Sustainability and Plumbing – practical challenges

National Plumbing Regulators Conference 2008

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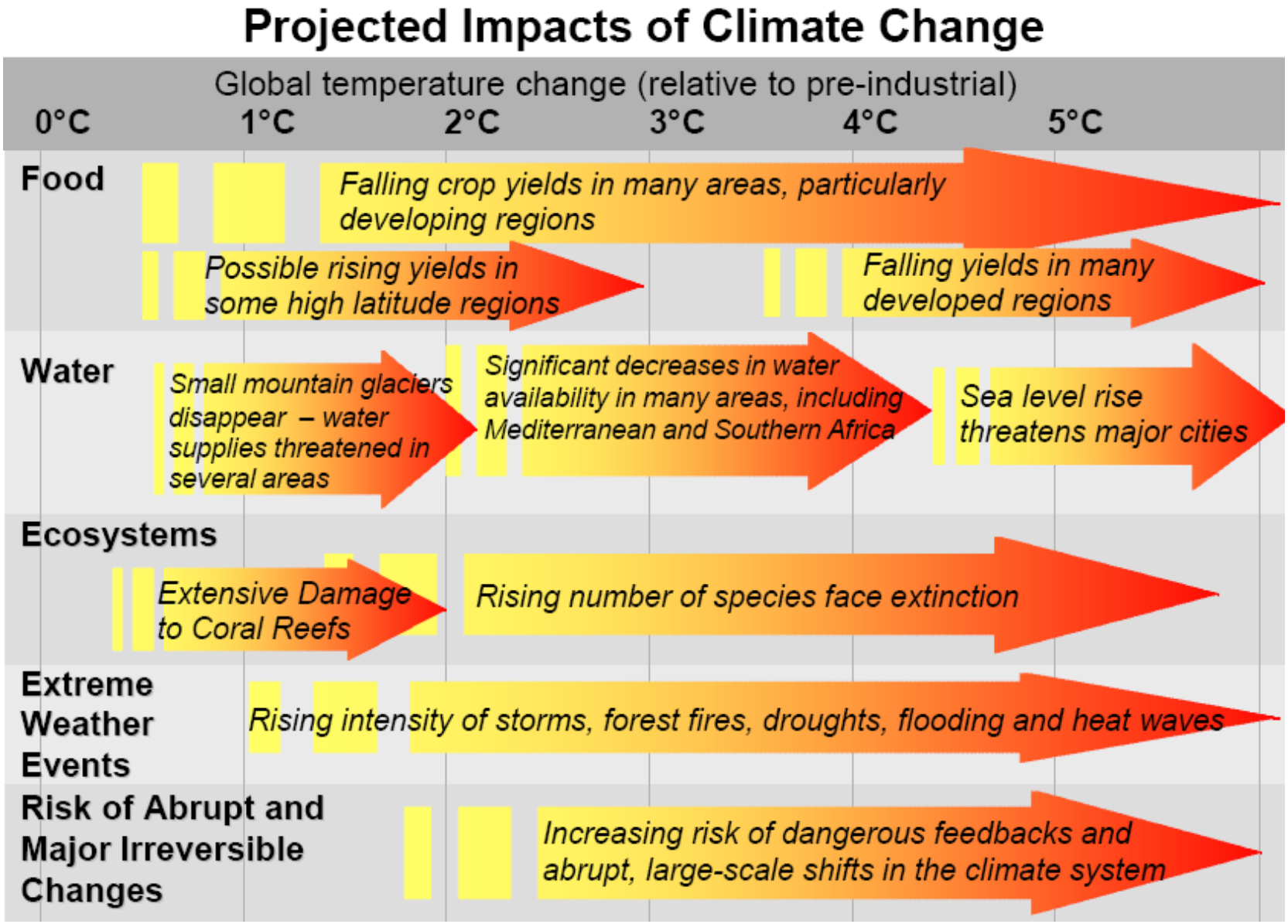
In this presentation:

- Policy development challenges for the plumbing sector
- New approaches needed to address sustainability
- Some practical examples

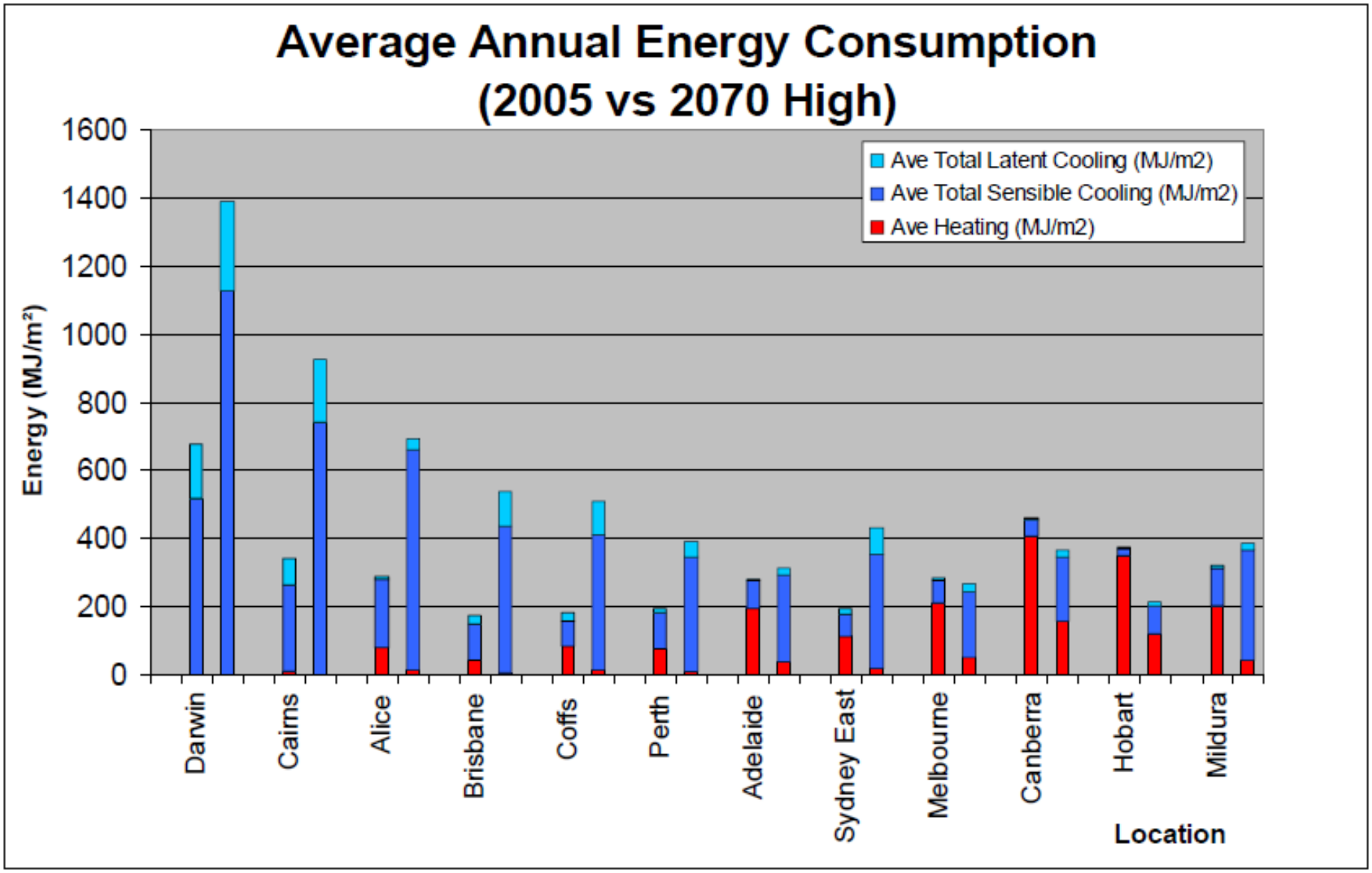
Sustainability Issues:

- Management of emerging resource constraints
- Adapting to ongoing climate change *and* cutting contribution to emissions to sustainable levels
- Responding to higher density development
- Responding to rapid changes in technology:
  - Shift from large scale centralised to distributed
  - New consumer products, systems
  - Professional/trade techniques and equipment
- Responding to changing context:
  - Demographics, consumer expectations
  - Deregulation and national performance-based regulation

Risks increase with temperature rise (Stern, 2006) (yellow=small risk, red=very high risk)



Modelled impact of strong climate change on household heating & cooling energy (Starr, DEWHA, 2008)



Coastal shire may face class action

Age 1/7/08

Sea-level debate angers landowners

By **BEN DOHERTY**

A GIPPSLAND council is facing a multimillion-dollar class action for damage already done to coastal property values as it weighs banning development in areas vulnerable to rising sea levels caused [illegible] change.

Following a[illegible] *Age* that the W[illegible] Council was c[illegible] ning any new [illegible] The Honeysu[illegible] Ninety Mile B[illegible] landowners in t[illegible] ing to fight th[illegible] tially seeking hundreds of thousands of dollars each.

The Honeysuckles is a tiny coastal hamlet, sitting on a narrow isthmus between Lake Reeve and Bass Strait. The township of 100-odd houses — with subdivisions to build about 250 more — is behind a line of sand dunes, which pro[illegible] Lakes Entrance are just as vulnerable to rising sea levels.

Even Melbourne's bayside suburbs such as Elwood, Brighton and South Melbourne are at risk, according to CSIRO and State Government studies.

Graham Smit, a landowner who intended to build his retirement home at The Honeysuckles, said by singling out one settlement Wellington Shire Council had depressed property prices forever, even [illegible] starting a class action against the council for the way that our

KEY POINTS

- Residents say existing property values have been gutted by talk of a development ban.
- Up to 70 are considering a class action for millions of dollars in damages.

property values have been degraded since this announce[illegible] on whether to write to Victorian Planning Minister Justin Madden asking for a 12-month moratorium on all development in The Honeysuckles.

Shire chief executive Lyndon Webb said the council was "caught between a rock and a hard place".

"If we continue to ignore this and allow people to proceed, we can expect people to say, 'Well, why didn't you act on this information that you [illegible] a class action been discussed.

But in a submission it put to the State Government's Victorian Coastal Strategy Draft in January, the shire itself said banning development was not the only strategy to balance development with climate change concerns.

"There is a need to investigate alternative approaches including physical barriers such as sea walls, better-vegetated sand dune systems or even levy [illegible] measure while a long-term strategy was devised.

Plumbing regulators not the only ones with challenges in climate change adaptation!

BARRY PARK **DRIVE TODAY**

Reprieve on Ninety Mile Beach homes

Age 2/7/08

Council baulks at building moratorium

By **BEN DOHERTY**

RESIDENTS and landowners in a small community on Ninety Mile Beach in Gippsland have won a planning reprieve, with Wellington Shire Council backing down on a proposal to ban development in the hamlet.

But home owners in low-lying coastal settlements could still be slugged with extra building conditions, or forced to indemnify the council of any responsibility in the event of flood, with the council meeting behind closed doors yesterday afternoon to discuss legal advice on new regulations.

And the council might face a class action from angry landowners, who argue that speculation about The Honeysuckles being flooded had damaged property values.

A report to the Wellington Shire Council said The Honeysuckles was the most at-risk settlement on Ninety Mile Beach of being swamped by rising sea levels in Bass Strait, or by a flooded Lake Reeve. It recommended an immediate moratorium on new buildings in The Honeysuckles for 12 months.

But outraged residents overwhelmed a council meeting yesterday, with more than 50 protesters attending, and more than 20 residents and landowners condemning the move.

The council voted six to one to drop the proposed ban.

Kylie Stolk bought a block at The Honeysuckles last year just after she turned 21.

She broke down as she told councillors of the sacrifices she had made, and that her dream had been shattered by the council's actions.

KEY POINTS

- Proposed building ban at The Honeysuckles overturned.
- Council considers legal advice behind closed doors.
- Mayor fears big problems with projected rise in seas.

"There is more at stake here than just liability for the council. You're not just taking my right to build, you're taking my dream, you're taking my future, you're taking all of our futures."

Residents spokesman David Lawther said the council backdown was "a win for residents" but that landowners had still suffered. He foreshadowed possible legal action.

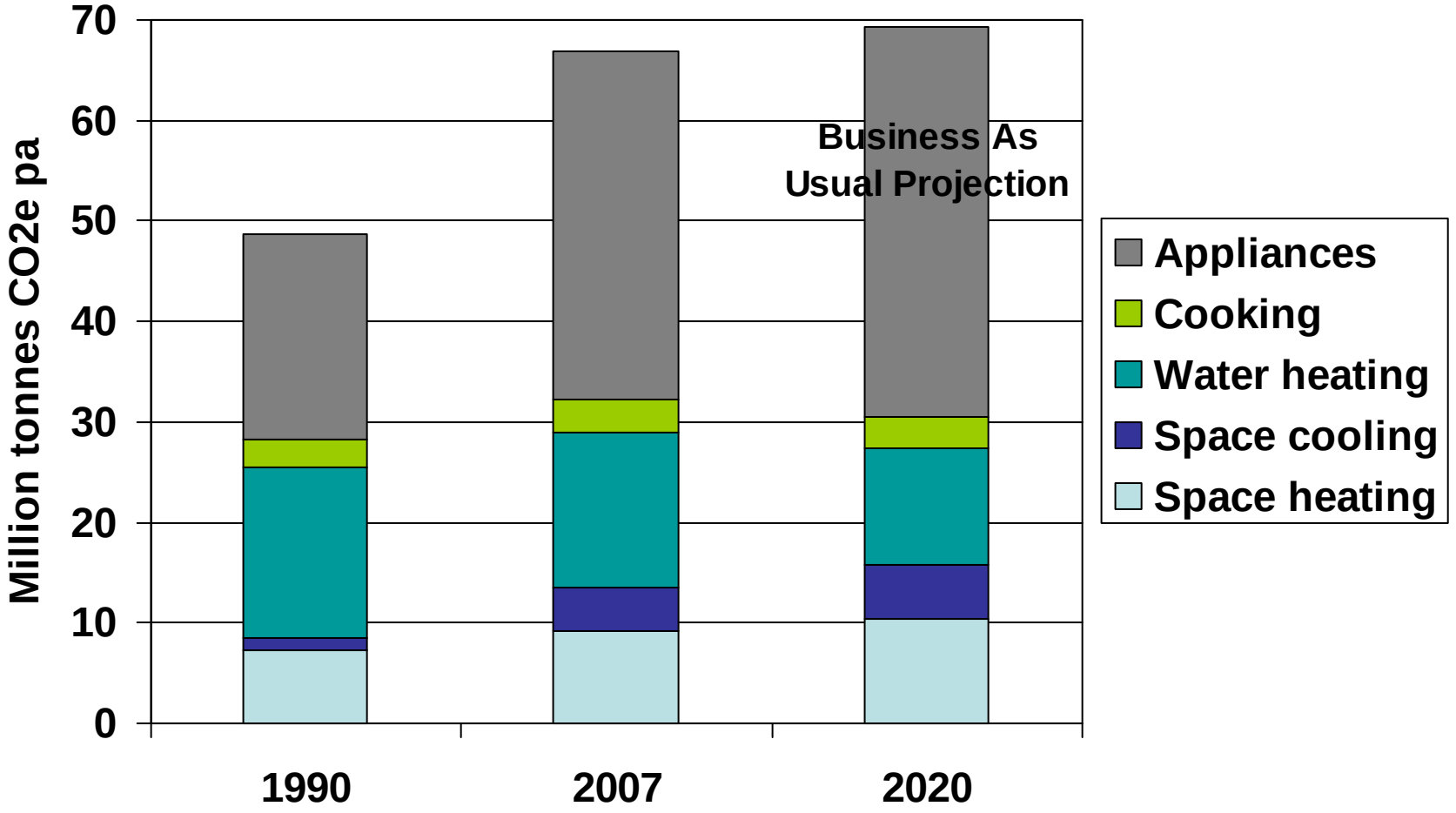
Local real estate agent Wendy Forward told councillors that land in Honeysuckles was unsaleable since news of the proposed ban was made public.

Wellington Shire is still considering how to counter the effects of climate change on coastal settlements and, in particular, how to minimise any exposure to legal liability.

Yesterday, the council considered legal advice behind closed doors about the possibility of mandating certain building conditions — for instance, that all dwellings be demountable, or setting minimum floor levels — for new coastal dwellings. It also considered section 173 agreements, which could relieve council of any legal liability in the event of flood.

Wellington Shire Mayor Peter Cleary said, in addition to the Ethos NRM report, a CSIRO study showed land subsidence exacerbating the impact of rising seas. "If the predictions contained in these two reports come to pass, things look very grim for some of our coastal areas," Cr Cleary said.

Aust residential sector greenhouse gas emissions from energy use (from Holt 2007 and DECC GH Workbook 2008) – assumes success in cutting emissions from HW!



Some CoAG ‘best practice regulation’ principles:

- Adopt option that best meets identified objective with greatest net community benefit:
  - What timeframe? Which costs and benefits?
  - How to address health risks and irreversibility?
- Do not restrict competition unless benefits outweigh costs and objective can only be met by restriction:
  - How to avoid restricting innovation?
  - How to manage infrastructure investment?
- Provide guidance to regulators and regulated parties on policy intent and expected compliance requirements:
  - Tensions between performance regulation, DTS and technology-specific regulation
- Ensure regulation remains relevant and effective over time
  - How do we ‘futureproof’ investments in systems to cope with ongoing technological, social and environmental change?
  - How do we update policies, regulations and field practices?

Assumptions by Economic Policy Makers:

- Government intervention in markets should be minimised because it distorts and increases costs: but what about benefits such as:
  - Economies of scale and improved delivery quality from standardisation
  - Increased certainty as a driver of investment in innovation
  - Reductions in transaction costs
  - Reducing future cost of performance upgrades
  - Management of risks that require specialist knowledge
  - Capture of benefits not captured by voluntary action
- Rationalisation of regulation and regulatory institutions improves efficiency: but
  - Transition costs and impacts can be high
  - Can ‘on the ground’ effectiveness be maintained

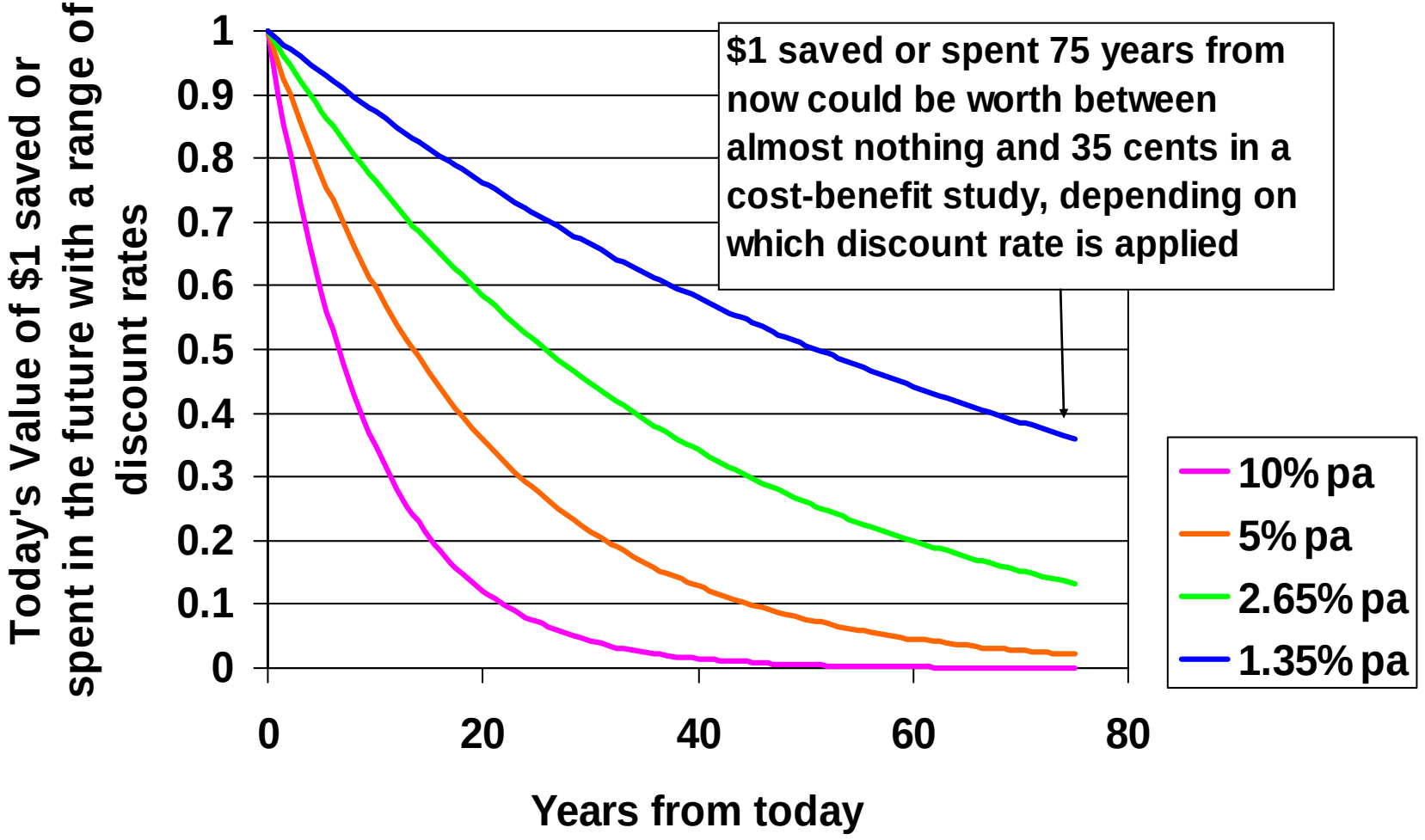
Assumptions by Plumbing Sector:

- Existing institutions, cultures and approaches have inertia
- Technical assumptions about:
  - What services plumbing provides
  - What technologies and systems are needed to deliver these services, including sustainability outcomes
- We need flexible, comprehensive, evidence-based policy and regulatory development that recognises subtle community benefits that can easily be lost

We need to apply:

- Holistic thinking – integrating sustainability and multiple benefits into policy
- Lifecycle thinking: all investments should be future assets, not liabilities
- Services thinking – a shift from supply-side thinking to useful services
- Systems thinking – understanding the relationships between elements and capturing synergies
- Smart and efficient ways of ensuring sustainable outcomes are delivered *in practice*

What discount rate to apply to value of future costs and benefits? Garnaut suggests 1.35% pa and 2.65% to value the future properly. Many RISs use 5% or 10% pa discount rates, while business uses 10-25% pa.
But price of carbon emission permits could increase at 6% pa! And cost of future upgrading to cope with climate change may be high



‘Dead Water’ costs and lifecycle thinking

Lifetime (75 year house life) cost of 20 metres of 20 mm hot water pipe:

*Based on 4 litres of ‘dead water’ replaced 5 times/day

*Water cost: 4x5x365 (days)x75(years)=548 kL x $2/kL = $1095

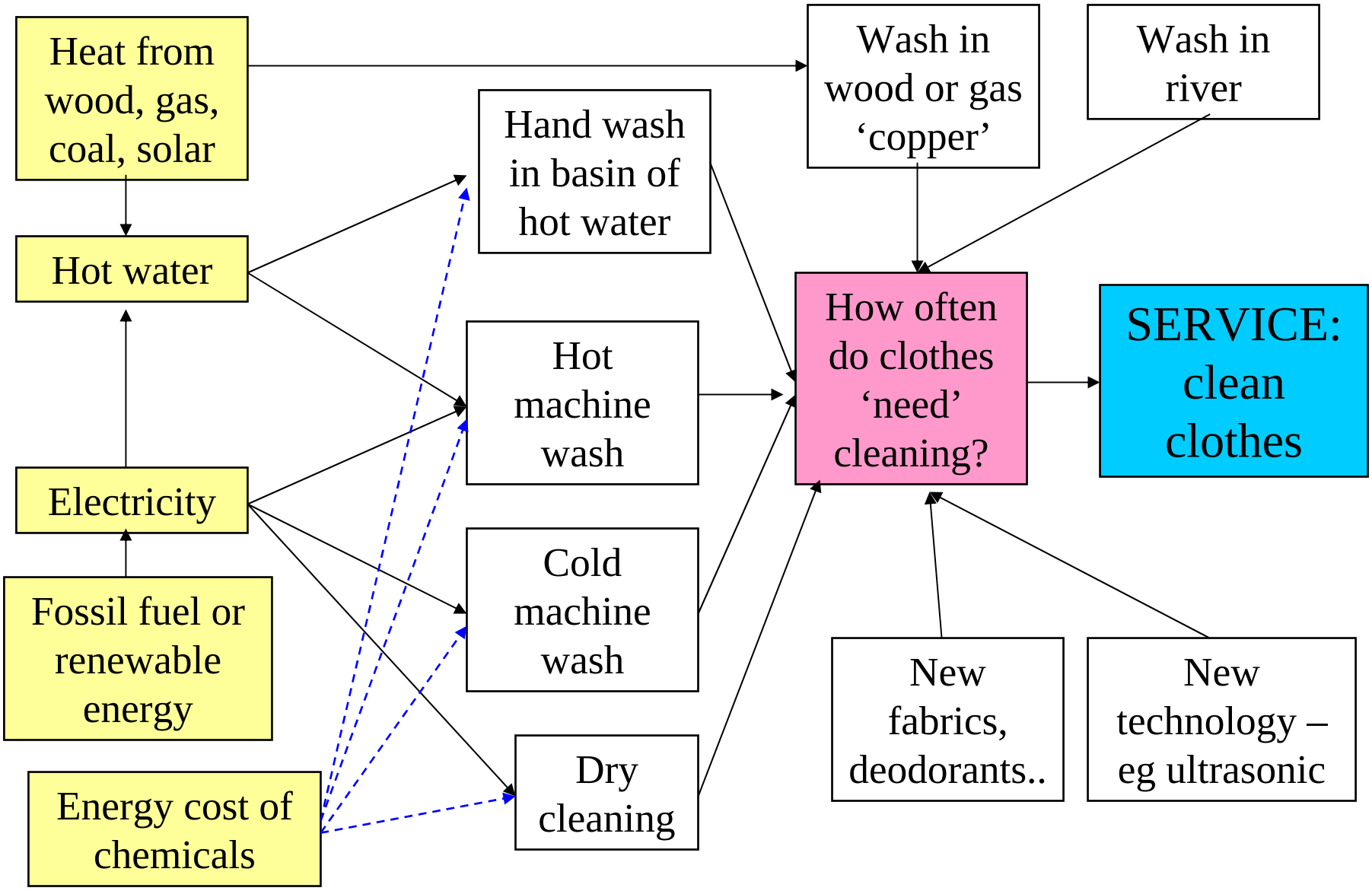
*Energy cost (gas): 548x220 (MJ/kL)x0.012 ($/MJ) = $1470 (if electricity $3100)

*Greenhouse gas: 7.3 tonnes, $140-400 (gas); 30 tonnes, $600-?? (electric)

*Time (@ 4L/min and $10/hour): $22,800 (plus frustration!)

Annual: 7.3 kL hot water, $34-46 water+energy, 0.1-0.4 tonne CO2, $304 time

An example of an energy service: supply of clean clothes (adapted from Pears & Versluis, 1993)



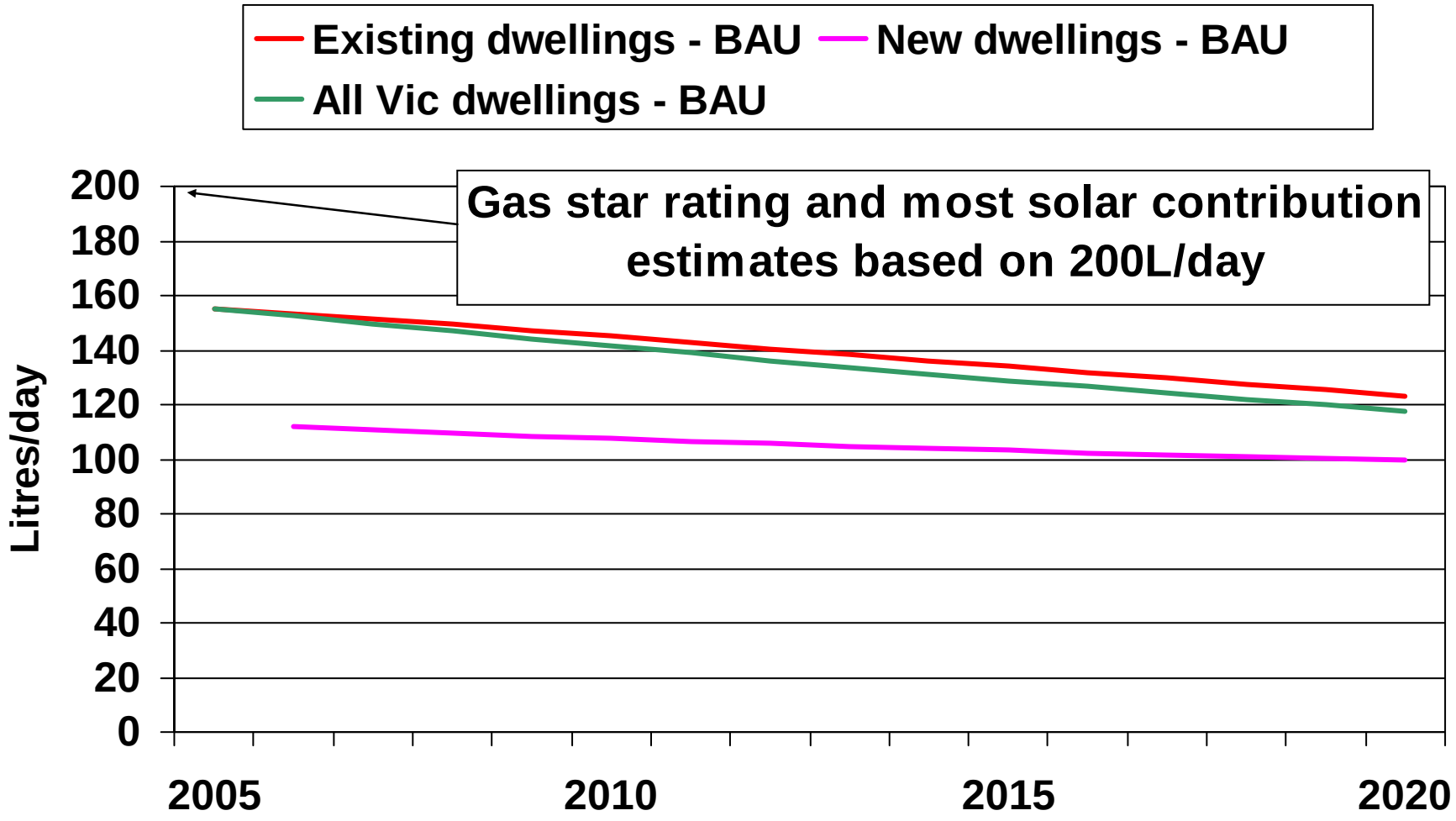
Trends in Hot Water services:

- Declining average household size – but more variability in loads
- Cold-connect dishwashers and clothes washers heat own water
- Water-efficient showers and taps
- More likely to run on pressure pump from tank
- Increasing consumer concern about water waste and greenhouse gas emissions
- Growing wealth and waste
- Multiple outlets spread throughout home
- Tighter constraints on HWS location
- Shift to higher density/apartment living with communal HW systems

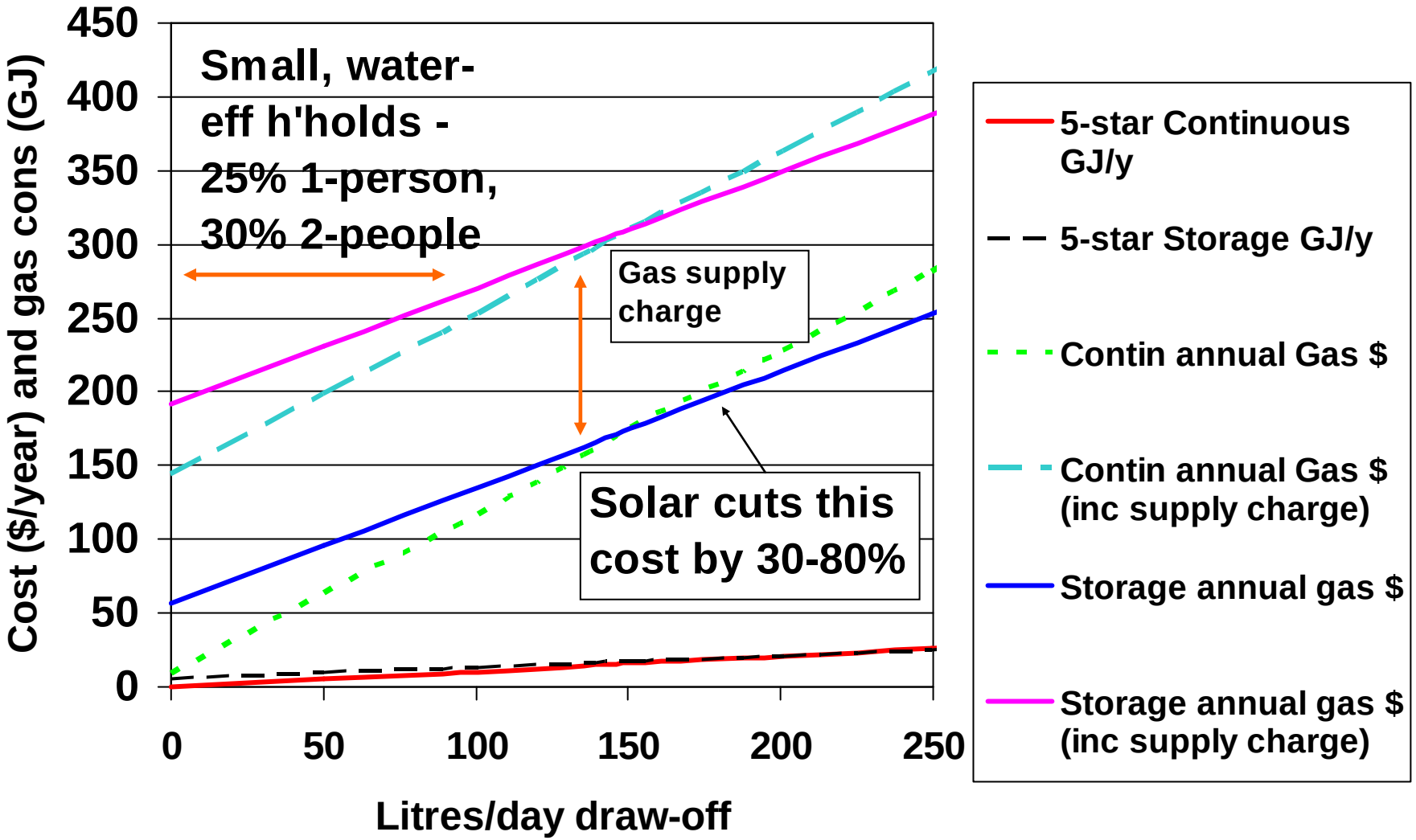
Implications of trends in HW demand:

- Standby energy losses become more significant
- ‘Dead water’ and HW distribution losses become more significant
- Temperature variation under shower becoming a bigger consumer issue
- As dish washers, clothes washers become more water-efficient and detergents allow lower temperature washing, internal heating makes more sense
- Economics of traditional solar HW and other high capital cost options look worse

Victorian Household Hot Water Use Projections (unpublished, George Wilkenfeld for Sustainability Victoria, March 2007)



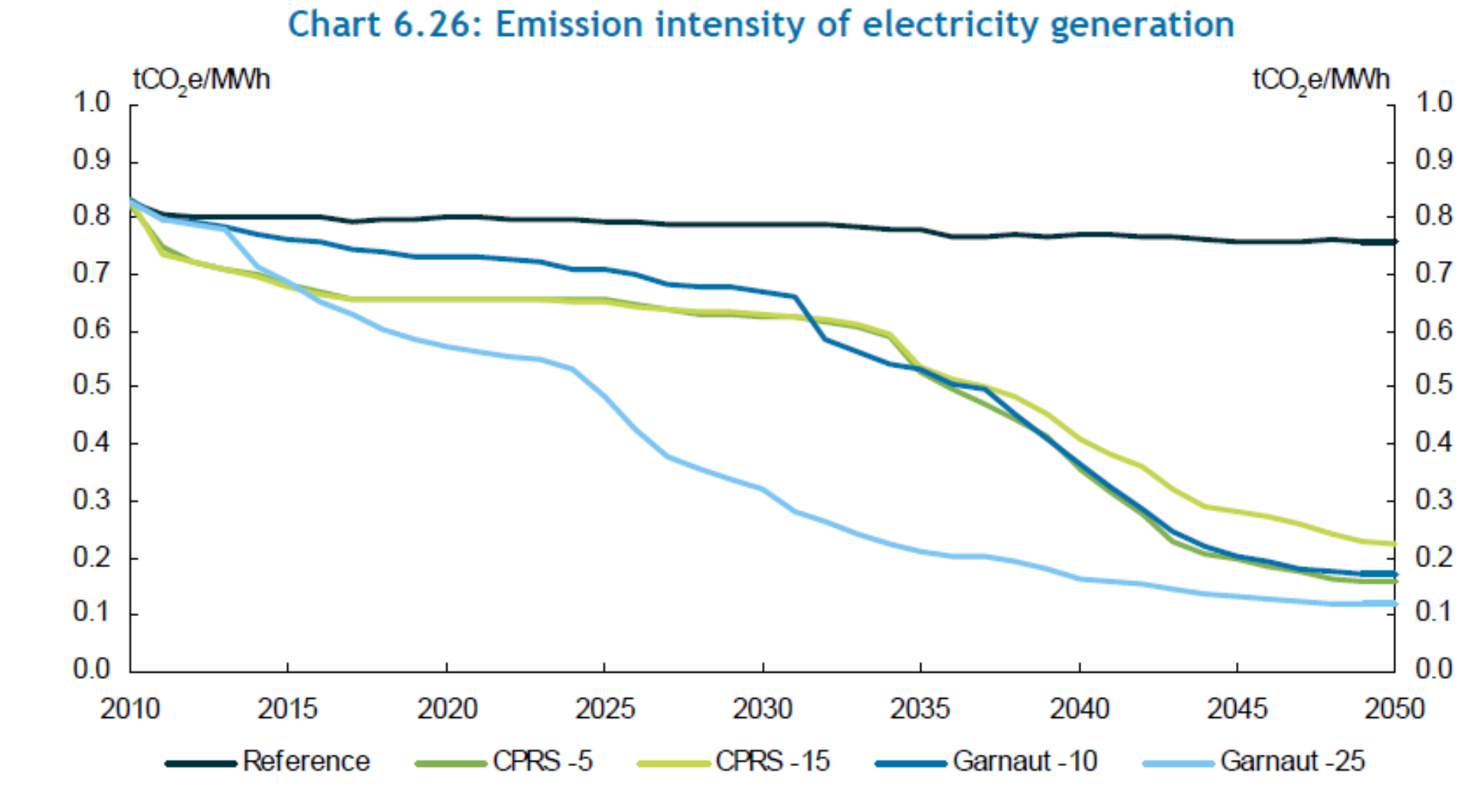
Cost-effectiveness of solar and gas-solar HWS units is an issue for small, water-efficient households. But economies of scale are cutting solar cost. And should HWS specification be based on house occupancy *potential*?



Is gas a good greenhouse solution?

- Installation/connection charges
  - New homes – cheapest to install pipes during development
  - Existing homes – costs and problems
- Supply charges - $150 pa! (over ½ of my bill)
- Emerging technologies and declining costs of energy efficiency and advanced electric and renewable technologies challenge gas:
  - Electric cooking – induction, microwave, highly insulated ovens
  - Heating and cooling – 10 Star reverse cycle in 7 Star building envelopes
  - Heat pump HWS, local instant electric HW, solar with heat pump boost, high performance solar…..
- Maintaining competition?
- Green Power (and PV) vs ‘Green Gas’ and future gas sources – and prices….
- Will on-site electricity generation from renewables+gas avoid need to connect to electricity?

Scenarios for Australian electricity greenhouse intensity (from *Australia's Low Pollution Future: the economics of climate change mitigation* Australian Government 2008)



Source: Treasury estimates from MMRF and MMA.

Ensuring outcomes delivered in the field


South-east facing solar HWS


Overshadowed solar HWS

- I get luke-warm showers
- I can’t use a water-efficient showerhead
- My plastic downpipes melted
- My dog was scalded by hot water from the roof
- I found a pool of hot water around my tank
- 3 plumbers worked on my solar system – it doesn’t work but none will take responsibility
- Boosting element stayed on 6h/night – took 3 months to get someone to fix it

Systems solution for HW?

- End-uses:
  - High water/energy efficiency appliances
  - Insulated shower cubicle with door or no exhaust fan above + smart temperature control – + heat recovery?
- Pipes:
  - Short, well-insulated, 10 mm to all outlets except showers (15 mm) and 5L/min flow controls on washing m/c and dishwasher taps
  - Ultra-water-efficient taps – maybe with cold-only water supply to wash basins (with in-line electric heaters?)
- HWS:
  - Very low standby losses (no pilot lights!!!!)
  - Solar, heat pump (or compatible with later add-on)
  - Low greenhouse gas emissions
  - Compatible with water-efficient taps and showers
  - Low running costs for rental properties

Legionella issues (Broadbent (2001 ABCB paper))

- Legionella risk in household water very low – no Australian cases known from HWS (over ½ are from potting mix!)
- 37-43C is most dangerous temperature (can grow > 30C)
- 46C kills slowly, 55C kills<1 hour, 63C official ‘kill’ temperature (a few minutes)
- Temperature change itself stresses and kills
- O/s study: gas HWS units with average temp 50.6C and burner at base of tank had zero Legionella
- Greatest risk when burner or element above base of tank (with lukewarm water below it) - sediment may collect

Safety: Legionella vs scalding

- Present situation:
  - Legionella: store HW above 60C
  - Scalding: deliver HW at 50C
- Present solution:
  - Tank thermostats set to 60C+
  - Tempering valves used to drop temp to 50C
- Present outcome:
  - Negligible proven Legionella benefit - no/few deaths linked to household HWS before new approach….
  - Risk of scalding returns if tempering valve fails (and occupants may not notice failure until too late)
  - Higher capital and maintenance costs of tempering valves and separate HW pipe legs to kitchen and bathroom
  - Sustainability conflicts (next slide)
- Does this meet CoAG Principles?

60C requirement: sustainability trade-offs

- Heat losses from tanks, fittings, pipes 20+% higher c/f 50C storage
- Separate pipe legs to kitchen increase ‘dead water’ losses (water, energy, time)
- Solar contribution lower (by up to 10% c/f 50C)
- Increased complexity and lower consumer flexibility for in-line gas boosted solar HWS
- How do we compare sustainability impacts against health and safety benefits?
- Can existing Legionella risks be reduced in other ways (eg HWS design to avoid sediment and warm water below heating element; ensure significant temperature change/cycling)?

Summary

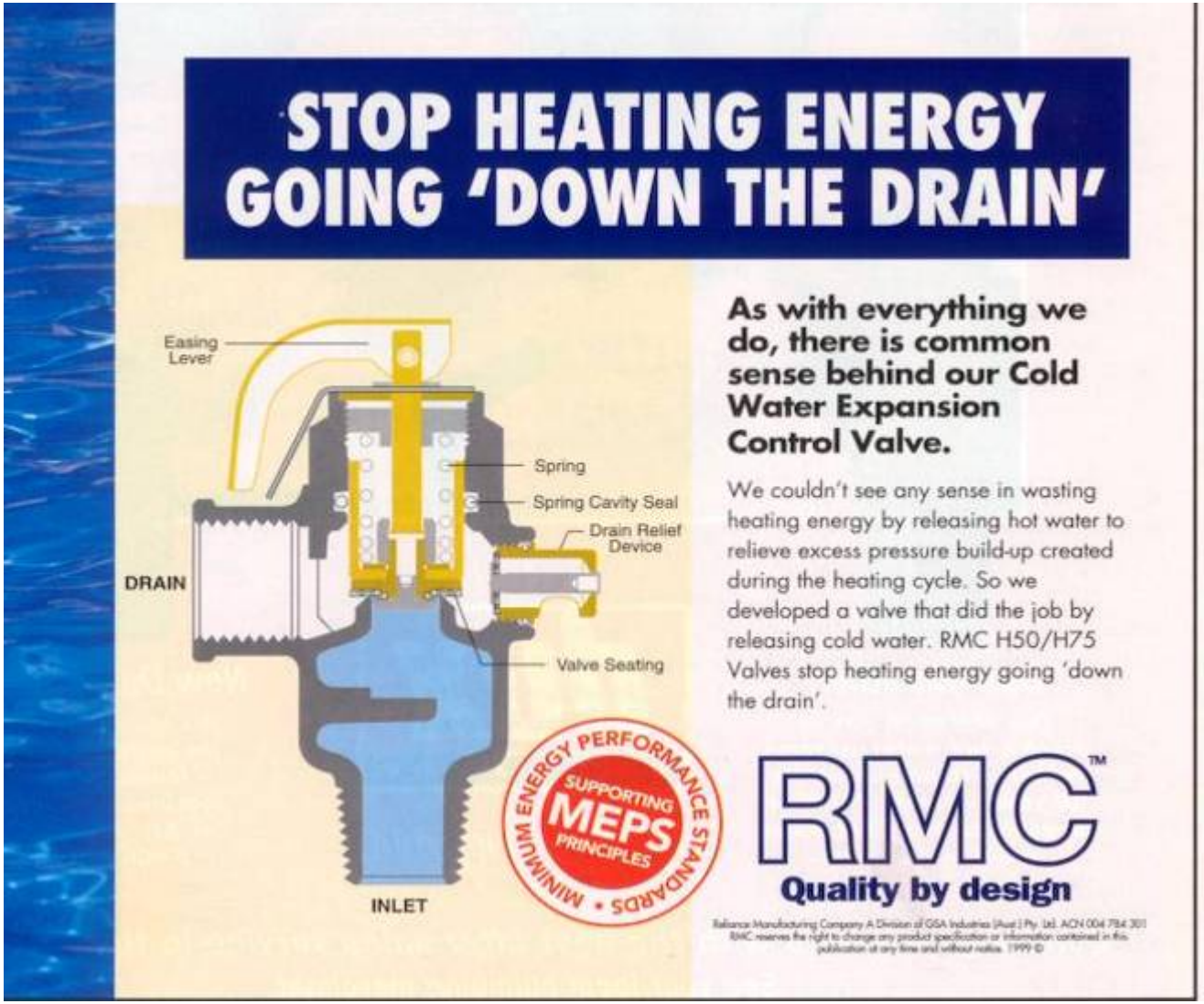
- Plumbing regulators have a very challenging task dealing with rapid change across many dimensions
- We need to understand much better:
  - How the context is changing
  - What services plumbing really provides
  - How well existing and emerging systems really work
- We need to actively innovate in policy, practice and technology to deliver practical, sustainable outcomes

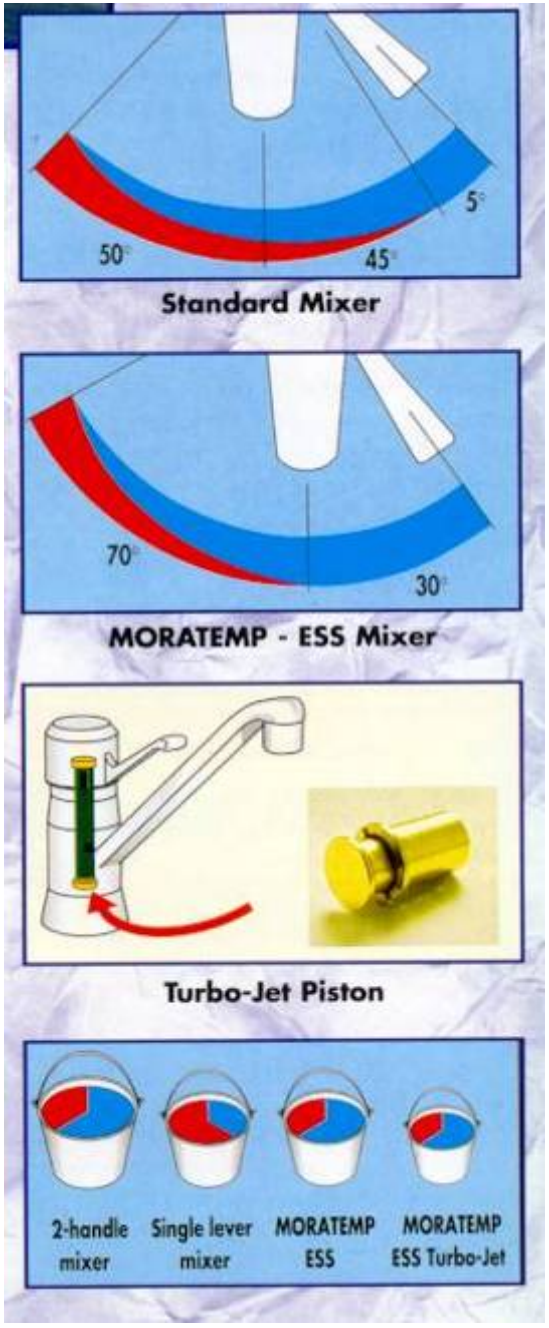

The end
Thankyou

Some pseudo-solutions & myths

- Pumped ring mains – waste energy (especially when poorly insulated), more dead water losses when pump not running
- On-demand recirculation pumps – save water but not much energy (and may increase energy)
- Fatter pipes – reduce temperature variation but increase time delay and energy/water waste
- ‘Plastic pipes don’t need insulation’ – they do!
- ‘Pilot lights provide useful heat’ – and waste more
- Tempering valves – do they really work? NZ study found 40% had HW temp 55-60C, 15% 60+C

Cold water expansion valve – save 2+% of hot water usage plus heat loss from valve and pipe attached to it plus losses from undetected failures

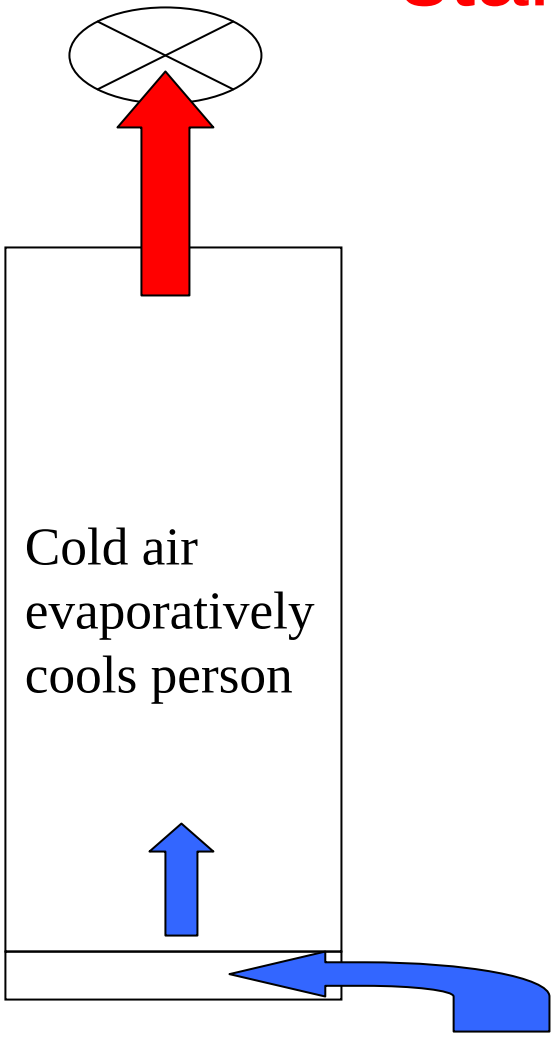




Fittings and appliances

- Water-efficient (and hot water-efficient) mixer taps and taps that don't drip
- Water-efficient showerheads with built-in permanent flow controls (or flow controls in taps) – and good shower quality
- Ultra water-efficient taps with in-line heaters for powder rooms – only cold supply needed
- Water-efficient clothes and dishwashers with 'smart' control that diverts fairly clean water to a different outlet for re-use or recycling, and built-in heat recovery systems
- Waterless urinals, low-flush or waterless toilets, urine separation…

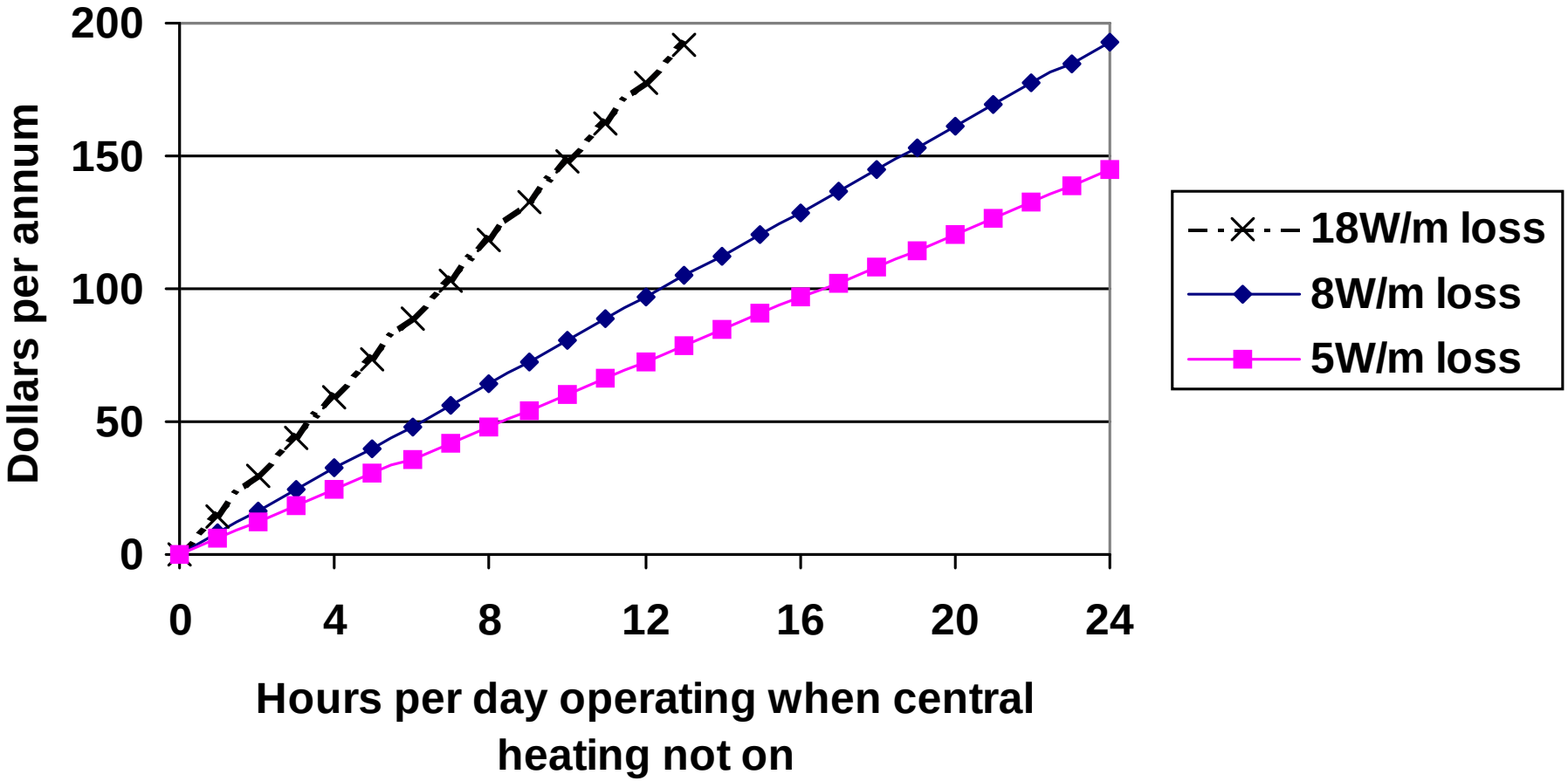
Shower facilities: making the most of 3-star+ showerheads



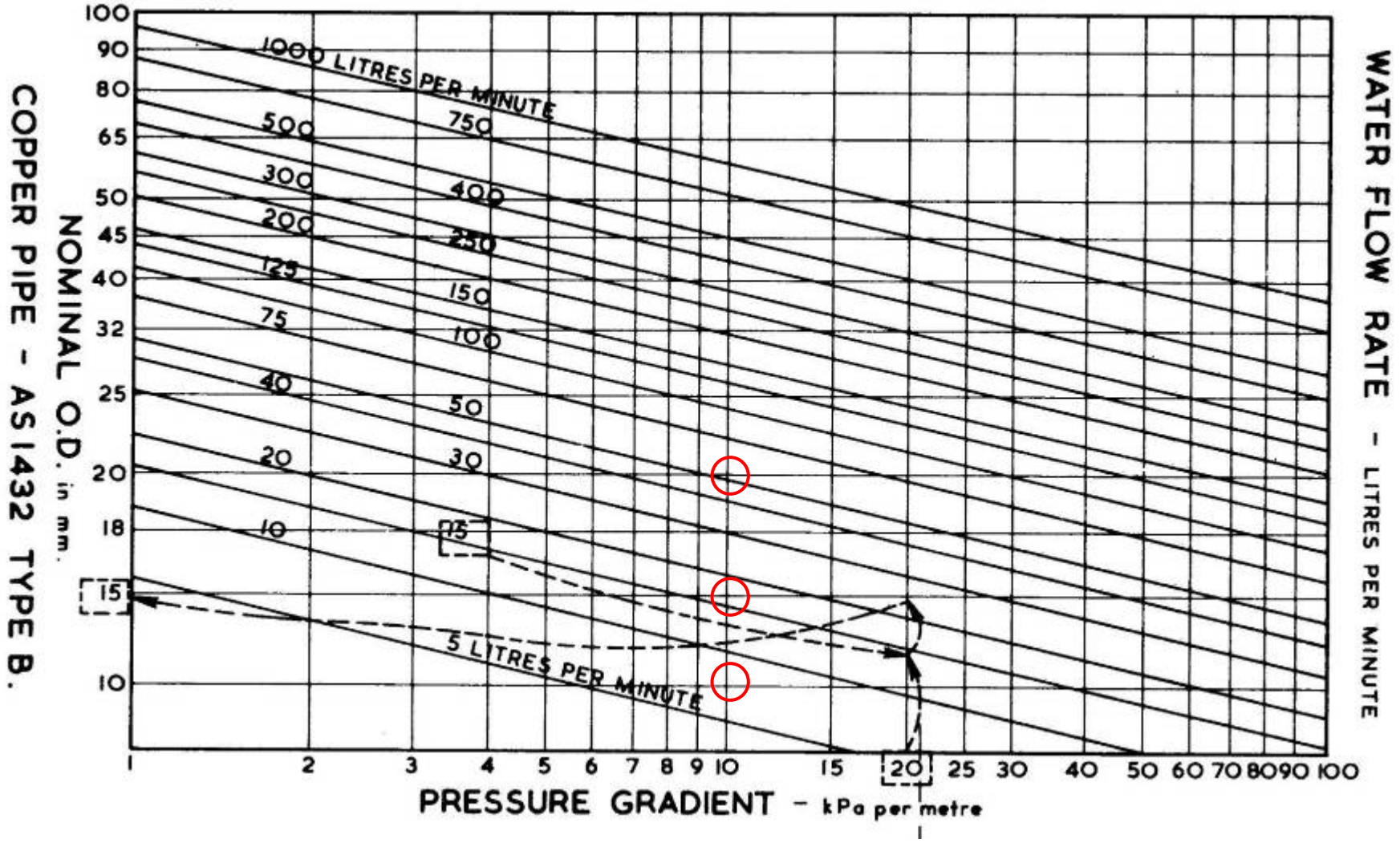
- 3-star+ shower provides much less heat
- Exhaust fan switched separately from room light and NOT above shower cubicle – evaporative cooling!
- Temperature/volume control instead of taps (avoid temperature variations)
- Insulated cubicle walls (heated by recovered water?)
- Heat recovery system built-in to warm incoming cold water supply or water (and heat) recycling?

Pumped ring main systems have very high energy costs – eg for gas HW. And when used with instant HWS, it dumps heat!

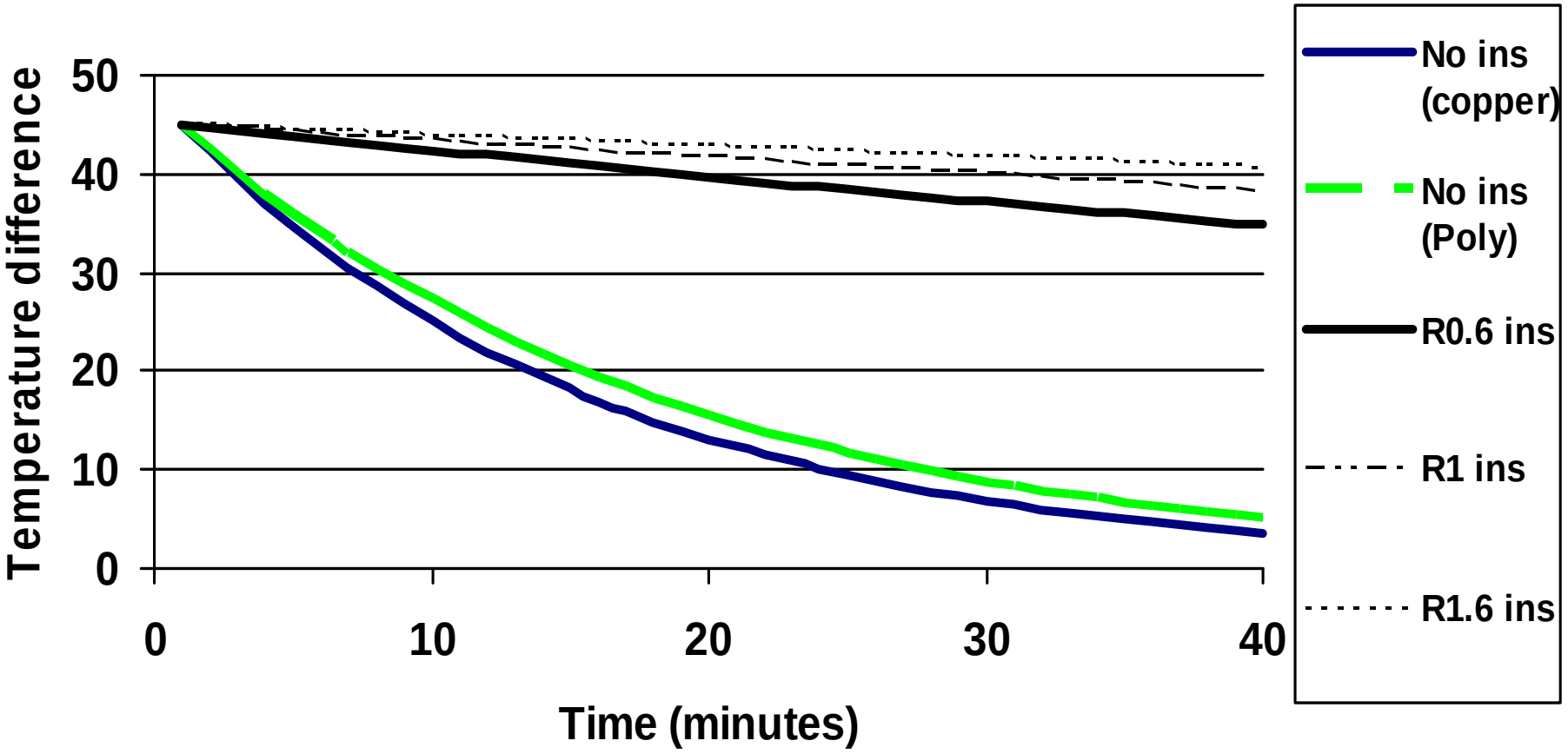
Annual cost of losses from pumped ring main system



Pressure drop vs flow rate (Rheem) – lower flow means smaller pipe gives same pressure drop. Eg for 10 kPa/metre, 7.5L/min in 10mm pipe, 17 L/min in 15 mm and 50 L/min in 20mm pipe



Temp difference between ambient and water in a hot water pipe over time with varying insulation. R0.6 insulation is 25 mm of closed cell polymer or equivalent, R1.0 is equivalent to 38 mm of fiberglass or equivalent



Medium density solutions? George St Apartments

- Communal gas-boosted solar HW:
  - Fewer collectors
  - Fewer gas boosters
- Retailer allowed gas cook-tops to be centrally metered
- Issues:
  - Dead water, pipe losses
  - Allocation of costs to users

Pipes: Minimise ‘dead water’ losses and delivery time; facilitate grey water use, etc

- 10 mm – 21.5 metres/litre; 15 mm – 10.7 metres/litre; 20 mm 4.4 metres/litre
- At 3 litres/minute draw-off, time delay for 10 metre pipe is:
  - 10 mm: 10 seconds; 15 mm: 20 seconds; 20 mm: 45 seconds
- Pressure drop an issue, but 5L/min in 10 mm pipe has same pressure drop as 12L/min in 15 mm pipe, so smaller pipes OK for water-efficient taps but probably not showers
- Small pipes must be linked to aggressive flow controls for dishwashers, clothes washers, etc (6 L/min on hot and cold)
- Pipes should be well-insulated
- Outlets from showers and baths separate from black water to edge of slab, third tap in laundry – design for adaptation
- Plumbing design for non-potable supply to garden, HWS etc

Solar boosting gas HWS units

- Storage units:
  - Need electronic ignition so extra insulation, flue damper can be added without overheating tank
  - After cutting standby losses, add solar pre-heater with its own unboosted storage
  - OR burner installed above solar storage volume
- Continuous/instantaneous units:
  - Develop ‘smart’ module to control inlet temp to HWS so that burner operation is stable, then install solar pre-heater with its own unboosted storage OR burner able to turn down to very low flame
  - OR circulate water from storage tank through HWS to heat top section of tank when boosting required

At 2.5L/min, 10 MJ/h burner raises water temp by 12C.Maximum inlet water temperature (mix of mains cold supply and solar pre-heated) for continuous flow HWS delivering water to user at 50C. If solar HW temp is above 50C, burner can shut down and 100% solar can be used.