Appliance energy efficiency and climate change: Absolute MEPS and energy sufficiency

George Wilkenfeld & Associates

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Does energy efficiency *really* reduce emissions?

- IEA expects Energy Efficiency (EE) to account for half of global emissions reduction by 2030 (renewables for other half)
- The IEA metric is primary energy per unit of Gross Domestic Product (PJ PE/$ GDP).
- BUT this metric changes with:
  - Structure of economy (more services, less manufacturing = more $/PJ)
  - Renewable share of electricity (more renewables = more PJ DE/PJ PE)
  - Technical efficiency (energy service output/delivered energy input)
    - which is what we at EEDAL usually think of as EE)
- Even if technical efficiency rises, it does not mean energy use falls

Energy efficiency trends

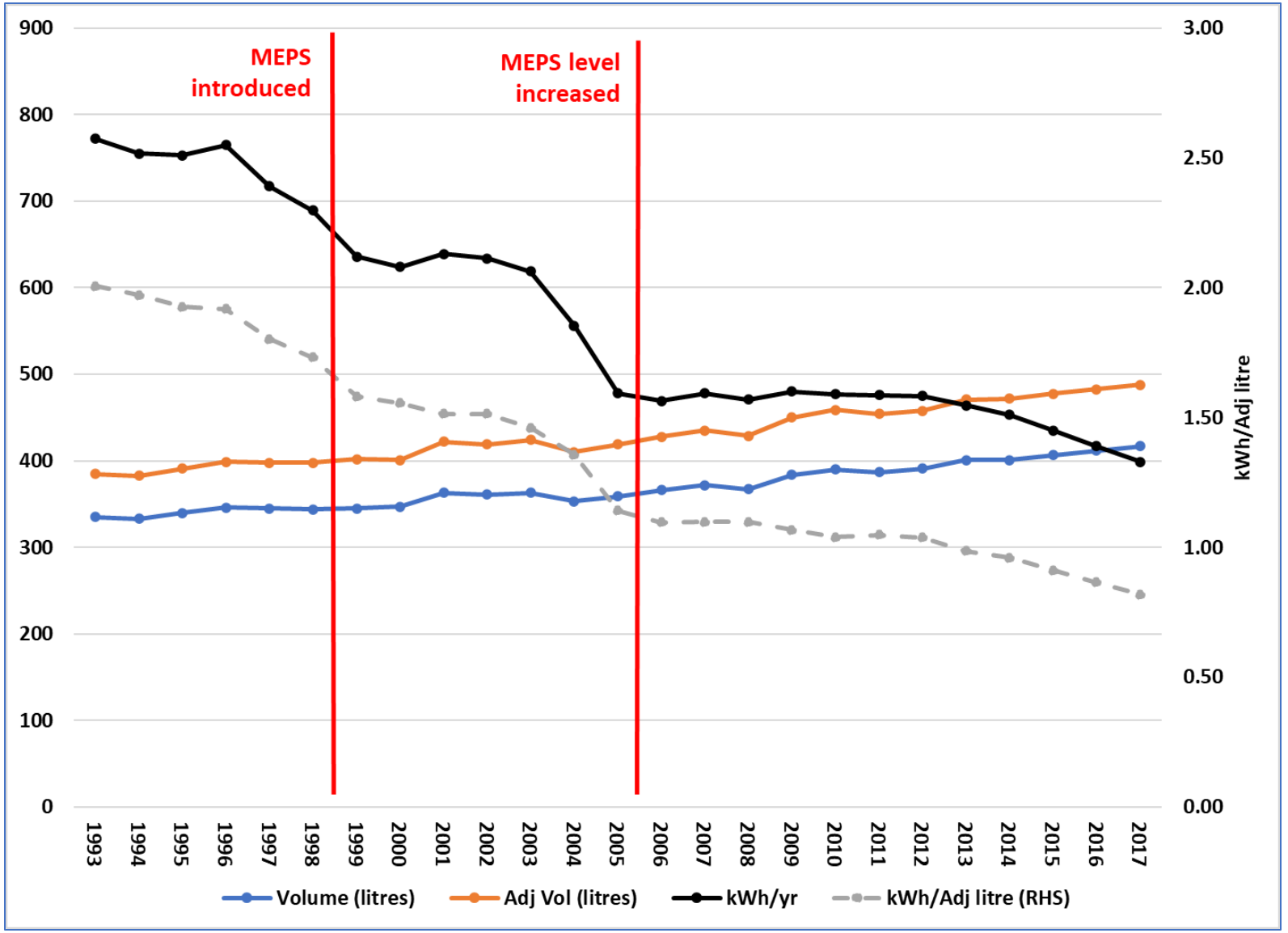
- Australia has had energy labelling since 1986 and Minimum Energy Performance Standards (MEPS) since 1999
- Good data series on market trends for products sold (Aust and NZ)
  - Size/capacity, average kWh on standard cycles, average efficiency
- I analysed the data sets for some appliance covered by labels/MEPS
  - Refrigerator-freezers (RF)
  - Clothes washers (CW)
  - Dishwashers (DW)
  - Televisions (TV)
- Also energy use trends in new single-family houses
- Will present data for RF, CW, Houses

Refrigerator-freezers

- The great success story of EE programs
- Energy use relatively unaffected by user behaviour
- Average volume and adjusted volume have been rising
- Labelling (1986) and MEPS (1999) have been effective
- Average standardised energy per unit (kWh/yr) has been falling
- BUT over the long term, rate of improvement has slowed

Refrigerator-freezers with energy labels

Refrigerator-freezer trends

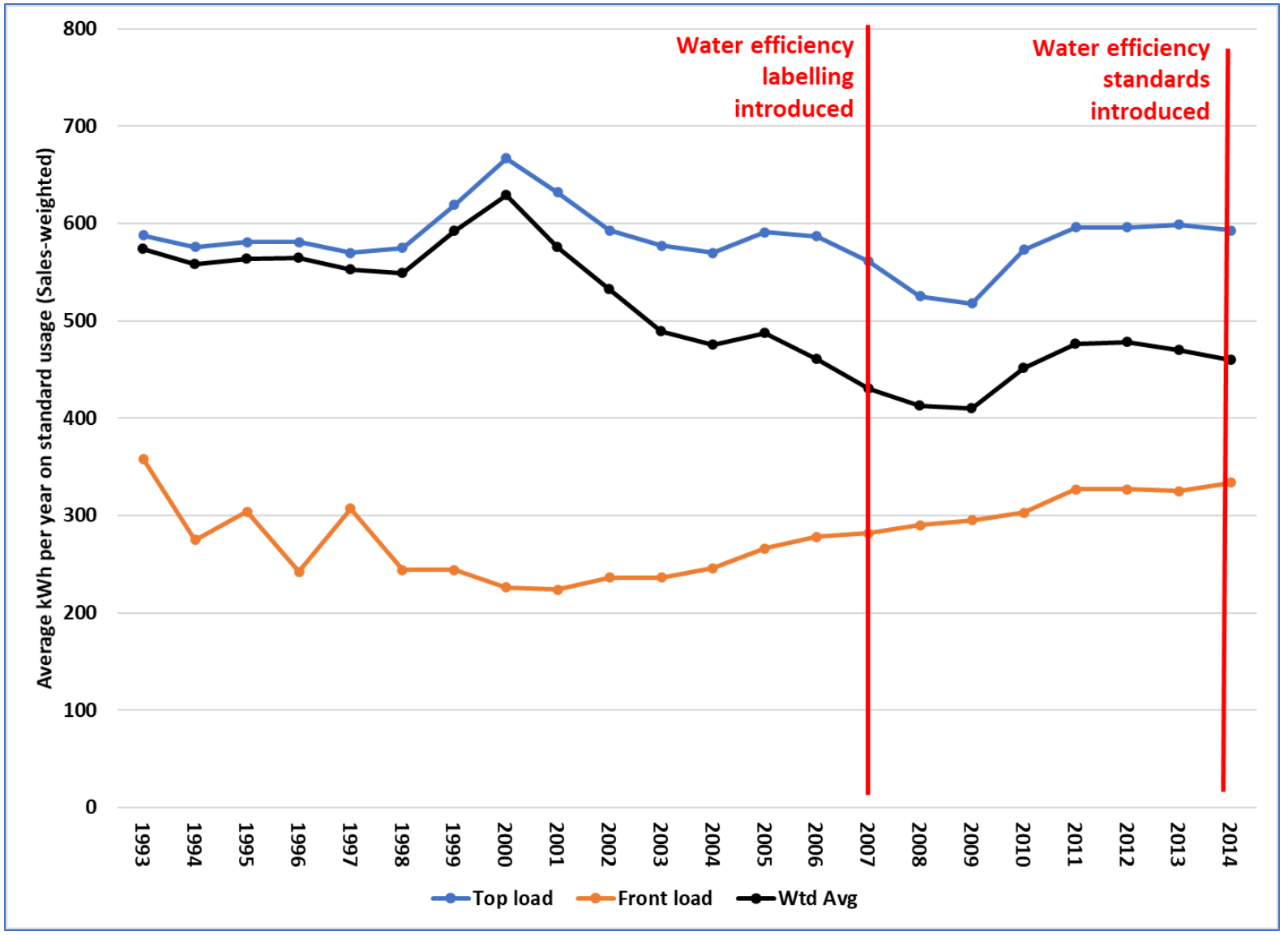


Clothes washers

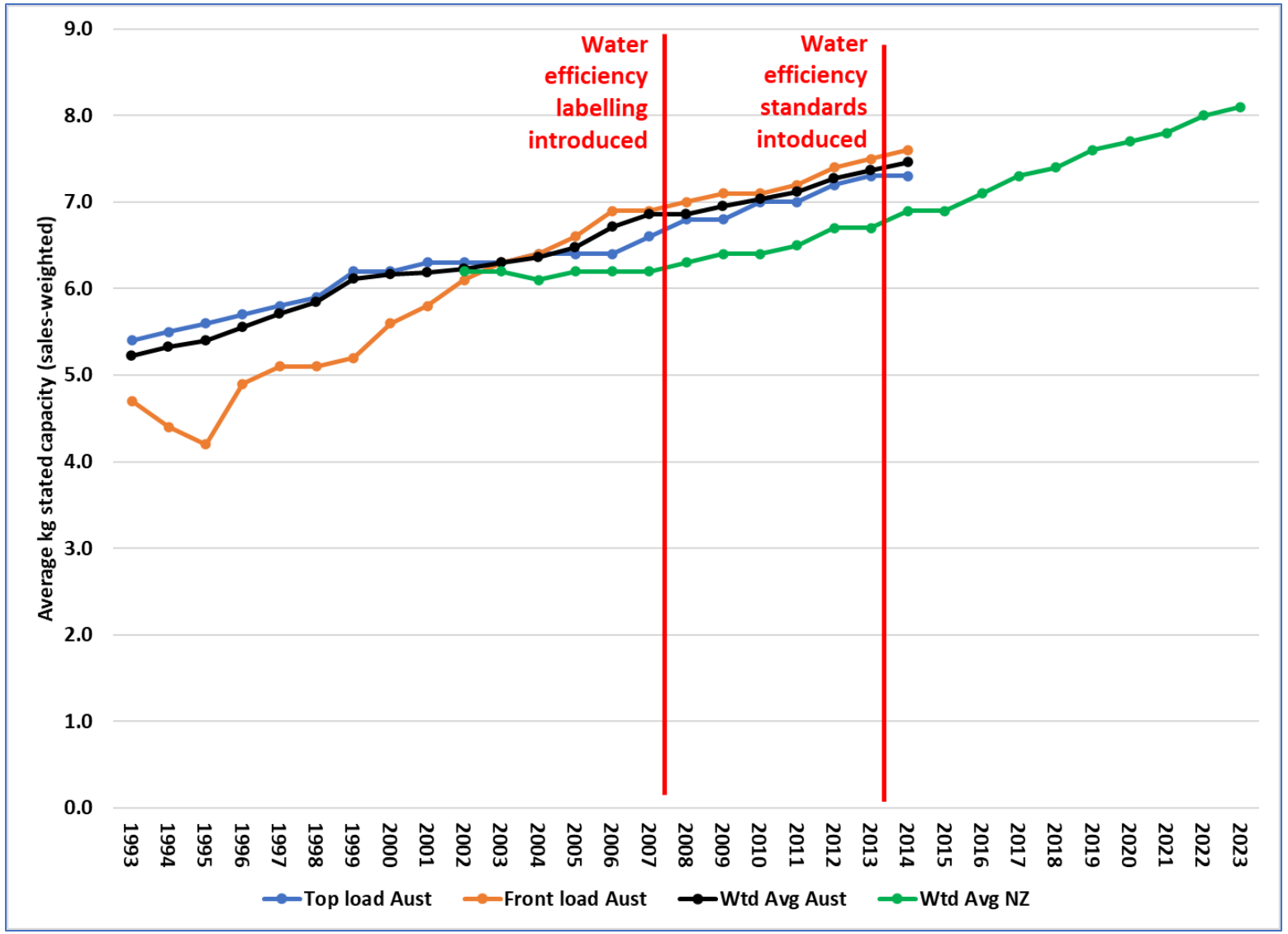
- A more complicated story
- Energy use sensitive to user preference and behaviour
- Shift from top to font loaders drove efficiency gains 2000 - 2010
- Energy labelling (1990) helped drive this shift
- Water efficiency labelling (2007) and standards (2013) less effective
- Marketing is now driving increases in average capacity
- Product size (kg) is growing faster than energy efficiency (kg/kWh)
- Energy use per wash is increasing even faster in practice, since under-loading is getting worse

Clothes washer with energy and water labels

Clothes washers – kWh/yr (warm wash)



Clothes washers – kg capacity

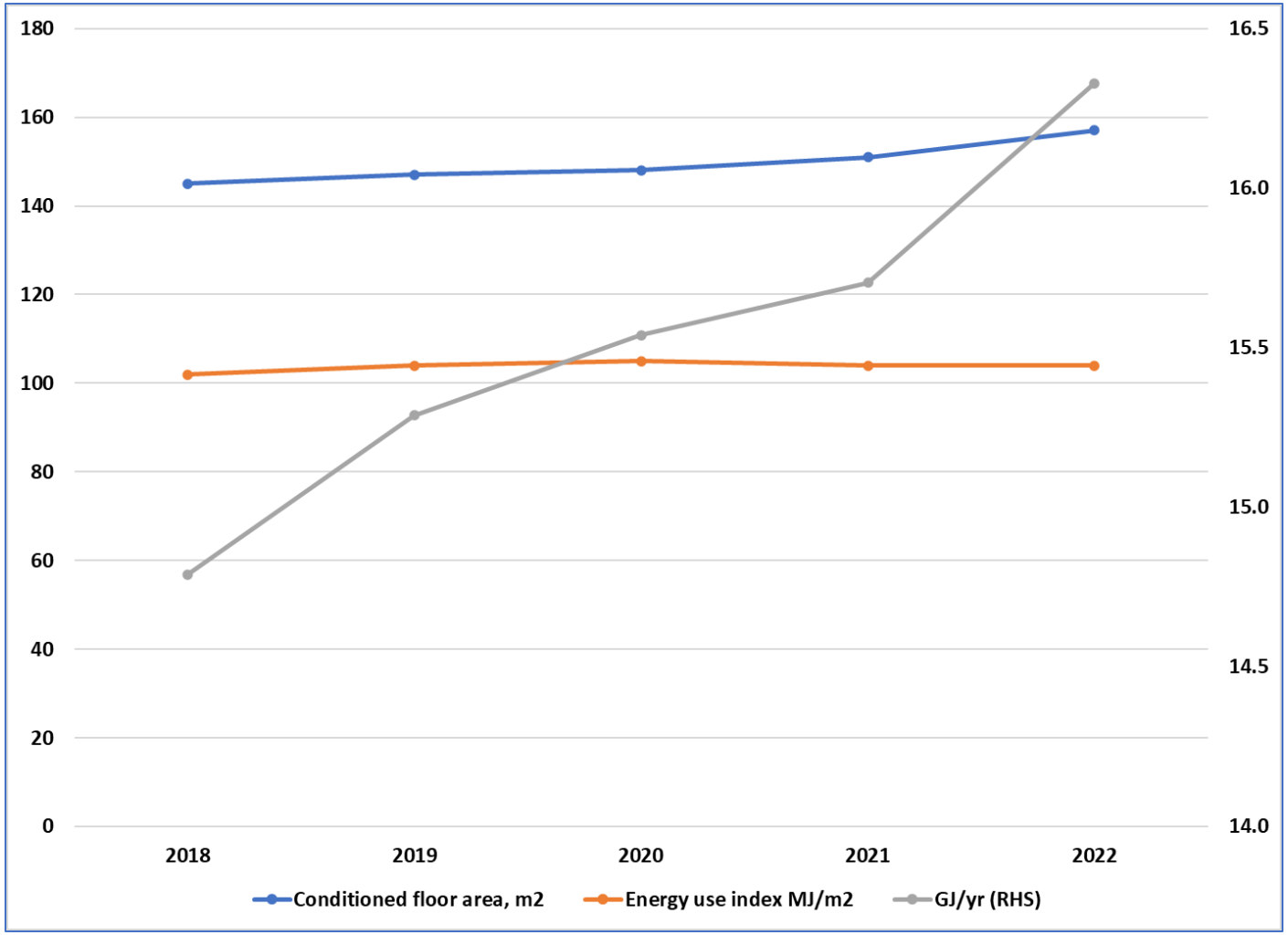


Houses

- Designs must meet thermal performance standards to get approval
- Performance modelled with Home Energy Rating (NatHERS) software
- NatHERS output is Energy Use Index (EUI, MJ/m^2) for heating & cooling
- Modelled energy demand depends on Conditioned Floor Area (CFA m^2)
- Analysis of 580,000 design certificates issued 2018-2022 found:
  - Energy efficiency (EUI) is stable and below mandated maximum BUT
  - CFA is growing so fast that energy demand per house is rising by 2% per year
- Australians now build largest houses in the world
  - Actual energy use depends on type & efficiency of heating & cooling installed

New housing development – Western Sydney

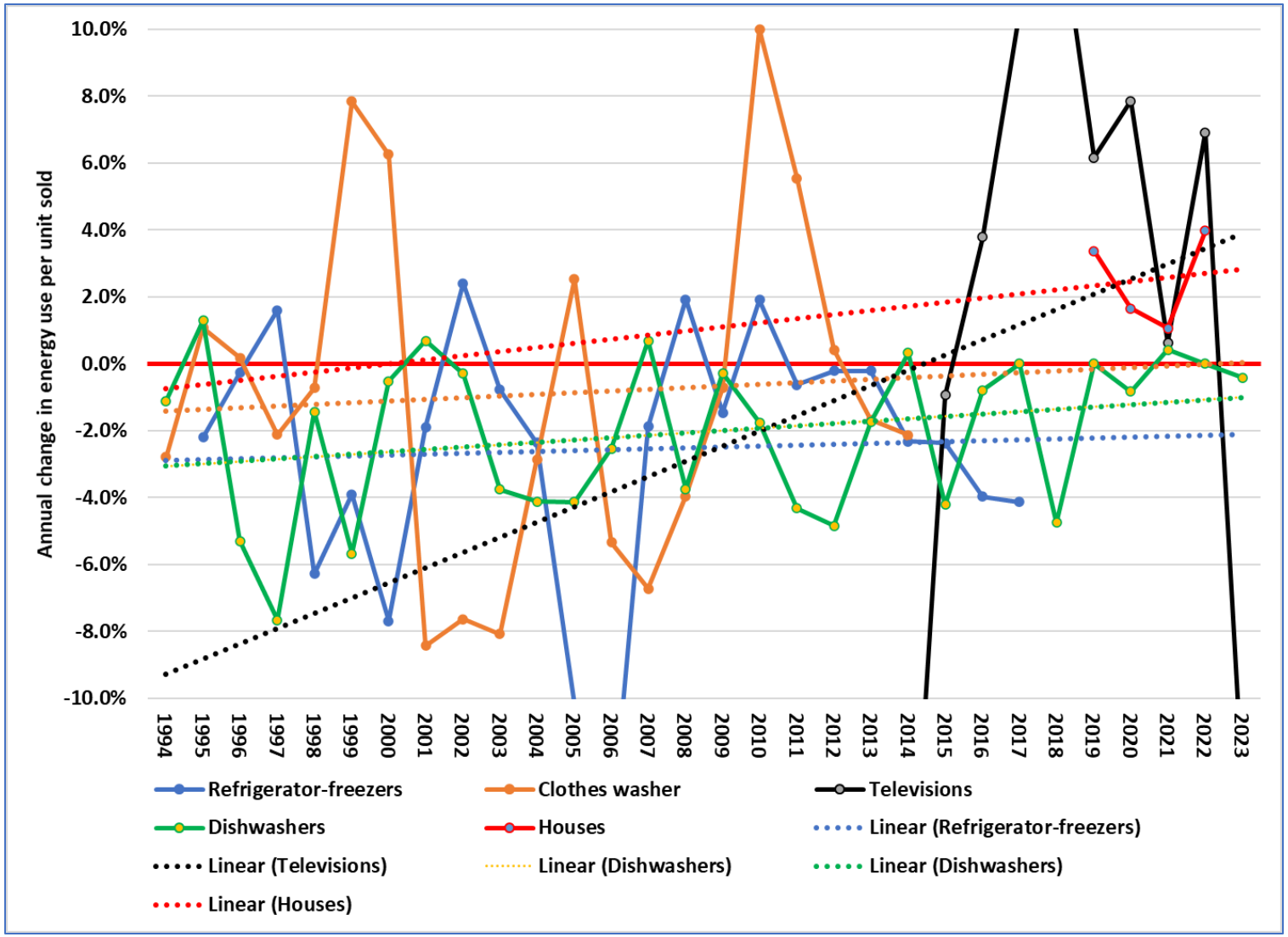
Houses – size and total energy demand



Product Summary

- Televisions
  - All flat screens now
  - Screen size growth has stopped, but screen resolution driving energy use
- Dishwashers
  - Unlike clothes washers, no increase in product capacity
  - Big improvement in water & energy efficiency 1994-2018, very little since
- Houses
  - Efficiency static, but growing floor area driving energy use
- Clothes washers
  - Efficiency improving, but growing capacity keeping energy use static
- Refrigerator-freezers
  - Efficiency improving, but energy savings being eroded by size

Energy use (kWh/yr) – all going the wrong way



Televisions
Houses

Clothes washers
Dishwashers
Refrigerators

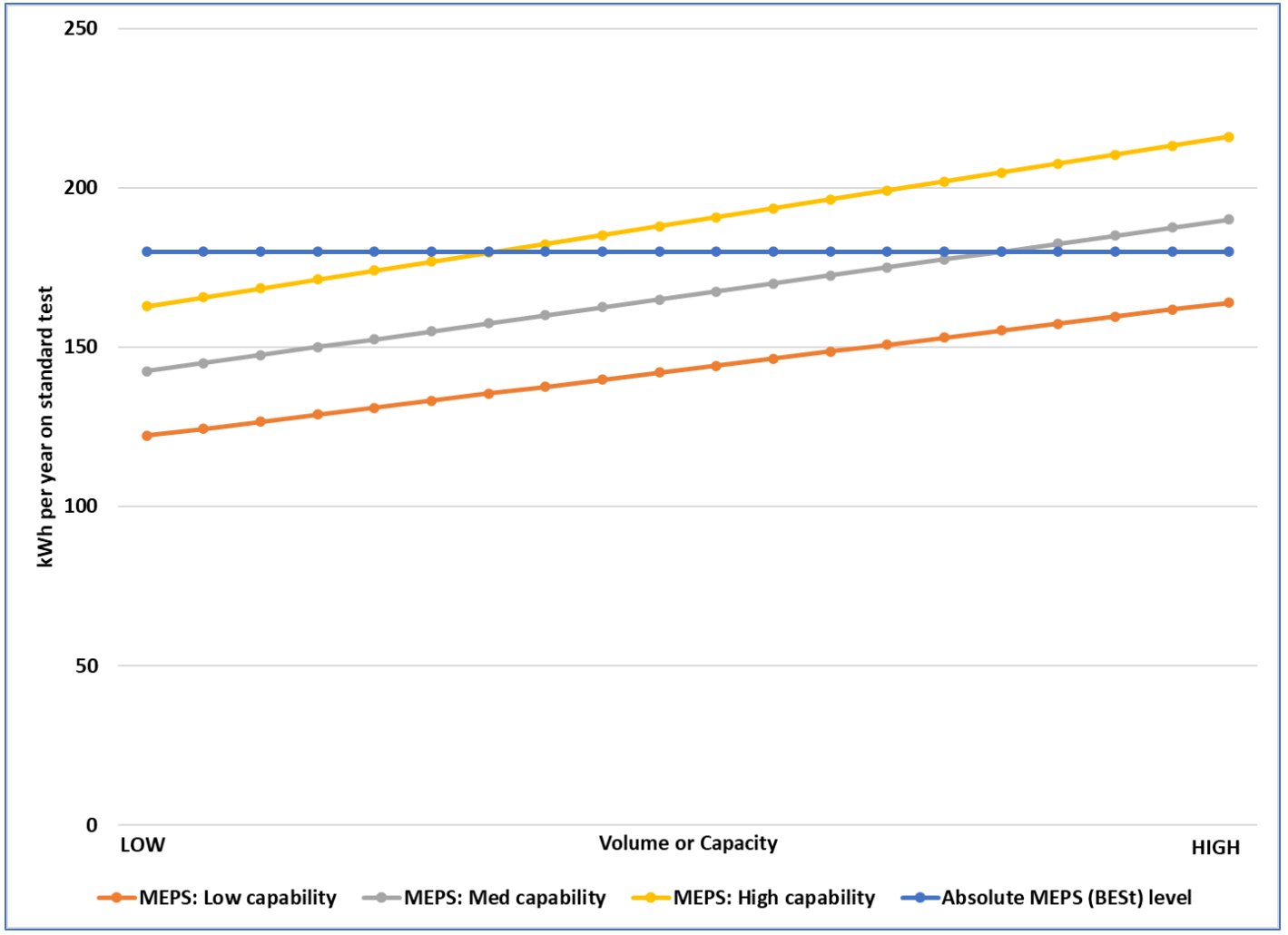
What can be done?

- Energy efficiency is not enough to achieve IEA energy savings target
- The problem is absolute but technical energy efficiency tracks ratios
- Need other measures to limit total energy use, e.g. 'Energy Sufficiency':
  - Sometimes defined as a *level* of energy service consumption that is consistent with equity, well-being and environmental limits and as a strategy for *reducing* energy service consumption to achieve that goal
- Many energy sufficiency strategies have been proposed
  - Energy & carbon taxes, personal & building carbon allowances, variable energy prices;
  - Most face serious technical and/or public acceptance barriers
- BUT the sufficiency principle can and should be incorporated directly into appliance efficiency policies & programs

The Budget Energy Standard (BESt)

- Catchy name for absolute maximum energy use per unit
- Would be in addition to current MEPS (which are ratio-based)
- Suppliers (and buyers) may have to trade off size against functionality
- Incentive for technical innovation: who can provide the largest and/or highest performing product within the BESt limit
  - Would suit refrigeration products and screens/TVs (max kWh/yr)
  - For cleaning products, need water use limit as well (to prevent trading off)
  - For fixed heating, air conditioning and water heating, rely on dwelling GJ limit
- We already have the legal, administrative and testing frameworks
  - Can simplify, because BESt limit avoids arguments over feature allowances etc.
- Setting initial BESt limits would be controversial; can reduce over time

MEPS and BESt working together



Conclusions

- IEA applies wrong energy efficiency metrics in relation to climate change
  - Objective should be absolute reduction in PE, not a higher $GDP/PJ PE ratio
- Energy efficiency programs also apply the wrong metrics
  - Objective should be absolute reduction in UE, not higher energy service/DE ratios
- Energy *use* per item can grow even while *technical efficiency* increases
  - Because products get bigger, or acquire more functions
  - Australian data shows this is already the case with TVs, houses, clothes washers
  - Not yet the case with refrigerators and dishwashers, but trending in that direction
- The answer is absolute energy limits (BESt) on top of conventional MEPS
  - This better aligns with the absolute nature of the emissions problem
  - Better chance of success than other 'energy sufficiency' approaches
  - But still needs other policies to deal with population and consumption drivers
- If we are serious about reducing emissions, we need to do this.

THANK YOU FOR YOUR ATTENTION