International Energy Agency

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Clean Energy Systems for Islands: Insights from IEA Analyses

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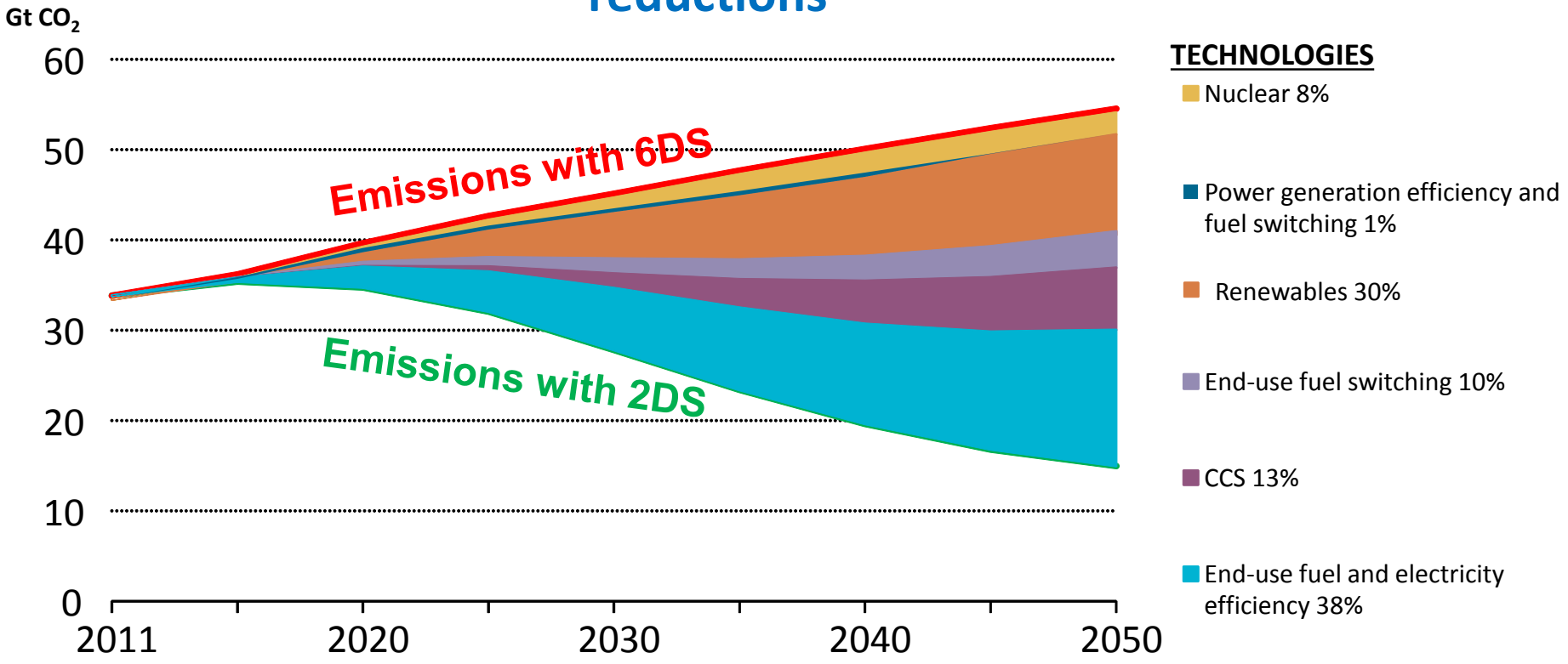
International Energy Agency

Tokyo, Japan
5 October 2015

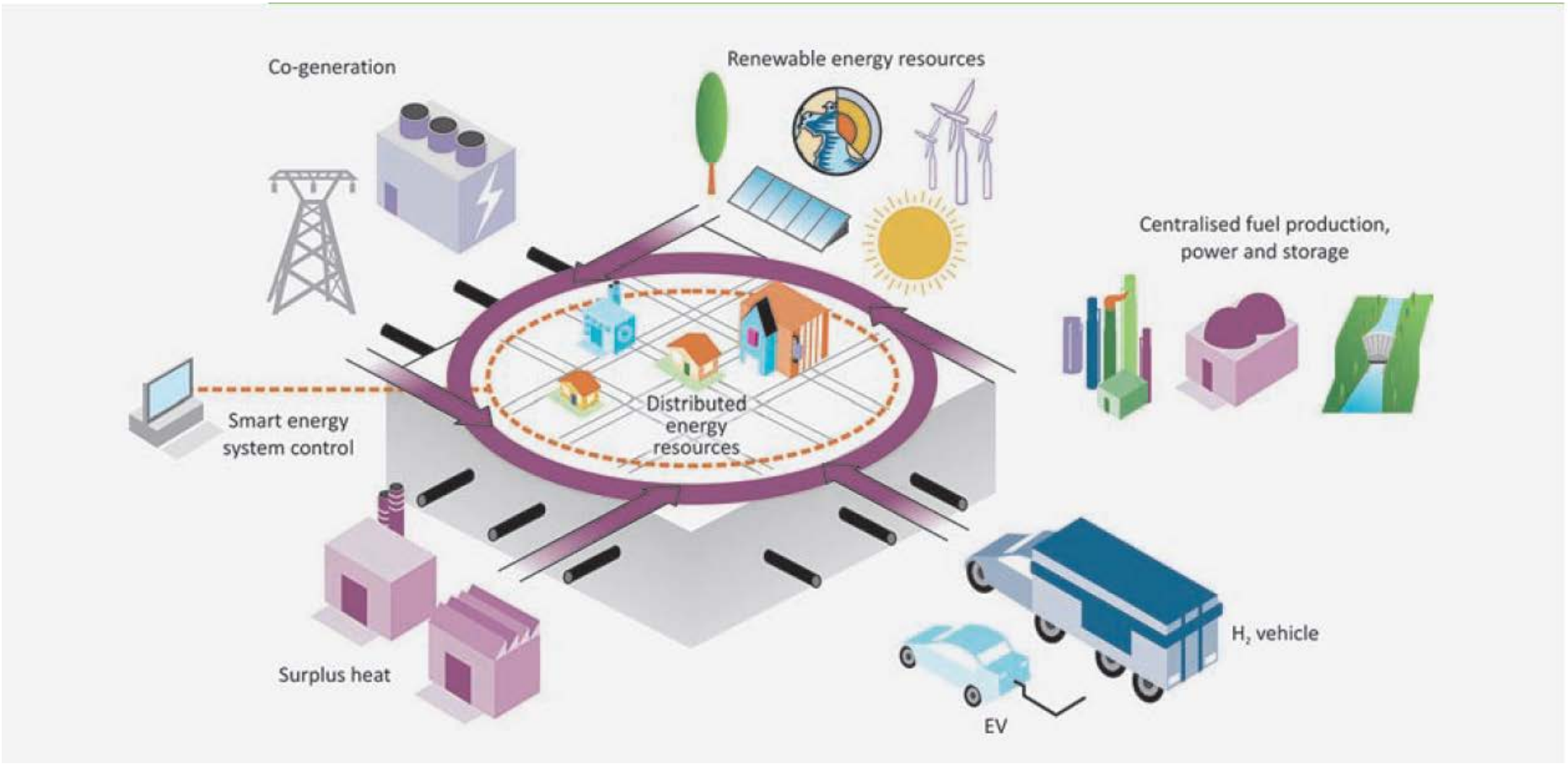
Contribution of technology area to global cumulative CO2 reductions



Source: ETP 2015

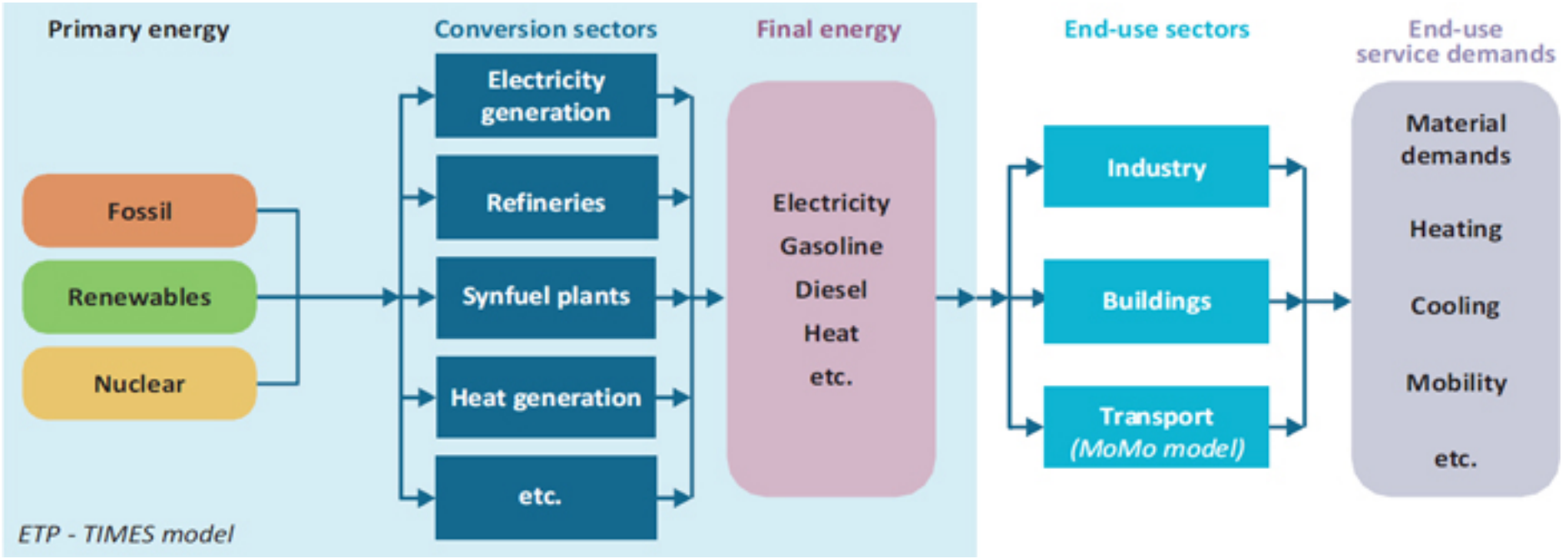
The 2DS remains within reach, with energy efficiency remaining the most significant opportunity

Integrated and intelligent energy network of the future



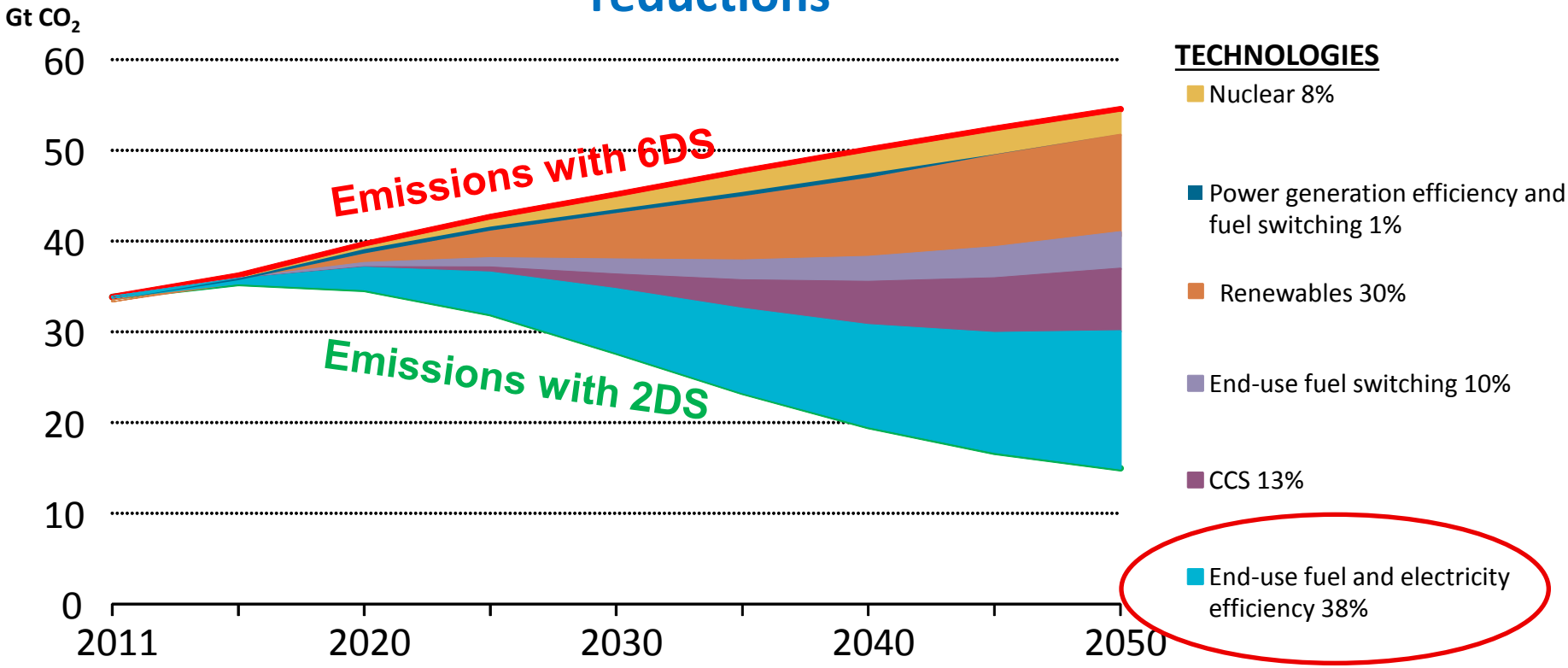
The energy system of the future will integrate the sources of and requirements for energy from all parts of the energy system

The 2DS is based on an integrated energy systems modeling approach



Enables assessment of least-cost pathways to climate change mitigation across energy supply and demand systems

Contribution of technology area to global cumulative CO2 reductions

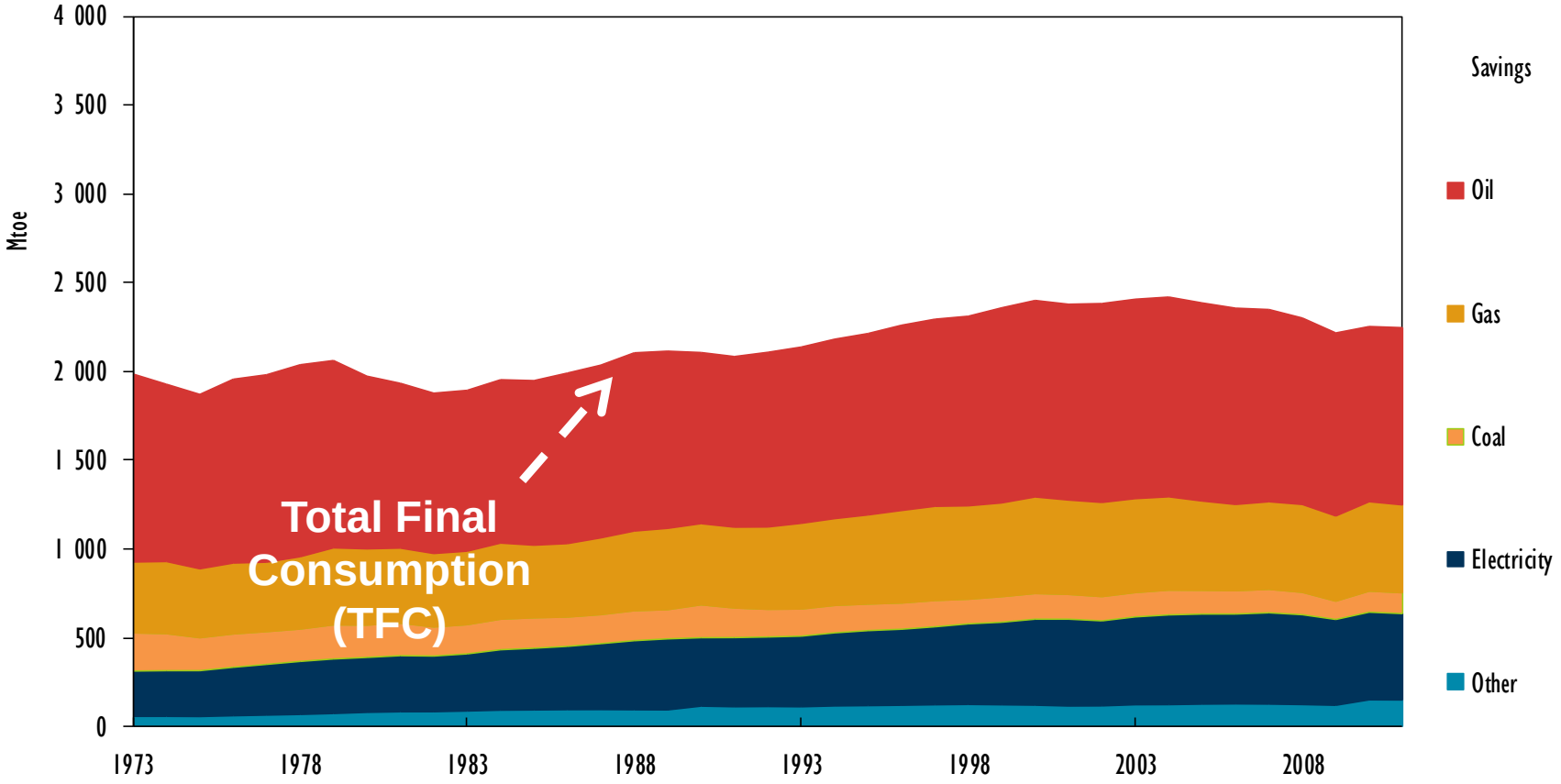


Source: ETP 2015

Energy efficiency remains the most significant opportunity!

Output - Energy efficiency: the 'first fuel'

savings larger than the contribution of any other fuel to TFC in 2012



*IEA-11: Australia, Denmark, Finland, France, Germany, Italy, Japan, Netherlands, Sweden, United Kingdom, United States

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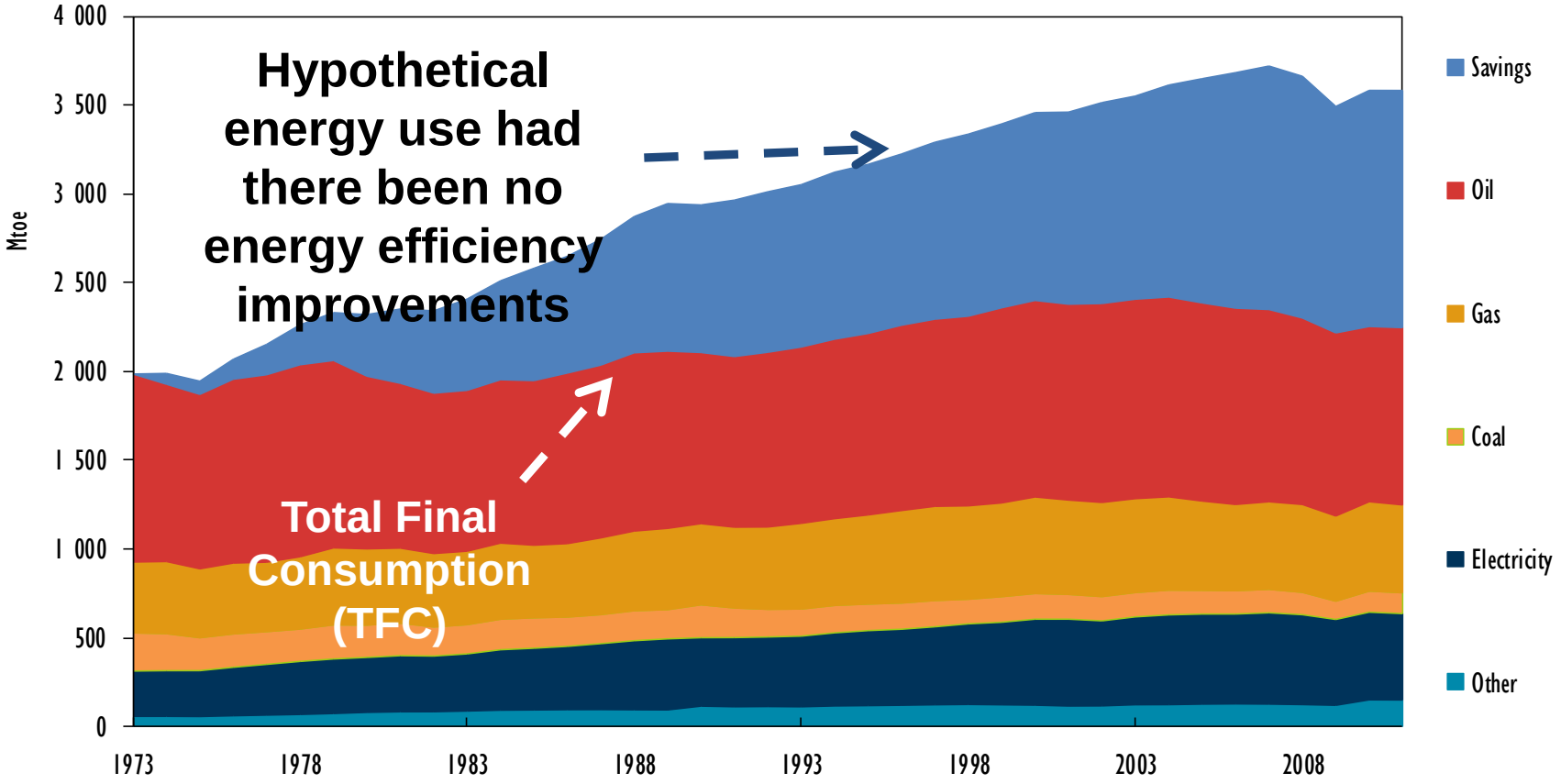

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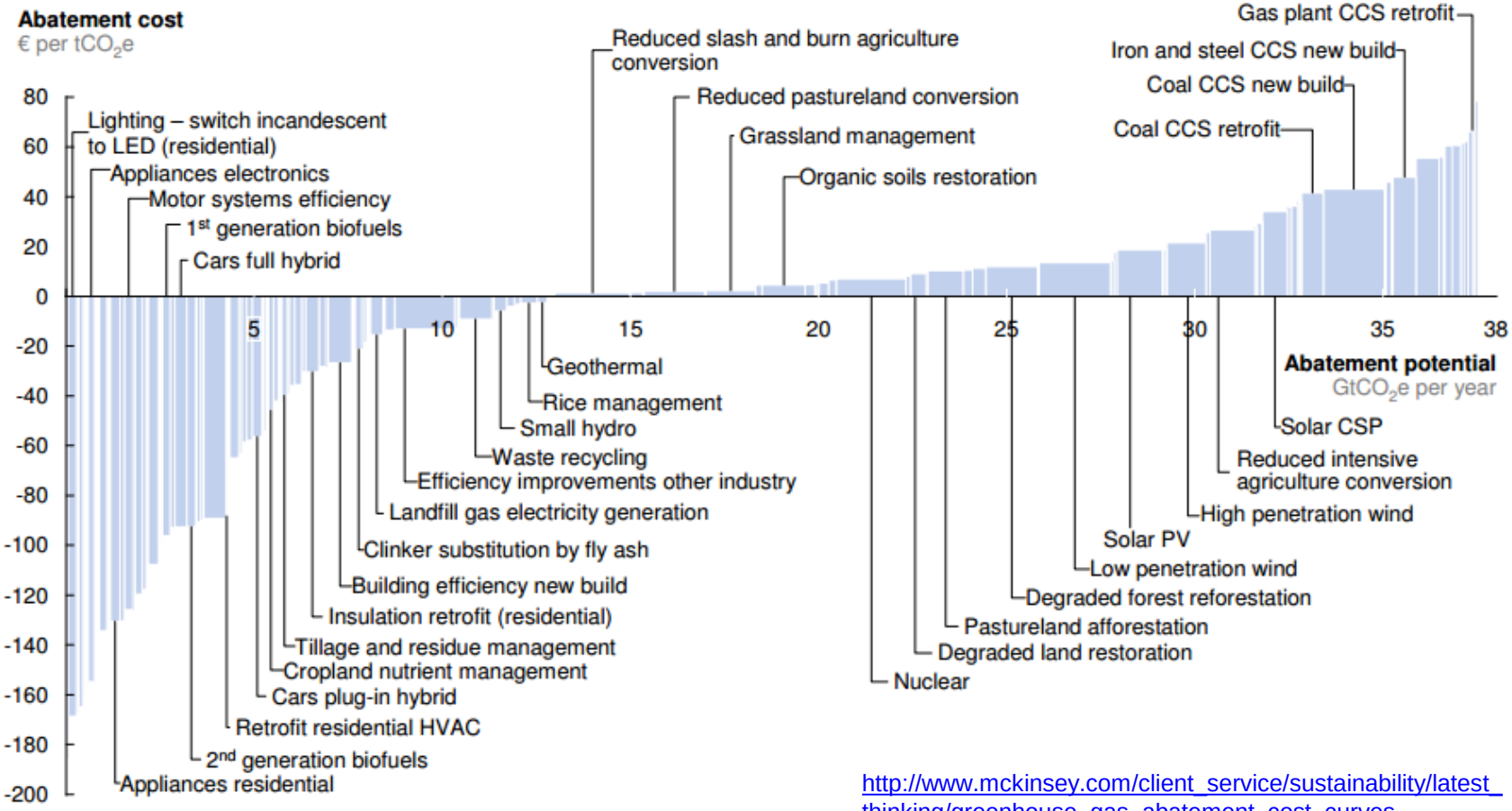
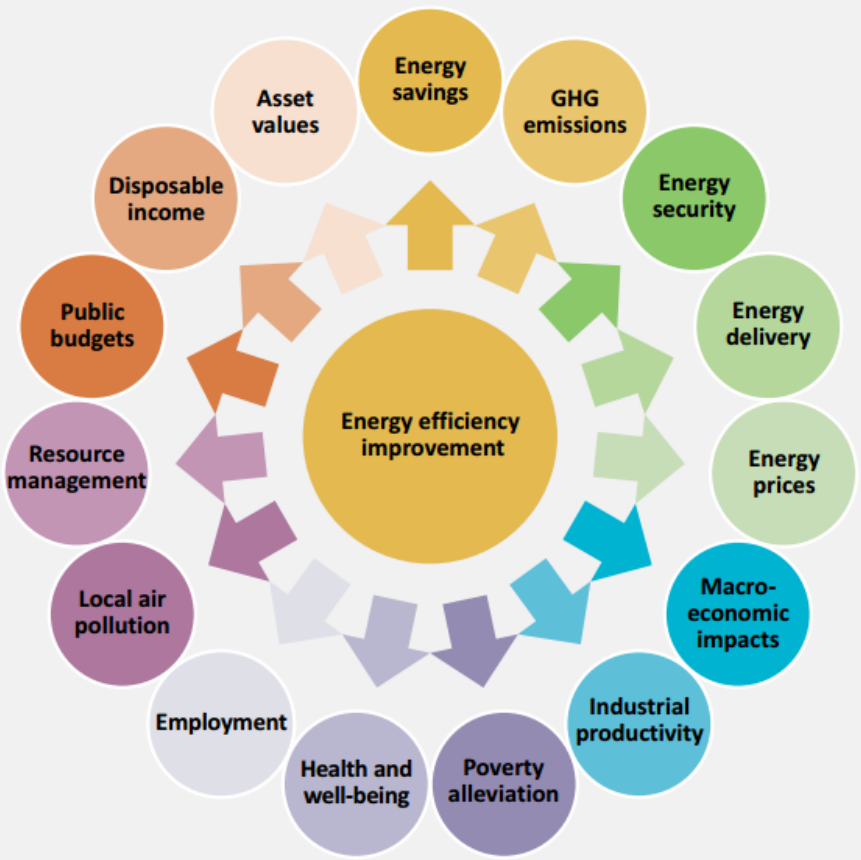


http://www.mckinsey.com/client_service/sustainability/latest_thinking/greenhouse_gas_abatement_cost_curves

Note: The curve presents an estimate of the maximum potential of all technical GHG abatement measures below €80 per tCO_2e if each lever was pursued aggressively. It is not a forecast of what role different abatement measures and technologies will play.
Source: Global GHG Abatement Cost Curve v2.1

Energy efficiency makes economic sense

Multiple benefits of energy efficiency

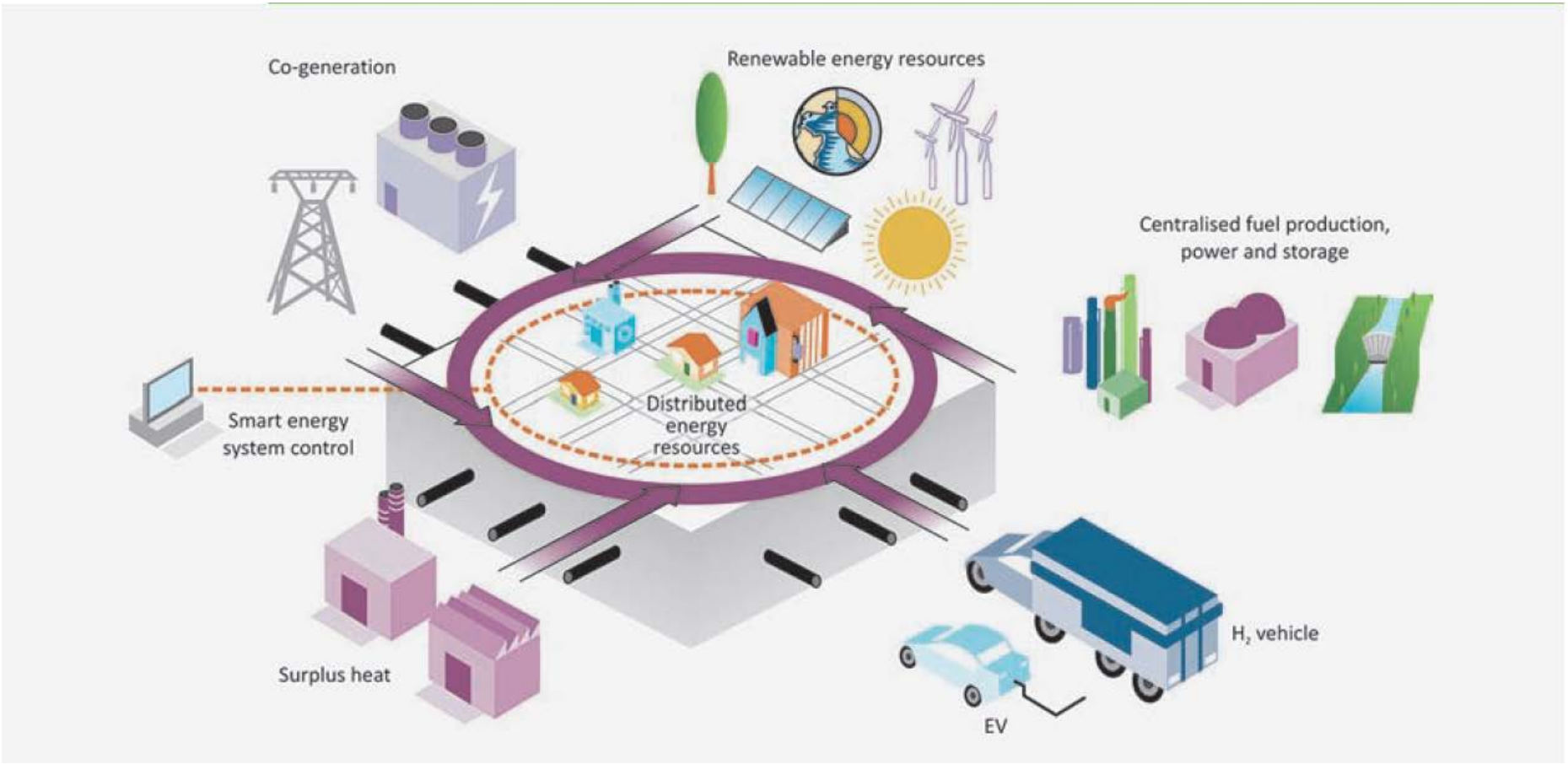


Note: This list is not exhaustive, but represents some of the most prominent benefits of energy efficiency identified to date.
Source: Unless otherwise noted, all material in figures and tables in this chapter derives from IEA data and analysis.

A multiple benefits approach to energy efficiency reveals a broad range of potential positive impacts.

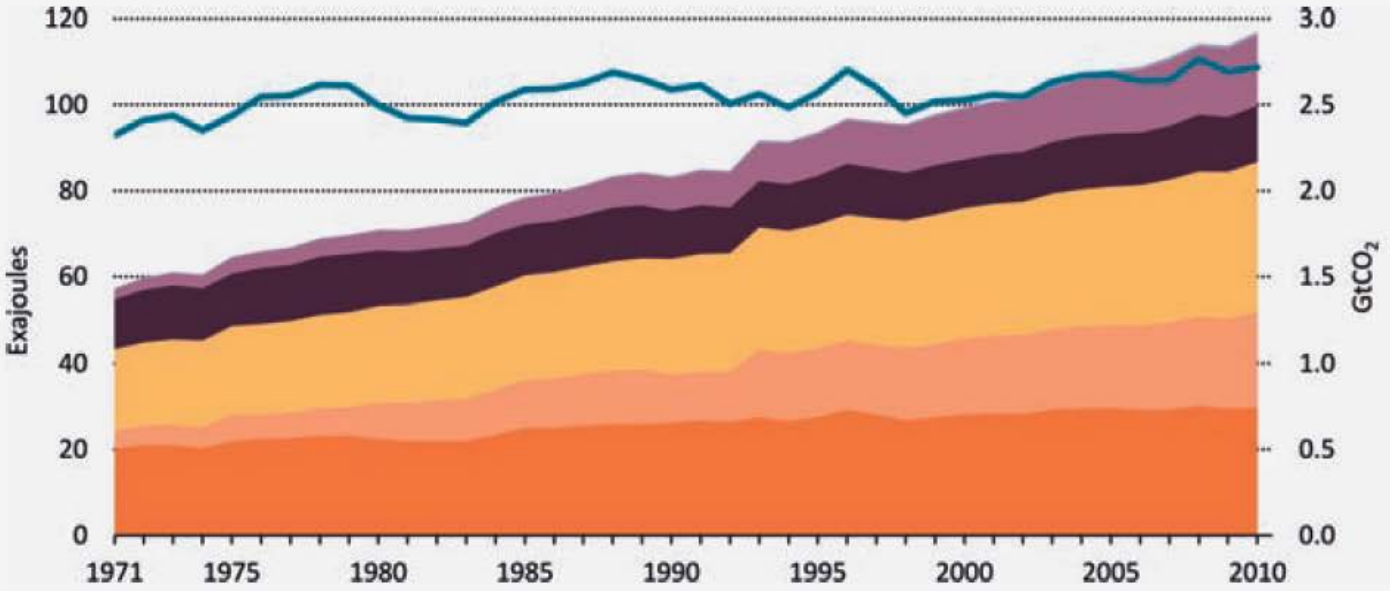
http://www.iea.org/topics/energyefficiency/energyefficiencyiea/multiplebenefitsofenergyefficiency/

Integrated and intelligent energy network of the future



The energy system of the future will integrate the sources of and requirements for energy from all parts of the energy system

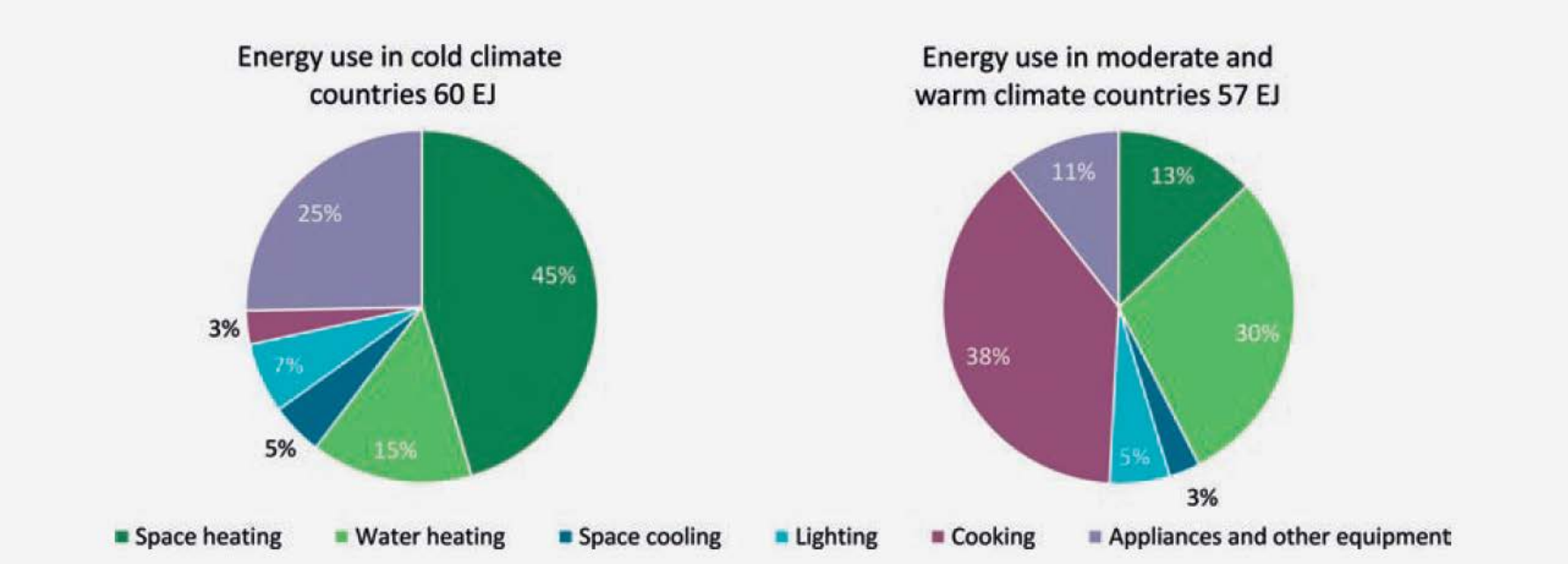
Global buildings direct energy use and CO2 emissions by energy source



Note: $GtCO_2$ = gigatonne of CO_2.

The residential sub-sector consumes about three-quarters of direct energy in the global buildings sector

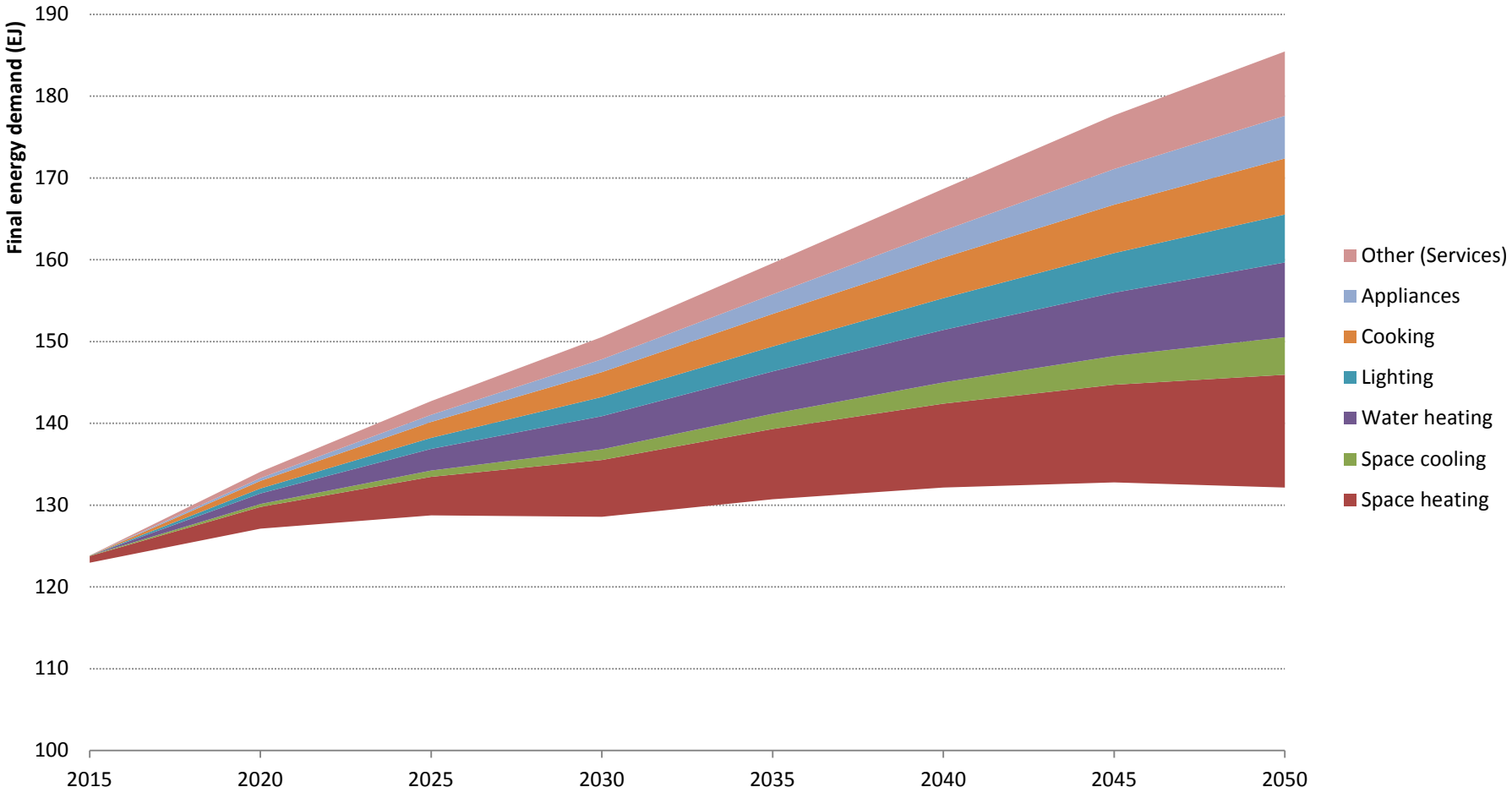
Energy end uses in buildings, 2010



About 70% of buildings energy consumption is for space heating and appliances in cold climates, and for water heating and cooking in moderate and warm climates.

Importance of Energy Efficiency

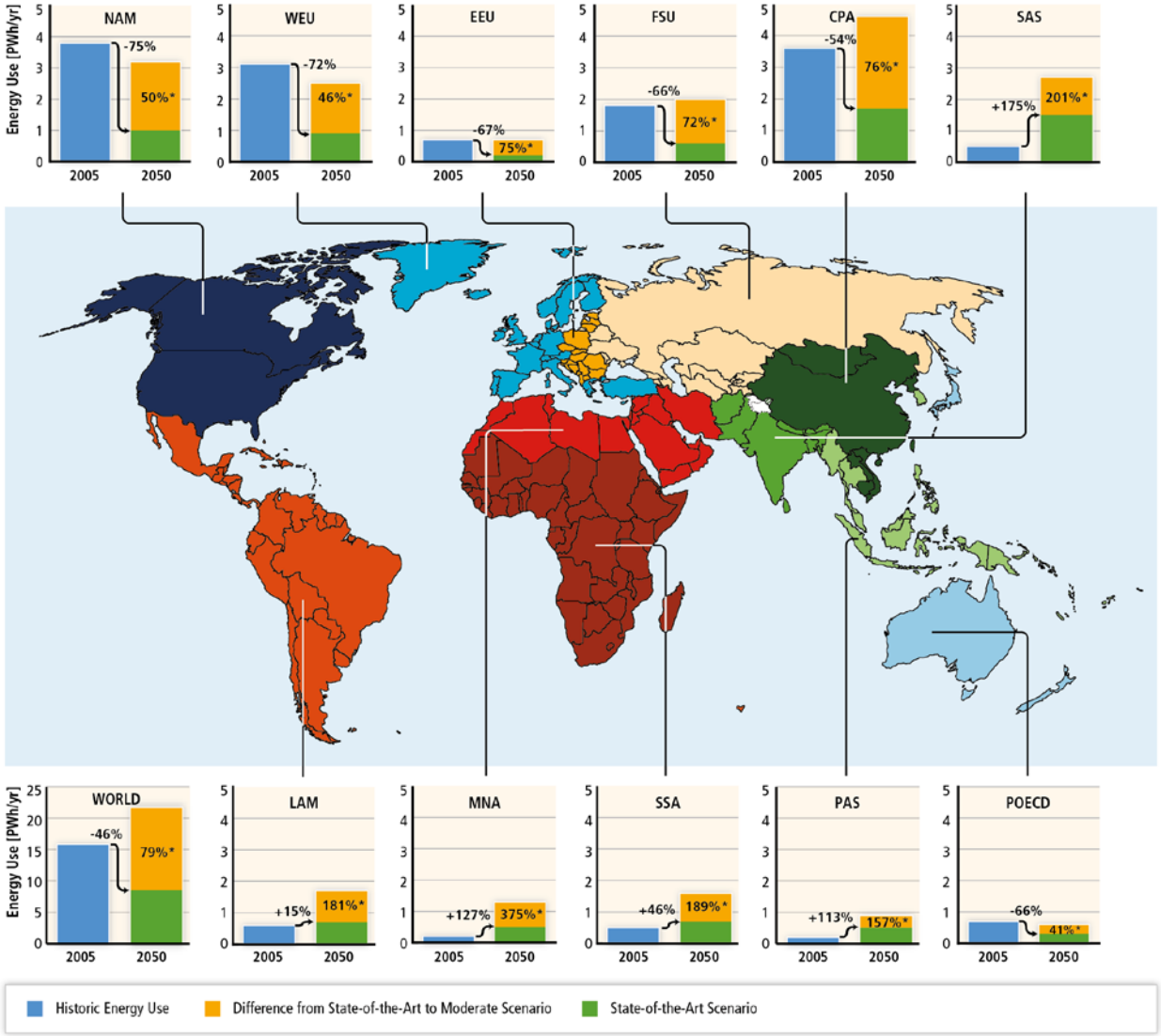
Global building emissions growth and savings potential to 2050



Source: IEA Energy Technology Perspectives 2014

Global energy efficiency potential

- Potential to reduce final energy use for space heating & cooling through energy efficiency



*Lock-in Risk of Sub-Optimal Scenario Realative to Energy Use in 2005.

Source: IPCC 2014

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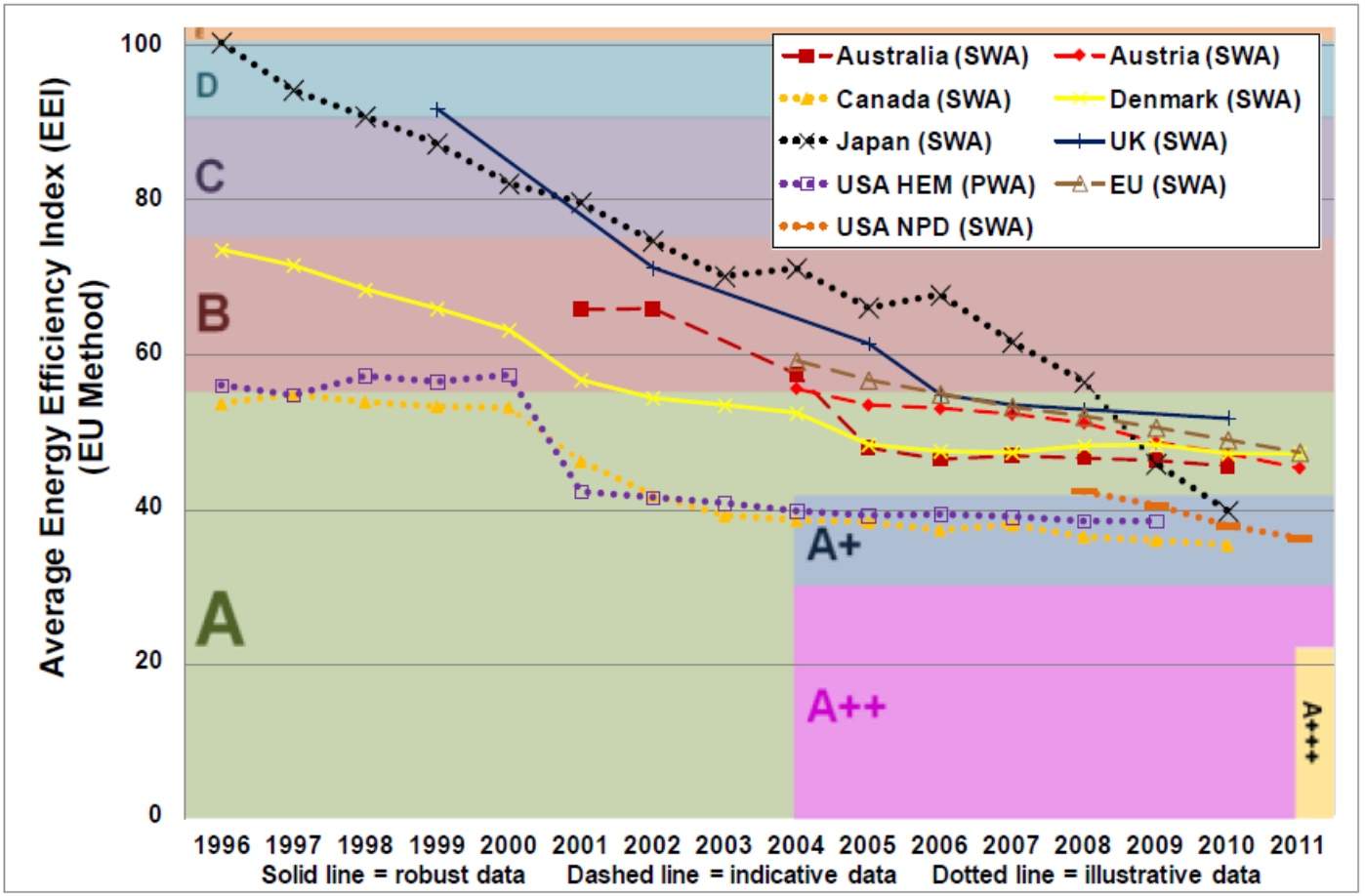
GBPN
Global Buildings Performance Network

COPENHAGEN CENTRE ON ENERGY EFFICIENCY
SE4ALL EE HUB

UCD DUBLIN RESEARCH

Comparative Refrigerator/Freezer Energy Efficiency Index (EU EEI)

(SWA: Sales weighted average
PWA: Product weighted average)



- EEI accounts for different sizes/types giving a comparable efficiency metric
- Same graph overlaid with EU label boundaries

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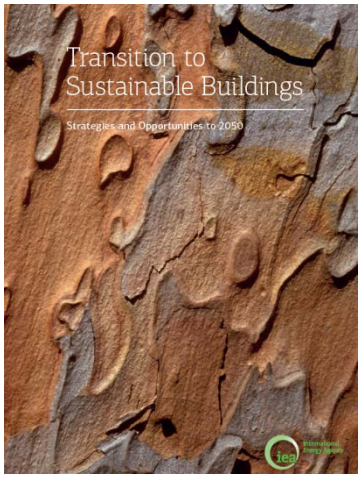
- Regional priorities in the buildings sector

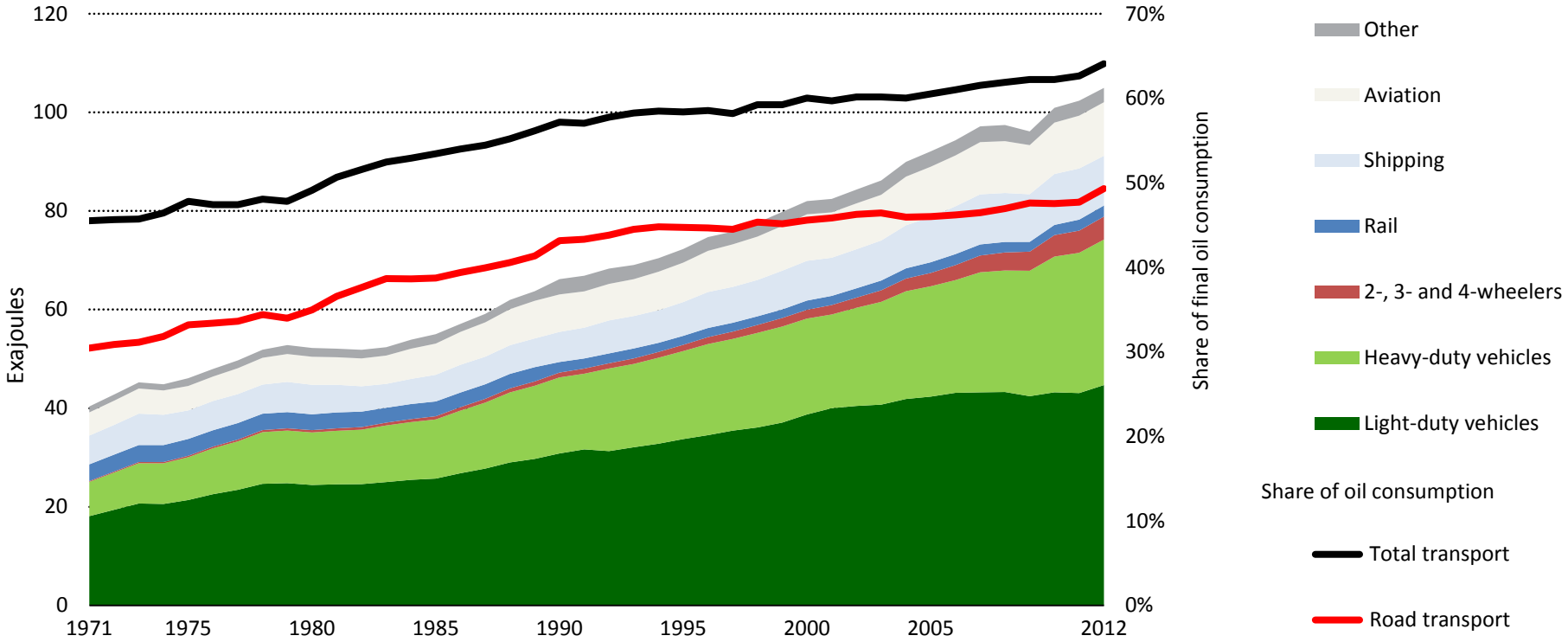


Technology	ASEAN[4]	Brazil	China	European Union	India	Mexico	Russia	South Africa	United States
Advanced envelope – cold climate (highly insulating windows, air sealing and insulation)			●	○			●		●
Reduced cooling loads – hot climates (reflective technologies and advanced cooling equipment)	○	○				○			
Heat pumps (water heating and/or space heating and/or space cooling)			○	●			○		○
Solar thermal (water heating and/or space heating)		●			○	●		●	
More efficient use of biomass (more efficient cooking and water heating, and leading to modern biogas)	●				●			○	
Policy									
Building codes with supporting infrastructure (education, product ratings, and implementation to pursue holistic approach with advanced envelopes)	○	○	○		●	○	○	○	
Appliance and equipment standard (promoting advanced appliances, lighting, heat pumps, heat pump water heater, gas condensing boilers, miscellaneous electrical loads, efficient cooling)	●	●	●		○	●		●	
Deep renovation of existing buildings (systems approach with advanced envelopes and high-performance equipment)				●			●		●
Zero-energy new buildings (advanced holistic building design with integrated renewable energy)				○					○

Notes: red indicates immediate priority, while gold indicates second priority. This is not intended to be an exhaustive list, but intentionally shows the immediate priority for technology and policy, along with a second goal, to help highlight which technologies and policies will have the largest impact in the country or region. Most of the technology and policy categories could be applicable to all countries.

Energy consumption in transport

World transport energy use by mode, 1971-2012



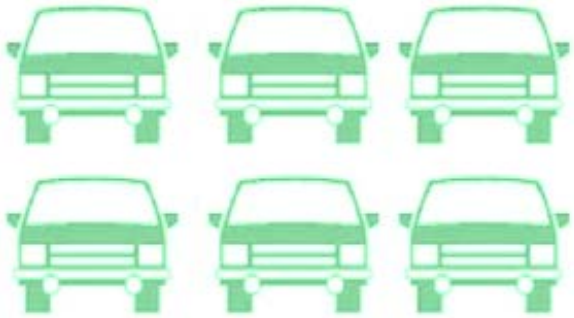
- Road transport modes account for most energy consumption
- The share of road in total transport final oil use has grown from less than 50% in 1973 to nearly 76% in 2012

Transport & energy policies

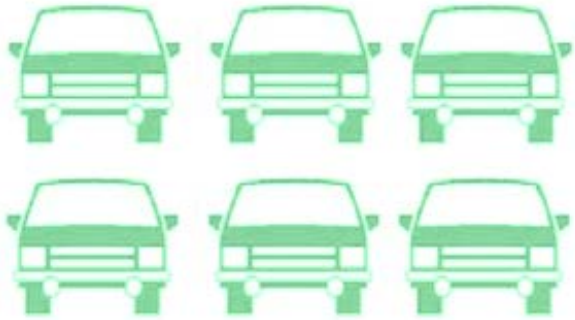
Fundamental concepts

AVOID
unnecessary trips
REDUCE km

SHIFT modes



IMPROVE vehicles
low carbon fuels



Transport & energy policies

Fundamental concepts

Avoid unnecessary travel

- Urban design & transport integration in land use planning: shorter trips in high density, mix-use cities
- Congestion pricing and other fees (e.g. parking): higher transport costs reduce total pkm
- Logistics: better use of available capacity reduces total tkm

Transport & energy policies
Fundamental concepts

Shift travel to more efficient modes

- Urban design & transport integration in land use planning: transit-oriented developments promoting walking, cycling and the use of public transport
- Congestion pricing, access restrictions, parking fees targeting primarily more energy-intensive modes, combined with subsidies for public transport
- Travel demand management to avoid traffic peaks
- Logistics and intermodal terminals: wider potential for co-modal goods

Transport & energy policies

Fundamental concepts

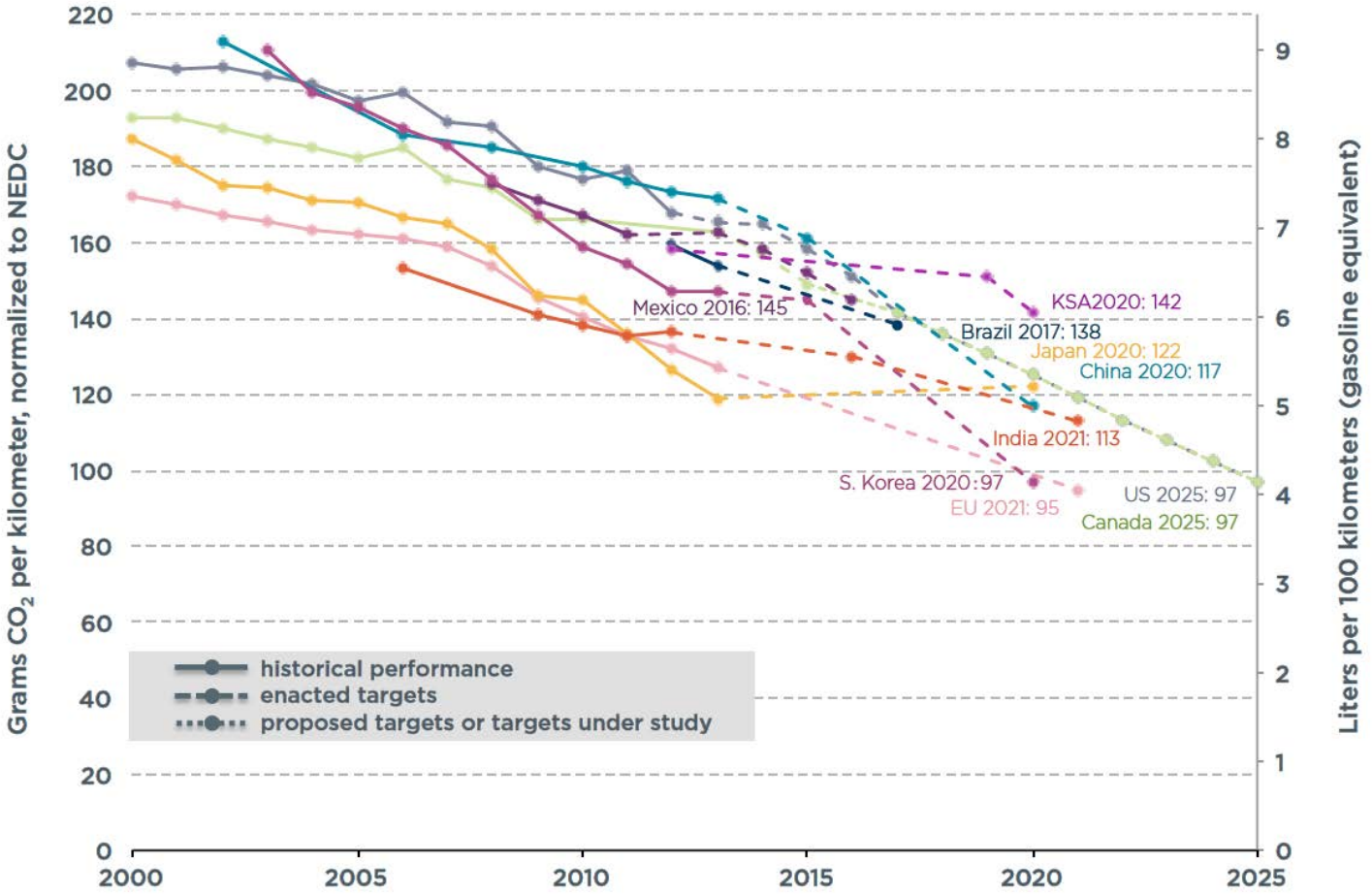
Improve the energy efficiency of each mode

- Standards/regulations (e.g. on fuel economy, pollutant emissions, vehicle speed) and fiscal charges/incentives to promote the introduction of energy efficient and more sustainable technologies on vehicles in all modes (market pull)

Specific fuel consumption of vehicles

Evolution from 2005 to 2010, light passenger vehicles (cars)

- The evolution of the specific fuel consumption of vehicles influences the way energy demand develop with respect to transport activity
- Light passenger vehicles experienced some improvement in recent years



Transport & energy policies

Fundamental concepts

Improve the energy efficiency of each mode

- Standards/regulations (e.g. on fuel economy, pollutant emissions, vehicle speed) and fiscal charges/incentives to promote the introduction of energy efficient and more sustainable technologies on vehicles in all modes (market pull)
- Support research to reduce the costs of advanced vehicle technologies (technology push)

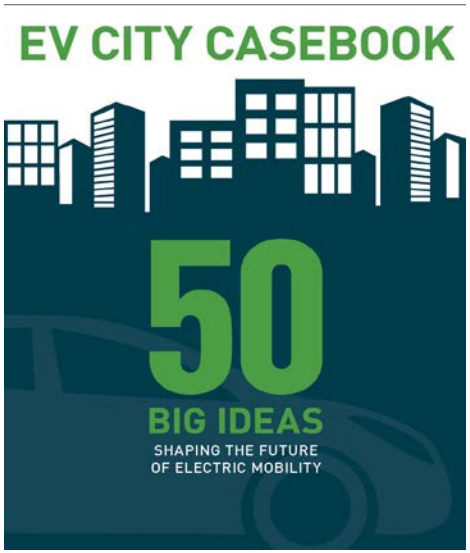
Urban mobility technologies

	Motorcycles		Passenger cars			Buses		Trucks			Rail		
	Lead acid	Li-ion	PHEV	Small BEV	Large BEV	Urban	Rural	LCV	MFT	HFT	Passenger Urban	Passenger Intercity	Freight
Battery charging	+	+	+	+	+	+	+	+	+	−	−	−	−
Swapping	+	−	−	−	+	+	+	+	−	−	n.a.	n.a.	n.a.
Static induction	−	−	+	+	+	+	+	+	+	+	+	−	−
Dynamic induction	−	−	+	+	+	+	+	+	+	+	+	−	−
Catenary	n.a.	n.a.	n.a.	n.a.	n.a.	+	−	−	−	+	+	+	+

Economic potential: + positive, − negative

Technological maturity: ● developed, ● moderate, ● nascent

Notes: it is not only the vehicle itself that determines the potential/maturity, but also the application in which it is used. Bicycles, for example, have different results if considered individually or within the context of bike sharing. Abbreviations: Li-ion – lithium ion battery. PHEV – Plug-in hybrid electric vehicle. LCV – Light commercial vehicle. MFT – Medium freight truck. HFT – Heavy freight truck. n.a. – not available.



Stakeholders plan to increase the global market share of electric vehicles in cities to reach at least 30% by 2030.

Transport & energy policies

Fundamental concepts

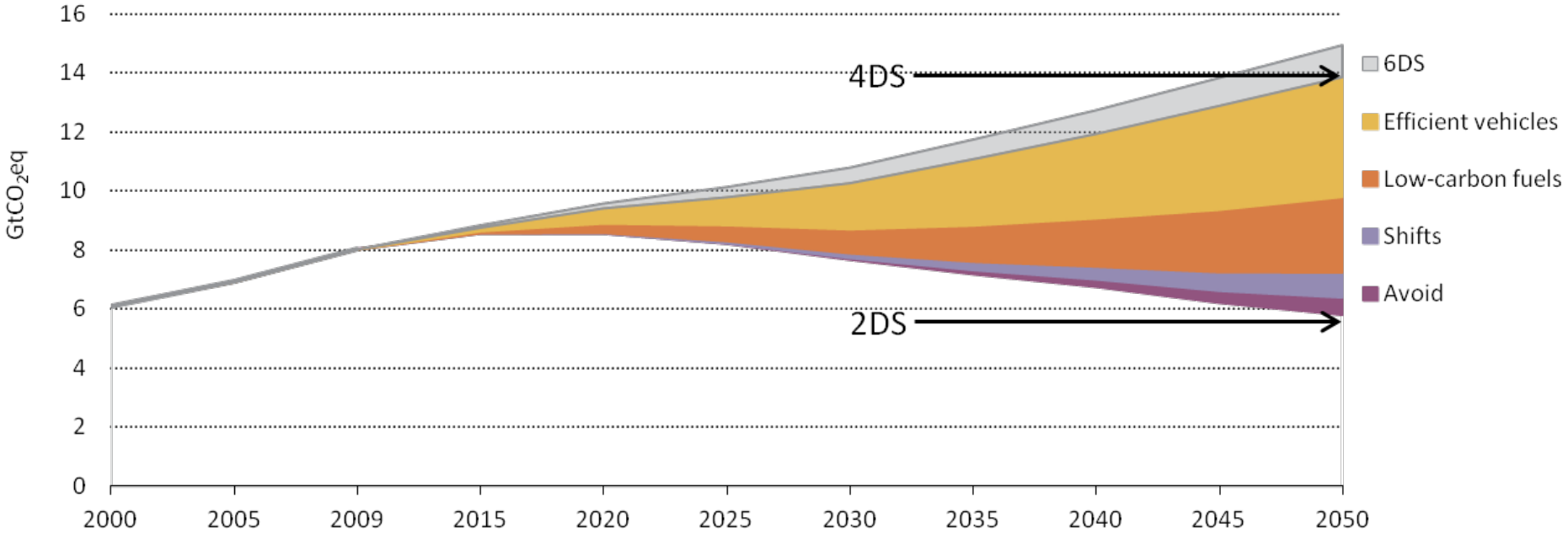
Improve the energy efficiency of each mode

- Standards/regulations (e.g. on fuel economy, pollutant emissions, vehicle speed) and fiscal charges/incentives to promote the introduction of energy efficient and more sustainable technologies on vehicles in all modes (market pull)
- Support research to reduce the costs of advanced vehicle technologies (technology push)
- Support behavioral changes resulting in more efficient use of vehicles (high occupancy, energy efficient driving) and virtuous consumer choices to contain costs (e.g. smaller vehicles)

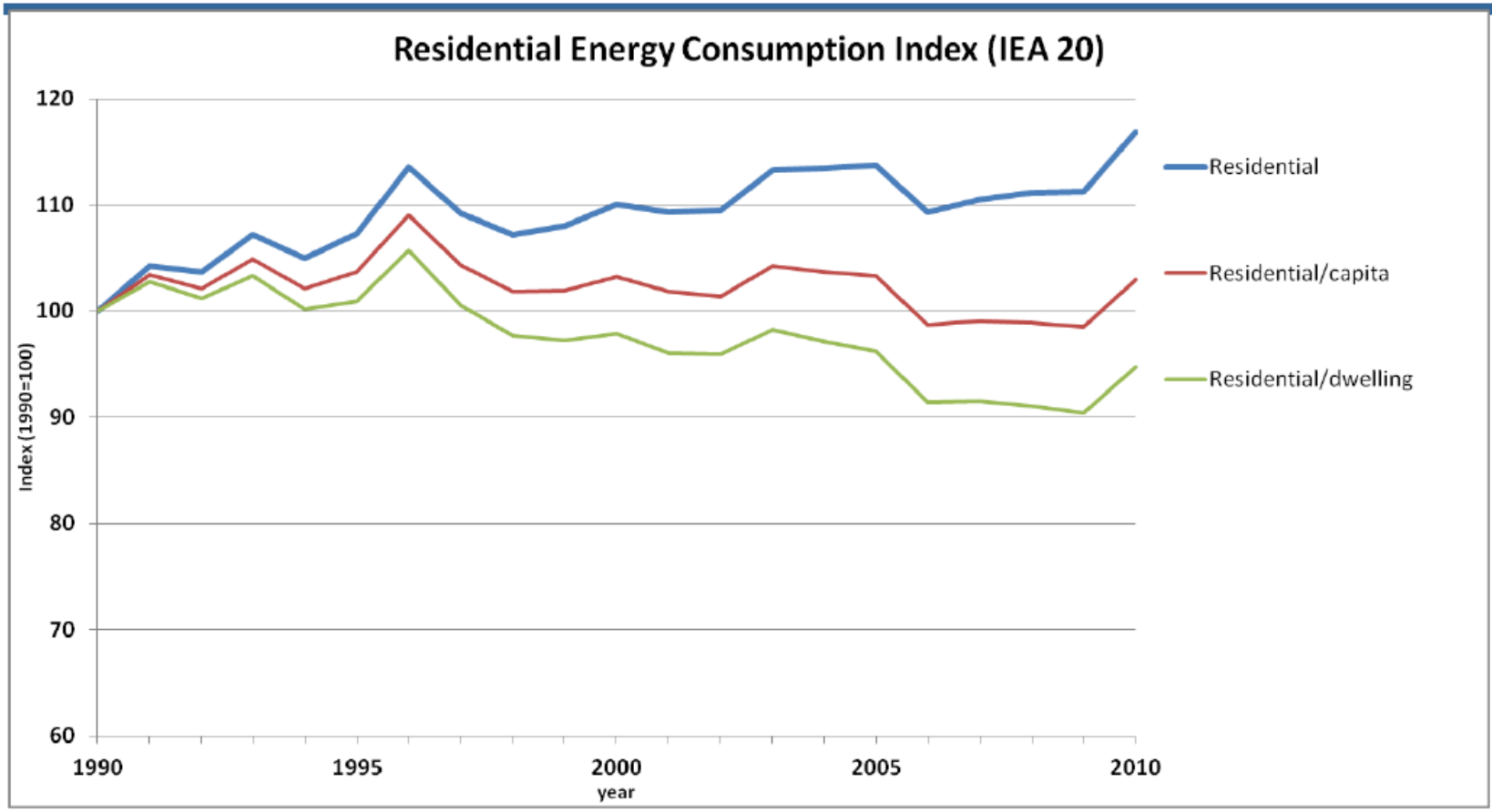
The IEA Mobility Model

ETP analysis

- Scenarios allowing to reduce GHG emissions to 2000 levels in 2050



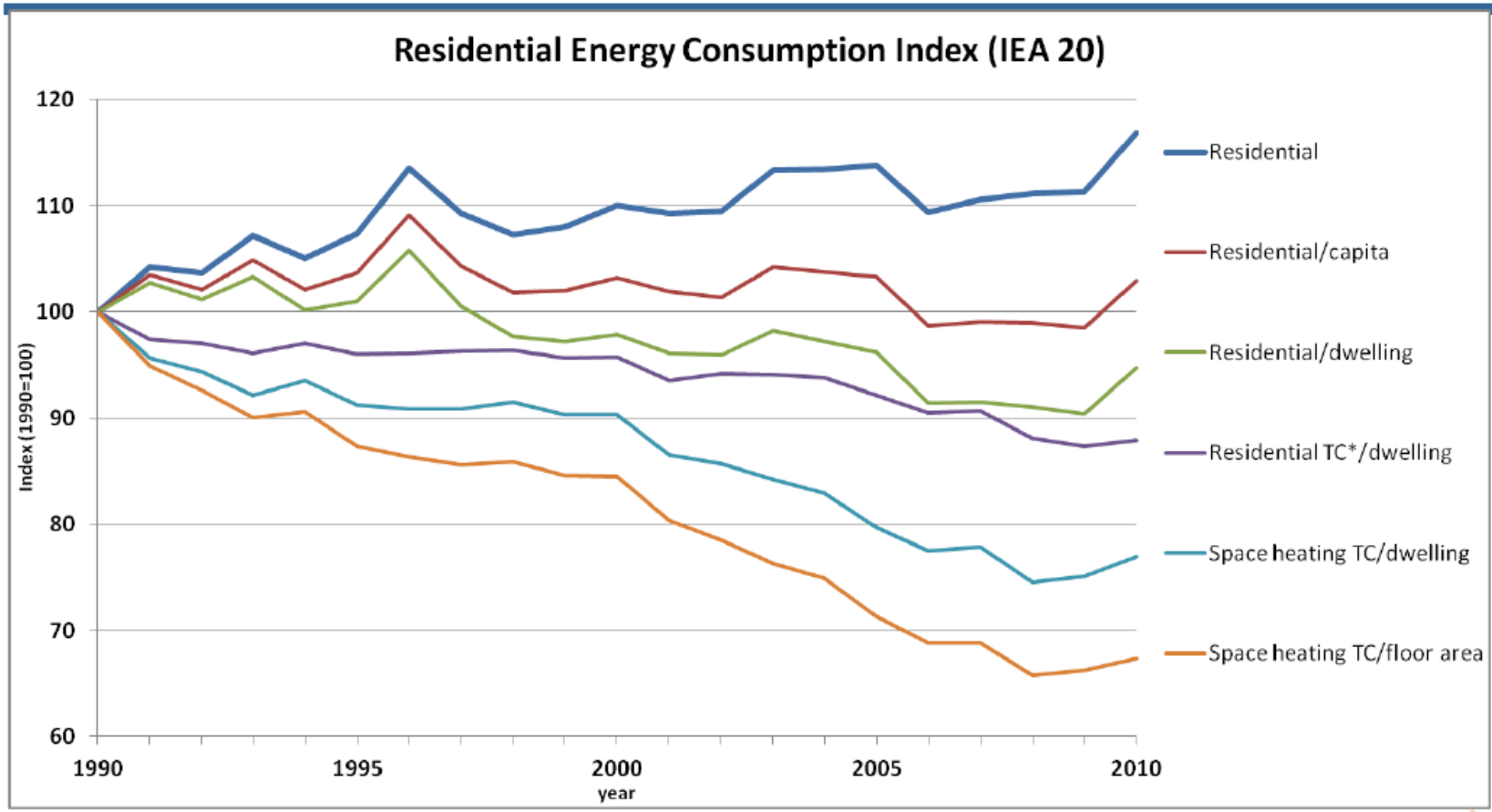
… energy balances, coupled to macroeconomic information, explain basic energy consumption patterns



Data for IEA 20 (Australia, Austria, Canada, Czech Republic, Denmark, Finland, France, Germany, Hungary, Ireland, Italy, Japan, Netherlands, Norway, Slovakia, Spain, Sweden, Switzerland, UK, USA).

Source: IEA energy balances.

… but we need more disaggregated data to get the full picture

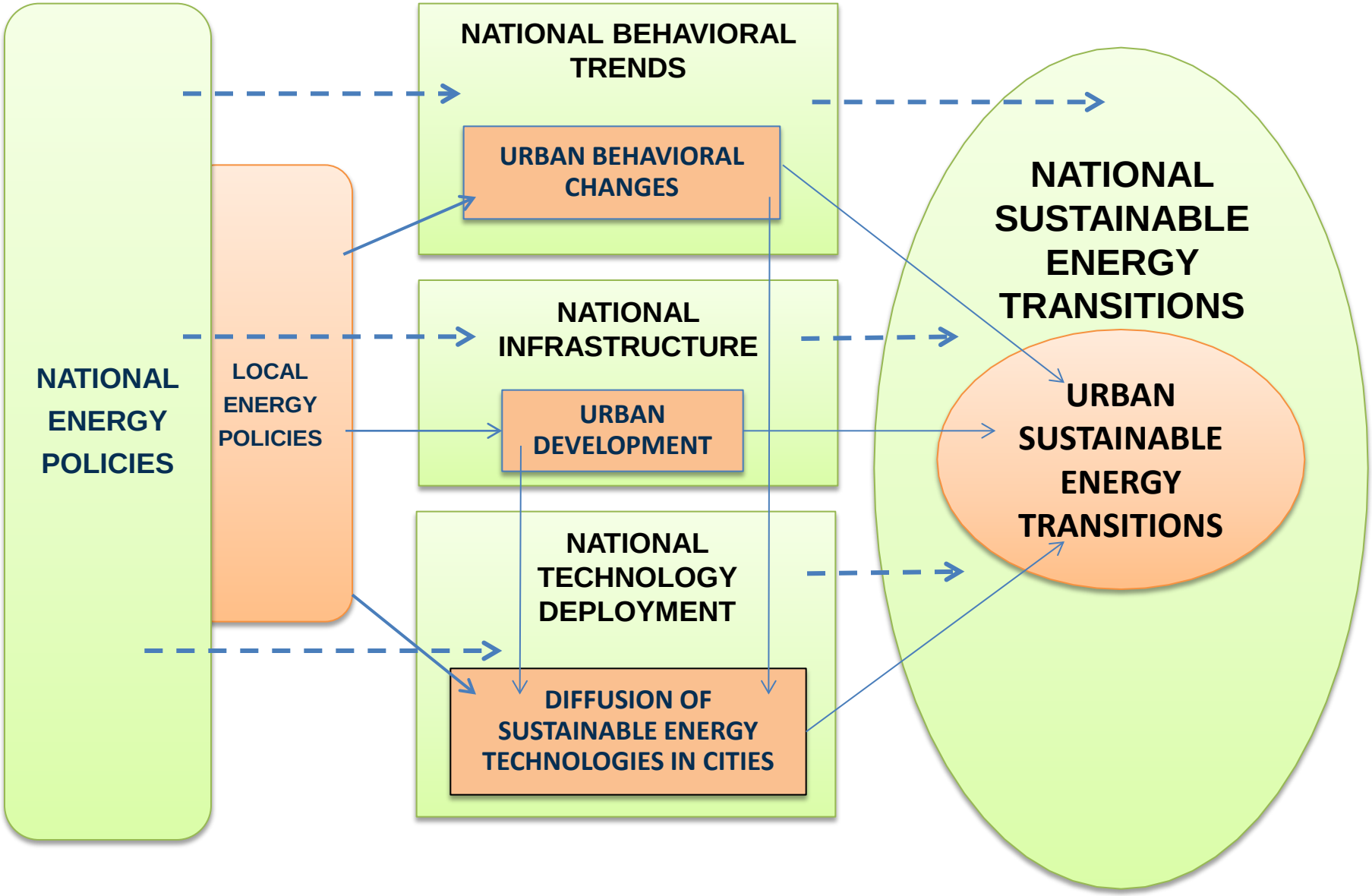


* Temperature correction using heating degree days

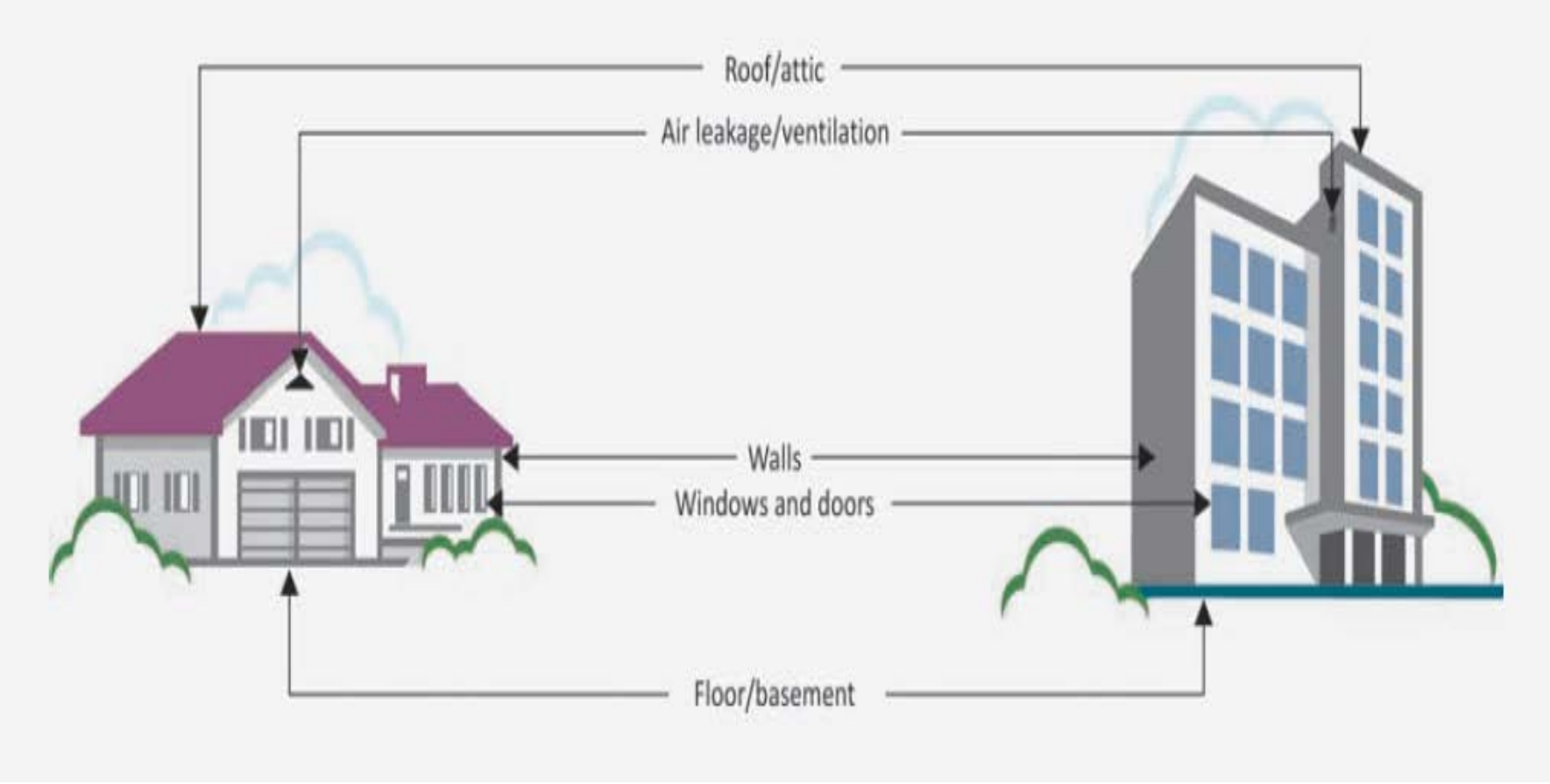
Data for IEA 20 (Australia, Austria, Canada, Czech Republic, Denmark, Finland, France, Germany, Hungary, Ireland, Italy, Japan, Netherlands, Norway, Slovakia, Spain, Sweden, Switzerland, UK, USA).

Source: IEA energy indicators database.

ETP 2016: integrating local and national energy policies

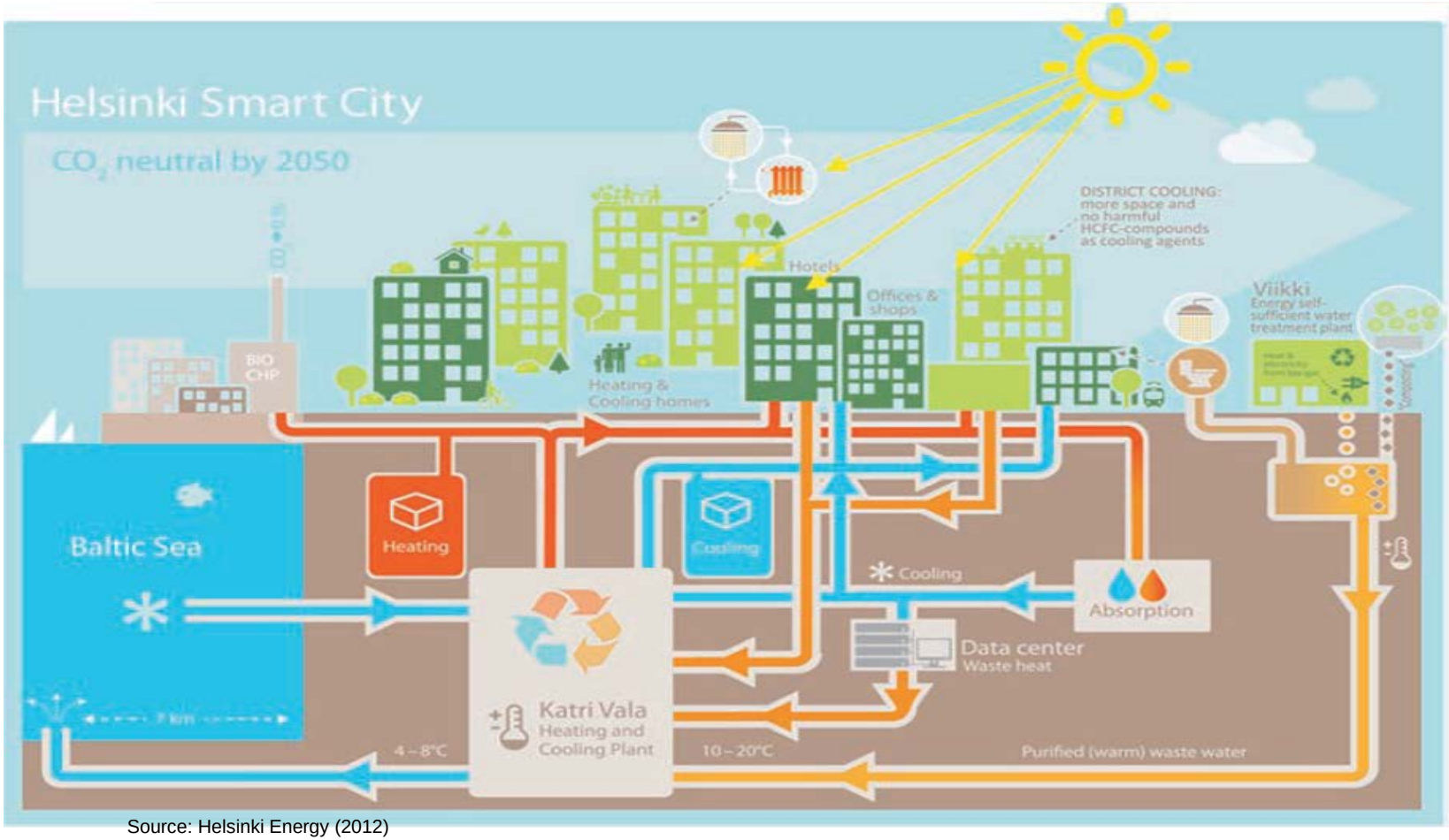


ETP 2016: Sustainable buildings



Sustainable urban buildings incorporate building envelope solutions adapted to denser built environment; district heating

ETP 2016: Sustainable buildings and low-carbon heat supply

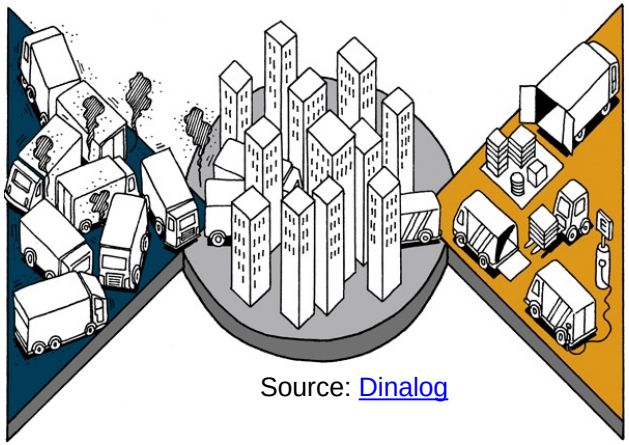


Source: Helsinki Energy (2012)

Meeting thermal comfort demand in dense urban areas in a sustainable way requires informed planning decisions from policy-makers

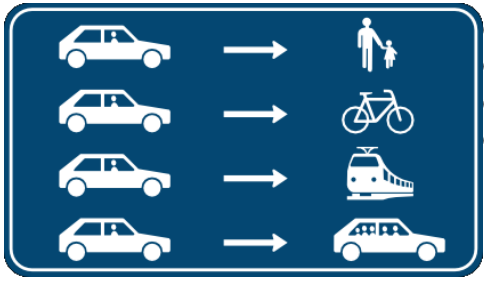
ETP2016: Options for urban mobility

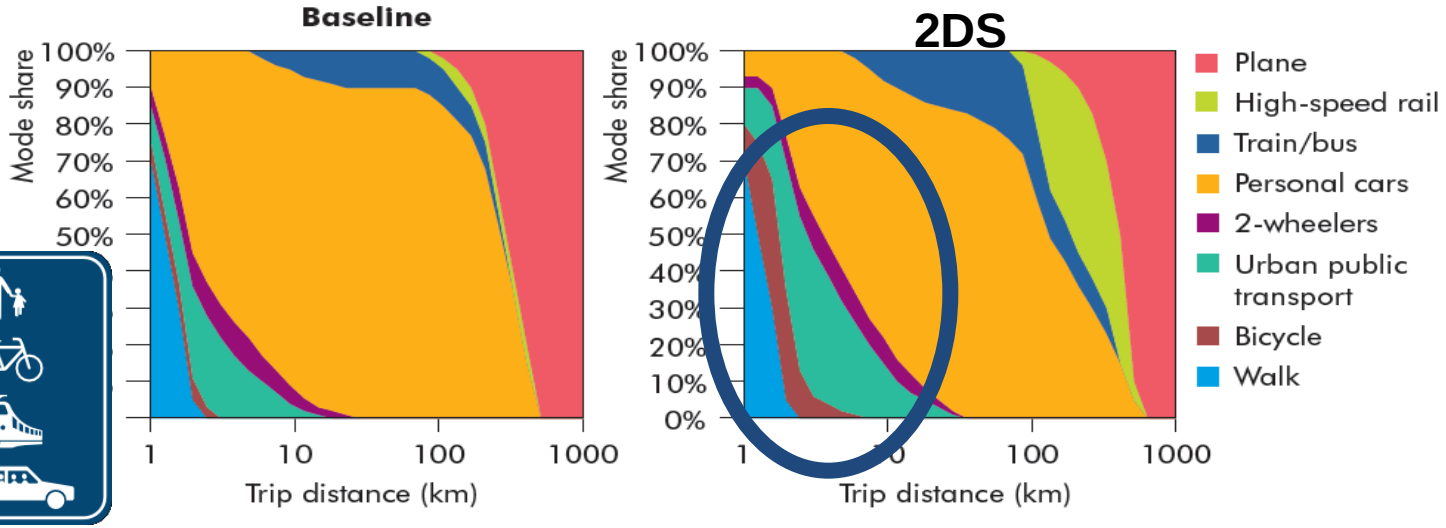
- **Logistics**



Source: Dinalog

- Mode Shares





A significant portion of travel can be avoided or substituted by more efficient modes and lower carbon options

A few IEA global technology collaboration initiatives …

The work included in Industrial Energy-Related Technologies and Systems (IETS) ranges from specific developments of process or energy technologies to overall system aspects, in which energy efficiency is an important part, for practically all types of industry types.

The Energy in Buildings and Community (EBC) Programme carries out research and development activities toward near-zero energy and carbon emissions in the built environment. These joint research projects are directed at energy saving technologies and activities that support technology application in practice.

The Efficiency of End-Use Equipment (4E) IA supports sound policy development in the field of energy efficient appliances and equipment.

The IA for co-operation on Hybrid and Electric Vehicle Technologies and Programmes (IA-HEV) enables member parties to discuss their respective needs, share key information, and learn from an ever-growing pool of experience from the development and deployment of hybrid and electric vehicles.

… 14 IEA Implementing Agreements related to energy end uses and efficiency

https://www.iea.org/aboutus/standinggroupsandcommittees/cert/euwp/