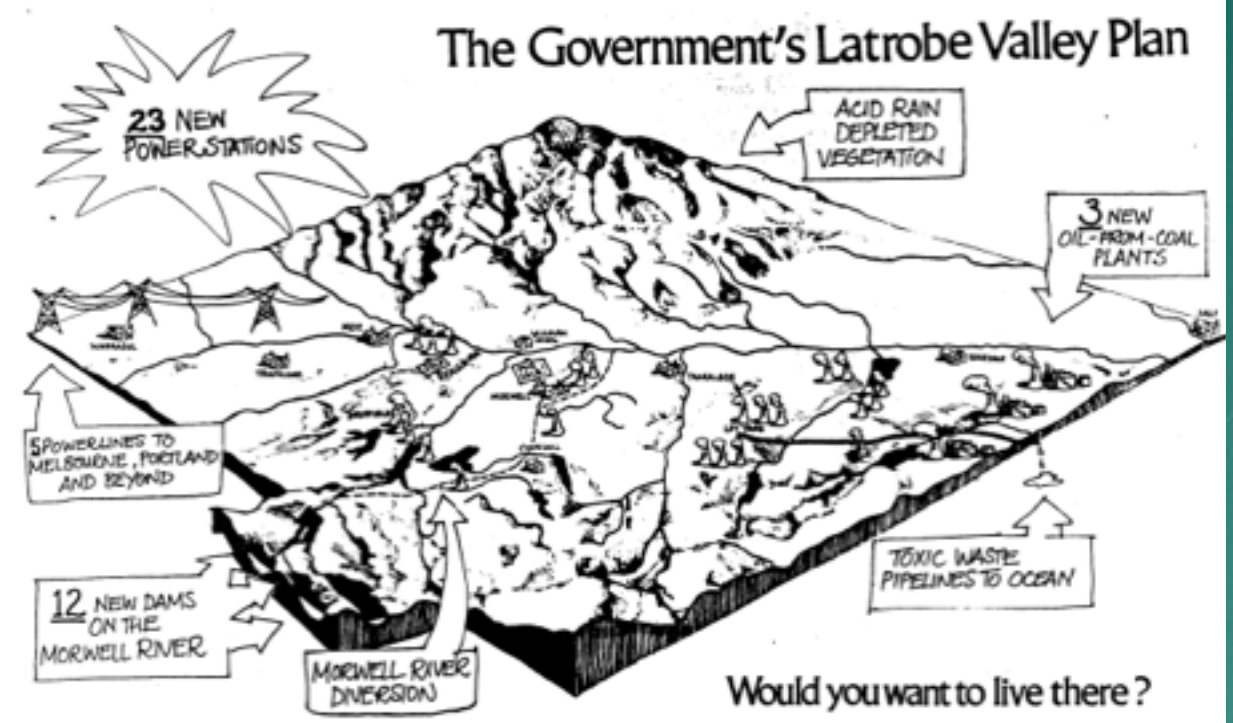


From a large-scale centralised electricity past, to a very uncertain future

Sustainable Engineering Society (Vic) Meeting 26 Aug 2014

Alan Pears AM, RMIT University and Sustainable Solutions

The Energy System – driven by demand

Services:

Shelter

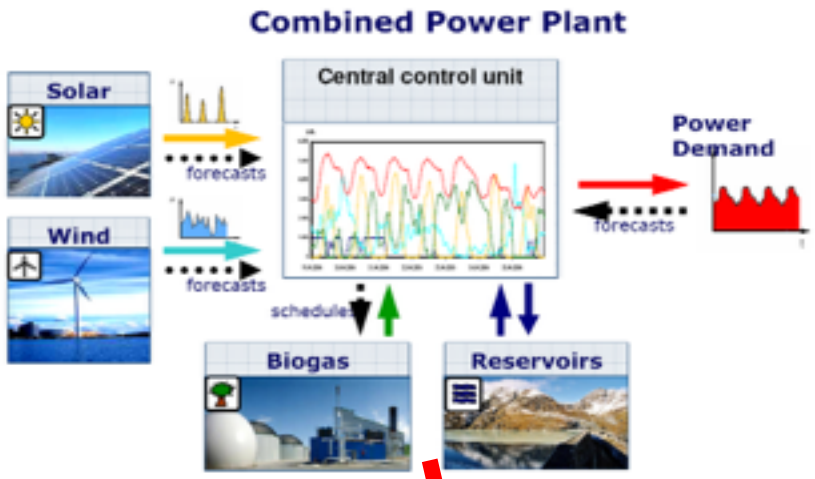
Nutrition

Access

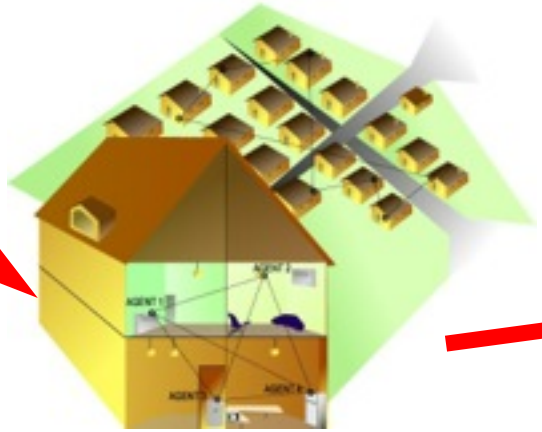
Entertainment

Goods & services

Energy production and supply



End-use technologies: types, efficiencies, usage



Demand for energy: type, amount and timing

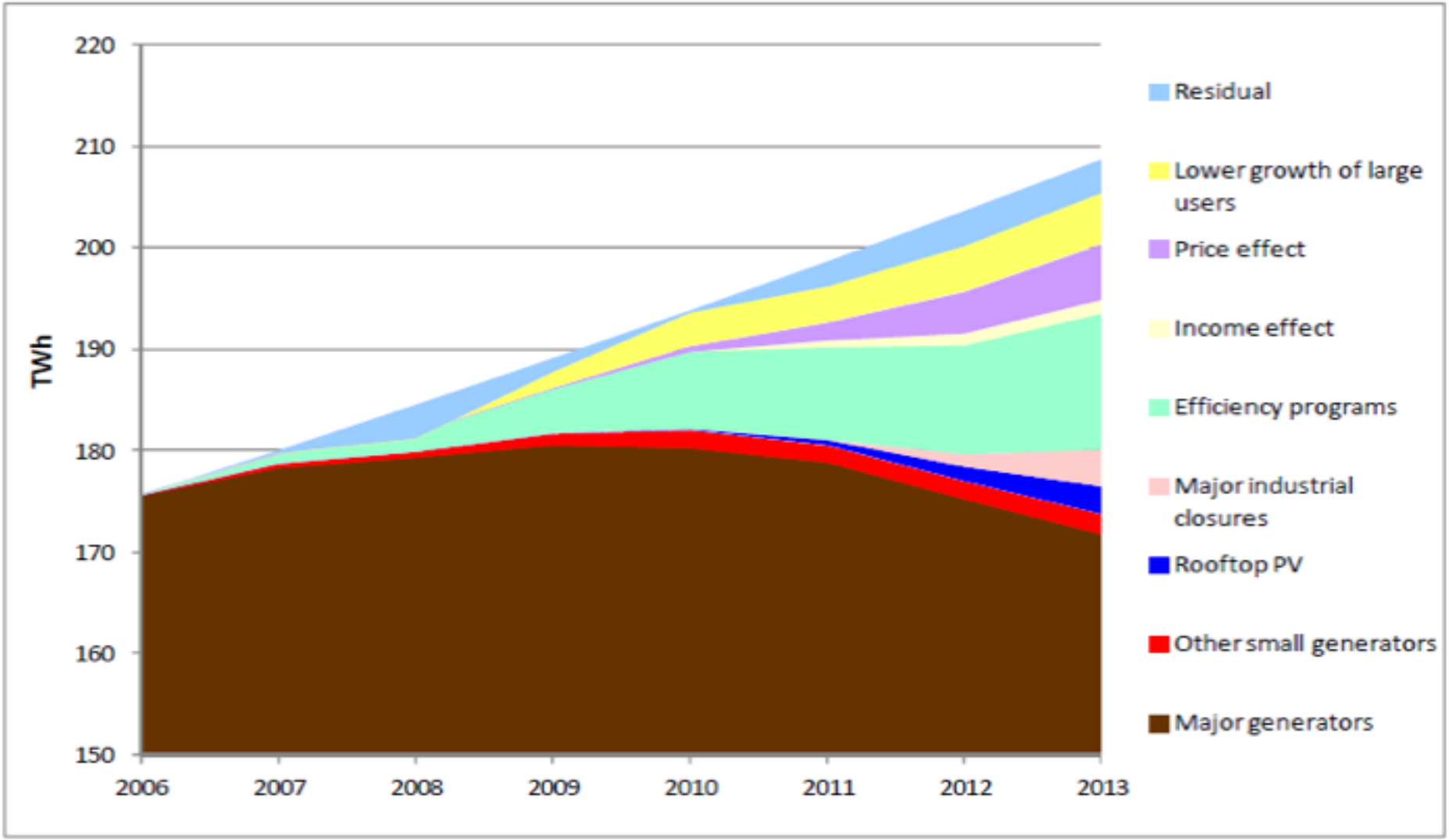
Building supply capacity is ‘cart before horse’, but made sense in the past – not now.

The Present

- Present NEM:
  - Narrowly focused on large centralised supply and meeting uncontrolled instantaneous demand
  - NEM and policy framework give incumbents enormous market power
  - Rewards higher electricity sales and capital investment in delivery infrastructure
- Nature of existing model of high capital investment, lumpy and long-lived investment:
  - Creates incentives to prop up incumbents
  - Blocks emerging competitors
  - Works against long term interests of consumers
  - Privatisation has led to inflated asset valuations and high debt, which adds to problems
- No-one knows where we are headed, as radical innovation is diverse and rapid. Much is on consumer side of meter, which ‘reformed’ ESI has largely ignored.

From Hugh Saddler *Why is Electricity Consumption Decreasing?* Aust Institute of Energy Sydney Branch, 7 April 2014

Contribution of the various factors to reduced demand for electricity since 2006



Future drivers of electricity demand

- Change in economic structure, eg closure of electricity-intensive plants, ongoing growth of services sector, ‘smart’ manufacturing
- Energy efficiency improvement across all sectors and activities – in unimagined ways
- Interactions between energy efficiency measures that amplify savings
- Decline in resistive electric water heating (still 48%)
- Generation on consumer side of meter
- Storage and smarts to manage demand
- Pricing structures, new electricity retailing business models
- Shift from gas to electricity
- East coast LNG plant electricity demand
- Electric vehicles

Where might demand profile head?

- Declining overnight demand (even with EVs)
- Evening and morning peaks may dominate as PV cuts daytime grid demand – but very large scope for energy efficiency, storage and DM to fix this – see 'Beheading the Duck' (www.theconversation.com.au)
- Total consumption will continue to decline – if effective policy is introduced
- Demand scale and profile?
  - By sector
  - By activity
  - Generation, storage and management solutions
  - New business models

Profiles of Australian business sectors – shares of employment, economic output and energy-related greenhouse gas emissions, 2003 (Saddler et al, 2006)

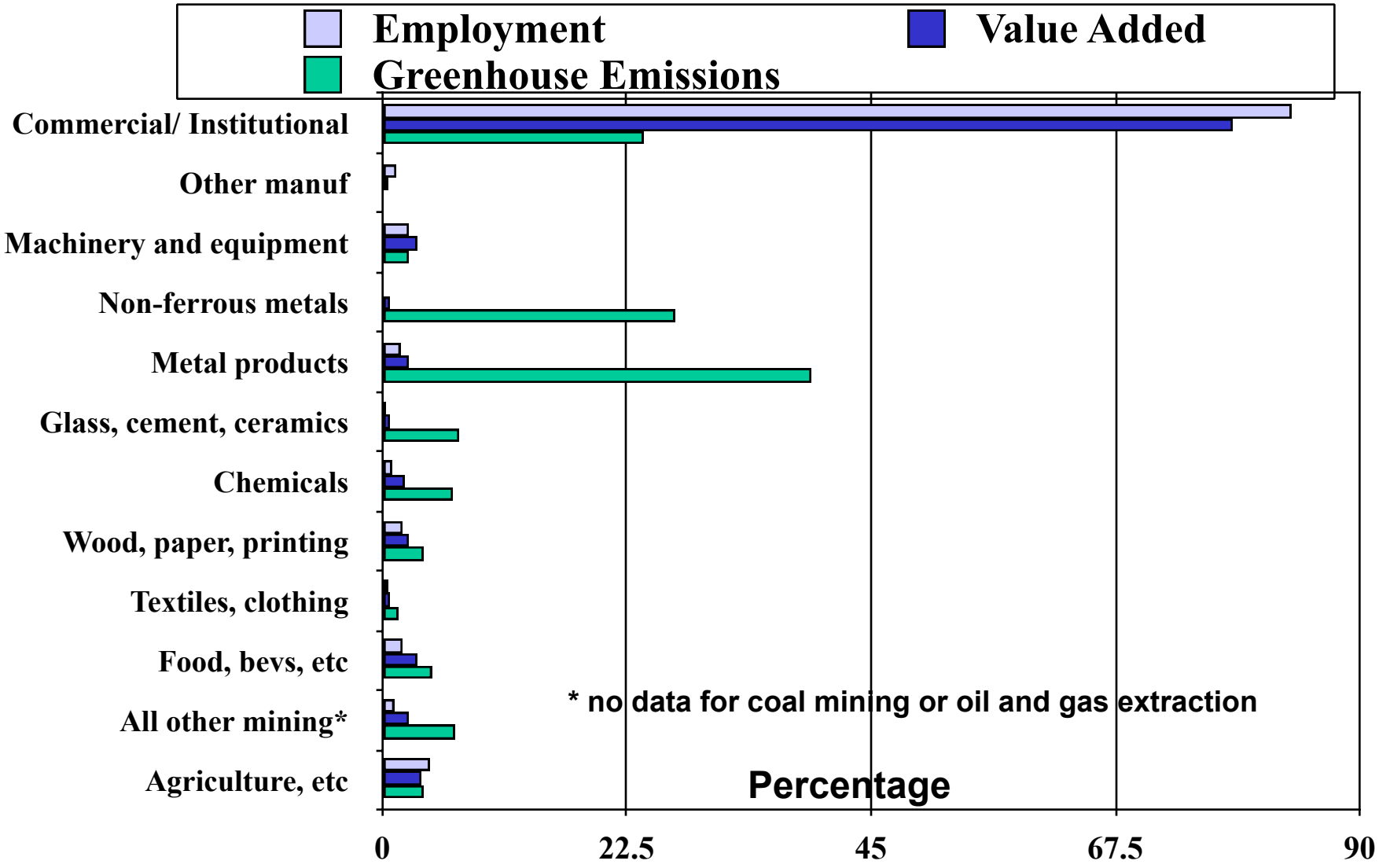
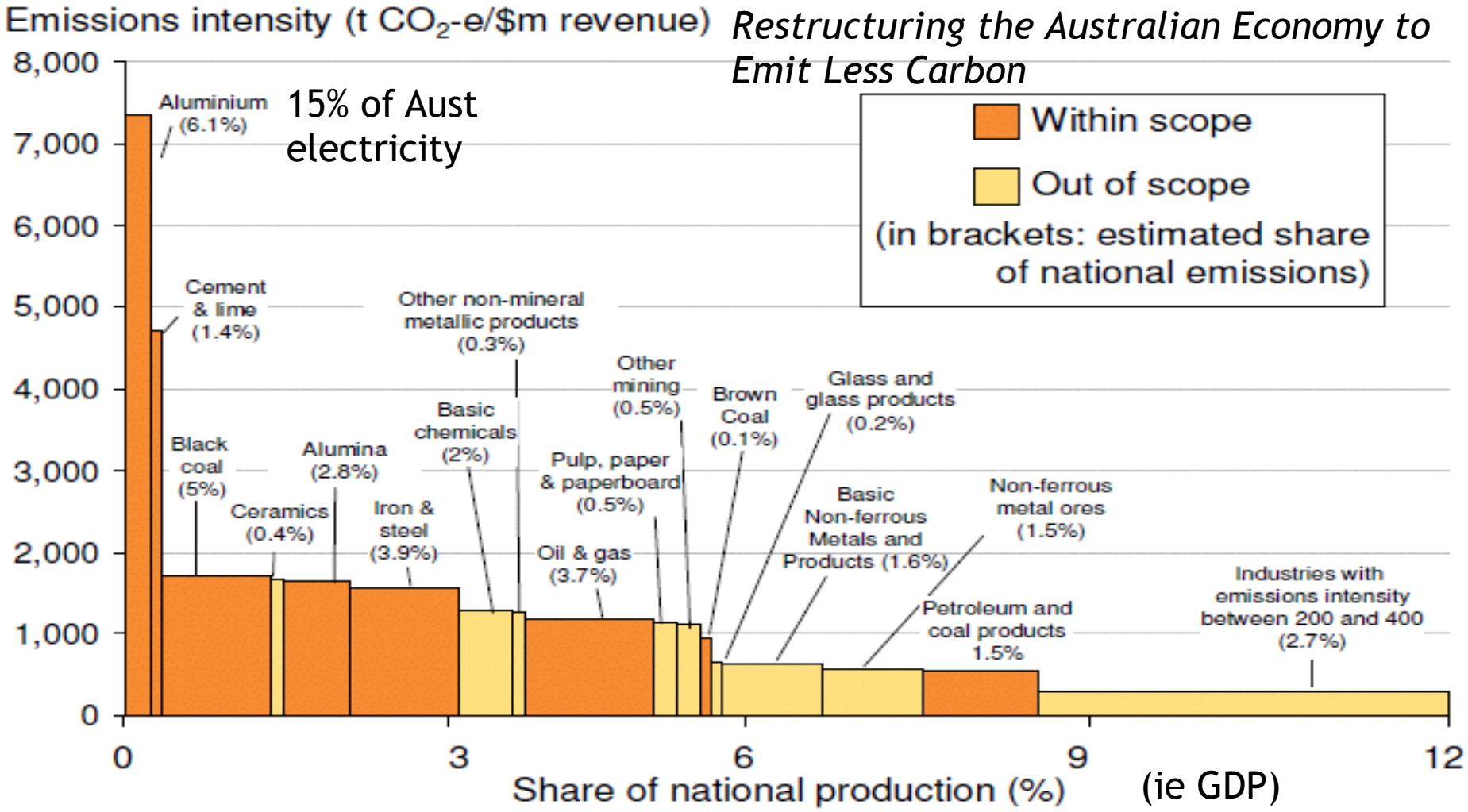


Figure 2.1 Australian trade-exposed industries with highest emissions intensity as a proportion of national production

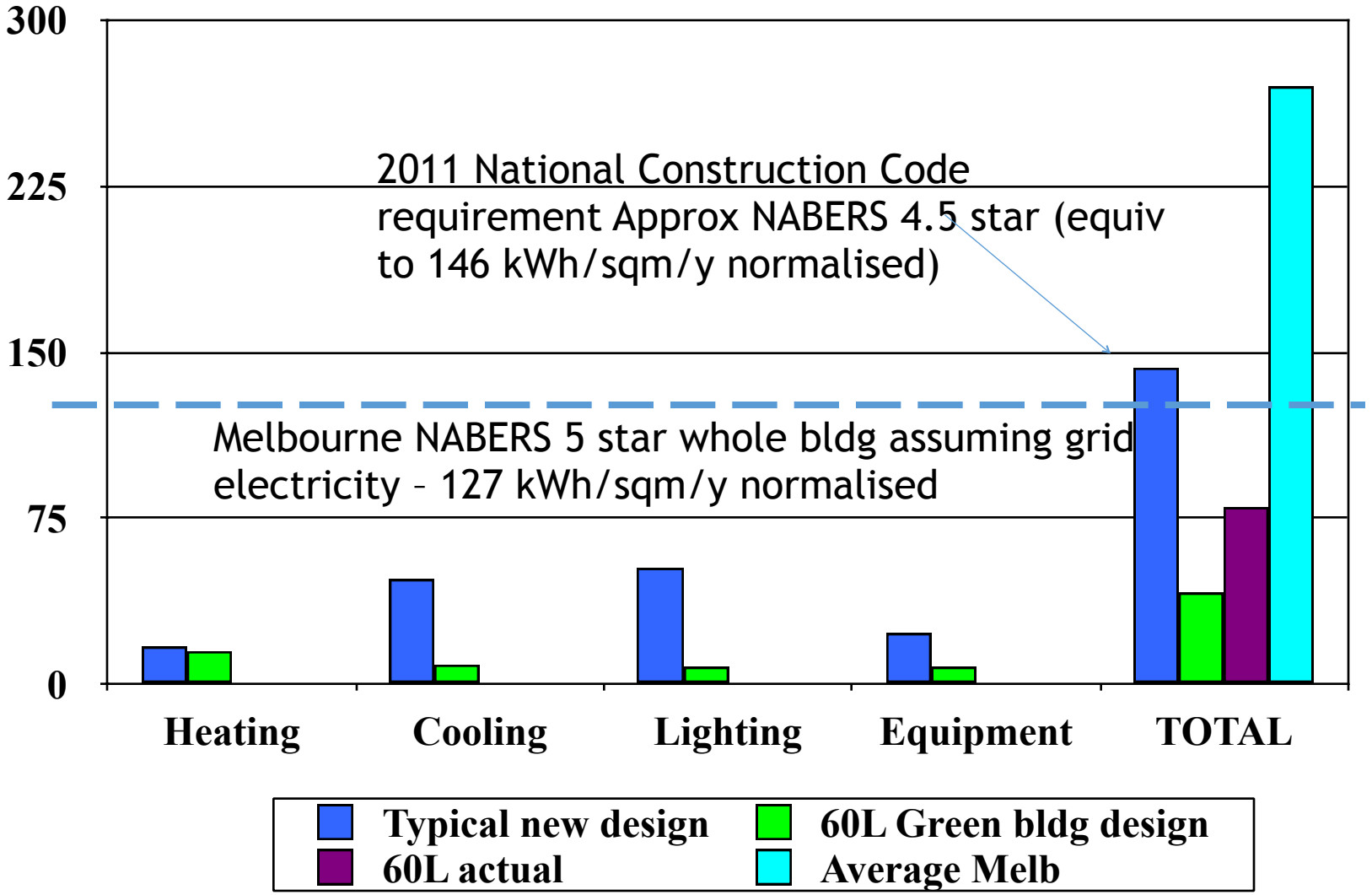
From Grattan Institute 2010
Restructuring the Australian Economy to Emit Less Carbon



Note: Preliminary analysis based on 2001-02 ABS data. Emissions intensity likely to have changed since this time.
Source: Australian Government Department of Climate Change (2008)

Building code and rating schemes drive commercial sector consumption down

Annual office building energy consumption, Melbourne (kWh/square metre/year)

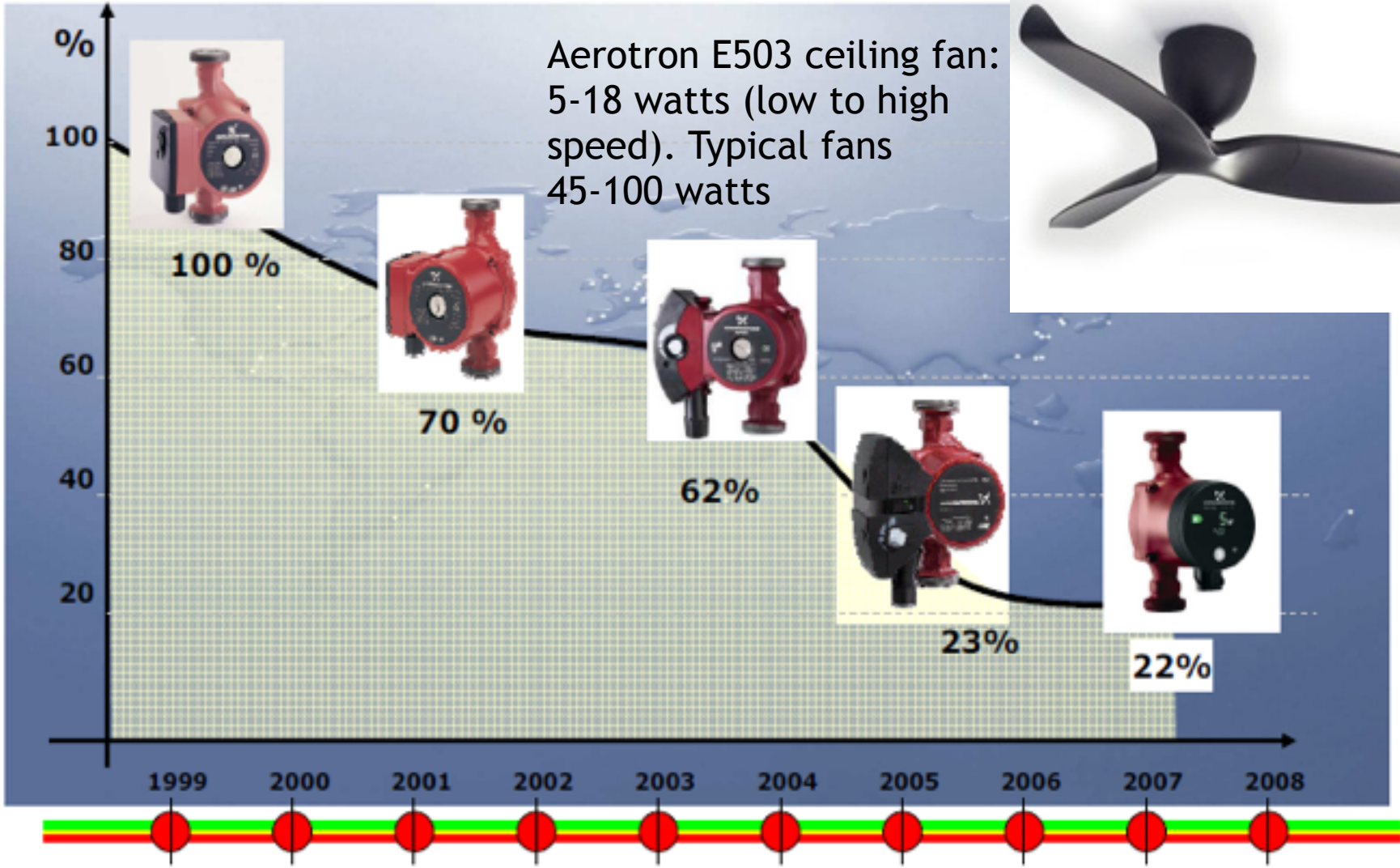


Reducing floor area (and refrigeration energy) of supermarkets: ‘virtual’ supermarket at a railway station in South Korea by Tesco - potentially dramatic reduction in energy use and floor space for supermarkets, shopping travel

(Popular Science Aug 2011 By Clay Dillow Posted 07.05.2011 at 11:00 am)

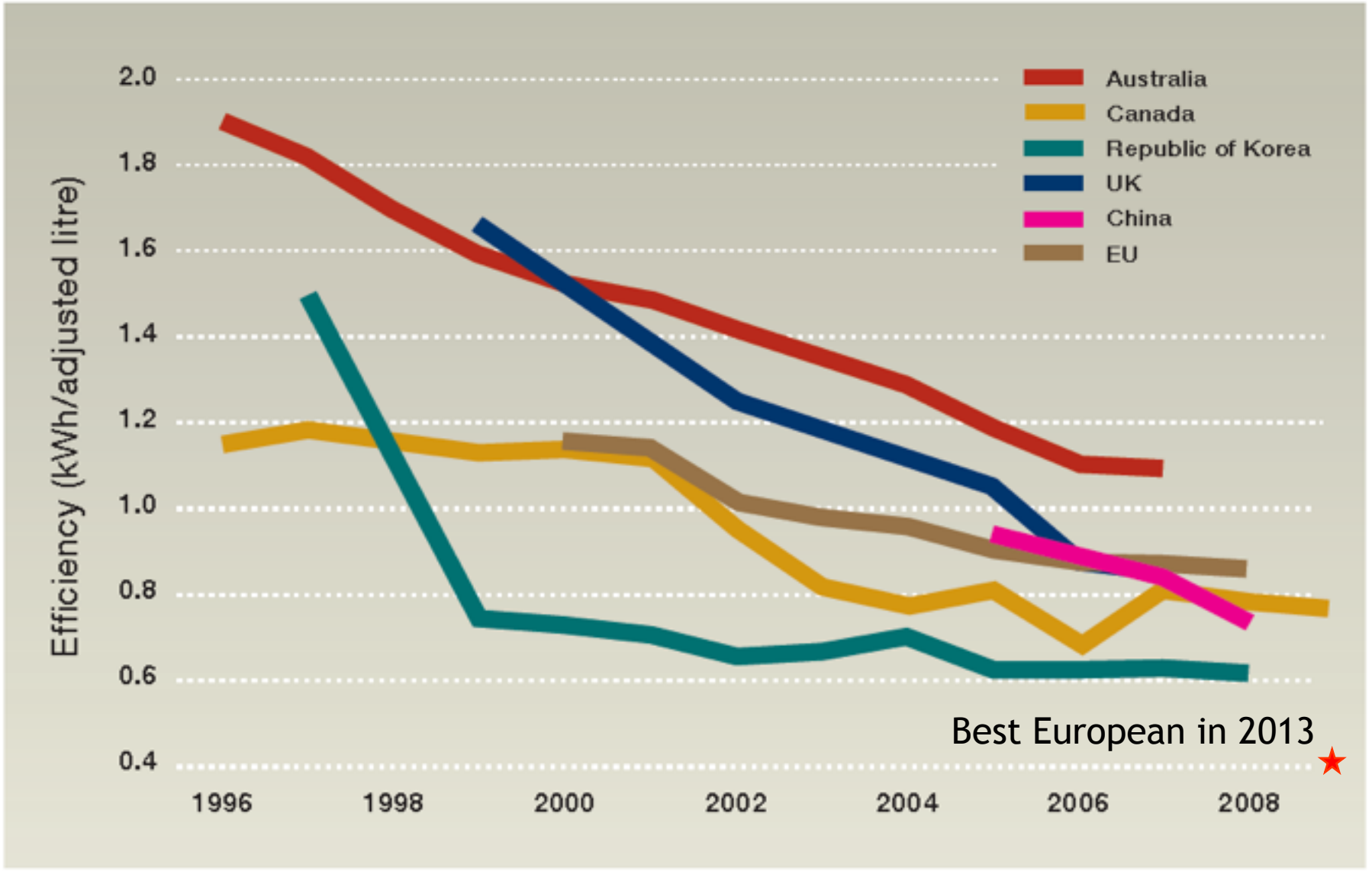
There is rapid change: check for the latest options!

Reduction in annual energy consumption of Grundfos small circulators



Aerotron E503 ceiling fan: 5-18 watts (low to high speed). Typical fans 45-100 watts

From 2013 Whitegoods Forum: refrigerator performance http://www.energyrating.gov.au/wp-content/uploads/Energy_Rating_Documents/Library/General/1200A-Day1-International-projects-4E.pdf



Do we need large screen TV? What services do we really want? How much energy might *really* be needed? How important is energy in decisions – annual old plasma TV energy cost up to $350 pa. Best 165cm TV uses 70 watts and costs $70 pa to run

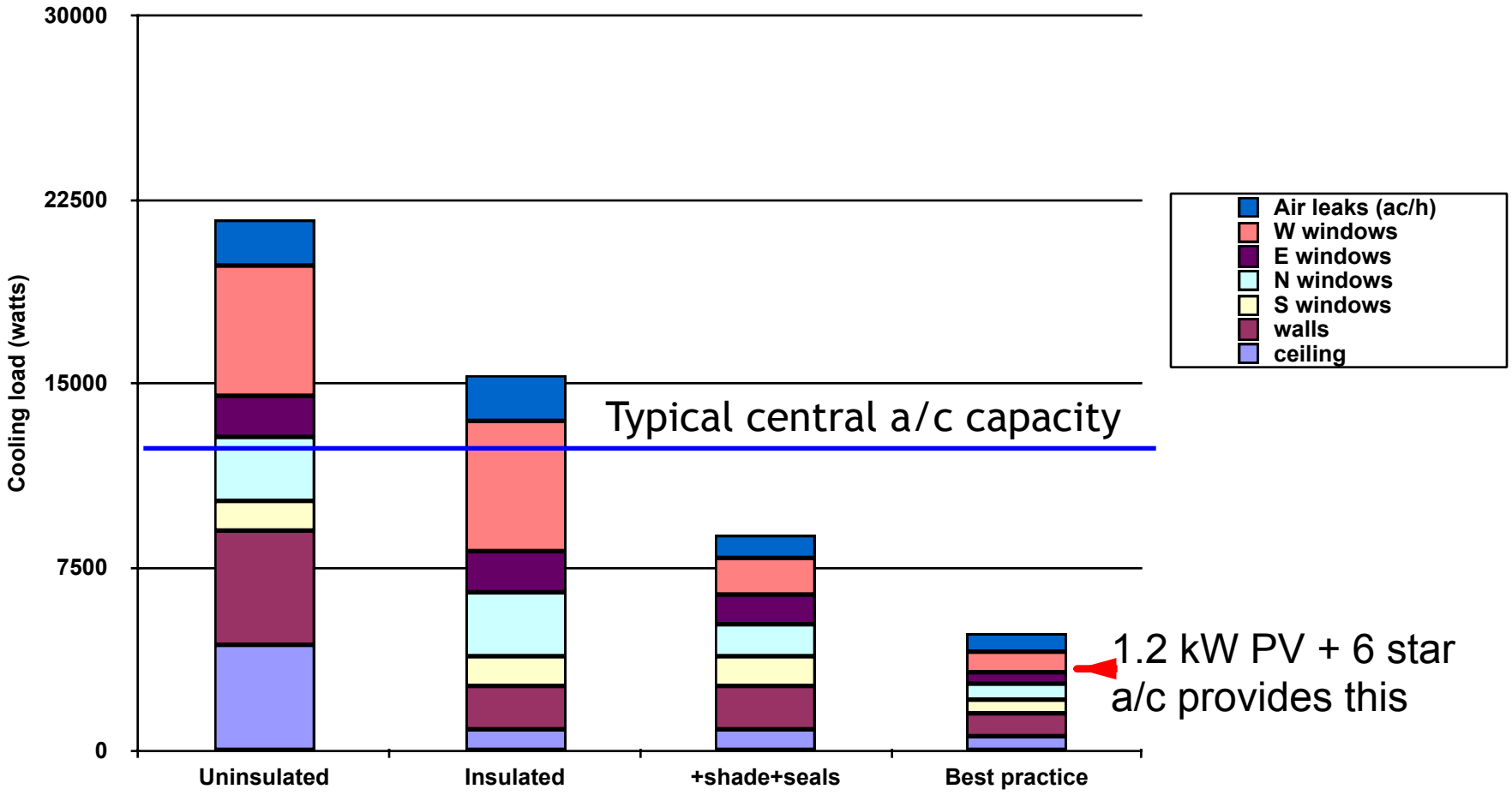
Best 65 inch (165cm TV: LG 65LB7500-TE: 70 watts

Sony 3D personal viewer
(Age online 1 11 11)

Also see www.vuzix.com/consumer/products_wrap_1200vr.html

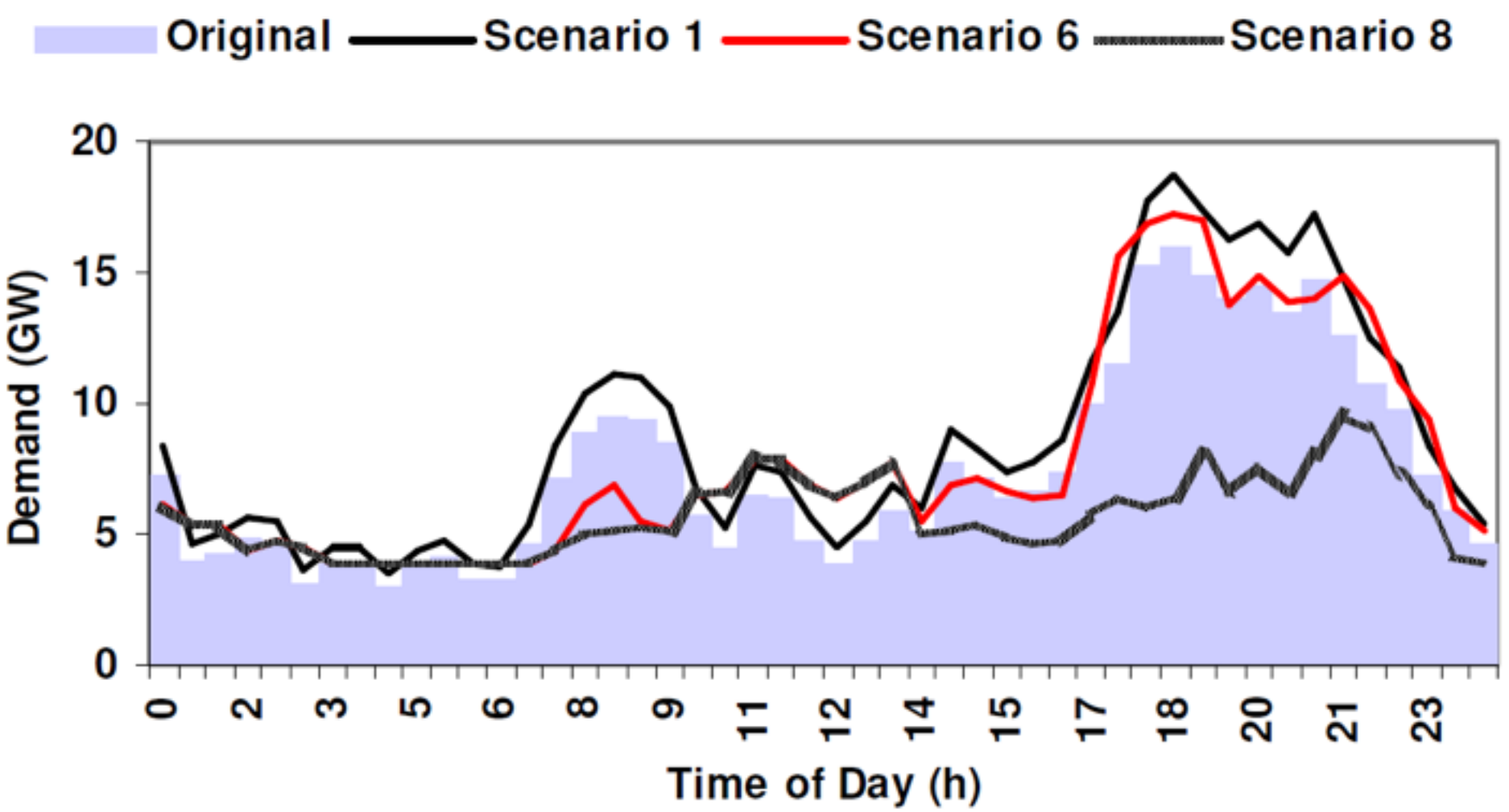
Google Glass A few watts - and it’s a camera too

Afternoon cooling requirements for a house on a very hot afternoon – a complex system



Scope to change residential peak electricity demand using energy efficiency, lower wattage heating elements and smarter controls: UK study (Peacock and Newborough 2004: *The 40% House Project*)

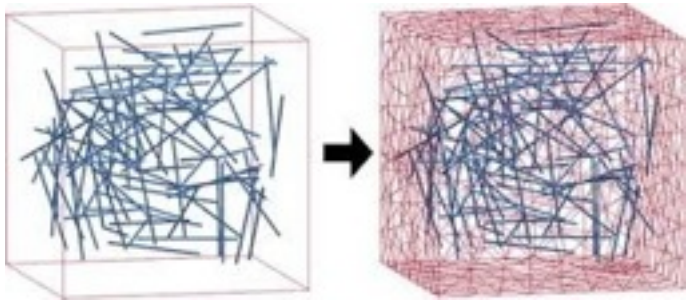
Figure 25: Synthetic Domestic Demand by Technological Scenario



Embodied energy: Forte building by LendLease in Melbourne Docklands, Aust: world's tallest timber apartment building – uses cross-laminated timber to reduce embodied energy

Low embodied energy (and CO2 emission) materials are becoming available and improving

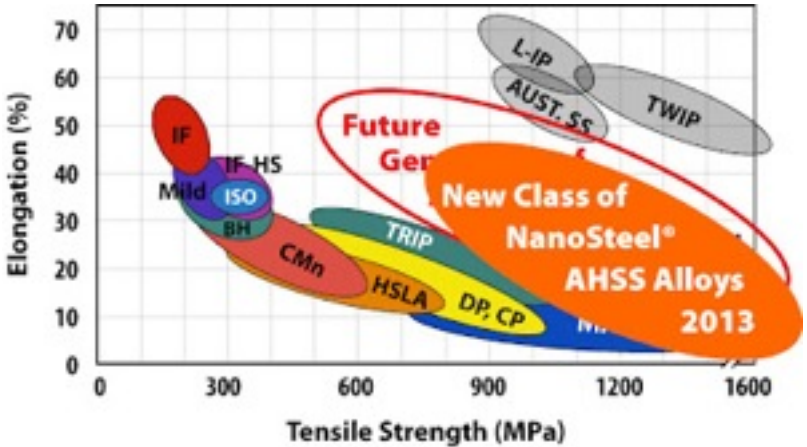
Engineered timber structural elements
http://www.hobbithouseinc.com/personal/woodpics/_g_IJK.htm



Concrete with low emission geopolymers, extenders such as blast furnace slag and fly ash

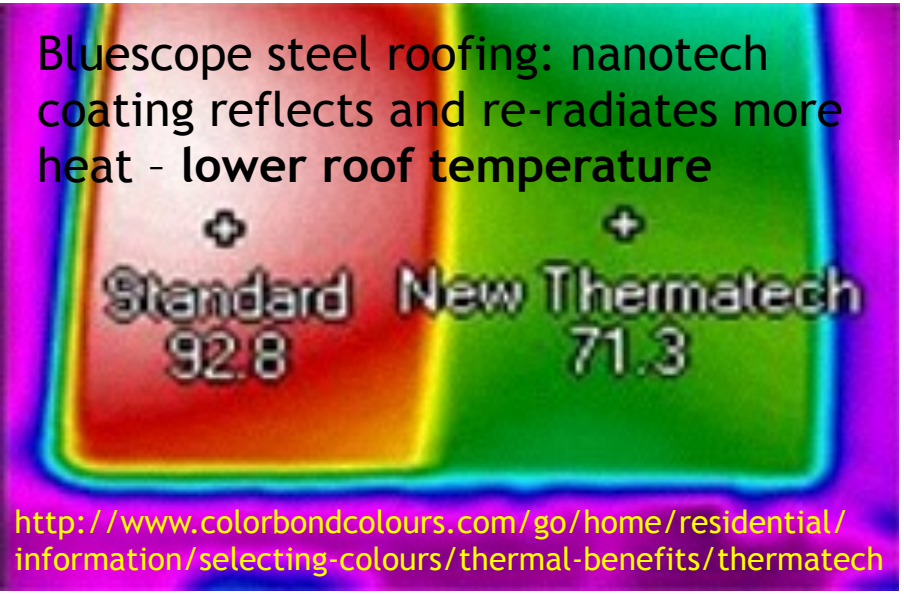
Fibre reinforced concrete
http://www.sciencedirect.com/science/journal/09500618/44

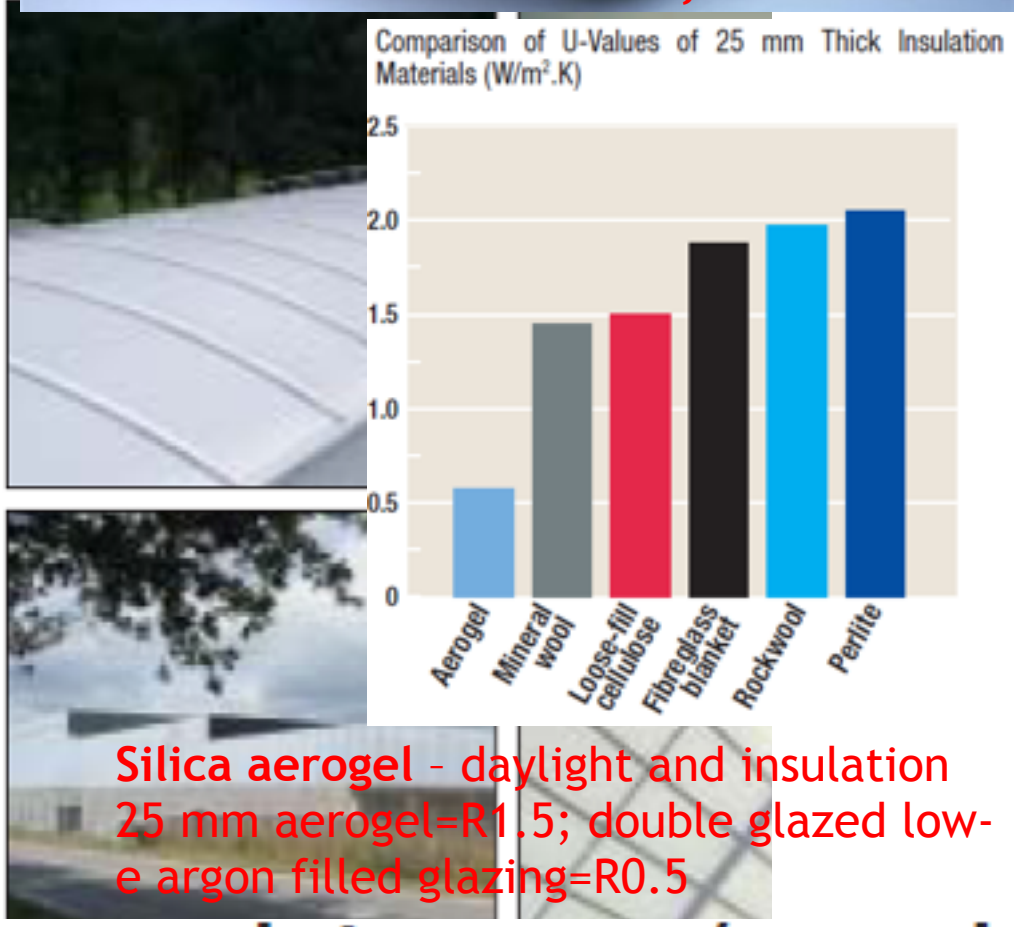
Tensile structures http://www.tensilefabricstructure.com/kolkata/stadium-tensile-structure.html



High strength steel from car industry
http://nextbigfuture.com/2012/08/nanosteel-has-new-high-strength-light.html

Many new low embodied energy and/or high performance materials and products are emerging





Samsung Home Energy Management System (http://www.treehugger.com/gadgets/ces-2012-oled-tvs-transparent-tvs-and-home-energy-management-samsung.html).
Also check out SMA *Sunny Home Manager* (Solar Progress 05/12 p.21)

Emerging demand-side solutions

Main Messages (from my 2011 presentation to AEMO)

- Government policies, technology trends and other factors are accelerating impacts on demand profile and level
- Emerging nimble, modular demand side/distributed technologies may drive rapid change that leaves traditional energy businesses with stranded assets and higher costs
- Over-estimating the cost and/or under-estimating the potential rate of roll-out/development of demand side measures increases the risk of stranded assets and unnecessary costs
- We have very poor data on what is really happening on the demand side – this increases risk of poor decisions
- Energy networks are NOT 'natural monopolies' – they compete with EE, DM, distributed generation and fuel switching. Their monopoly status in energy rules leads to market failures
- Consumer fears about increasing prices and risk of lower reliability drive higher interest in alternatives
- Energy market rules must be changed so networks and retailers can profit from helping consumers pursue alternatives