INTERGOVERNMENTAL PANEL ON climate change

The need for disruptive innovation

Based on findings of the Fifth Assessment Report and looking into the Sixth AR by WGIII

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Outline

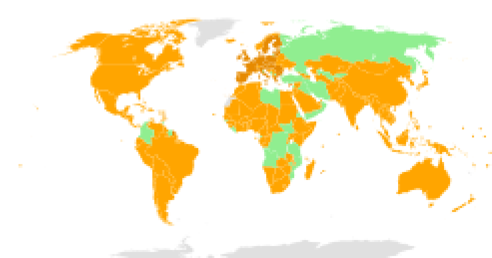
- The “miracle year” of 2015
- GHG emission scenarios and the carbon budget in the context of 1.5 – 2C
- Mission impossible?
- Lessons from the past
- Elements of ambitious GHG scenarios
  - Supply vs demand
  - Co-benefits, adverse side effects
  - Lock-in
- Need for disruptive innovation
  - some areas of that are bad need of innovation on the demand-side
- Summary: some characterstics of idealised innovations

The year 2015 gave a new chance to planet Earth (or civilisation?)

PARIS2015
UN CLIMATE CHANGE CONFERENCE
COP21·CMP11

- March 18, Sendai Framework for Disaster Risk Reduction
- September 25, the UN Sustainable Development Goals were adopted by 193 governments
- December 12, the Paris Agreement
  - As of today, 170 countries ratified it

orking Group III contribution to the
CC Fifth and Sixth Assessment Reports



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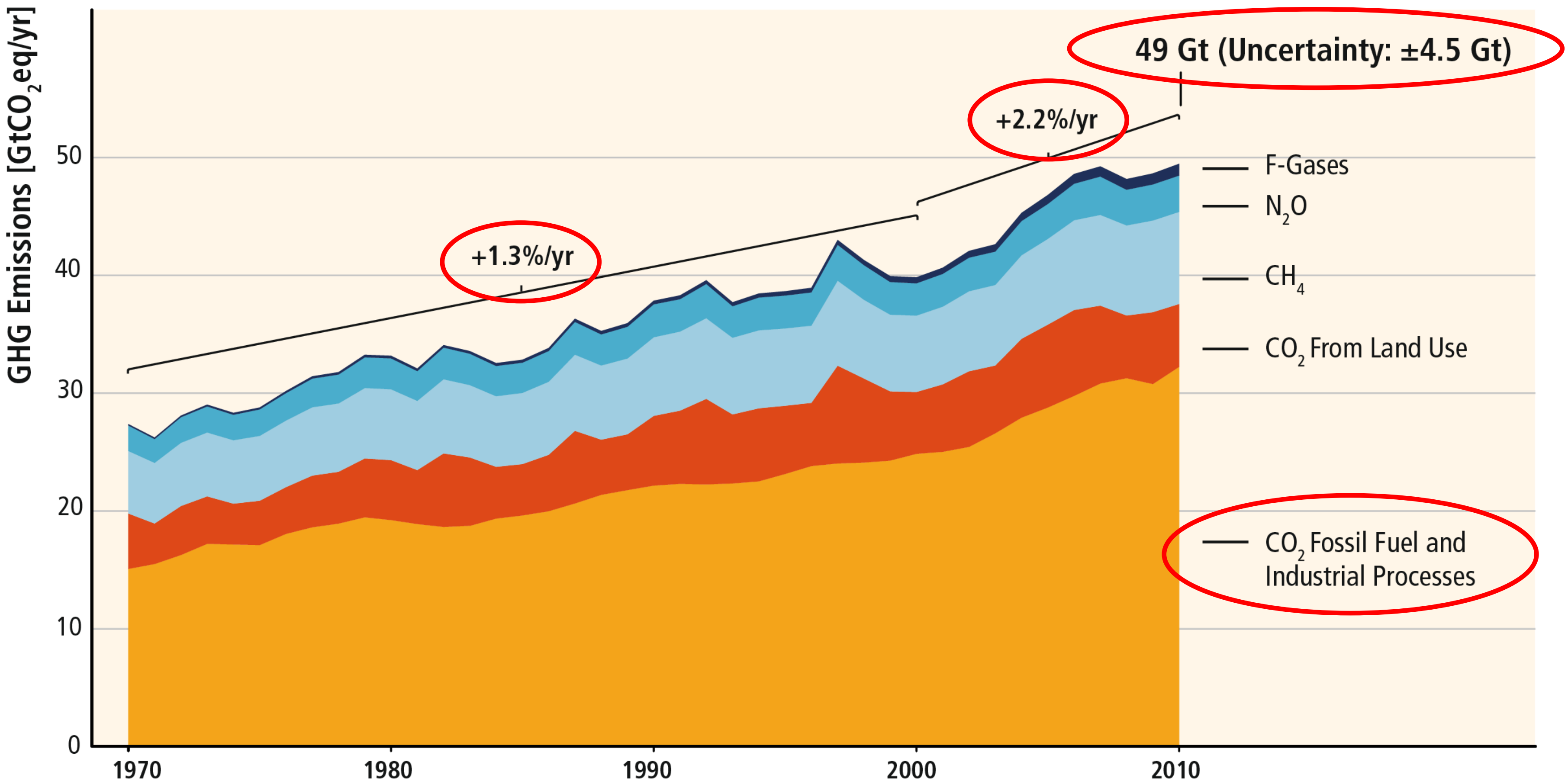
INTERGOVERNMENTAL PANEL ON climate change

The challenges set out in the Paris Agreement

- “Holding the increase in the global average temperature to well below 2 °C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5 °C above pre-industrial levels”
- “aim to reach global peaking of greenhouse gas emissions as soon as possible”
- “to achieve a balance between anthropogenic emissions by sources and removals by sinks of greenhouse gases in the second half of this century”

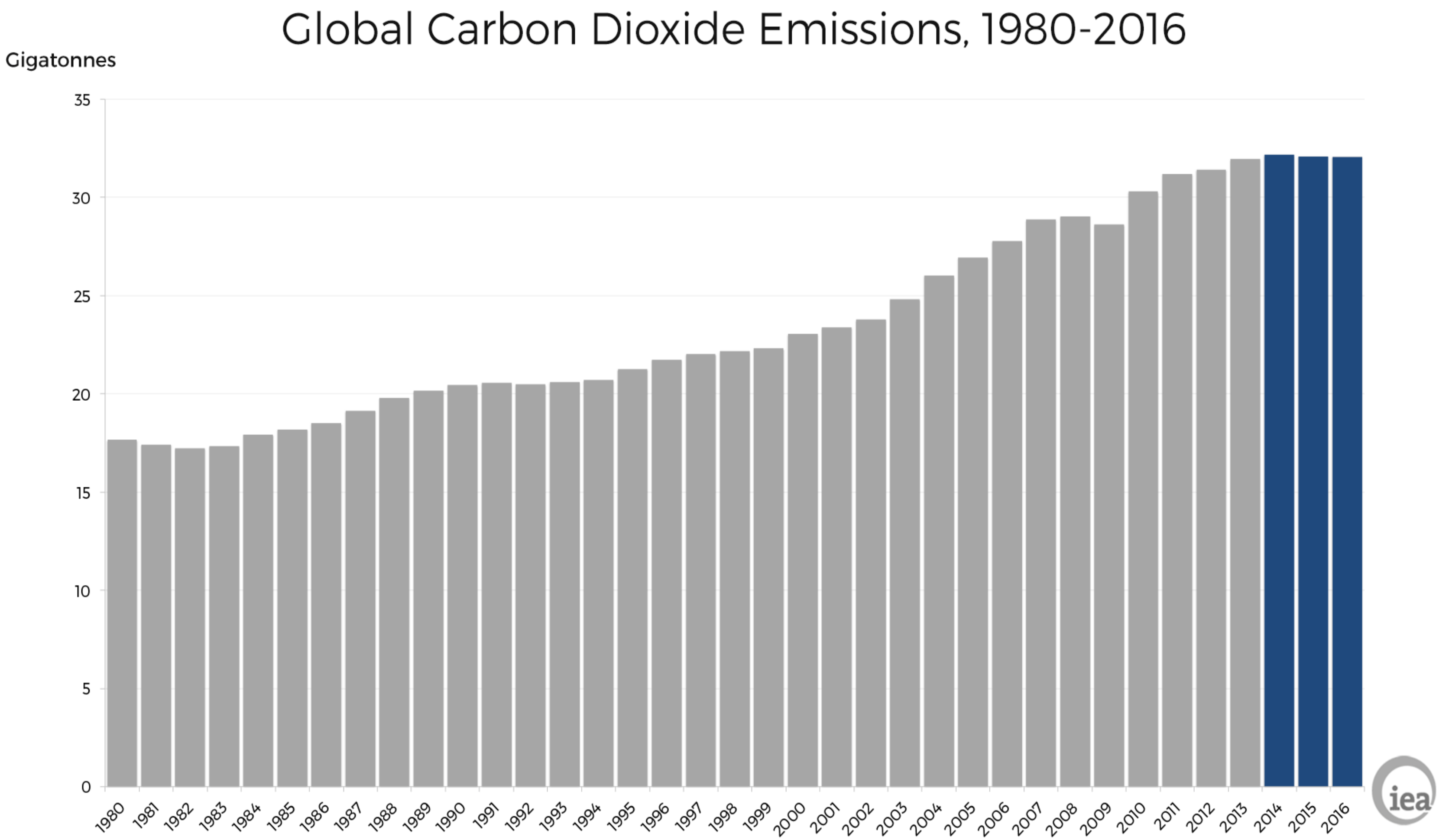
GHG emissions growth has accelerated despite reduction efforts.

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

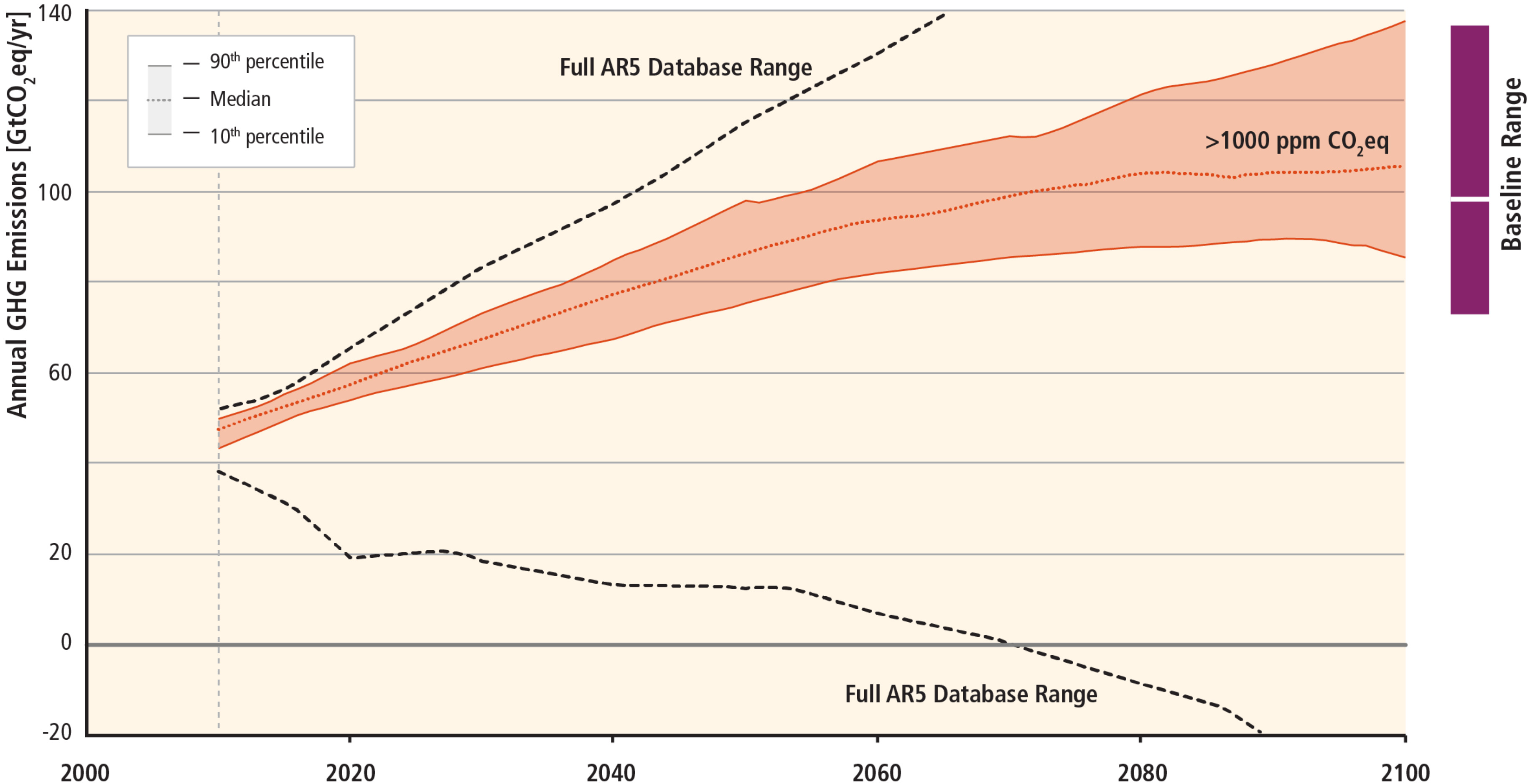


Based on Figure 1.3

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

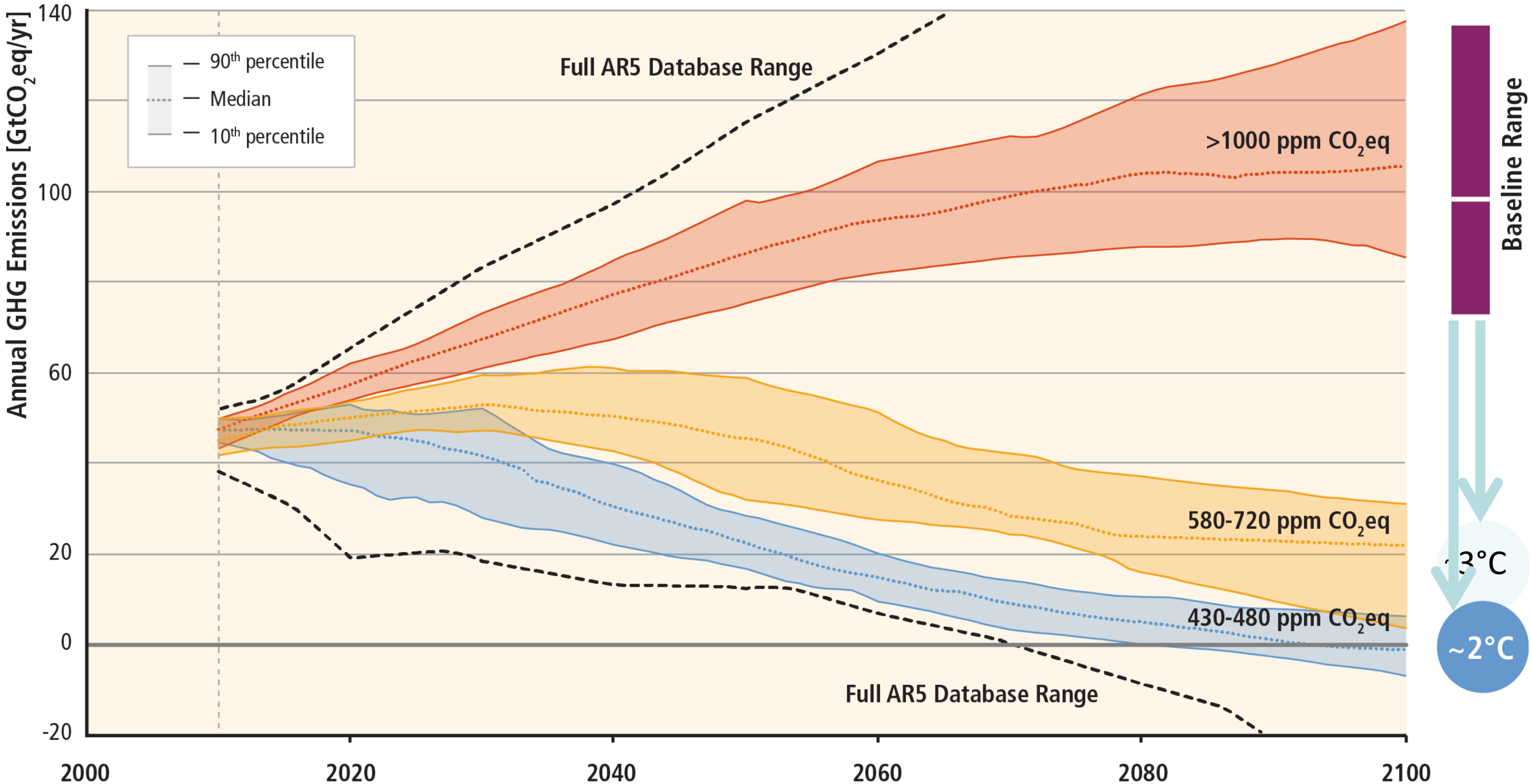


Stabilization of atmospheric GHG concentrations requires moving away from business as usual.



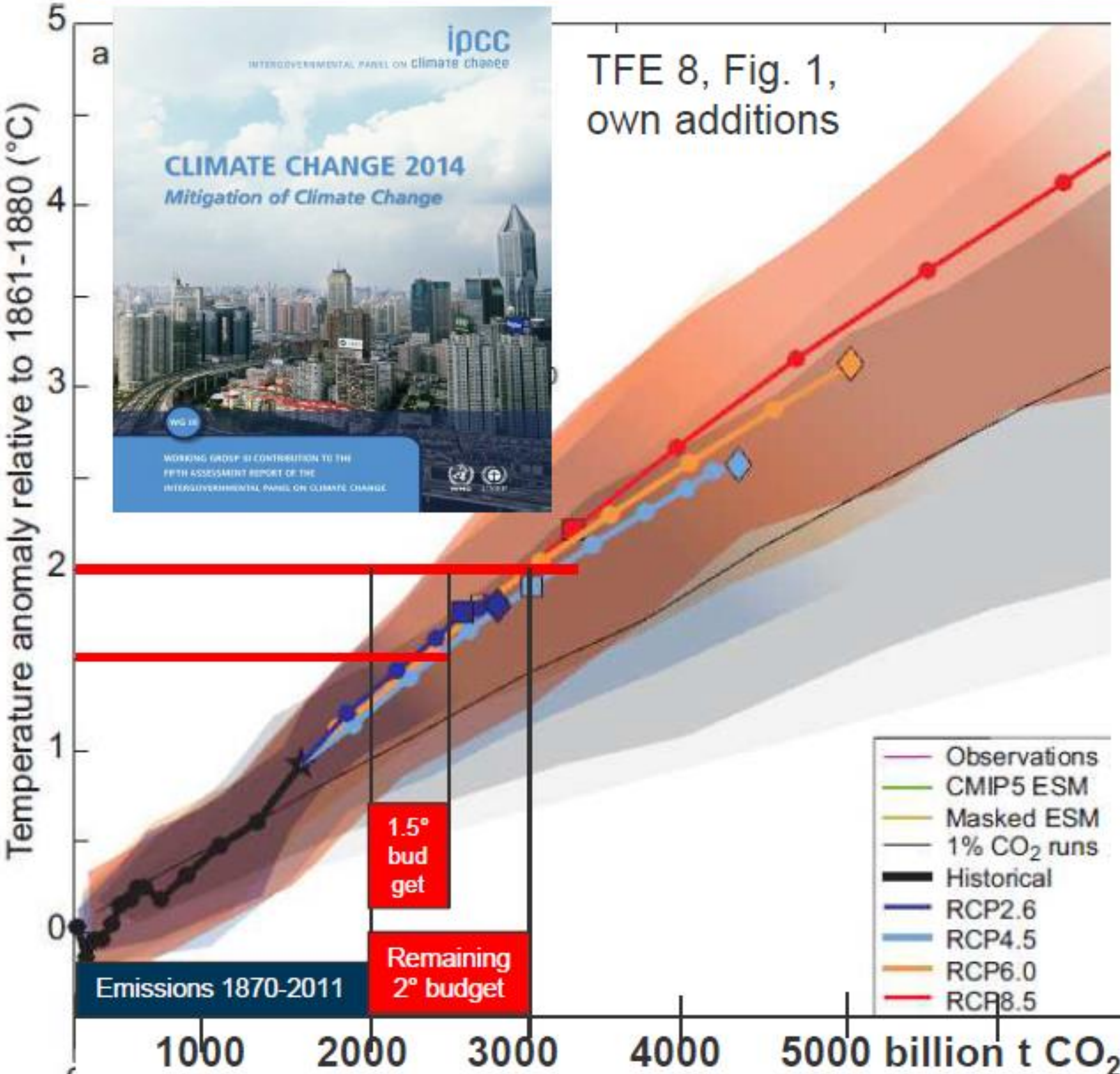
Based on Figure 6.7

Lower ambition mitigation goals require similar reductions of GHG emissions.



Based on Figure 6.7

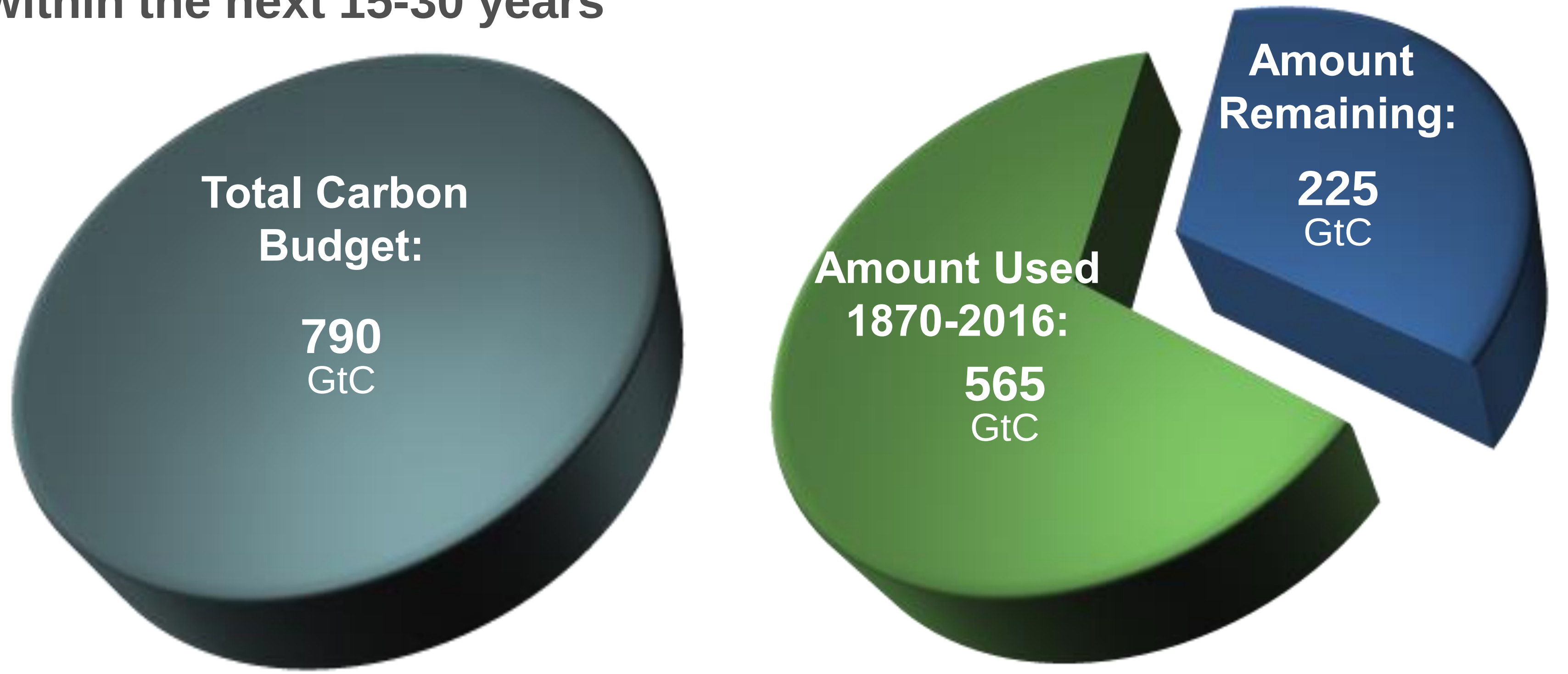
The mitigation challenge of the 1.5°-2° target



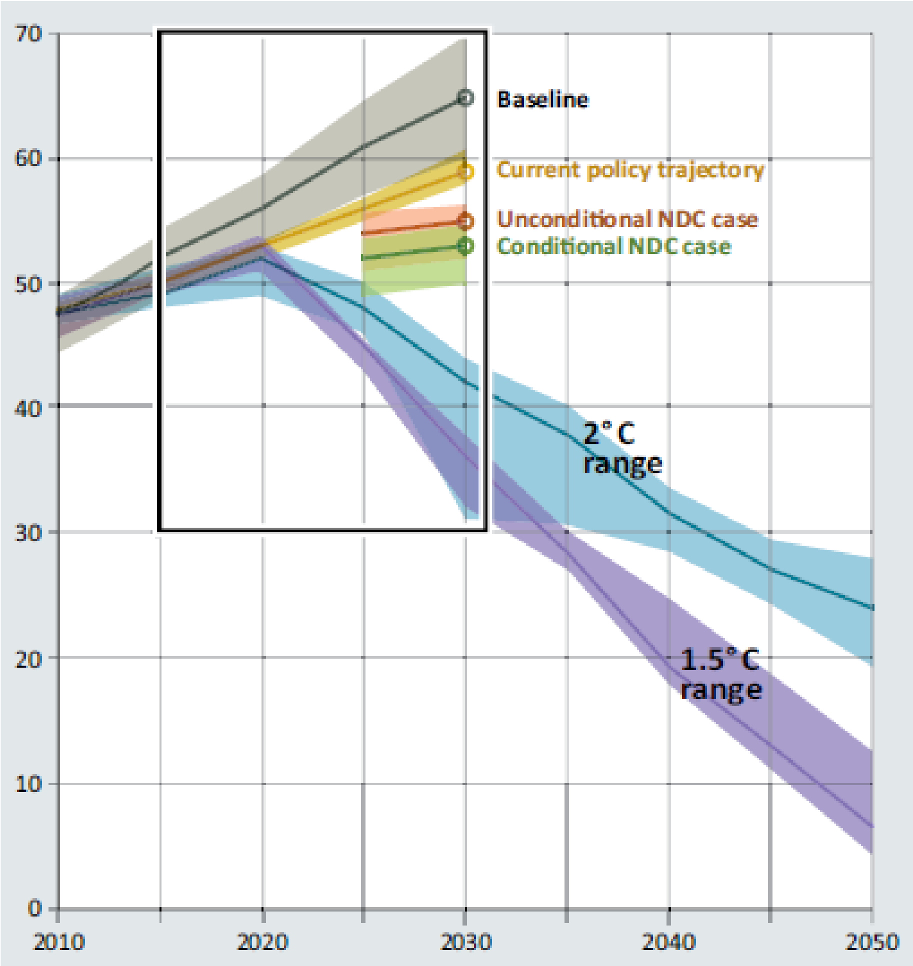
- **Remaining emissions budget to reach**
  - **2°C target is 1000-1200 billion t CO_2**
  - **1.5°C target is 500-600 billion t CO_2**
- **Current annual global emissions are ~ 50 billion t**
- **Only 20-25 years left at current rate for 2°C, a decade for 1.5°C!**
- **Massive challenge for decarbonization**

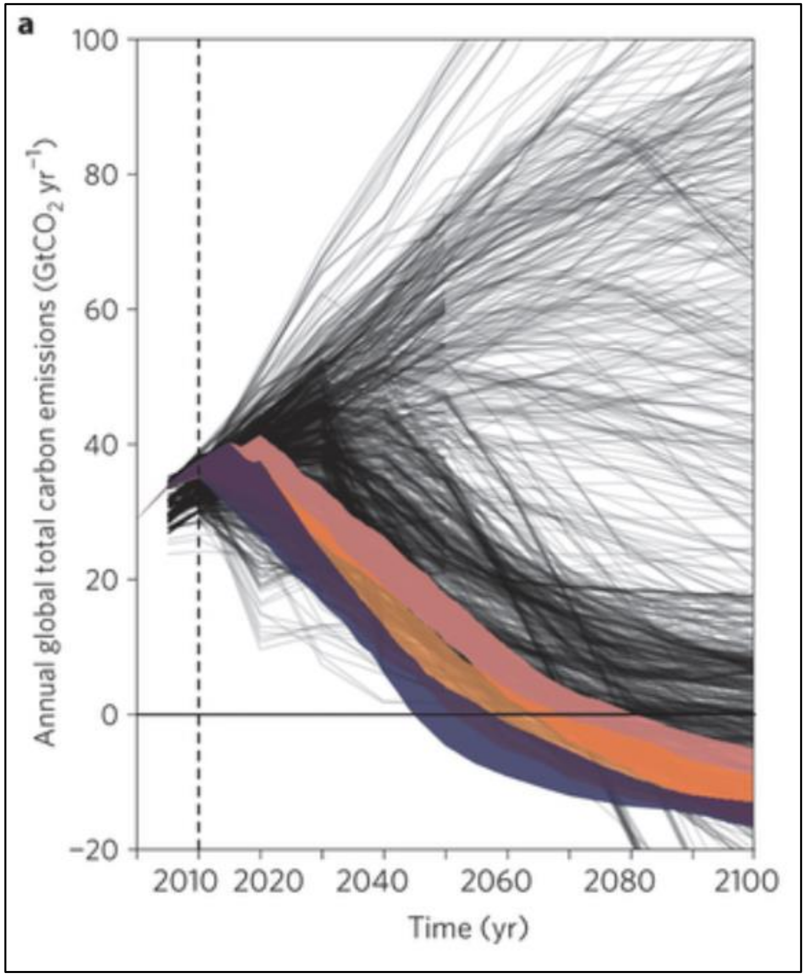
The window for action is rapidly closing

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



The view to 2050 and beyond





Source: UNEP

Source: Rogelj et al, 2015

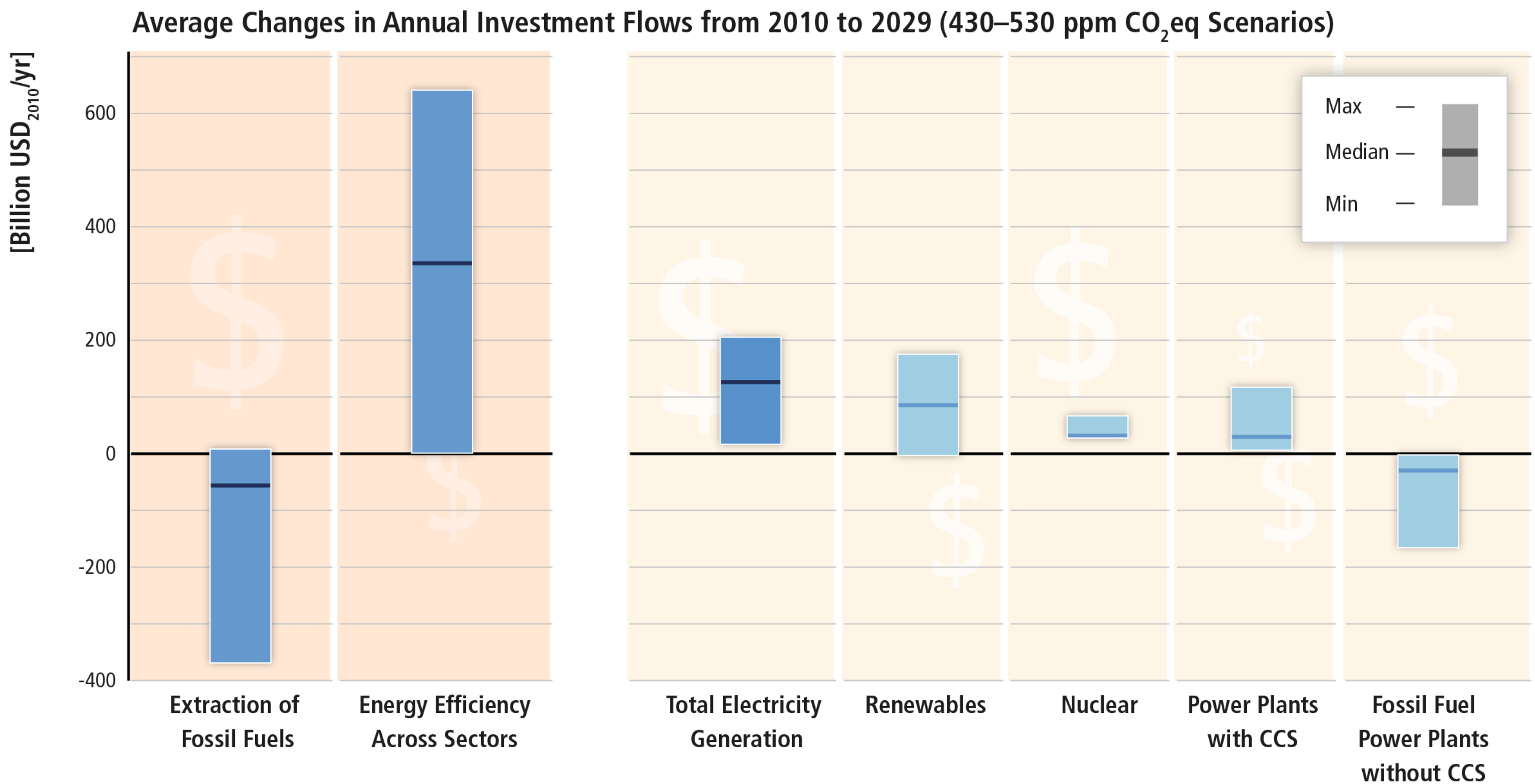
Mission impossible?

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

The elements of the solution

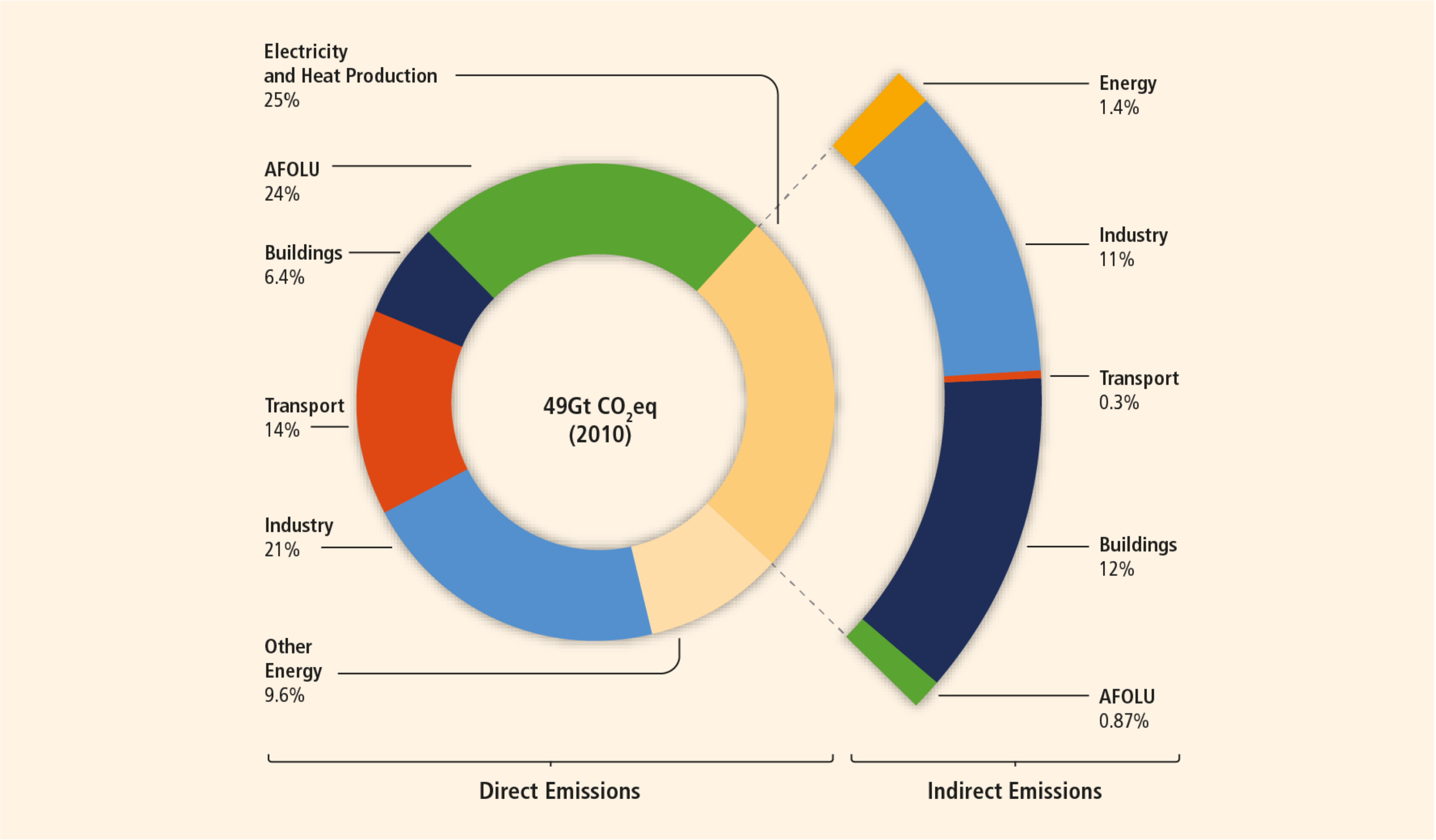
And remaining challenges

IPCC AR5: Substantial reductions in emissions will require large changes in investment patterns

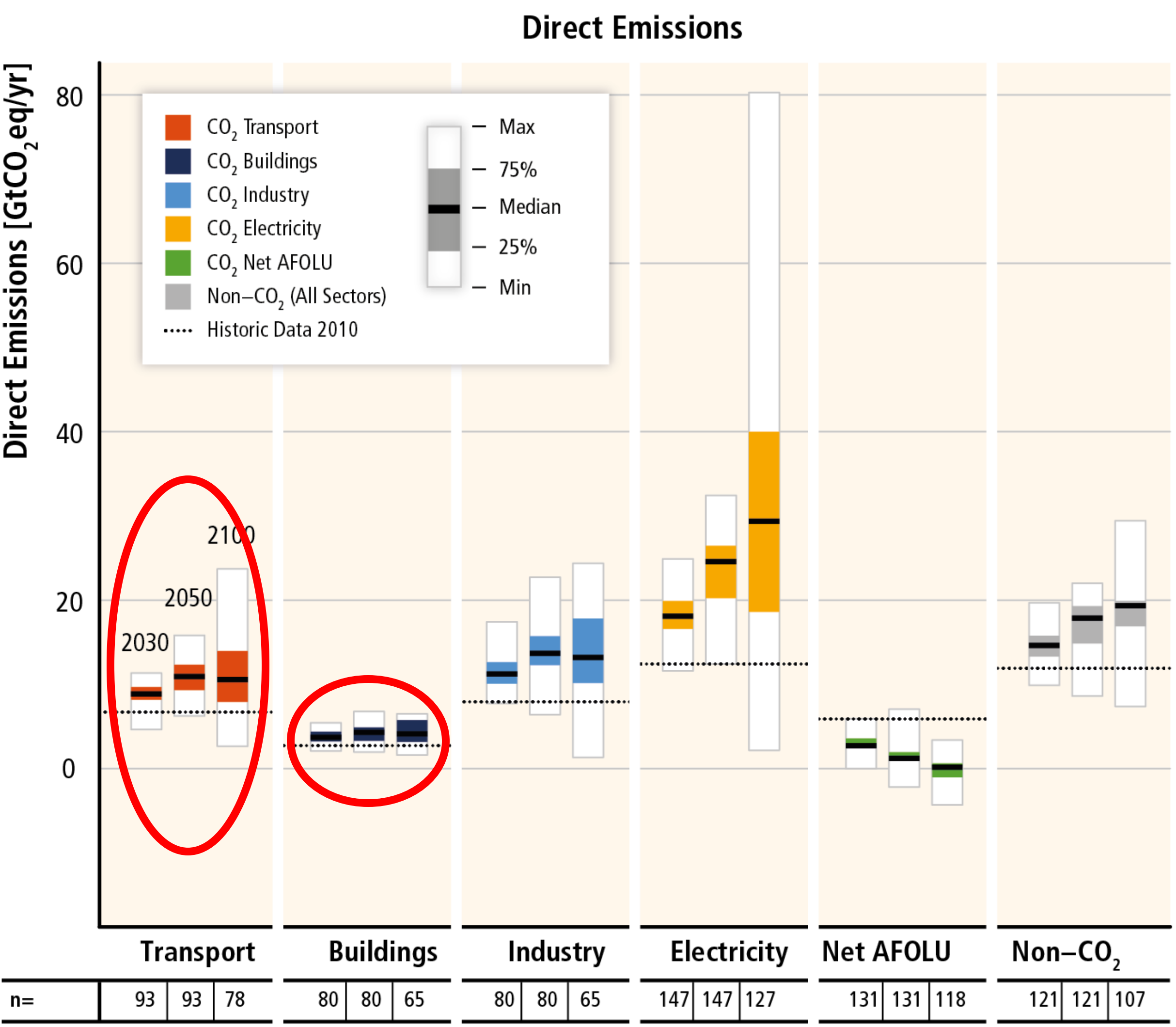


Based on Figure 16.3

Accounting for indirect emissions has key implications on mitigation strategy!

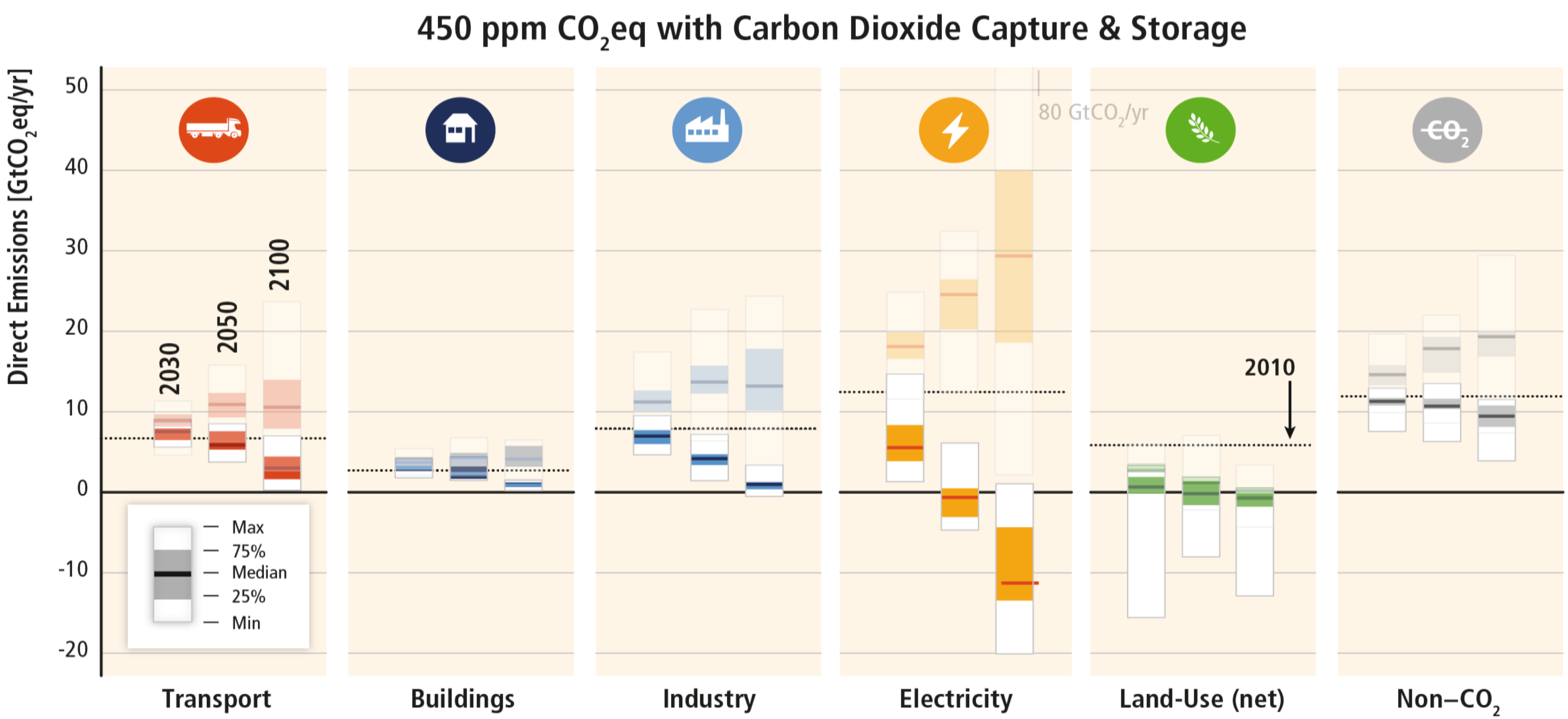


Baseline Scenarios: Direct vs. Indirect Emission Accounting

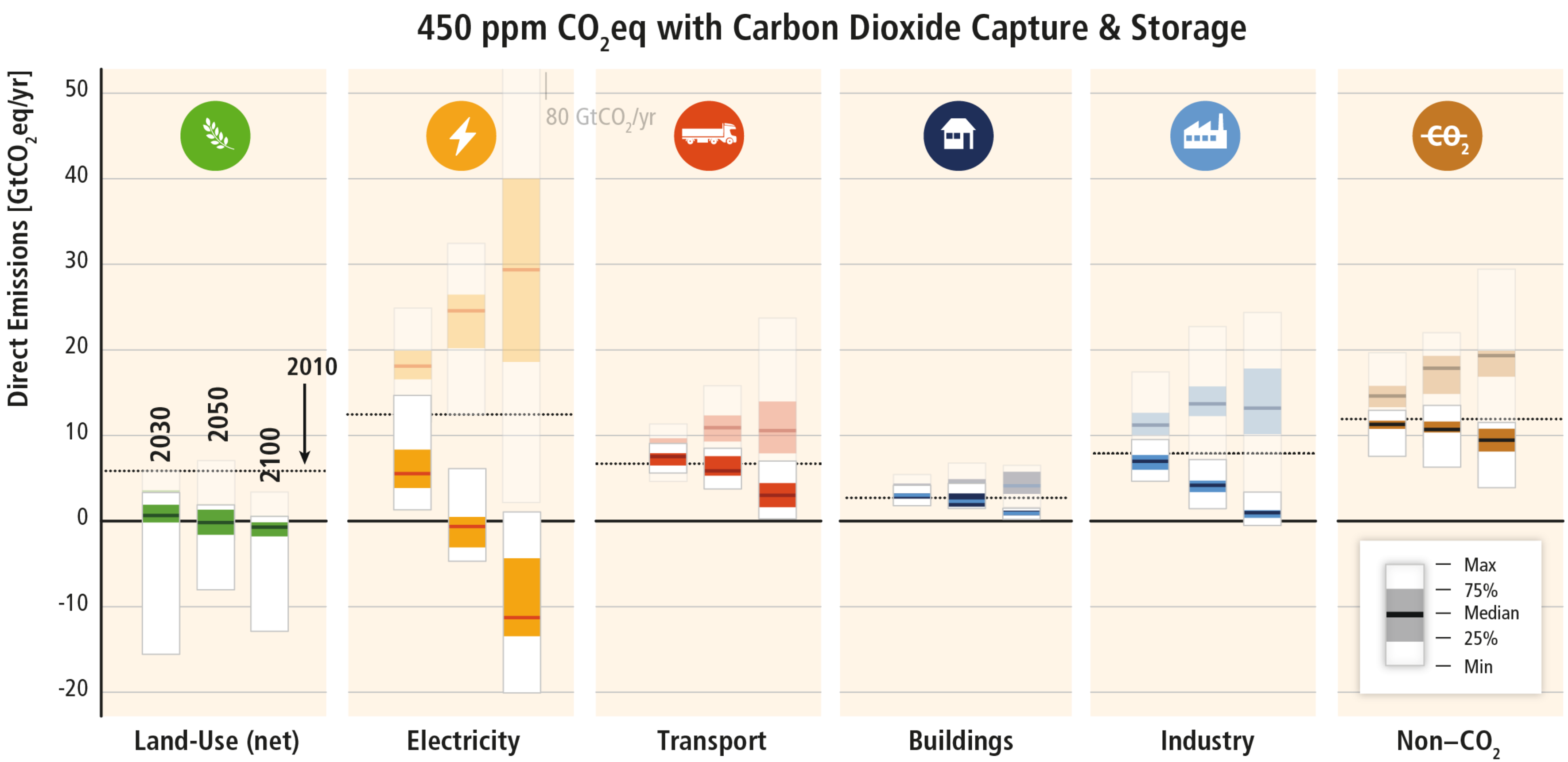


Source: Volker Krey, using IPCC AR5 Figure SPM.10,

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

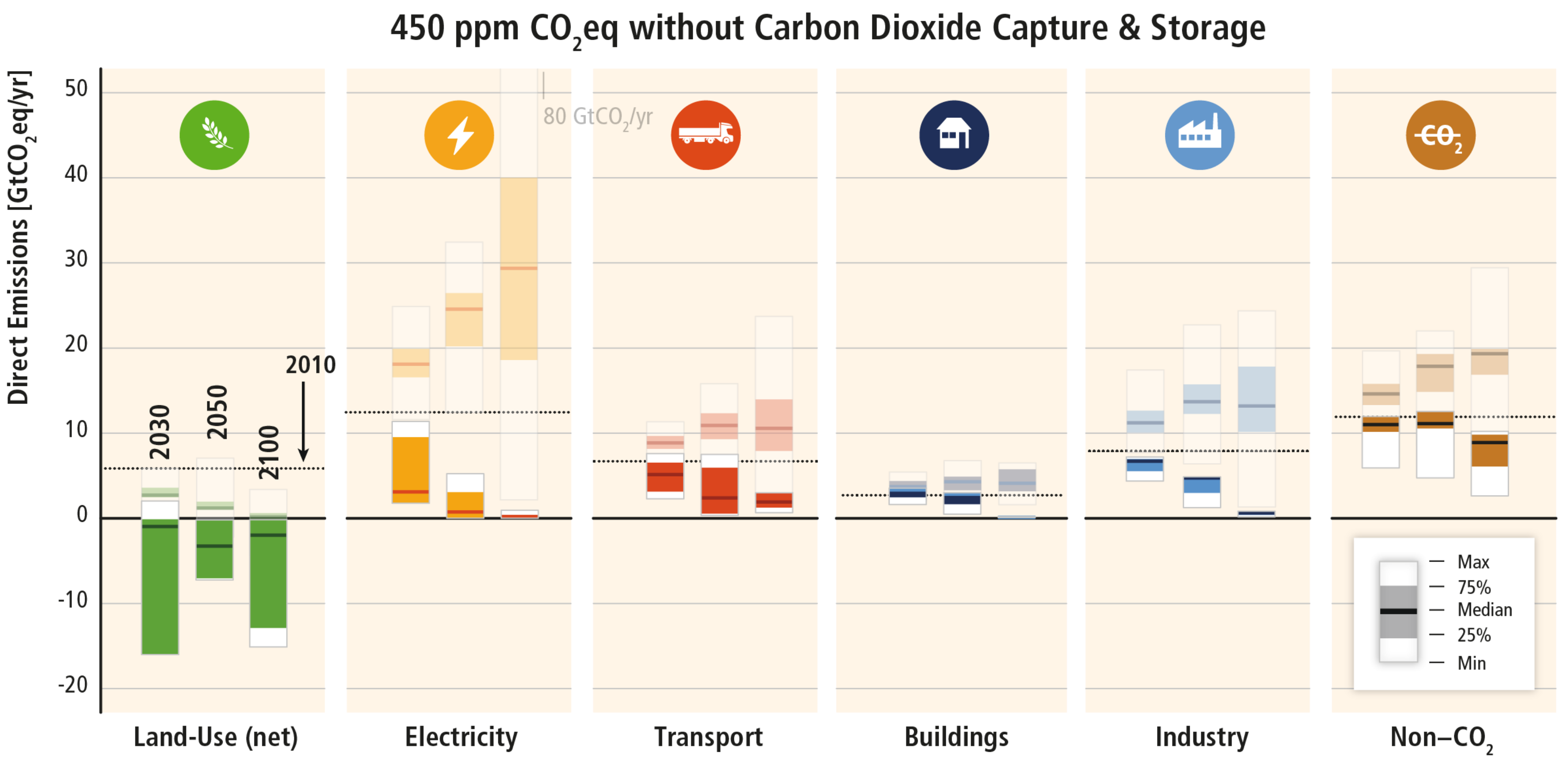


Mitigation requires changes throughout the economy. Systemic approaches are expected to be most effective.



Based on Figure TS.17

Mitigation efforts in one sector determine efforts in others.



Based on Figure TS.17

Some examples from the past when policies pulled radical innovations

- Japan's Top Runner program
- California's zero emission vehicle mandates
- Zero energy building mandates
- …

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)

Selected examples of disruptive innovations

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Zero energy buildings, passivhaus

Example of savings by reconstruction

Before reconstruction

Reconstruction according to the passive house principle

over 150 kWh/(m^2a)

-90%

15 kWh/(m^2a)

55.000 Passive Houses exist in 28 European member countries

PASSIVHAUS Austria www.passivhaus-austria.org

International PASSIVE HOUSE Association iPHA

Passive House Institute

...king Group III contribution to the
Fifth and Sixth Assessment Reports

IPCC INTERGOVERNMENTAL PANEL ON climate change

First retrofit to Passive House Plus

Office building **Technical University Vienna**

Architect: Arch. DI Gerhard Kratochwil

Building physics: Schöberl & Pöll GmbH

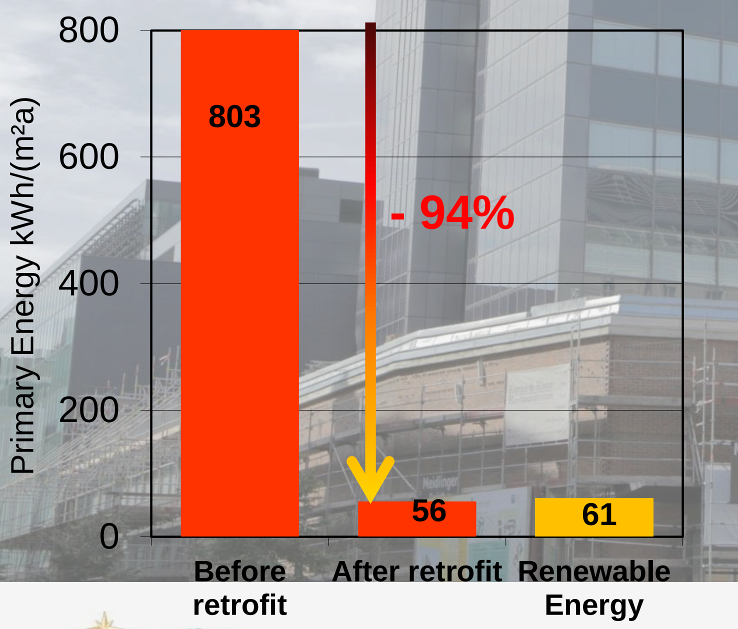
Owner: BIG Bundesimmobilien gesmbH

Treated floor area: 7,322 m² = 80,000 ft²

Heating demand: 14 kWh/m²a = 4.4 kBTU/ft²a

Heat load: 9 W/m² = 2.85 BTU/ft²

Primary energy: 56 kWh/m²a = 17.75 kBTU/ft²a



Passsive houses spread around the world

Based on draft UNEP Emissions Gap Report, contributed by PHI

World's largest Passive House city district

Zero-Emission-City areal **Heidelberg-Bahnstadt**

116 ha, 1,700 flats

Passive House as Standard for urban development

www.heidelberg-bahnstadt.de

Belgian Energy provider Elia
Brussels mandated Passive House in January 2015
Sinds 2010:
all public buildings
are passivehouse
+ 12%
-17%
Brussels : Energy & CO2 per inhabitant
>2015:
all new
building must
achieve
Passivehouse
standard
Brussels
High rise renovation to full PH
Brussels Environnement Ministry
PASSIVHAUS Austria
International PASSIVE HOUSE Association
Passive House Institute

New York City may go Passive

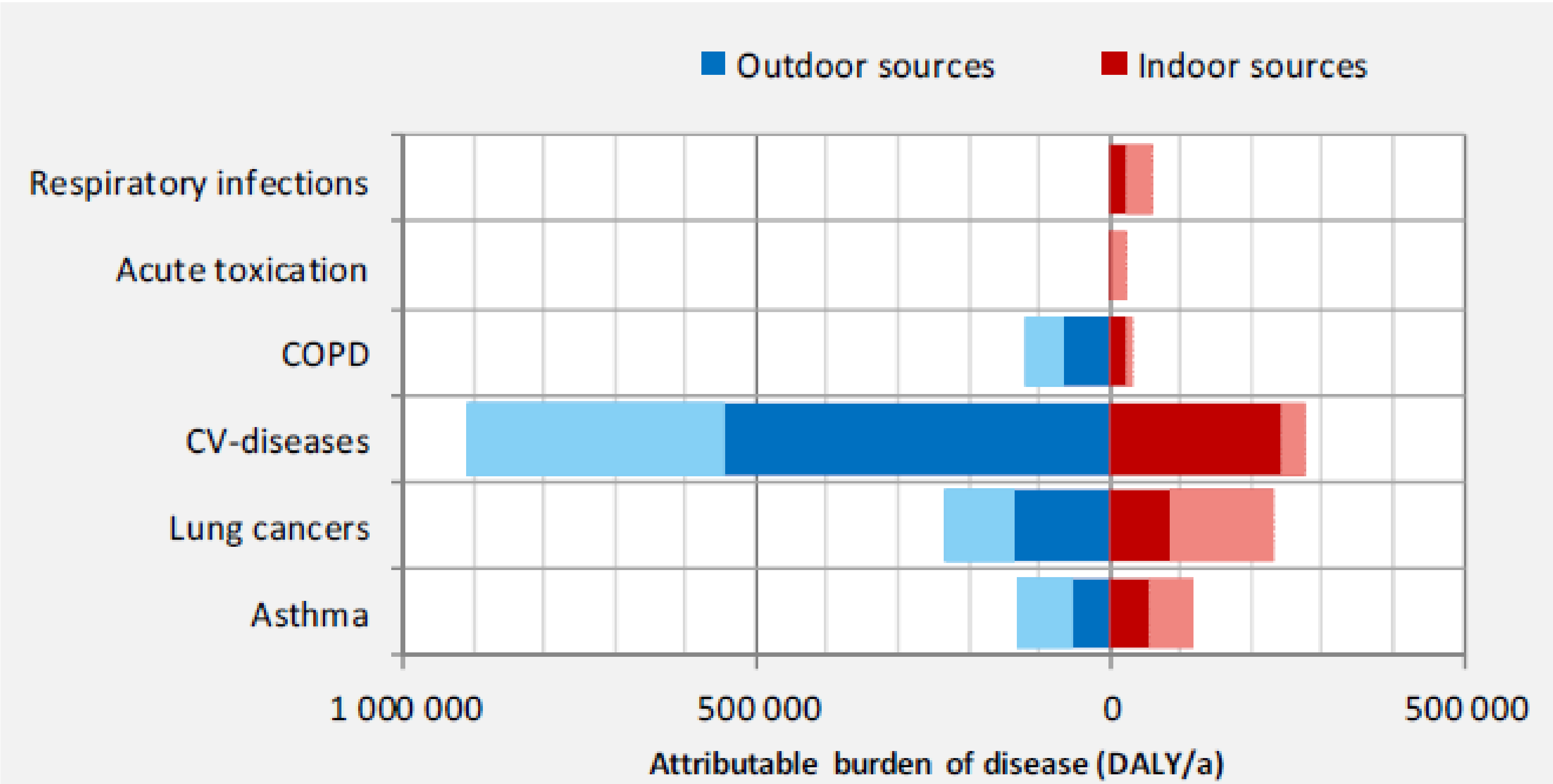
NYC Mayor De Blasio

A Roadmap for New York City's Buildings:

"The City Government will implement leading edge performance standards for new construction that cost effective achieve highly efficient buildings, **looking to Passive House to inform the standards**"

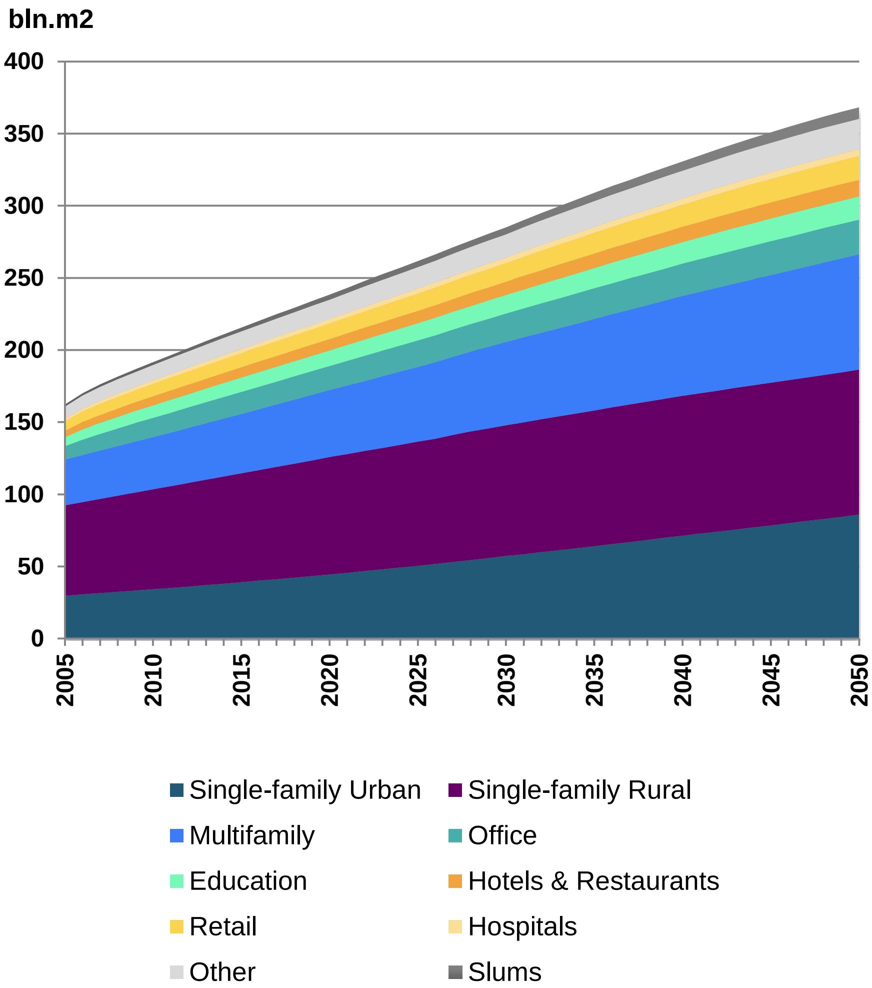
Attributable burden of diseases due to indoor exposures in 2010 in EU26

The lighter shade represents the maximum reducible fraction through well operated ventilation systems

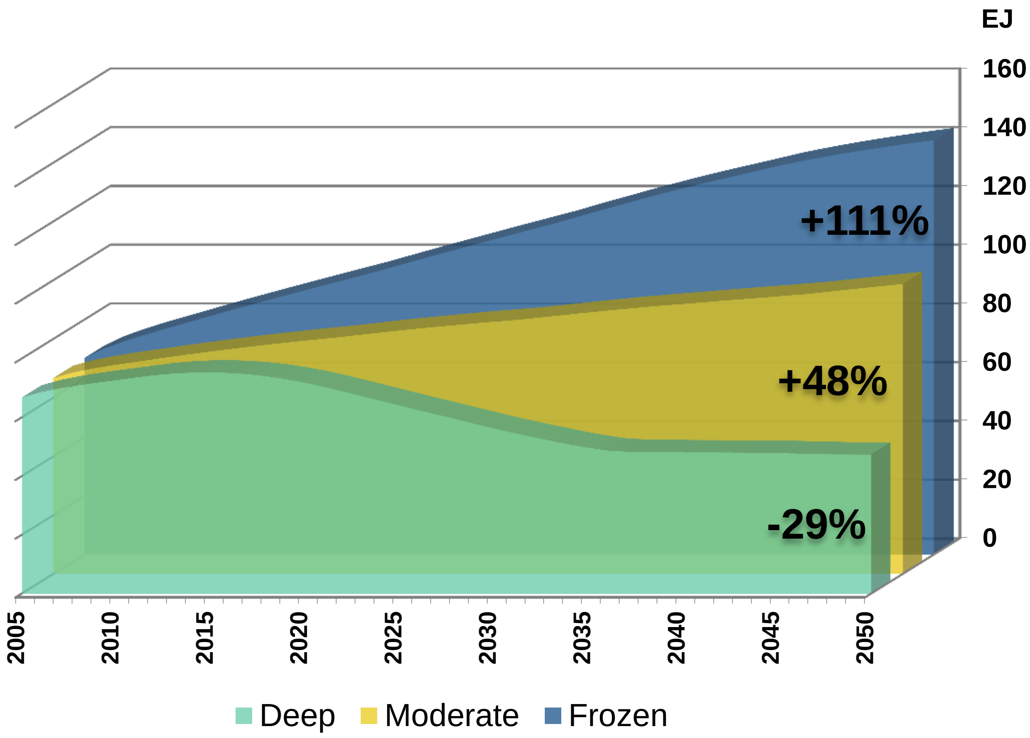


Source: Otto Hänninen and Arja Asikainen (Eds.) 2013. Efficient reduction of indoor exposures: Health benefits from optimizing ventilation, filtration and indoor source controls

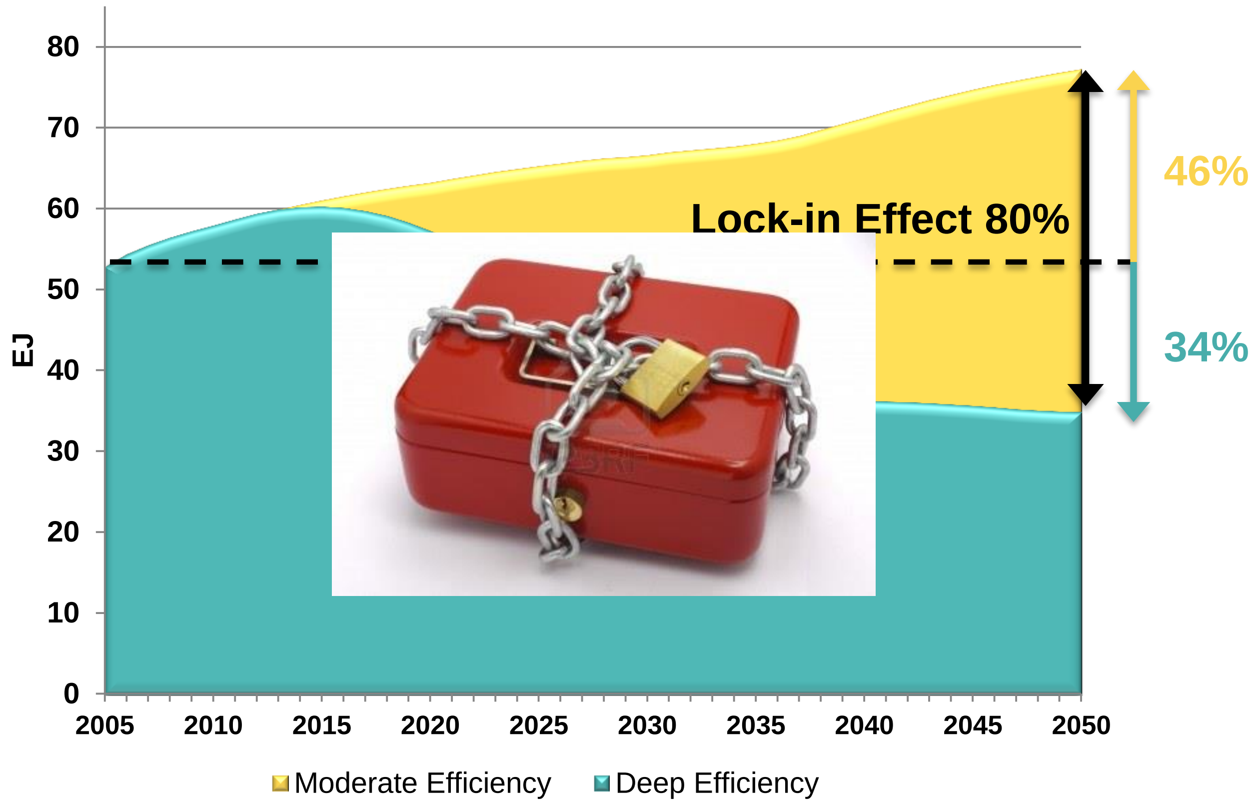
World floor area



World final thermal energy use

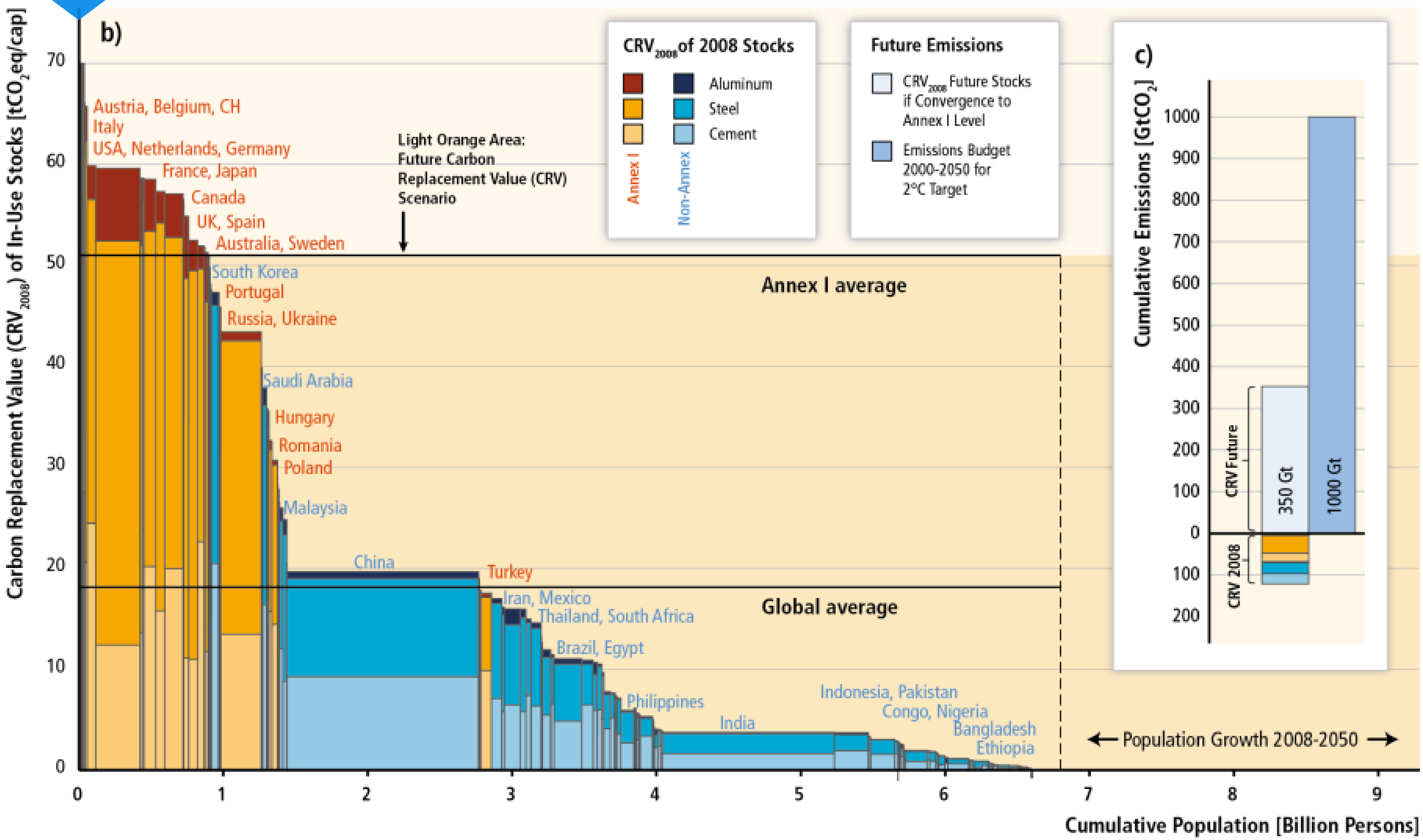


The Lock-in Risk: global heating and cooling final energy in two scenarios

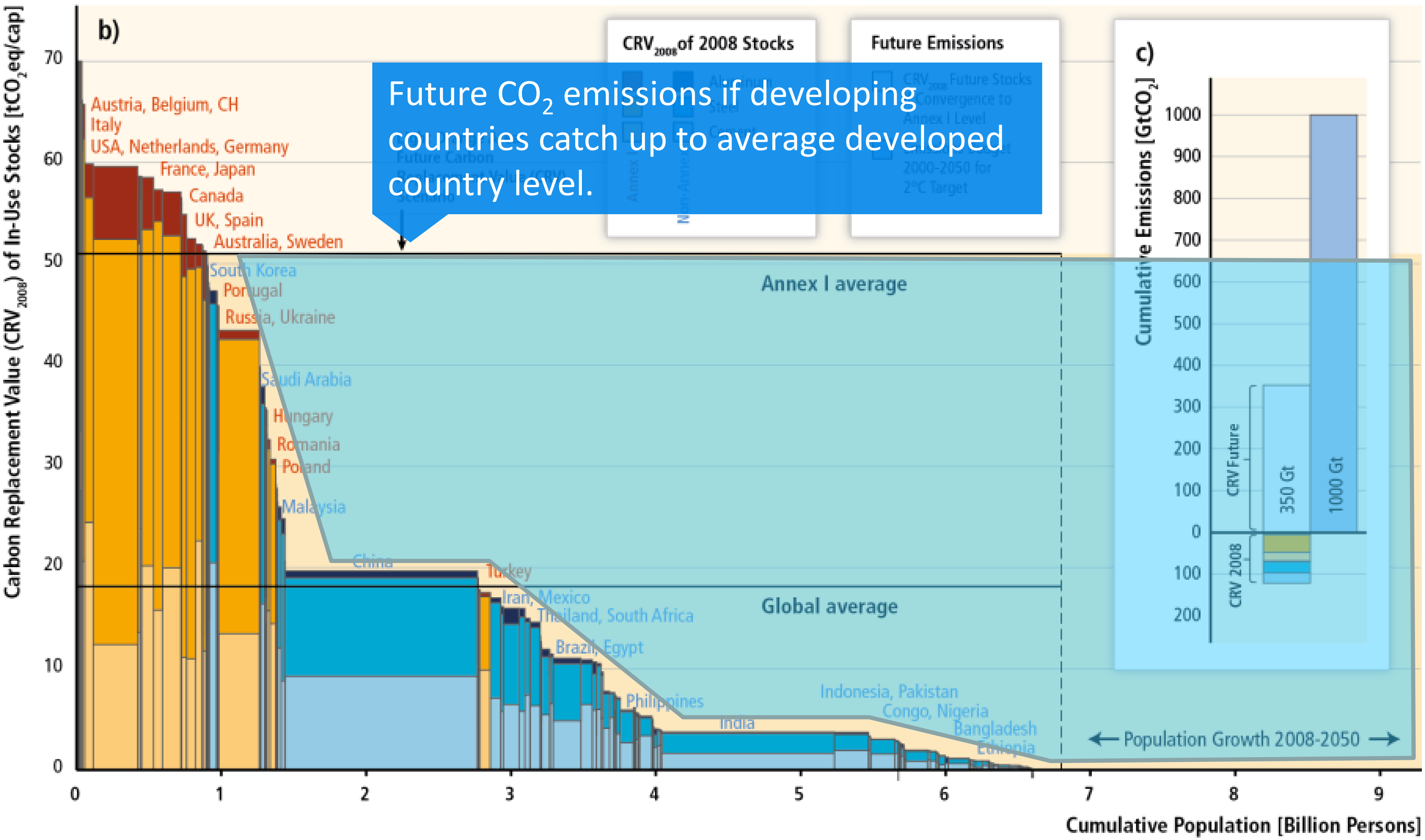


Infrastructure build-up over the next few decades will result in significant emissions

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



Infrastructure build-up over the next few decades will result in significant emissions



Can we turn this potentially giant source of emissions into a giant *carbon sink*?

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Sometimes the highest tech is low-tech?


DensGlass

Brock Commons: 19-story timber building

Brock Commons Carbon Impact

Volume of wood:
2,233 cubic meters of CLT and Glulam

U.S. and Canadian forests grow this much wood in:
6 minutes

Carbon stored in the wood:
1,753 metric tons of CO_2

Avoided greenhouse gas emissions:
679 metric tons of CO_2

TOTAL POTENTIAL CARBON BENEFIT:
2,432 metric tons of CO_2

EQUIVALENT TO:

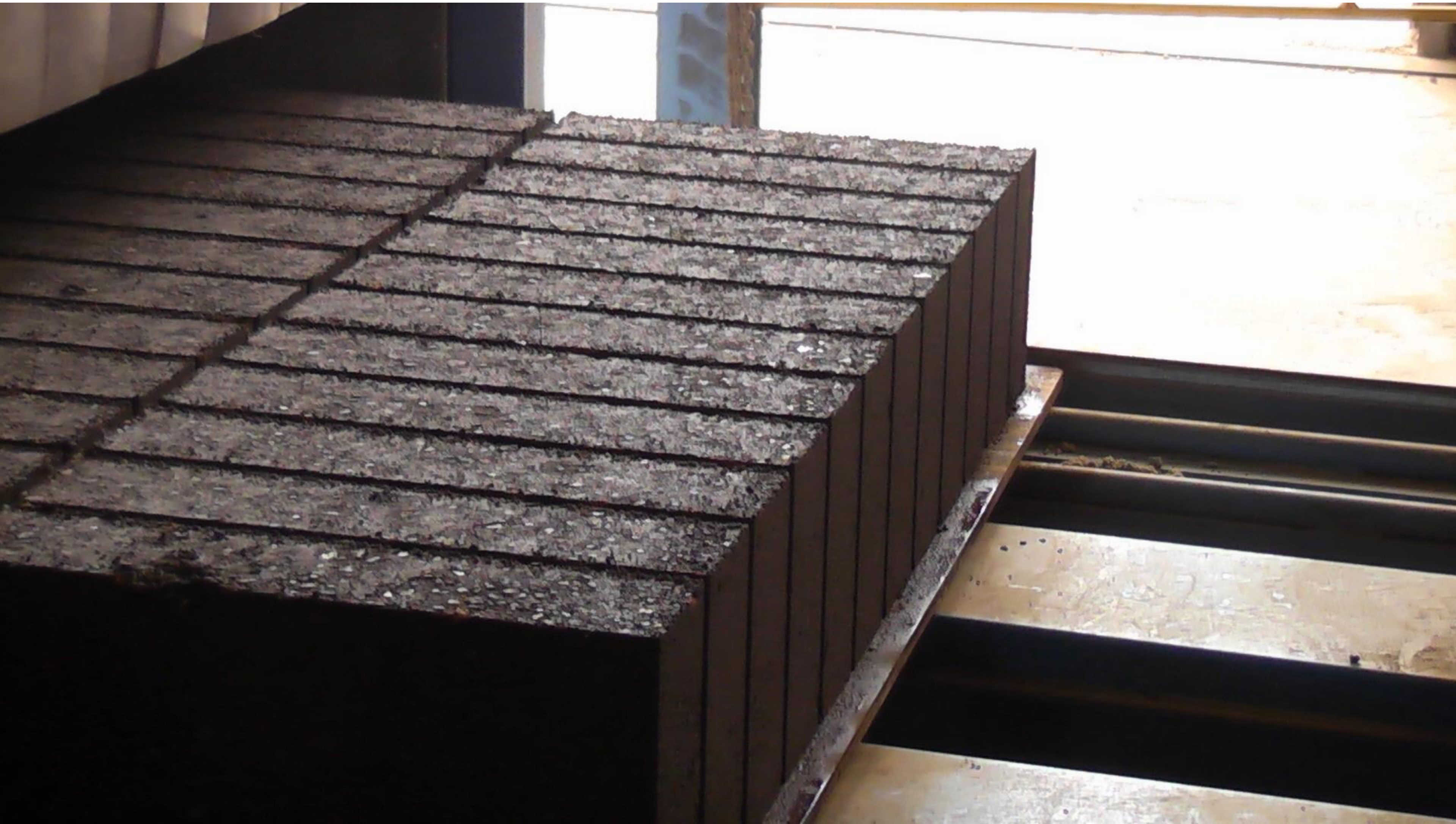
511 cars off the road for a year

Energy to operate a home for 222 years

Source: US EPA

Source: Naturallywood

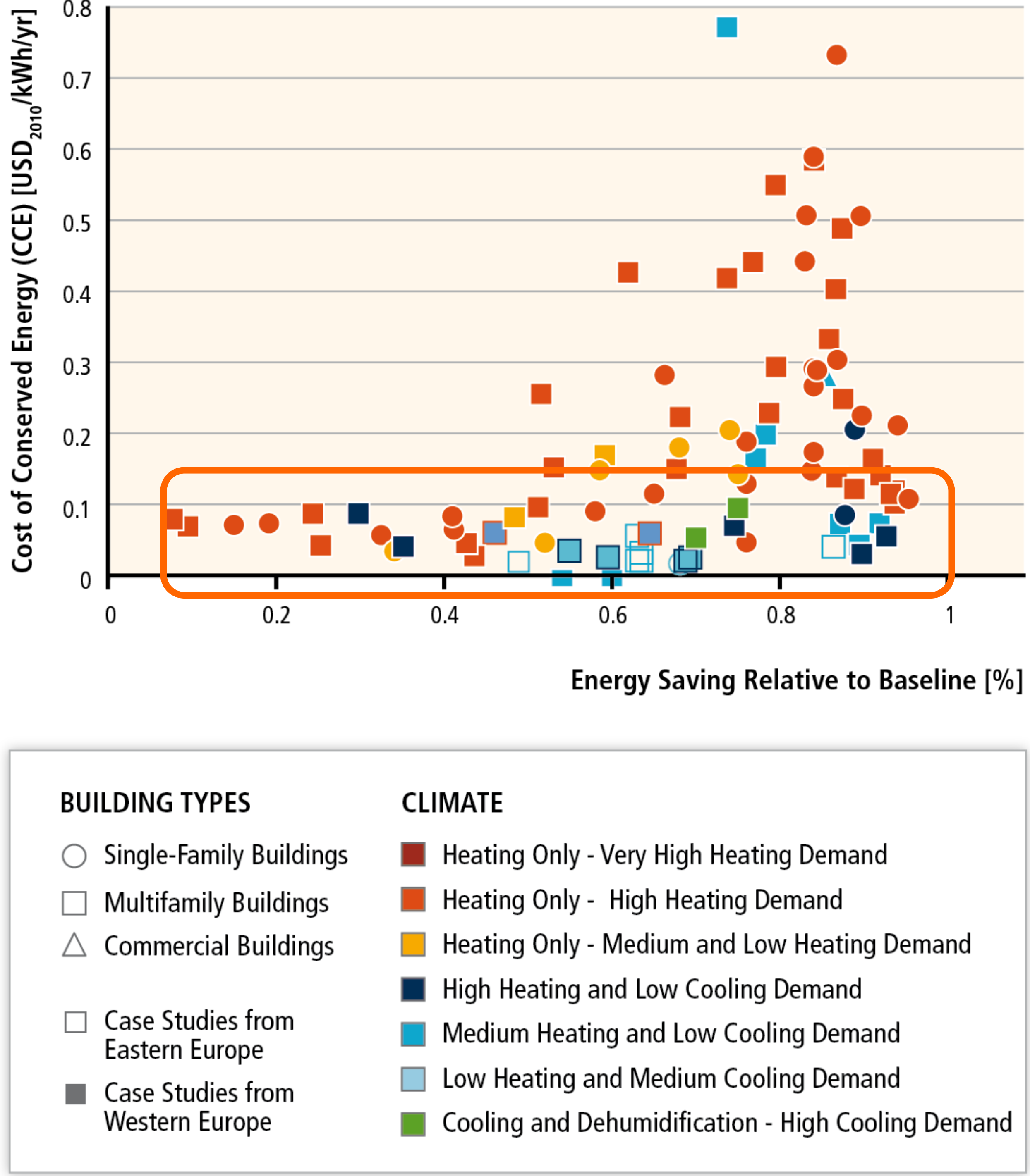
CO2 capture in construction materials?



permanent capture of carbon dioxide, resulting in products that are carbon-negative materials used, for instance, by the construction industry

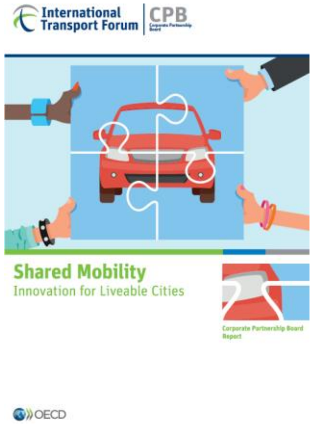
Further innovation criteria: durability

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.




TESLA

URBAN MOBILITY INNOVATIONS OF THE DIGITAL ERA: THE ROLE OF DIGITALLY OPTIMISED SHARED MOBILITY SERVICES



- Based on the study of the OECD's International Transport Forum
- Thought experiment: what if all car and bus trips in a city are provided through fleets of shared vehicles
- based on high-resolution real mobility and network data from a mid-size European city, namely Lisbon
- shared mobility is delivered by a fleet of six-seat vehicles ("Shared Taxis") offering on-demand, door-to-door shared rides in conjunction with a fleet of 8 and 16 seat mini-buses

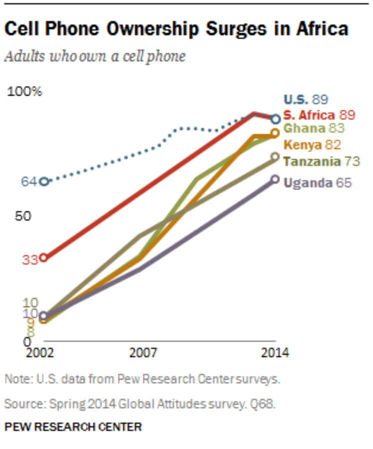
findings: a completely transformed city

- Congestion completely disappears
- traffic emissions reduced by one third
- 95% less space was required for public parking
- The vehicle fleet needed is only 3% in size of today's fleet
- total vehicle-kilometres would be 37% less even during peak hours
- Higher vehicle use-> shorter vehicle life cycles -> faster uptake of newer, cleaner technologies
- more rapid reduction of CO2 emissions from urban mobility

How else citizens gain from such a digitally enabled urban mobility future

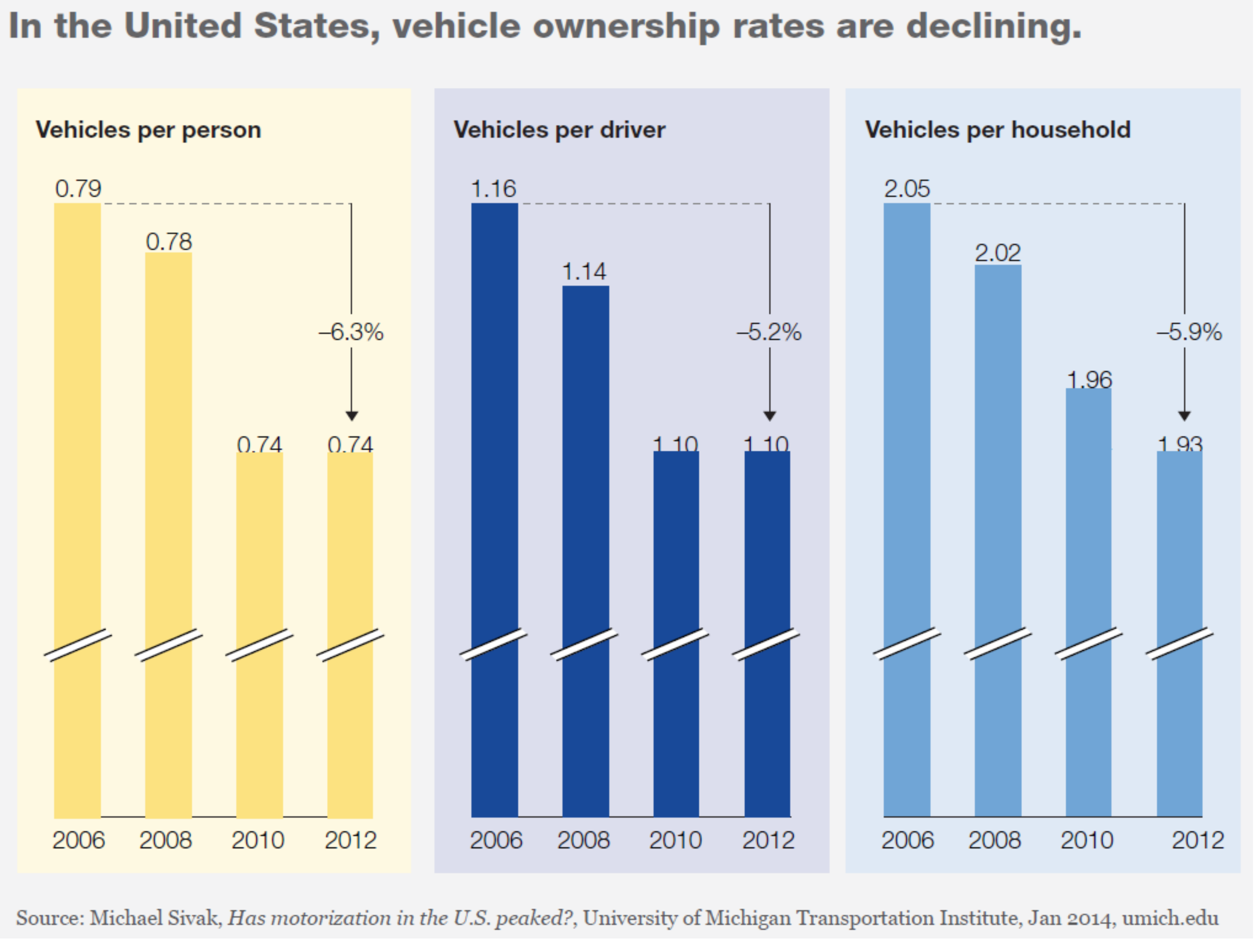
- No productivity losses due to congestion; commute time can be utilized instead of driving
- All trips are door-to-door; almost all trips are direct, without need for transfer
- Mobility is much cheaper: prices for journeys in the city could be 50% or less of today without subsidy
- Significant amounts of space previously dedicated to parking can be converted to uses that increase livability, from public parks to broader sidewalks, and more and better bicycle lanes
- Particularly striking is how a shared mobility system improves access and social inclusion. In the simulation, inequalities in access to employment, education or health services across the city virtually disappeared
- Air pollution is significantly reduced even without any vehicle or fuel change
- Possible to reduce individual automobile ownership (reducing costs to households) and parking infrastructure needs around the home (potential for shared ownership that is spreading in several European cities)

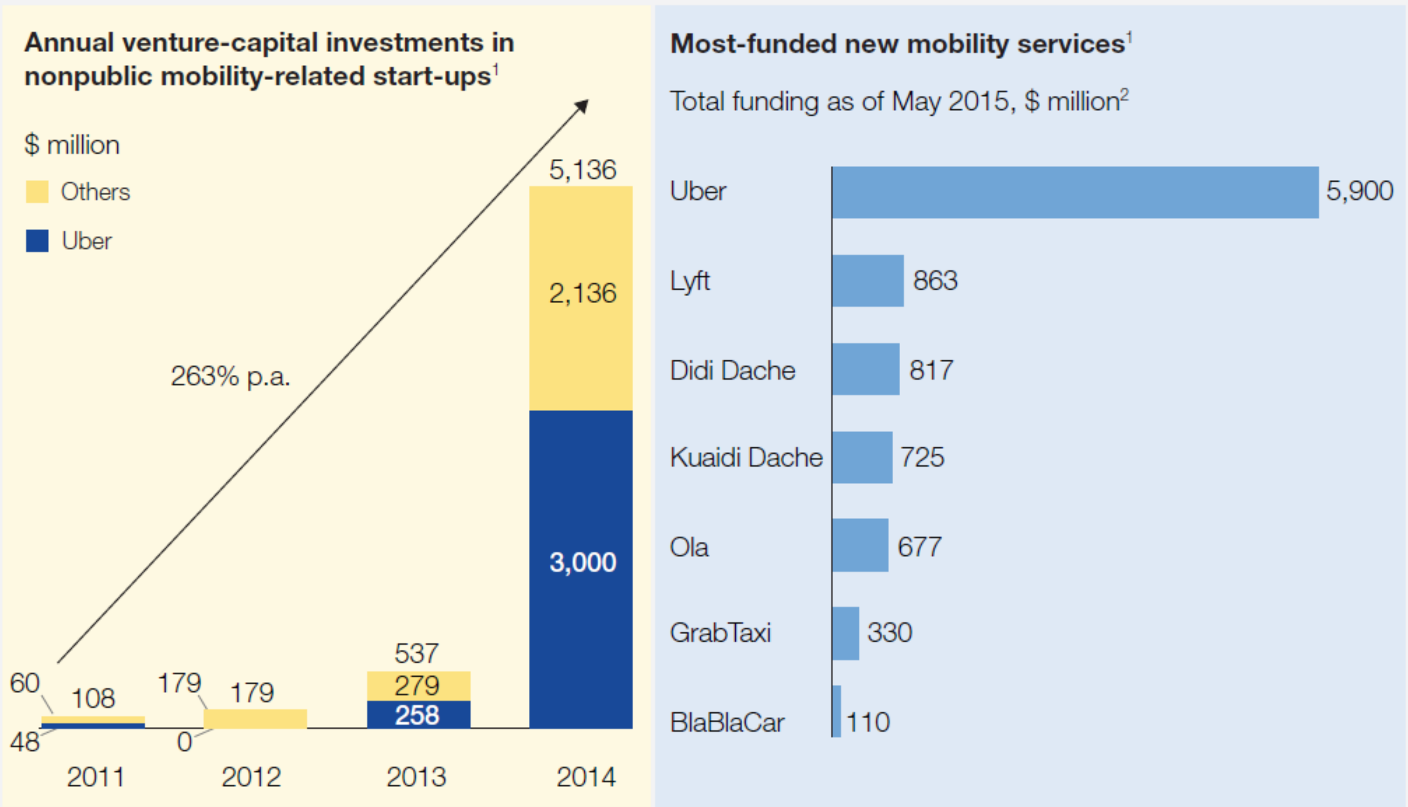
The technologies are available in all cities



TreEhugger daydream…?

Source: McKinsey: "urban mobility at a tipping point", 2016





[1]By total funding raised to date. Publicly disclosed information only.
[2]Does not include mobility services offered by automotive OEMs (eg, DriveNow, Car2Go), as data are not disclosed.

Source: CrunchBase; PitchBook Data; Preqin; Venture Scanner

Private investment into mobility services is skyrocketing

SOURCE: MCKINSEY: "URBAN MOBILITY AT A TIPPING POINT", 2016

Further areas in need for major innovations

- Long-distance shipping
  - Logistics?
- Aviation
- Food waste
- packaging

Summary

- Mission is not impossible but extremely challenging
- Will not happen without substantial further (disruptive) innovation
- Innovations are especially beneficial if:
  - Systemic solutions often have highest emission impact
  - They have more positive co-benefits than adverse side-effects, risks, i.e. also contributes to other societal goals
  - Result in little negative, or positive emission lock-in
  - Focus on durability, longevity
  - Socially widely acceptable
  - Leverage the major digital and social transformation enabled by the ICT revolution that is taking place
- High-tech may actually be very low-tech!

Thank you for your attention

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Supplementary slides

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UBC Brock Commons: Vancouver

18 Storeys: 1 concrete + 2 concrete cores supporting 17 storeys of mass timber (a students residence)

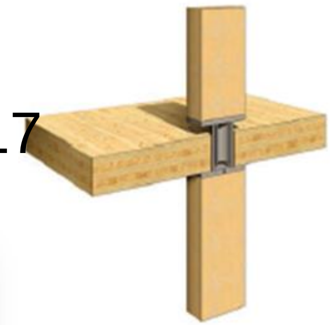
Encapsulated CLT and glulam columns

Two-way CLT floor system: NO BEAMS!

Innovative post-post connection system

Mock-up built to verify constructability

In-situ testing and monitoring

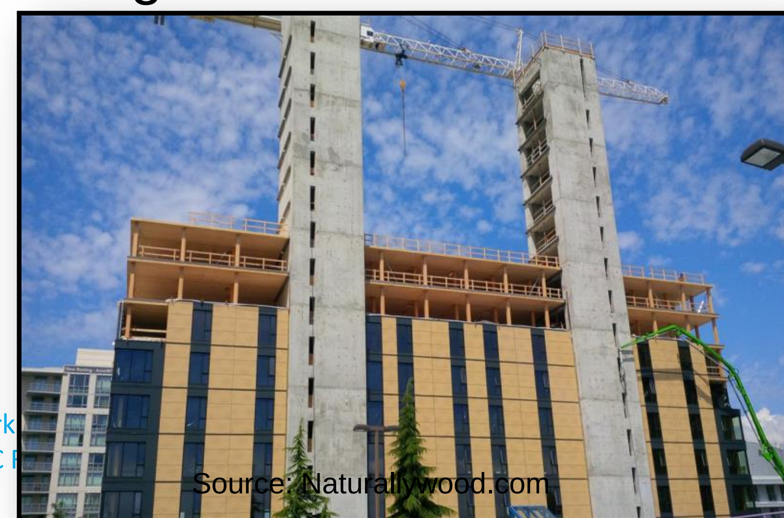


CLT floor slabs with glulam columns and steel connectors

partial encapsulation during construction

completed construction

UBC TWB Mock-up



Source: Naturallywood.com