



University of Wollongong winning entry in Solar Decathlon

The Energy-Efficient All-Electric Home

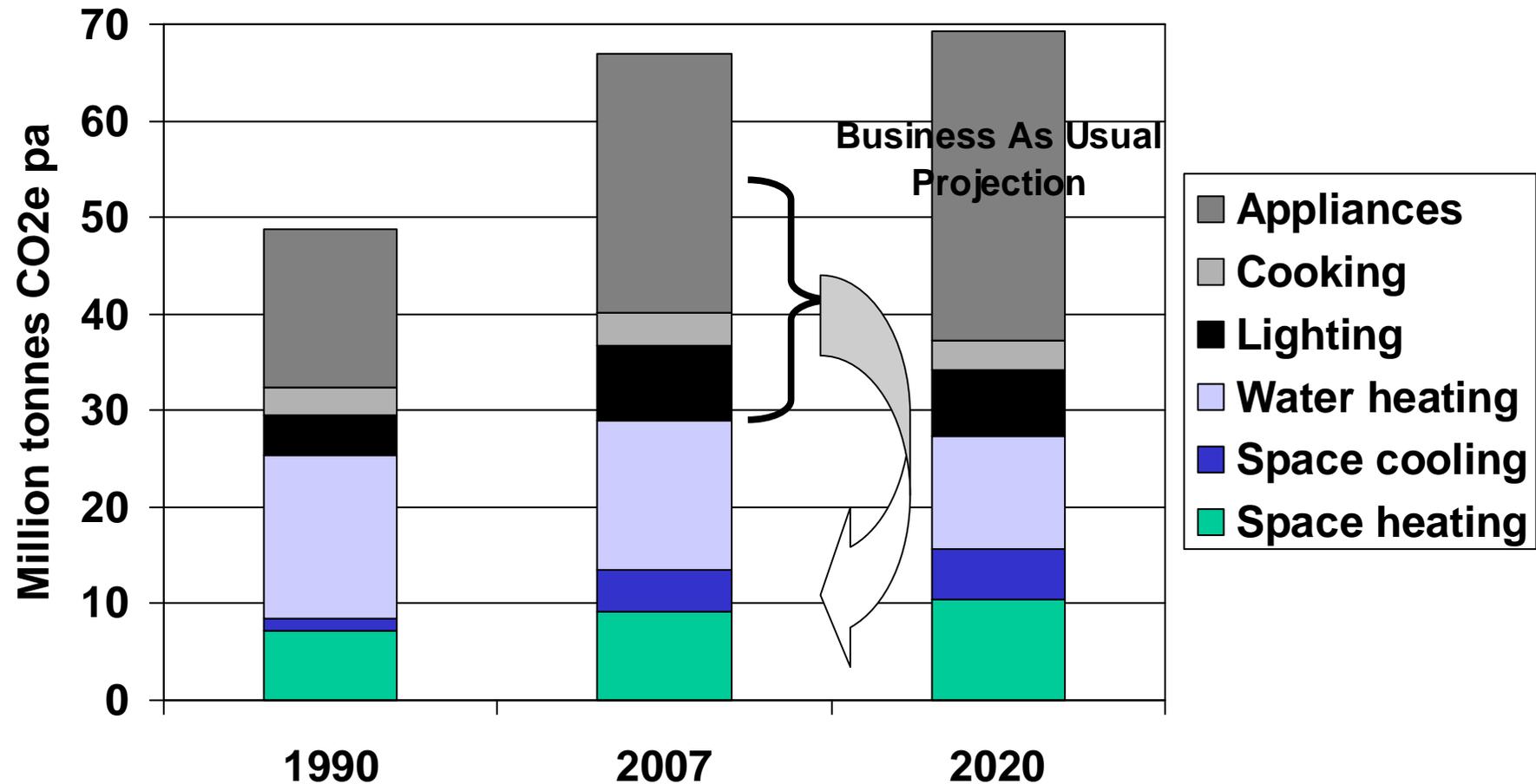
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Key points

- Ongoing improvement in building envelope performance DOES MATTER: energy bills, peak demand, comfort, health, productivity, capacity (and capital cost) of H&C equipment
- But we must also focus more on:
 - Appliance and equipment efficiency, storage, smarts
 - User behaviour and interfaces between user and equipment
 - Factors influencing decisions
 - Ensuring energy market supports EE
 - Dwelling size and location relative to services needed
 - Embodied and end-of life energy
 - innovation and effective policy
- We can cut residential energy use by 80% - but will we take the necessary actions?
- Speaking the new language of 'energy productivity'

Where do we focus for 80% energy savings (and ghg reductions)? Already, heating and cooling energy has fallen to ~20% of residential ghgs

Aust residential sector greenhouse gas emissions from energy use (from Holt 2008, based on EES 2008, and DECC GH Workbook 2008)

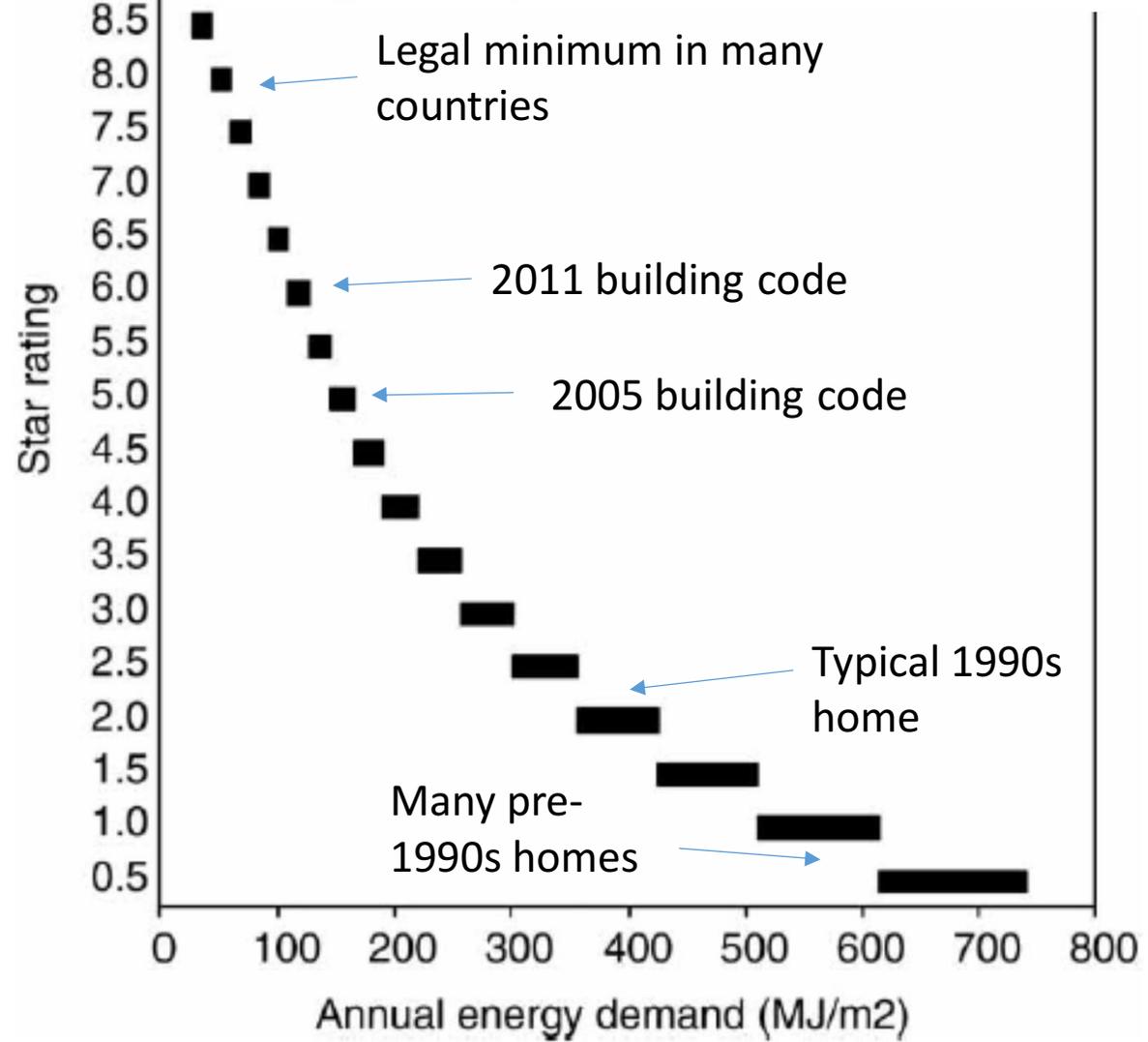


Key services: comfort; light; cleaning (people, clothes, dishes, surfaces); food storage and preparation; entertainment/recreation

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CONTEXT: building

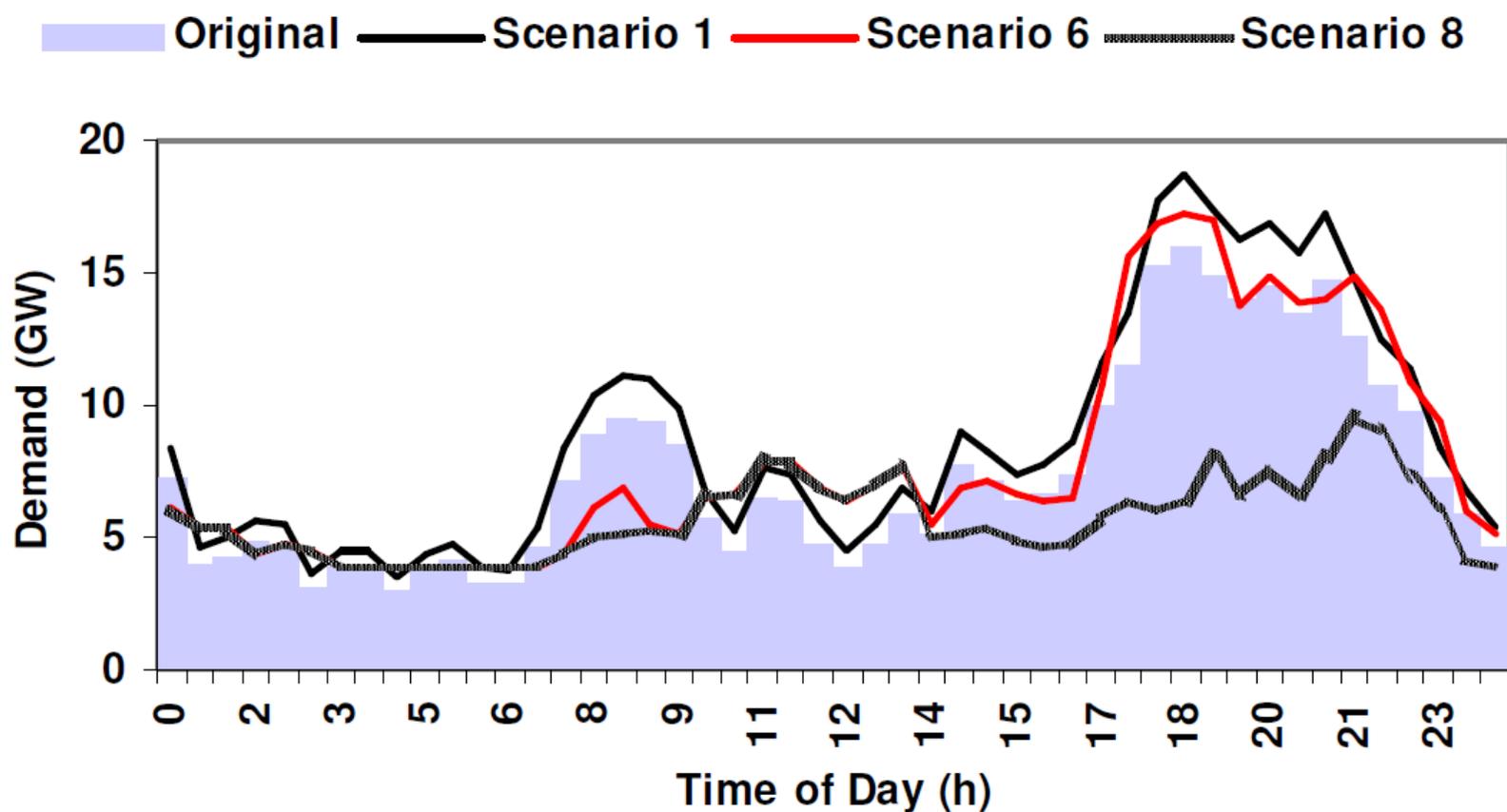
As building envelope performance improves, annual energy requirement for heating and cooling declines **dramatically**

NOTE: these are thermal energy flows, ignoring equipment efficiencies

Figure 1 Residential heating and cooling Star ratings for Melbourne in Victoria, Australia

Scope to change residential peak electricity demand, including cooking peak: UK study (Peacock and Newborough 2004: *The 40% House Project*)

Figure 25: Synthetic Domestic Demand by Technological Scenario



Activity/ service	Typical stock (kWh pa)	Best Aust/EU now	Possible	Further improvement potential - examples
Heating + Cooling	2000- 8000 + 800	350 + 100	250?	Better bldgs than 7 star, heat recovery ventilation, solar warming; movable thermal storage? Climate change. New design ducting, COP>5, smart controls, 2-stage a/c, dessicant or evaporative pre-cool a/c inlet air? Bigger heat exchangers; variable Tx; 'coolth' and heat recovery from tighter building. In any case, lots of PV power available for cooling.
Refrigeration (family fridge)	Approx 600	320/250	150?	Improved insulation, changed food storage, COP up (multi-stage compressor?), variable speed compressor, eutectics. Best EU 458 litre 206 kWh (approx. 250 kWh adjusted to Aust test). Remove old faulty, inefficient stock.
Hot water (3300 kWh COP=1.67)	2000 (HP)	700	450?	Better COP than EcoCute 4.5 (maybe 2 stage compressor), low loss pipes and storage, shower water efficiency>3*, pre-heat inlet air of heat pump?
Lighting	850	150	80?	Advanced daylighting, OLED etc further improve LED eff to 150 Lumen/watt LED, smart lighting, reduce light levels
TV/AV/IT	TV 400	100	60?	OLED TV, personal viewers. Desktop computer ~100 watts, tablet 4 watts, new laptops 10 watts
Cooking	525	350	200?	Insulated cookware, induction or resistance in insulated cooking appliance, diet change, bulk cooking, smart controls, micro electricity storage, induction, more use of microwave, insulated oven with heat recovery from exhaust air
Clothes washing (312 loads/y)	Approx 235	60+ext hot water/150	80?	Load washer nearer full (auto-weight sensing), maybe even real time water cleaning during program, HW from heat pump. Best EU 8kg 0.43 kWh for 40C half load, 0.62 kWh for 60C full load, better low temp detergents
Clothes drying (60 loads/y)	Approx 300	100/60	40?	COP>3, better water removal before drying, weather protected drying, especially for apartments. Best EU 7 kg 0.95 kWh for mix of full and half loads.
Dishwashing (175 loads/y)	Approx 200	130/125	75?	Improved low temp detergents, heat recovery, insulation, smart water eff, maybe even real time water cleaning during program. Use external hot water? Lightweight dishes and pots
Pool (if present)	2000	400	200?	PV floating copper electrolysis reduces pumping, low pressure filters, low loss pipes, low flow rate (longer pumping period)
standby	800	250	100?	

Residential 'Energy Productivity'?

- Productivity of energy supply infrastructure:
 - Increase utilisation of existing infrastructure – or minimise long-term societal costs of delivering energy-related services?
 - Limit peak demand – or match supply to societally-preferred demand using best technologies?
- Household financial productivity:
 - Reduce energy price/unit – or reduce lifecycle energy related costs for households?
 - Facilitate access to housing with focus on affordable house price – or capacity to pay mortgage repayments and operating costs?
 - Ensure homes promote health and safety to support business productivity and reduce health care costs?
- Overall economic productivity:
 - Minimise costs of climate adaptation and abatement
 - Divert money from over-sized car dependent housing to other economic activity
 - Capture economies of scale and 'learning effects' for emerging technologies through RDD&C, incentives, regulation and effective enforcement and promotion
 - Build social capital