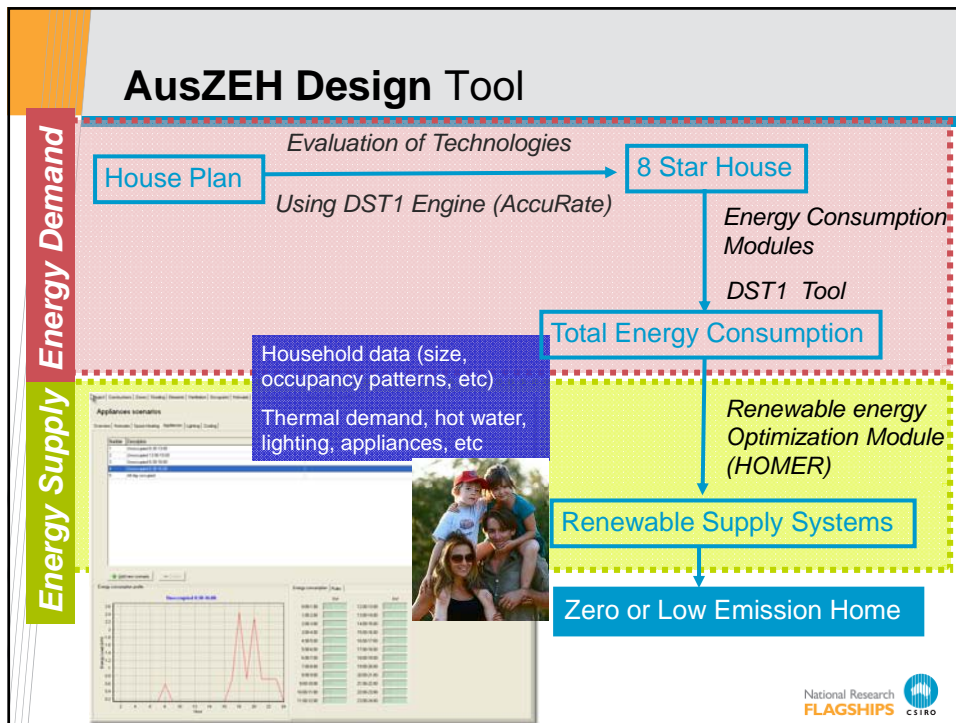


One word, **Delfin**



→ Public launch on 29 Apr '10  
 → First mass-market ZEH  
 → One-year tenancy & performance study to commence

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## Reduction potential in Five Australian cities

Location	% Energy consumption reduction			% CO <sub>2</sub> emissions reduction		
	Average - Best			Average - Best		
Melbourne	77			46		
Sydney	69			49		
Canberra	81			54		
Brisbane	62			42		
Townsville	61			47		

61-81%
~48% average

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## Another example of ZEH Design Tool Application 'Guide for Designing Low-Carbon & Zero-Carbon Homes'

### Performance Level

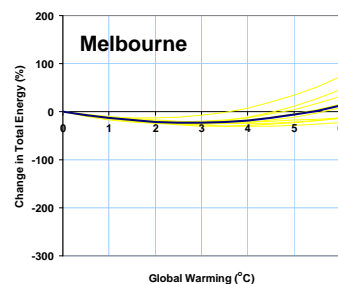
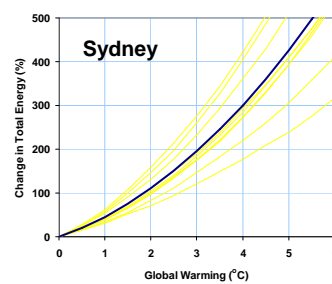
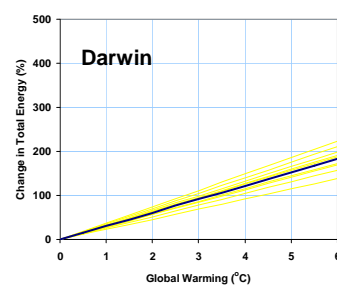
- AusZEH 10 – 100% carbon reduction
- AusZEH 8 – 80% reduction
- AusZEH 6 – 60% reduction
- etc.

### Example 'Solutions'

- Design sets A1 to A10
- Design sets B1 to B10
- etc.



## Percentage Change of Heating and Cooling in Relation to Global Warming Temperature



— GCMs  
— Average

Source: Wang et al, *Building and Environment* 45 (2010) 1663-1682.

## Prototype Home Energy Manager in Aus ZEH



### Zero Emissions House

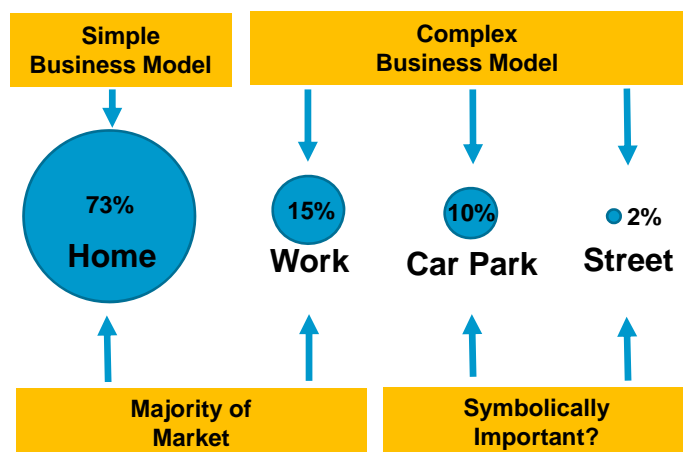
- 8 Star Family Home
- 6kW PV Array
- Living Laboratory

### Home Energy Manager

- CSIRO / LaTrobe University
- Prototype platform for intelligent EV charge & discharge



## Measured Recharging Patterns (UK)



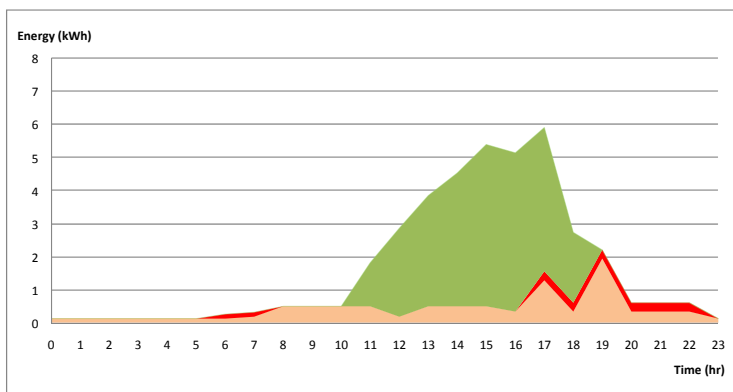
## Field Trials - First Three PHEV Vehicles

### Conversion of three Toyota Prius for SP-Ausnet:

- Plug-in charge & discharge
- Extra battery capacity
- Advanced monitoring & control of energy flow

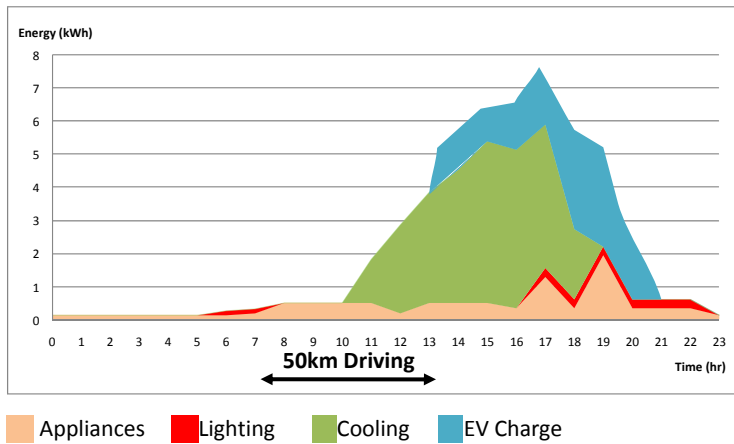


## VIC 3 Star House : 19<sup>th</sup> Jan : 24hr occupied

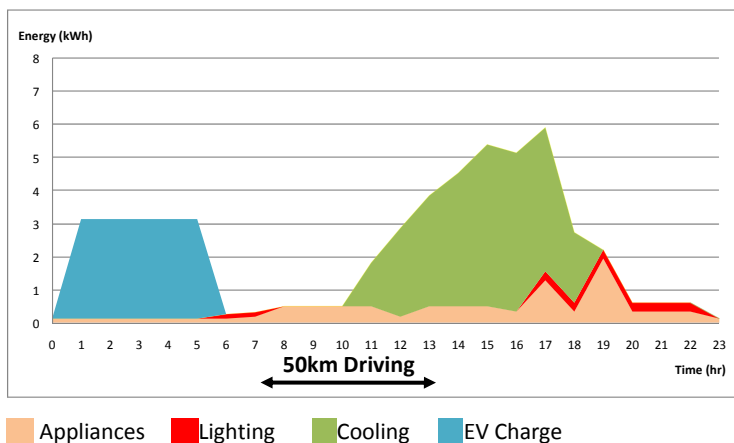


Appliances Lighting Cooling

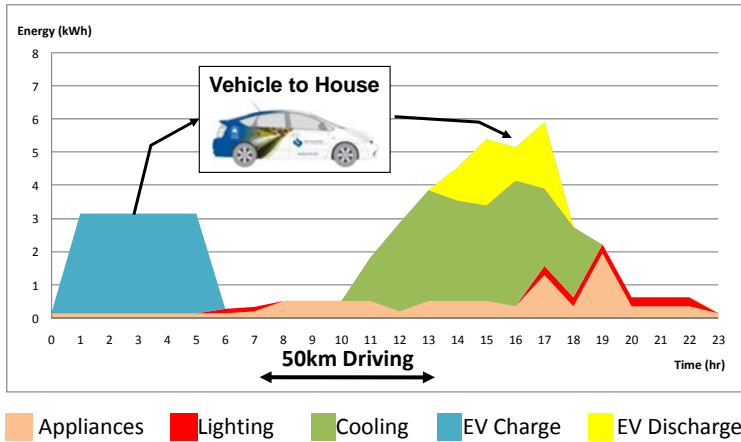
**VIC 3 Star House : 19<sup>th</sup> Jan : 24hr occupied**  
**+ Uncontrolled Charging 15kWh**



**VIC 3 Star House : 19<sup>th</sup> Jan : 24hr occupied**  
**+ Controlled Charging 15kWh**

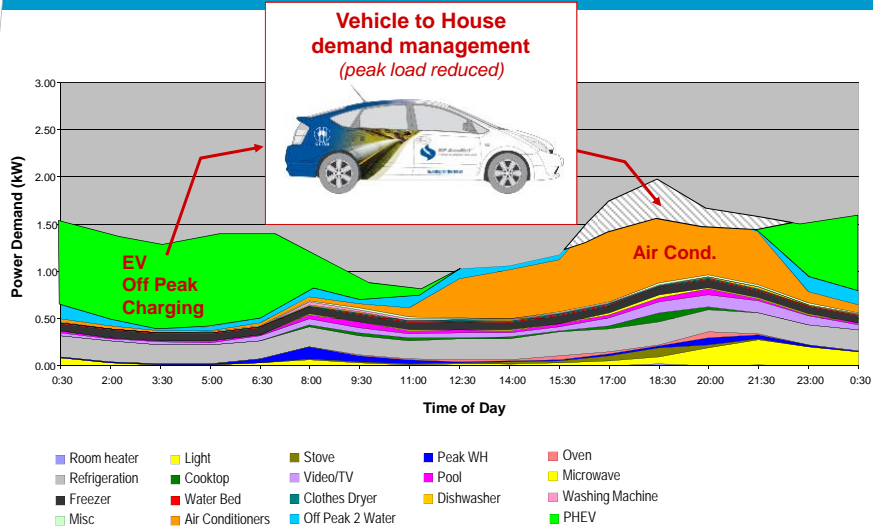


## VIC 3 Star House : 19<sup>th</sup> Jan : 24hr occupied + Vehicle to House 6kWh



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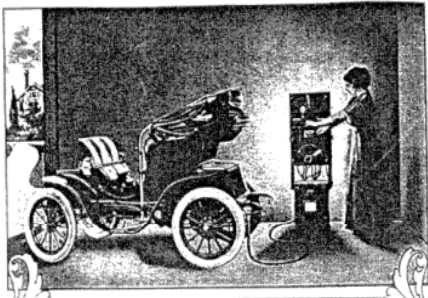
## Vehicle to House Load Management (Summer Peak- NSW)



Source: UTS Sustainable Futures

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## General Electric Advertisement



### There's No Place Like Home For Charging Your Electric

Eight Thousand G-E Rectifiers Are Used for Auto Charging Because the G-E Rectifier Makes Home Charging Really Practical

G-E Rectifiers can be operated by any man or woman who runs a car. They spare the trouble and expense of frequent trips to the public garage. They are simple, have no moving parts, require no oil, and take up little room in the garage.

G-E Rectifiers cost less, are more easily installed, and waste less current than any other charging device.

You can get the full value from a new car by installing a rectifier. The car will always be at home ready for use when you want it.

Write for circular on "Charging the 'Electric' at Home"

**General Electric Company**

Largest Electrical Manufacturer in the World

Principal Office:  
Schenectady, N. Y.

Sales Offices in  
All Large Cities



May 29, 1912 p. 16

**'There's No Place Like Home For Charging Your Electric'.....  
May 1912**

Source : Le génie électrique automobile  
la traction électrique

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## Housing Sector Framework & Scope

Housing stock



Individual house



### AusZEH Design Tool & Guide

AusZEH Demo  
House 2 @  
Pascoe Vale

AusZEH Demo  
House 1 @  
Laurimar

Existing

New

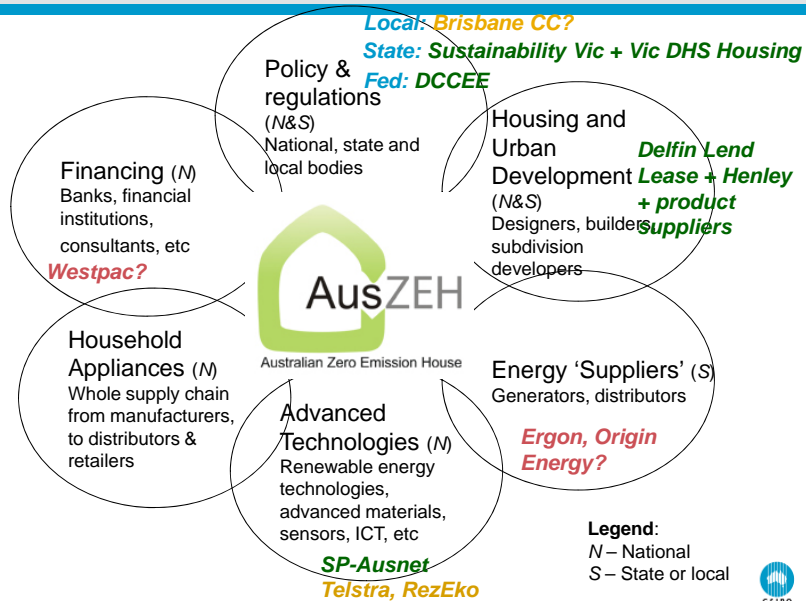
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## AusZEH Demo House 2 - Retrofit



- Location: Pascoe Vale (Melbourne)
- DHS Owned House
- Built in the 1960's, BV, Tiled, Raised floor
- Current rating ~1 Star
- Aim – Max possible Star-Rating
- Explore:
  - Thermal performance
  - Acoustic
  - Lighting
  - Moisture
  - Appliance efficiency
  - Leakiness

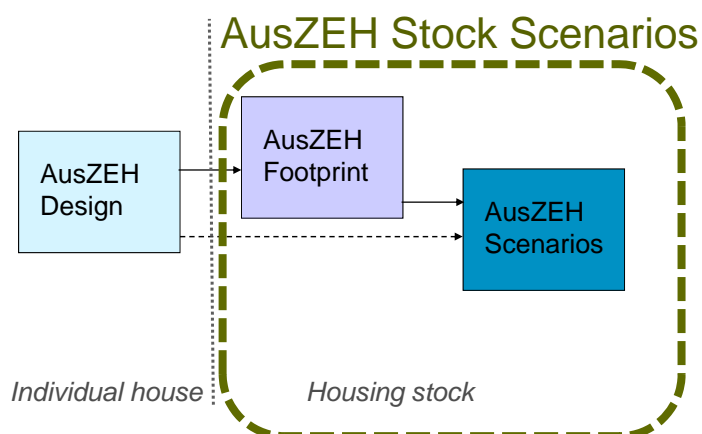
## Consortium to Support a ZEH Ecosystem



# All Housing Stock

Tools for Carbon Foot-printing & Assessment of Policy or “Intervention” Options

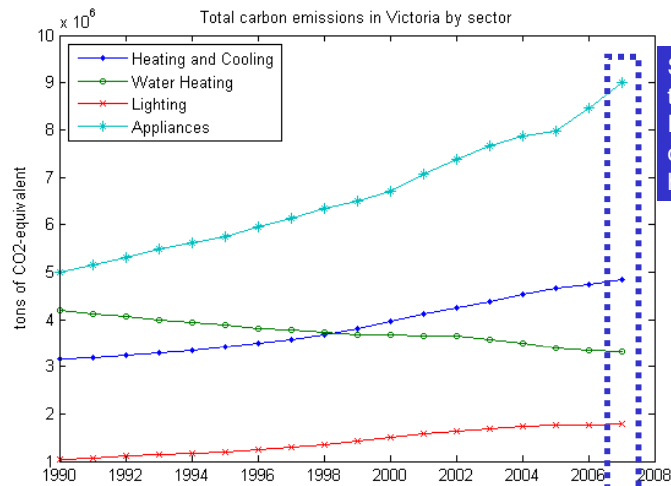
## Suite of AusZEH Decision Support Tools





## Evolution of carbon emissions by use in Vic housing (to present)

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Footprint



Sum is the  
total Carbon  
Footprint (CF)  
of Vic  
housing

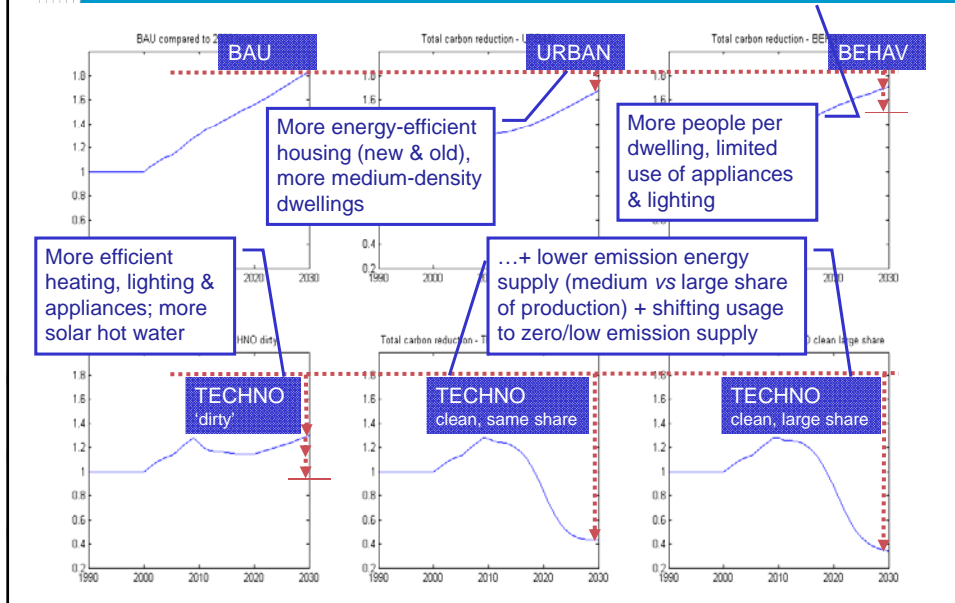
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## Housing Stock Level – Intervention options

- *What* regulations, policies, incentives & technologies need to be introduced to bring down Australian houses' carbon footprint considering specified planning horizons?
- e.g. reduction to be 5% of 2000 levels in 2020? ...60% by 2050?

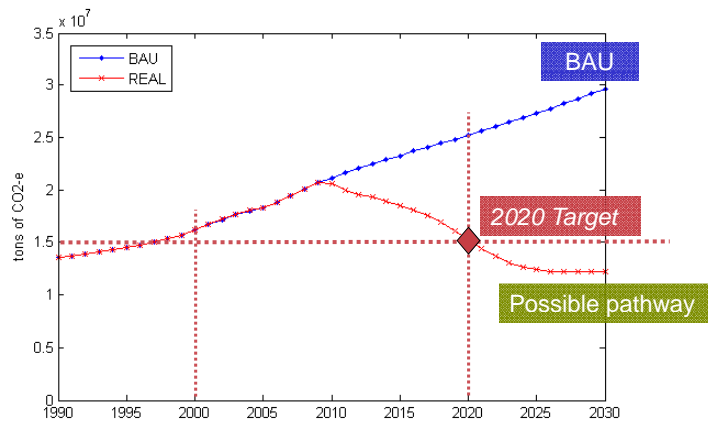


## Scenarios of **total** carbon emissions in Vic housing compared to 2000 level (projected to 2030)



## Scenarios of **total** carbon emissions in Vic housing BAU vs requirements to meet 2020 target

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Footprint



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## Case Study: Brisbane City Council Assessing cost-effectiveness of Rebate options

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Scenarios



- Seven Brisbane Suburbs – 25,000 houses of varying demographics and house types

Suburb	Separate house	Semi-detached	Units/apartments
Camp Hill	3198	213	323
Chermside	1319	505	1066
Coorparoo	2956	342	2777
Fitzgibbon	889	157	30
Indooroopilly	2278	416	1457
Nundah	1474	508	2007
Upper Mount Gravatt	2422	240	337

- Two Options

- \$1500 rebate for solar hot water
- \$8000 rebate for solar 1.5 kW PV, means-tested to \$100,000 p.a. income

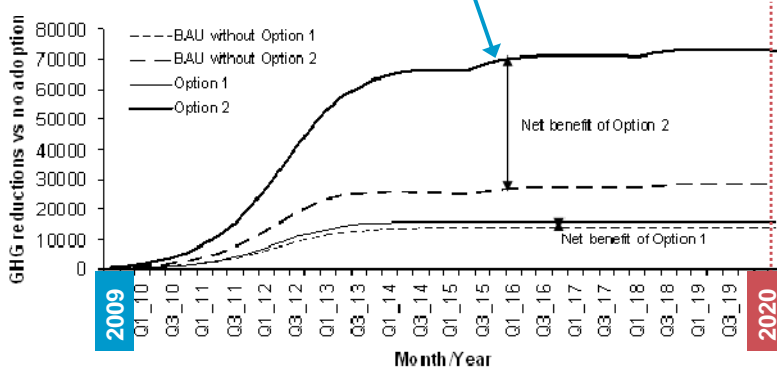
→ Compared to Business as Usual (BAU) – adoption of technologies w/o the rebates

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## Case Study: Brisbane City Council Overall comparison of Options 1 and 2 and BAU

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Scenarios

Option 2 (PV rebate) has bigger impact due to attractive rebate

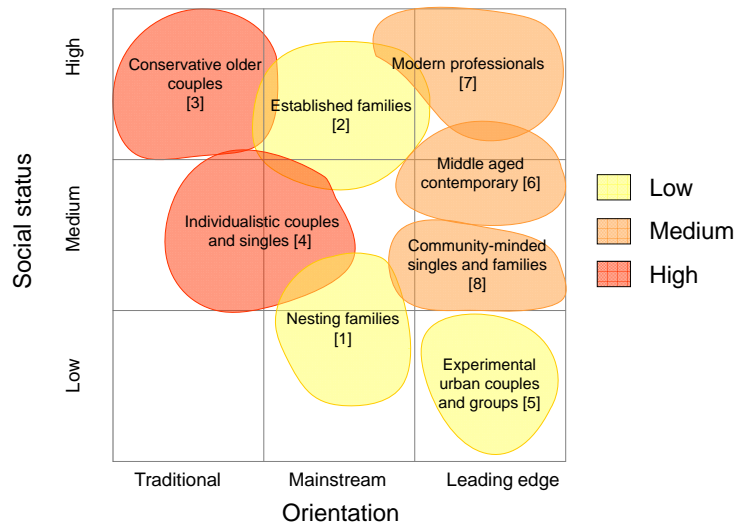


- Option 1. \$1500 rebate for solar hot water  
 2. \$8000 rebate for solar 1.5 kW PV, means-tested \$100,000 pa

→ Compared to Business as Usual (BAU) – adoption of technologies w/o rebates

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## Preliminary Australian Lifestyle Clusters – emissions intensity

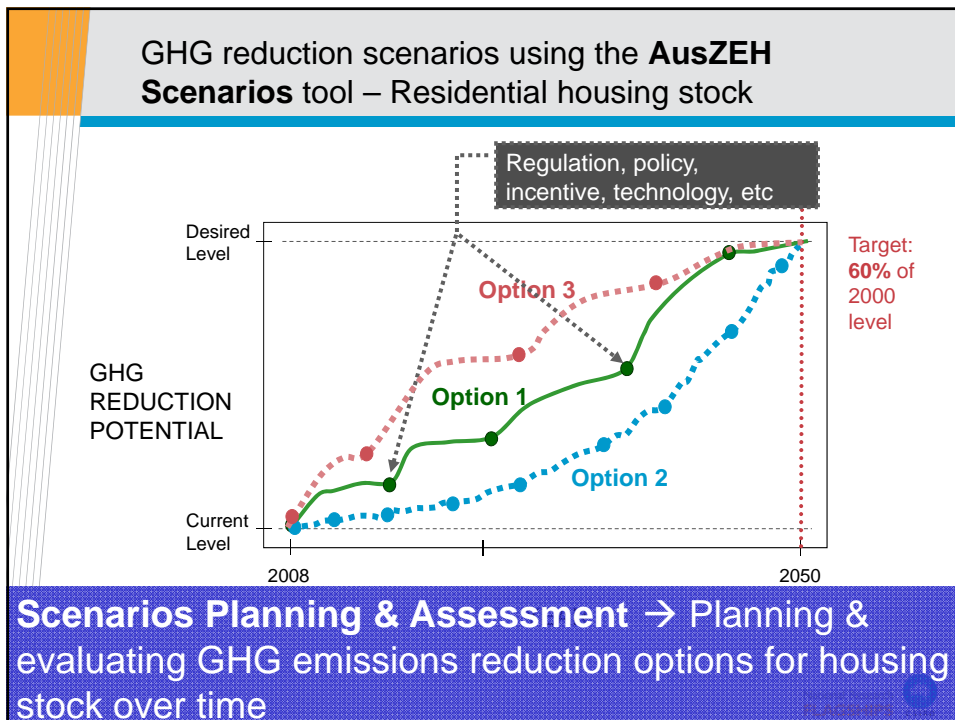
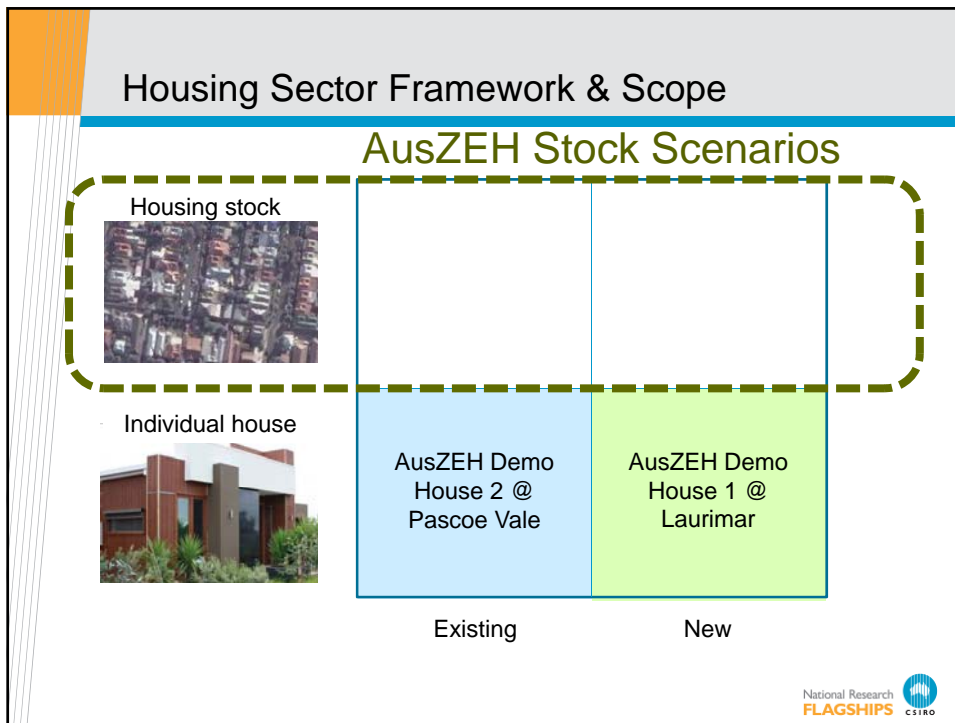


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## AusZEH Scenarios Tool Analysis Capability

- **Regulatory & policy options**, e.g. new minimum star ratings for new houses
- **Technology options**, e.g. housing retrofit, efficient appliances, and energy sources such as solar power
- **Incentive schemes**, e.g. rebates introduced at different times
- **Optimisation of policy and technology combinations** that best meet GHG or budget targets at key dates
- **Impact of external events – climate change & disasters**
- Predict the CO<sub>2</sub> impacts of different types of **urban development or re-development options**





# AusZEH

Context | Systems Approach | **Conclusions**

## Housing Sector Framework & Scope



AusZEH is contributing to GHG emissions reduction in ...

- **New & existing** housing
  - Demo house
  - Design tool & guide for low-carbon & ZEH
- **All** housing to 2020 ... 2050
  - Housing stock carbon foot-printing
  - Scenario planning & assessing cost-effective 'intervention' options

... in close collaboration w/  
government & industry partners

**CSIRO Energy Transformed Flagship**

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Thank you

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