



REMODECE workshop

Trends in residential electricity consumption

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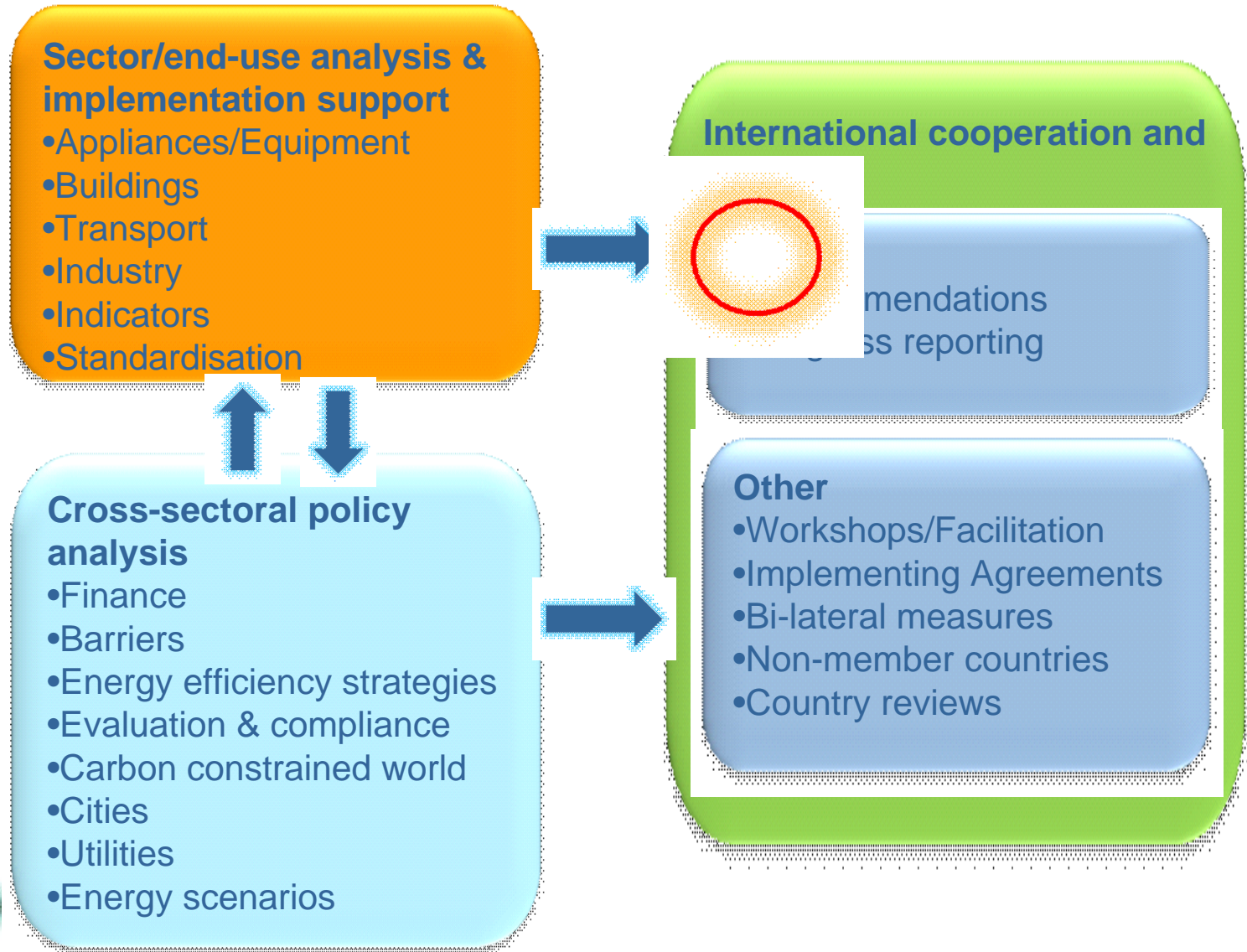
Energy Efficiency & Environment Division

International Energy Agency

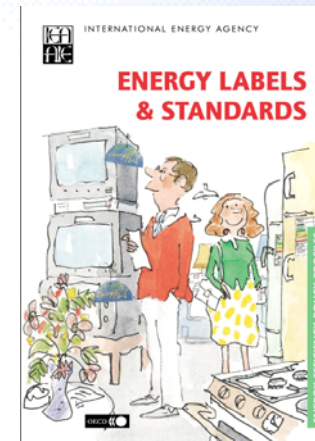
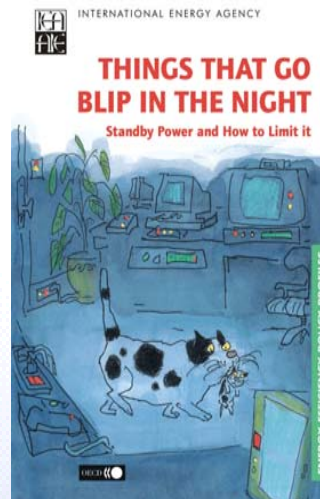
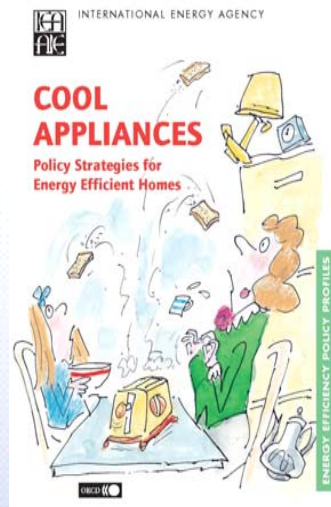
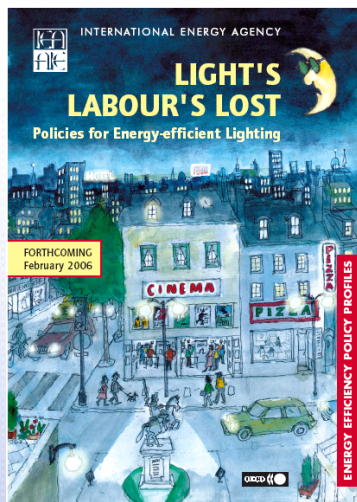
19th September 2008, Brussels



IEA energy efficiency policy analysis

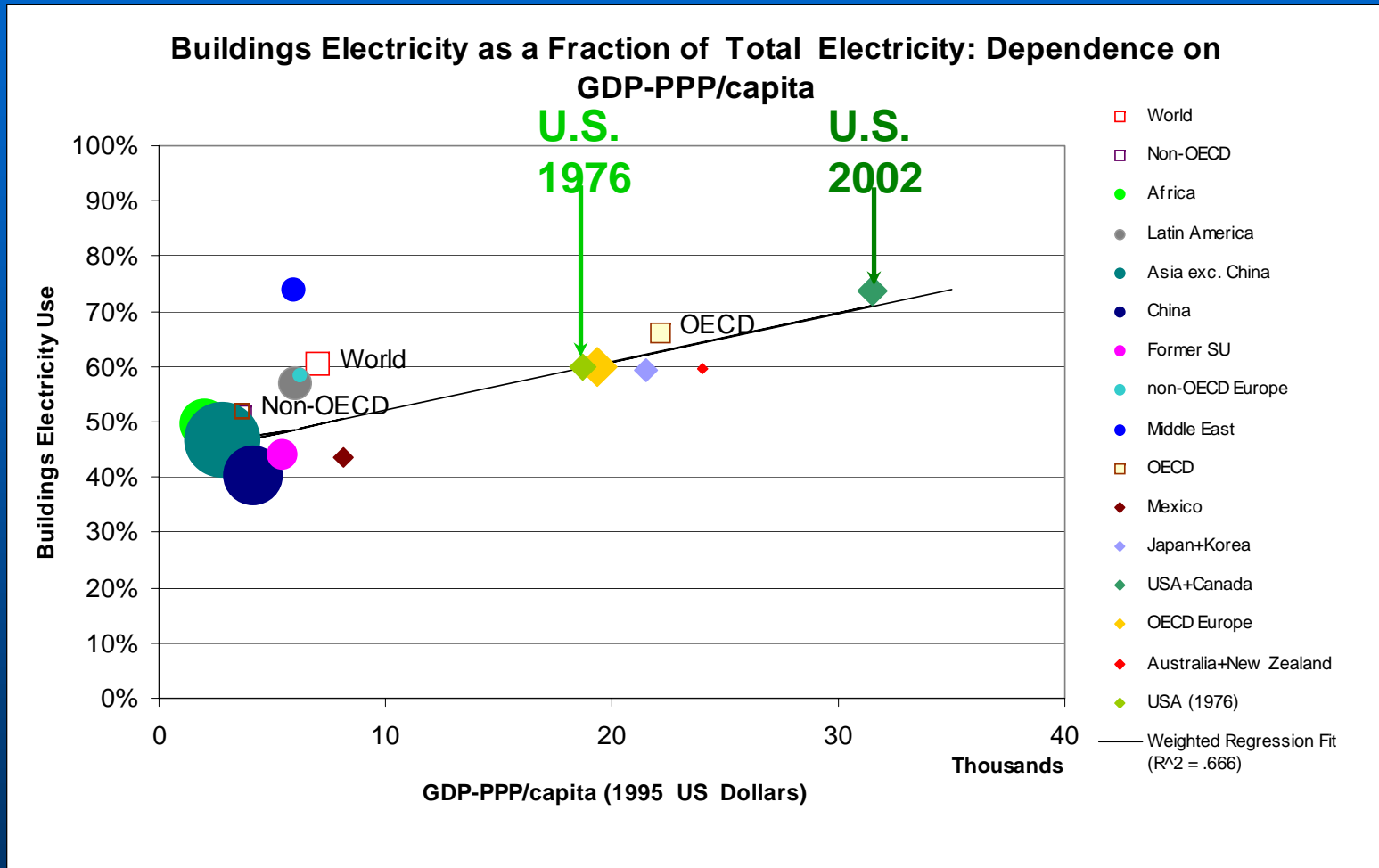


IEA publications on equipment energy efficiency





Most electricity is used in buildings

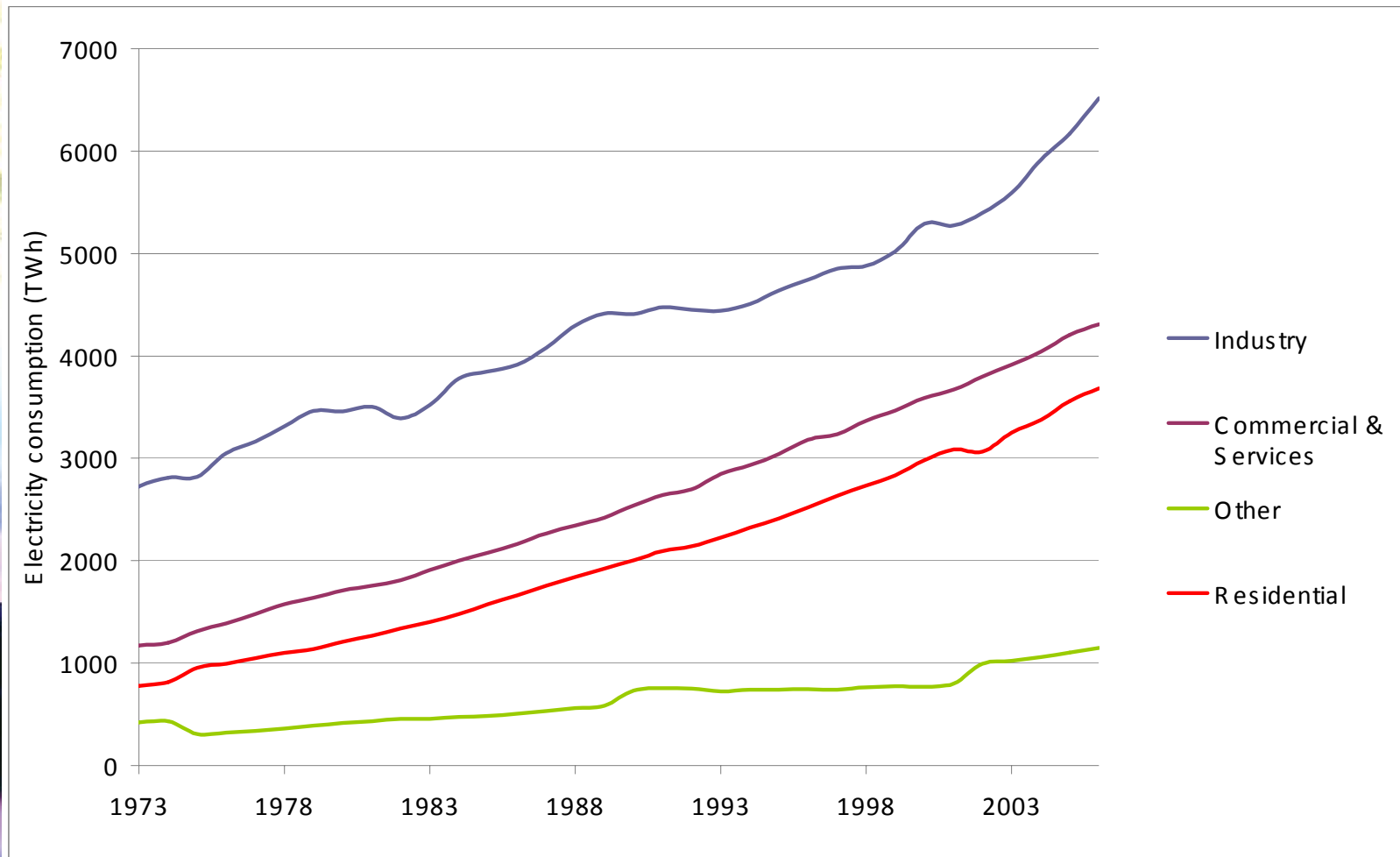


“Buildings Electricity” = 100% Commercial and Residential + 15% Industrial + 10% Agricultural

Source: P. Waide, S. Chakravarty & R. Socolow

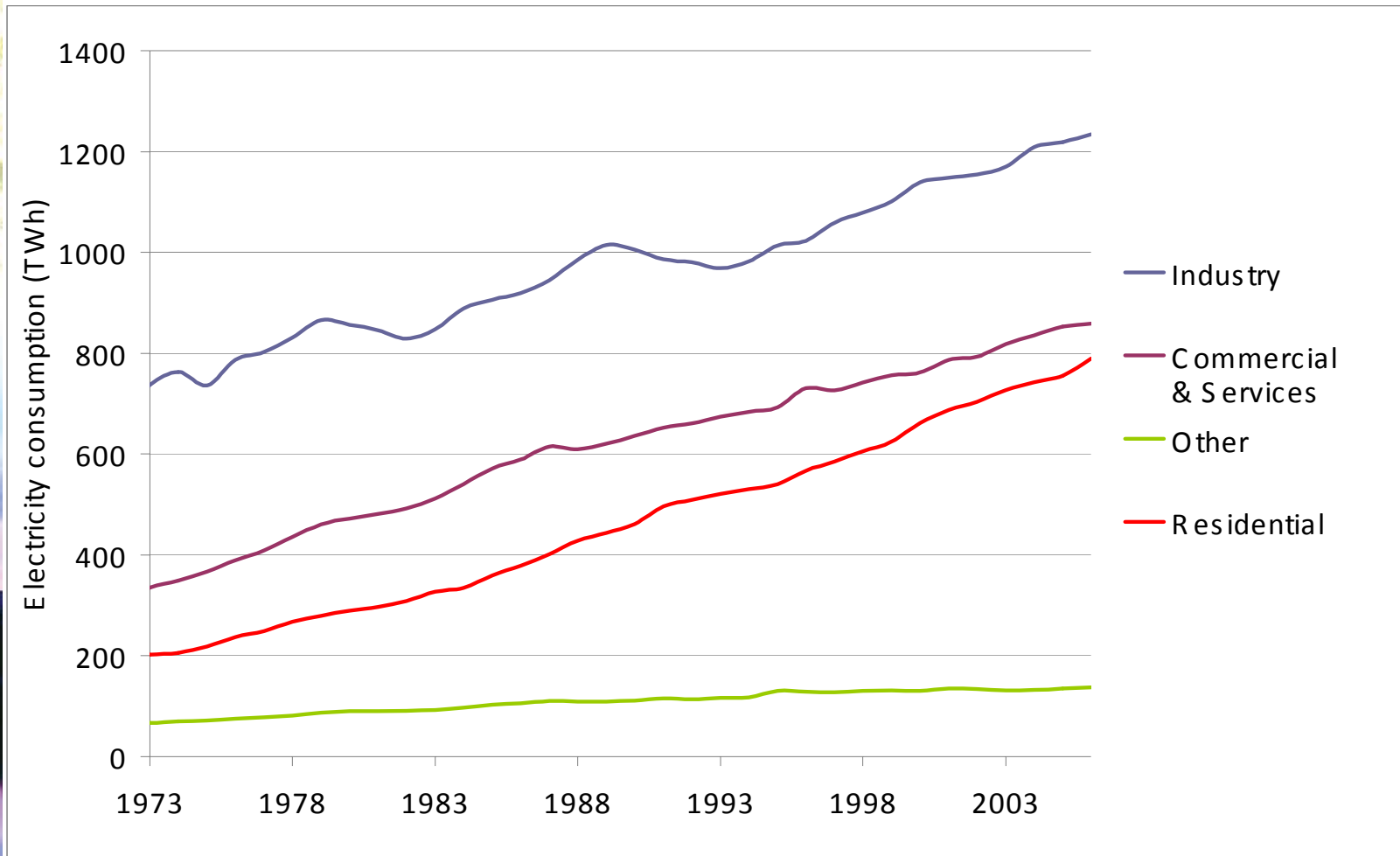


Global electricity consumption by user sector



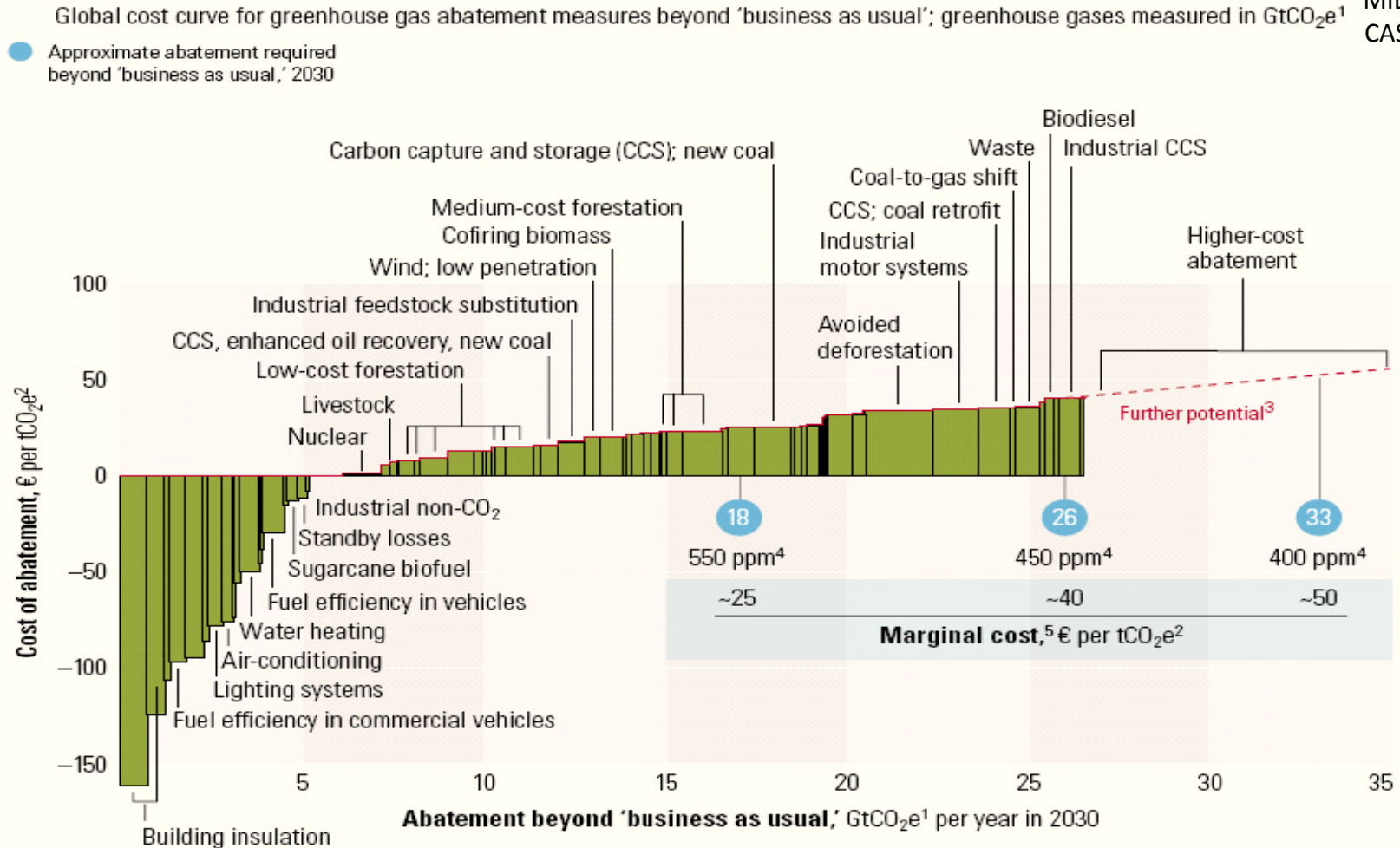


Electricity consumption in OECD Europe by user sector



E.g. Vattenfal/McKinsey abatement cost curve

MID-RANGE
CASE – 2030



¹ GtCO₂e = gigaton of carbon dioxide equivalent; "business as usual" based on emissions growth driven mainly by increasing demand for energy and transport around the world and by tropical deforestation.

² tCO₂e = ton of carbon dioxide equivalent.

³ Measures costing more than €40 a ton were not the focus of this study.

⁴ Atmospheric concentration of all greenhouse gases recalculated into CO₂ equivalents; ppm = parts per million.

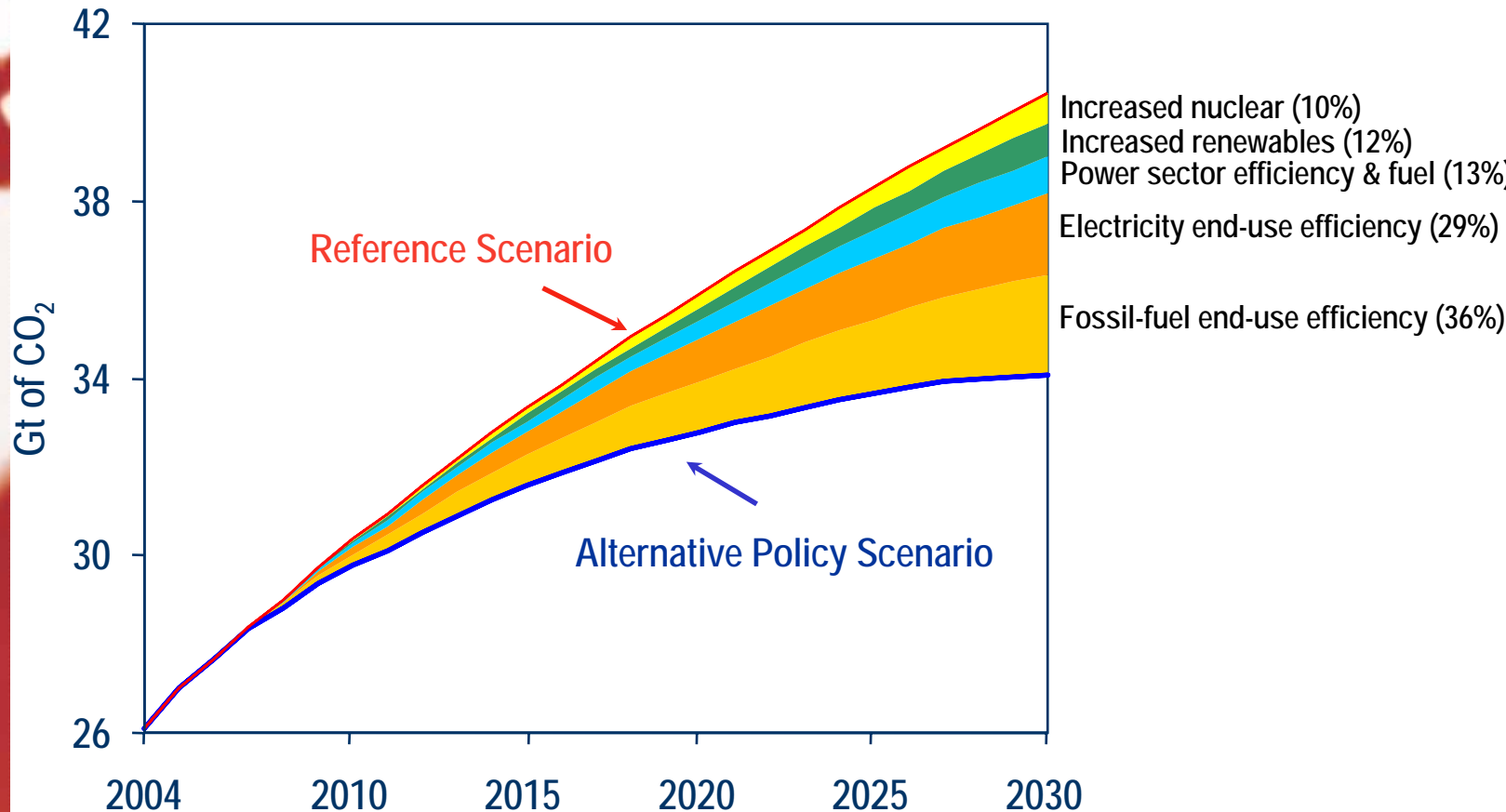
⁵ Marginal cost of avoiding emissions of 1 ton of CO₂ equivalents in each abatement demand scenario.



Policy is needed: the market doesn't deliver all cost-effective savings

- Missing or partial information on energy efficiency – it is not visible to end users
- Low levels of awareness re cost-effective savings potentials
- Split incentives: Landlord-Tenant issue; division of capital acquisition vs. operation & maintenance budgets; energy capital lifespan often longer than ownership period, etc.
- Fragmented supply chains and shortage of necessary skills to deliver higher efficiency
- Energy budgets have low priority: EE is bundled-in with more important capital decision factors
- All result in emphasis on 1st not Life-cycle costs

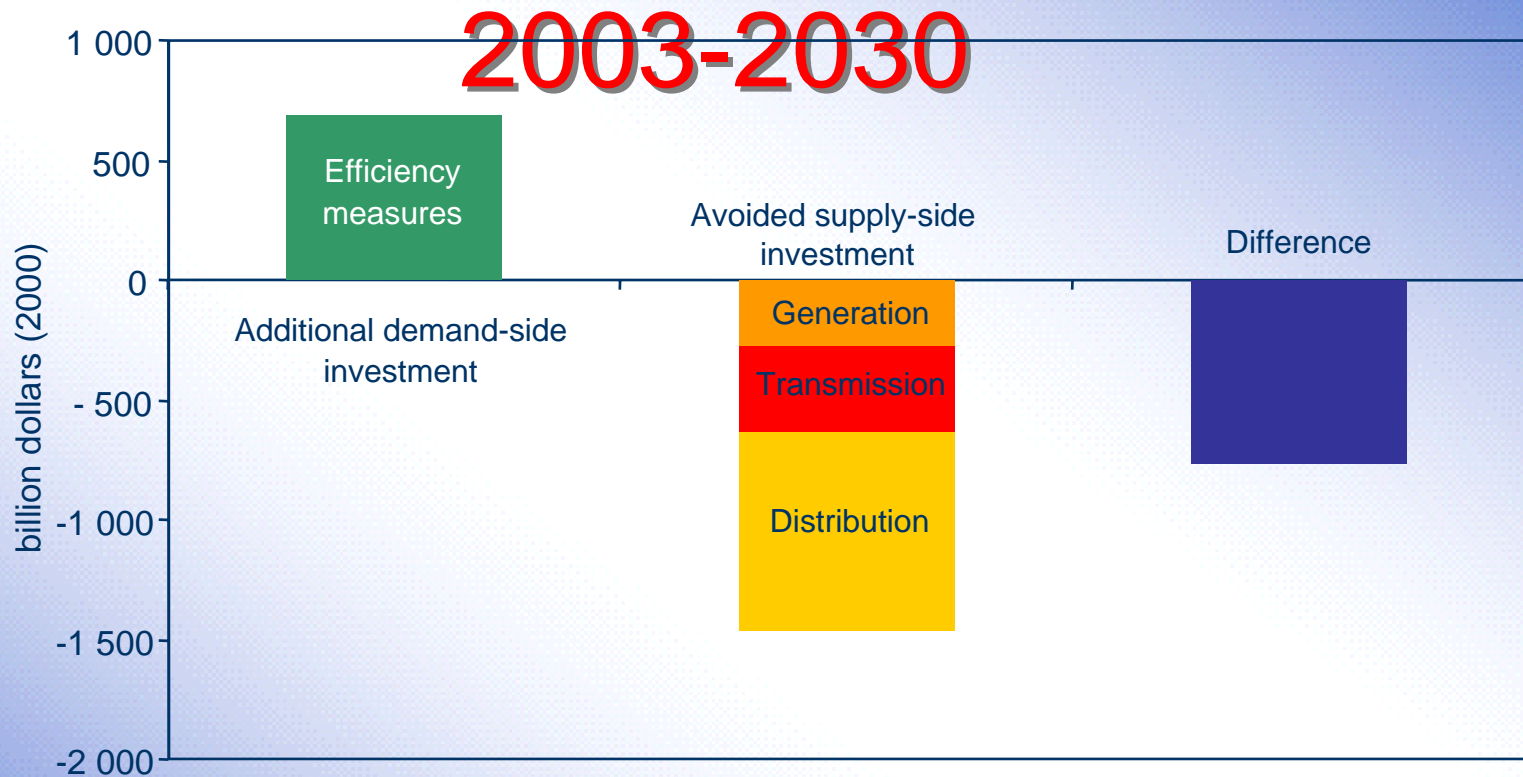
Alternative Policy Scenario: Key Policies for CO₂ Reduction



Improved end-use efficiency accounts for two-thirds of avoided emissions in 2030 in the APS



Difference in global electricity investment in the Alternative vs. Reference Scenario

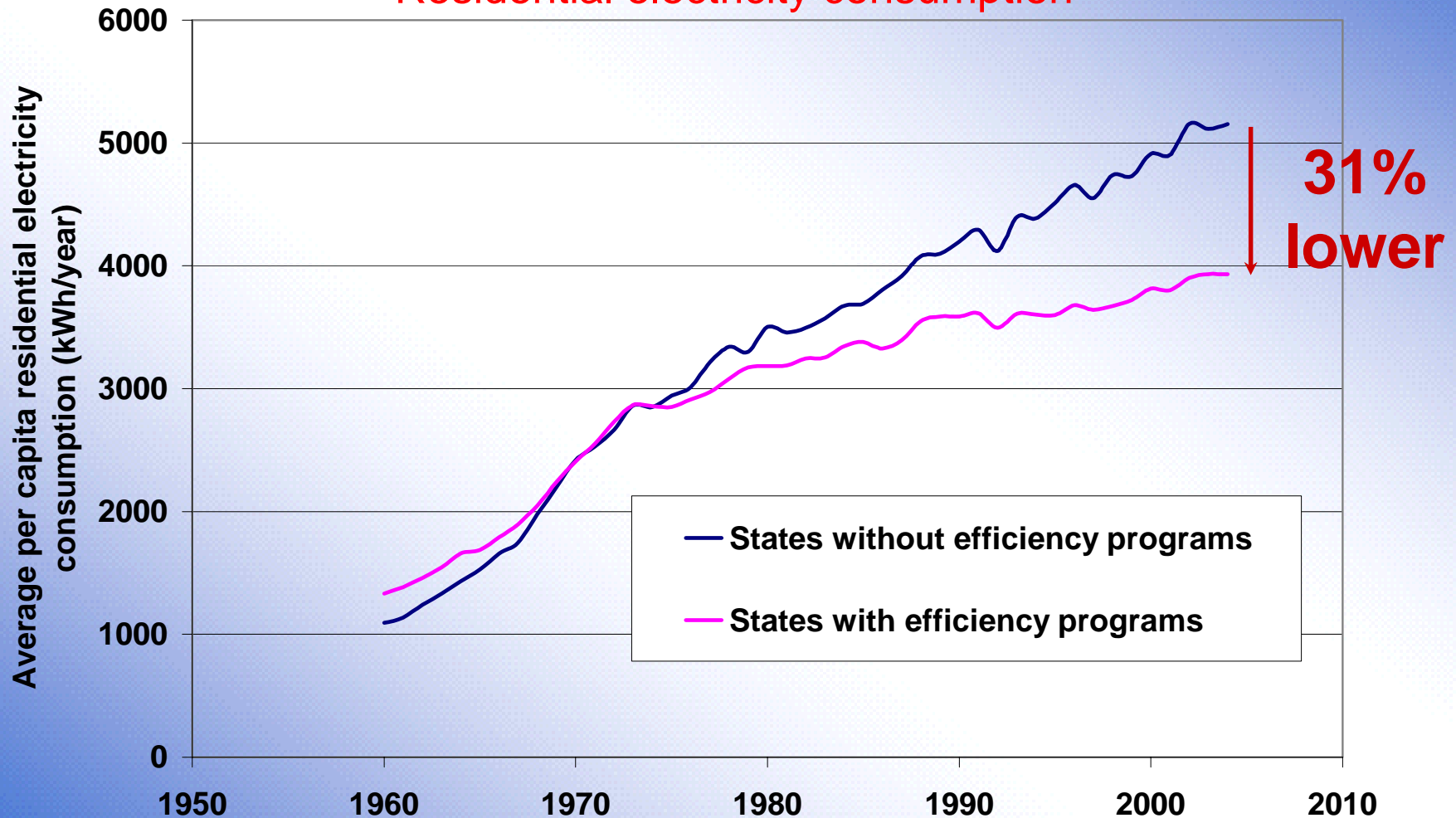


Additional investments on the demand side are more than offset by lower investment on the supply side



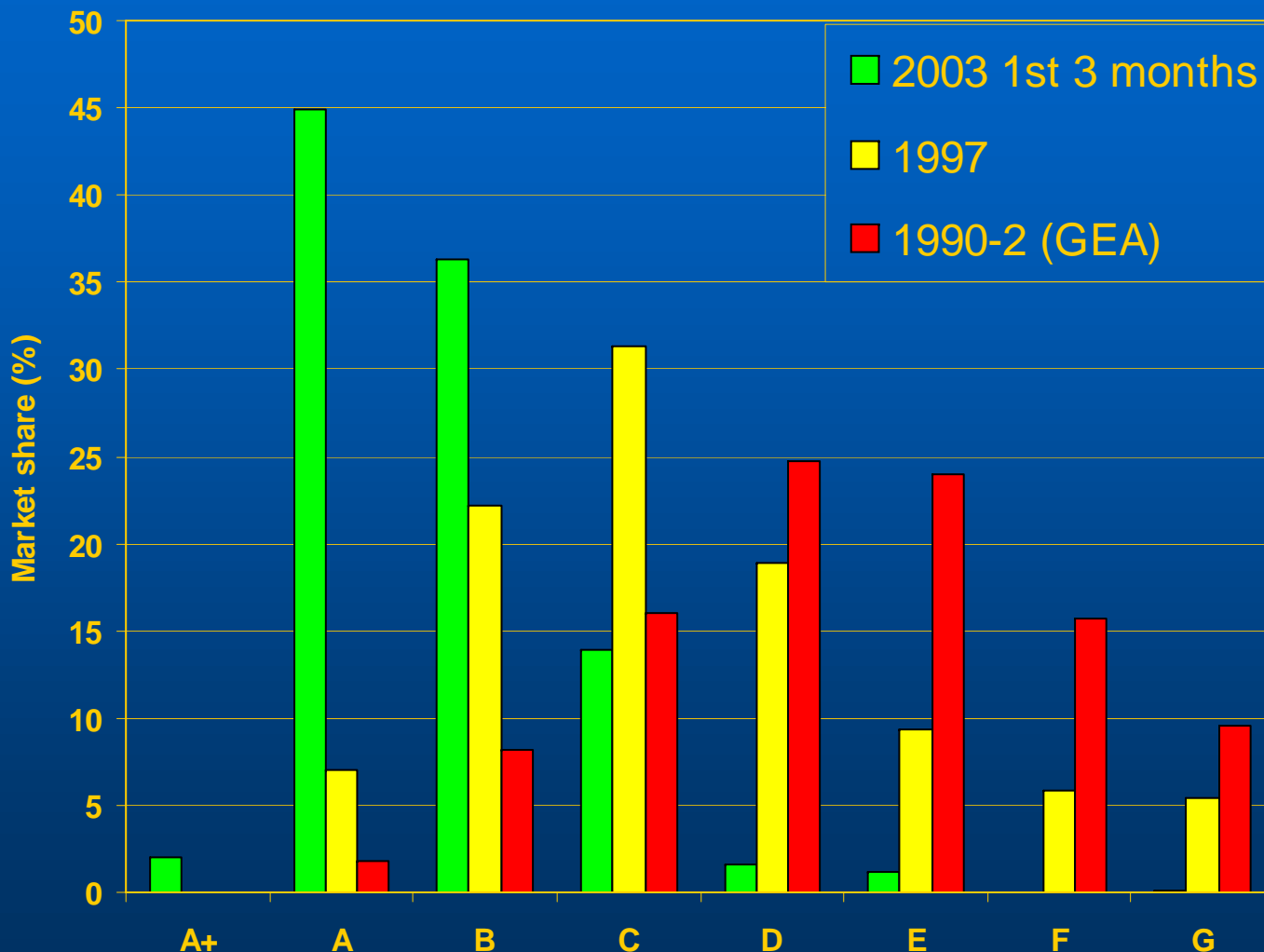
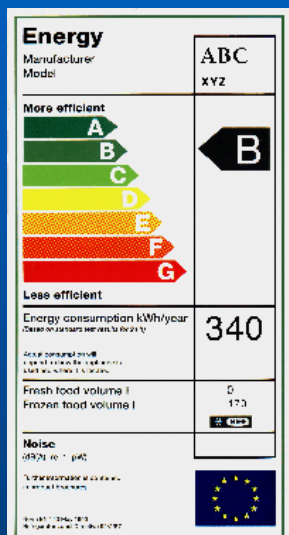
But do efficiency policies work? Half of US states have utility EE progs...

Residential electricity consumption





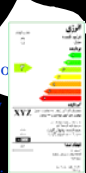
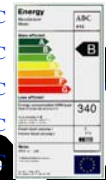
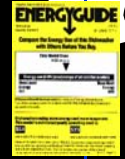
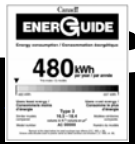
Labelling can produce major market transformation: e.g. refrigerators in EU





In 1997 ~22 countries with 16% of the world's population had standards and labelling

Mandatory standards	Voluntary Standards	Comparative Label	Endorsement Label
Algeria *	EU	Algeria *	Australia
Australia	India	Argentina *	Brazil
Bangladesh *	Indonesia *	Australia	China
Bulgaria	Korea	Bangladesh *	Chinese Taipei
Brazil*	Switzerland	Bulgaria	EU
Canada		Brazil	Japan
Chile*		Canada	Korea
China		Chile*	Singapore
Columbia *		China	Switzerland
Czech Rep		Columbia *	UK
Egypt*		Czech Rep	USA
Estonia		Egypt*	
EU		Estonia	
Hungary		EU	
India *		Hong Kong	
Iran		Hungary	
Israel		India	
Japan		Indonesia	
Korea		Iran	
Lithuania *		Israel	
Malaysia		Japan	
Maldives *		Korea	
Mexico		Lithuania *	
Nepal*		Malaysia *	
New Zealand		Maldives *	
Peru *		Mexico	
Philippines		Nepal*	
Poland		New Zealand	





The new Chinese Room air- conditioner energy label

中国能效标识

能效等级	1	2	3	4	5
能效比 (EER)	3.6	3.4	3.2	3.0	2.6
制冷量 (W)	2600	2600	2600	2600	2600
制冷功率 (W)	722	765	813	867	1000

中国能效标识

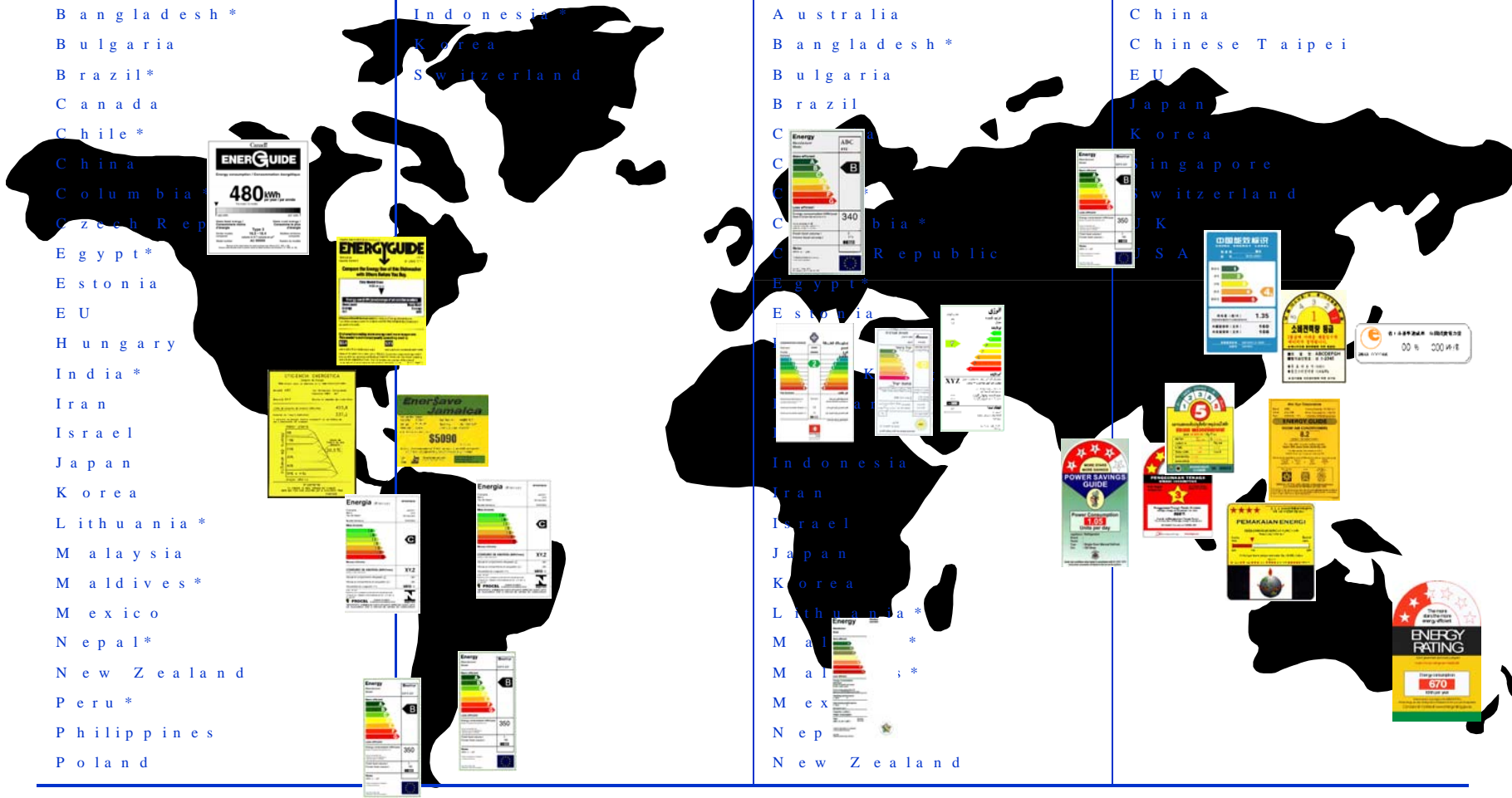
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国家发展和改革委员会环境和资源综合利用司指导

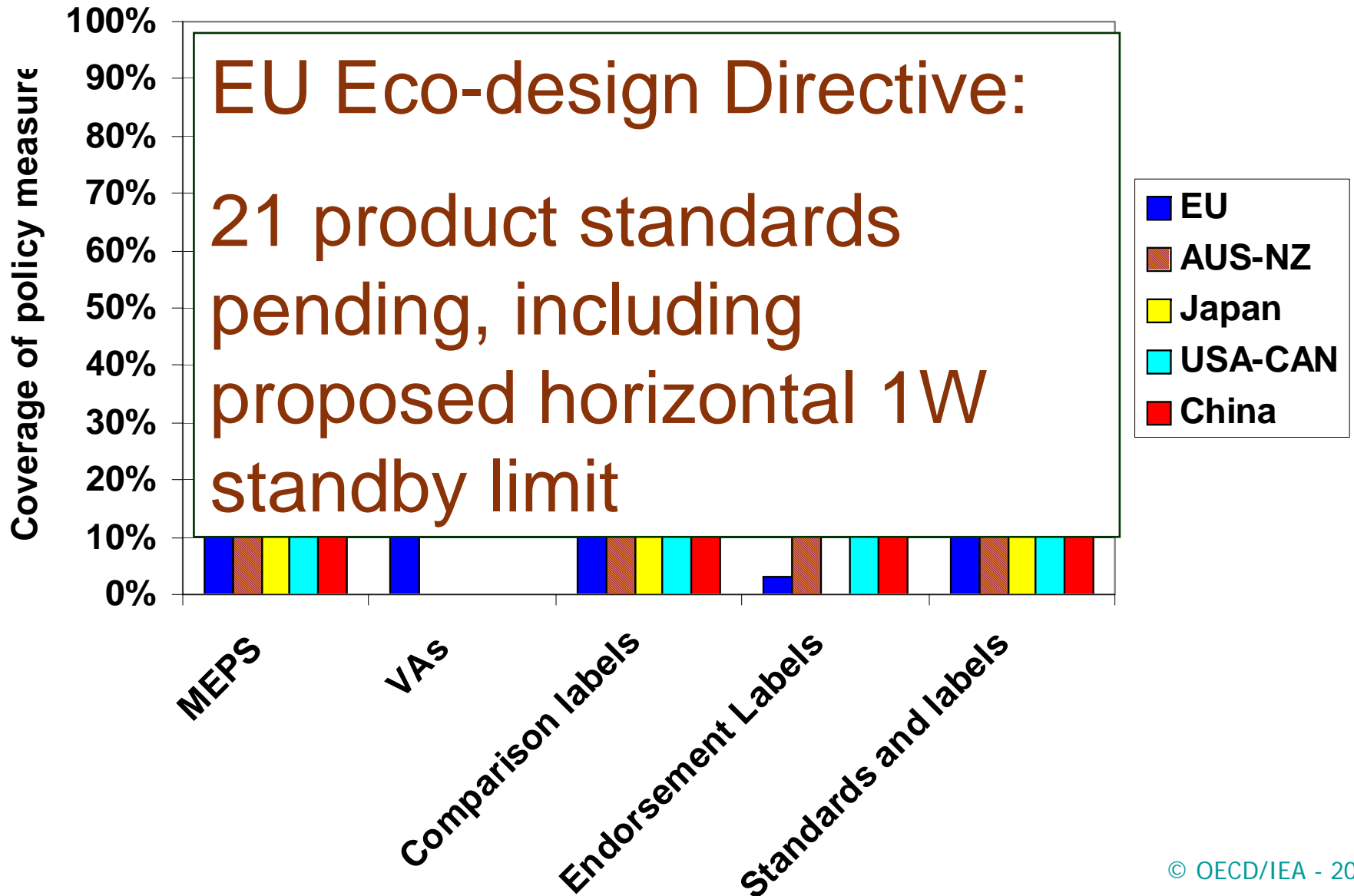


Today 61 countries with more than 80% of the world's population have standards & labelling

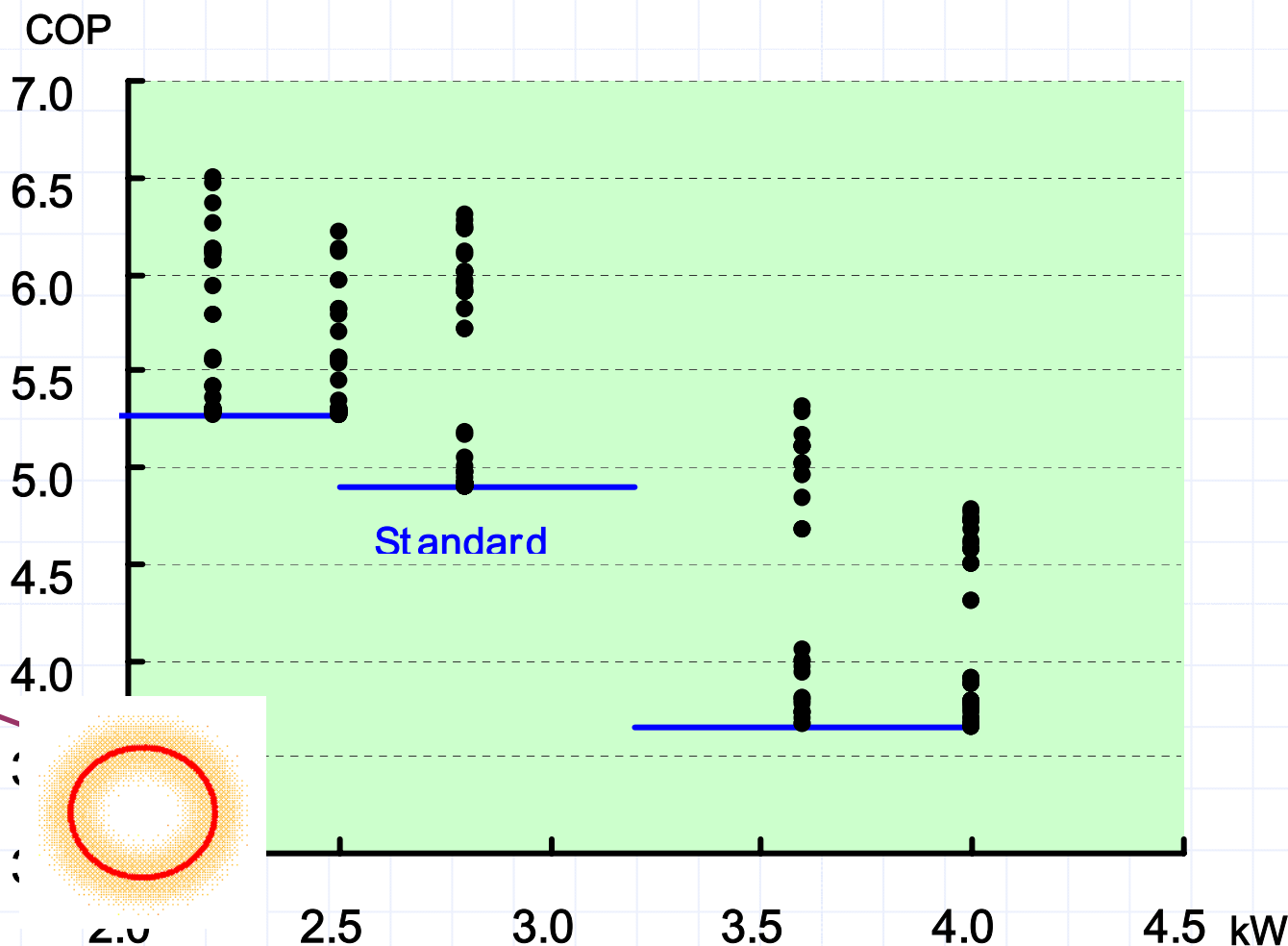
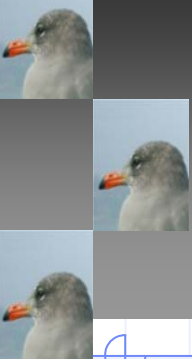
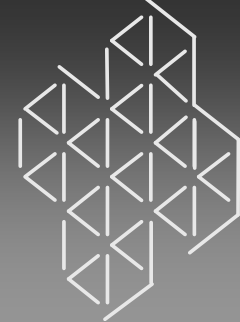
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Bangladesh *	Indonesia *	Australia	China
Bulgaria	Korea	Bangladesh *	Chinese Taipei
Brazil*	Switzerland	Bulgaria	EU
Canada		Brazil	Japan
Chile*		Canada	Korea
China		Chile*	Singapore
Columbia*		Columbia*	Switzerland
Czech Rep		Czech Republic	Taiwan
Egypt*		Egypt*	USA
Estonia		Estonia	
EU		India	
Hungary		Iran	
India*		Israel	
Iran		Japan	
Israel		Korea	
Japan		Lithuania*	
Korea		Malaysia	
Lithuania*		Maldives*	
Malaysia		Mexico	
Maldives*		Nepal*	
Mexico		New Zealand	
Nepal*		Peru*	
New Zealand		Philippines	
Peru*		Poland	



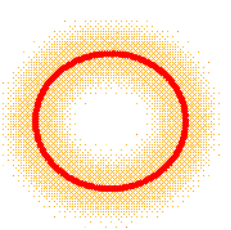
Yet policy coverage as a share of residential electricity use is still incomplete



And stringency can be increased e.g. Japanese “Top Runner” standards for reversible room air conditioners



- EU Class A
- ANZ MEPS
- US MEPS

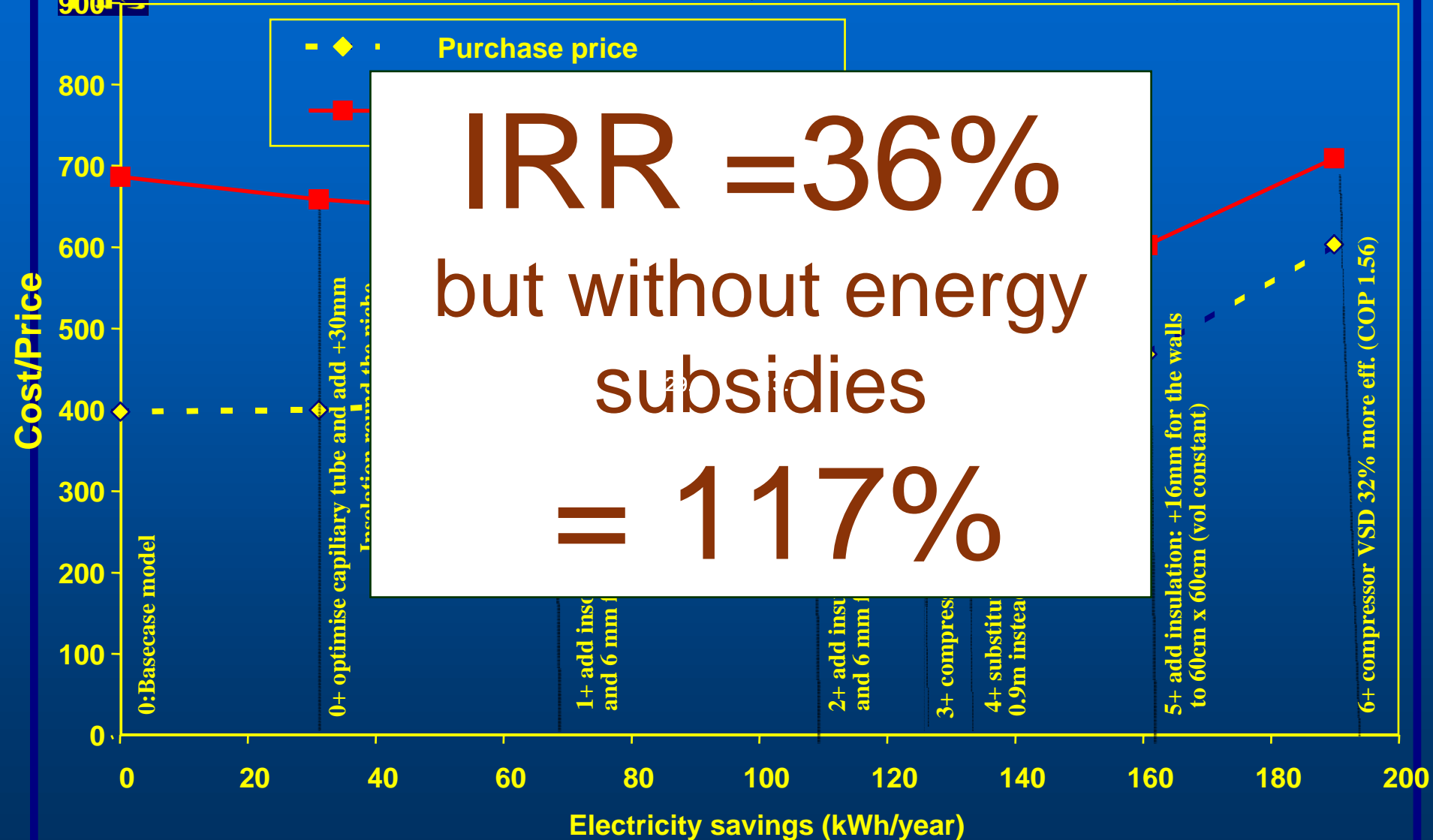


Source: C. Murakoshi et al, Jyukankyo Research Institute



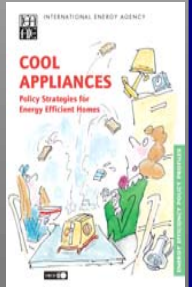
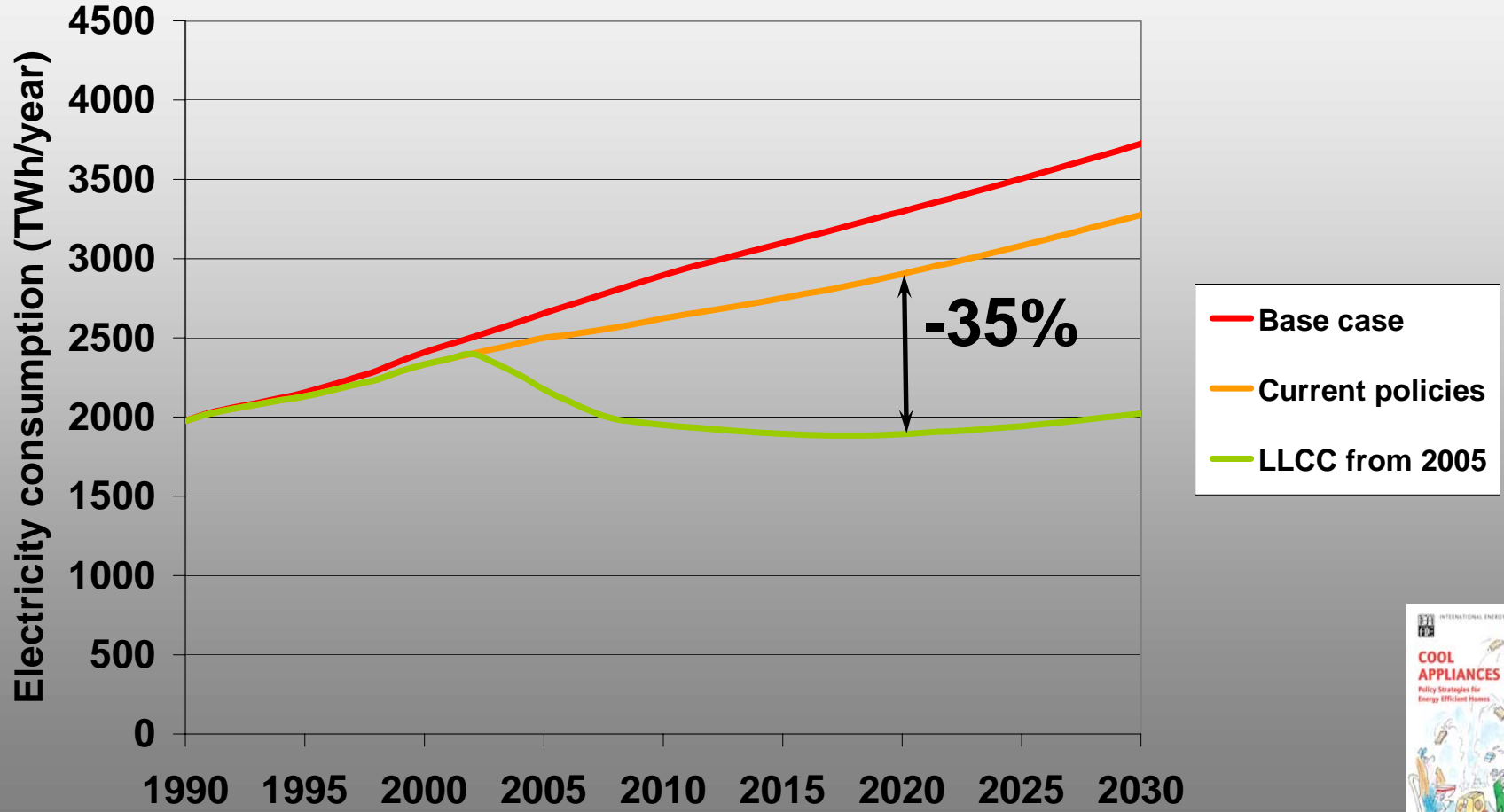
Example: 2-star refrigerator (1 door) in Tunisia

(useful volume ~220 litres, electricity consumption = 299 kWh/year)





Residential electrical electricity consumption scenarios in IEA countries 1990-2030





Cost and CO₂ impacts of *LLCC from 2005* scenario compared with *Current Policies*

- Compared with Current Policies implementing the LLCC from 2005 scenario across the OECD would:
 - reduce electricity demand by 26% in 2010
 - reduce electricity demand by 35% in 2020
 - avoid 344 Mt-CO₂ emissions in 2010
 - avoid 524 Mt-CO₂ emissions in 2020
- The cost of avoided CO₂ in 2020 is projected to be:
 - -\$66/Tonne-CO₂ in OECD-North America
 - -169 Euro/Tonne-CO₂ in OECD-Europe



Consider use of CFLs in homes



**Incand-
escent**



CFL



Initial cost
Efficacy

IRR = 186%

Lifespan

1000 hours

10000 hours

For 10000 hours
use

Electricity cost

US\$75

US\$15

Cost of lamps

US\$5

US\$10

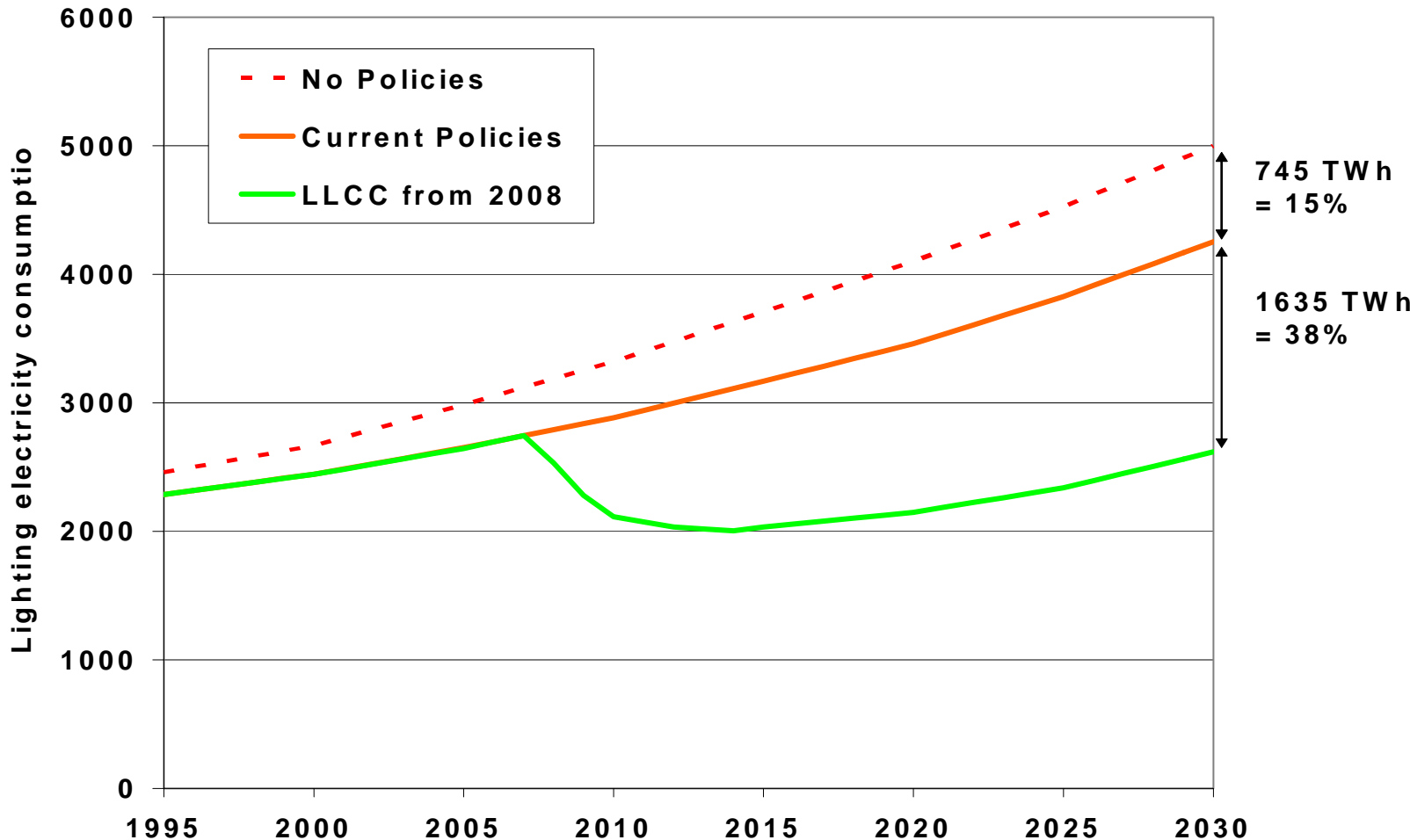
**Total cost of
ownership**

US\$80

US\$25



Global lighting electricity demand: What can be saved cost-effectively?





Cumulative benefits of the lighting *LLCC* from 2008 scenario (to 2030)

- **Avoids 28000 TWh of electricity use** (almost 6% of all global electricity demand over the same timeframe)
- **Total costs of lighting are US\$2.6 trillion (1000 billion) lower**
- **Avoids 16 Gt of CO₂ emissions**
- **Net cost of avoided CO₂ emissions are negative at:**
 - US\$161 per tonne of CO₂

Countries in process of phasing-out incandescent lamps



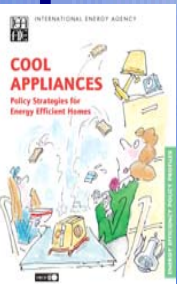
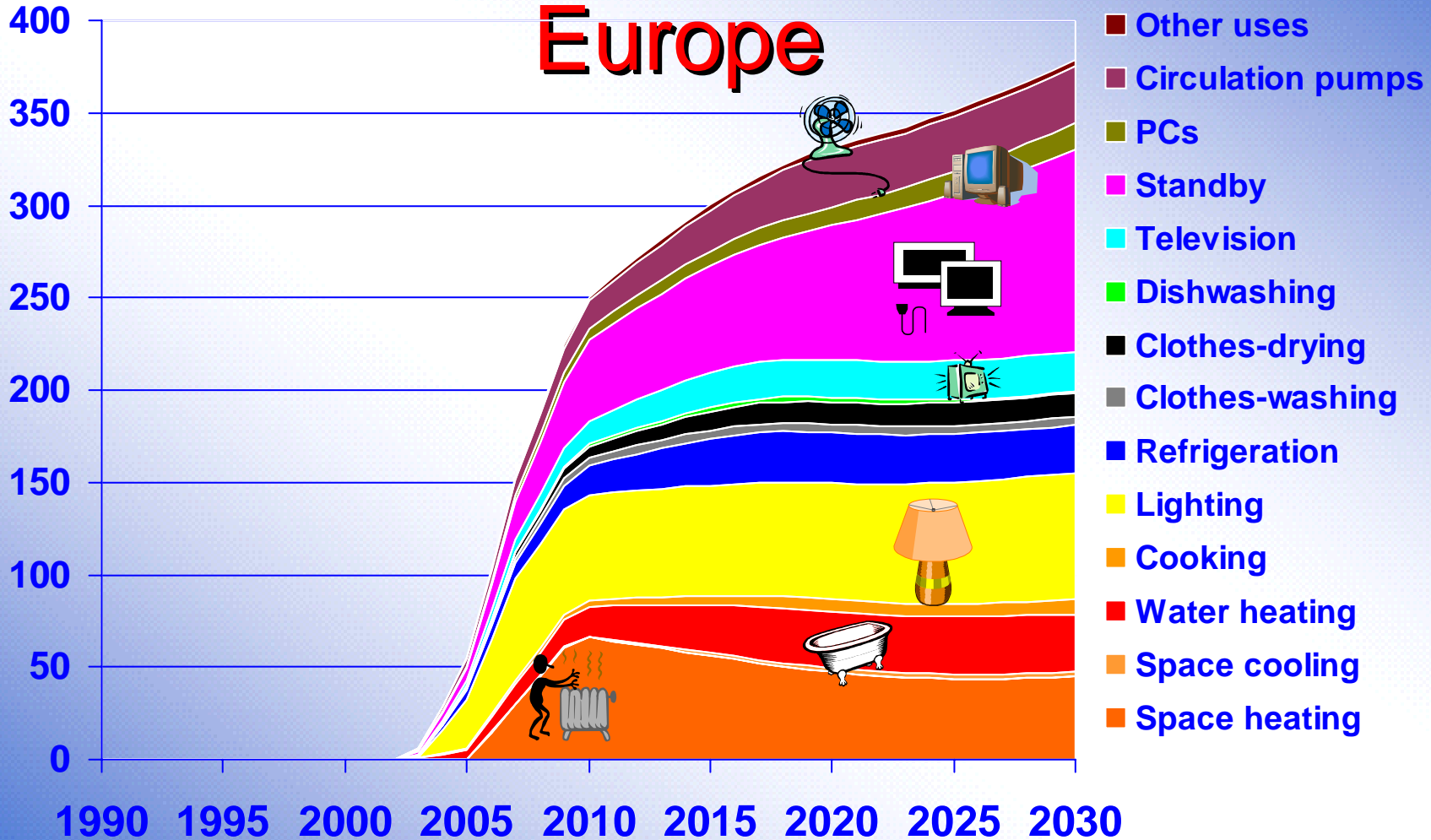
- **Cuba (already done!)**
- **Australia + New Zealand (start 2008)**
- **US (2012-14 but also CA, NV)**
- **EU (fully by 2010/11 UK, Por, Bel, Ire, Fr)**
- **Canada (finalising regulation details)**
- **Switzerland (finalising details)**
- **Philippines, Mexico, Argentina, Tunisia**

savings

by electrical end-use for IEA-Europe



TWh/year





Principles behind IEA's efficiency policy recommendations for G8



➤ there's a high degree of international consensus

IEA E.E. Recommendations to G8: appliances

- **Standards and labels:** All countries should adopt mandatory energy performance requirements and comparative energy labels. Adequate resources should be allocated to ensure that stringency is maintained and that the requirements are effectively enforced
- **Standby power:** adopt a common 1W limit for standby power but consider allowing negotiated exceptions when merited
- **Set top boxes:** adopt minimum efficiency standards for digital television adaptors
- **Low power modes:** adopt policies which require electronic devices to enter low power modes automatically after a reasonable period when not being used



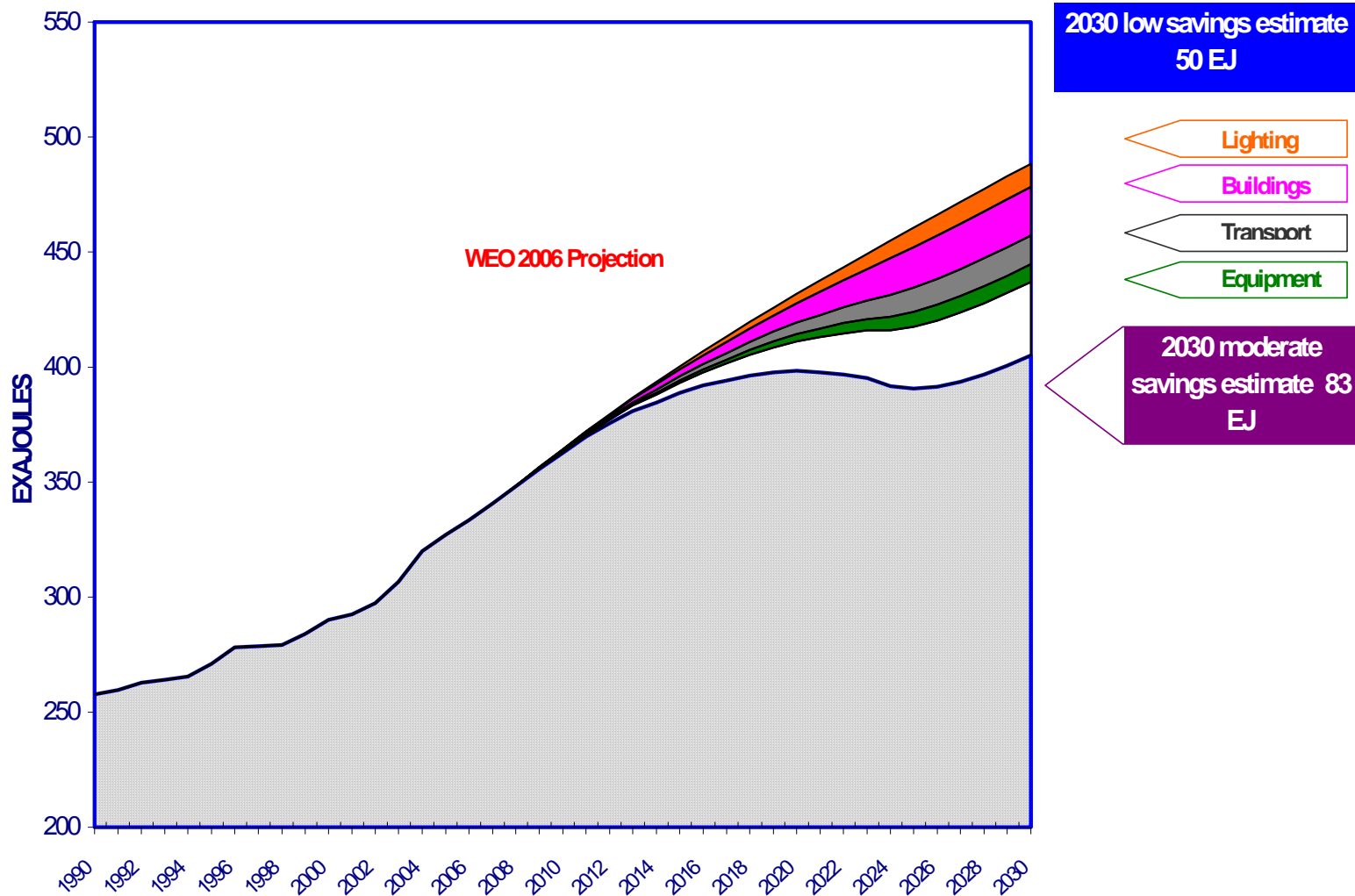
IEA E.E. Recommendations to G8: lighting & utilities

- **Comprehensive policy package for lighting: Countries should adopt a comprehensive policy package aimed at achieving best-practice in lighting energy efficiency across all lighting usage sectors**
- **Incandescent lamps: Governments should move to phase out the most inefficient incandescent bulbs as soon as commercially and economically viable**
- **Governments and utility regulators should consider implementing mechanisms that strengthen the incentives for utilities to deliver cost-effective energy savings among end-users such as:**
 - i) **Establishing regulation which decouples utility revenue and profits from energy sales and allows energy savings delivery to compete on equal terms with energy sales; or**
 - ii) **Placing energy efficiency obligations on energy utilities**
 - iii) **Allowing energy efficiency measures to be bid into energy pools, on an equal basis to energy supply options; or**
 - iv) **Other appropriate policy measures that encourage utilities to play an active part in funding and or delivering end-use efficiency improvements among their customer base**





Estimated impact of full implementation of IEA G8 policy recommendations on world energy demand¹



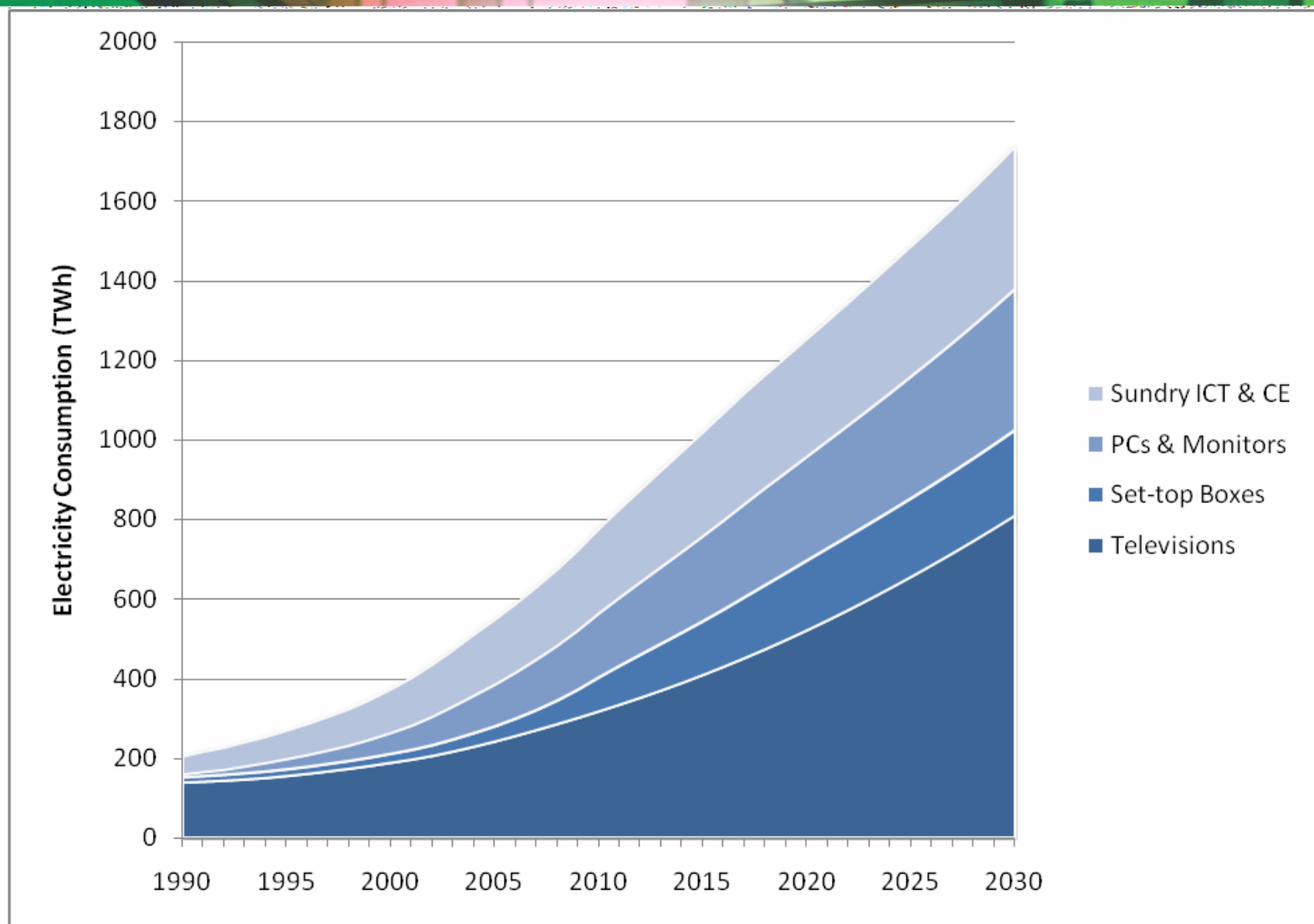
¹provisional estimates for final energy



Residential ICT and Consumer Electronics (CE) electricity usage

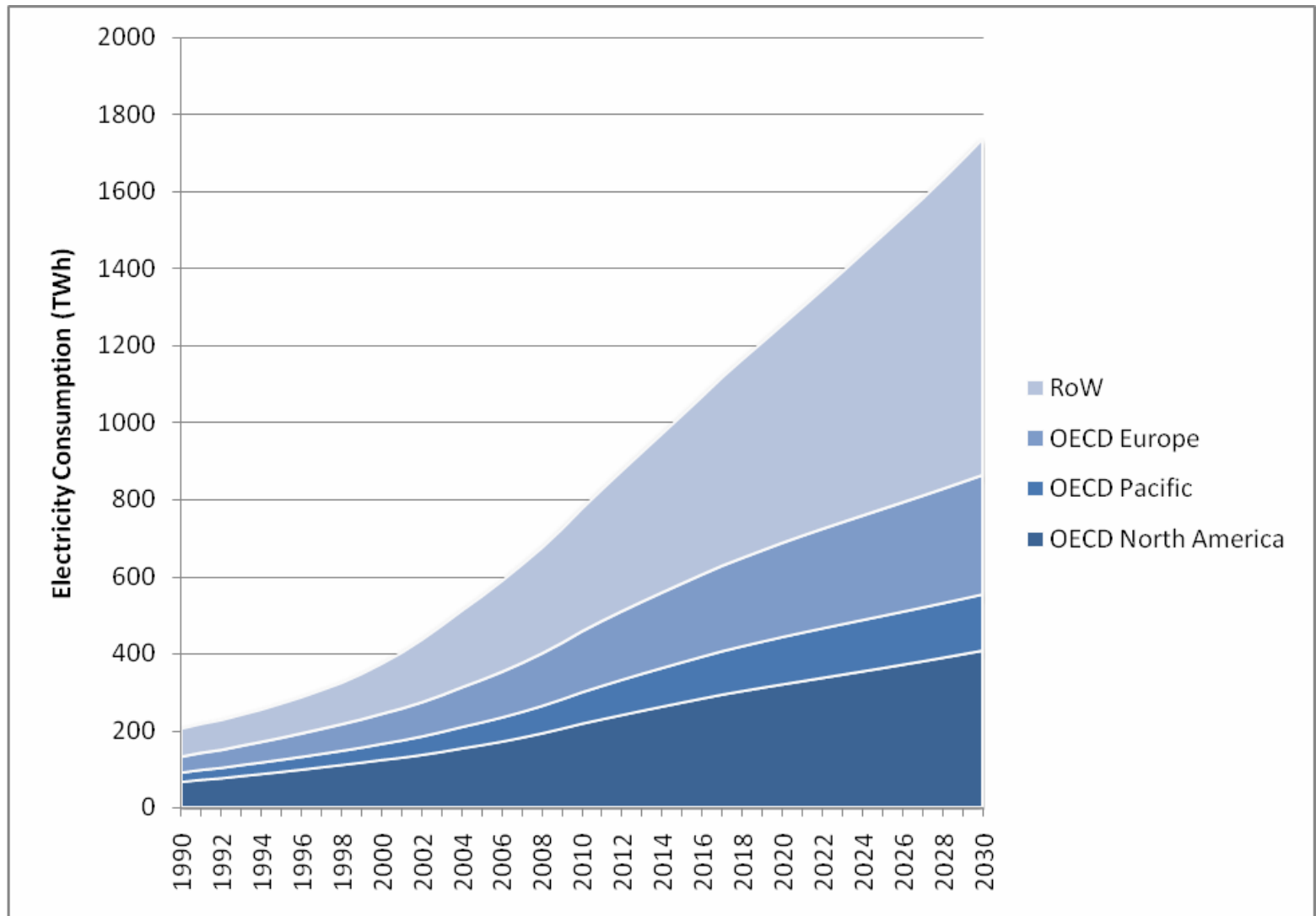
- Now estimated to account for 15% of household electricity consumption (700 TWh globally)
- Grew by 7% p.a. from 1990 to 2007
- Draws 100GW of power demand
- Costs US\$80 billion in electricity bills each year
- Numerous dynamics (sometimes opposite) produce this aggregate result

Projected global residential ICT & CE electricity consumption



Source: Appliances in a Digital Age

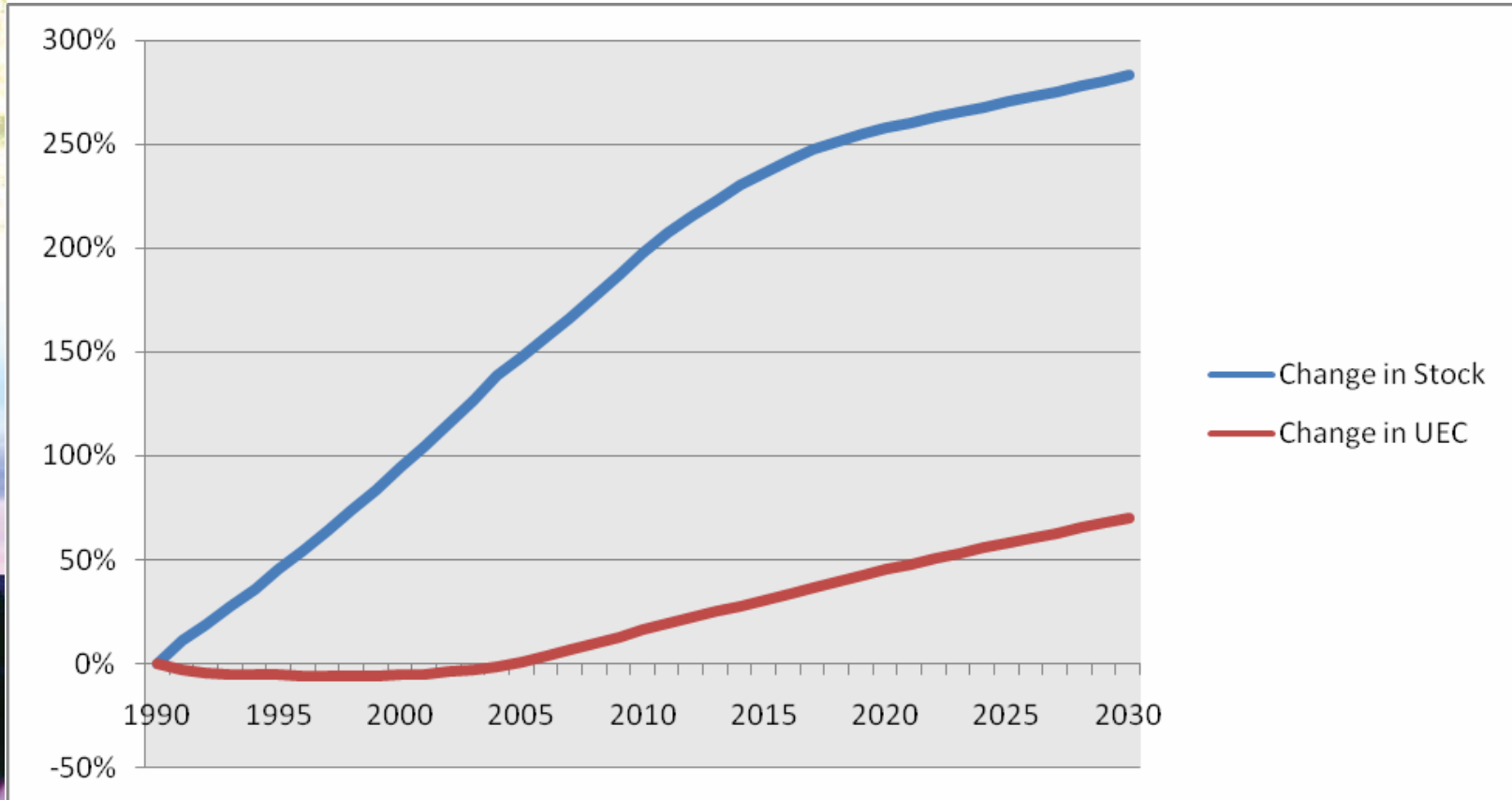
Projected global residential ICT & CE electricity consumption



Source: Appliances in a Digital Age

Estimated change in ICT & CE stocks and unit elec. consumption

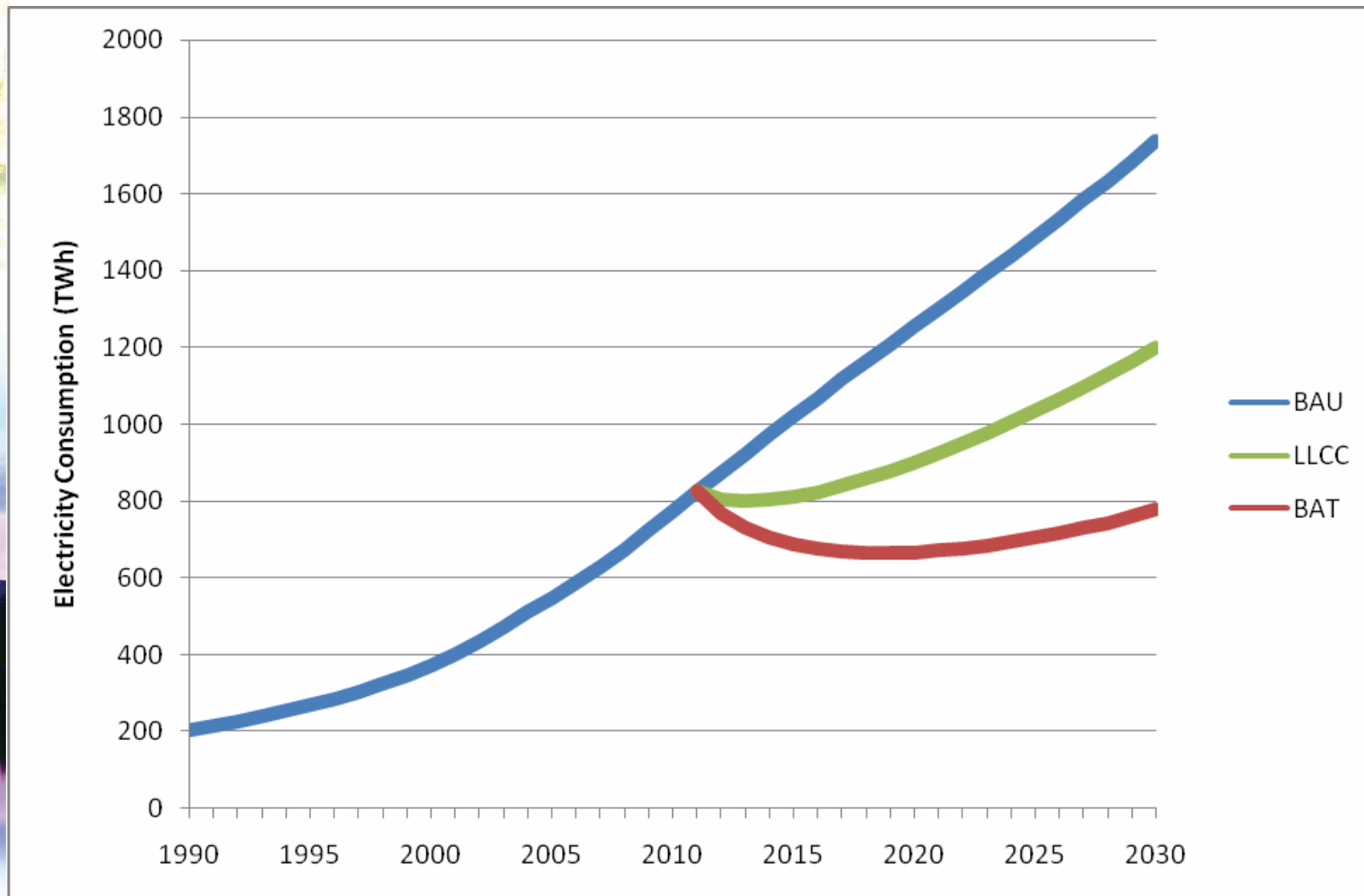
for non-OECD countries



Note: The effect of structural changes, mainly the switch to flat screen technologies and laptop computers is evident in the reduction of UEC values prior to 2005

Source: Appliances in a Digital Age

Estimated global residential ICT & CE electricity consumption



Source: Appliances in a Digital Age



Residential ICT and Consumer Electronics (CE) electricity usage

- Reaching BAT would reduce growth in electricity demand from 4.5% p.a. to 1%
- The majority of savings will be achieved through improved power management to ensure that energy is only used when, and to the extent that, it is needed
- This will save ~150GW of new power demand and US\$130 billion in electricity bills each year by 2030
- Reaching LLCC will save 30% of power demand, US\$90 billion in bills and 85GW of new power demand

Source: Appliances in a Digital Age

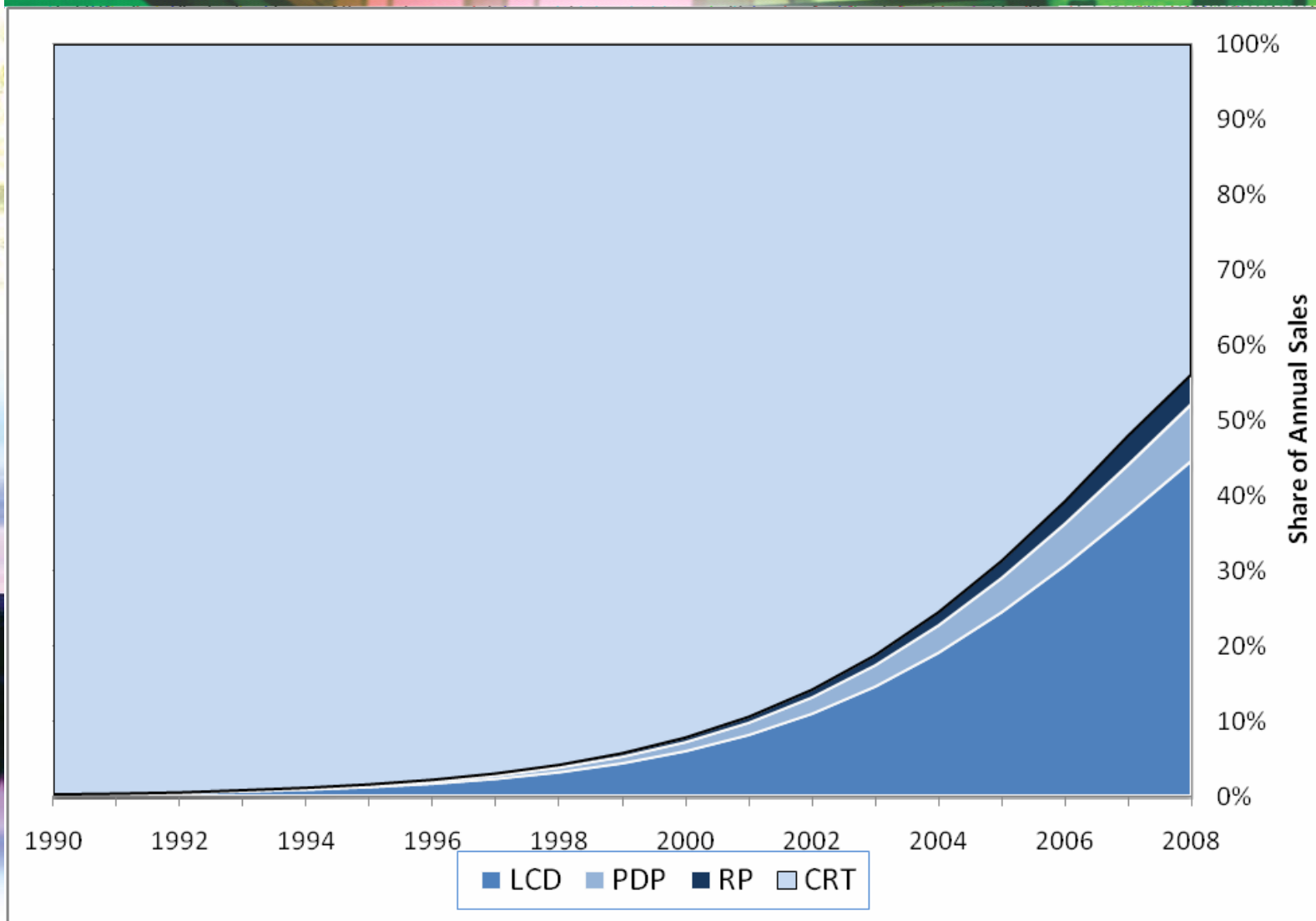


Factors influencing TV energy usage

- Ownership levels (up)
- Hours of use (up)
- Screen size (up)
- Screen technology type
(CRT,PDP,LCD, Rear Projection)
- Digital or analogue (definition up)
- Additional functions (Pay TV,
TV&Telecom, TV+Radio/PC etc.: up)
- Standby power (down)

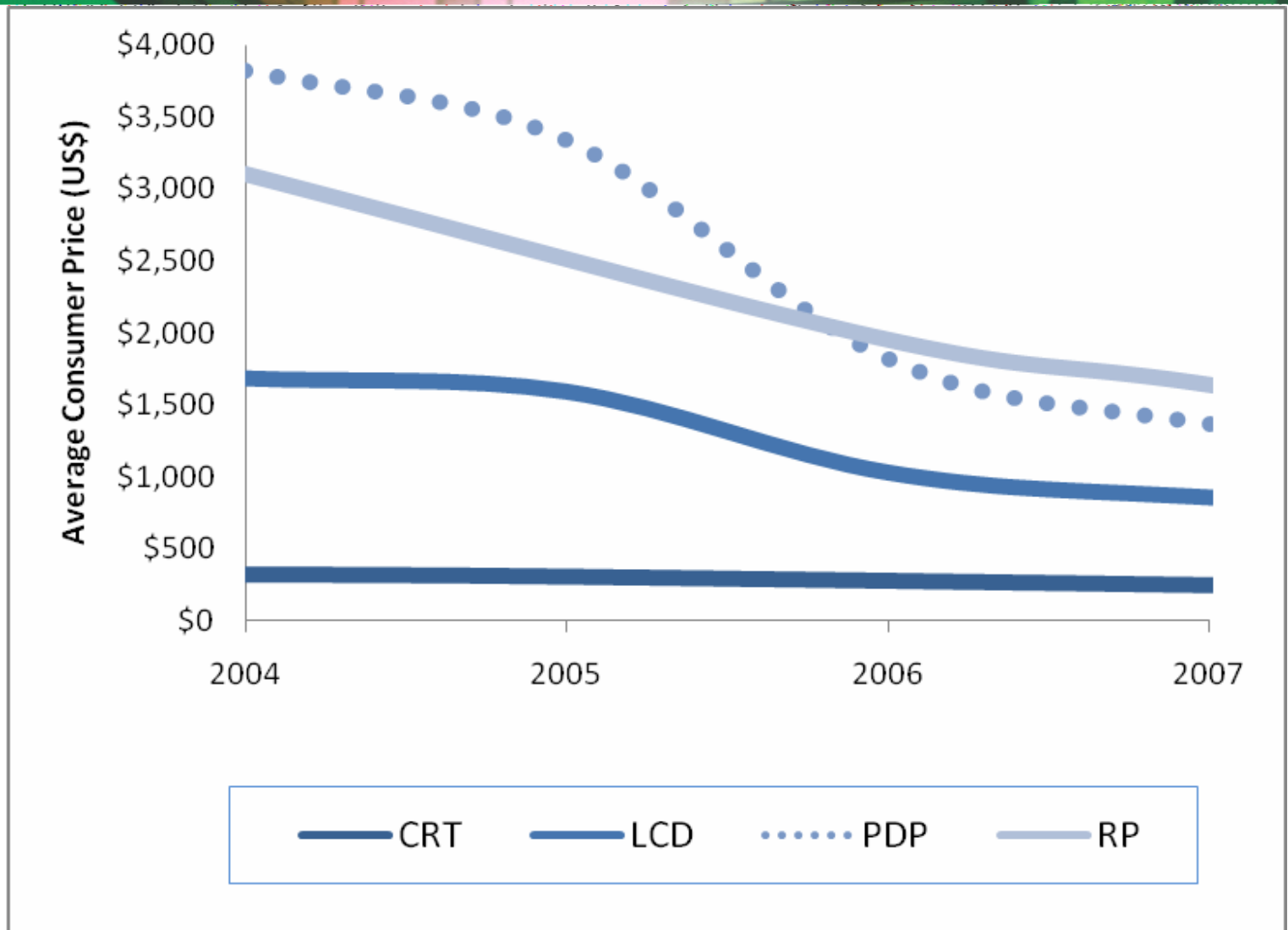
Source: Appliances in a Digital Age

Share of global TV sales by technology



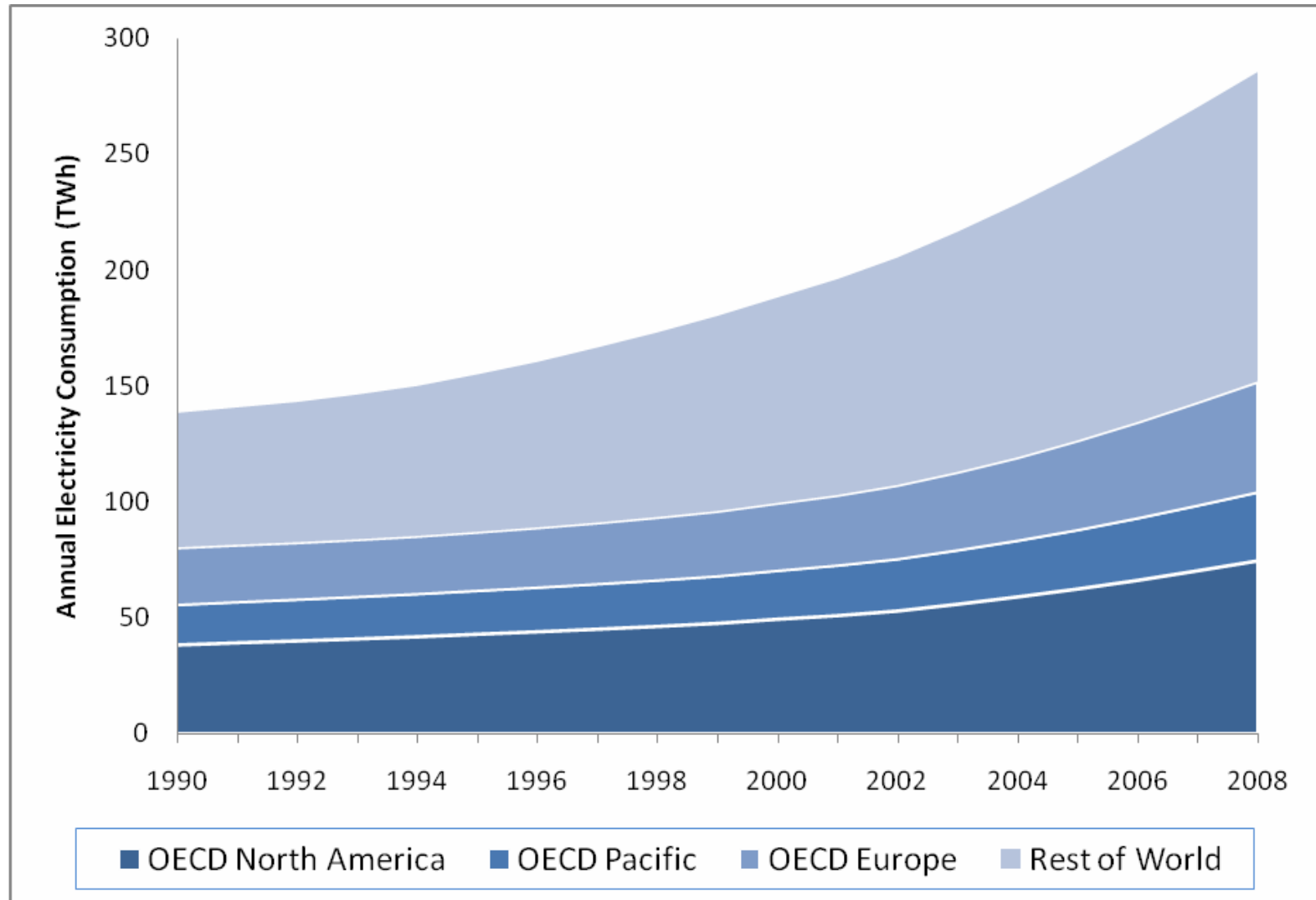
Source: Appliances in a Digital Age

Price of US TVs by technology



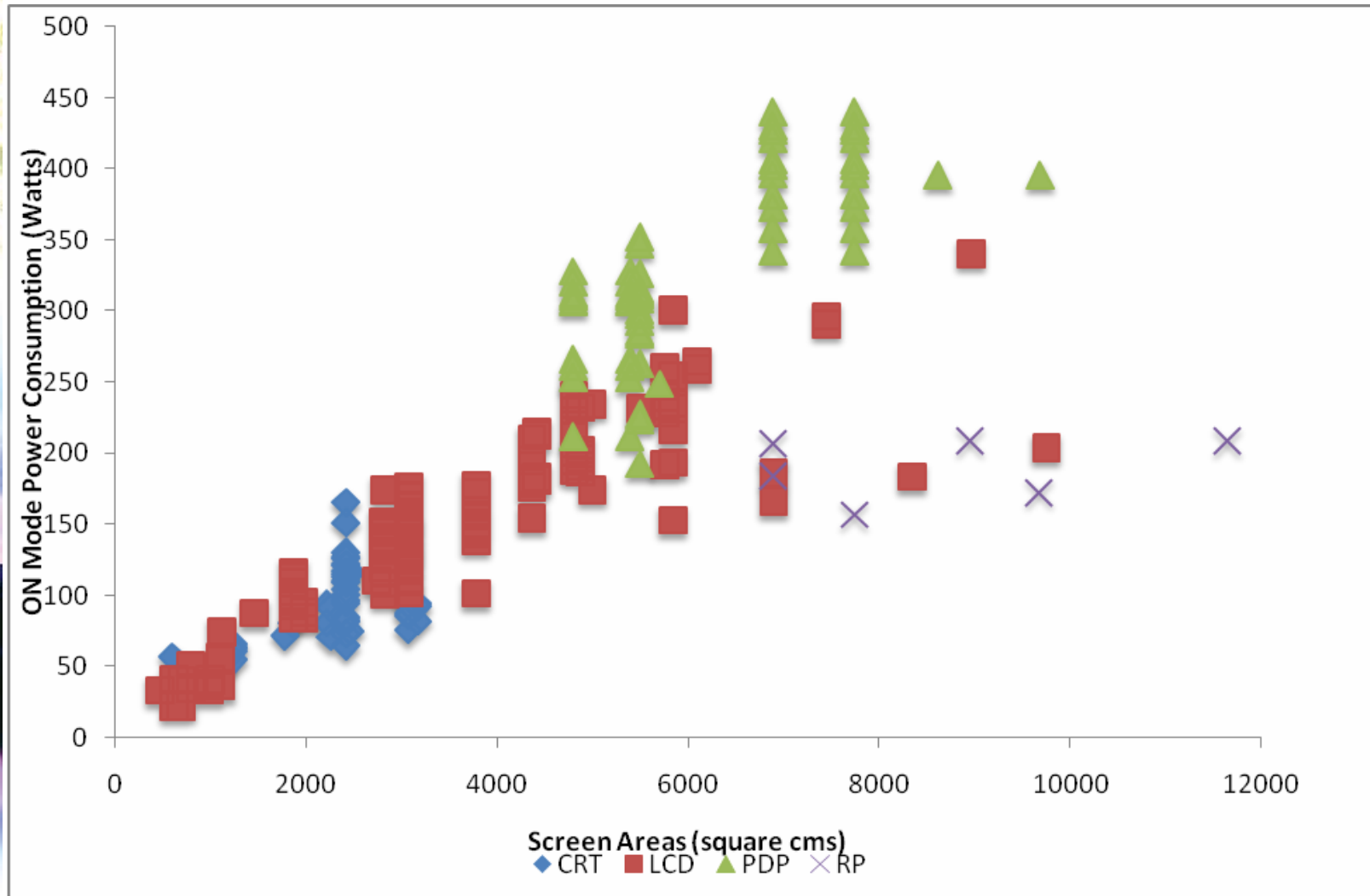
Source: Appliances in a Digital Age

Estimated global electricity consumption of TVs

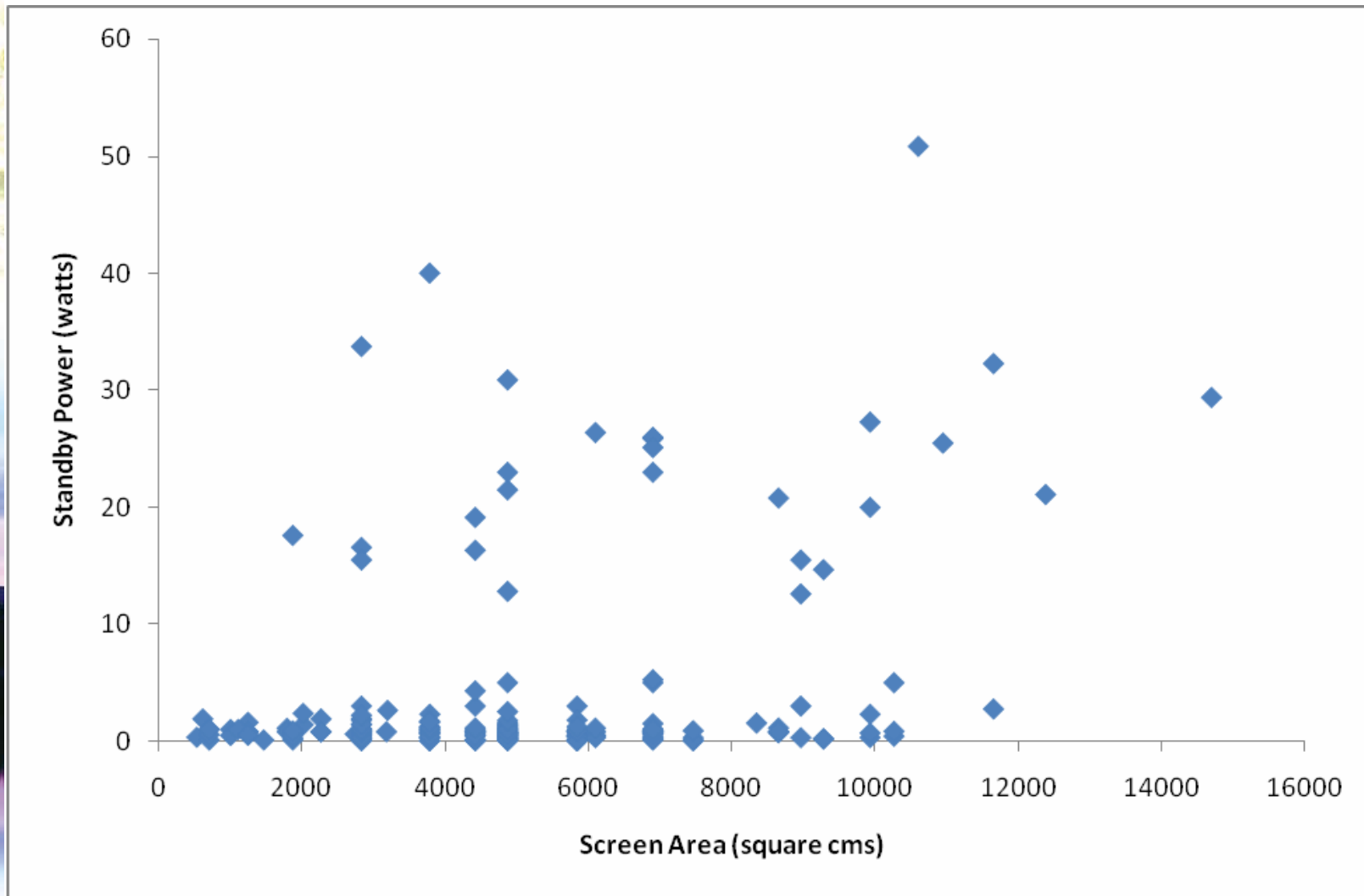


Source: Appliances in a Digital Age

Variation of TV on-mode power consumption with screen size

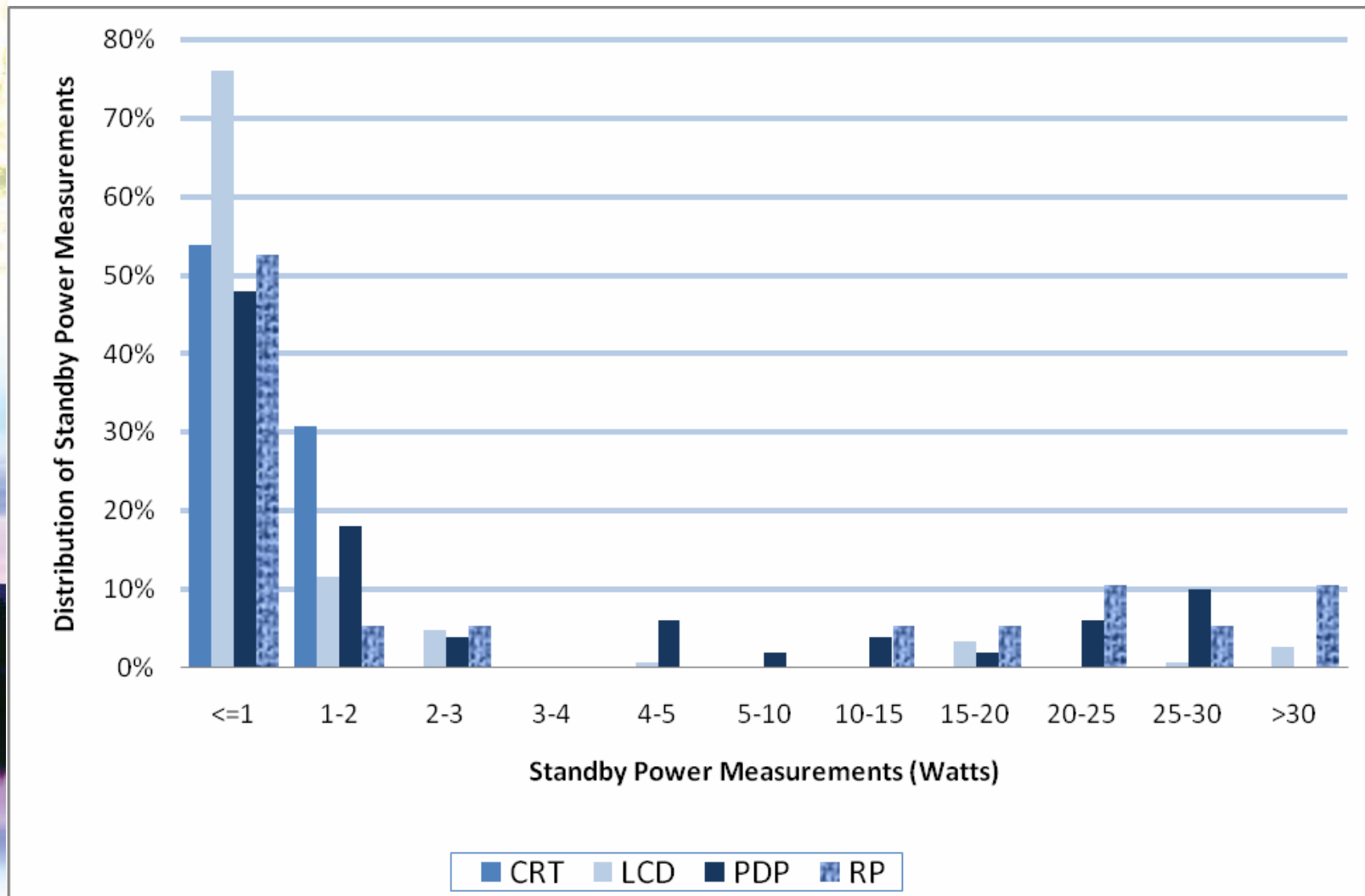


TV standby power as a function of screen size (2007 data)



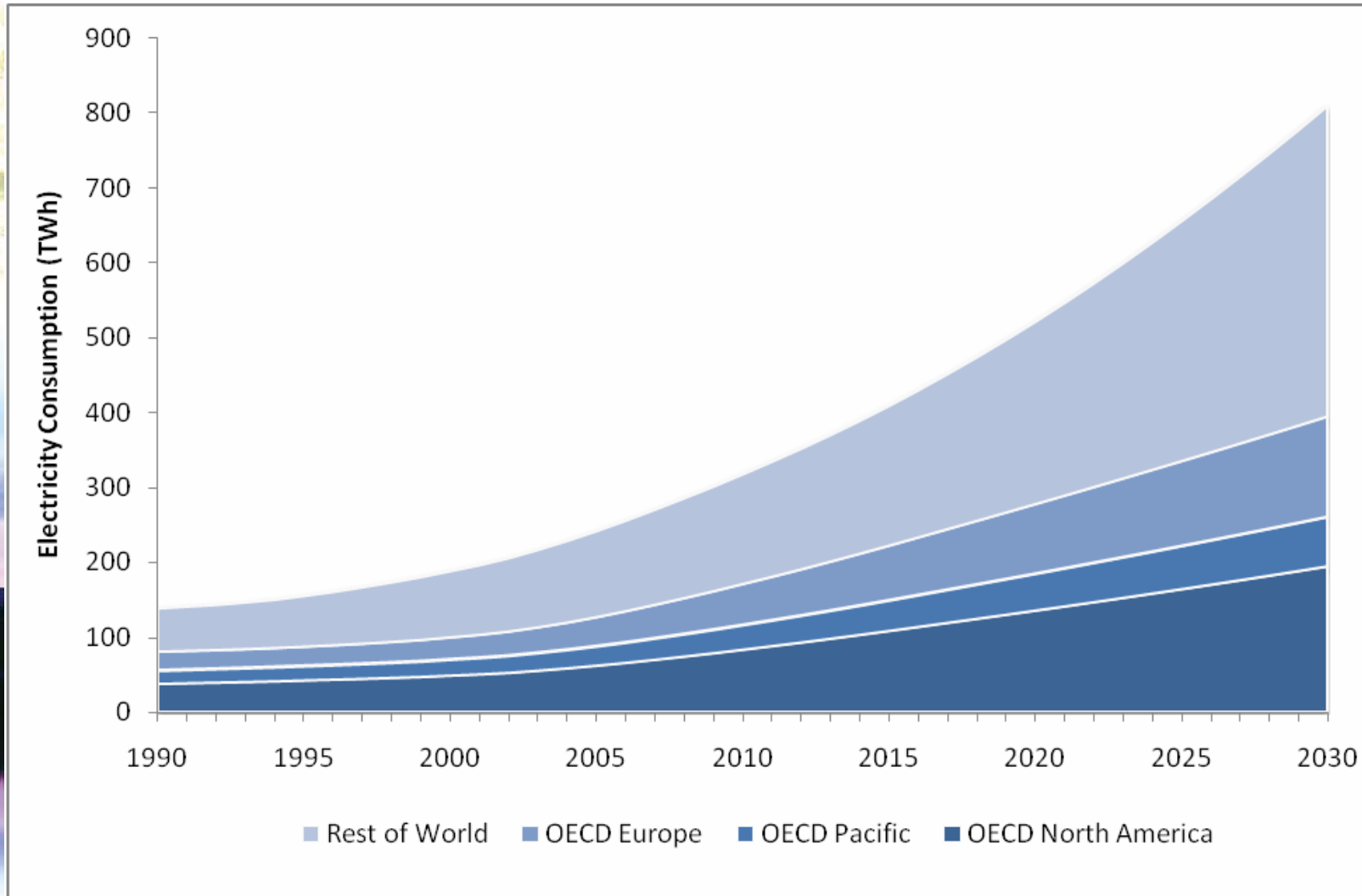
Source: Appliances in a Digital Age

Distribution of TV standby power measurements



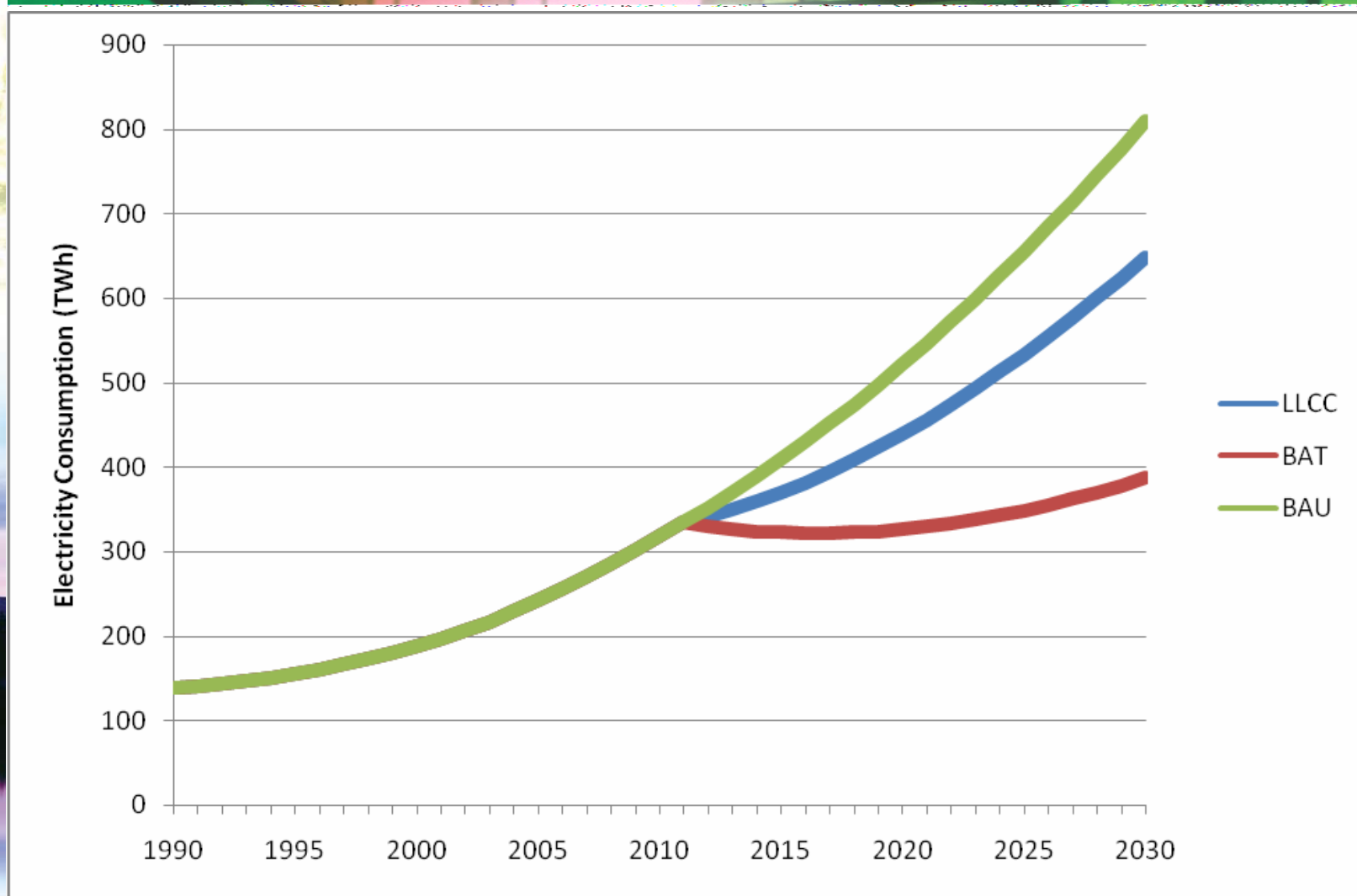
Source: Appliances in a Digital Age

Projected global TV electricity consumption to 2030



Source: Appliances in a Digital Age

Estimated global TV electricity consumption



Source: Appliances in a Digital Age

Status of international energy efficiency policies for TVs

Country	Programme Type	Television category	Mode	Status
Canada	Endorsement Label	All	<i>standby</i>	Current
Japan	Top Runner	CRT, LCD, Plasma	all modes	Current
China	MEPS	CRT	all modes	Current
China	Endorsement Label	All	<i>standby</i>	Current
US (Energy Star)	Endorsement Label	All	all modes (revision)	November 2008
Brazil	Comparison Label		<i>standby</i>	Current
Australasia	MEPS & Comparison Label	All	all modes	Under consideration
Europe	MEPS	All	all modes	Under consideration
India	Endorsement Label	All	<i>standby</i>	Under consideration

IEA E.E. Recommendations to G8: televisions

- **Governments should implement energy efficiency policy measures for TVs and set-top boxes designed to:**
 - i) **Promote the best performing current TV products and technologies;**
 - ii) **Stimulate the market entry of new television technologies which aim to halve TV energy consumption compared to current performance levels; and**
 - iii) **Minimise the energy used by TVSP customers in receiving TV services by**
 - **ensuring that such requirements are included in relevant franchise or licensing**
 - **agreements that allow TVSPs to operate.**





Implementation issues

- **Energy performance test procedures:**
 - repeatable, reproducible, representative
- **Reliable performance declarations**
 - Certification, market-monitoring, compliance
- **Communication and outreach**
 - Effective labels, awareness building, actions through the supply chain
- **Timely implementation processes**
 - Structured design and policy setting process envisaging revision
- **Evidence-based decision making**
 - Sound broadly-based analysis, proper process and impact evaluation
- **Supporting measures**
 - Fiscal/financial incentives, procurement programmes, retailer/distributor engagement, R&DD, utility programmes, white certificates, etc..

Conclusions

- Energy efficiency presents a vast under-exploited and cost-effective GHG saving opportunity
- It merits being the single greatest focus of GHG abatement strategies in the near and medium-term
- A carefully designed, well implemented and soundly evaluated portfolio of measures is needed to address all barriers
- IEA recommendations support this and are being extended
- Regular detailed end-use metering is an essential element supporting policy and programme design, implementation and impact evaluation





Thank you

Paul Waide

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