
Smart Appliances for Smart Grids: Flexibility in the face of uncertainty

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What I will cover

- What is *my* understanding of the ‘smart grid’
- Why ‘smart’ appliances are necessary
- Why they will not appear on their own
- Where does the ‘smartness’ reside?
- What we are doing in Australia
- Conclusions

The smart grid

- No specific meaning (eg 'sustainability')
- Set of generally agreed concepts
 - » Utility-level SCADA
 - » Advanced customer metering/gateways
 - » Automated appliance response
 - » Time of use, critical peak & innovative pricing
 - Maybe magnified/reinforced by in-home displays
 - » Sympathetic utility & government regulation
- Set of generally agreed objectives

Smart grid objectives?

- Economic efficiency
 - » Better use of existing infrastructure; lower costs
 - » Better manage peak demand (important for Aust)
- End use efficiency & greenhouse reduction
 - » Actually not very effective – other programs better
- Supply side efficiency & greenhouse reduction
 - » Better integrate renewable & distributed energy
- Finer-grained emergency management

Why smart appliances

- Main value of Smart Grid is to do things that supply side or demand side cannot do alone
- Neither side has to be completely smart – smartness lies in the integration
- Appliances need very few basic functions:
 - » Turn off/on (in emergency & for dumber products)
 - » Limit load (eg to 50%)
 - » Store energy (safely) when there is surplus supply
 - » Discharge stored energy when required

Some smart appliance truths

- Few consumers want to (or will) manage these functions on their own
- In return for incentive (\$ or other), will let (a trusted) utility or aggregator do it
- The communications do not have to reside in the appliance – better if not
 - » Utility infrastructure, comms and appliances evolve at different rates (25-50 yrs, 1-3 yrs, 12-15 yrs)
 - » Same appliance could be managed by either direct load control or by user (and change over time)

Barriers to smart appliances

- Commercial risk to appliance suppliers
 - » Will customers buy them?
 - » Will utilities be able to communicate with them (many systems in use, many 'smart' meters actually dumb)
- Commercial risk to electricity utilities
 - » Demand response programs (combination of technology & contracts) now very expensive to roll out because successful connection rates too low
 - » Cannot influence new appliance standards alone
- Classic 'positive externality' market failure

What to do about it?

- Need interface standards
 - » At least at national/trade bloc level, preferably global
 - » Best chance of success is if comms left flexible
 - Maximises size of potential market
- Need to build up critical mass of 'smart enough' appliances rapidly
 - » Legislation may be preferable (analogous to mandatory energy labelling/MEPS)
 - » Utility regulators can then authorise (or force) large scale rollout of demand response

What Australia is doing

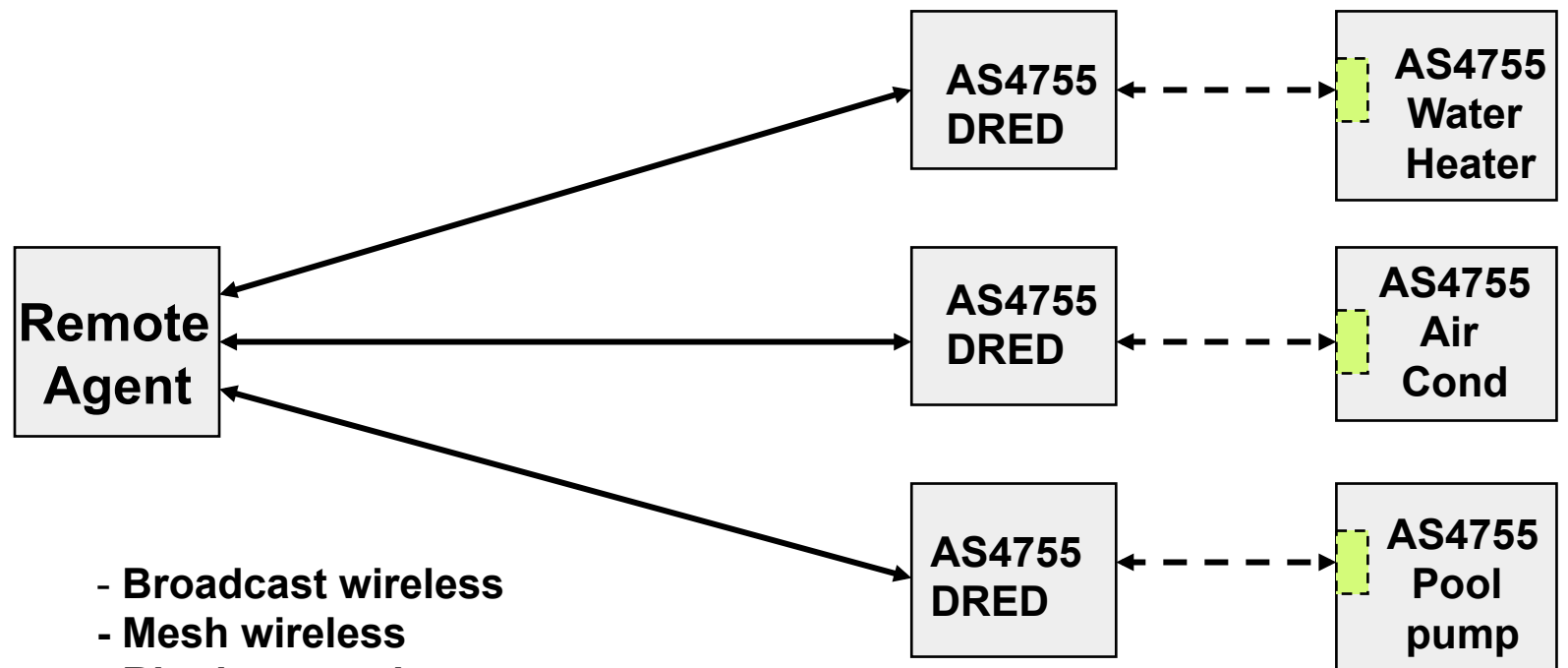
- Started work in 2005 on demand response standard for selected appliances
- Most parts will be published by end 2011
- Australia, NZ considering making standard interface mandatory for these appliances
- Demand Response Enabling Device (DRED) separate from appliance; can use any comms
- Participating in global standards processes
 - » IEC TC59, ISO, APEC

AS/NZS 4755 Modes – all products

Product	Standard Part	Minimum load/Off	Reduced load	Absorb or shift energy	Dis-charge to grid
Air Conditioner	3.1	DRM1	DRM2,3	NA	NA
Pool pump controller	3.2	DRM1	DRM2	DRM4	NA
Electric WH	3.3	DRM1	DRM2	DRM4	NA
Heat pump WH	3.3	DRM1	DRM2	DRM4	NA
Solar-elec WH	3.3	DRM1	DRM2	DRM4	NA
EV/storage charger/ discharger, PV inverter	3.4	DRM1	DRM2	DRM4	DRM5



DRED / HAN Activation (1)

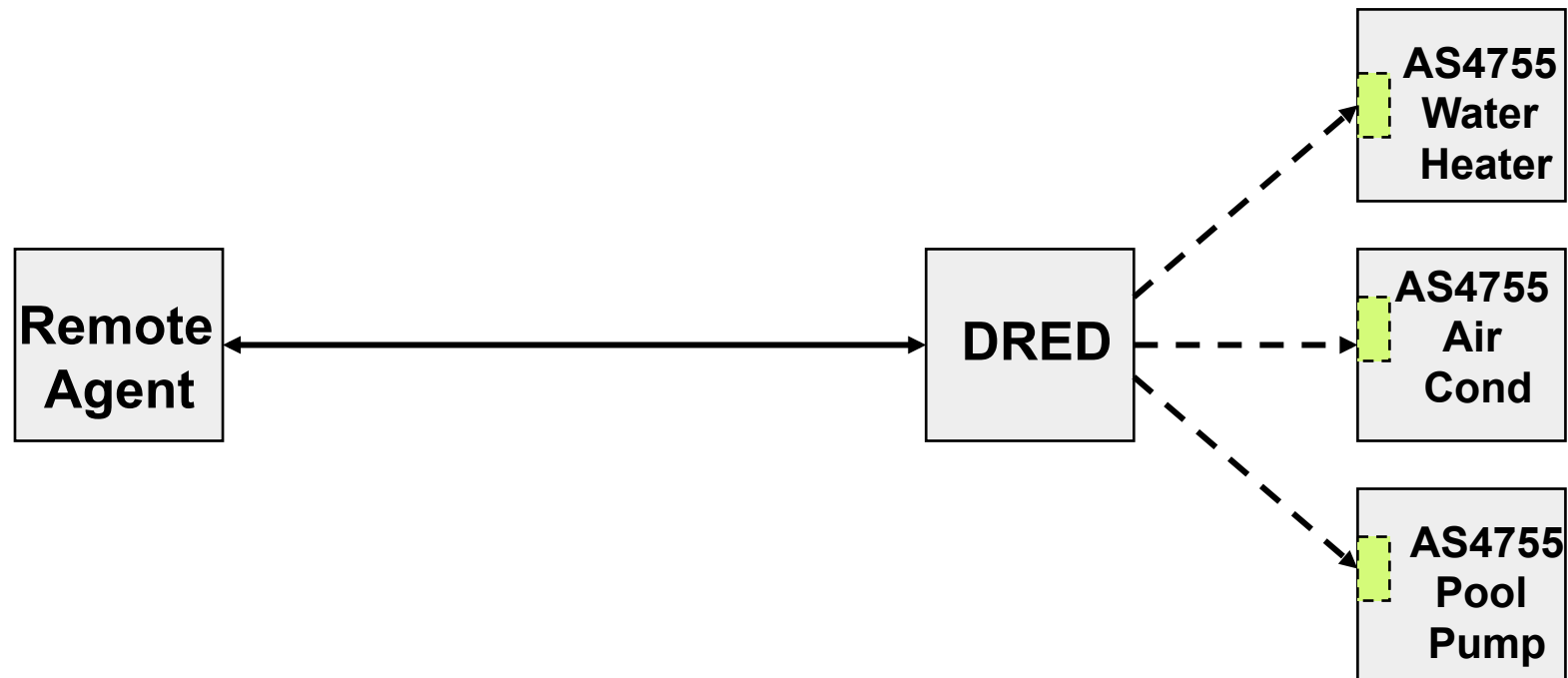


- Broadcast wireless
- Mesh wireless
- Ripple control
- Internet
- Other

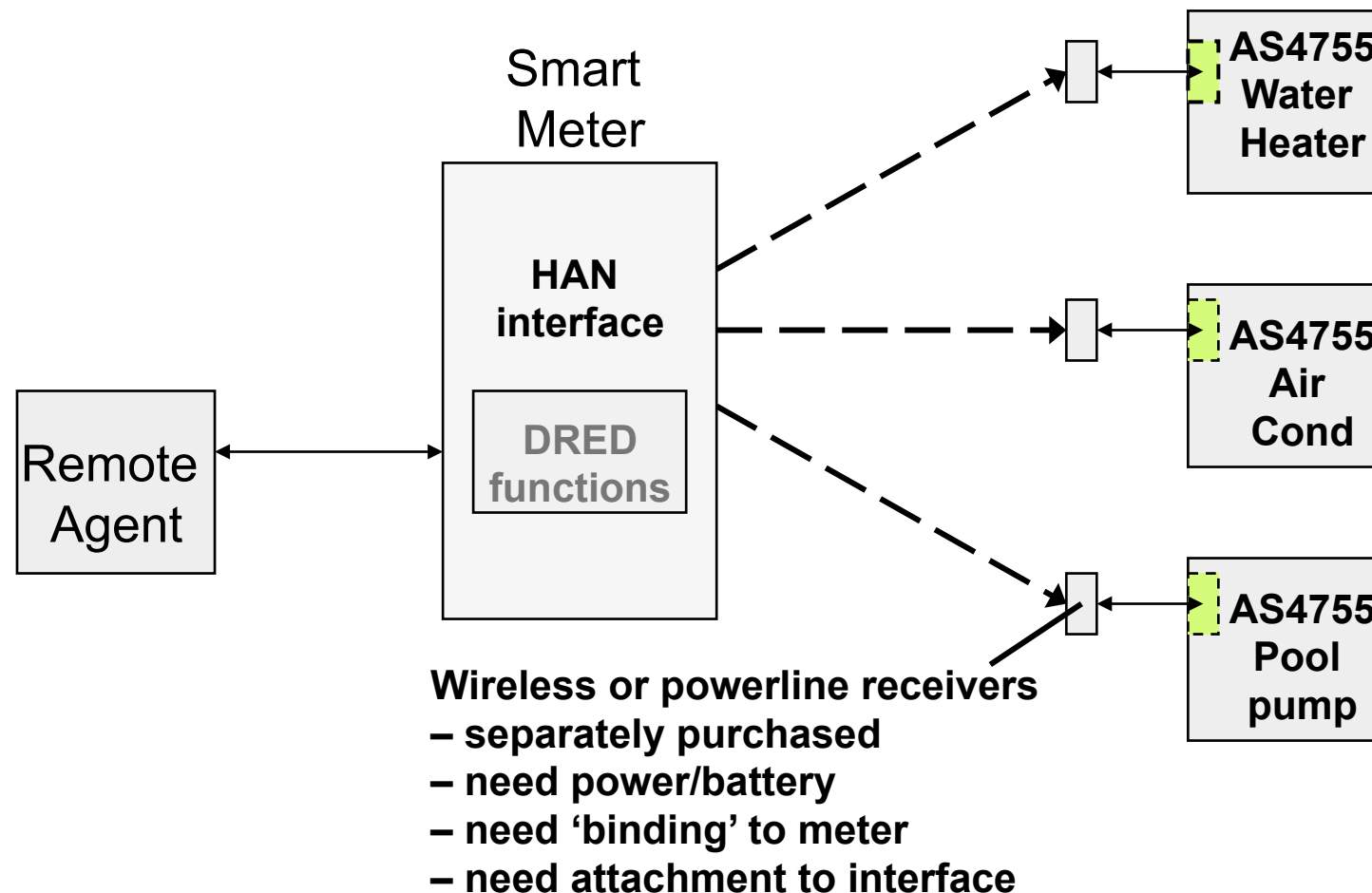
DRED may be separate or
clicked on to product or
integral with product
- needs power/battery

- Cat 5 Cable
- Wireless (eg Zigbee)
- PLC (eg Homeplug)
- needs power/battery

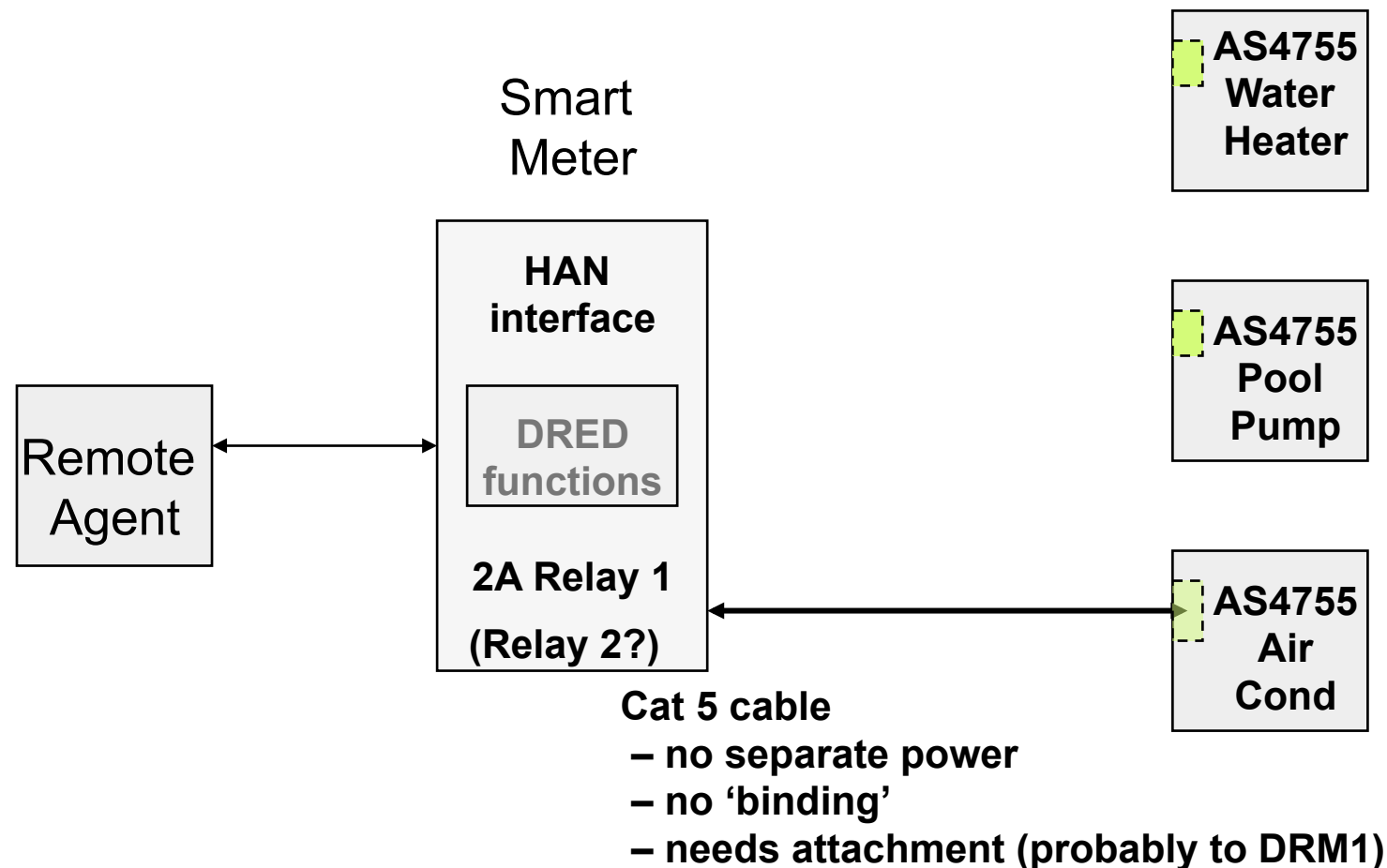
DRED/HAN Activation (2)



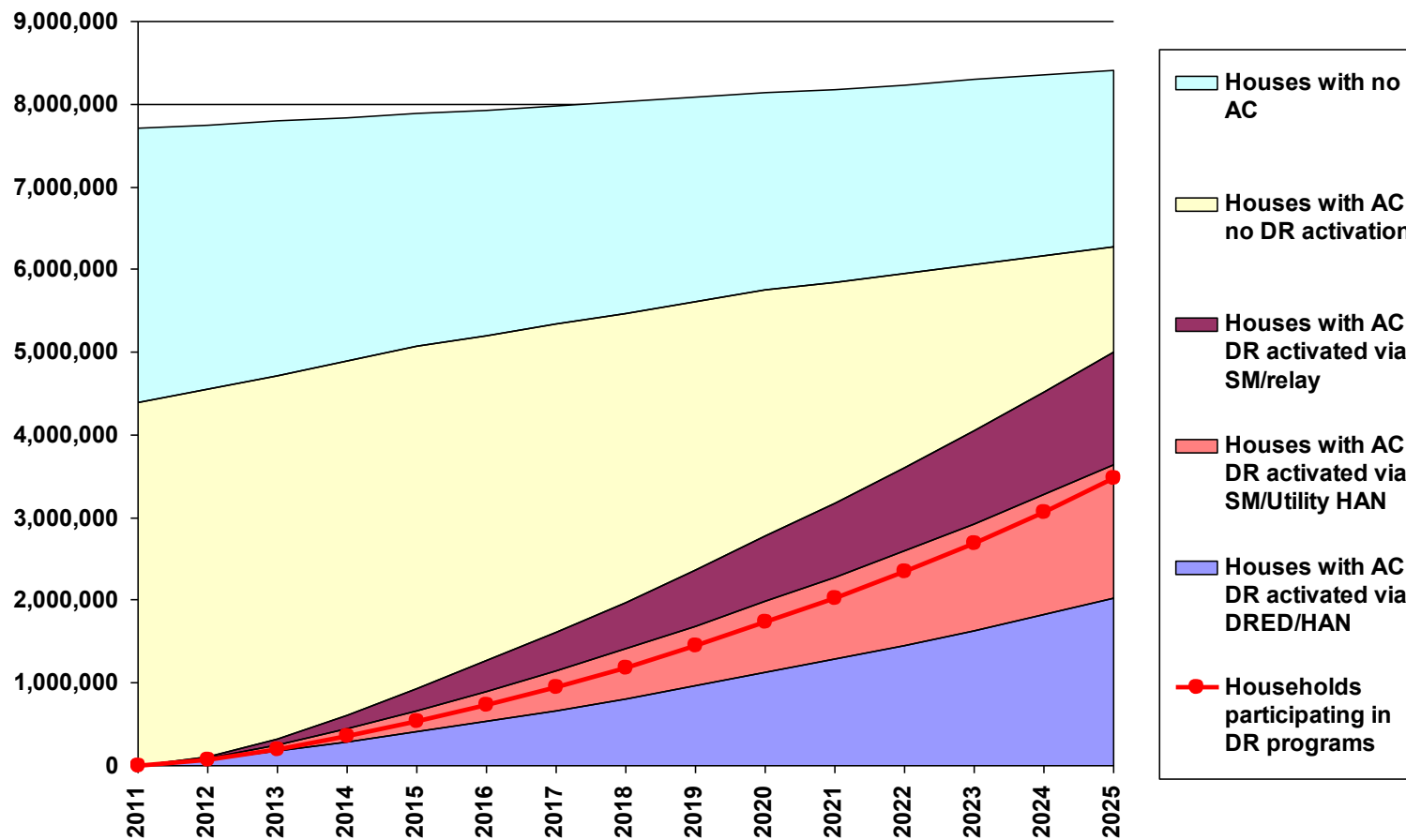
Meter/HAN activation



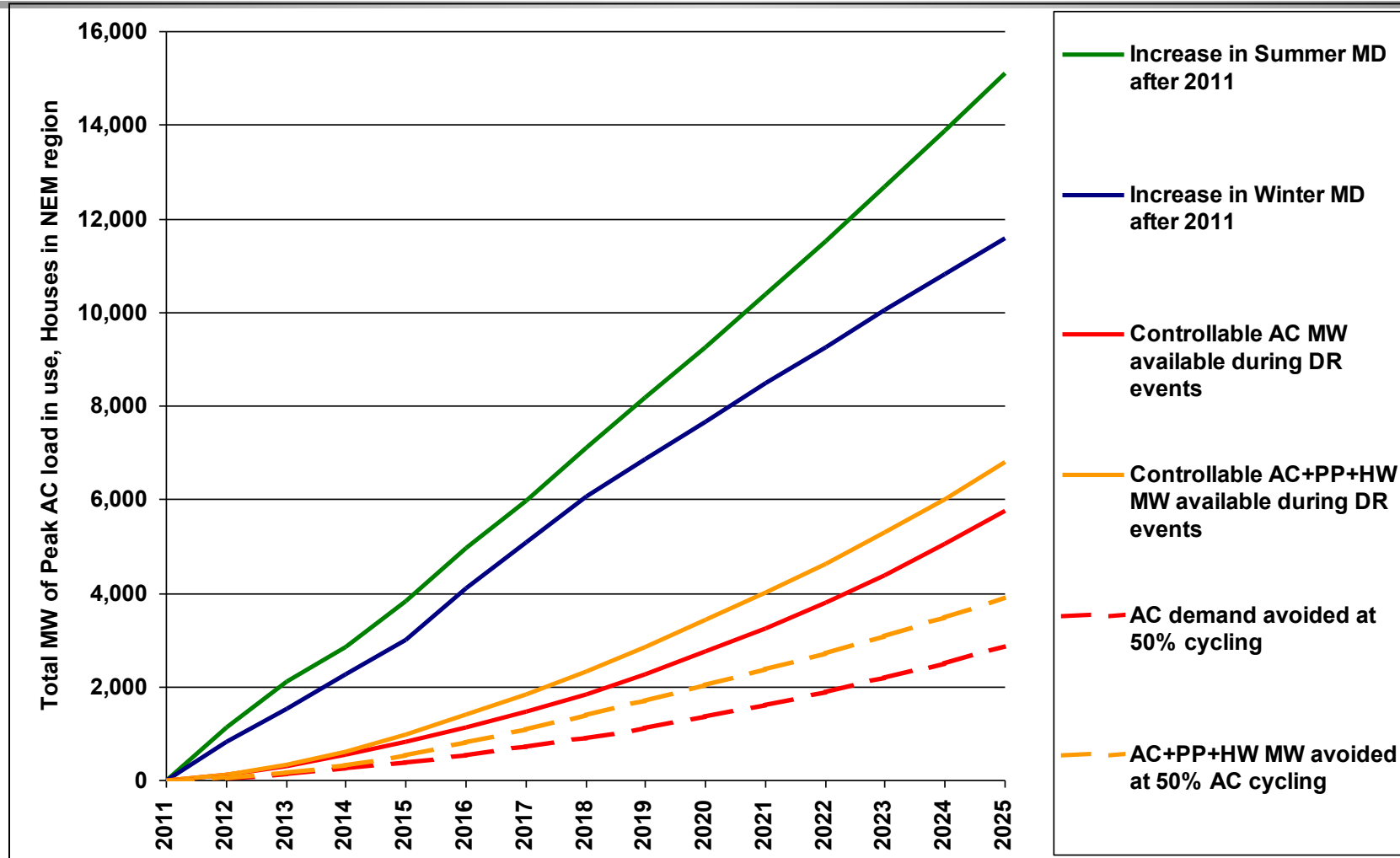
Meter/relay activation (1)



AC activation pathways



Projected controllable MW



Projected costs & Benefits

- Interface cost about \$10 retail per appliance
- Activation costs \$150-250; borne by utility
- \$3,000 value per controllable kW during peak
- After-diversity reduction potential: 1.0 kW per controllable AC, 0.6 kW per water heater
- NPV of net benefit for appliances activated 2012-2025: \$M 13,600 at B/C ratio >9
 - » NPV energy efficiency programs: \$M 32,000, B/C=2
- \$170 per yr bill reduction (if returned to users)

Conclusions

- Appliances do not have to be very smart – but the system (standards, regulation, pricing) does
- Need to build up critical installed mass
- Best way to do this is to leave comms flexible
- The ‘value proposition’ is with the utilities; they will manage the appliances better than owners
- Only governments can solve the market barriers
- If we regulate for efficiency & greenhouse, at least as strong a case to regulate for ‘smarts’.