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Transitioning to Zero-Carbon Housing: Hybrid Buildings

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In collaboration with

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Department of Planning and Community Development; Sustainability Victoria

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HYBRID BUILDING : ENERGY AND CARBON TRANSITIONS

Net zero energy building supplies as much energy to the grid over the course of a year as it uses, without any reference to carbon emissions. This class of building does not preclude use of low emission local energy generation technologies.

Carbon neutral building generates sufficient surplus CO₂-e free energy over the course of a year that balances any purchase of grid energy (primarily fossil fuel based). This recognises the fact that a single dwelling/household may be unable or unwilling to generate sufficient CO₂-e free energy to be classed as zero-carbon.

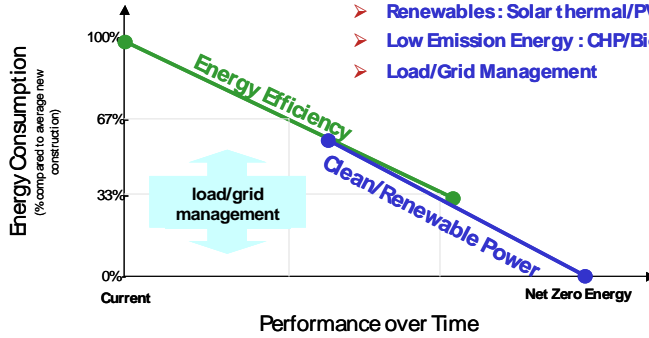
Zero carbon building uses carbon free energy over the entire year, sufficient in quantity to supply all household energy needs (both dwelling operations and appliances to match any lifestyle). Connection to grid is primarily in order to supply energy that is surplus to household needs, and for periods of emergency supply when local energy system may be inoperable.

An energy efficient building is assumed to be a key component in each of these building scenarios.

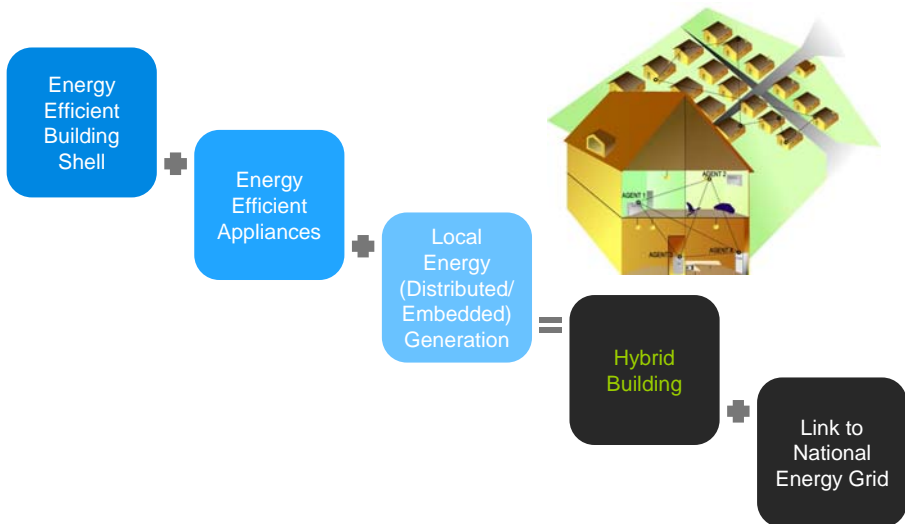
HYBRID BUILDINGS: TRANSITIONING TO ZERO CARBON HOUSING

The Net Zero Approach:

- > Integrated Solar Design
- > Energy Efficiency—Shell+Appliances
- > Renewables : Solar thermal/PV/Wind etc
- > Low Emission Energy : CHP/Biomass etc
- > Load/Grid Management



HYBRID BUILDING

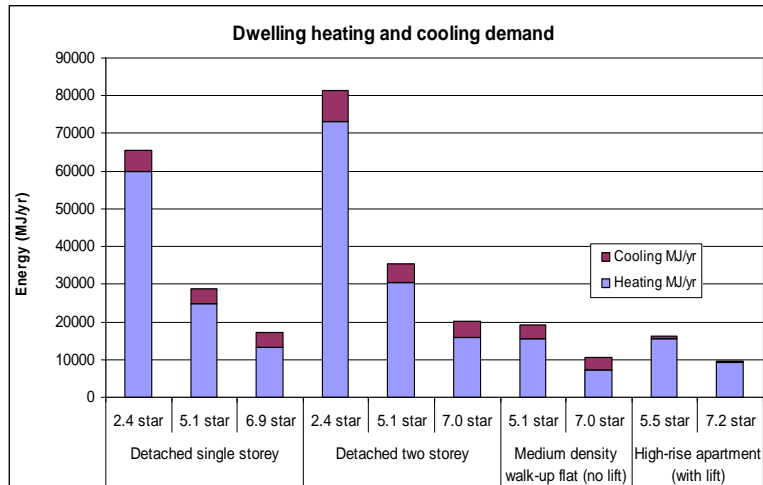


HYBRID BUILDING SCENARIOS

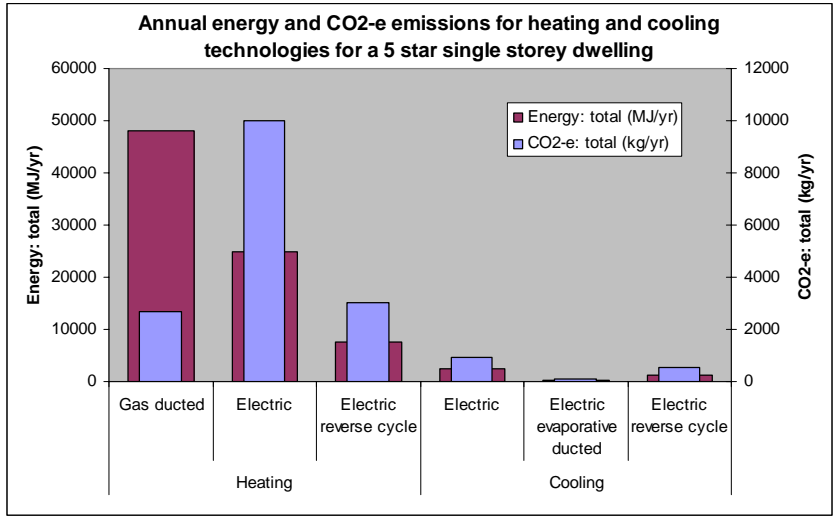
Hybrid building scenarios are created from combinations arising from:

- > Different **building types**, and the extent to which they contribute to more or less eco-efficient building 'shells'
- > The extent to which **domestic appliance** use is adding to the energy footprint of the residential sector; capable of being examined via:
 - > purpose – hot water, cooking, lighting, plug-in, common area;
 - > average vs. high energy efficiency rating;
 - > basic vs. affluenza set of appliances; and
 - > built-in vs. plug-in appliances
- > The relative contribution of different **local generation technologies**; including 'zero-emission' and 'low-emission' technologies

DWELLING HEATING AND COOLING DEMANDS



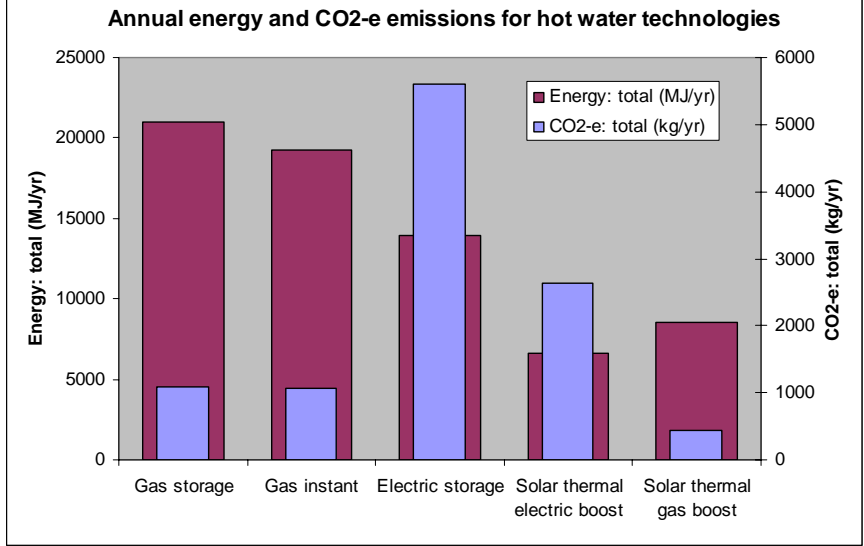
ENERGY AND GHG PROFILE FOR HEATING AND COOLING TECHNOLOGIES



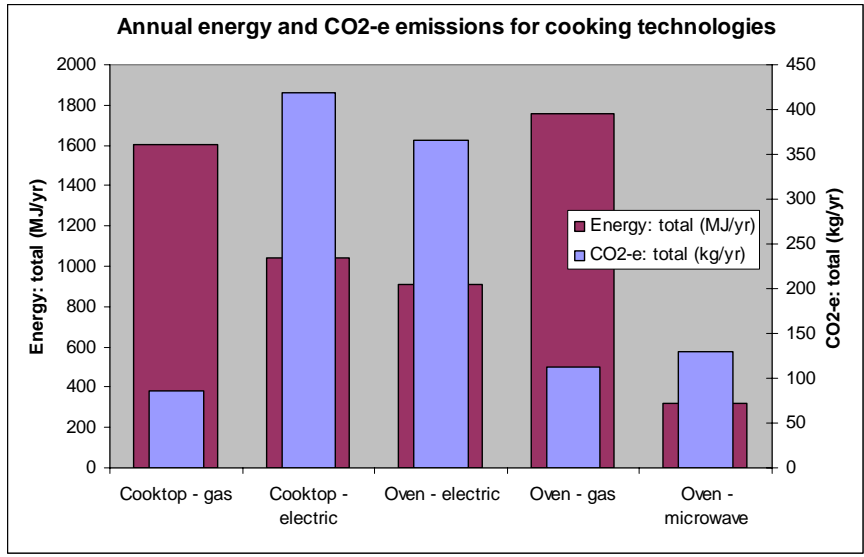
DOMESTIC APPLIANCES

Appliance	
Hot water	Plug-in appliances
Hot water - gas - storage	Refrigerator/freezer
Hot water - gas - instant	Dishwasher
Hot water - electric	Washing machine
Hot water - solar thermal	Clothes dryer
Hot water - shared services	Television
Built-in appliances	Computer
Cooktop - gas	Home entertainment systems
Cooktop - electric	Set top box
Oven - electric	Kettle - electric
Oven - gas	
Microwave oven	
Lighting	
Common area energy (Class2 buildings)	

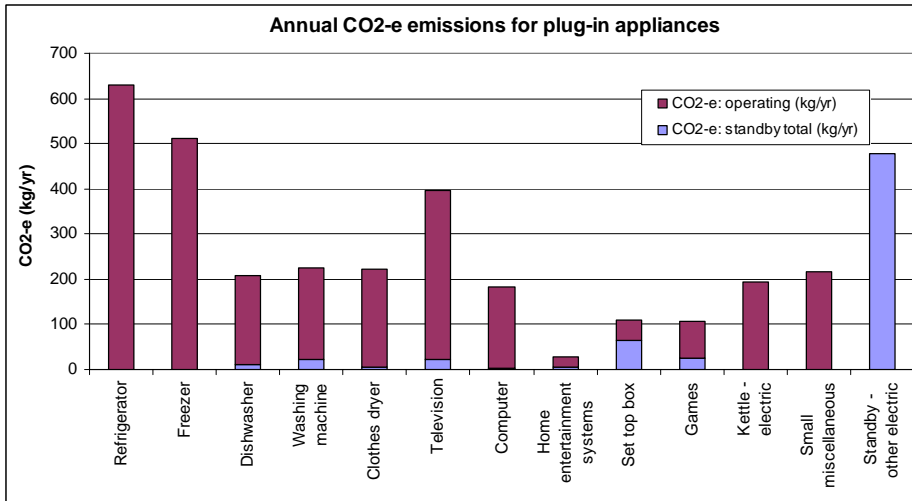
ENERGY AND GHG PROFILE FOR HOT WATER HEATING TECHNOLOGIES



ENERGY AND GHG PROFILE FOR KITCHEN SCENARIOS



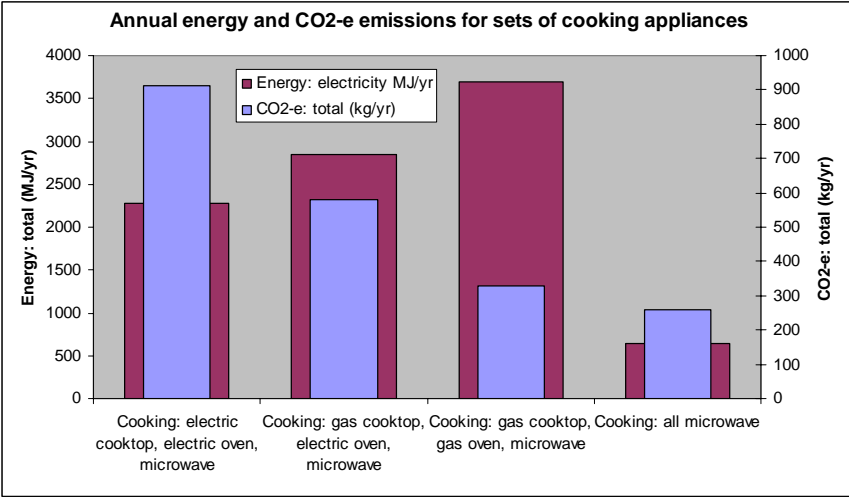
ENERGY AND GHG PROFILE FOR PLUG-IN APPLIANCES



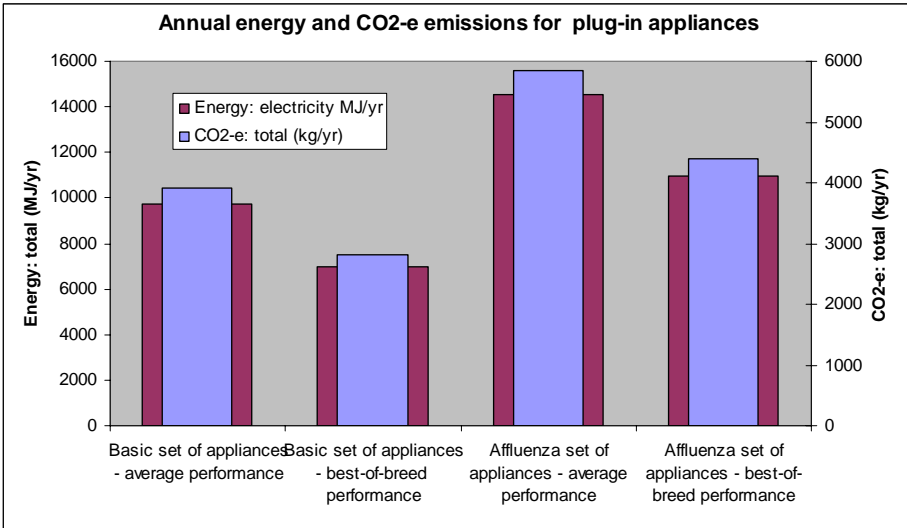
SCENARIOS

- > Sets of cooking appliances
- > Basic set of average performance appliances
- > Set of 'best-of-breed' appliances
- > 'Affluenza' (multiple and high use) set of appliances both average and 'best-of-breed' performance
- > Project home equivalents for different housing types

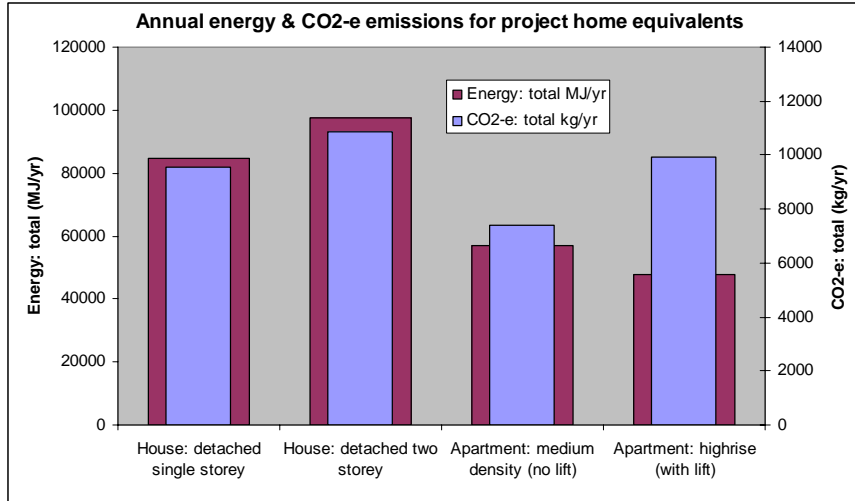
ENERGY AND GHG PROFILE FOR SETS OF COOKING APPLIANCES



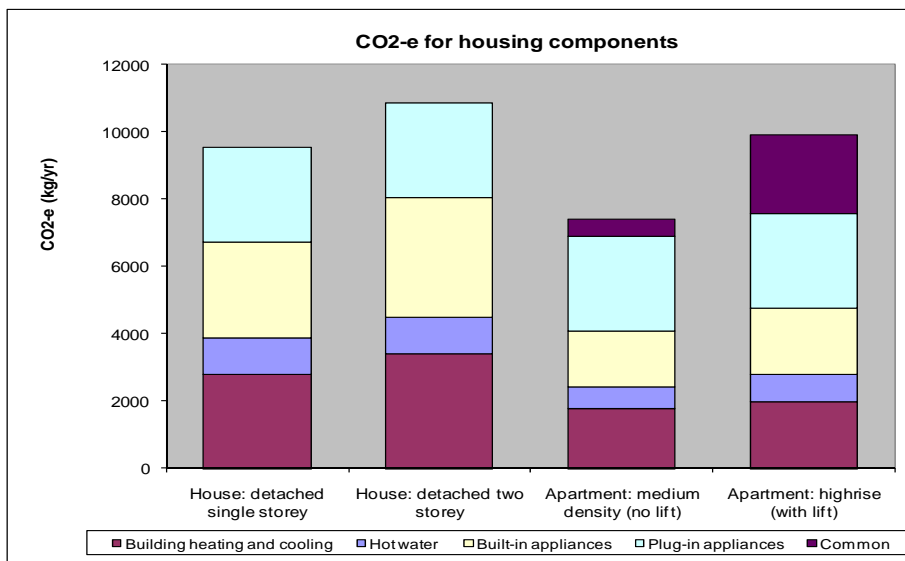
ENERGY AND GHG PROFILE FOR BASIC VS. AFFLUENZA APPLIANCE SCNEARIOS



DOES DWELLING TYPE MATTER?



FUTURE AREAS FOR REGULATION? BUILT-IN EQUIPMENT/APPLIANCES?

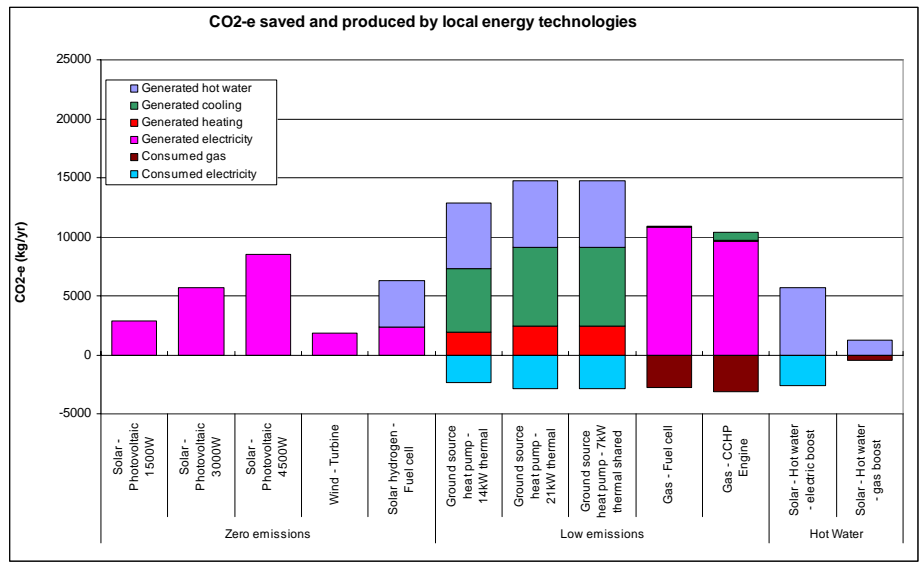


LOCAL ENERGY GENERATION TECHNOLOGIES

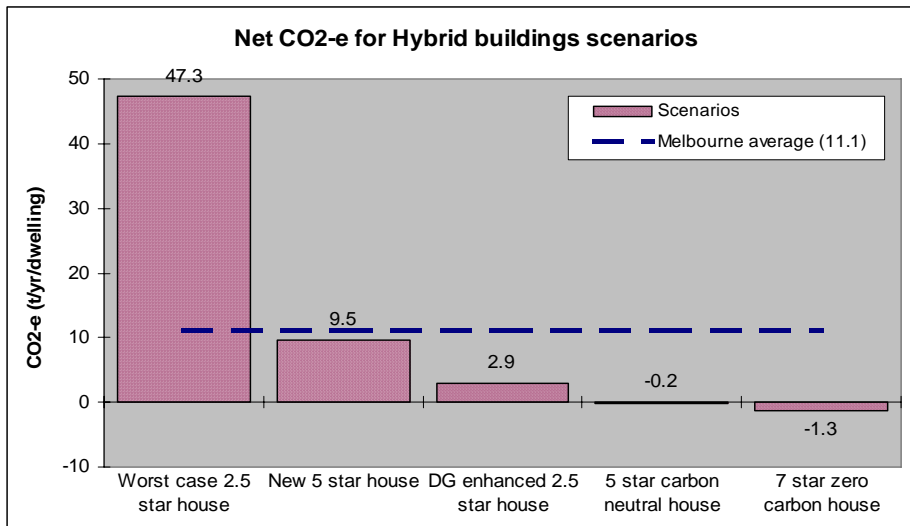
- > Photovoltaics (PV)
- > Solar gas boosted thermal
- > Wind
- > Fuel Cell (gas, solar)
- > Gas CCHP (combined cooling, heat and power)
- > Ground source heat pump



ENERGY AND GHG PROFILE FOR ALTERNATIVE LOCAL ENERGY GENERATION TECHNOLOGIES



NET CO₂-e EMISSIONS FOR SELECTED SCENARIOS IN TRANSITION TO ZERO CARBON DWELLINGS



HYBRID BUILDING AND TECHNOLOGY-BASED INNOVATION

Building Shell

- > 2.5 to 7.0 star = 74% reduction in annual energy use (equivalent to saving of 48,300 MJ/yr per detached dwelling)

Appliances

- > 92% reduction in annual CO₂-e from hot water heating with substitution of solar thermal gas boosted for electric storage
- > 28% reduction in annual CO₂-e from plug-in appliances with substitution of 'best-of-breed' for average energy efficiency
- > 72% reduction in annual CO₂-e with shift from all electric (cooktop+oven) to all microwave
- > 89% reduction in annual CO₂-e with shift from all halogen to all compact fluorescents

Hybrid Buildings

- > Annual net savings of CO₂-e per dwelling in shifting from a 5-star grid connected project home to a 5-star zero carbon home is of the order of 11 tonnes CO₂-e

CONCLUSIONS

- > Zero energy is not the same as zero carbon
- > Efficiency and use of appliances are major factors in reducing energy use and CO₂-e emissions in dwellings
- > Improved performances of appliances provide great opportunities to replace and/or retrofit low emission appliances several times over the life of a dwelling
- > Local energy generation (at individual dwelling or precinct scale) are a major part of the transition to achievable net zero energy and/or CO₂-e emissions
- > The wide range of options to reduce energy use and CO₂-e emissions in dwellings requires leadership to bring together all facets of transitioning to, or achieving, net zero energy and/or CO₂-e emissions