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INTERGOVERNMENTAL PANEL ON climate change

CLIMATE CHANGE 2014

Mitigation of Climate Change

Diana Urge-Vorsatz
Vice Chair,WGIII

Montreal, September 11, 2017

WMO UNEP

Working Group III contribution to the
IPCC Fifth Assessment Report

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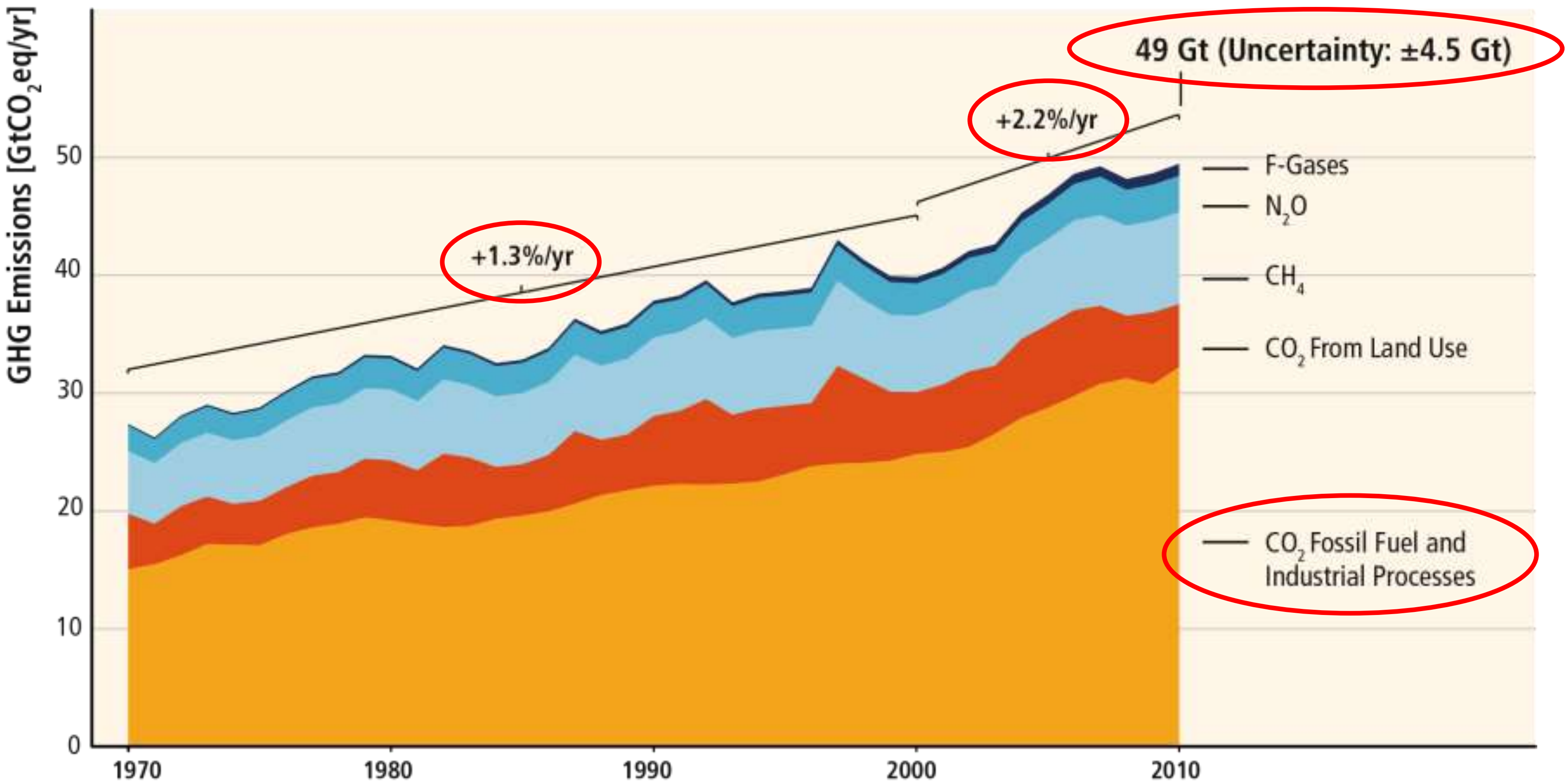
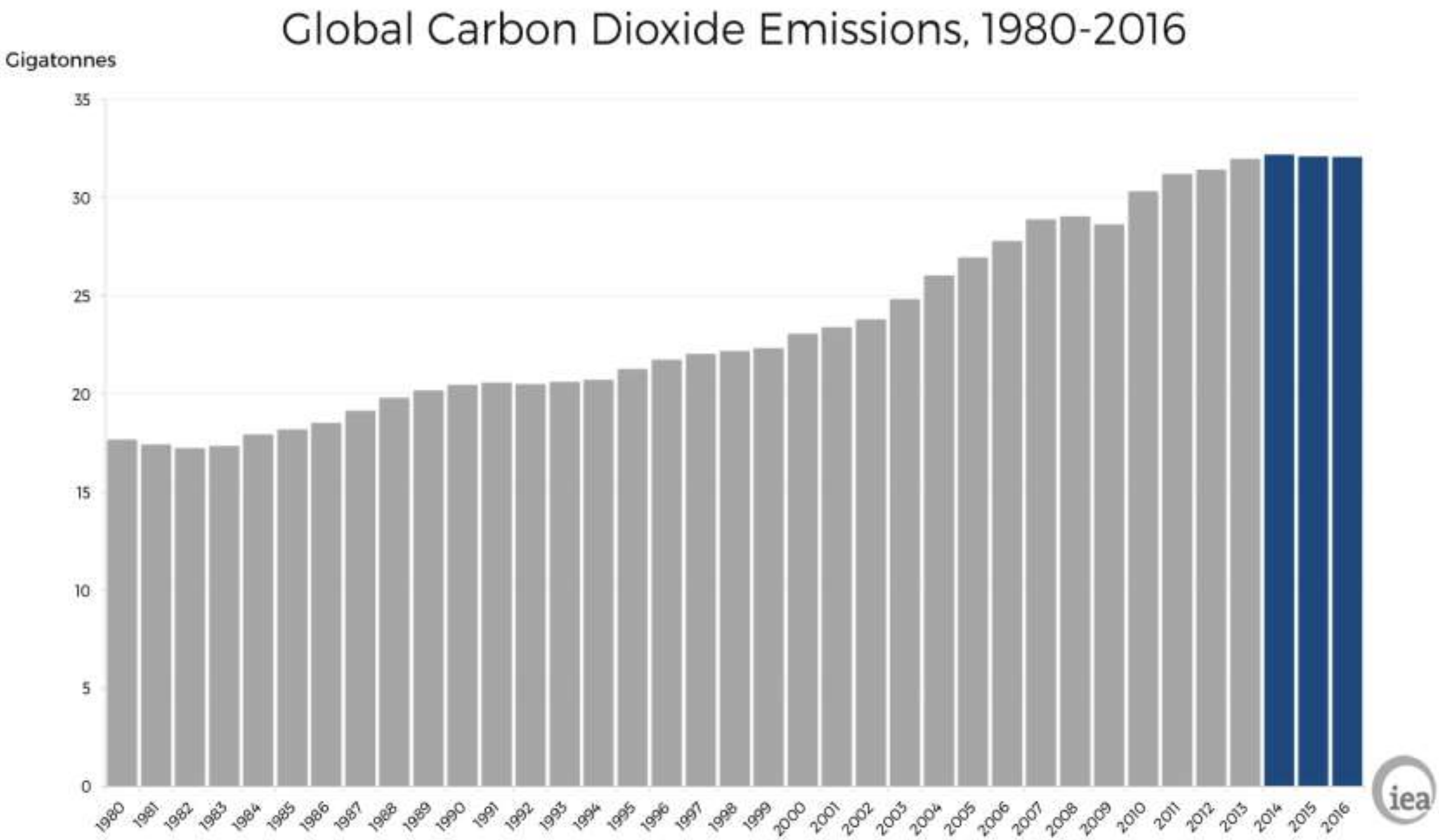
GHG emissions growth has accelerated despite reduction efforts.

GHG emissions growth between 2000 and 2010 has been larger than in the previous three decades.



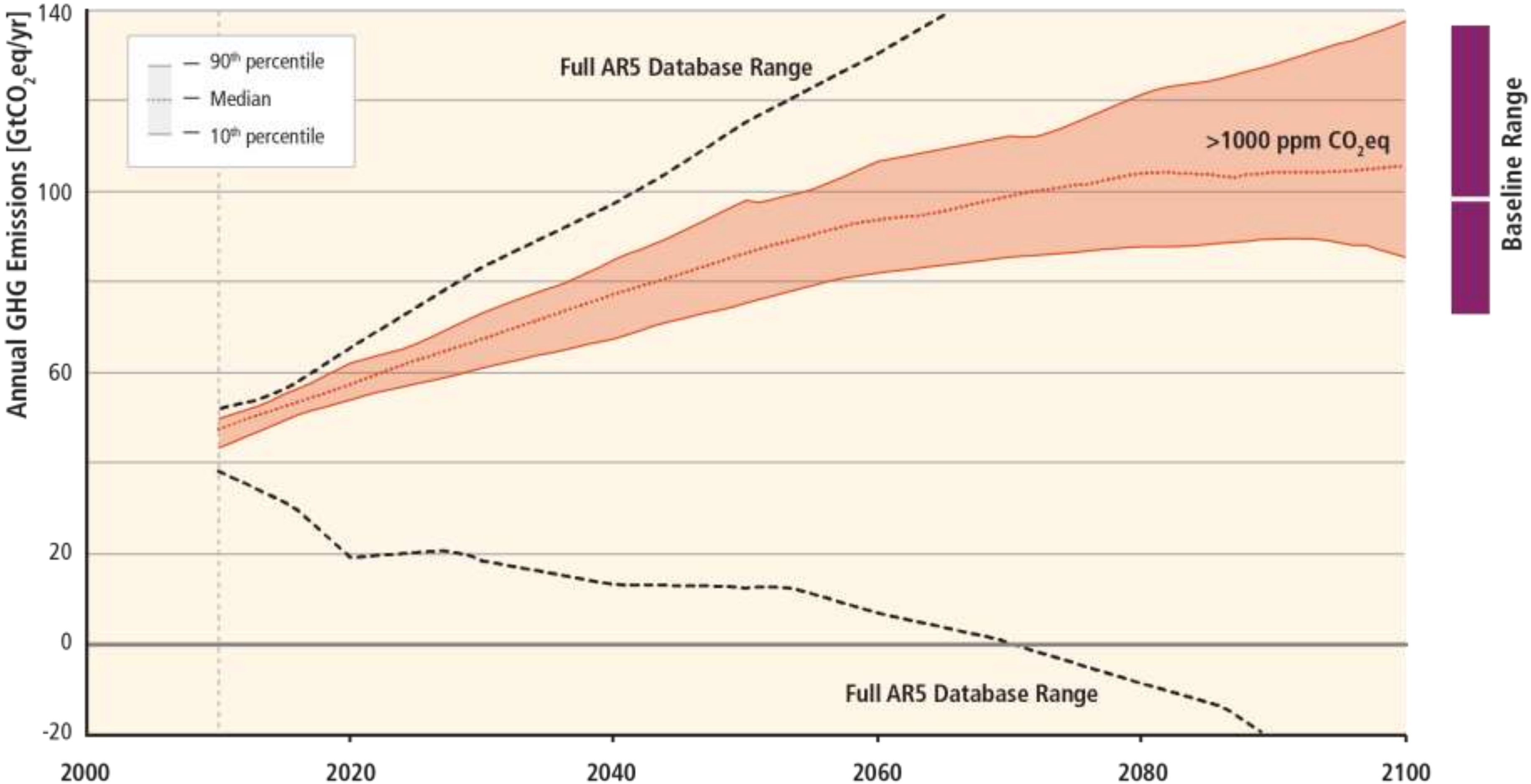
Based on Figure 1.3

Developments since AR5: global emissions have been level for 3 years despite GDP growth (IEA)



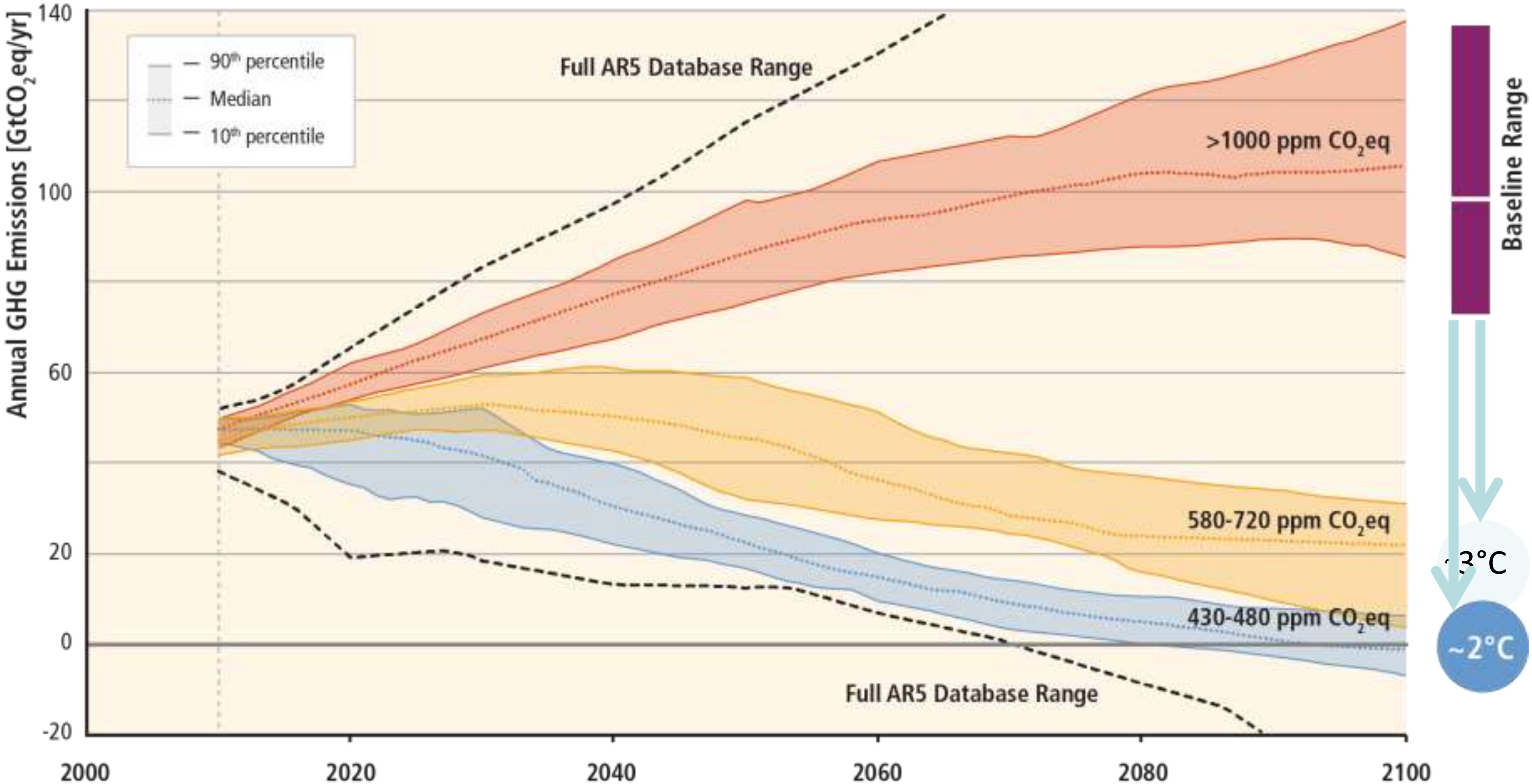
Limiting warming to 2°C is possible but involves substantial technological, economic and institutional challenges

Stabilization of atmospheric GHG concentrations requires moving away from business as usual.



Based on Figure 6.7

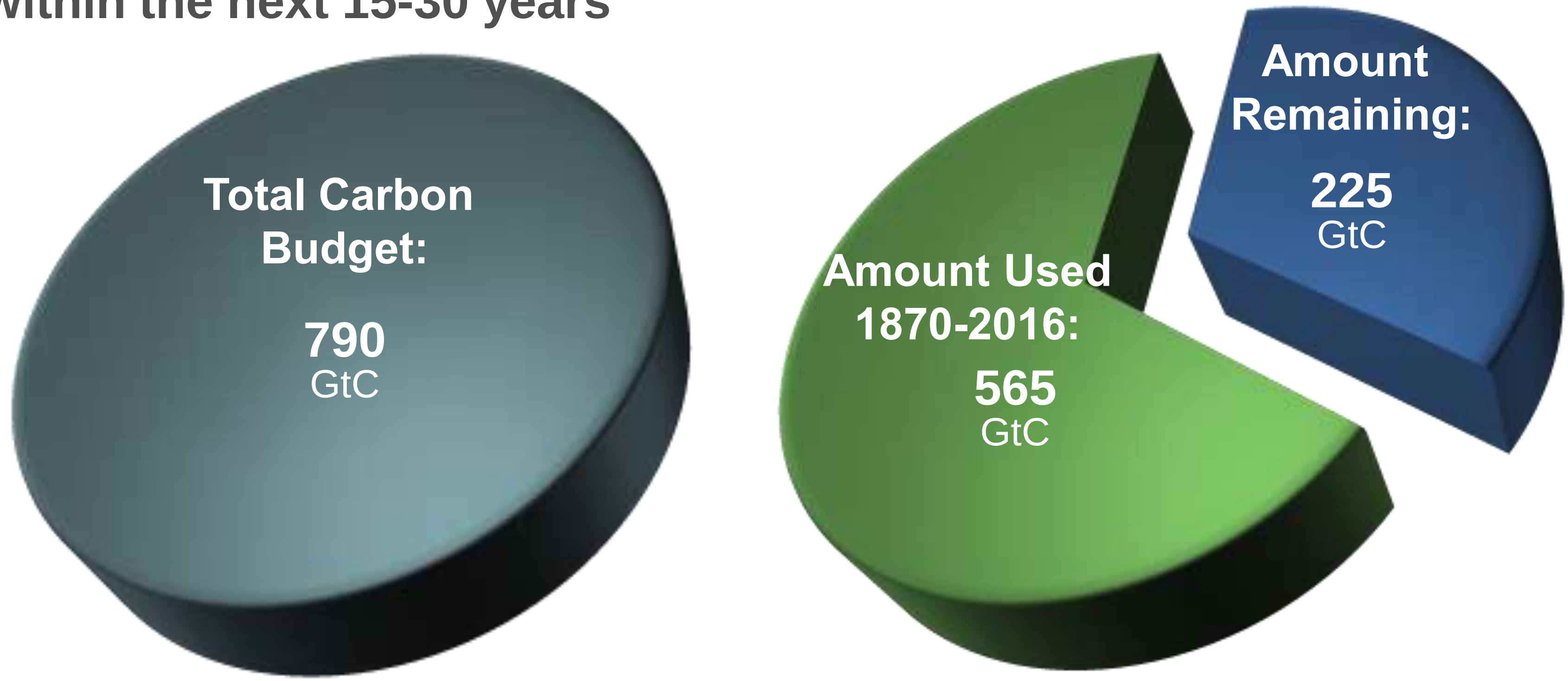
Lower ambition mitigation goals require similar reductions of GHG emissions.



Based on Figure 6.7

The window for action is rapidly closing

72% of our carbon budget compatible with a 2°C goal already used and continued emissions at current levels will exhaust the budget within the next 15-30 years



Mitigation cost estimates vary, but do not strongly affect global GDP growth.

Ambitious Mitigation Is Affordable

- ➜ Economic growth reduced by ~ 0.06% (BAU growth 1.6 - 3%)
- ➜ This translates into delayed and not forgone growth
- ➜ Estimated cost does not account for the benefits of reduced climate change
- ➜ Unmitigated climate change would create increasing risks to economic growth
- ➜ Opportunities for economic diversification

Source: AR5 WGI and WGII SPMs

There are several mitigation options that can also contribute towards development goals

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"Overall, the potential for co-benefits for energy end-use measures outweigh the potential for adverse side-effects, whereas the evidence suggests this may not be the case for all energy supply and AFOLU measures." (SPM 4.1)

How mitigation options can go hand-in-hand with development goals (co-benefits)

- Air quality improvement – indoor and outdoor
- Health – e.g. through indoor and outdoor air quality improvement, reduced thermal stress, increased activity
- Energy security
- Efficiency increases access to energy services
    - fuel poverty could be eliminated
- Better employment and economic opportunities through accessivity
- Reduced congestion
- Others: biodiversity conservation, water availability, food security, income distribution, improved productivity, efficiency of the taxation system, labour supply and employment, urban sprawl, and the sustainability of the growth of developing countries

IPCC Sixth Assessment (AR6)

Some overarching preliminary aspects for the Synthesis Report

- *Global Stocktake*
- *Interaction among emissions, climate, risks and development pathways*
- *Economic and social costs and benefits of mitigation and adaptation in the context of development pathways*
- *Adaptation and mitigation actions in the context of sustainable development*
- *Finance and means of support*

May 2019
Emission inventories

Oct. 2018
Global warming of 1.5 °C

Talanoa dialogue UNFCCC

Sept. 2019
Oceans and cryosphere

Land
Aug. 2019

April 2021
The Physical Science Basis

Mitigation of Climate Change
July 2021

October 2021
Climate Change Impacts, Adaptation and Vulnerability

April 2022
The Synthesis Report

Global stocktake 2023 UNFCCC

March 2018 — Cities and Climate Change Science Conference

May 2018 — Expert Meeting on Assessing Climate Information for Regions

May 2018 — Expert Meeting on Short Lived Climate Forcers

**** Dates are subject to change***

Thank you for your attention

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Supplementary slides

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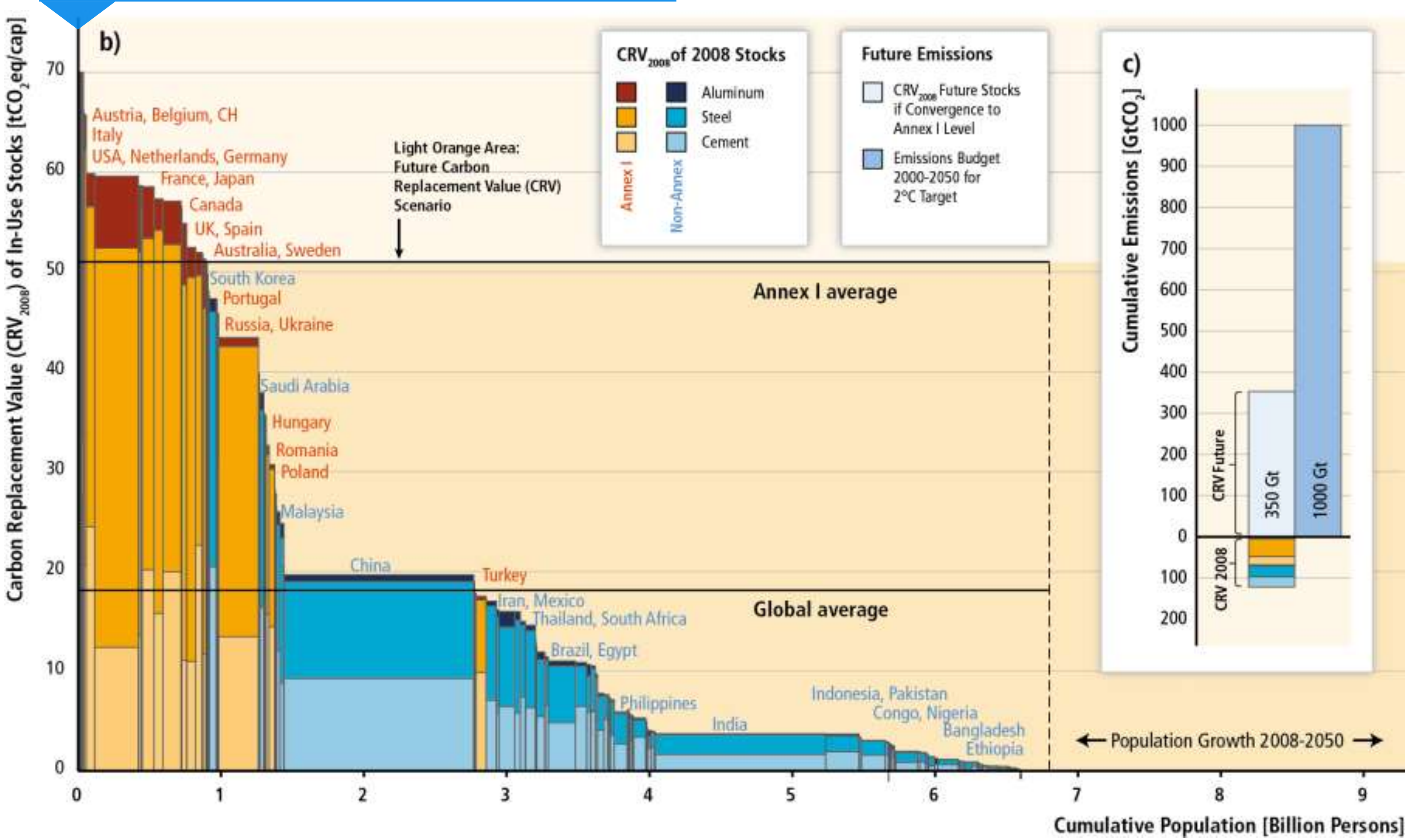
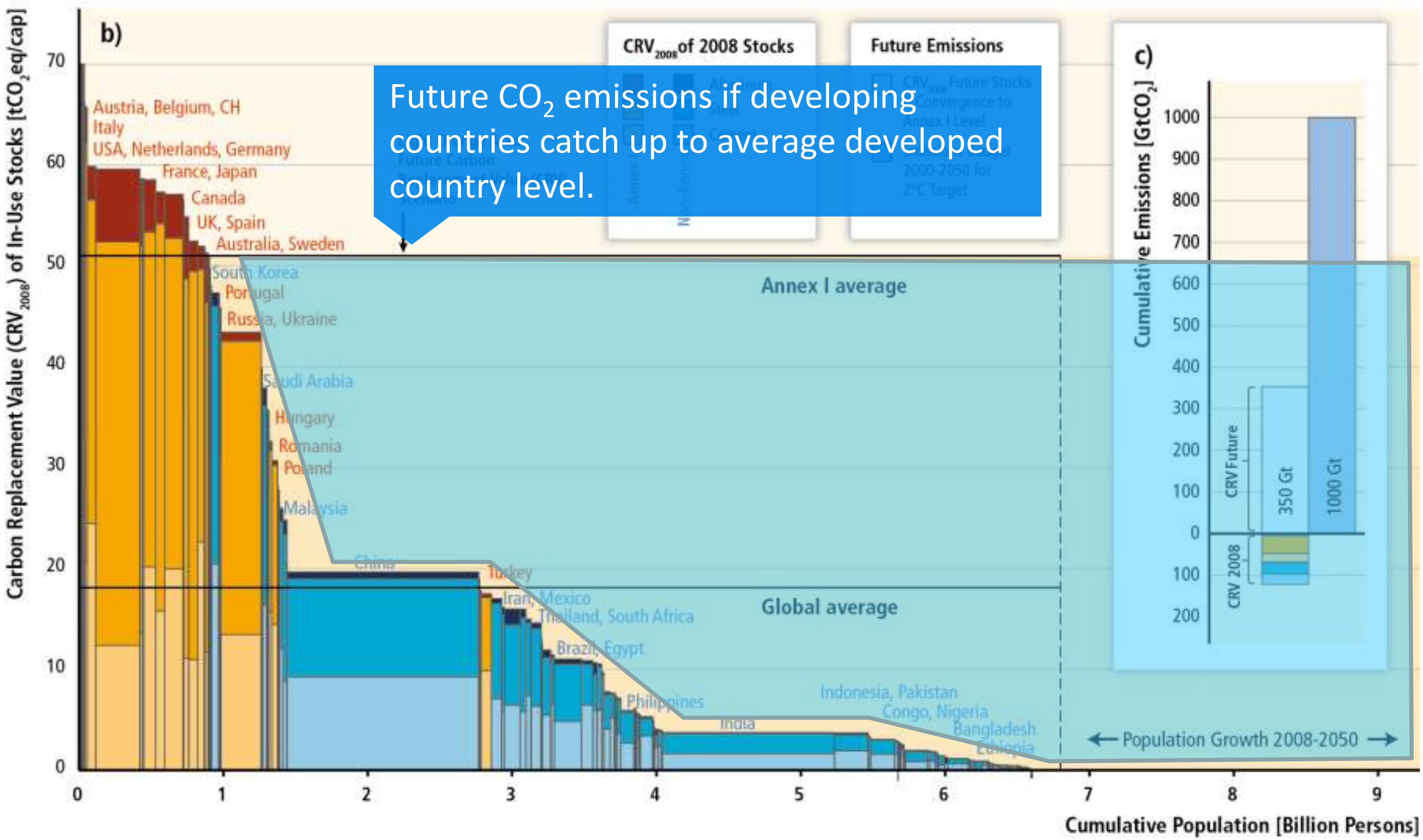
Key Message 4: Infrastructure build-up over the next few decades will result in significant emissions

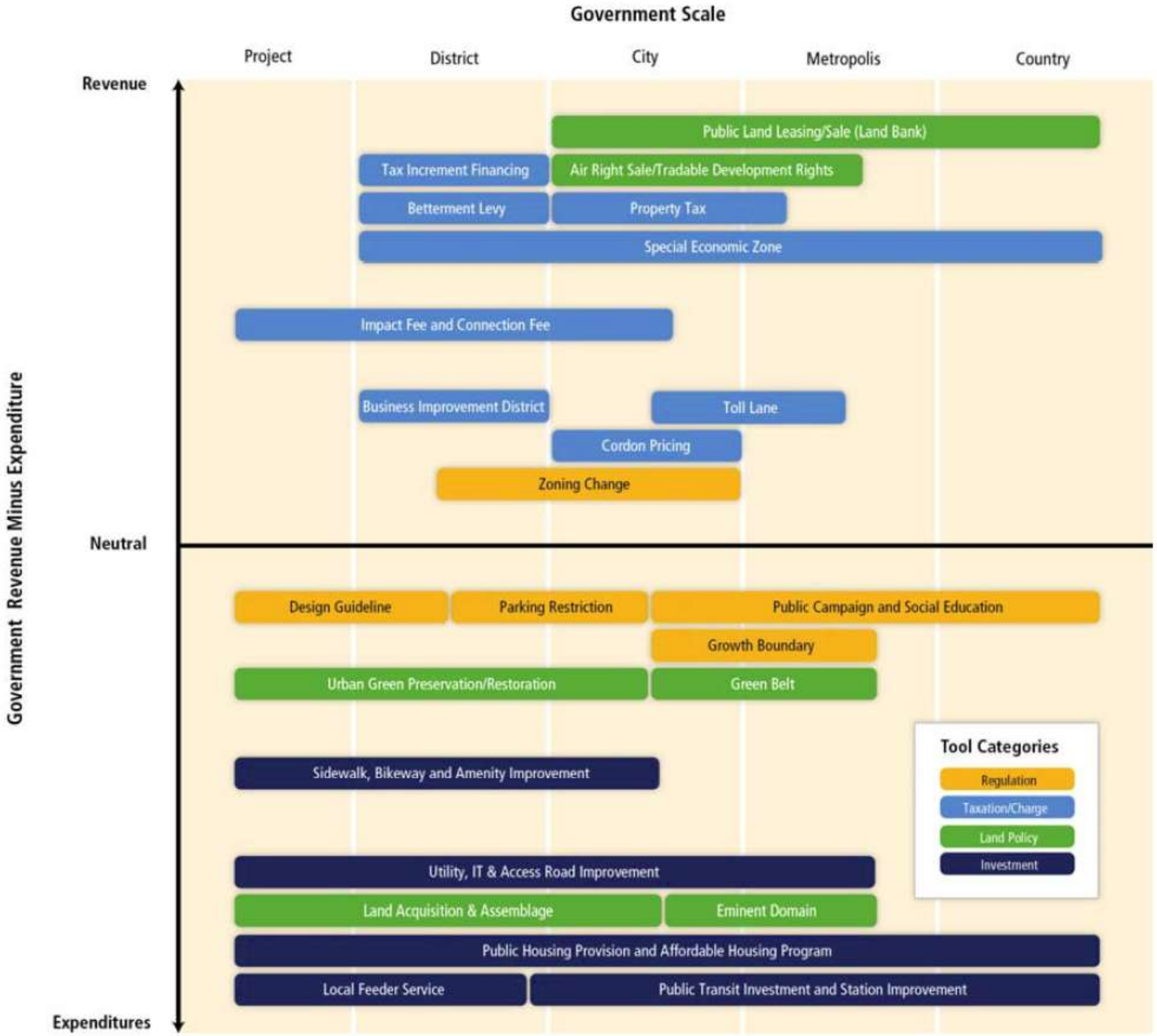
Total CO_2 emissions (per capita) needed to build up today's infrastructure



Key Message 4: Infrastructure build-up over the next few decades will result in significant emissions



Key Message 5: Large mitigation opportunities exist where urban form is not locked in, but often where there are limited financial and institutional capacities



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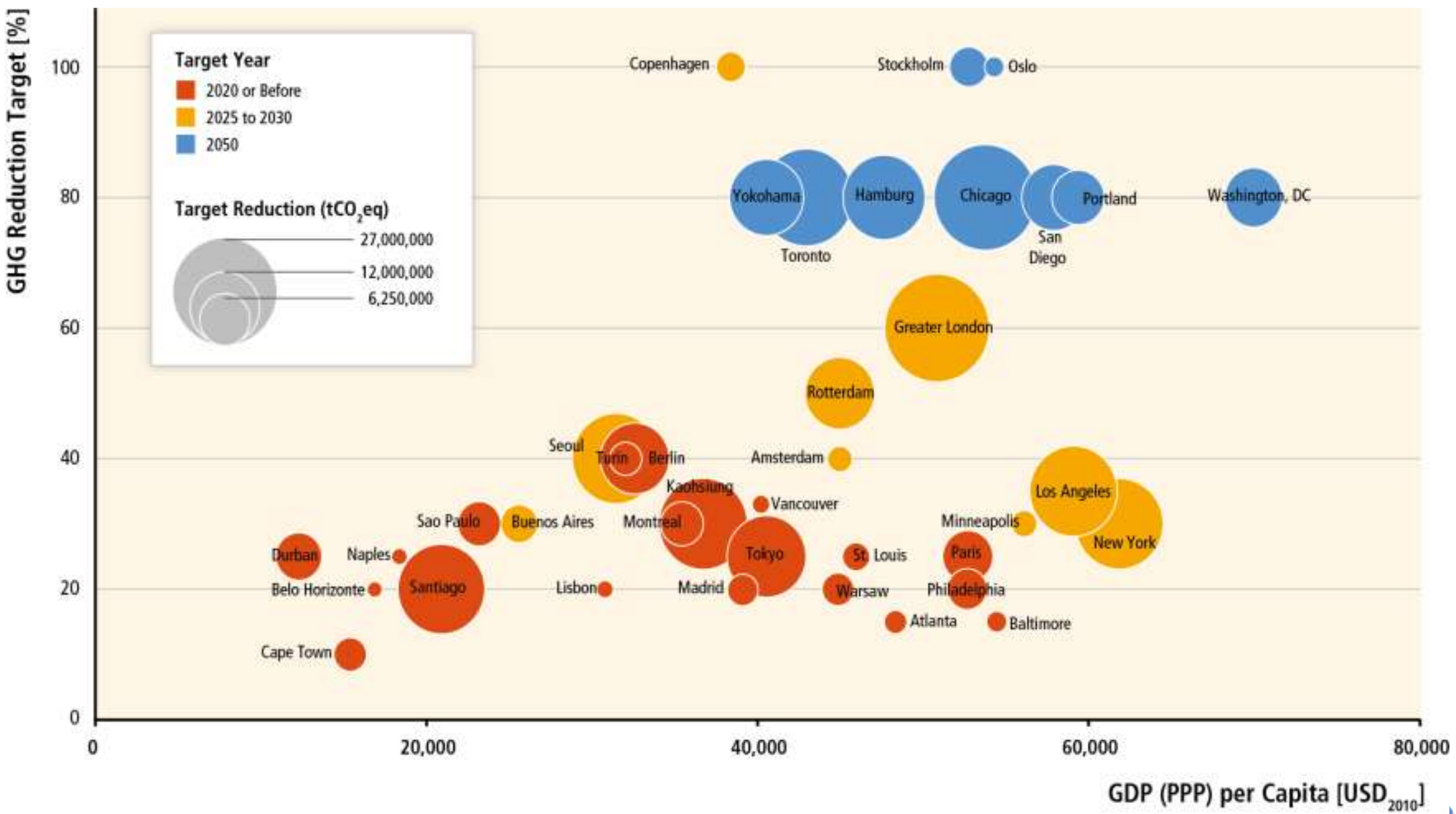
Key Message 6: Thousands of cities are undertaking climate action plans, but their impact on urban emissions is uncertain



Summary

1. Urban areas contribute considerably to global primary energy demand and energy-related CO_2 emissions.

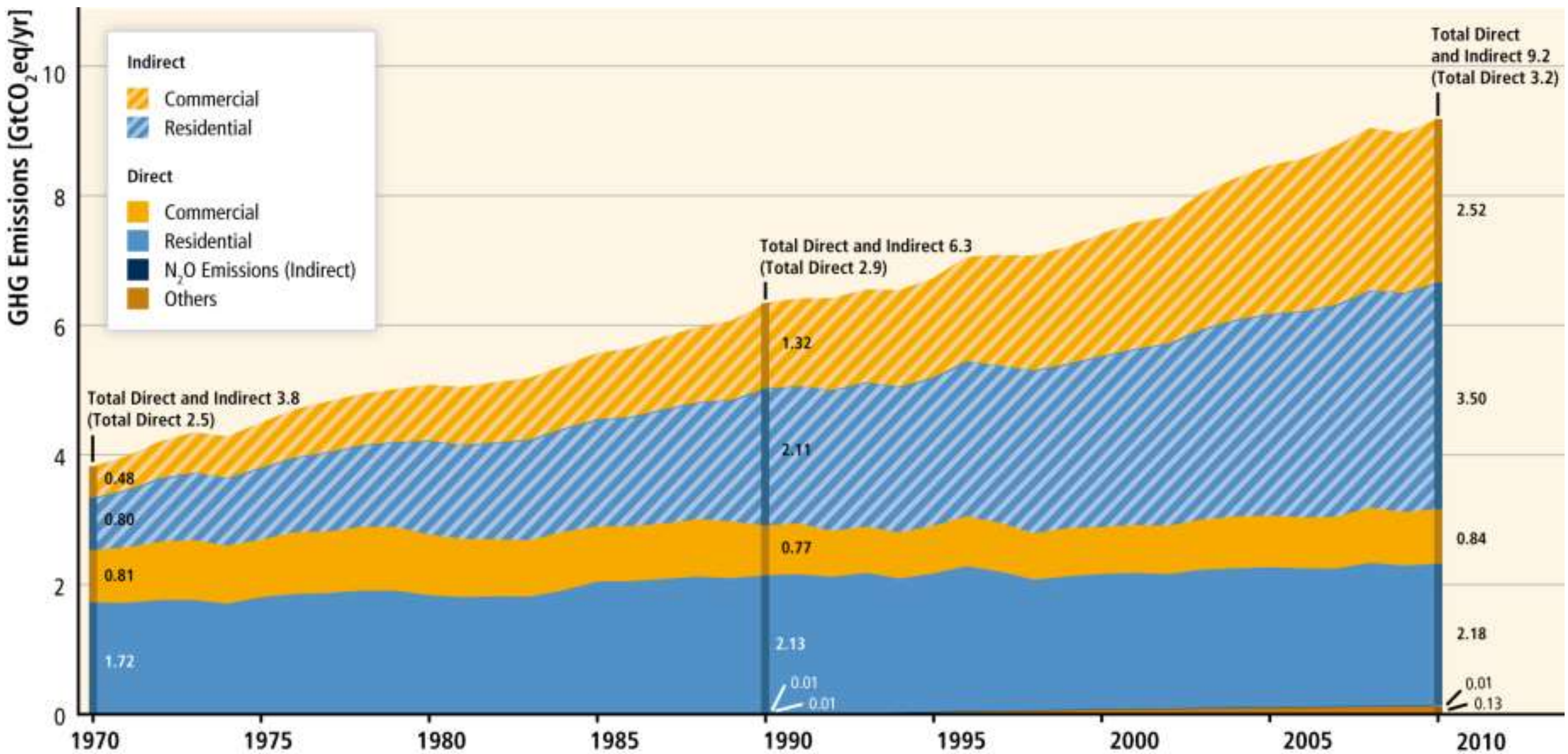
2. The feasibility of spatial planning instruments for climate change mitigation depends highly upon each city's financial and governance capability.

3. Urban planning mitigation options include:
    1. increasing accessibility
    2. increasing connectivity
    3. increasing land use mix
    4. increasing transit options
    5. increasing and co-locating employment and residential densities
    6. increasing green space and other carbon sinks

1. The building sector is responsible for a high share of emissions

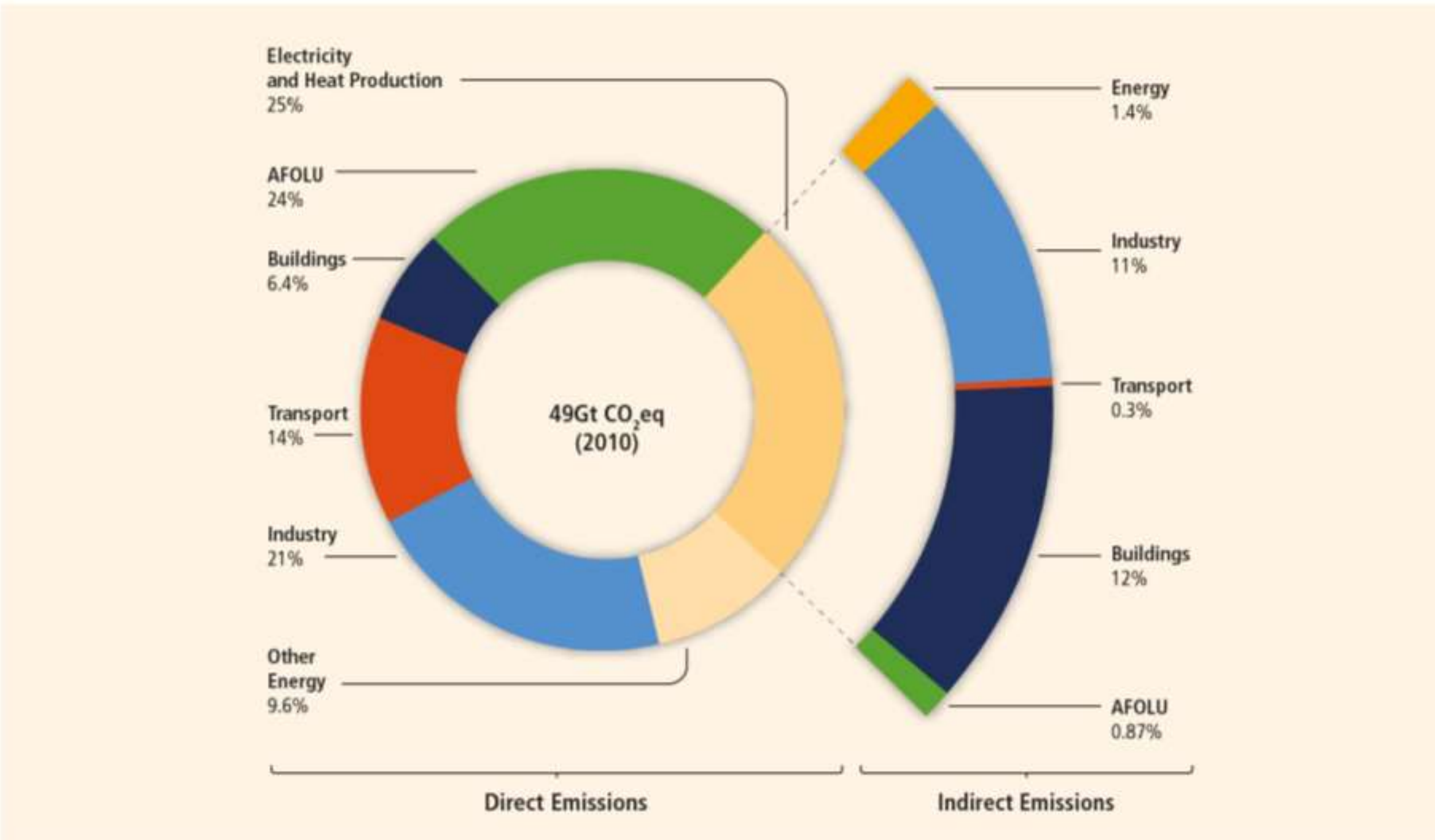
In 2010, the building sector accounted for

- 117 EJ or 32% of global final energy
- 25% of energy-related CO2 emissions (9.2 Gt CO2e)
- 51% of global electricity consumption
- a significant amount of F-gas emissions: up to a third of all such emissions
- app. one-third of black carbon emissions

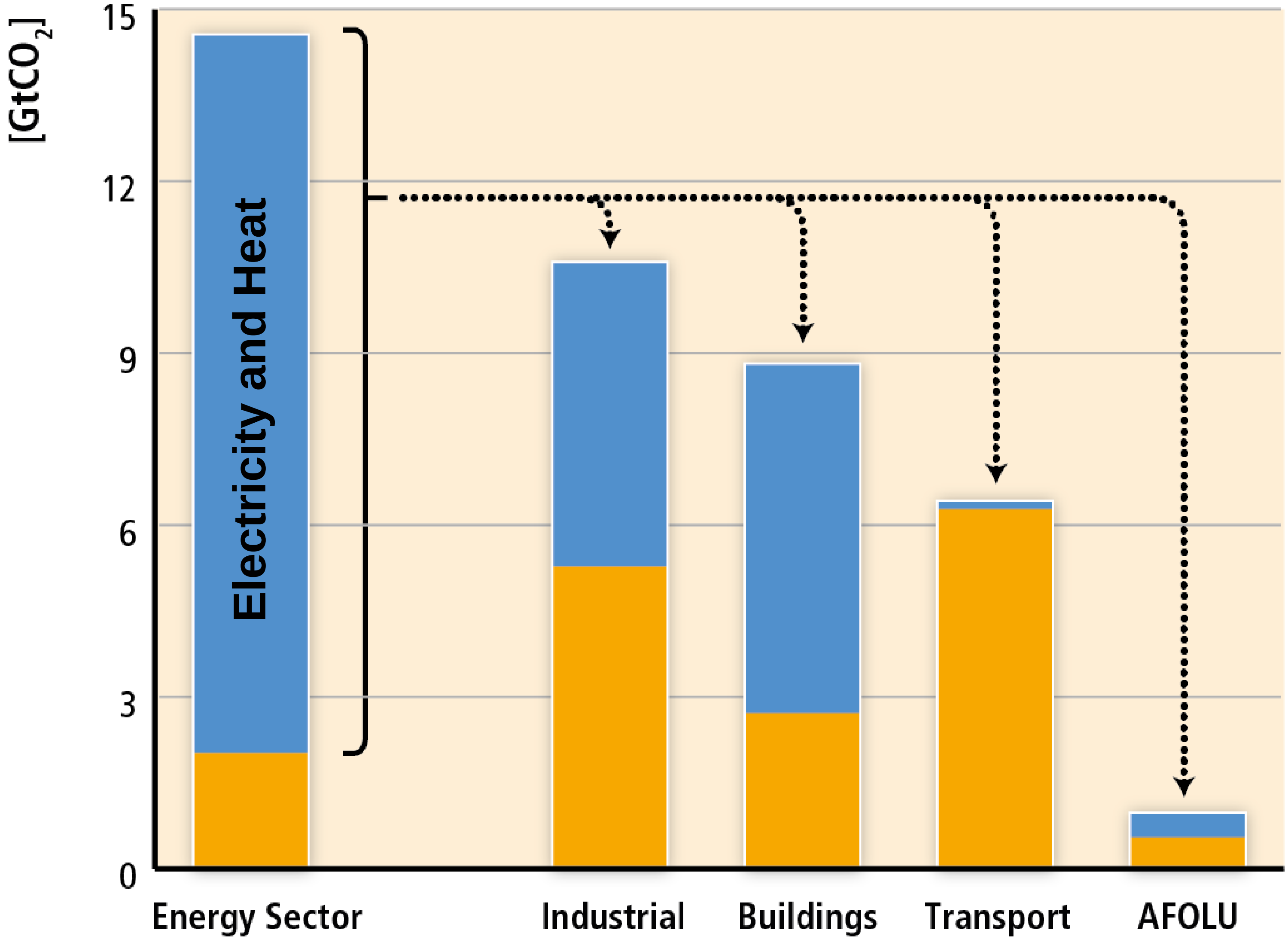


GHG Emissions [$GtCO_2$eq/yr]
Indirect
Commercial
Residential
Direct
Commercial
Residential
N_2O Emissions (Indirect)
Others
Total Direct and Indirect 3.8
(Total Direct 2.5)
0.48
0.80
0.81
1.72
Total Direct and Indirect 6.3
(Total Direct 2.9)
1.32
2.11
0.77
2.13
0.01
0.01
Total Direct
and Indirect 9.2
(Total Direct 3.2)
2.52
3.50
0.84
2.18
0.01
0.13
0
2
4
6
8
10
1970
1975
1980
1985
1990
1995
2000
2005
2010

Challenge #1
but if only direct emissions are reported, buildings are insignificant



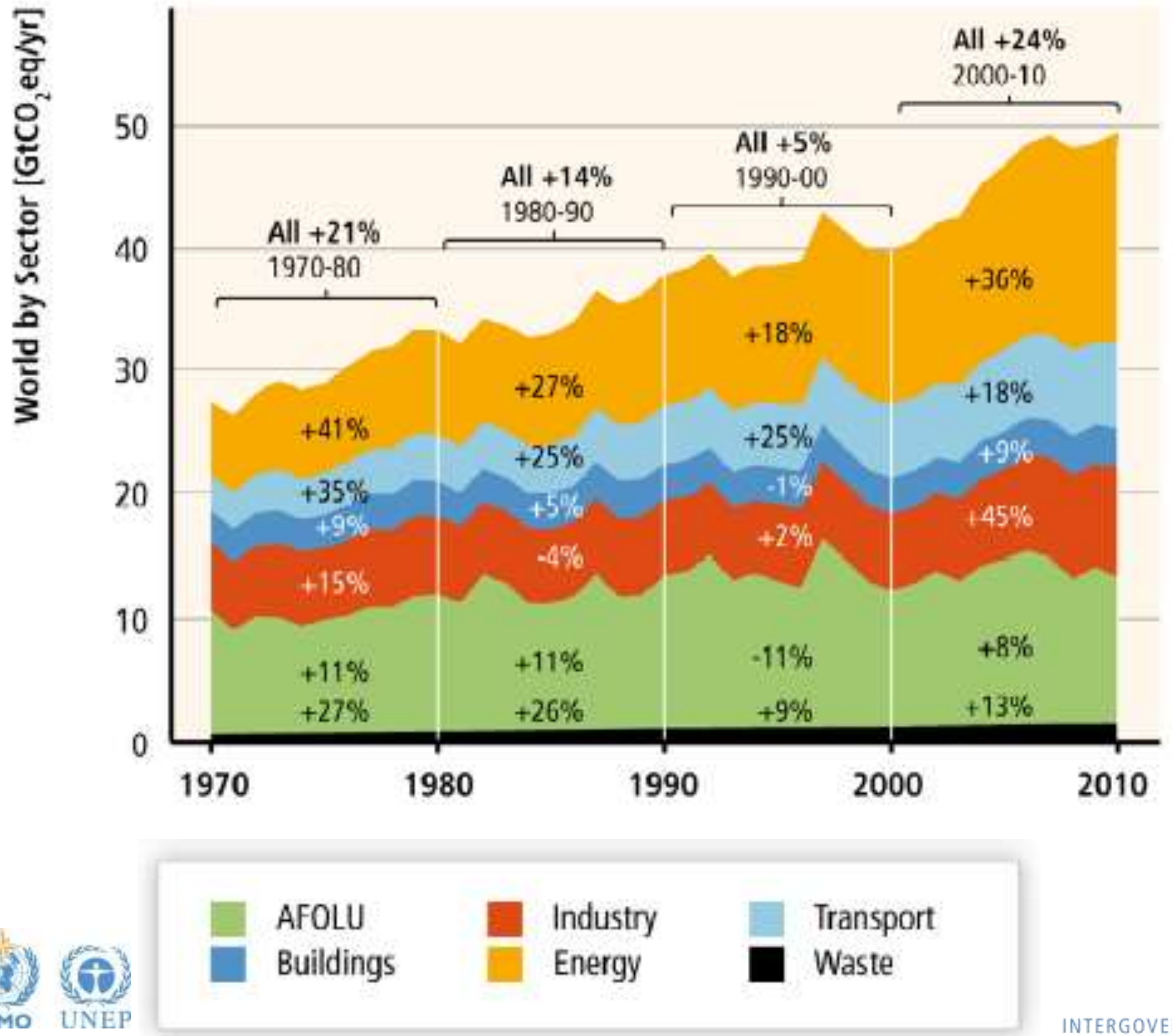
Allocation of Electricity/Heat Generation Emissions to End-use Sectors for 2010



Source: Figure A.II.2

Historical development of emissions by sector (fig 5.18)

(note: direct emissions only)



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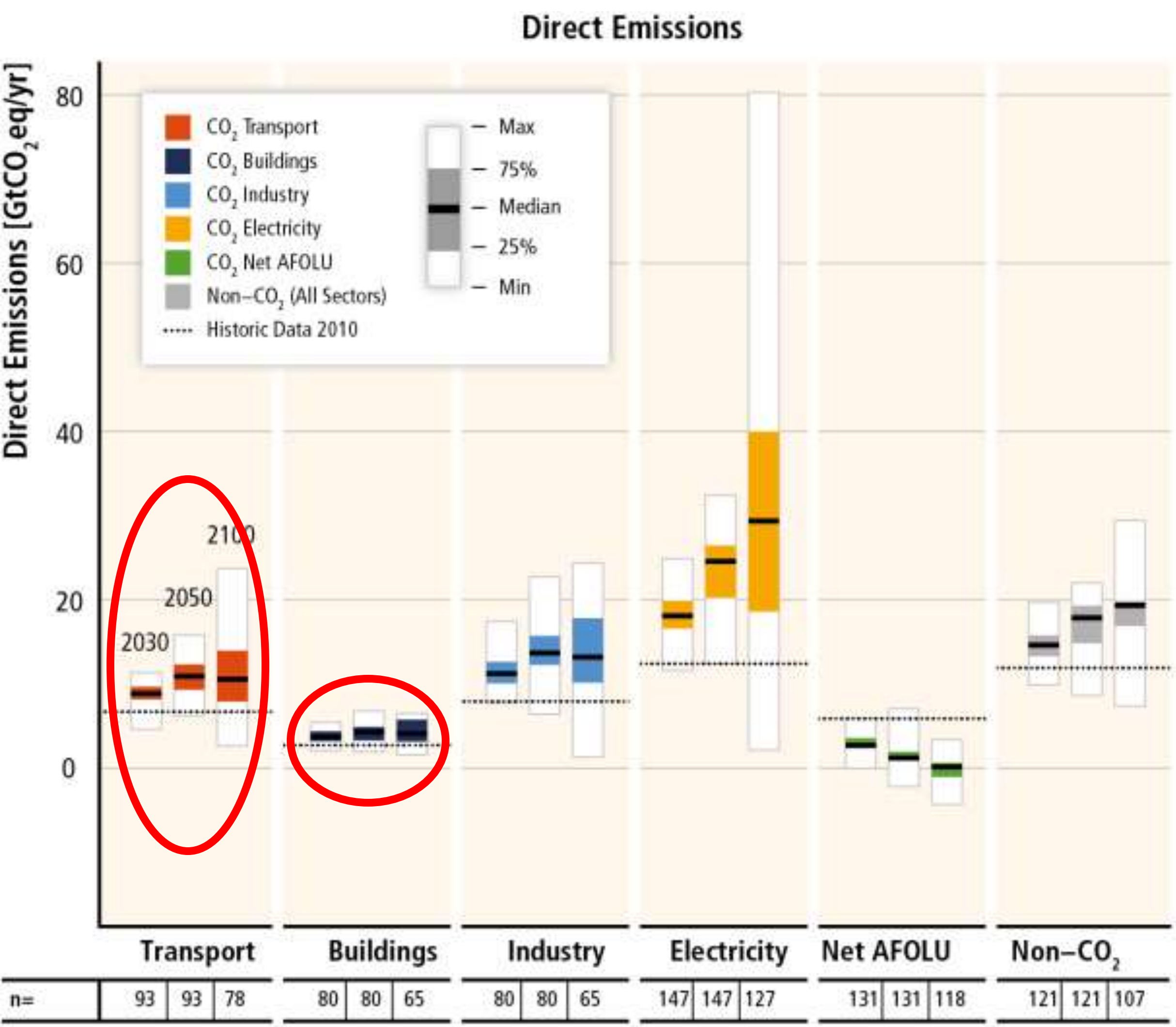
Baseline Scenarios: Direct vs. Indirect Emission Accounting



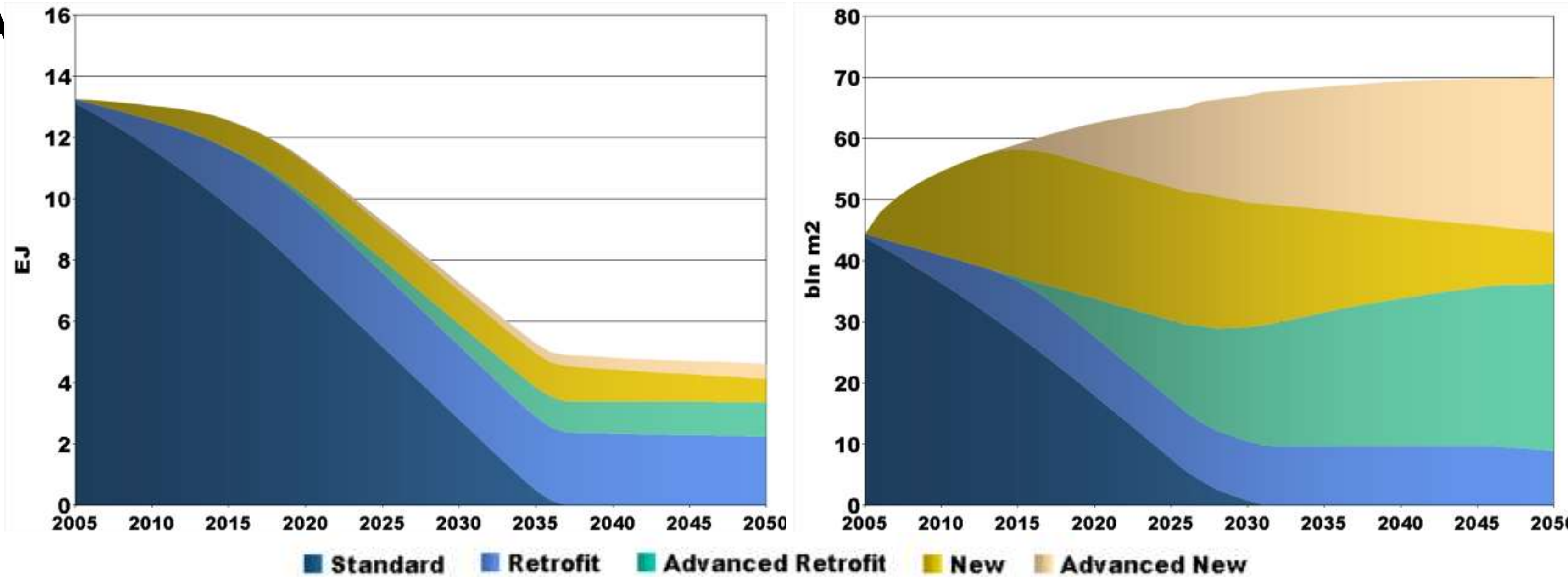
Source: Figure SPM.10, TS.15

Importance of building sector emissions

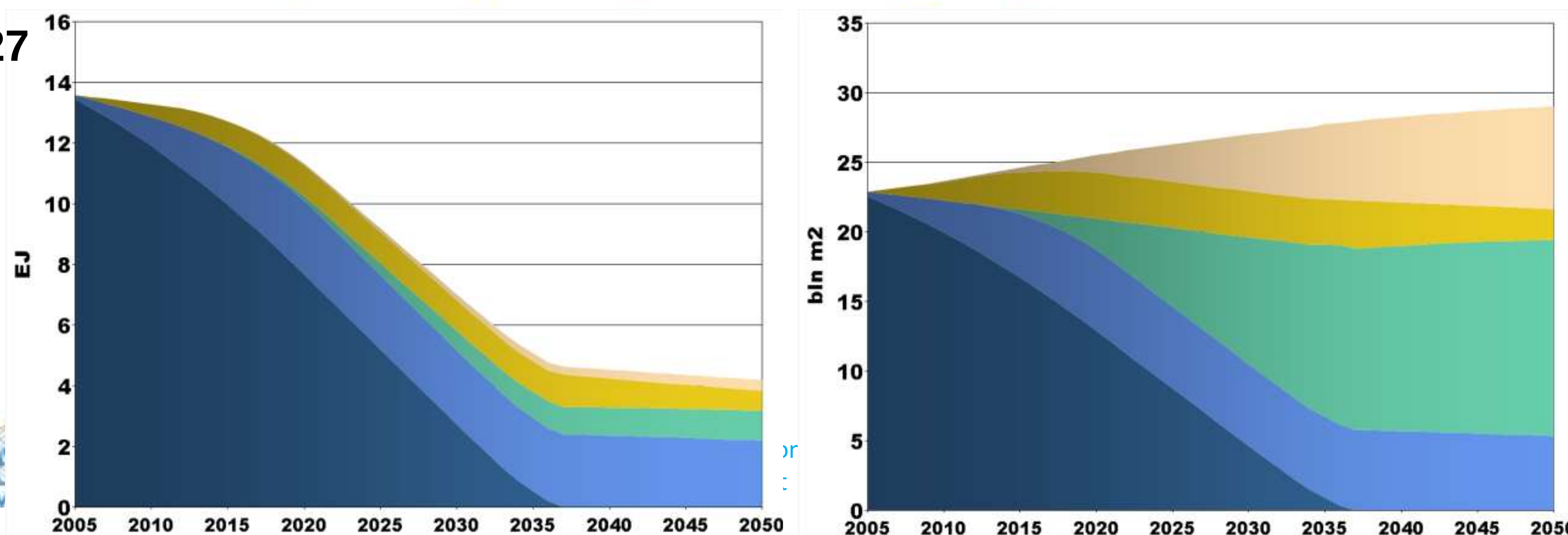
- In developed countries most future building emissions can be affected by retrofits….
- …while in developing countries through new construction.

Final Energy for SH&C and floor area by building vintage. Deep Efficiency Scenario

USA



EU-27



Lesson #2: importance of retrofits

In developed countries, high-efficiency retrofits are the key to a low-emission building future; while in developing countries very high efficiency new buildings (cooling!!).

2. Efficient buildings have a very high mitigation potential

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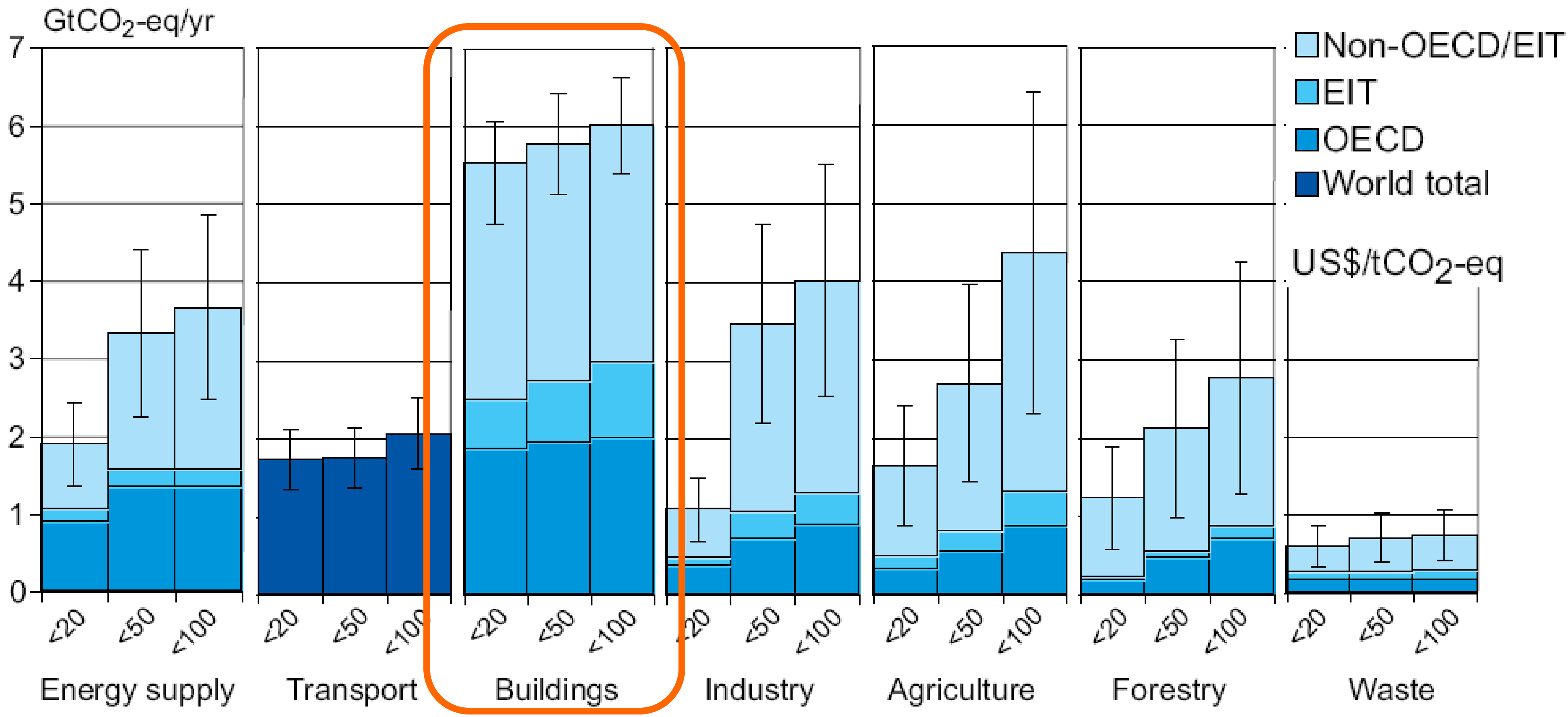
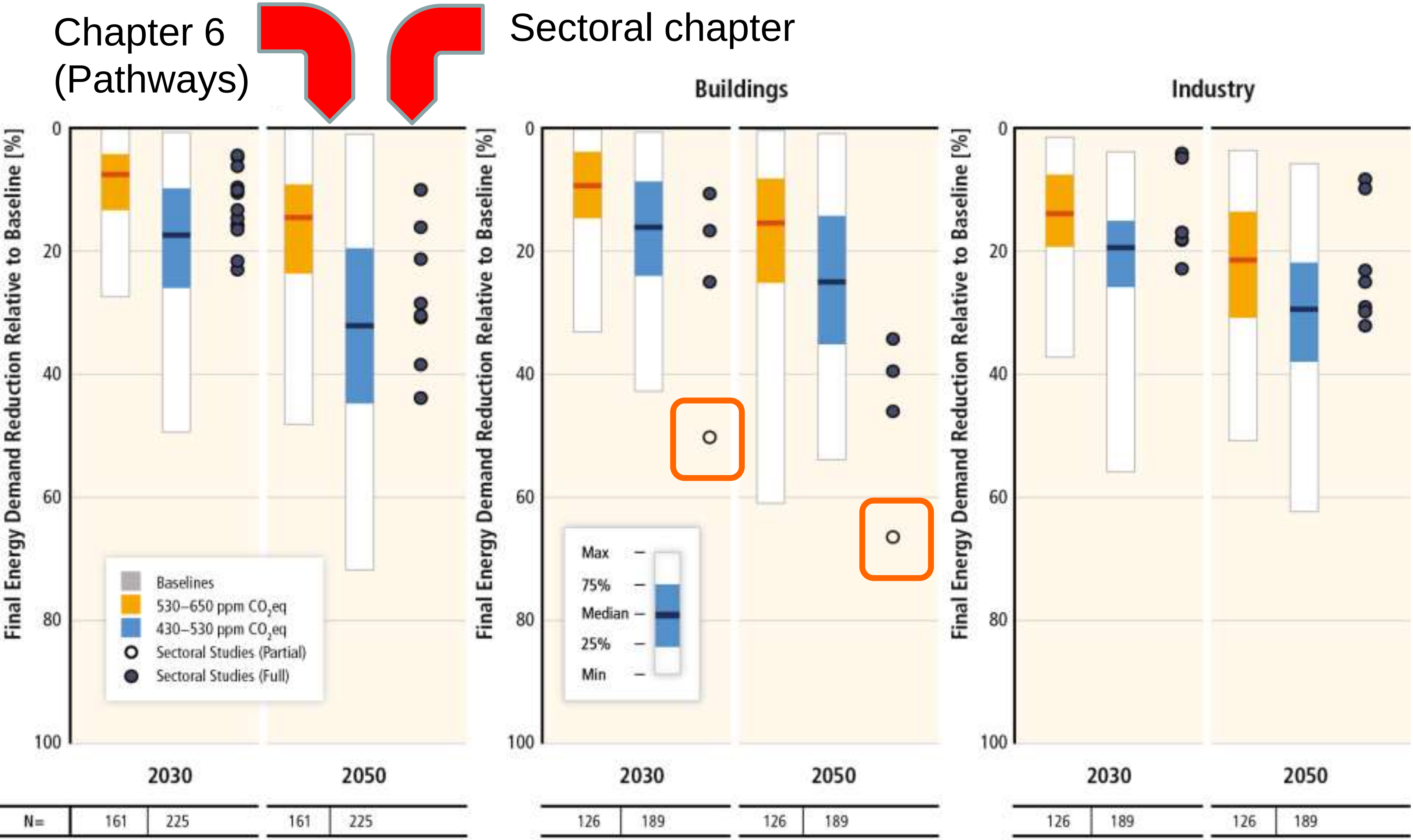
AR4: The buildings sector offers the largest low-cost potential in all world regions by



(potential at <US$100/ tCO_2-eq: 2.4 - 4.7 Gt CO_2-eq/yr)	*(potential at <US$100/ tCO_2-eq: 1.6 - 2.5 Gt CO_2-eq/yr)*	*(potential at <US$100/ tCO_2-eq: 5.3 -6.7 Gt CO_2-eq/yr)*	*(potential at <US$100/ tCO_2-eq: 2.5 - 5.5 Gt CO_2-eq/yr)*	*(potential at <US$100/ tCO_2-eq: 2.3 -6.4 Gt CO_2-eq/yr)*	*(potential at <US$100/ tCO_2-eq: 1.3 - 4.2 Gt CO_2-eq/yr)*	*(potential at <US$100/ tCO_2-eq: 0.4 - 1 Gt CO_2-eq/yr)*

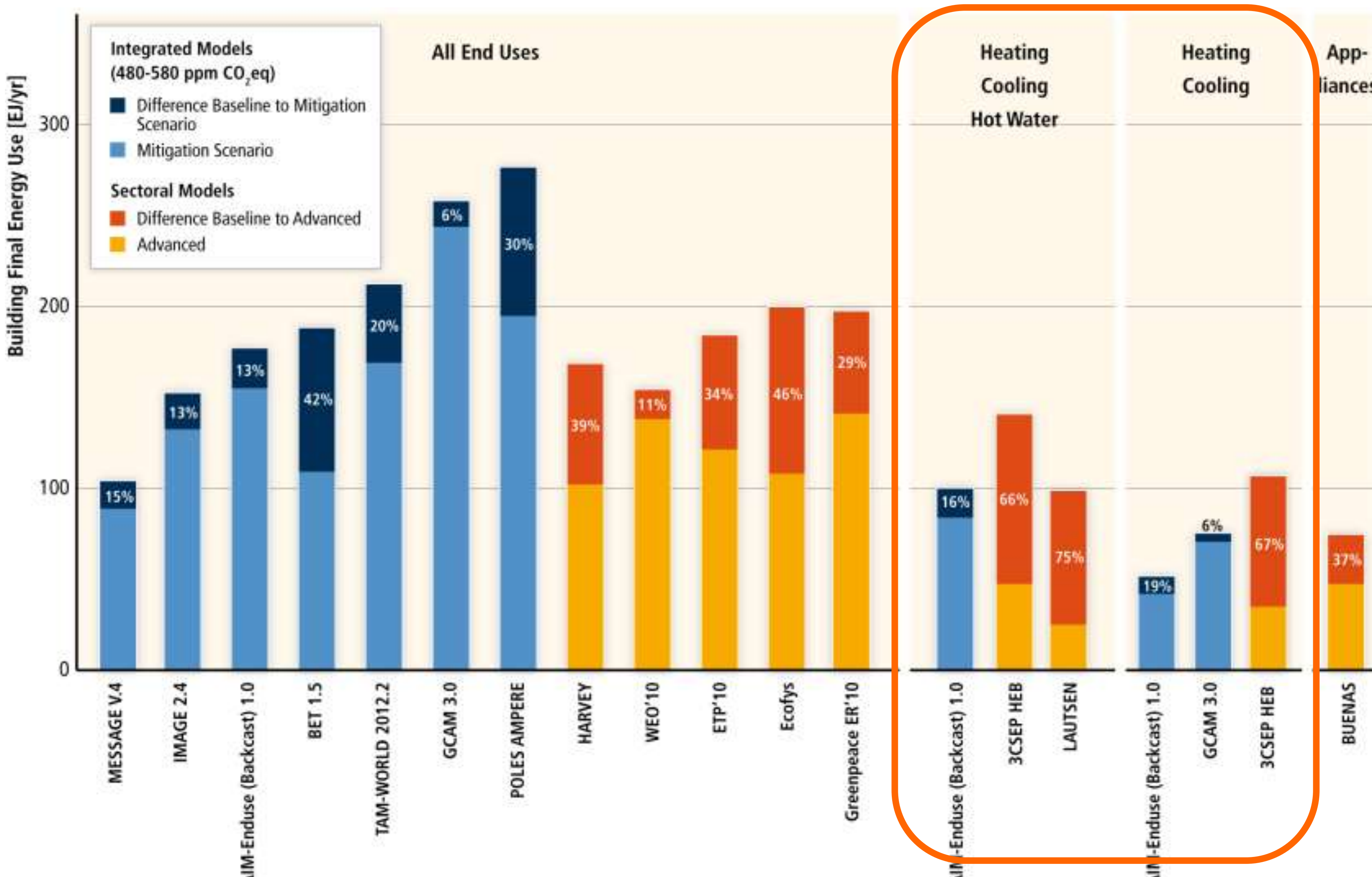
Source: IPCC 2007, AR4, Chapter 10

Energy Demand Reduction Potential

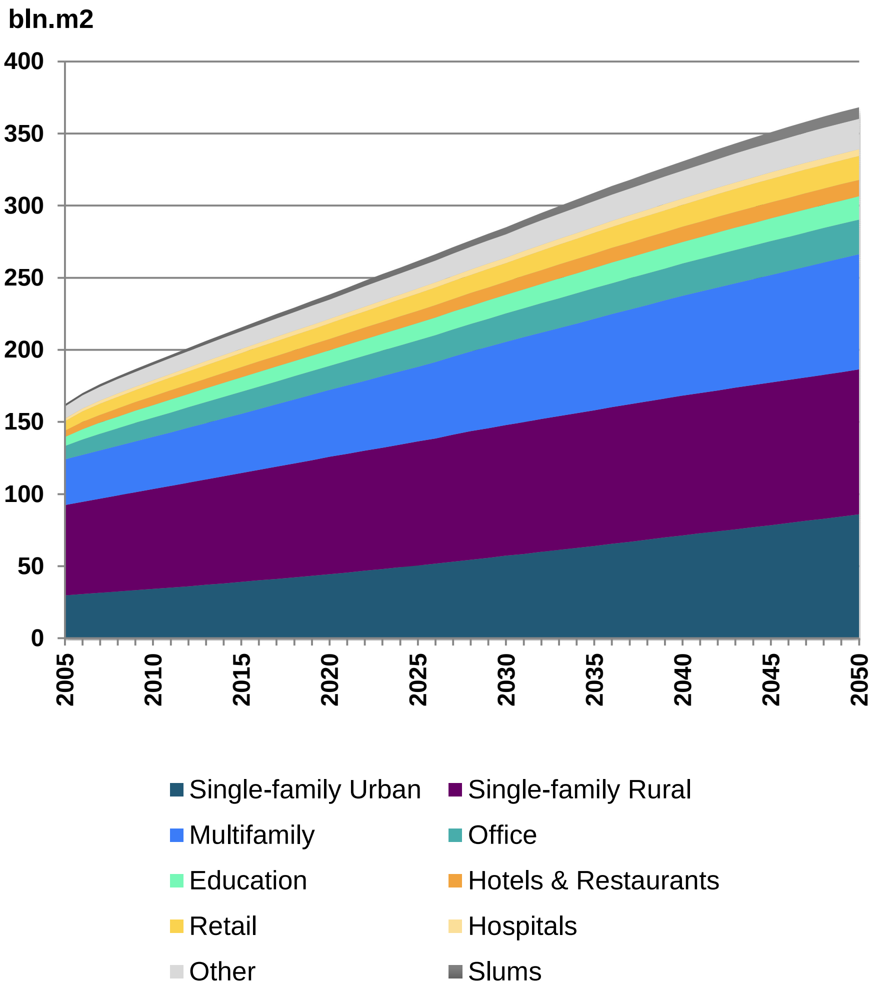


Source: Figure SPM.11

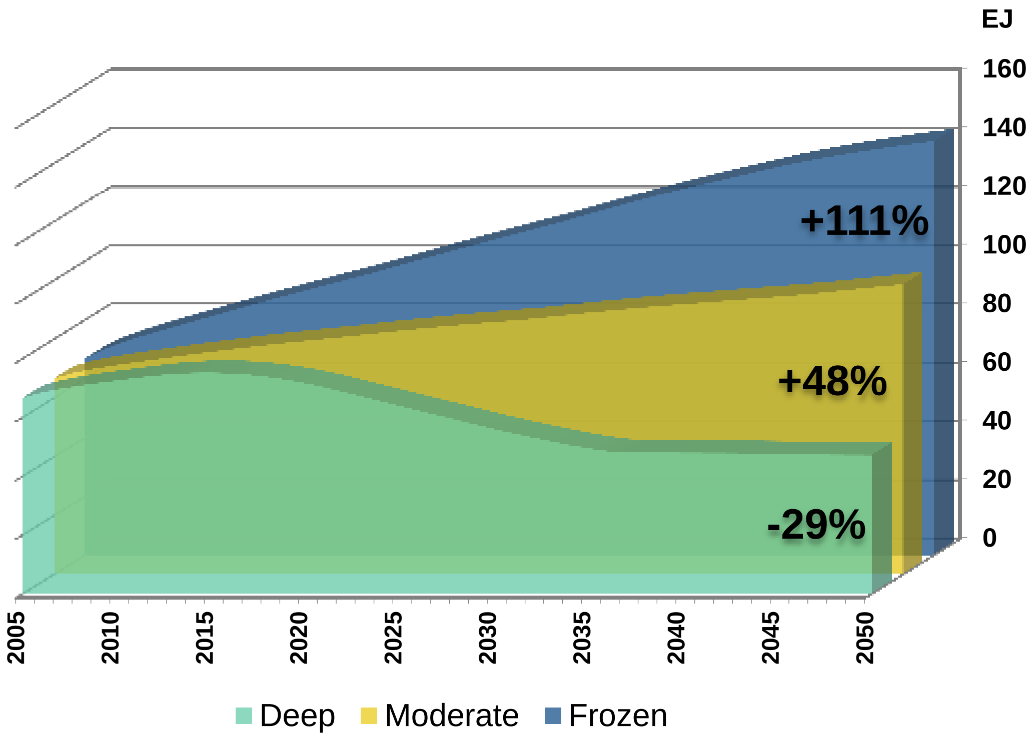
Thermal energy uses have the highest potential for energy use reductions in the building sector



World floor area



World final thermal energy use



3. They are among the most cost-effective options to mitigate CC

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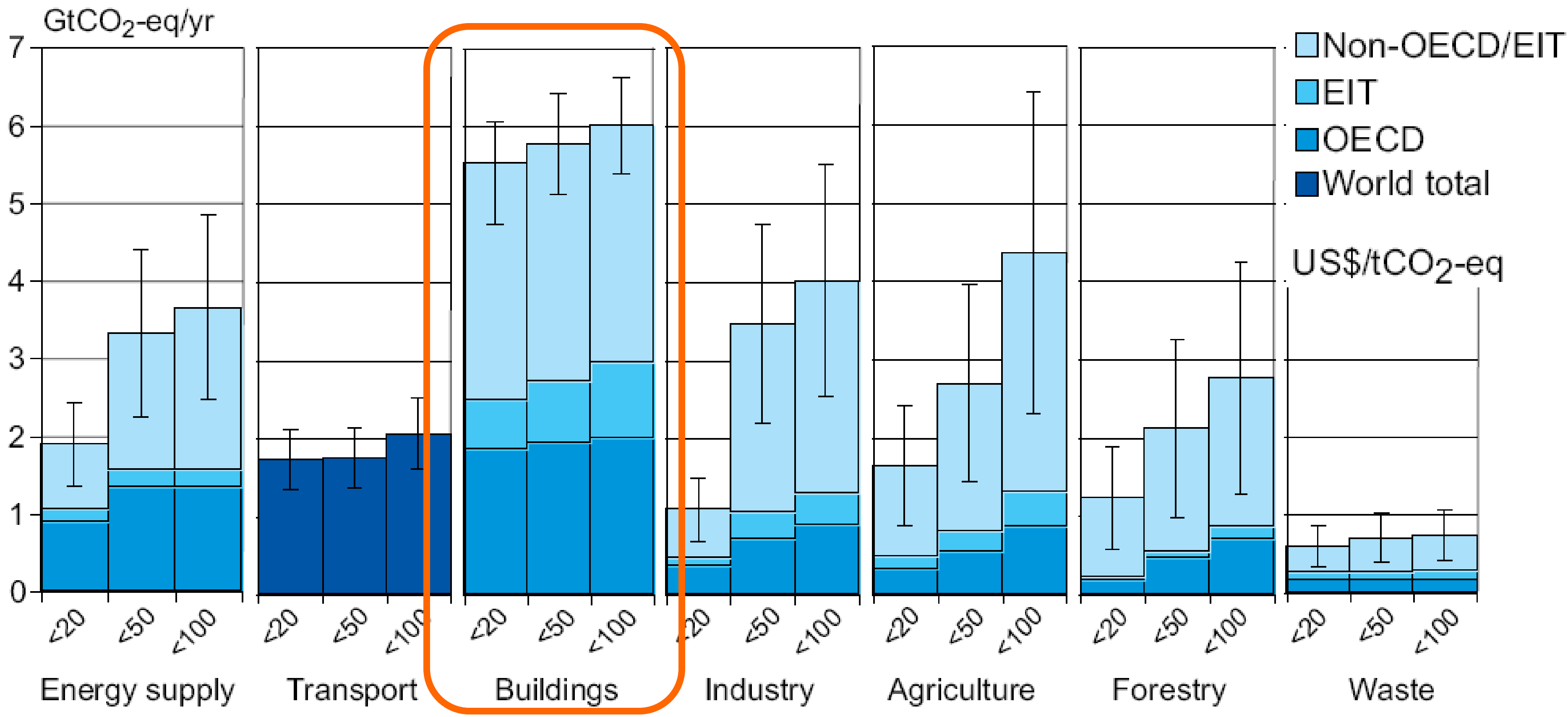
AR4: The buildings sector offers the largest low-cost potential in all world regions by 2030



(potential at <US\$100/ tCO_2-eq: 2.4 - 4.7 Gt CO_2-eq/yr)	*(potential at <US\$100/ tCO_2-eq: 1.6 - 2.5 Gt CO_2-eq/yr)*	*(potential at <US\$100/ tCO_2-eq: 5.3 -6.7 Gt CO_2-eq/yr)*	*(potential at <US\$100/ tCO_2-eq: 2.5 - 5.5 Gt CO_2-eq/yr)*	*(potential at <US\$100/ tCO_2-eq: 2.3 -6.4 Gt CO_2-eq/yr)*	*(potential at <US\$100/ tCO_2-eq: 1.3 - 4.2 Gt CO_2-eq/yr)*	*(potential at <US\$100/ tCO_2-eq: 0.4 - 1 Gt CO_2-eq/yr)*

Source: IPCC 2007, AR4, Chapter 10

Lesson #4: DURABILITY

Durability of (energy-efficient) buildings and their components are crucial in determining their mitigation cost-effectiveness;

as well as improve their mitigation potential due to reduced embodied emissions

Figure 9.14. Cost of conserved energy as a function of energy performance improvement (kWh/m2/yr difference to baseline) to reach 'Passive House' or more stringent performance levels, for new construction by different building types and climate zones in Europe

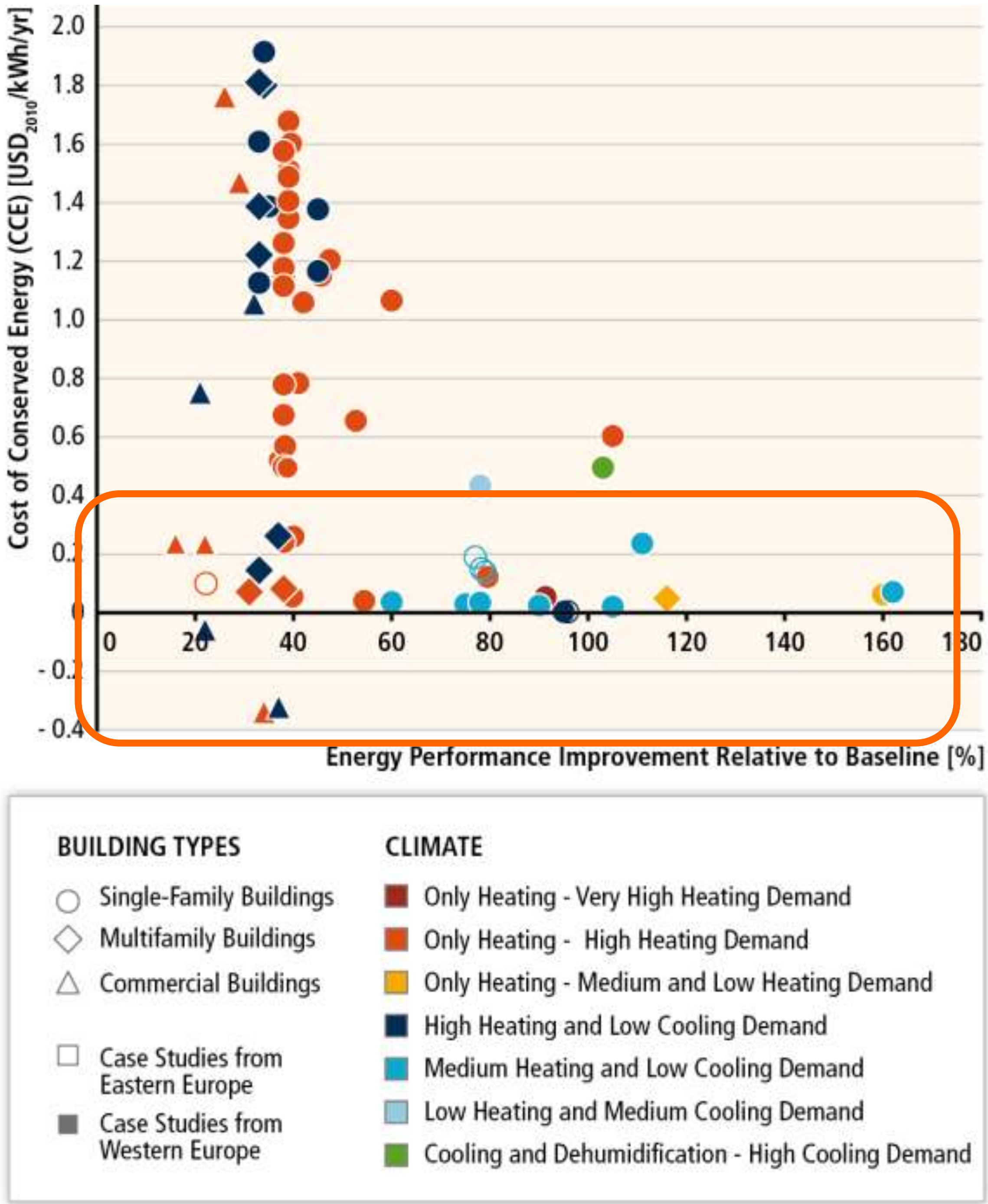
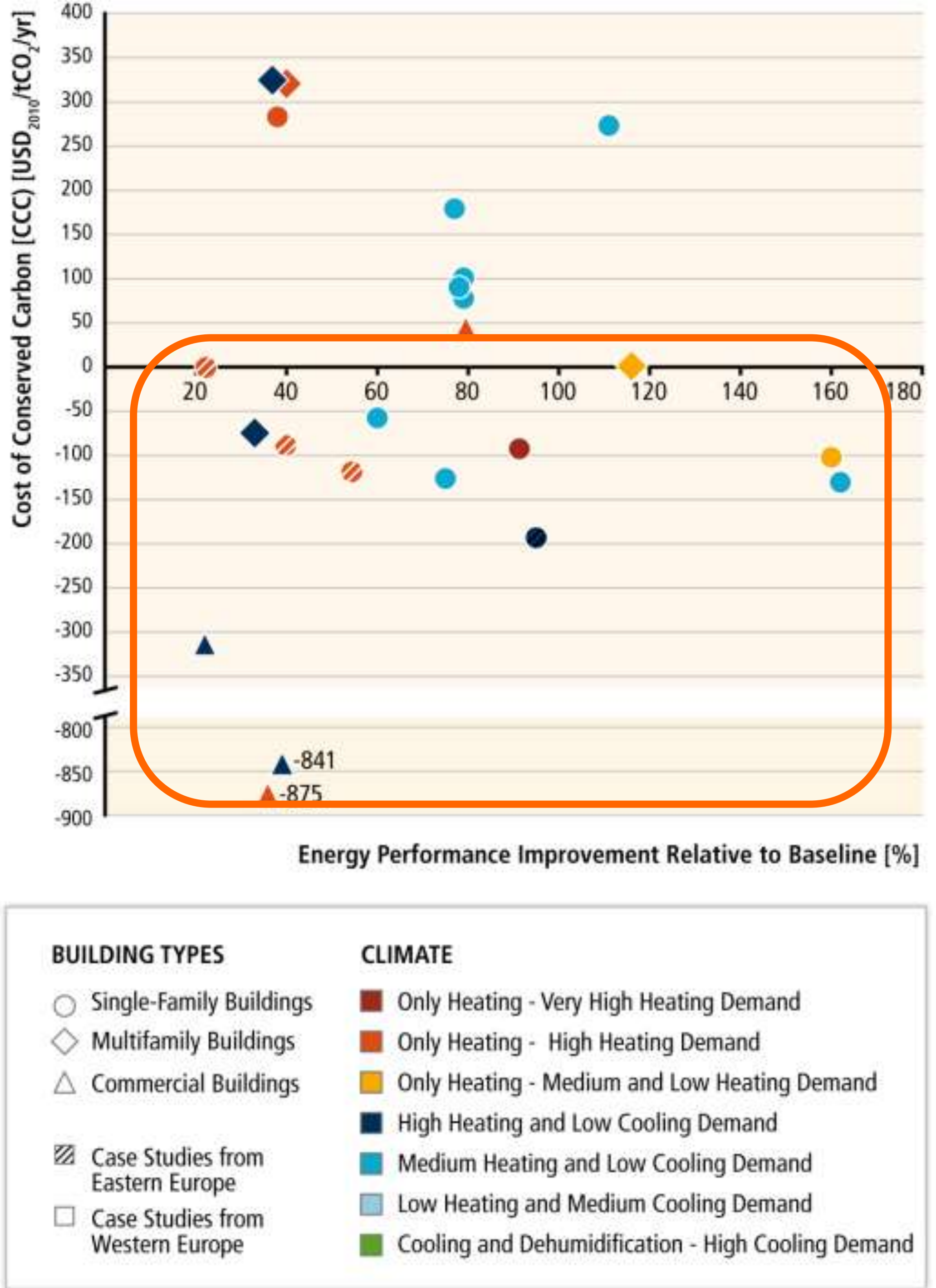


Figure 9.15. Cost of conserved carbon as a function of specific energy consumption for selected best practices shown in Figure 9.14.



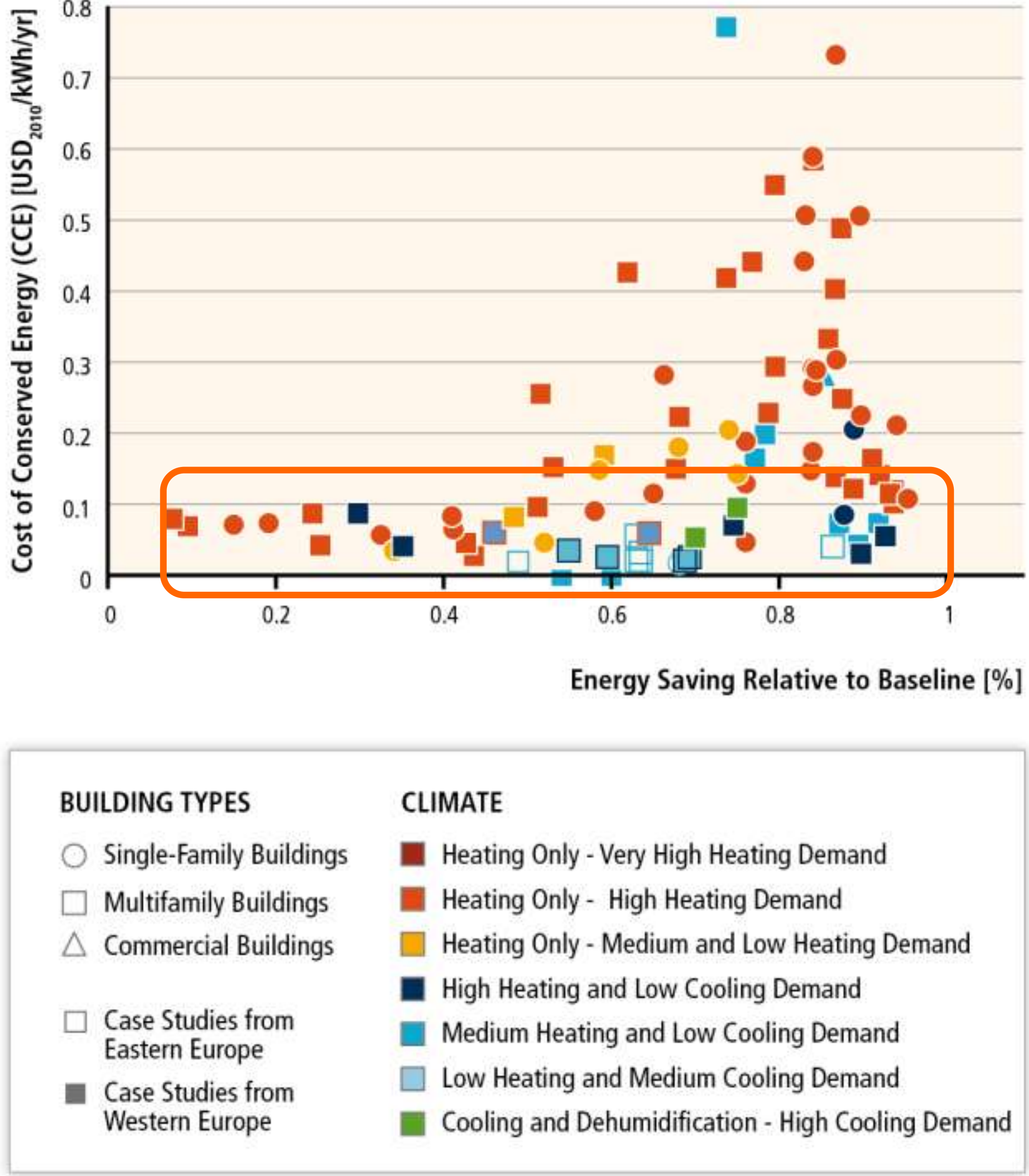


Figure 9.16. Cost of conserved energy as a function of energy saving in percent for European retrofitted buildings by building type and climate zones.

4. In addition, they have high co-benefits

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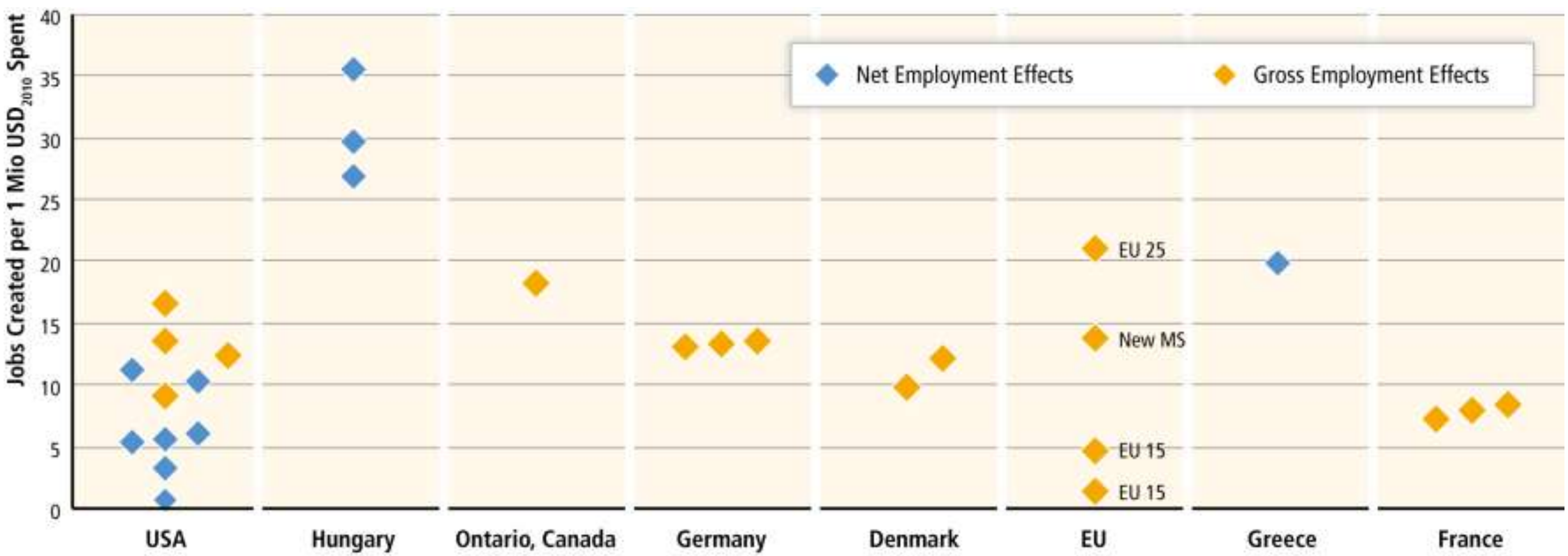
"Overall, the potential for co-benefits for energy end-use measures outweigh the potential for adverse side-effects, whereas the evidence suggests this may not be the case for all energy supply and AFOLU measures." (SPM 4.1)

Co-benefits and adverse side-effects of energy-efficient buildings

Buildings	/concerns		additional objectives/
	Environmental	Other	cial
			e Table TS.3.
Fuel switching, RES incorporation, green roofs, and other measures reducing emissions intensity	Health impact in residential buildings via ↓ Outdoor air pollution (r/h) ↓ Indoor air pollution (in DCs) (r/h) ↓ Fuel poverty (r/h) ↓ Ecosystem impact (less outdoor air pollution) (r/h) ↑ Urban biodiversity (for green roofs) (m/m)	Reduced Urban Heat Island Effect (UHI) (l/m)	) via energy cost) (l/m) en/children cookstoves) (m/h)
Retrofits of existing buildings (e.g., cool roof, passive solar, etc.) Exemplary new buildings Efficient equipment	Health impact via ↓ Outdoor air pollution (r/h) ↓ Indoor air pollution (for efficient cookstoves) (r/h) ↓ Indoor environmental conditions (m/h) ↓ Fuel poverty (r/h) ↓ Insufficient ventilation (m/m) ↓ Ecosystem impact (less outdoor air pollution) (r/h) ↓ Water consumption and sewage production (l/l)	Reduced UHI (retrofits and new exemplary buildings) (l/m)	s, efficient equipment) (m/h) st for housing due to the m) rofits and exemplary new en and children cookstoves) (m/h)
Behavioural changes reducing energy demand	↓ Health impact via less outdoor air pollution (r/h) & improved indoor environmental conditions (m/h) ↓ Ecosystem impact (less outdoor air pollution) (r/h)		

Studies on employment effects due to improved building energy efficiency



Further co-benefits, details

- monetizable co-benefits alone are at least twice the resulting operating cost savings.
- Energy efficient buildings may result in increased productivity by 1–9% or even higher.
- Productivity gains can rank among the highest value co-benefits when these are monetized, esp. in countries with high labour costs
- Significant potential energy security gains:
  - e.g. a CEU study found that deep retrofitting the Hungarian building stock can save 39% of natural gas imports, and up to 59% of January imports (when most vulnerable to supply disruptions)

While opportunities are great, there is also a substantial lock-in risk

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"Infrastructure developments and long-lived products that lock societies into GHG-intensive emissions pathways may be difficult or very costly to change, reinforcing the importance of early action for ambitious mitigation" (SPM 4.2)

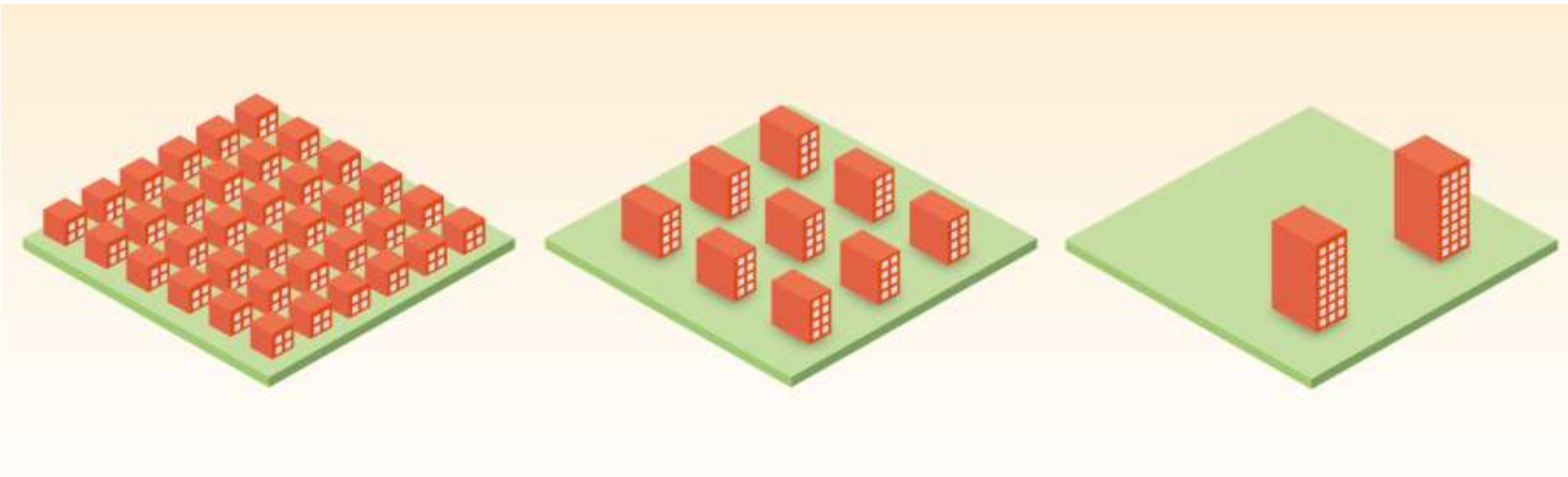
Lesson #4: need to go for the highest-tech

Building efficiency programs and policies need to encourage only the highest achievable efficiency levels. Shallow retrofits need to be avoided. It is better to "wait out" the opportunities for a deep, systemic retrofit rather engage in a shallow one. Most countries would need to revisit their support schemes and policies around retrofit!

Summary of lessons relevant for the PH community 1.

- External communication needs to improve
  - reporting achievements, costs, penetration to other communities
  - e.g. the academic literature
- Much stronger focus on very deep retrofits are needed in developed countries (as opposed to just new)
- in other areas, preventing the need for mechanical cooling is essential.
- Bringing down the costs of deep retrofits through experience is crucial

Increasing urban density is a necessary but not sufficient condition for lowering urban emissions



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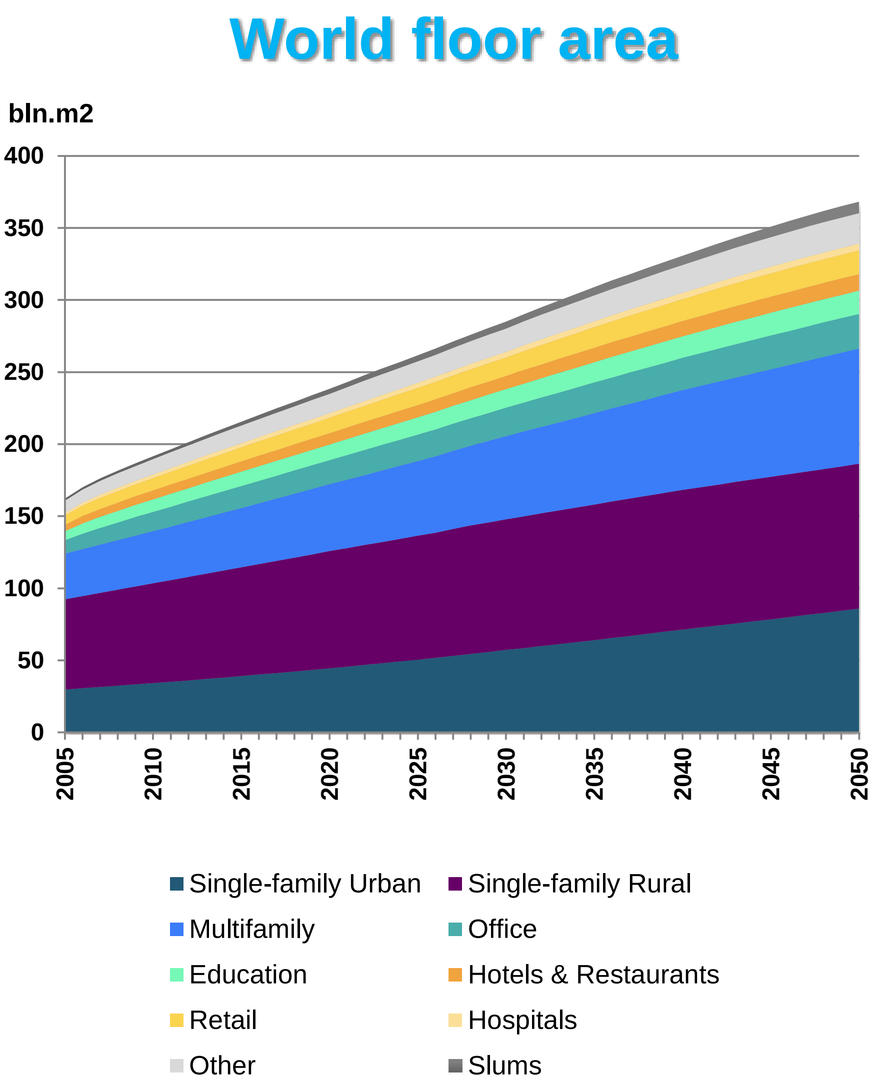
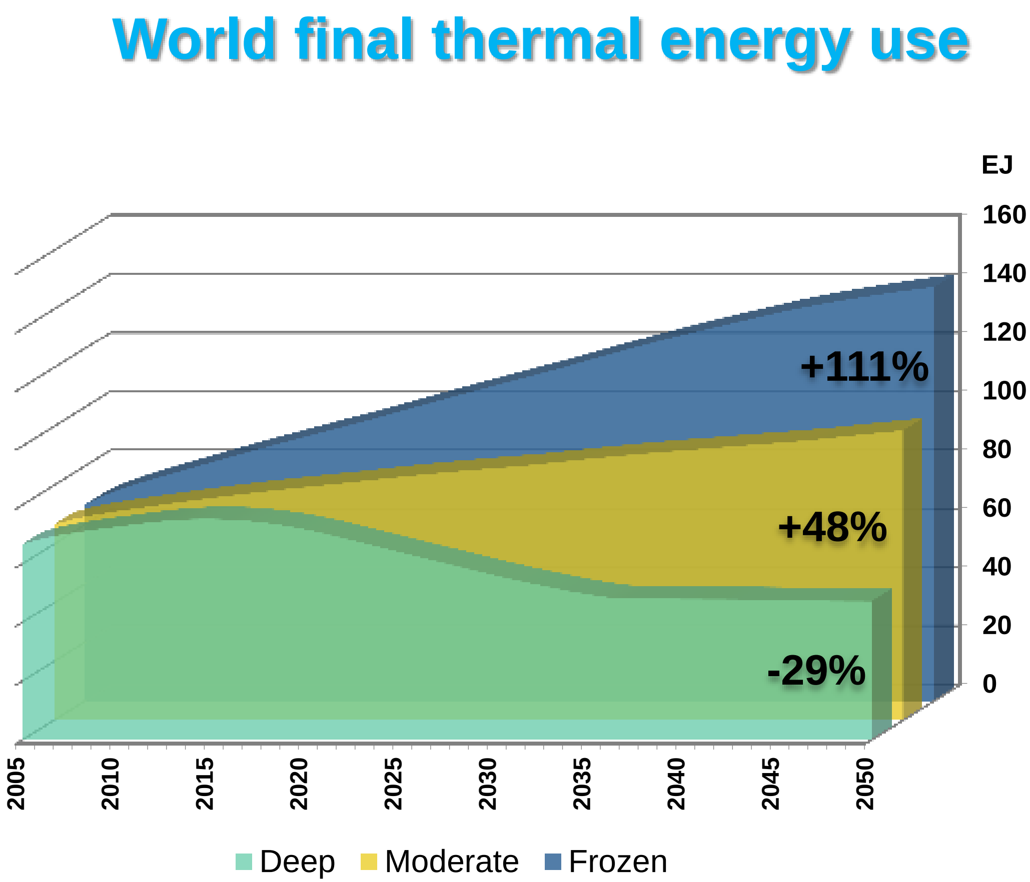
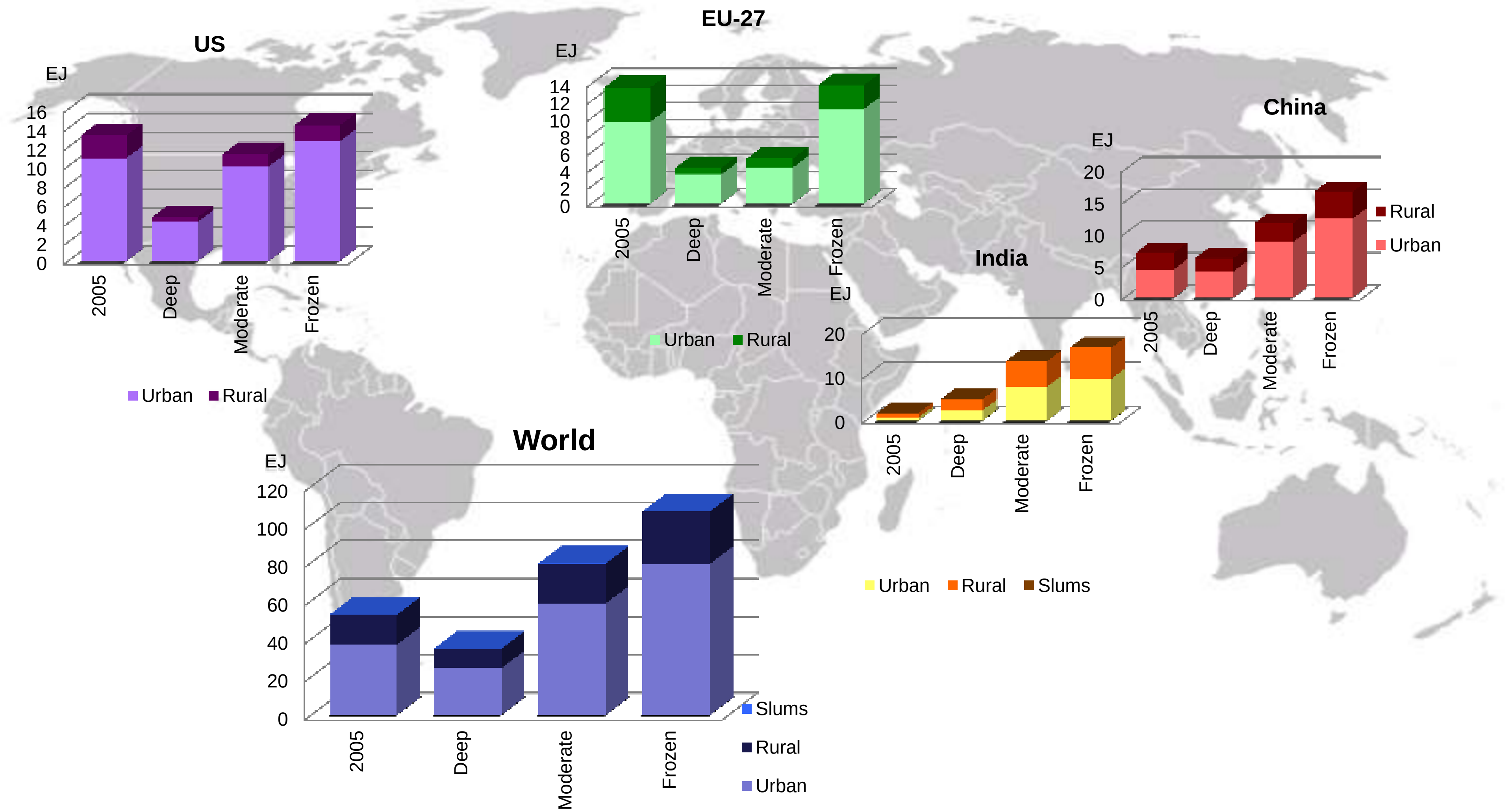


World floor area
bln.m2
400
350
300
250
200
150
100
50
0
2005
2010
2015
2020
2025
2030
2035
2040
2045
2050
Single-family Urban
Single-family Rural
Multifamily
Office
Education
Hotels & Restaurants
Retail
Hospitals
Other
Slums

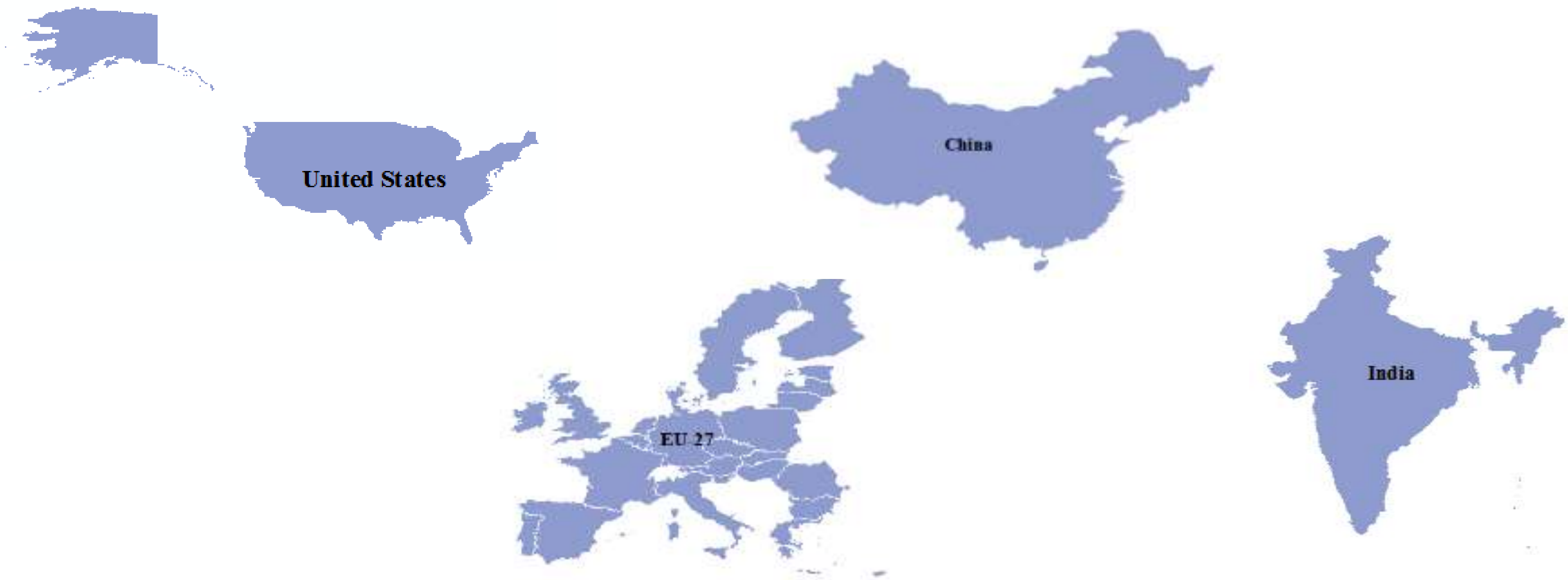


World final thermal energy use
EJ
160
140
120
100
80
60
40
20
0
+111%
+48%
-29%
2005
2010
2015
2020
2025
2030
2035
2040
2045
2050
Deep
Moderate
Frozen

Urban vs. Rural Energy Use

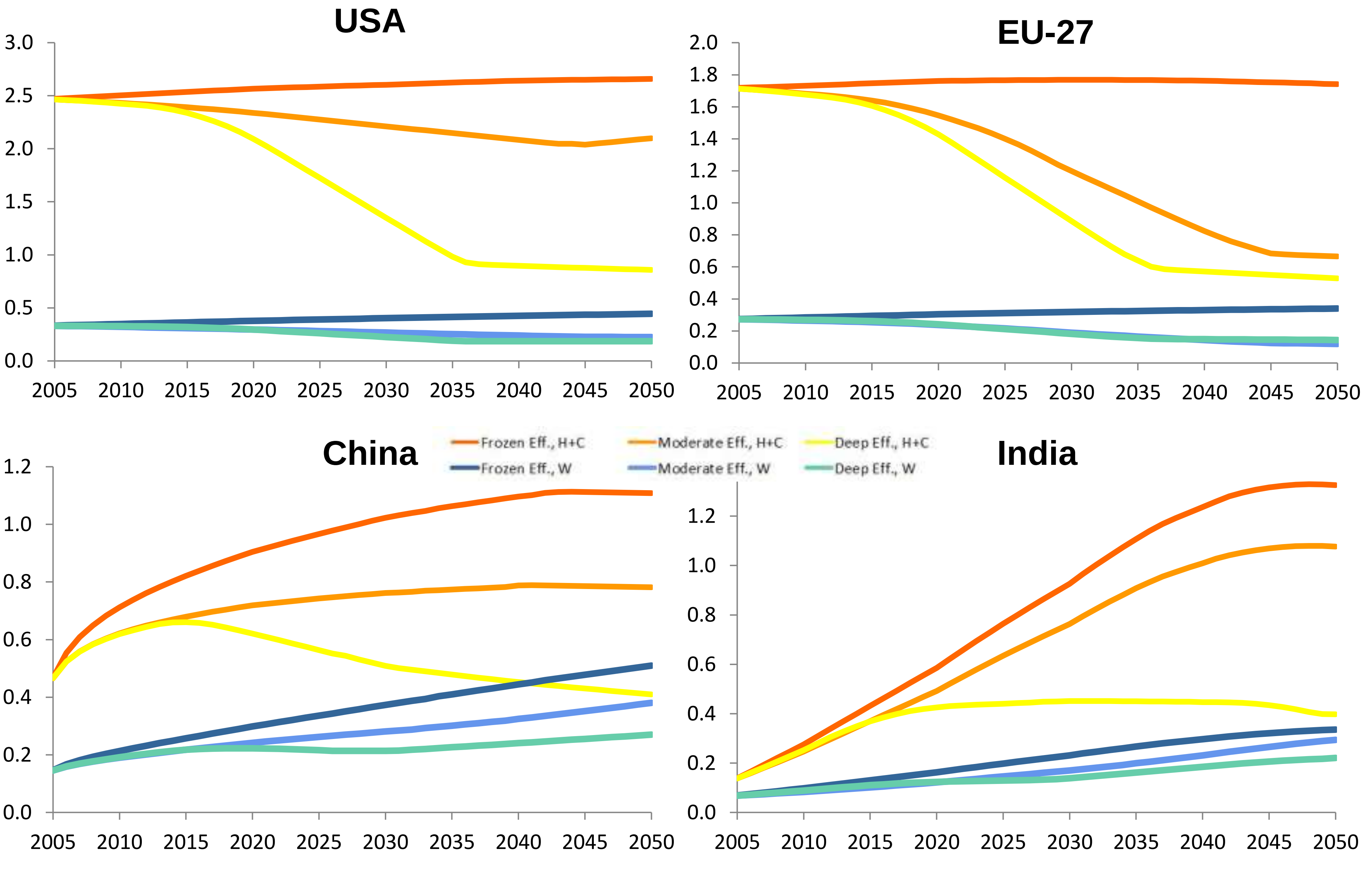


Regions



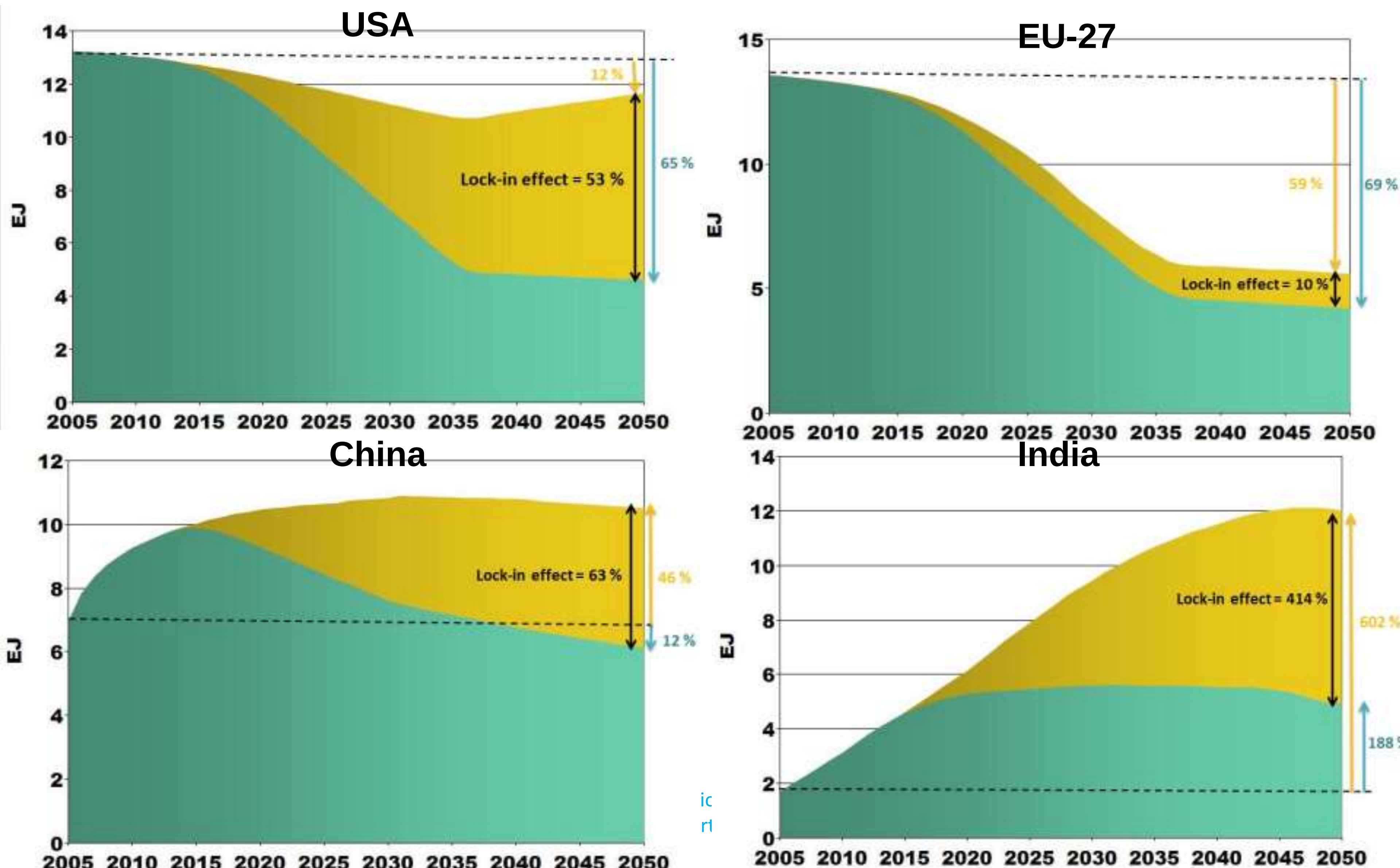
CO2 emissions

from space heating & cooling and water heating for key regions for all scenarios, GtCO2

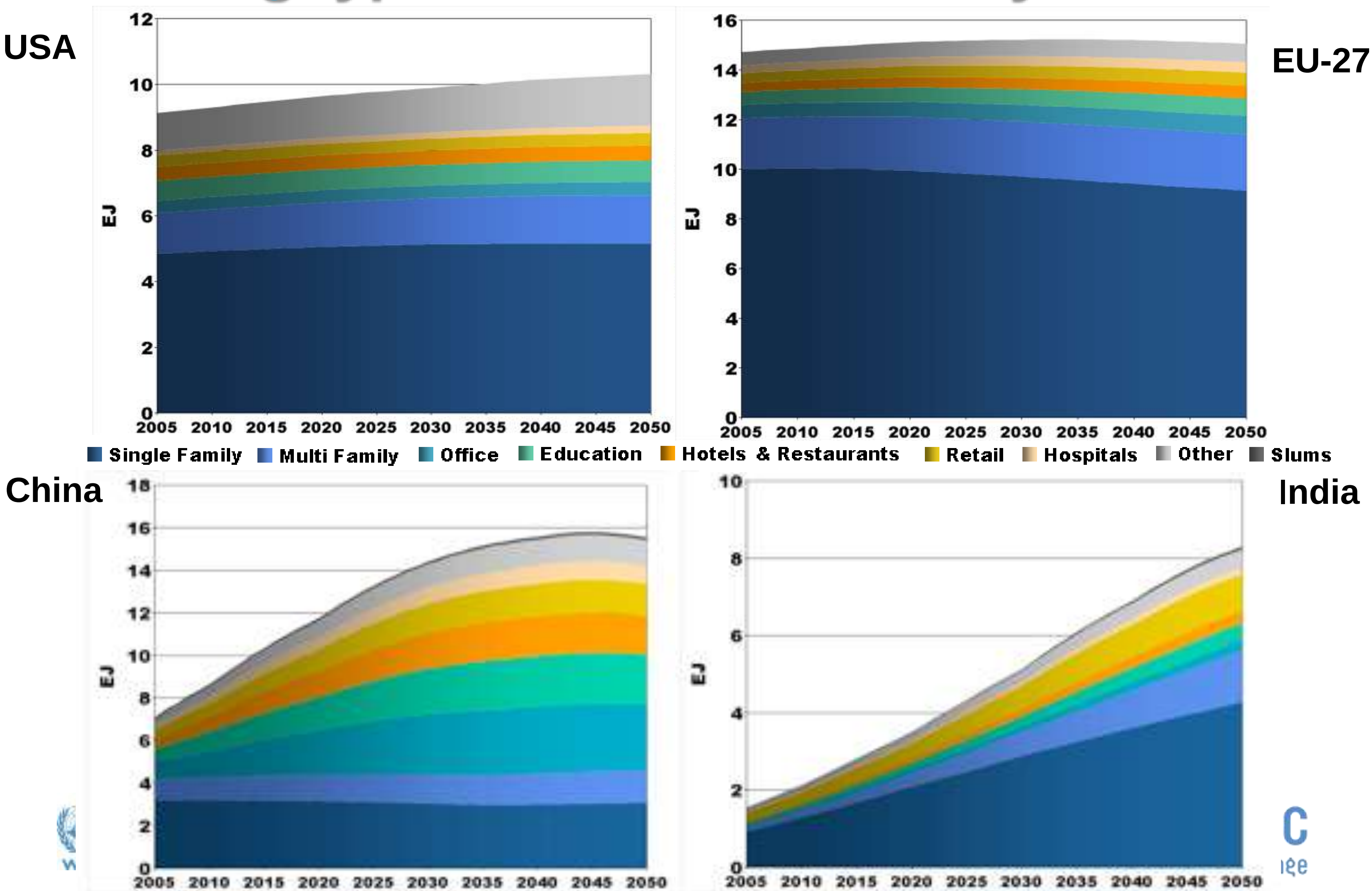


Lock-in Effect

from space heating & cooling for Moderate Efficiency and Deep Efficiency scenarios for key regions



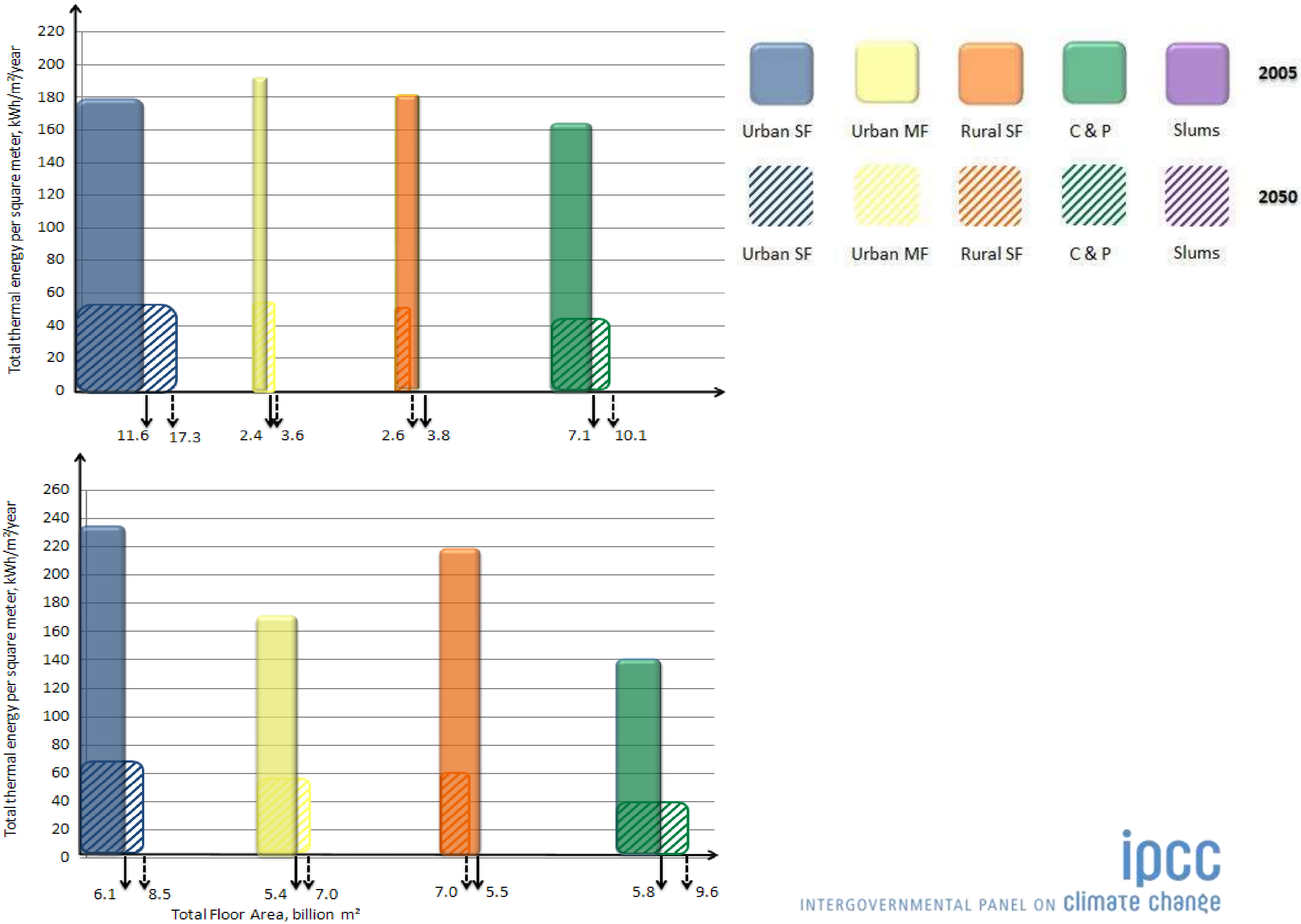
Final energy for space heating and cooling by building type in Frozen Efficiency Scenario



Final energy mitigation potential for Deep Efficiency scenario between 2005 and 2050

USA

EU-27



WMO

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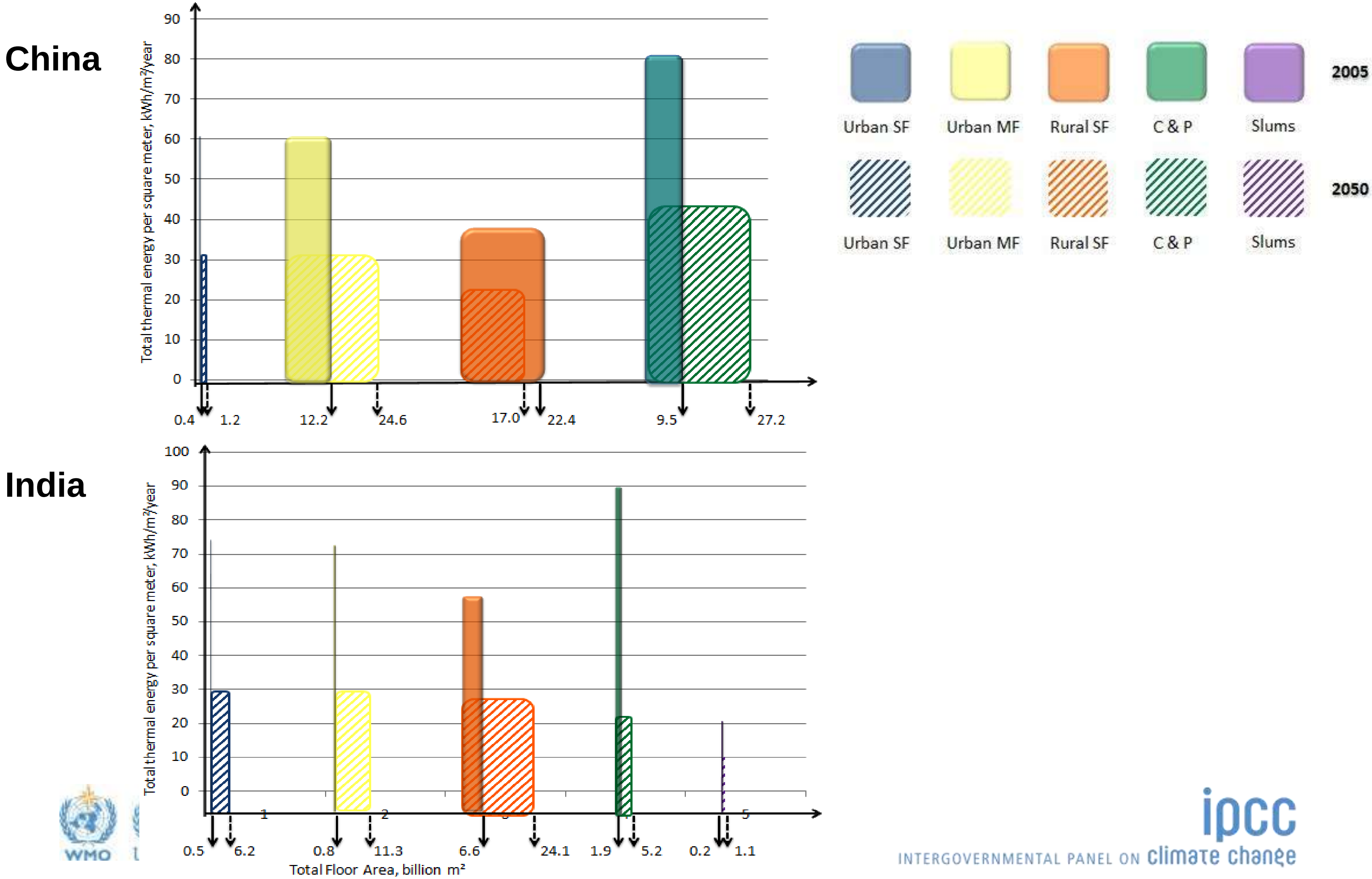
Final energy mitigation potential for Deep Efficiency scenario between 2005 and 2050



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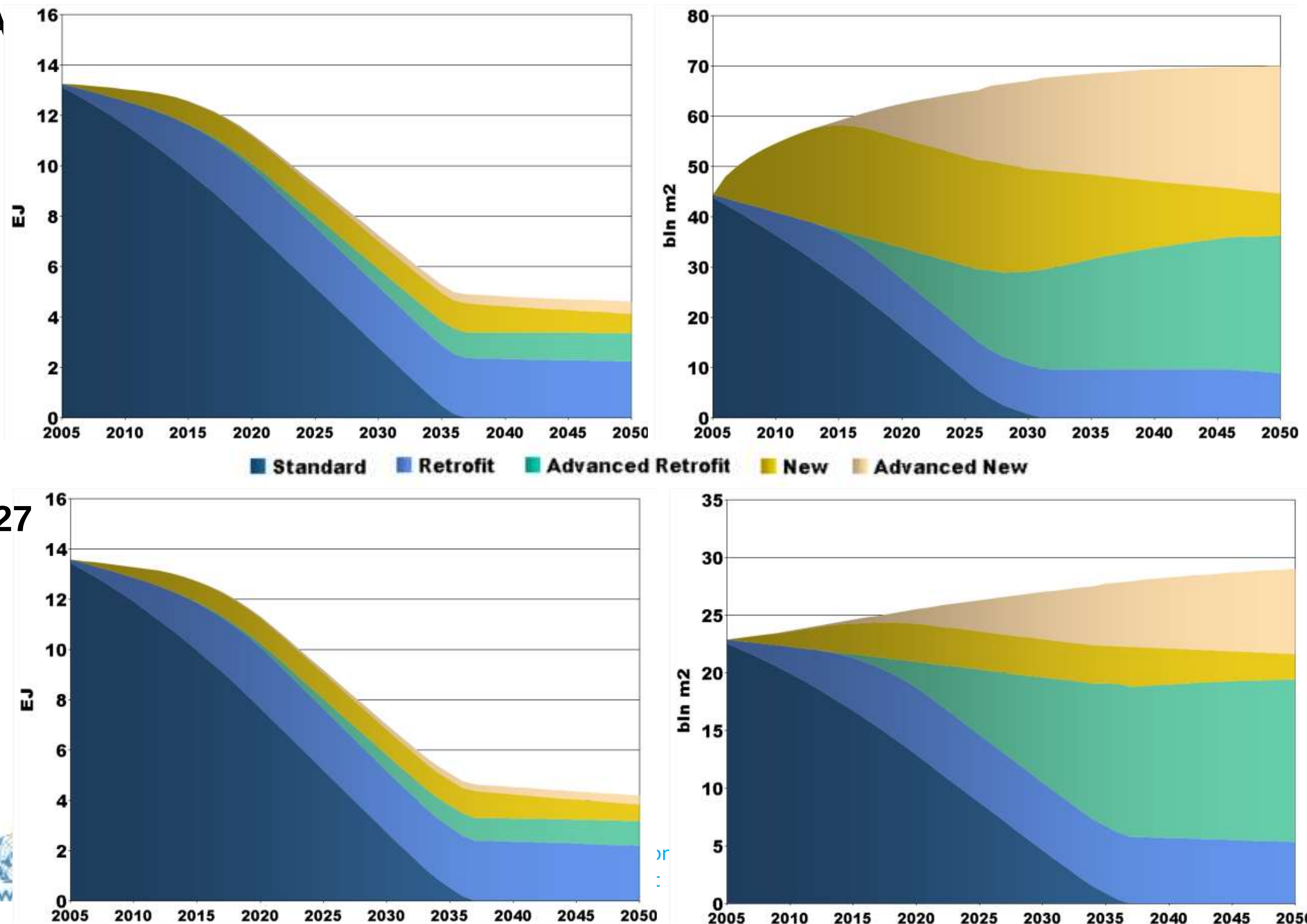
Final Energy for SH&C and floor area by building vintage. Deep Efficiency Scenario

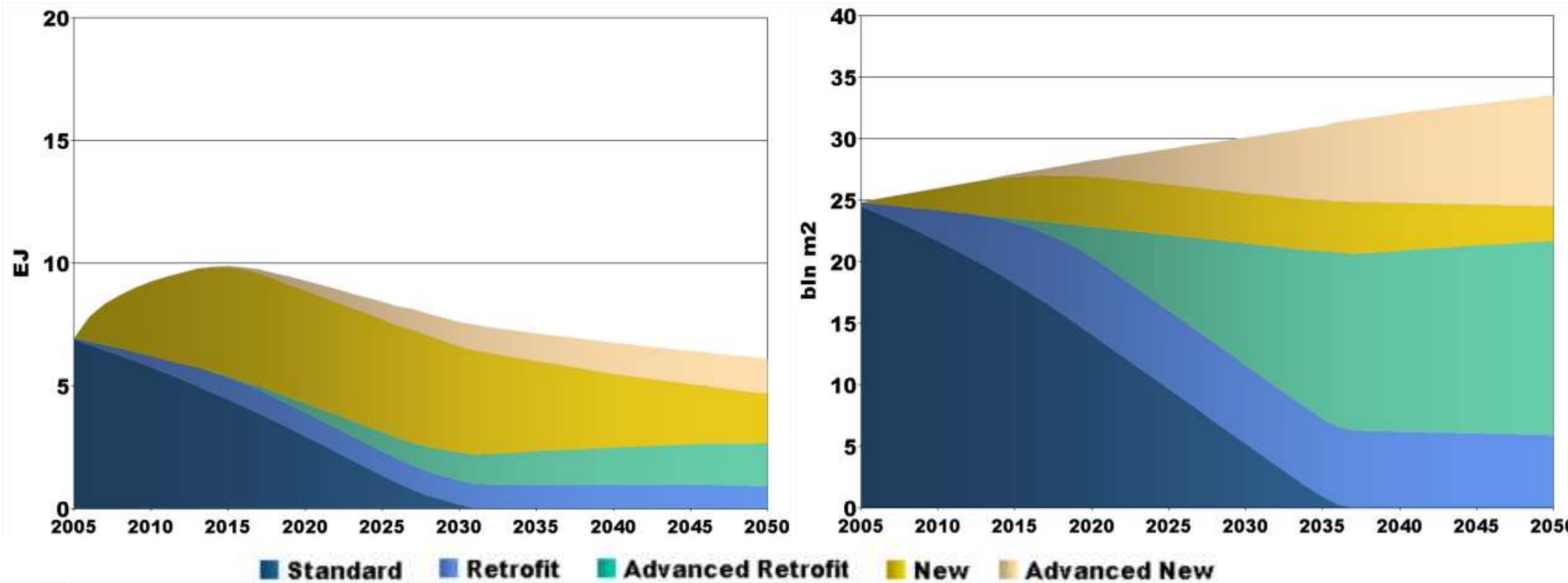
USA

EU-27

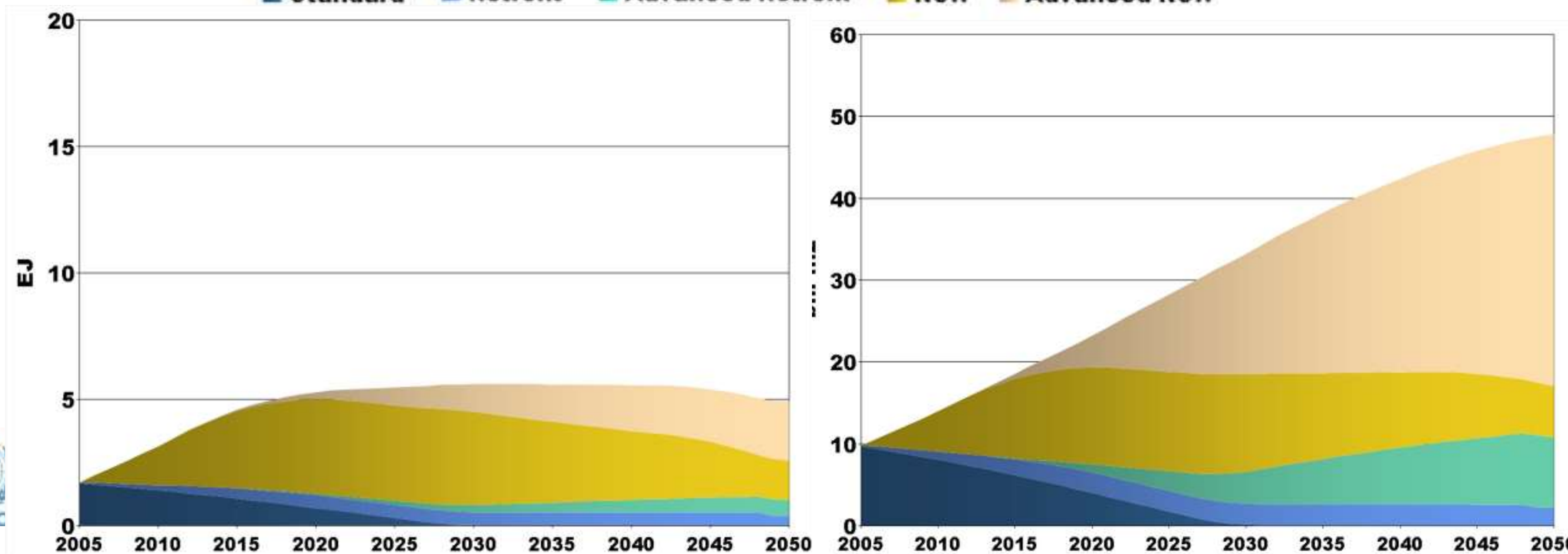


Final Energy for SH&C and floor area by building vintage. Deep Efficiency Scenario

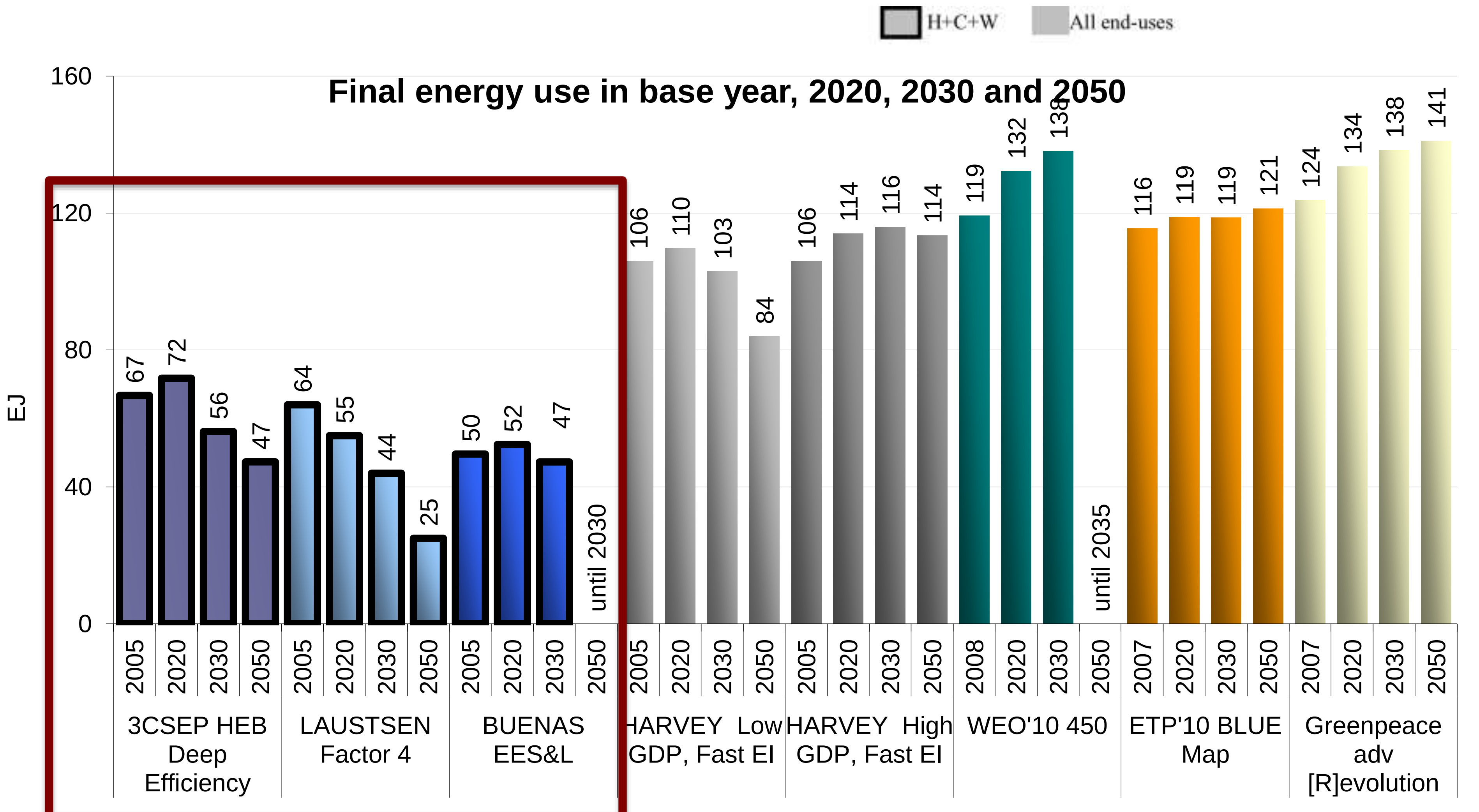
China



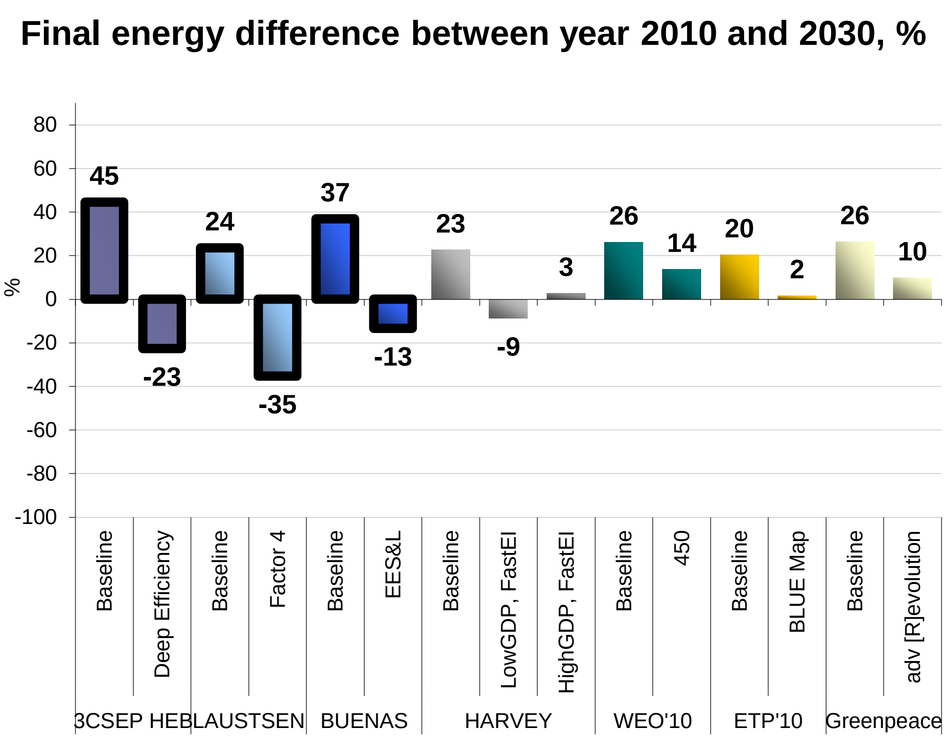
India

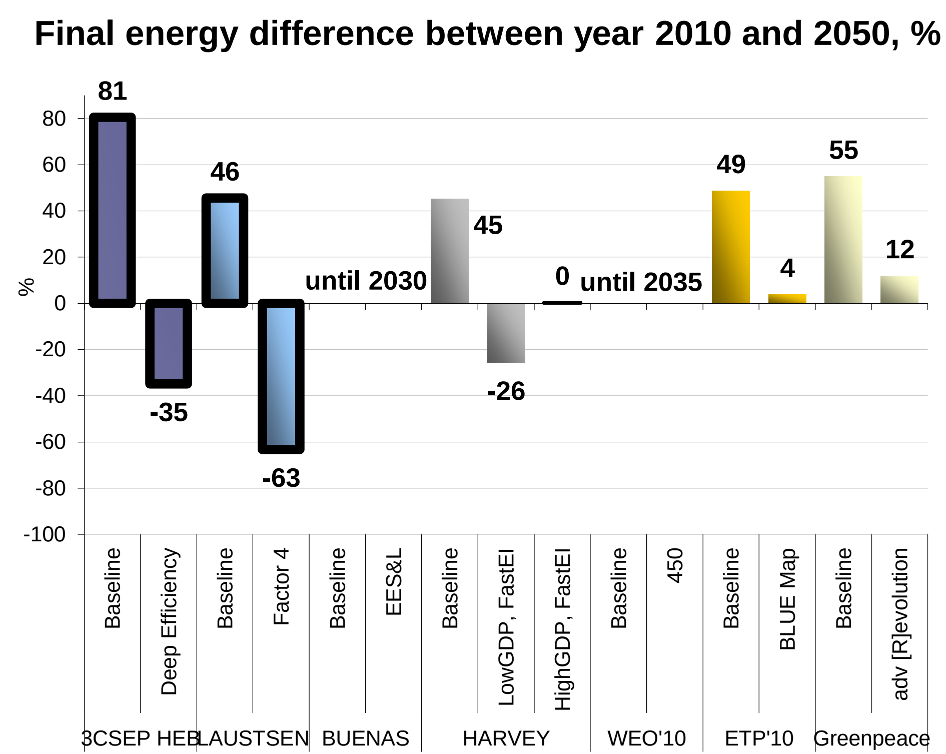


High potentials for SH&C energy use reduction

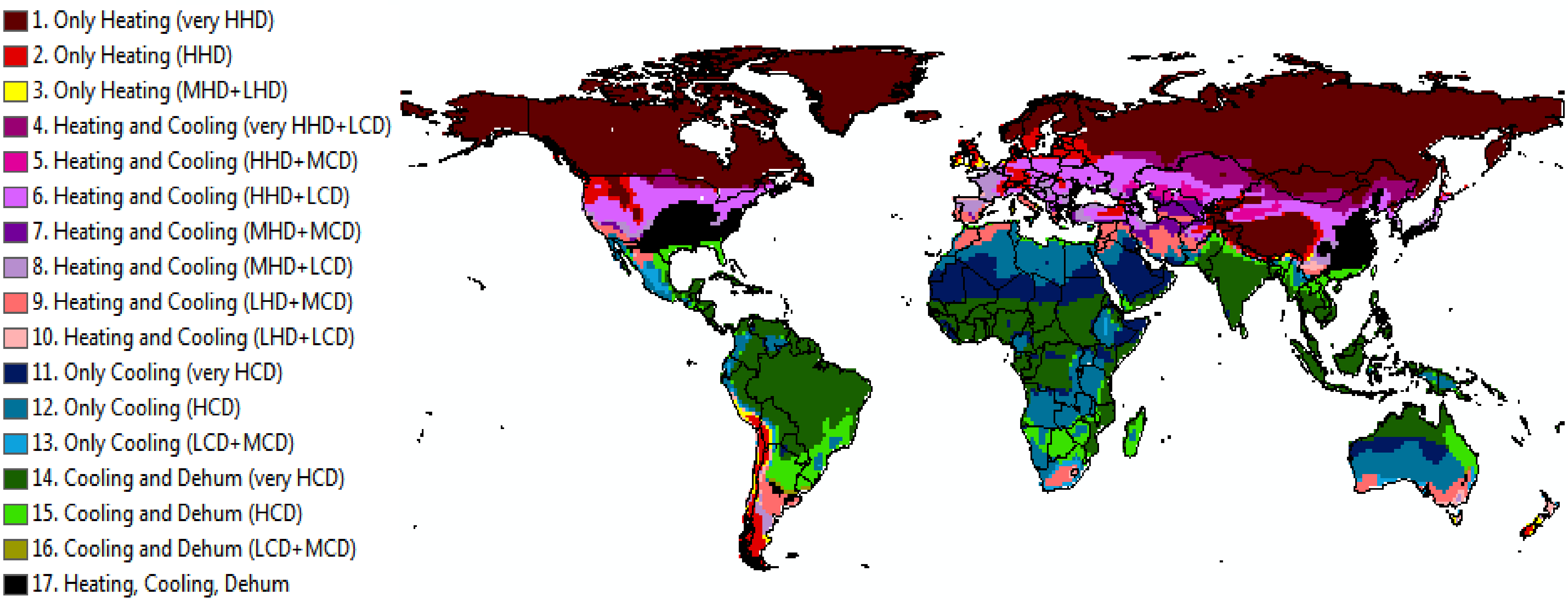


Longer periods offer higher savings

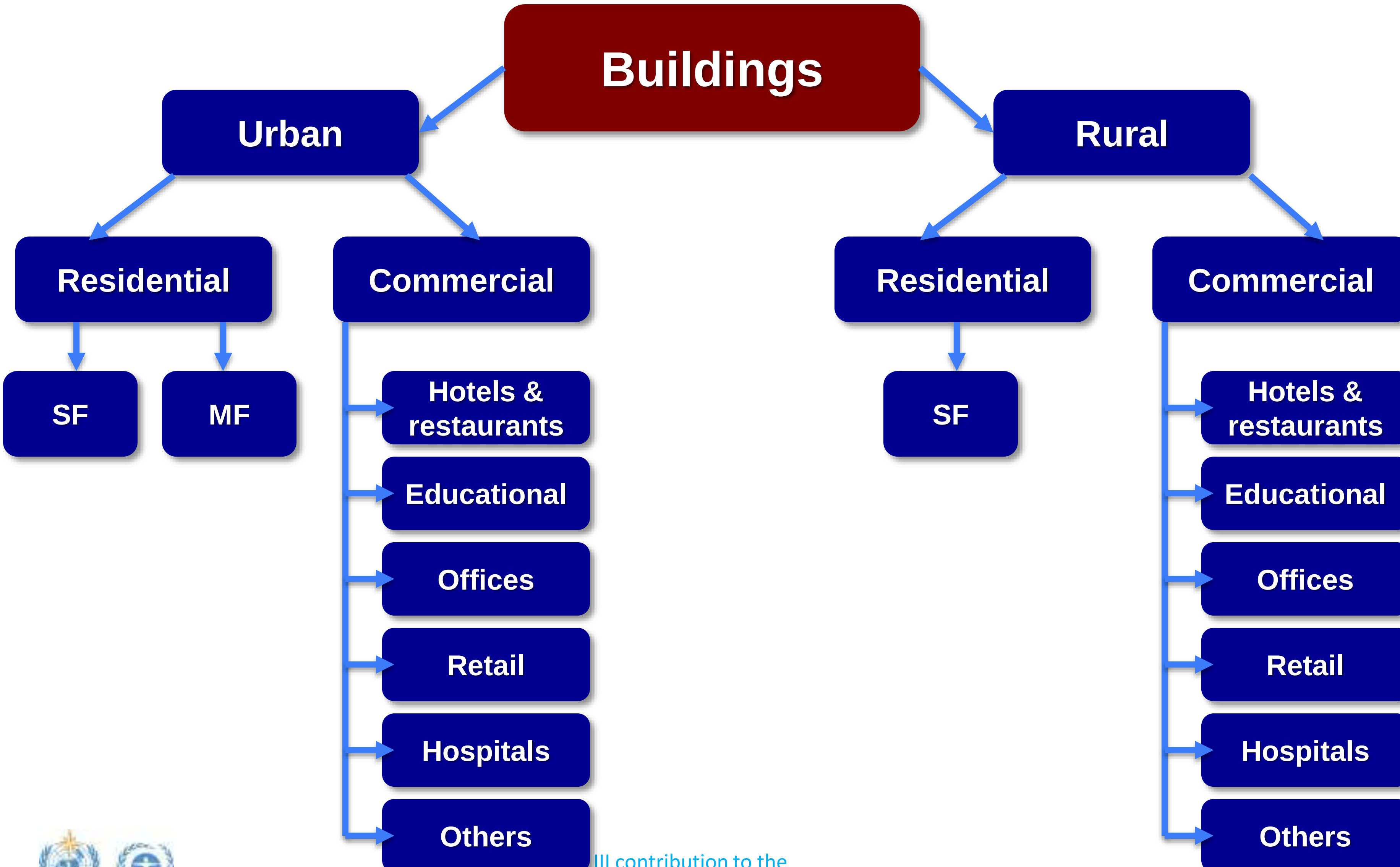


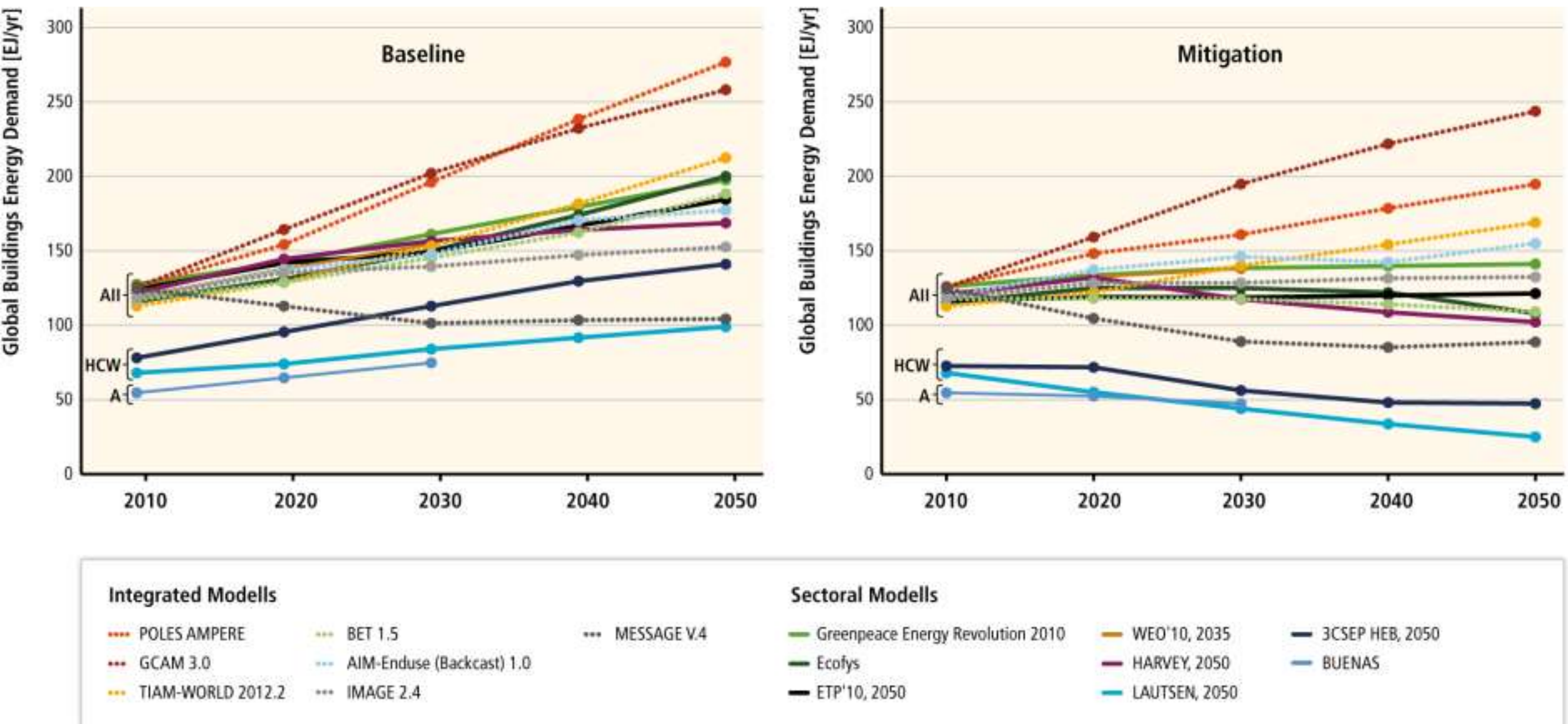


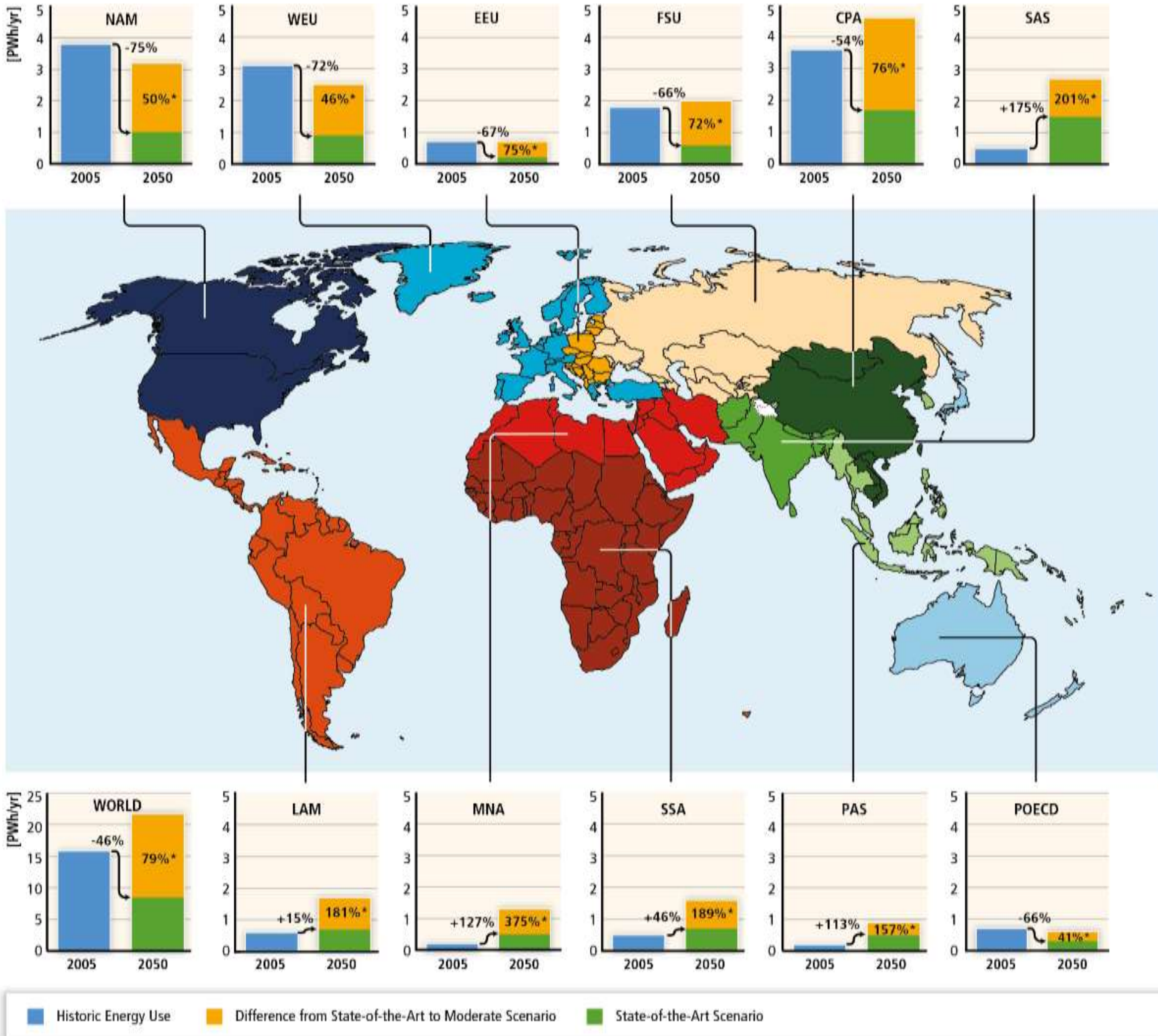
Climate Types



Key Assumptions on Building Types

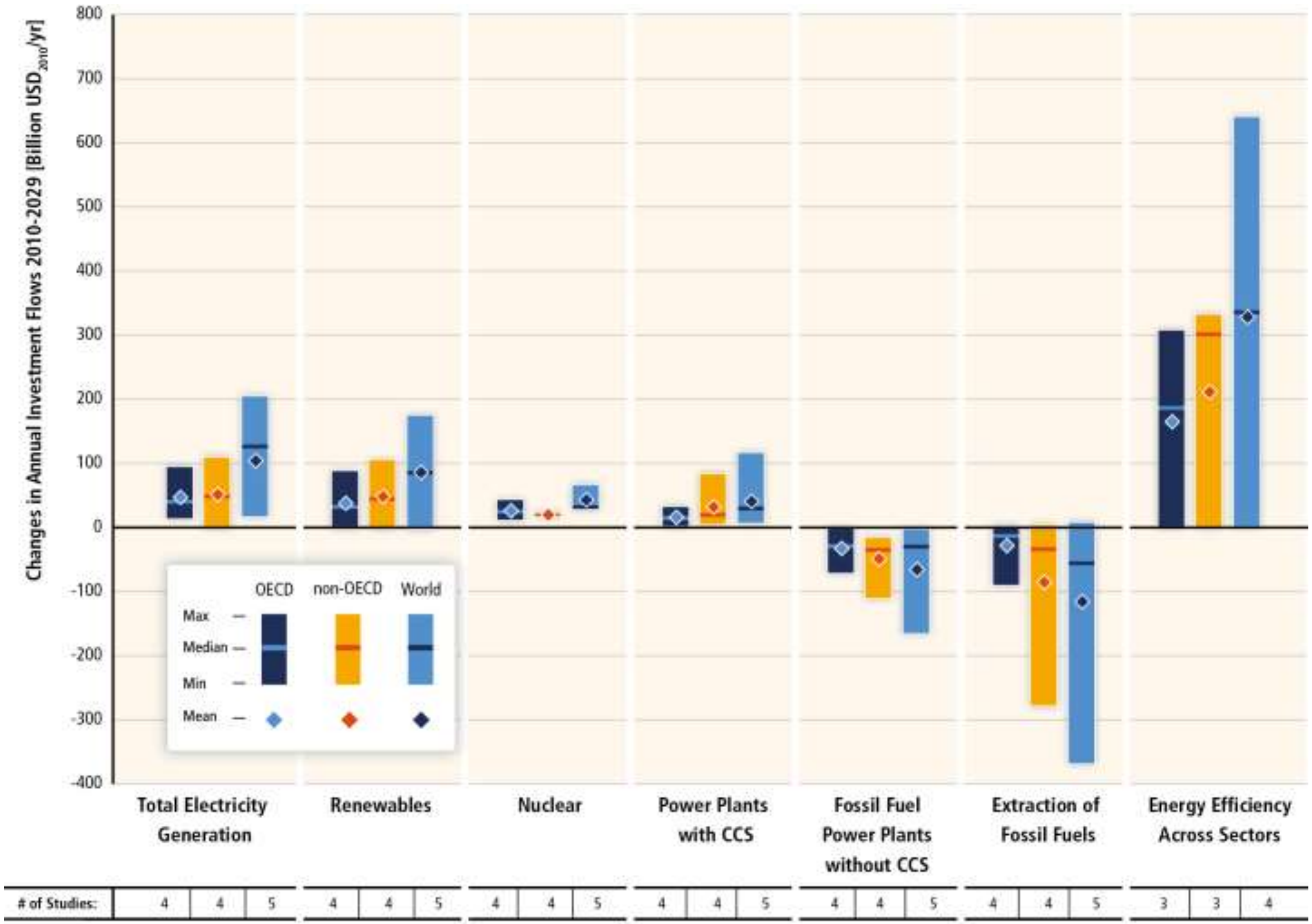



Baseline
Mitigation
Global Buildings Energy Demand [EJ/yr]
300
250
200
150
100
50
0
All
HCW
A
2010
2020
2030
2040
2050
Integrated Modells
POLES AMPERE
GCAM 3.0
TIAM-WORLD 2012.2
BET 1.5
AIM-Enduse (Backcast) 1.0
IMAGE 2.4
MESSAGE V.4
Sectoral Modells
Greenpeace Energy Revolution 2010
Ecofys
ETP'10, 2050
WEO'10, 2035
HARVEY, 2050
LAUTSEN, 2050
3CSEP HEB, 2050
BUENAS

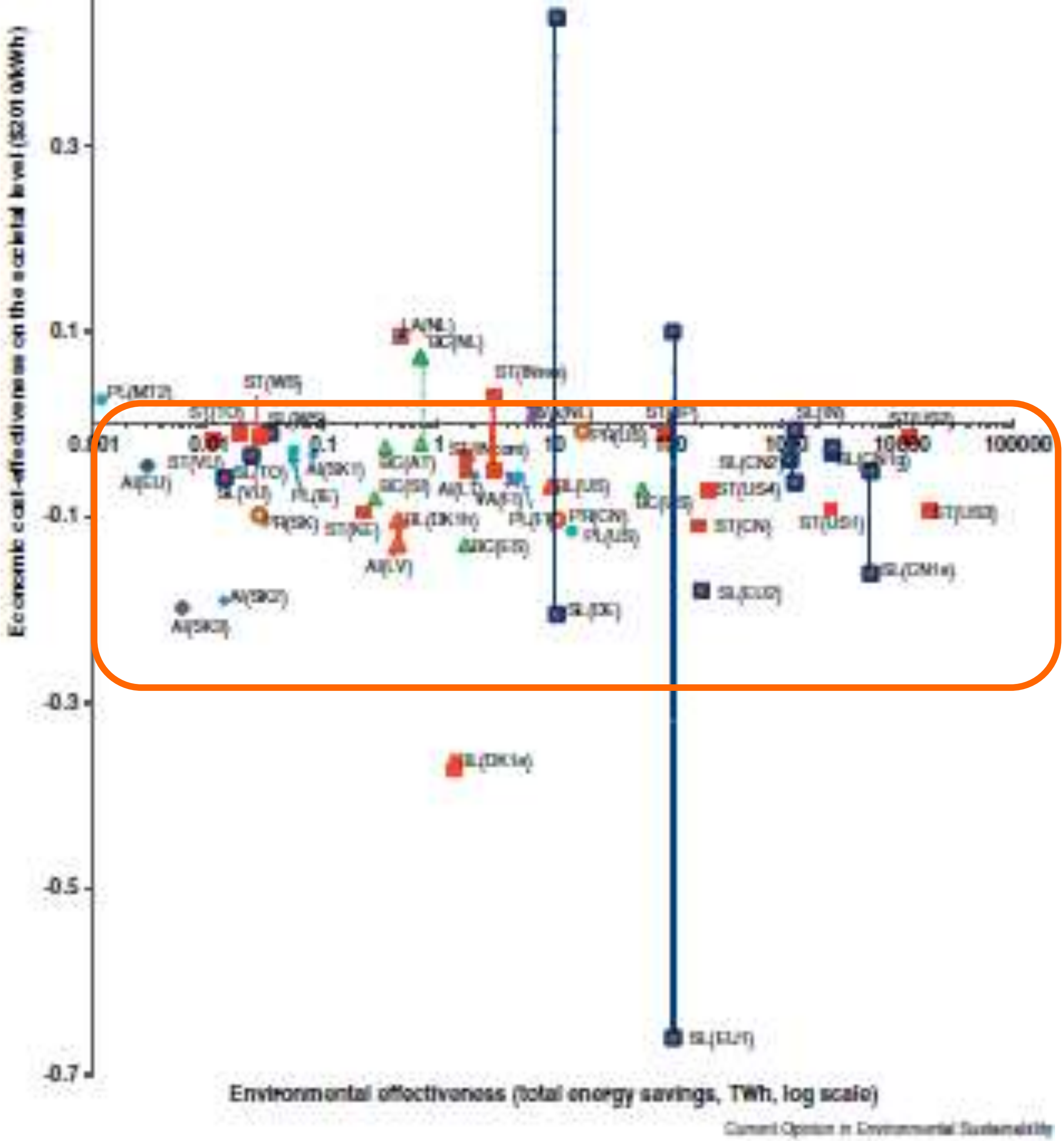


*Lock-in Risk of Sub-Optimal Scenario Realative to Energy Use in 2005.

Substantial reductions in emissions would require large changes in investment patterns.

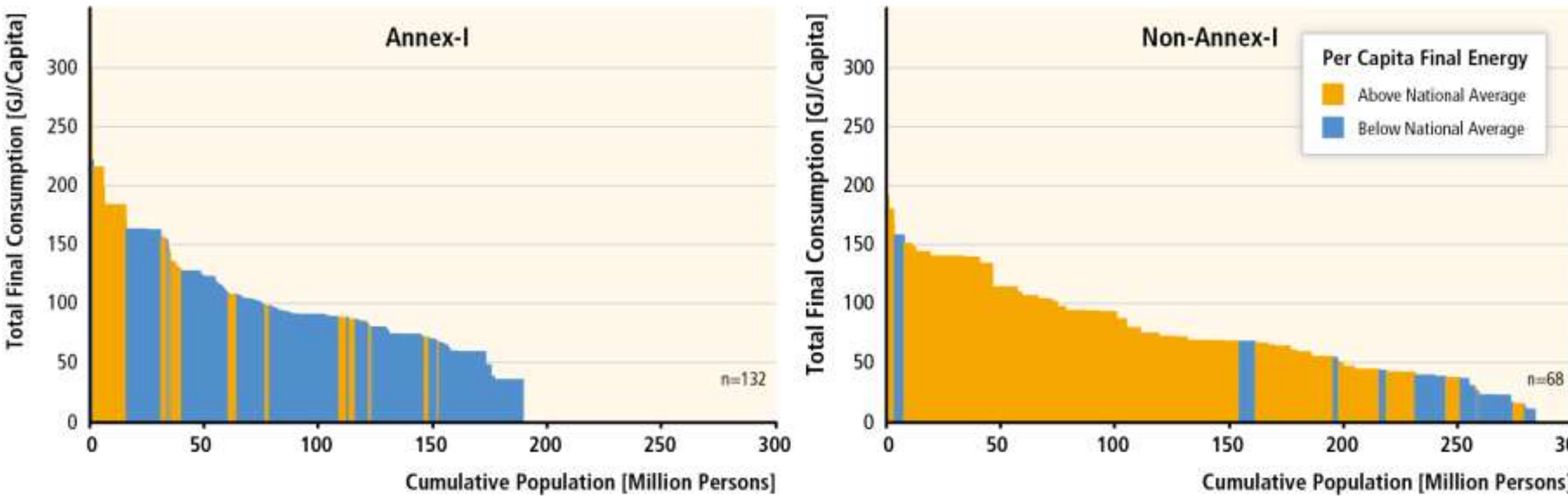


Cost of conserved carbon for implemented energy efficiency programs, post-ante evaluation results (based on data in Table 9.9 (boza-kiss et.al 2013 in COSUst)

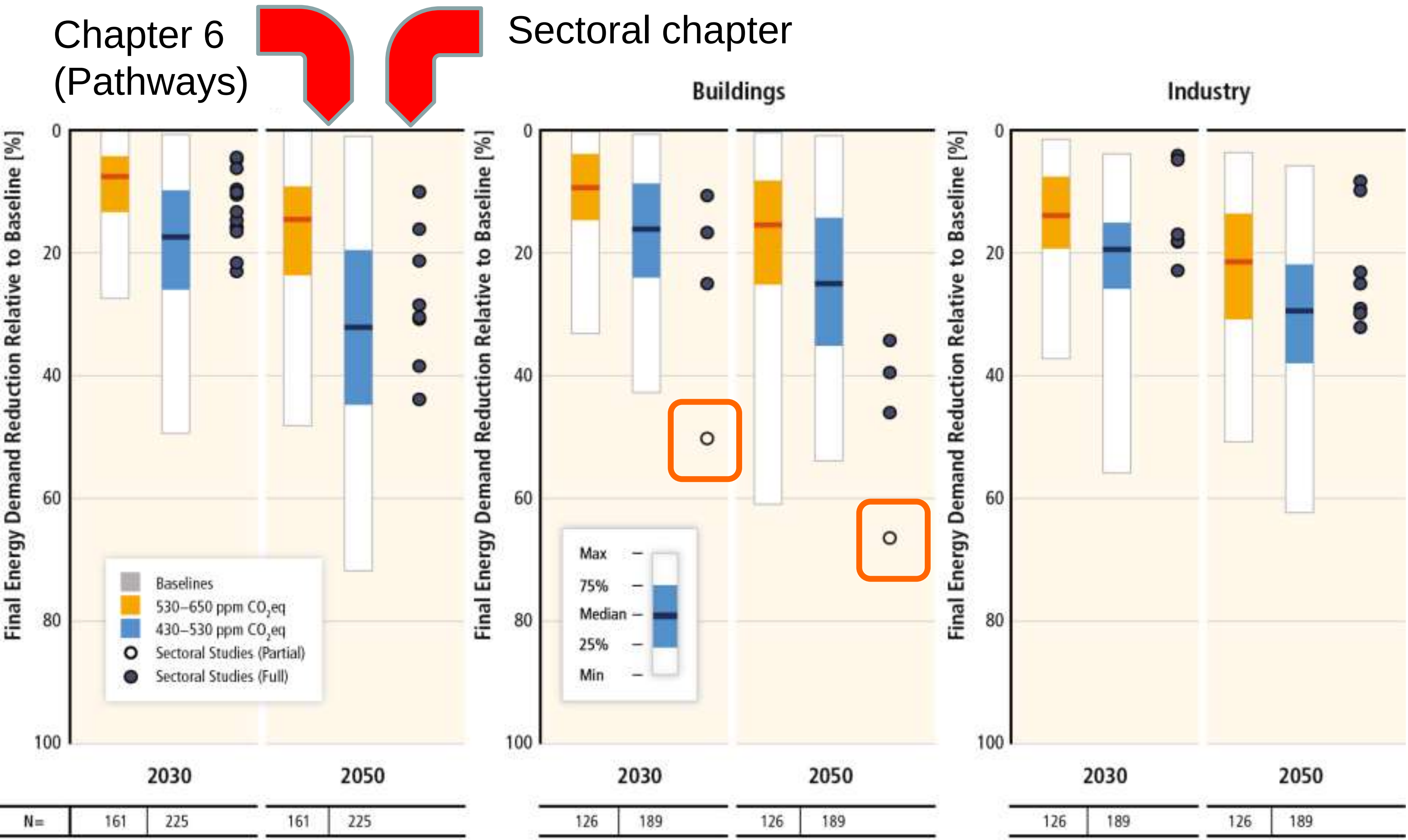


Key Message 1: Urban areas are focal points of energy use and CO_2 emissions

Urban energy use: 67–76%
Urban CO_2 emissions: 71–76%
} of global total

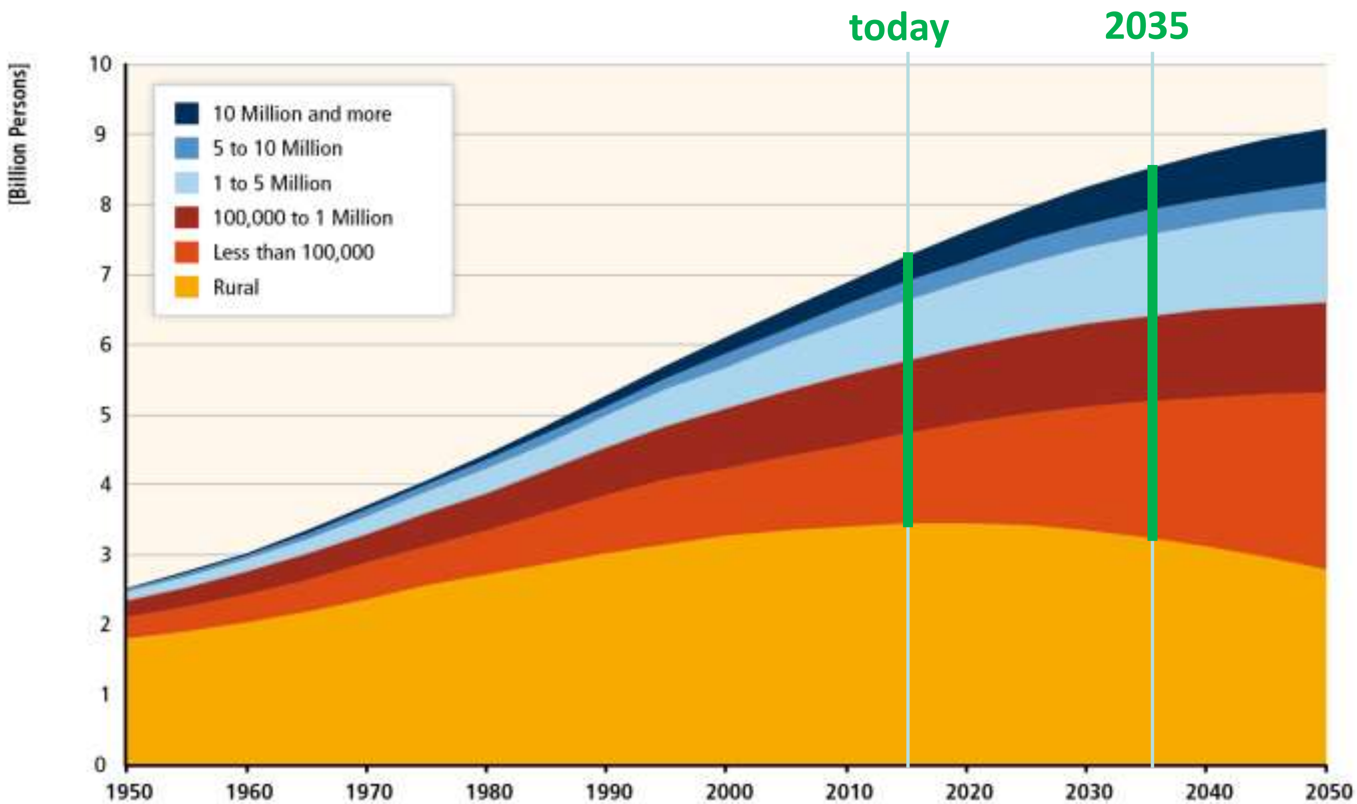


Energy Demand Reduction Potential



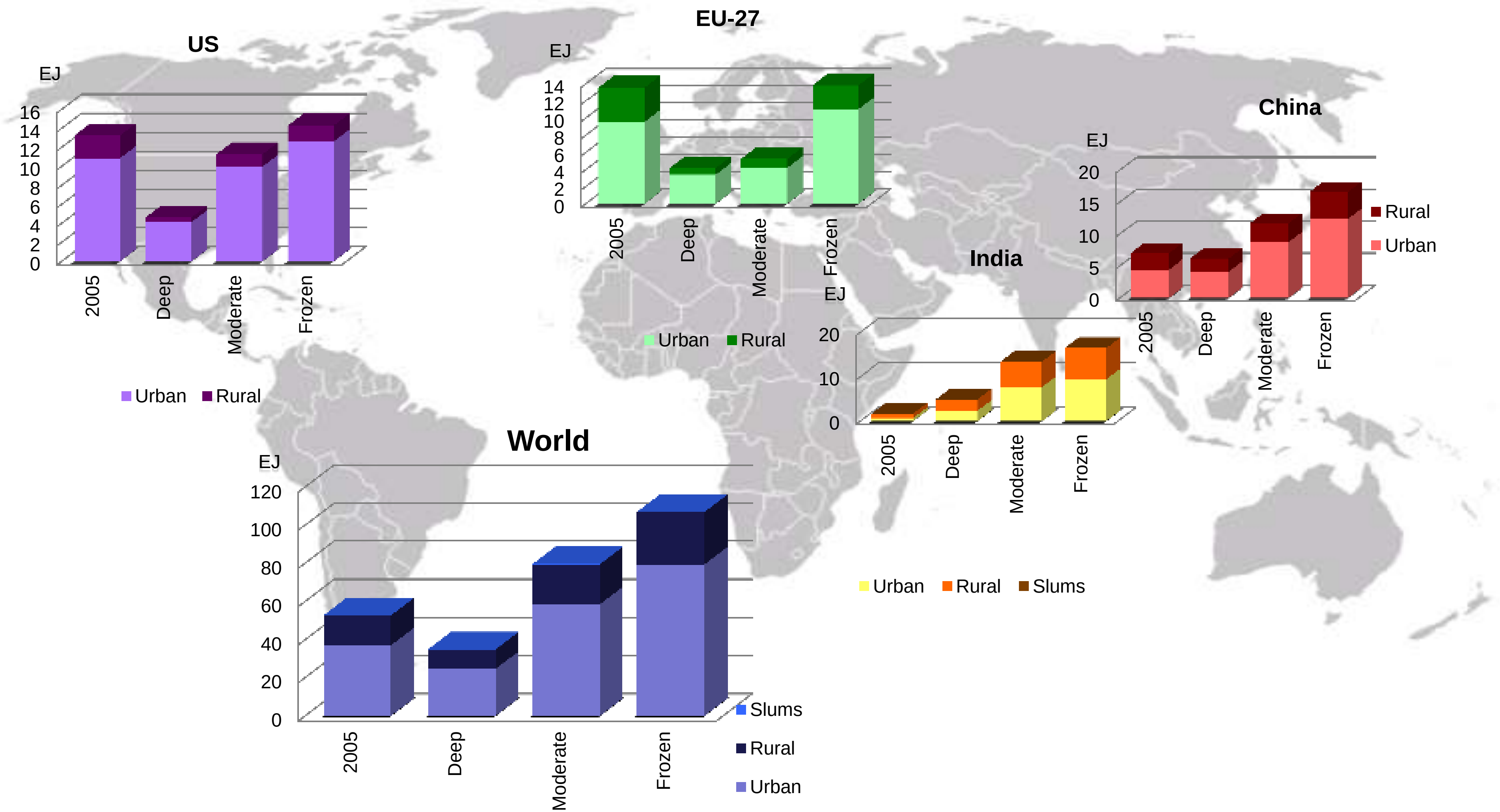
Source: Figure SPM.11

Window of opportunity in next two decades as large portions of global urban areas have yet to be built

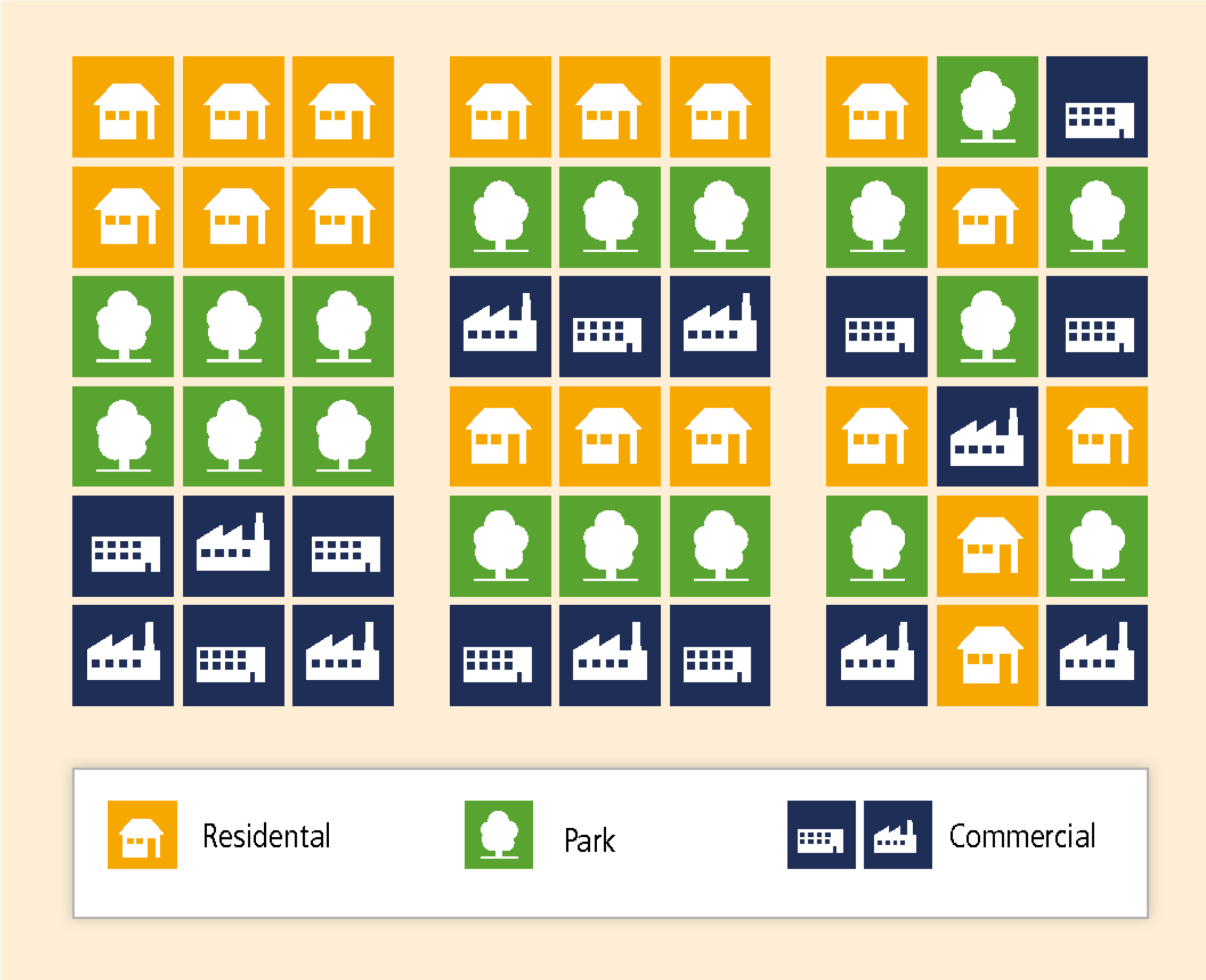


Need to avoid emissions lock-in from ***constructing*** *and* ***operating*** *the built environment*

Urban vs. Rural Energy Use

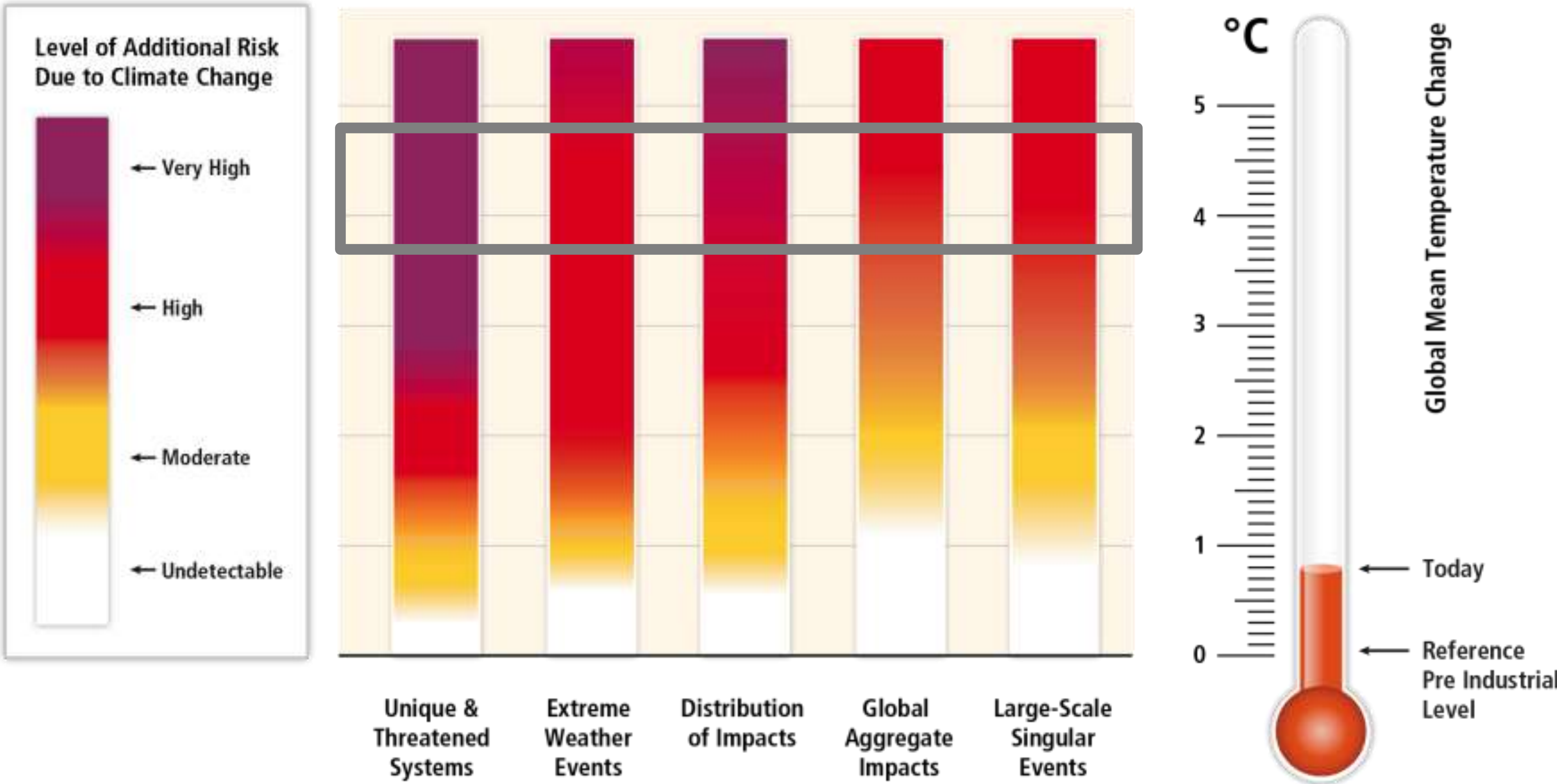


To lower urban emissions, need diverse urban land use mix



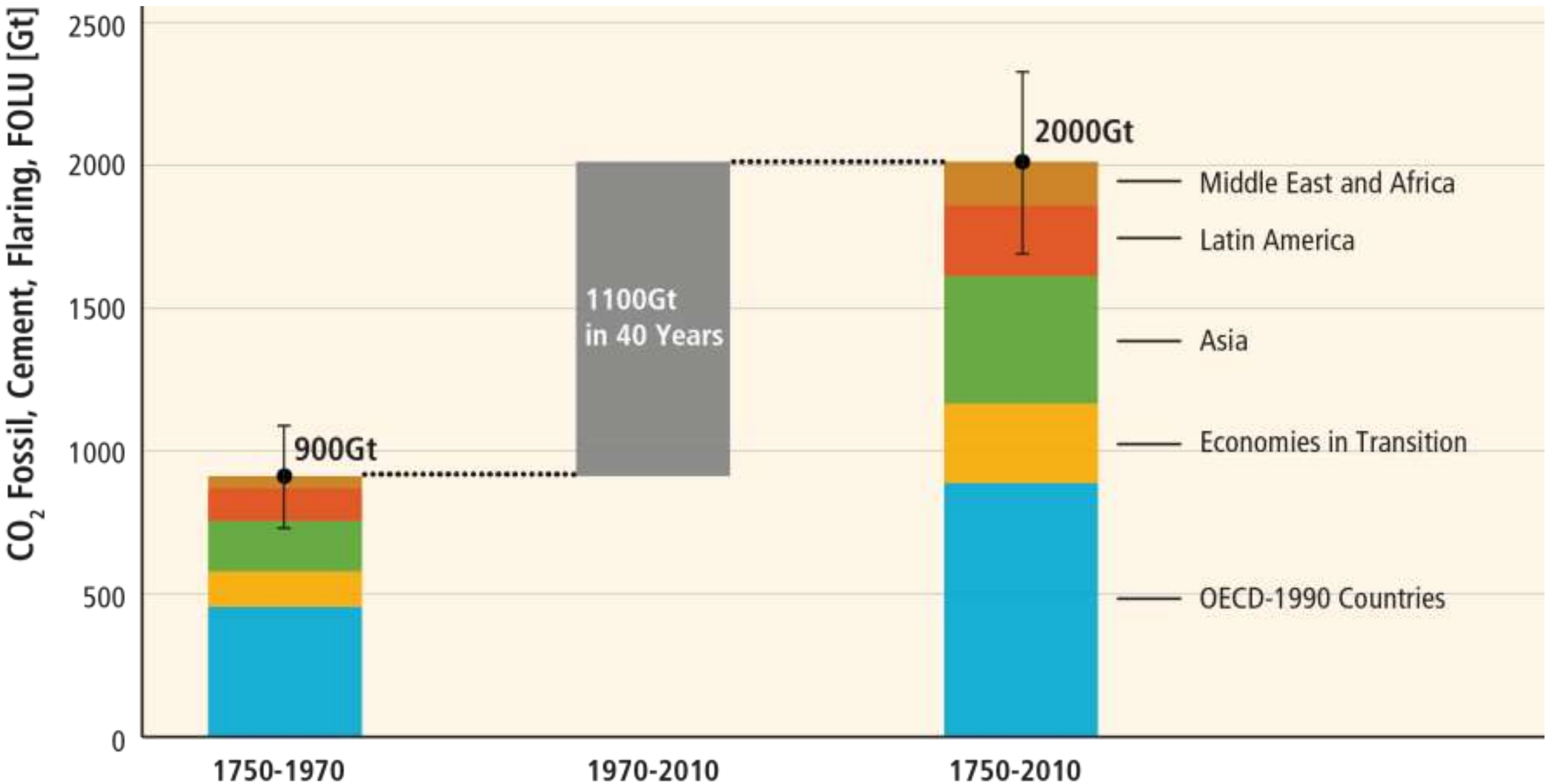
Working Group III contribution to the
IPCC Fifth Assessment Report

Without additional mitigation, global mean surface temperature is projected to increase by 3.7 to 4.8°C over the 21st century.



Based on WGII AR5 Figure 19.4

About half of the cumulative anthropogenic CO_2 emissions between 1750 and 2010 have occurred in the last 40 years.



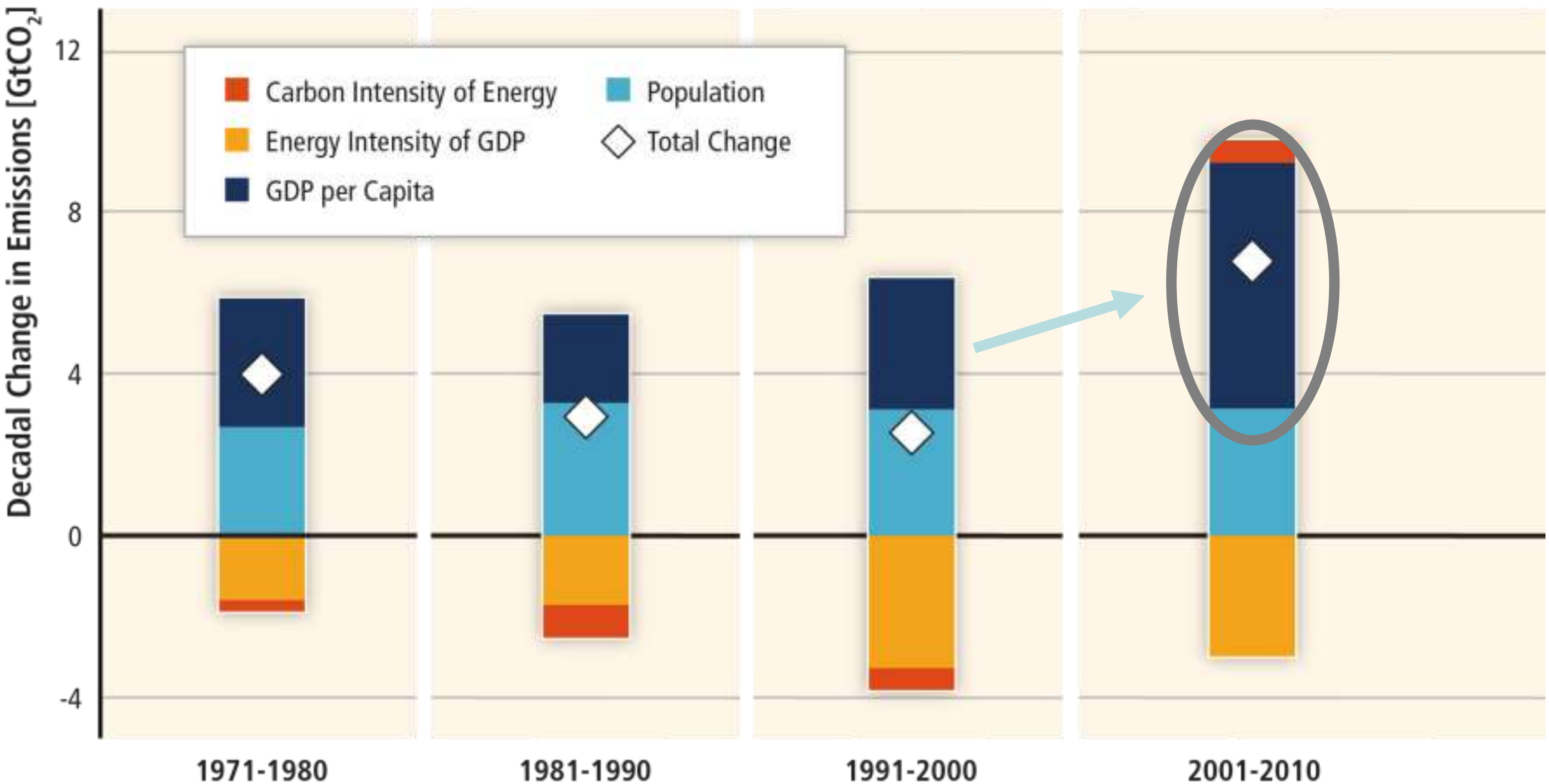
Based on Figure 5.3

WMO UNEP

Working Group III contribution to the
IPCC Fifth Assessment Report

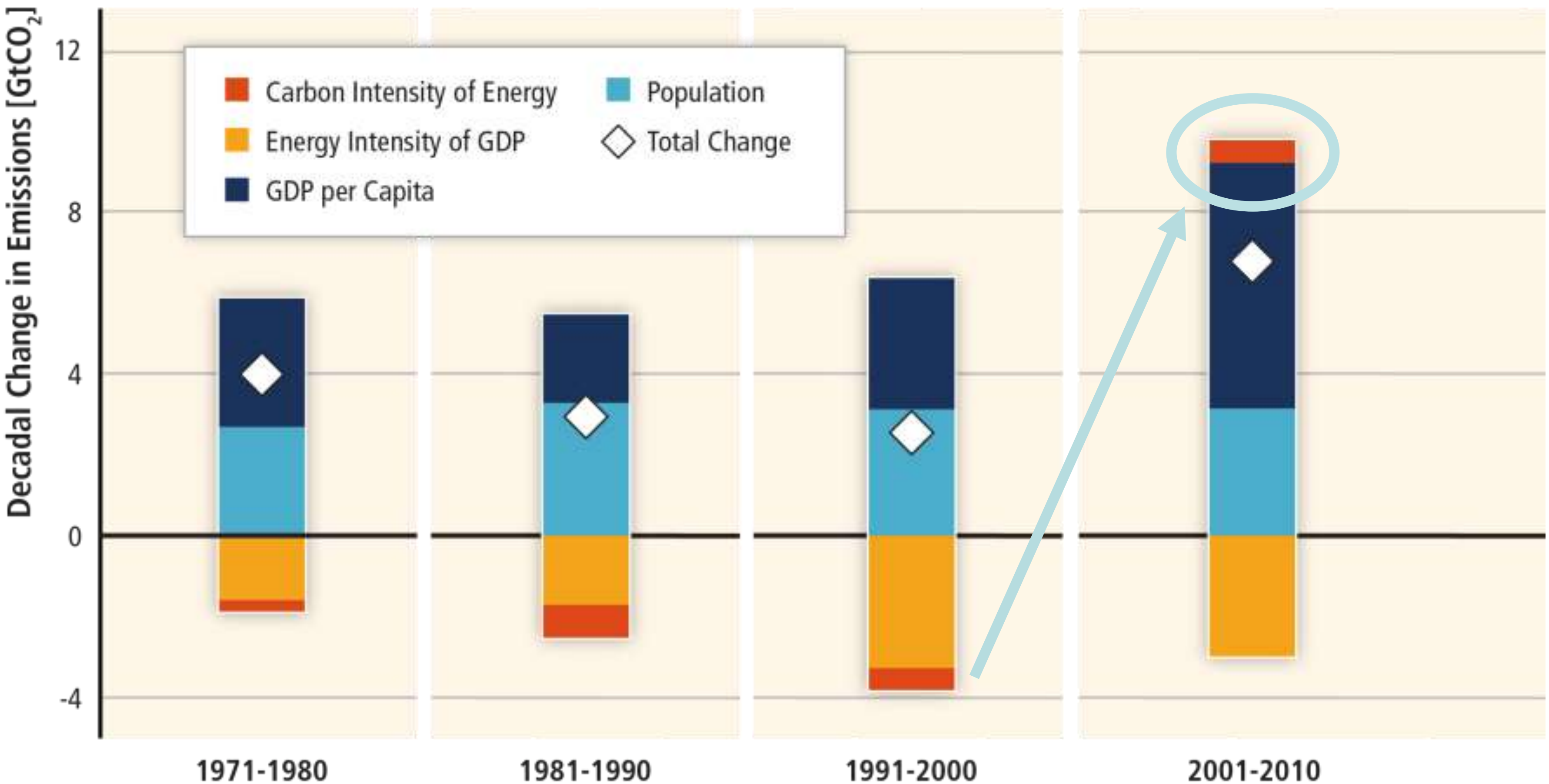
ipcc INTERGOVERNMENTAL PANEL ON climate change

GHG emissions rise with growth in GDP and population.



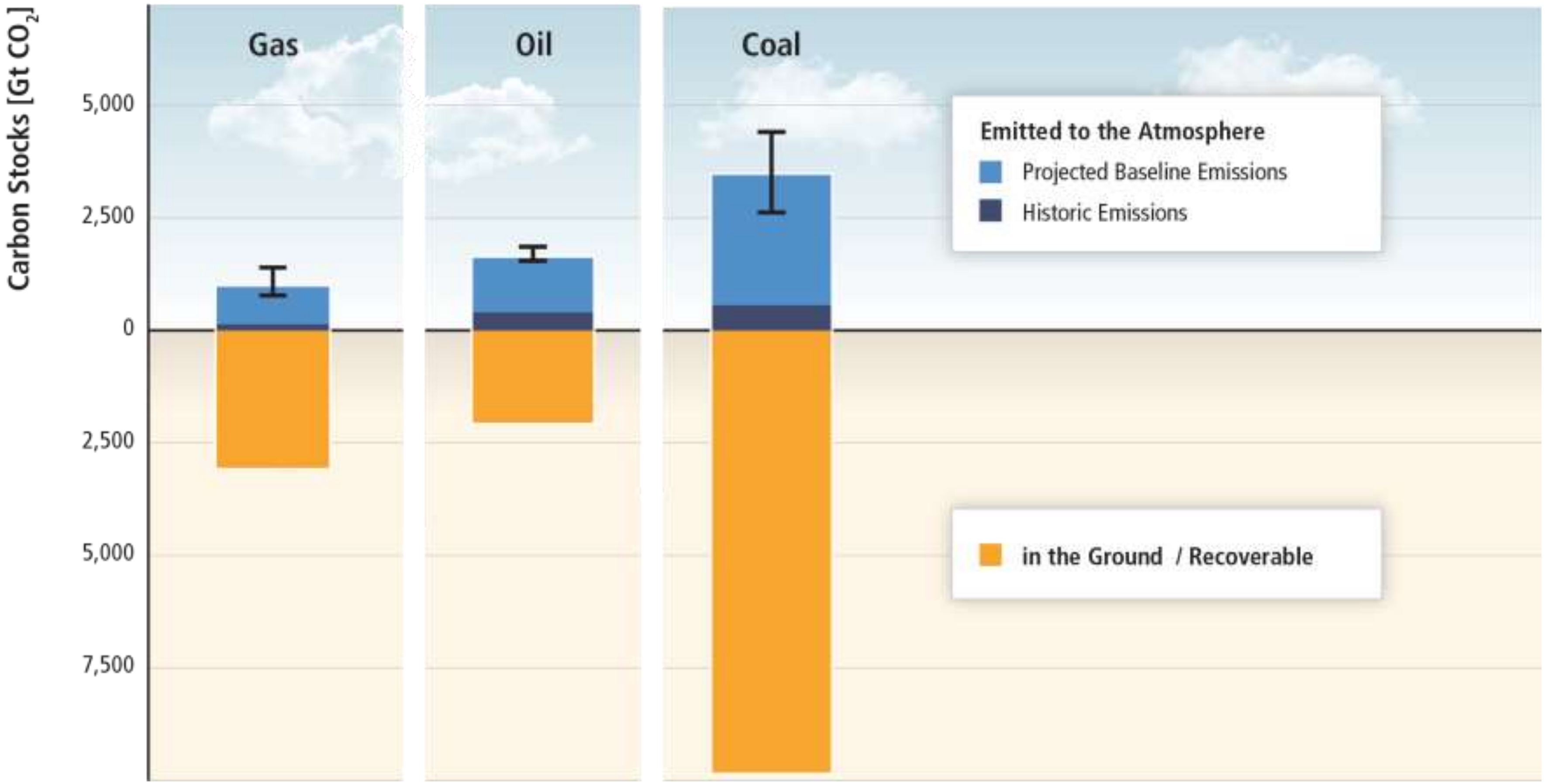
Based on Figure 1.7

The long-standing trend of decarbonisation has reversed.



Based on Figure 1.7

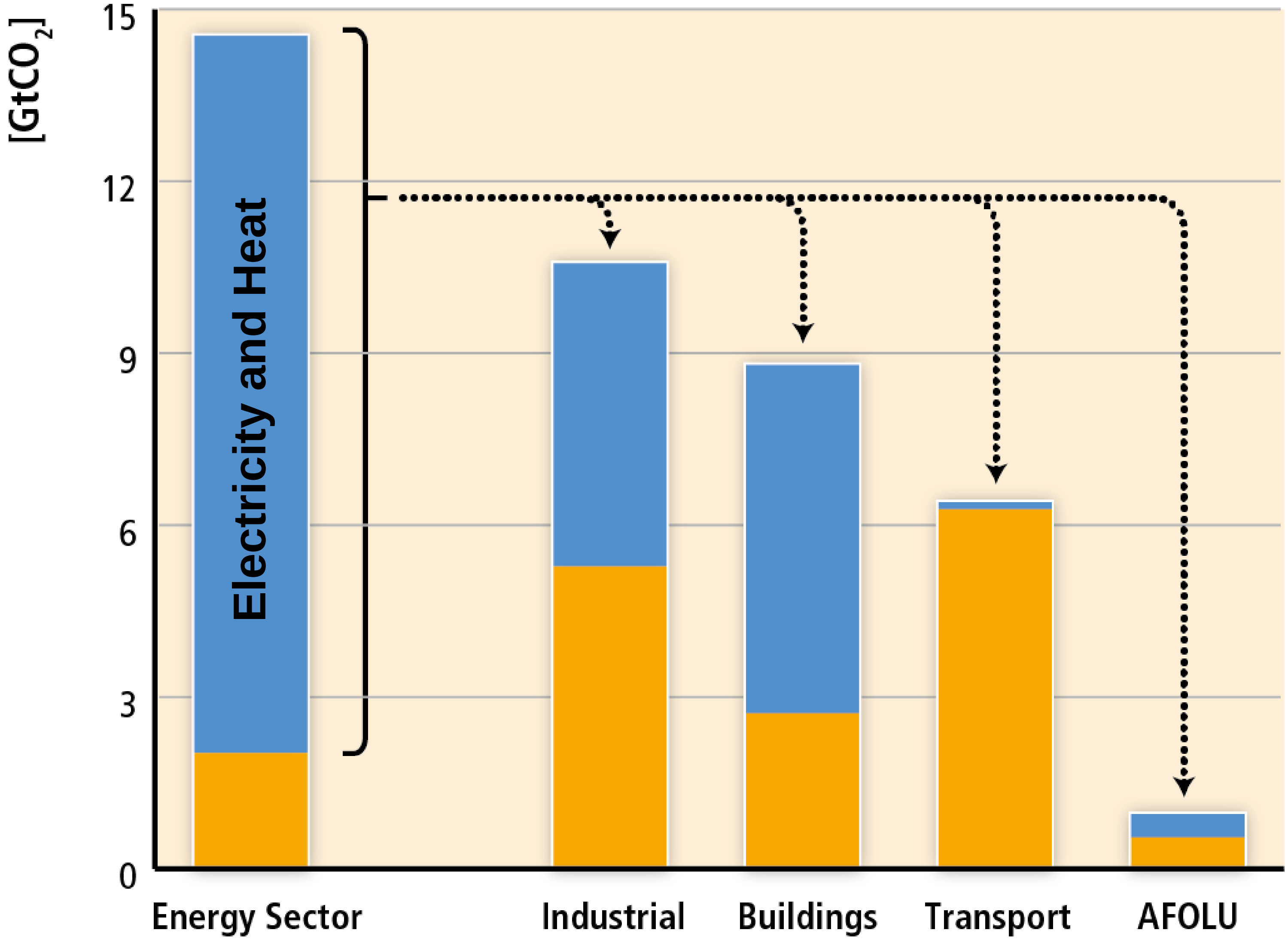
There is far more carbon in the ground than emitted in any baseline scenario.



Based on SRREN Figure 1.7

Climate change is a global commons problem.

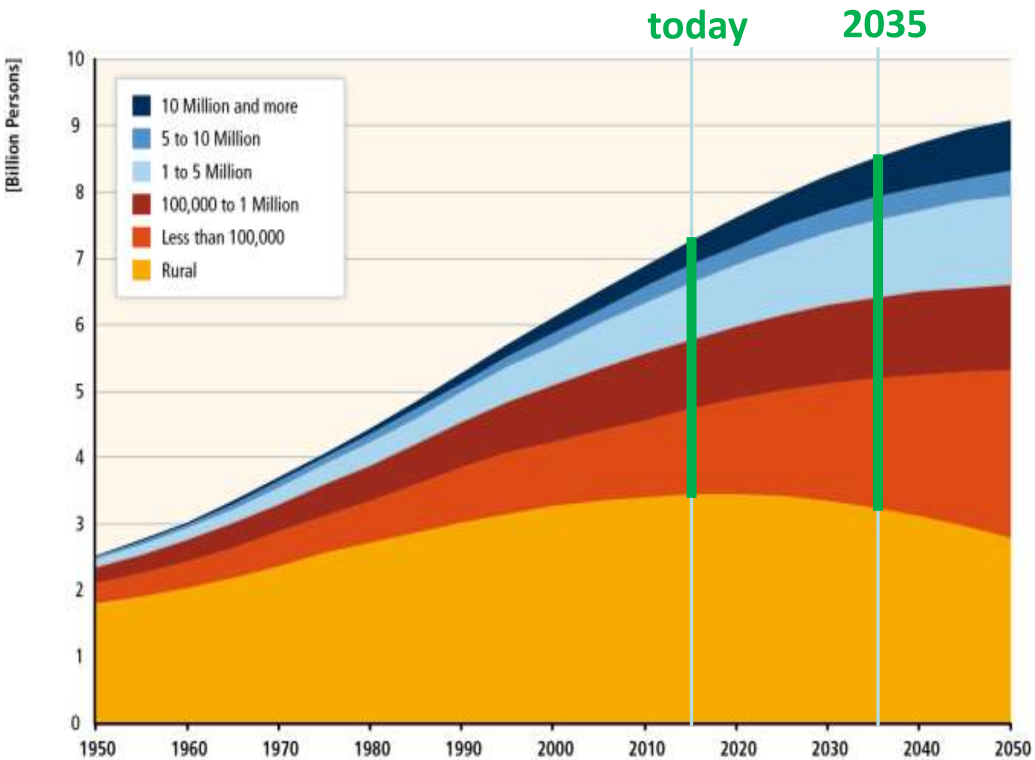
Allocation of Electricity/Heat Generation Emissions to End-use Sectors for 2010



Source: Figure A.II.2

Industry I

- **From a short and mid-term perspective energy efficiency and behaviour change could significantly contribute to GHG mitigation**
  - The energy intensity of the industry sector could be directly reduced by up to approximately 25% compared to the current level through the wide-scale deployment of best available technologies, upgrading/replacement, particularly in countries where these are not in practice and in non-energy intensive industries
  - Additional energy intensity reductions of up to approximately 20% may potentially be realized through innovation



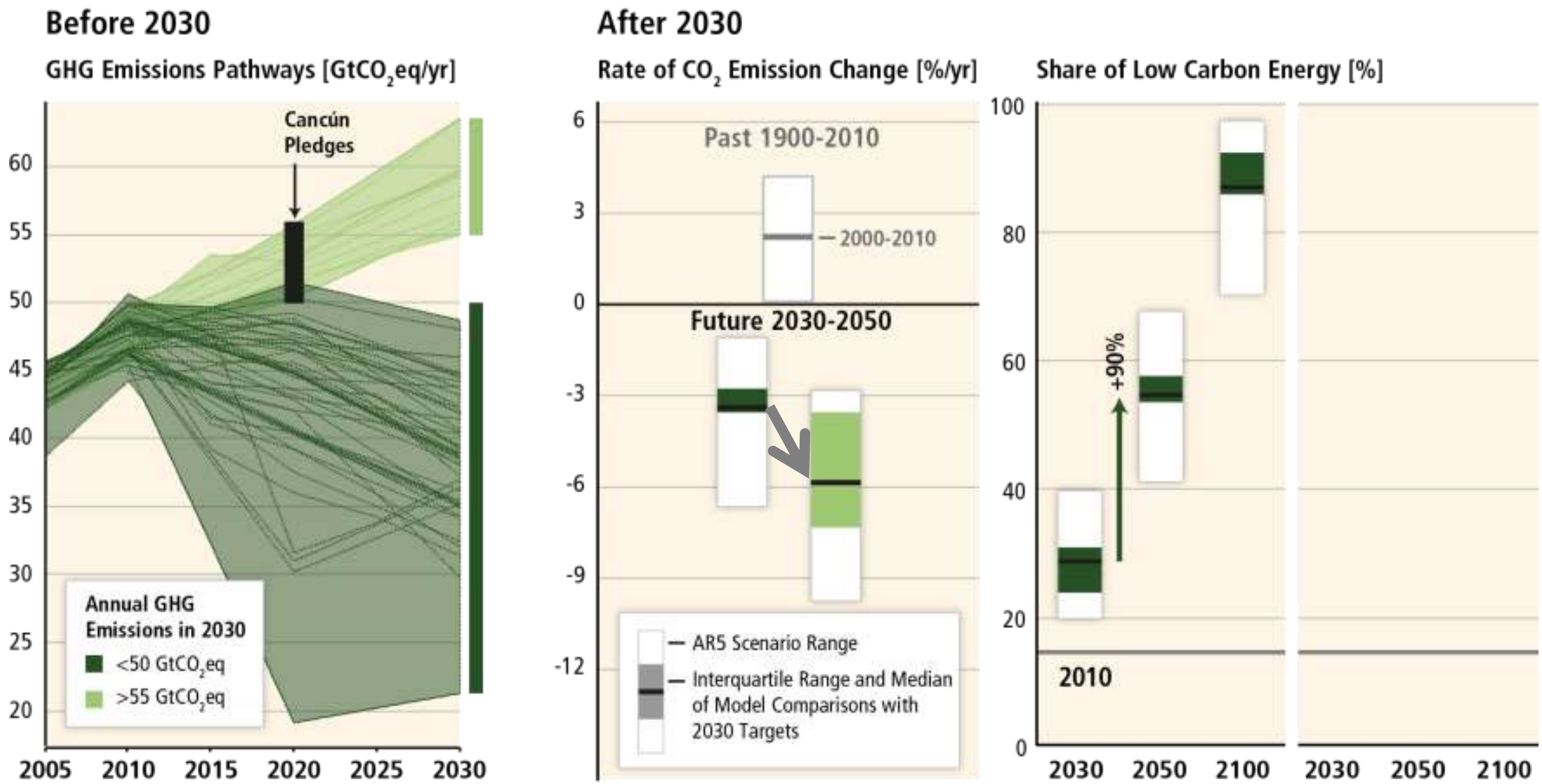
A substantial share of emission increase in Asia in the next few decades will come from cities

- **Urban areas generate 80% of GDP and 71% - 76% of CO2 emissions from global energy use**
- **Each week the urban population increases by 1.3 million**
- **By 2050 urban population is to increase by up to 3 billion**
- **Over 70% of global building energy use growth until 2050 will take place in developing country cities**
- **This enormous expected increase poses both an opportunity and responsibility**

To lower urban emissions, need diverse urban land use mix

Working Group III contribution to the IPCC Fifth Assessment Report

Delaying mitigation is estimated to increase the difficulty and narrow the options for limiting warming to 2°C.



Based on Figures 6.32 and 7.16

WMO UNEP

Working Group III contribution to the
IPCC Fifth Assessment Report

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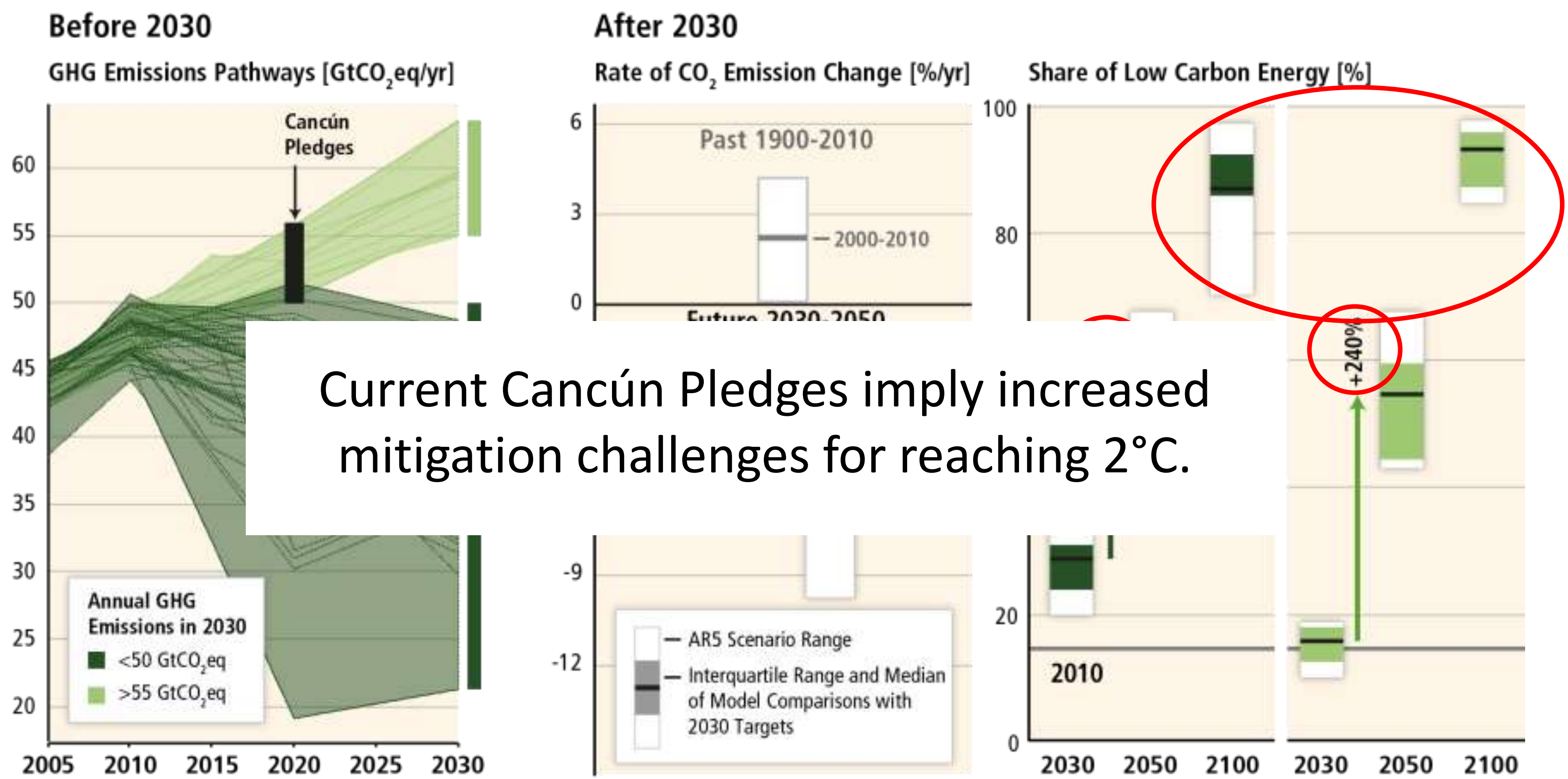
INTERGOVERNMENTAL PANEL ON climate change

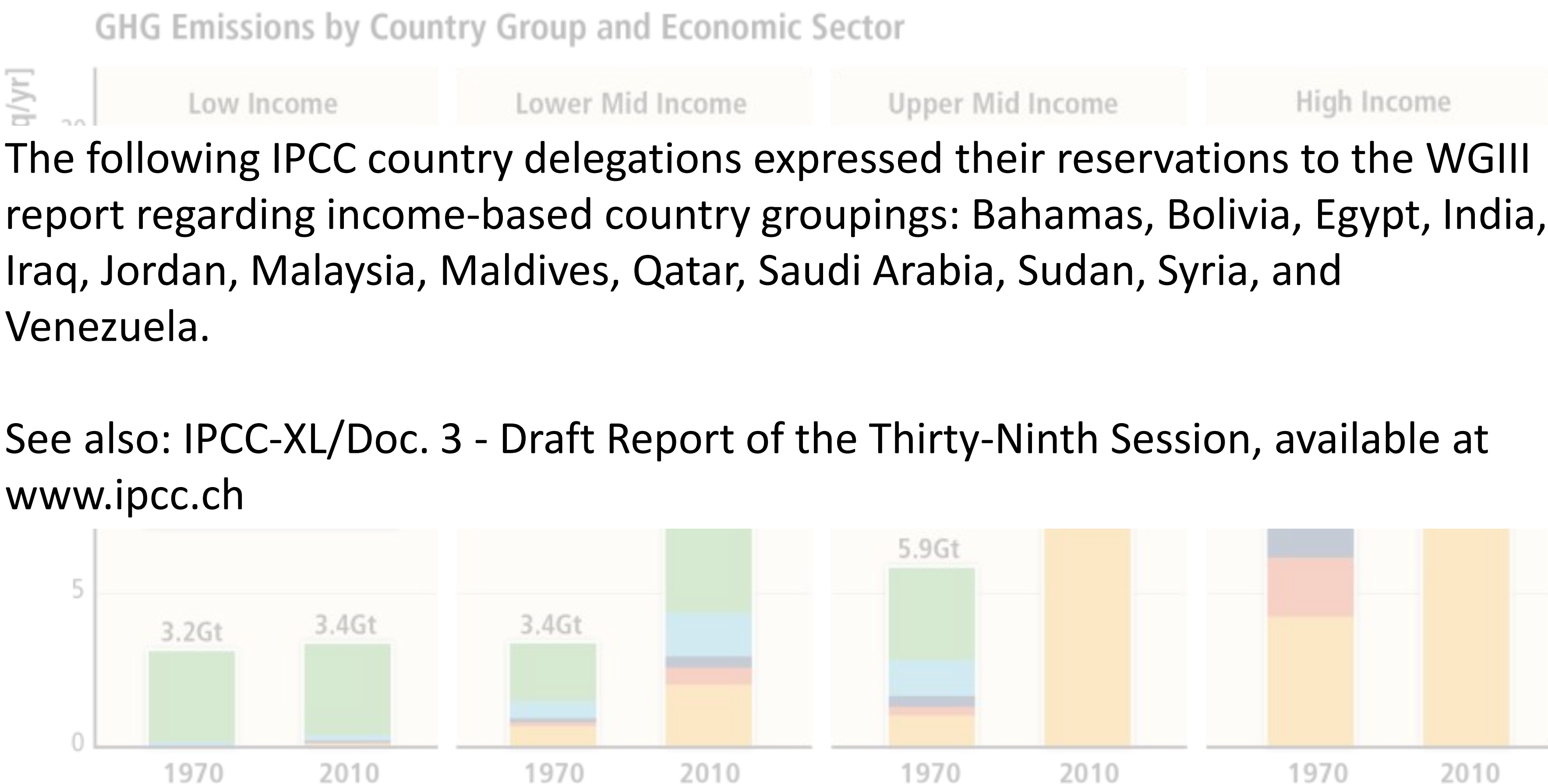
Delaying mitigation is estimated to increase the difficulty and narrow the options for limiting warming to 2°C.



Current Cancún Pledges imply increased mitigation challenges for reaching 2°C.

Based on Figures 6.32 and 7.16

Regional patterns of GHG emissions are shifting along with changes in the world economy.

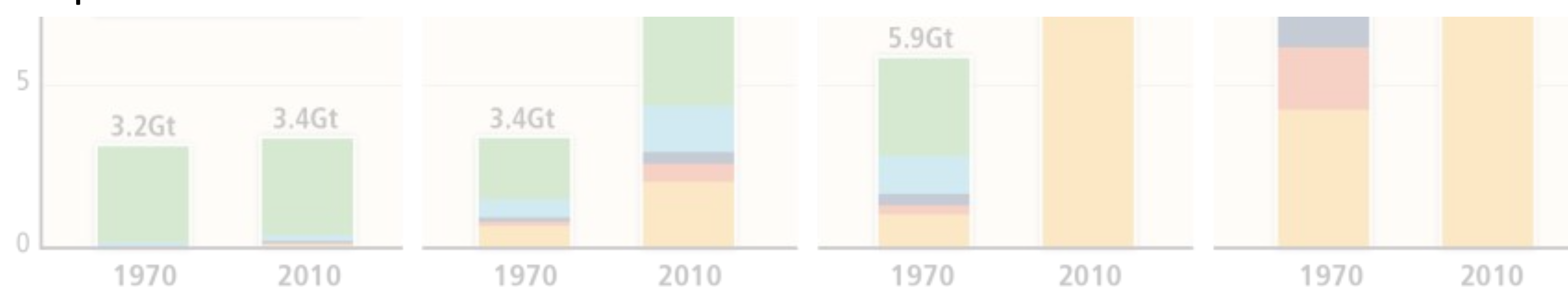


The following IPCC country delegations expressed their reservations to the WGIII report regarding income-based country groupings: Bahamas, Bolivia, Egypt, India, Iraq, Jordan, Malaysia, Maldives, Qatar, Saudi Arabia, Sudan, Syria, and Venezuela.

See also: IPCC-XL/Doc. 3 - Draft Report of the Thirty-Ninth Session, available at www.ipcc.ch

Based on Figure 1.6

Regional patterns of GHG emissions are shifting along with changes in the world economy.



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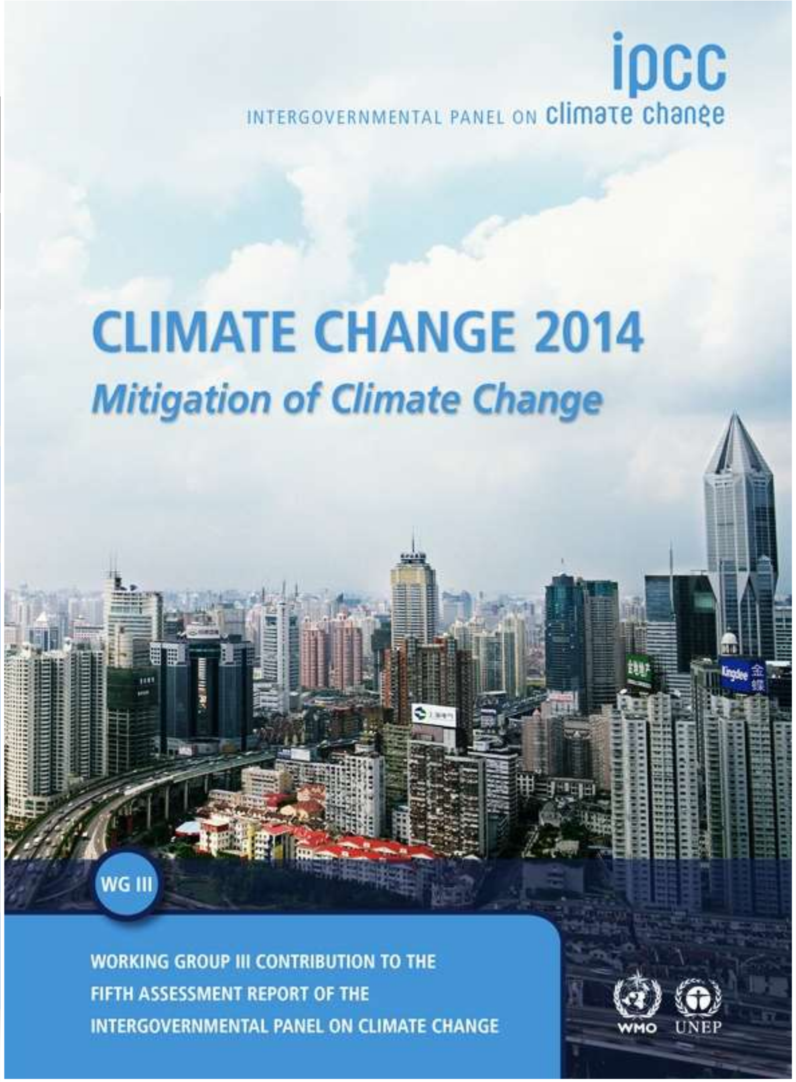
See also: IPCC-XL/Doc. 3 - Draft Report of the Thirty-Ninth Session, available at www.ipcc.ch

Based on Figure 1.6

IPCC reports are the result of extensive work of many scientists from around the world.

- 1 Summary for Policymakers
- 1 Technical Summary
- 16 Chapters
- 235 Authors
- 900 Reviewers
- More than 2000 pages
- Close to 10,000 references
- More than 38,000 comments



Mitigation

What do the IPCC findings mean for South Asia?

CENTER FOR CLIMATE CHANGE
AND SUSTAINABLE ENERGY POLICY

CENTRAL EUROPEAN UNIVERSITY

Diana Ürge-Vorsatz

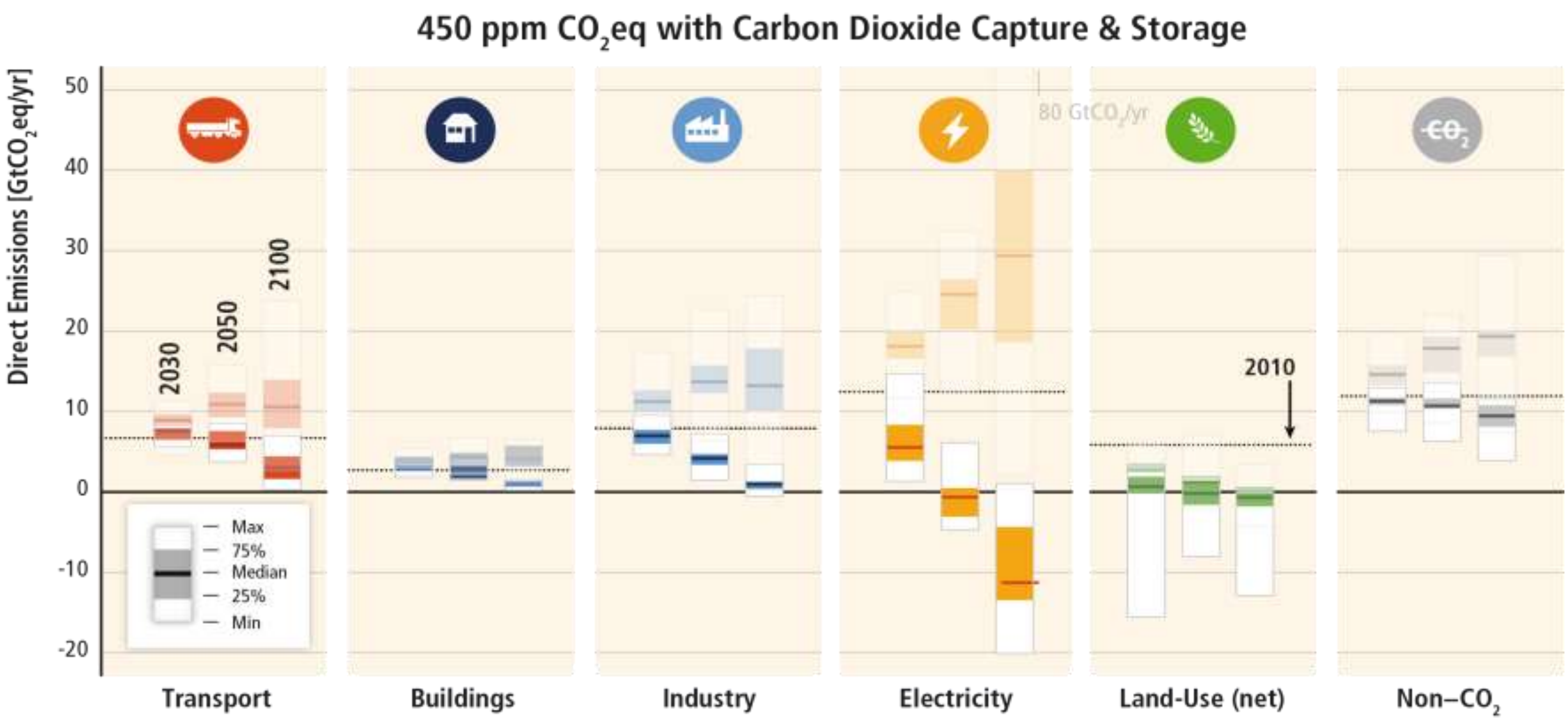
Center for Climate Change and Sustainable Energy Policy,

Central European University

Vice Chair, Working Group III, IPCC

Hanoi
October 24, 2015

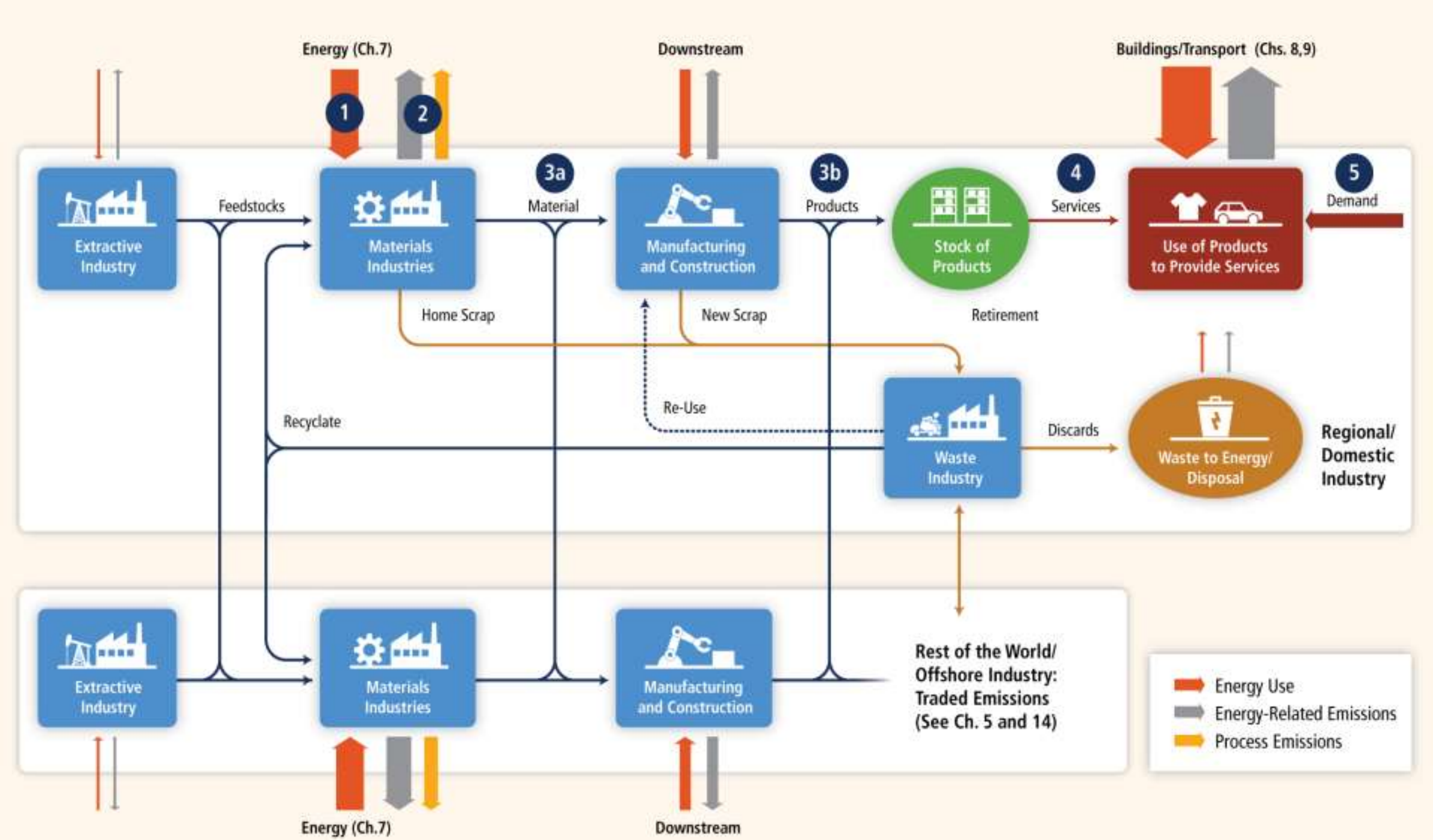
Systemic approaches to mitigation across the economy are expected to be most environmentally as well as cost effective.



Working Group III contribution to the
IPCC Fifth Assessment Report

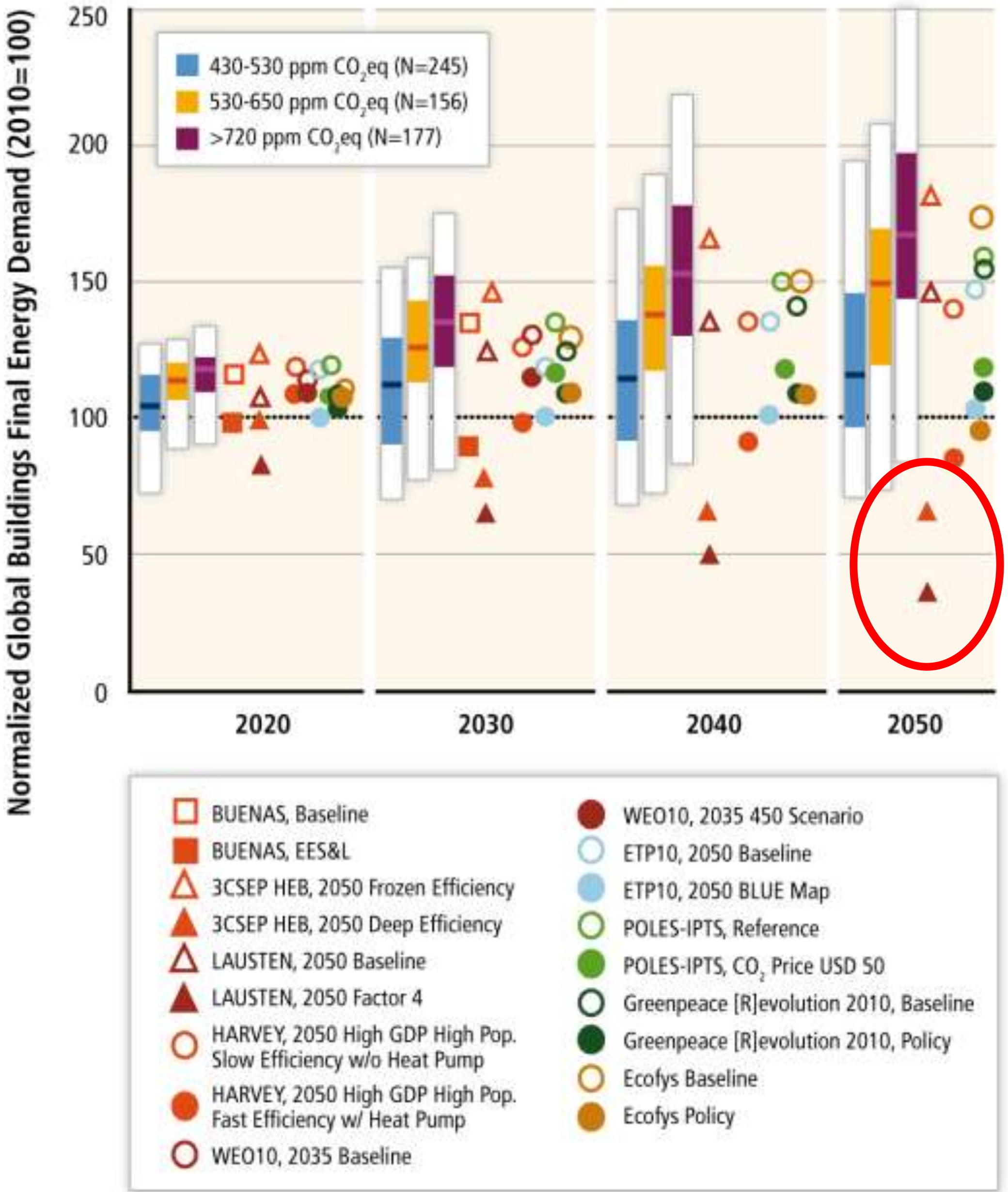
INTERGOVERNMENTAL PANEL ON climate change

Five main options for reducing GHG emissions related to industry (considering also traded goods)



Industry

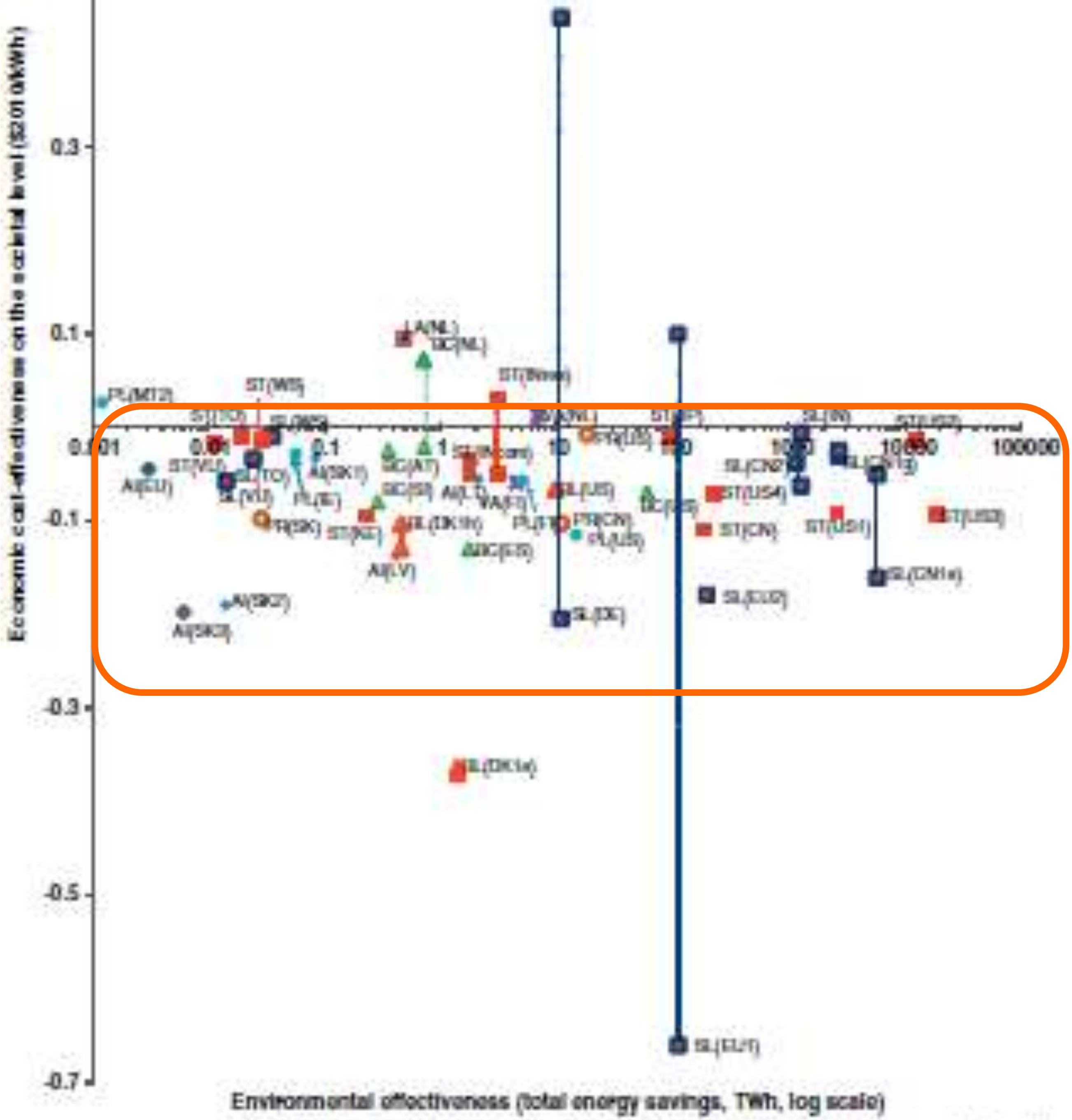
- In the long-term a shift to low-carbon electricity, radical product innovations (e.g. alternatives to cement), or CCS (for mitigating i.a. process emissions) could contribute to significant (absolute) GHG emissions reductions
- Systemic approaches and collaborative activities across companies and sectors and especially SMEs through clusters can reduce energy and material consumption and thus GHG emissions
- Important options for mitigation in waste management is waste reduction, followed by re-use, recycling and energy recovery



Energy efficiency in buildings can substantially lower sectoral energy use; thermal uses are most reducible

for further details on mitigation options and potentials, see Chapter 9

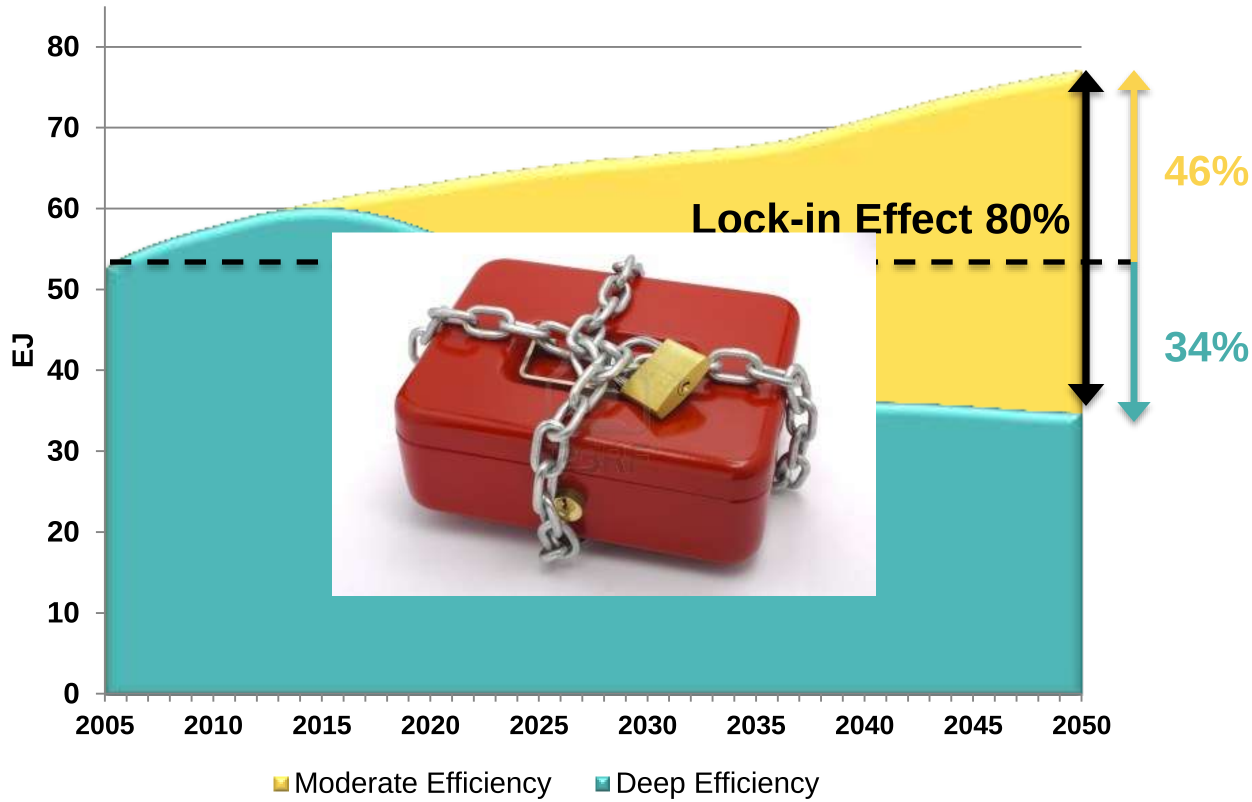
Cost of conserved carbon for implemented energy efficiency programs, post-ante evaluation results (based on data in Table 9.9 (boza-kiss et.al 2013 in COSUst)



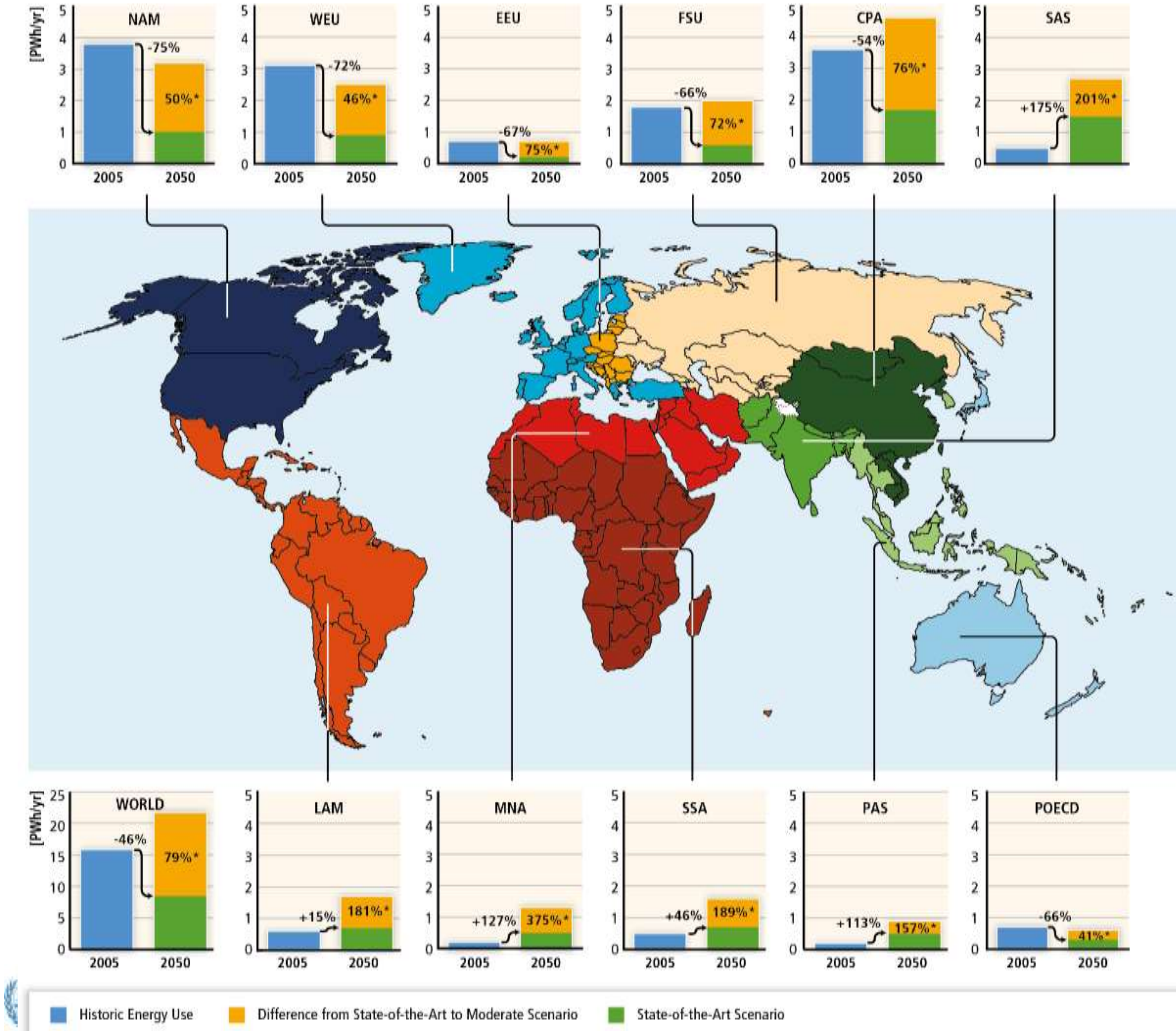
Current Opinion in Environmental Sustainability

However, there is a major lock-in risk

The Lock-in Risk: global heating and cooling final energy in two scenarios



The lock-in risk: heating and cooling energy demand by two scenarios



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

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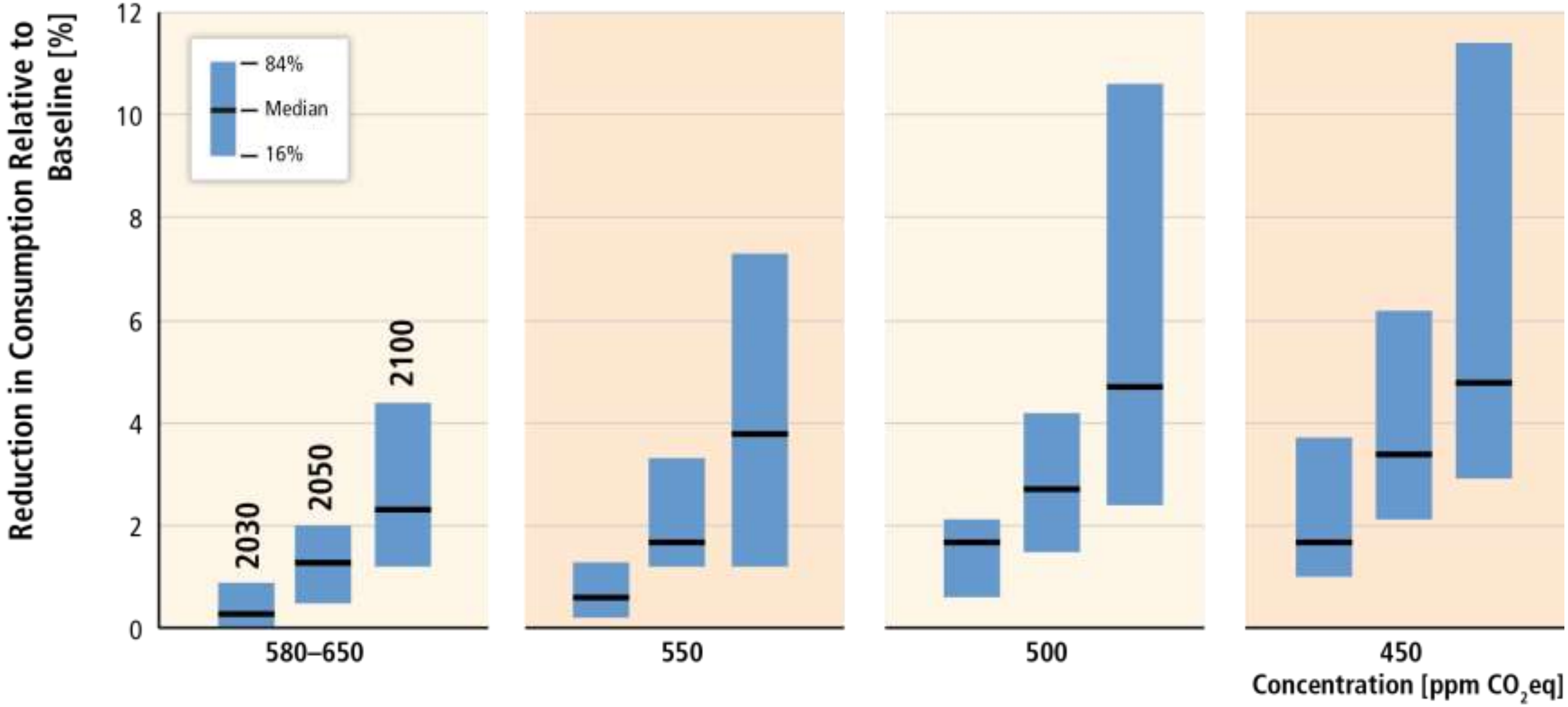
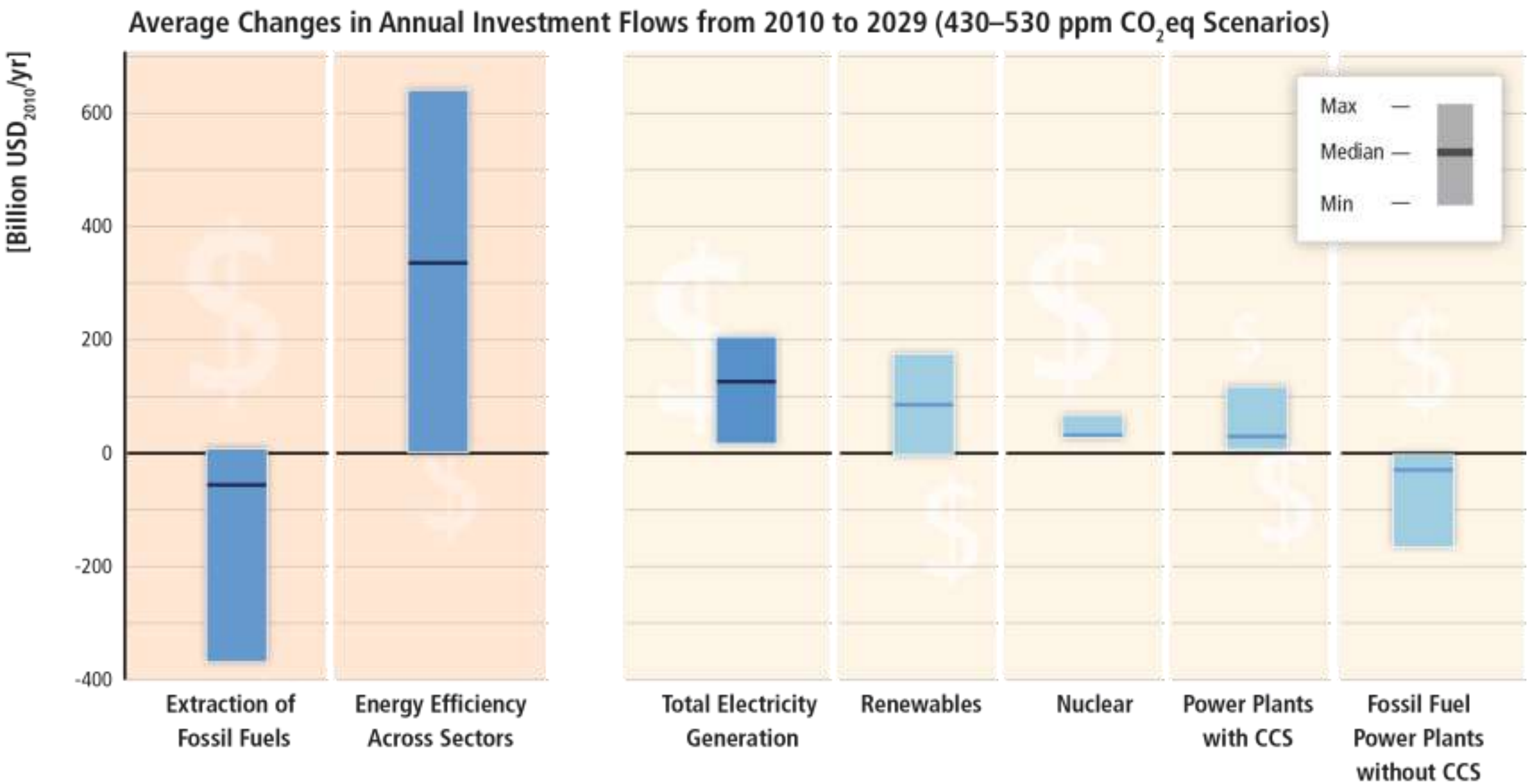
Global costs rise with the ambition of the mitigation goal.



Percentage Point Reduction in Annualized Consumption Growth Rate over 21st Century			
0.03 (0.01-0.05)	0.04 (0.01-0.09)	0.06 (0.03-0.13)	0.06 (0.04-0.14)

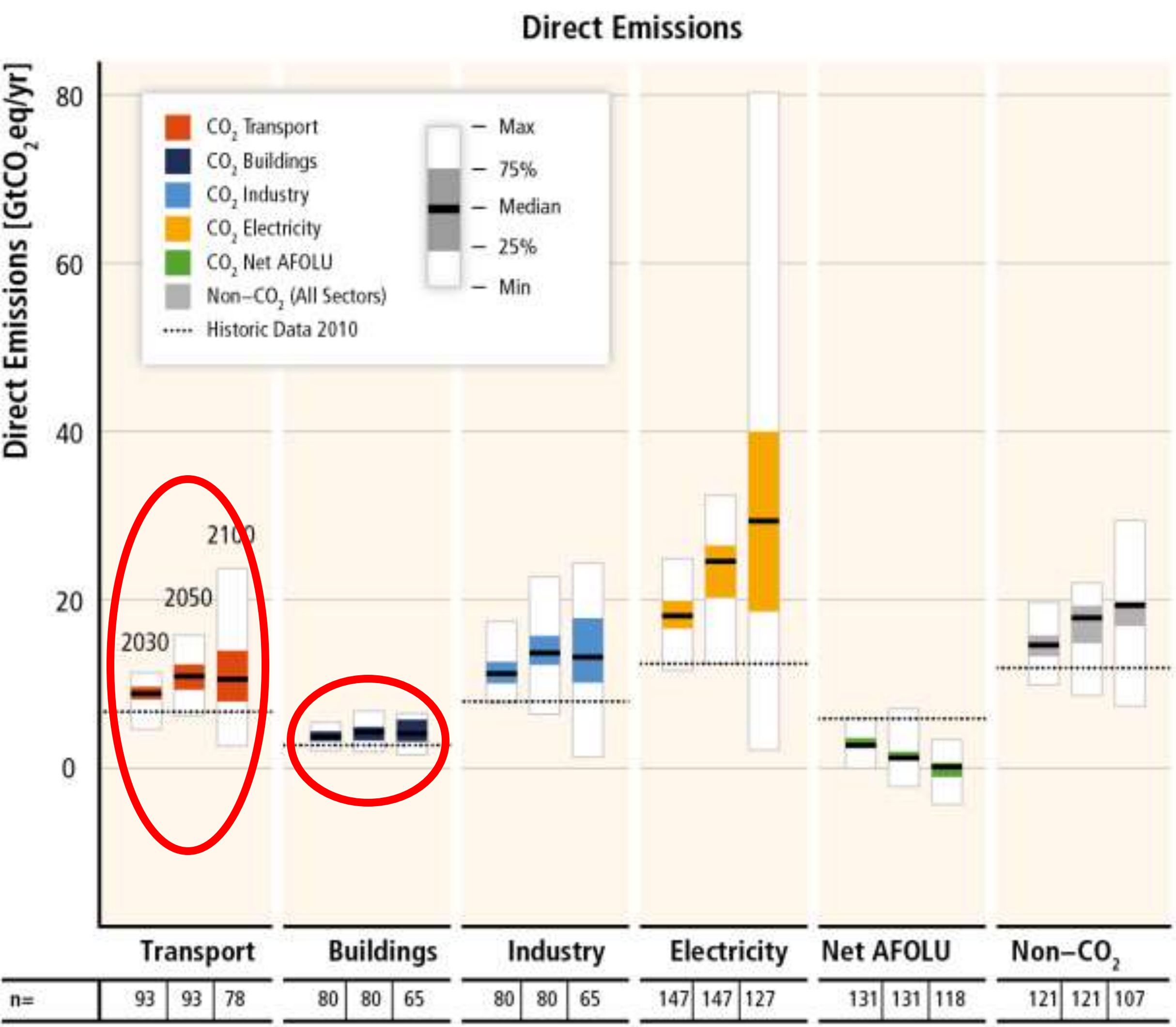
Based on Table SPM.2

Substantial reductions in emissions would require large changes in investment patterns and appropriate policies.



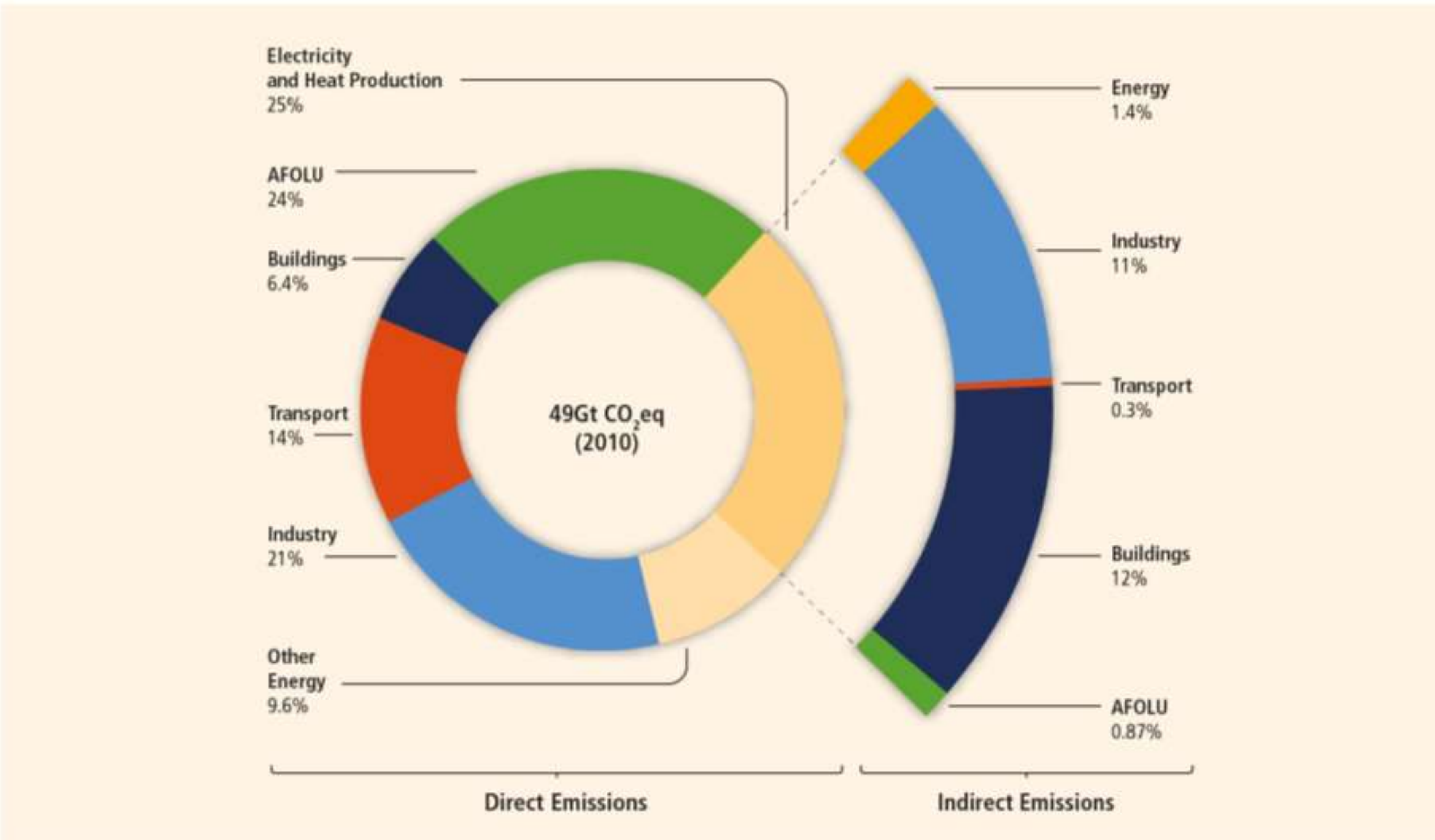
Based on Figure 16.3

Baseline Scenarios: Direct vs. Indirect Emission Accounting



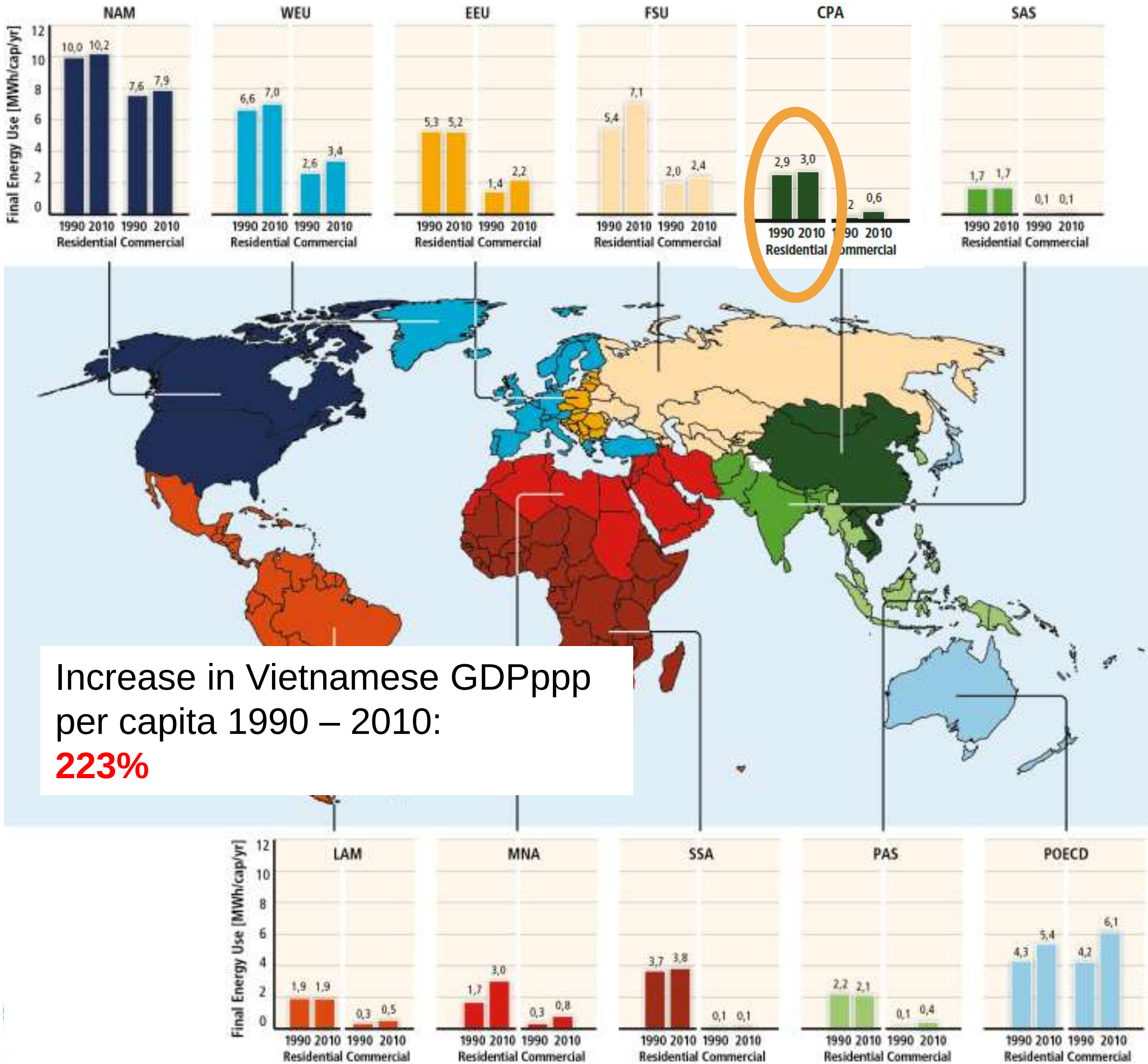
Source: Figure SPM.10, TS.15

Accounting for indirect emissions has key implications on mitigation strategy!



Increased efficiency has been a very powerful tool to keep emission and energy demand increases at bay for decades

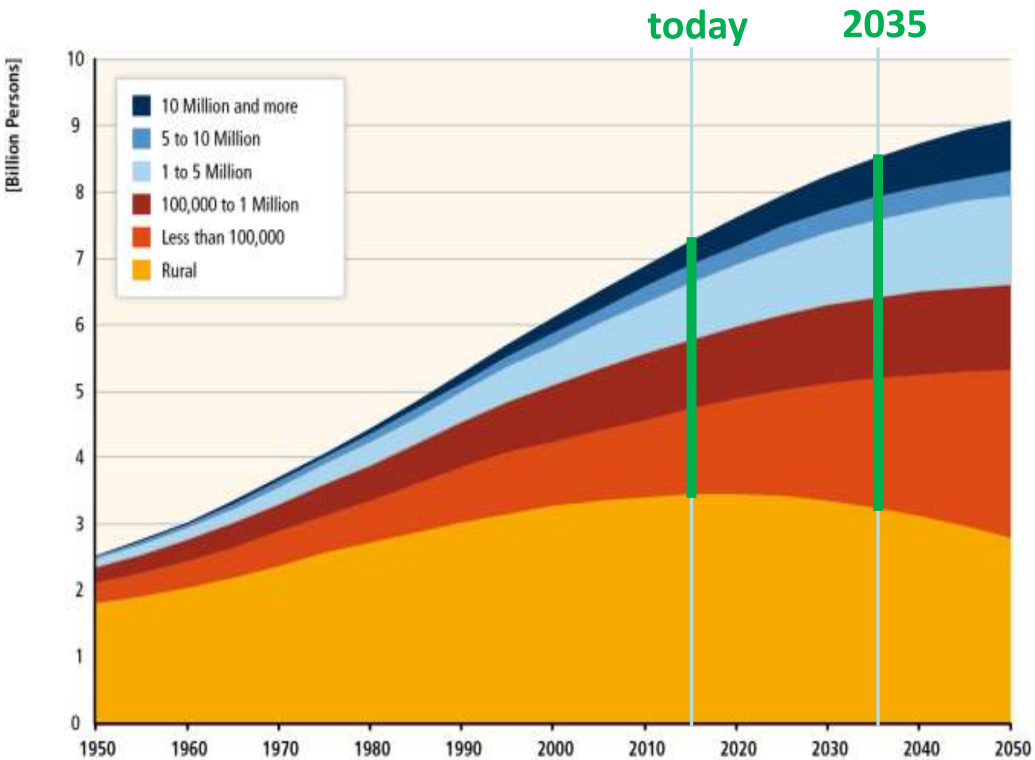
Per capita residential and commercial energy use, 1990 - 2010



Increase in Vietnamese GDPppp per capita 1990 – 2010:
223%

climate change

Mitigation opportunities in the end-use sectors



A substantial share of emission increase in Asia in the next few decades will come from cities

- **Urban areas generate 80% of GDP and 71% - 76% of CO_2 emissions from global energy use**
- **Each week the urban population increases by 1.3 million**
- **Over 70% of global building energy use growth until 2050 will take place in developing country cities**
- **This enormous expected increase poses both an opportunity and responsibility**

A broad diversity of opportunities exist to keep urban emissions at bay while increasing services

- Urban design and form
- Energy efficient buildings
  - low-energy architecture
    - avoiding mechanical cooling needs
  - High-efficiency appliances, lighting and equipment
  - High performance operation of buildings (mainly commercial)
- Fuel switch to low-carbon energy sources (RES) or high-efficiency equipment using energy contributing to CC
  - Hi eff cookstoves
- Lowering embodied energy in the built infrastructure –
  - affordable low-carbon, durable construction materials

Passive House standard can save 95% of heating/cooling energy use

1. Cornell Tech housing—Tallest PH building (Roosevelt Island, NY)
2. Office Building (Brussels, Belgium)
3. Firestation (Wolfurt-Bahnhof, Austria)
4. Supermarket (Hanover, Germany)
5. Complete urban district (Heidelberg-Bahnstadt, Germany)
6. Kindergarten (Gabrovo, Bulgaria)
7. Xingfubao— Combined Retail, Office and Residential Building (Urumqi City, China)
8. Seminar Building (Goesan, South Korea)
9. Austrian Embassy (Jakarta, Indonesia)
10. Glendowie House (Auckland, New Zealand)
11. Recreation Center—Salzburg, Austria
12. Belgian and Netherlands Embassy (Kinshara, DRC)
13. Single Family Home (Santiago, Chile)
14. TAPHA house (Mexico City, Mexico)
15. The Orchards—affordable housing project (Hillsboro, Oregon USA)
16. Passive House Factory (Pemberton, BC Canada)
17. Administrative office retrofit (Saint Etienne, France)

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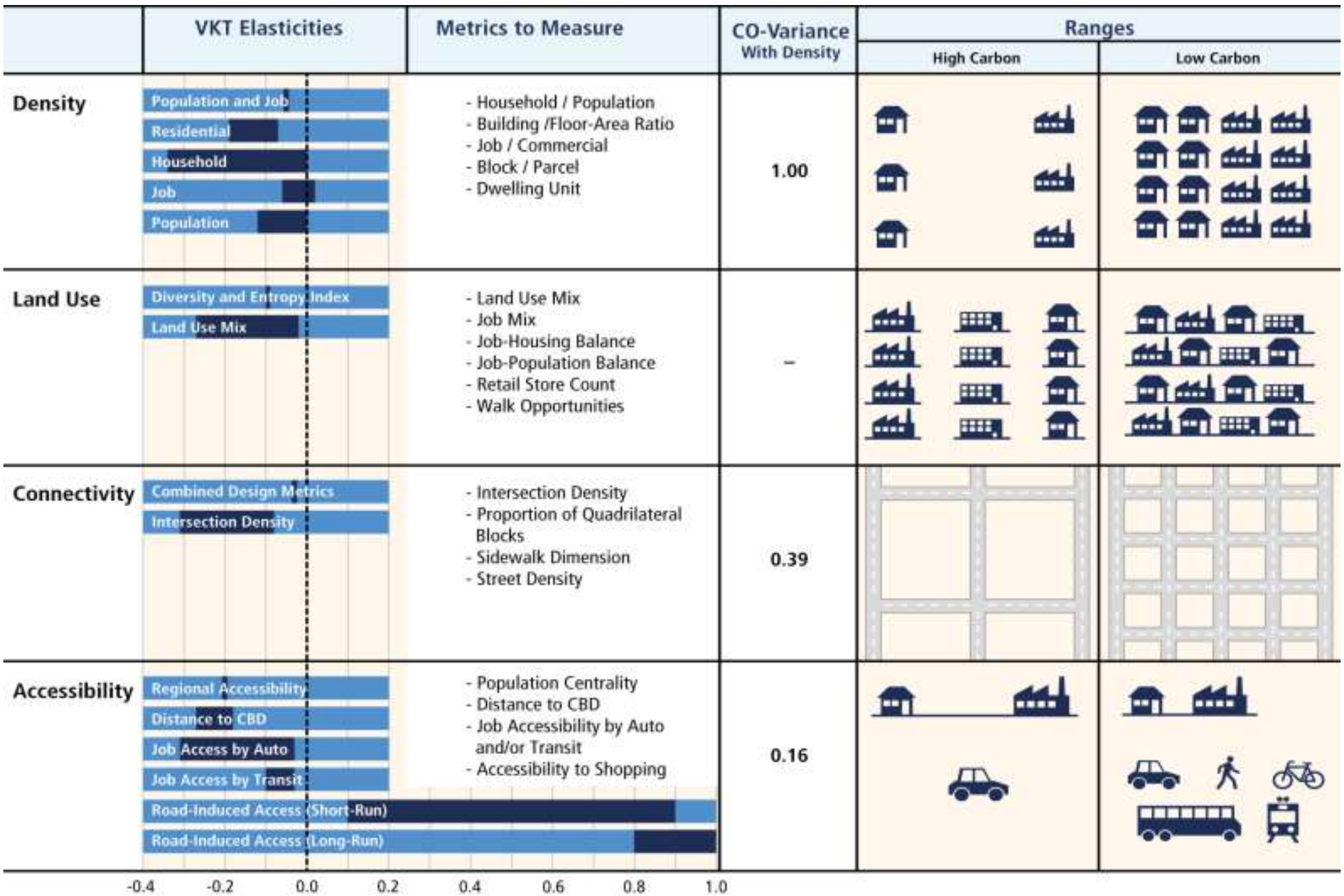
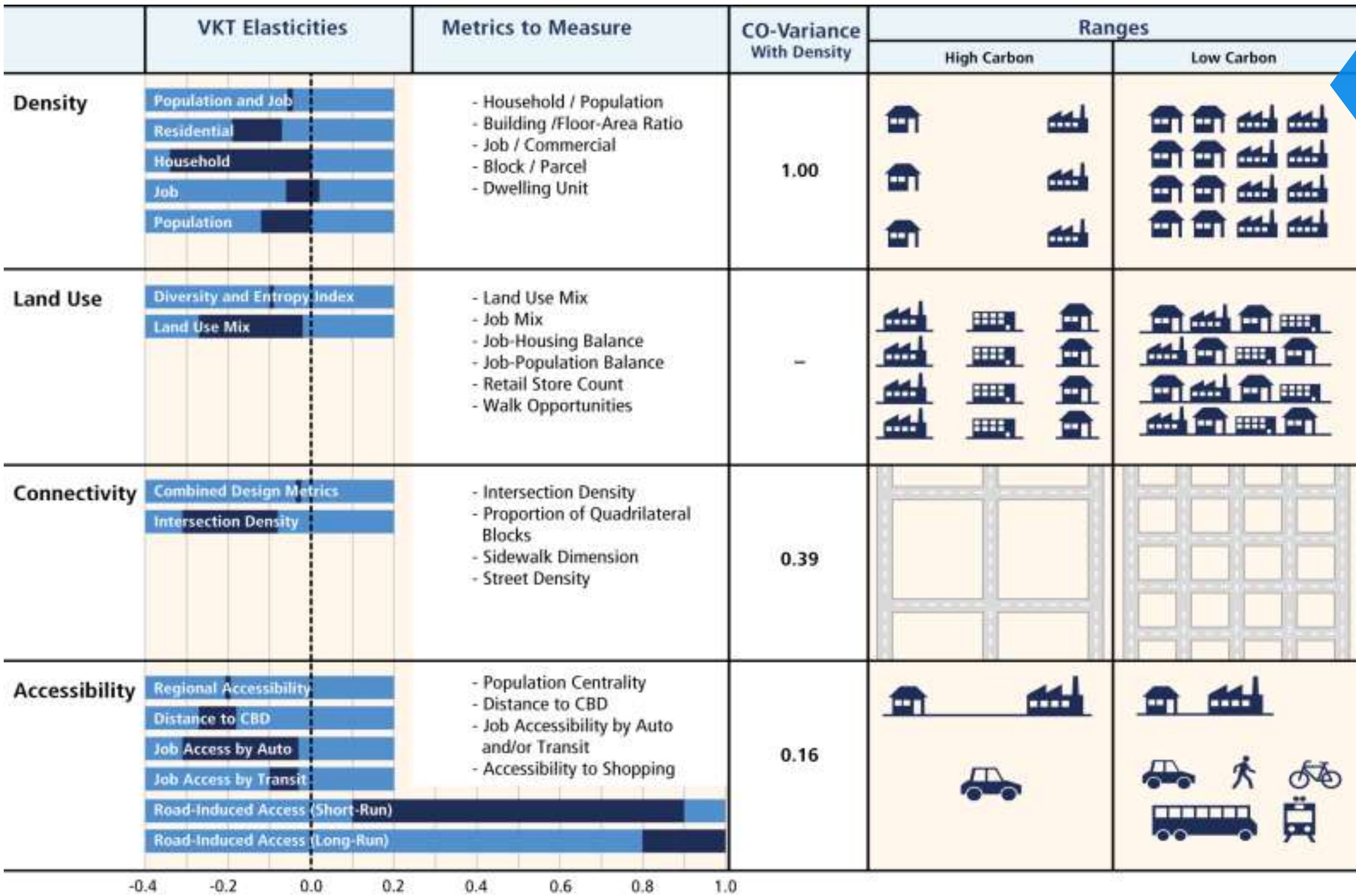
Mitigation through urban design

Infrastructure and urban form are strongly linked and lock-in patterns of land use, transport and housing use, and behavior

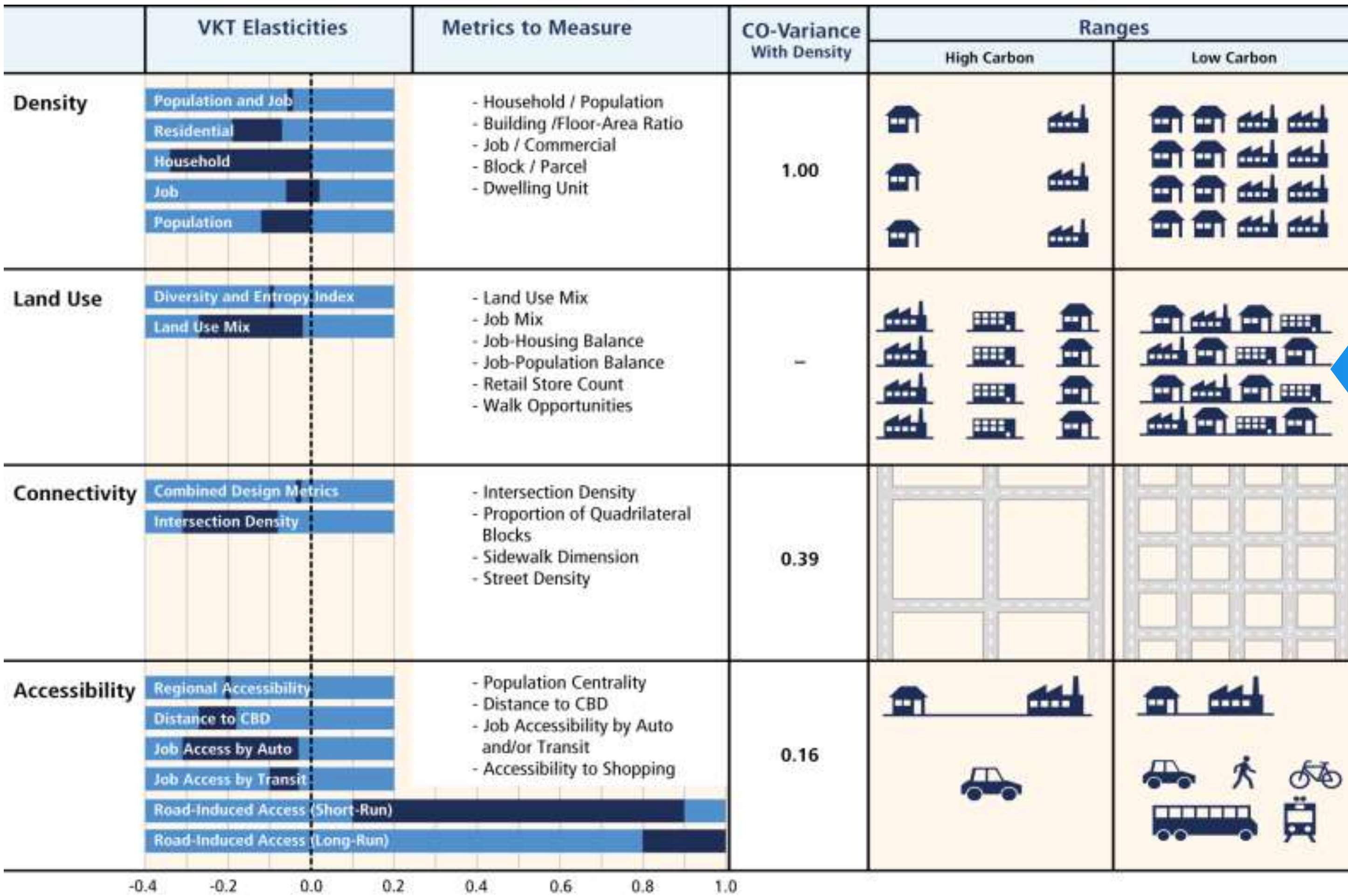


Increasing and co-locating residential and employment densities can lower emissions



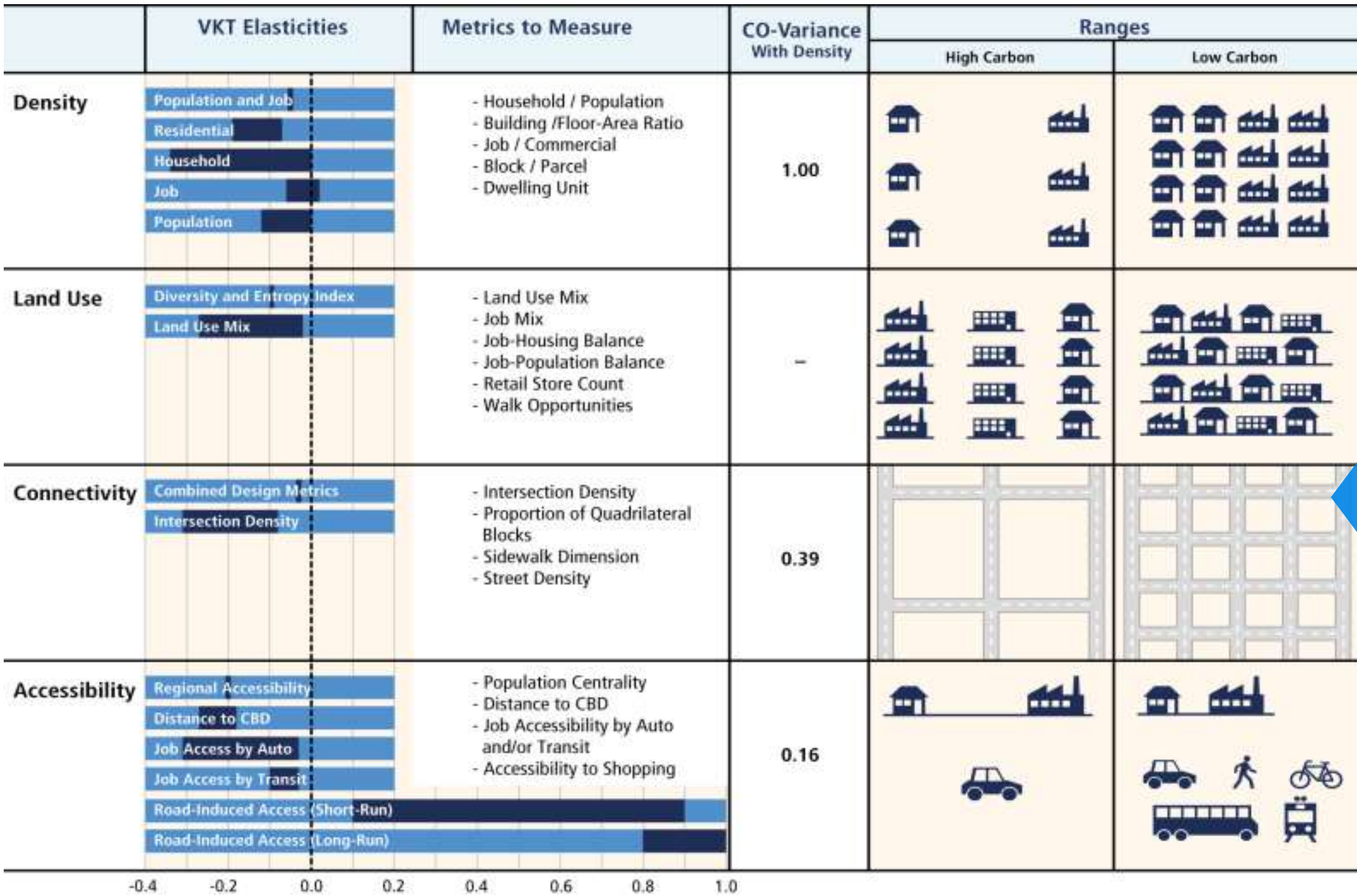
Higher density leads to less emissions (i.a. shorter distances travelled).

Increasing land use mix can significantly reduce emissions



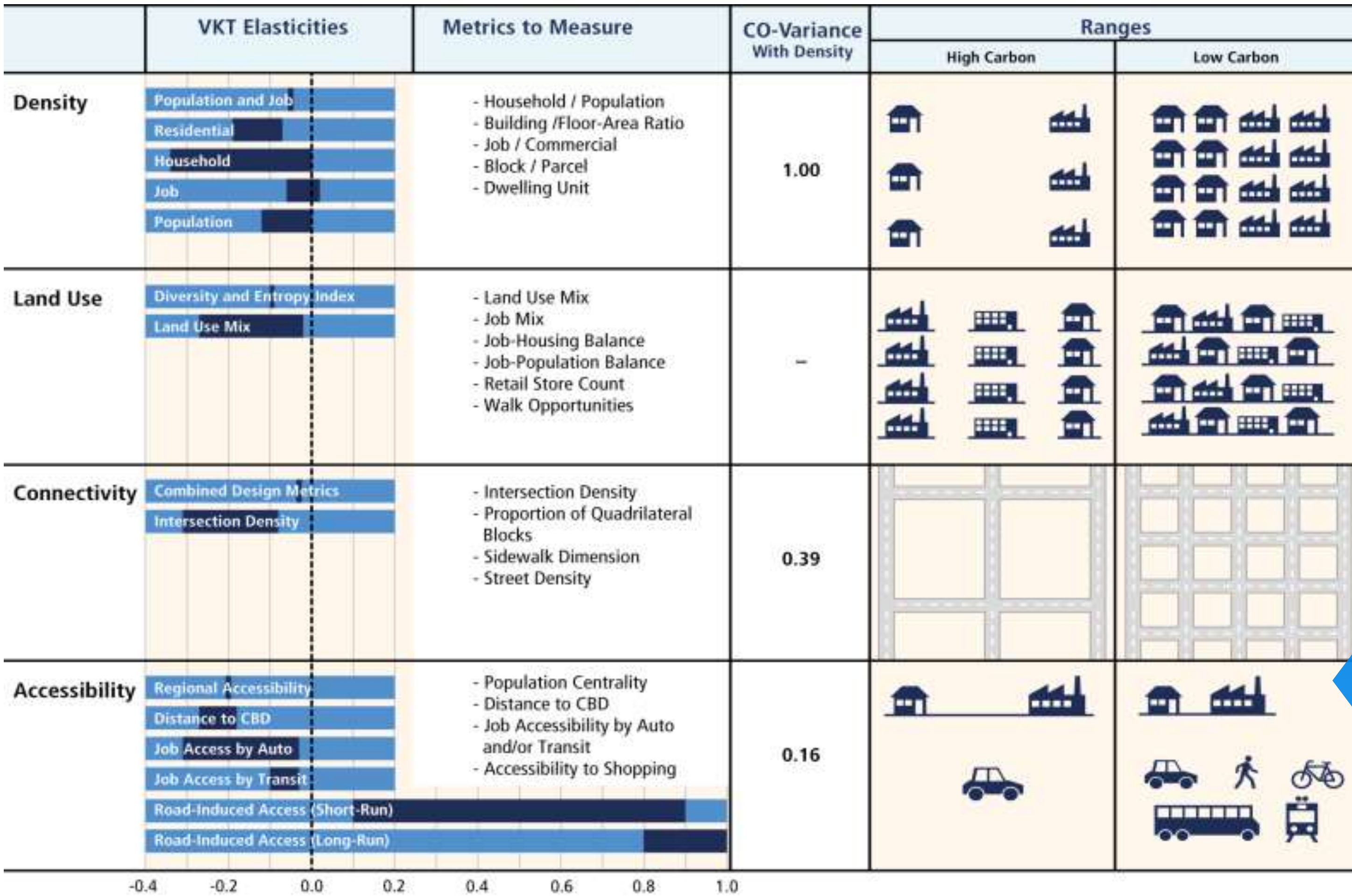
Mix of land-use reduces emissions.

Increasing connectivity can enable multiple modes of transport



Improved infrastructural density and design (e.g. streets) reduces emissions.

Co-location of activities reduces direct and indirect GHG emissions



Accessibility to people and places (jobs, housing, services, shopping) reduces emissions.

Mitigation opportunities through urban planning:

1. increasing accessibility
2. increasing connectivity
3. increasing land use mix
4. increasing transit options
5. increasing and co-locating employment and residential densities
6. increasing green space and other carbon sinks
7. Increasing white and light-colored surfaces

Key findings of the Fifth Assessment Report, WGIII contribution

- The rate of increase in emissions is growing
- Meeting a 2C target is still possible but entails significant challenges
- The costs will not compromise global growth in a major way
- There are several mitigation options can go hand-in-hand with economic development

Sixth Assessment Cycle (AR6)

AR6 Main Report

2021: Working Group I, II, and III contribution to the Sixth Assessment Report
April 2022: Synthesis Report of the Sixth Assessment Report

ar6

Methodology Report update

May 2019: 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories

Special Reports

1. **October 2018** - Special Report on Global Warming of 1.5 °C (**SR15**)
2. **August 2019** - Climate Change and Land **(SRCCL)**
3. **September 2019** - Special Report on the Ocean and Cryosphere in a Changing Climate **(SROCC)**

3 Special Reports

Dates are subject to change

Accepted outline for the WGIII contribution of the Sixth Assessment Report

Introduction and framing

Past emissions trends and drivers

Mitigation pathways compatible with long-term goals

Mitigation and development pathways in the near- to mid-term

Demand, services and social aspects of mitigation

Energy systems

Urban systems and other settlements

Buildings

Industry

Cross-sectoral perspectives

13: National and sub-national policies and institutions

14: International cooperation

15: investment and finance

16: Innovation, technology development and technology transfer

17: Accelerating the transition in the context of sustainable development

Chapter 5: Demand, services and social aspects of mitigation

- Mitigation, sustainable development and the SDGs (human needs, access to services, and affordability)
- Patterns of development and indicators of wellbeing
- Sustainable consumption and production
- Culture, social norms, practices and behavioural changes for lower resource requirements
- Sharing economy, collaborative consumption, community energy
- Implications of information and communication technologies for mitigation opportunities taking account of social change
- Circular economy (maximising material and resource efficiency, closing loops): and insights from life cycle assessment and material flow analysis
- Social acceptability of supply and demand solutions
- Leapfrogging, capacity for change, feasible rates of change and lock-ins
- Identifying actors, their roles and relationships
- Impacts of non-mitigation policies (welfare, housing, land use, employment, etc.)
- Policies facilitating behavioural and lifestyle change

Outlook to AR6

- While the technological solutions, economic costs, implementation pathways and governance options are well understood, the human-social aspects have been less covered
- Among others,AR6 will have more emphasis on the social science aspects

Estimates for mitigation costs show moderate effect on development

- Reaching 450ppm CO_2eq entails consumption losses of 1.7% (1%-4%) by 2030, 3.4% (2% to 6%) by 2050 and 4.8% (3%-11%) by 2100 relative to baseline (which grows between 300% to 900% over the course of the century).
- This is equivalent to a reduction in consumption growth over the 21st century by about 0.06 (0.04-0.14) percentage points a year (relative to annualized consumption growth that is between 1.6% and 3% per year).
- Cost estimates exlude benefits of mitigation (reduced impacts from climate change). They also exclude other benefits (e.g. improvements for local air quality).