MITIGATION:

Climate change and human settlements, role of cities in tackling climate change

Key findings of WGIII in the Fifth Assessment Report

With some recent developments

Diana Urge-Vorsatz

Vice Chair,WGIII

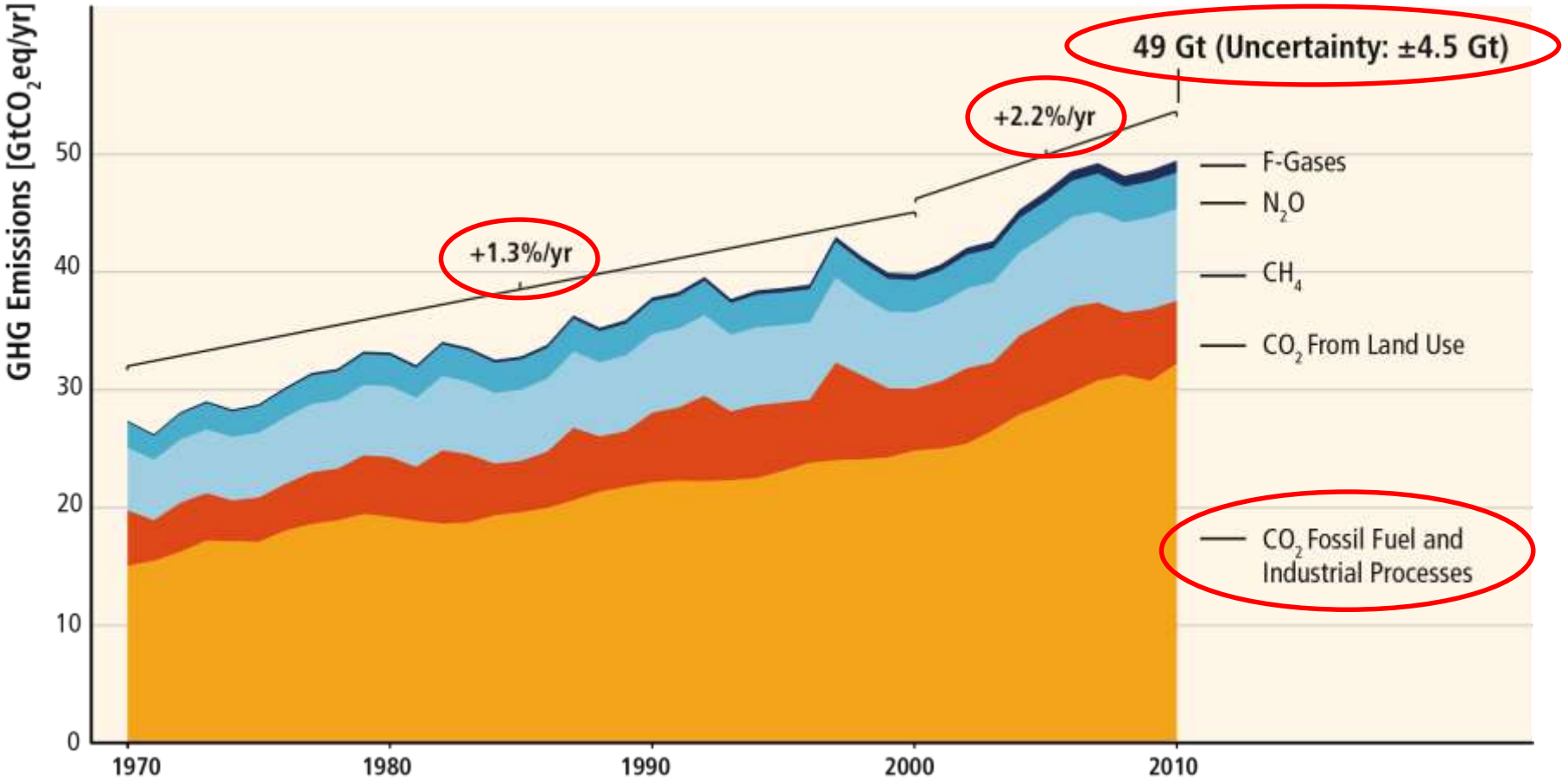
Director, Center for Climate Change and Systainable Energy Policy

Central European University

Riga, May 31, 2018


GHG emissions growth has accelerated
despite reduction efforts.

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

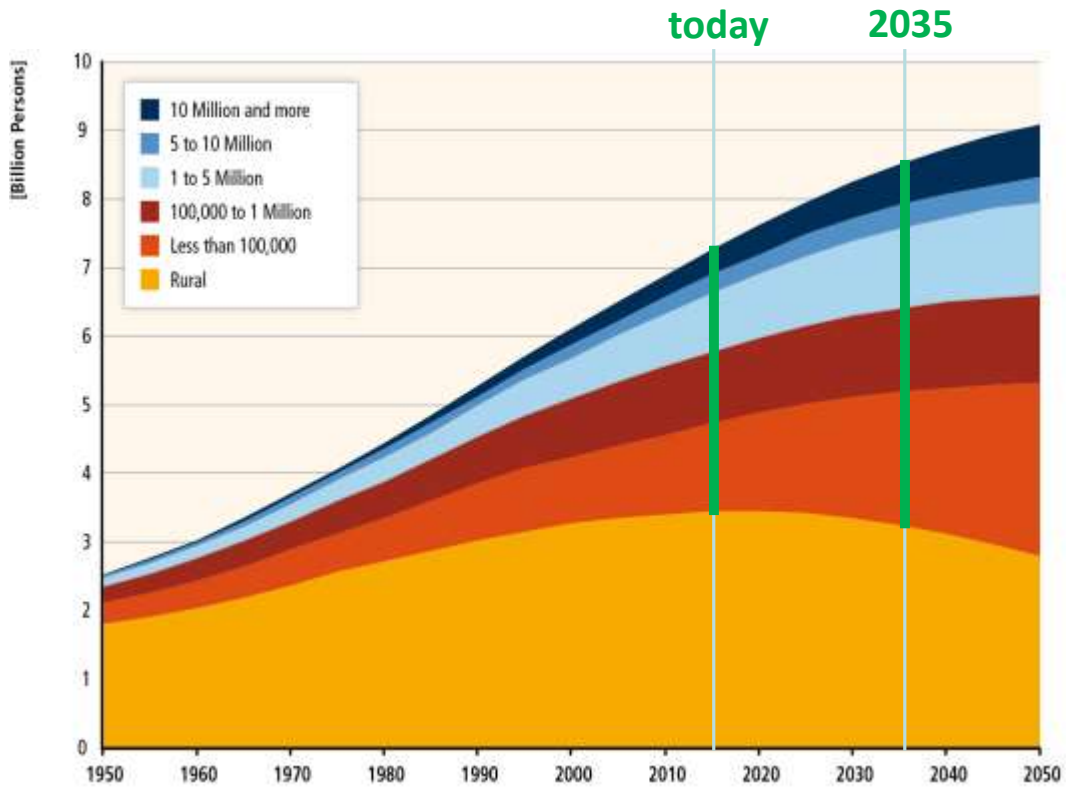


Based on Figure 1.3

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 **exclude benefits** of mitigation (reduced impacts from climate change). They also exclude other benefits (e.g. improvements for local air quality).

The elements of the solution: Focus on energy end-use and cities



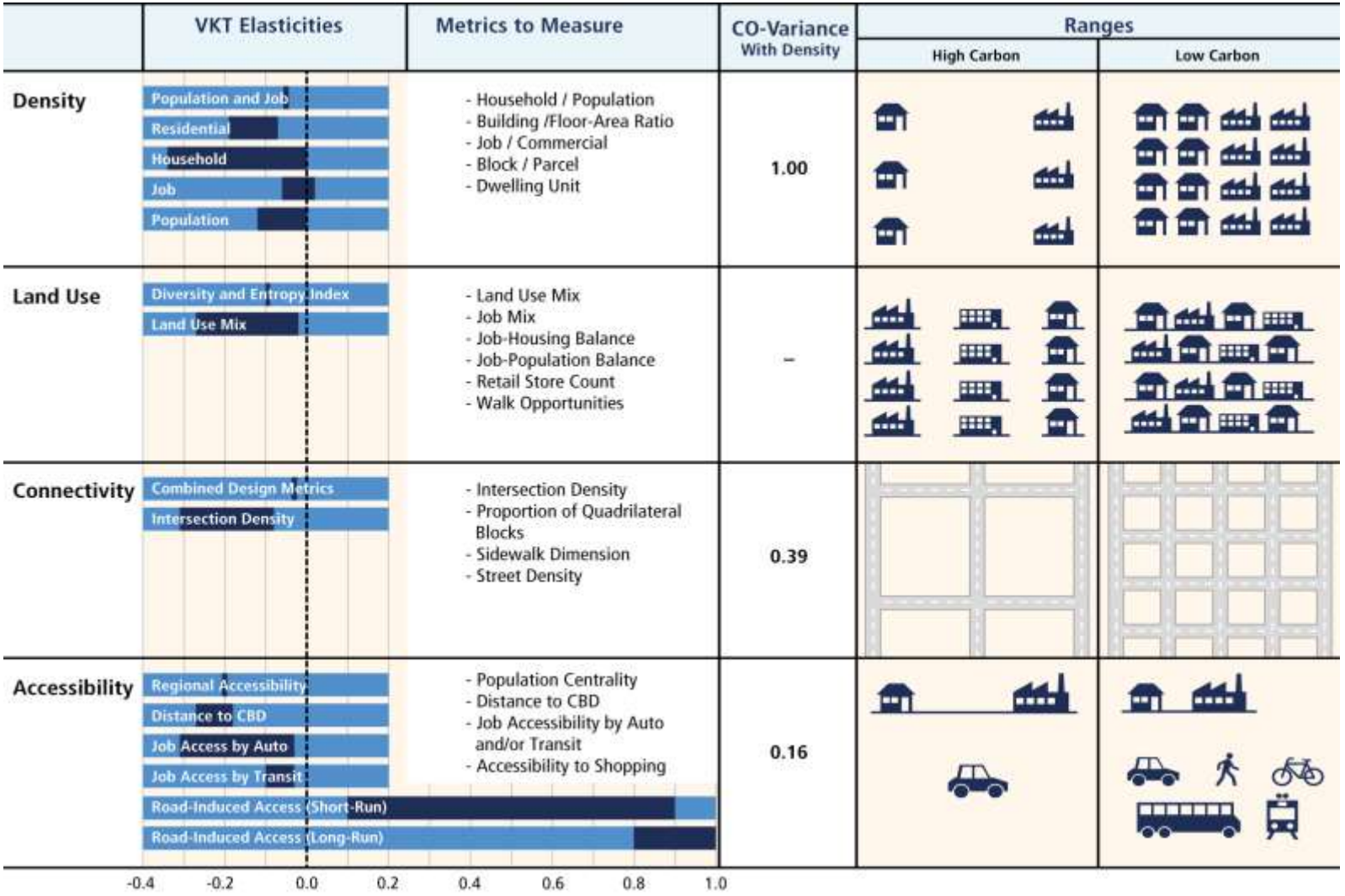
Responsibility and opportunity: A substantial share of emission increase in the next few decades will come from cities

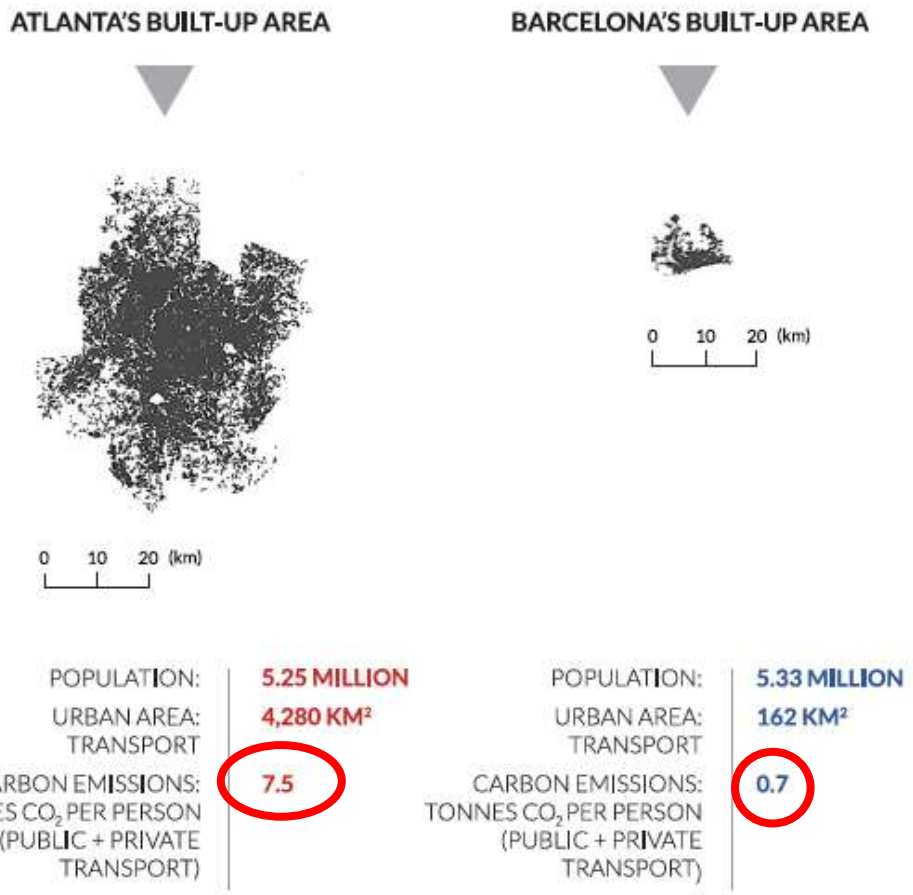
- Urban areas generate 80% of GDP and 71% - 76% of CO2 emissions from global energy use
- Each week the urban population increases by 1.3 million
- This enormous expected increase poses both an opportunity and responsibility
- Cities/municipalities can often take stronger leadership in strong climate action than nation states due to higher degrees of flexibility, larger room for individual leadership

A broad array of opportunities exist to keep urban emissions at bay while maintaining or increasing well-being

- Urban design and form
- Energy-efficient transport systems
  - Mobility services; e-transactions replacing physical mobility (e-banking, teleconferencing, e-government, etc)
  - Encouraging non-motorized and public transport
  - Efficient, small vehicles
  - Shared urban mobility schemes
- Energy efficient buildings
  - low-energy architecture
  - 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
  - Electric vehicles
- Lowering embodied energy in the built infrastructure and products –
  - affordable low-carbon, durable construction materials
  - Towards the circular economy: reuse and sharing economy
- Carbon storage in construction materials?
- Lifestyle, behavior, culture

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





Urban planning can make a very significant difference in urban emissions

Source: UN 2014 as cited by Fischedick, CFCC 2015

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

The elements of the solution: buildings

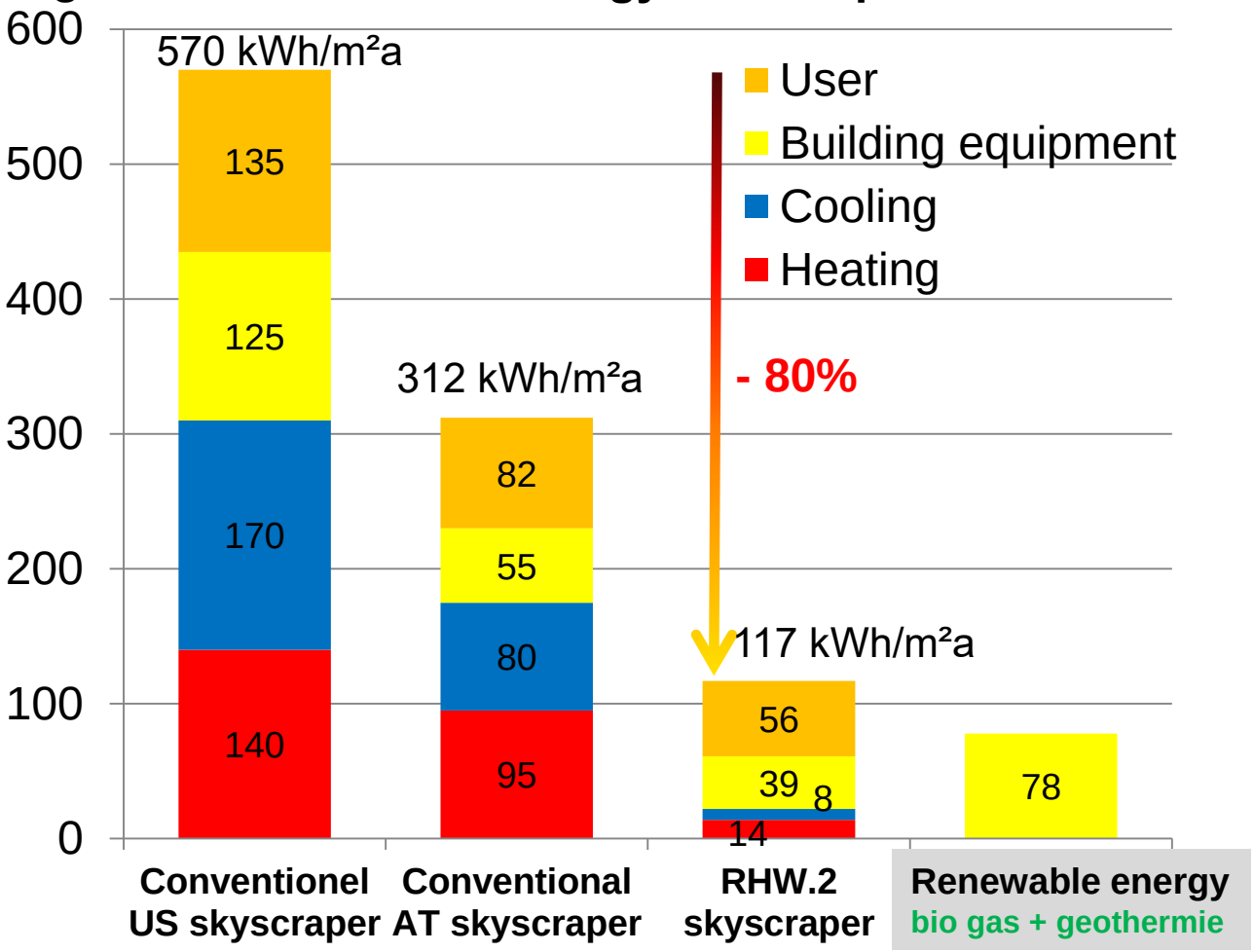
RHW.2 Tower Raiffeisen-Holding NÖ-Vienna office

World's first Passive high-rise office building

Architects DI Dieter Hayde and DI Ernst Maurer

Zertifiziertes Passivhaus
Passivhaus Institut

High-rise benchmarks energy consumption in kWh/m²a



Working Group III contribution to the
IPCC Fifth and Sixth Assessment Reports

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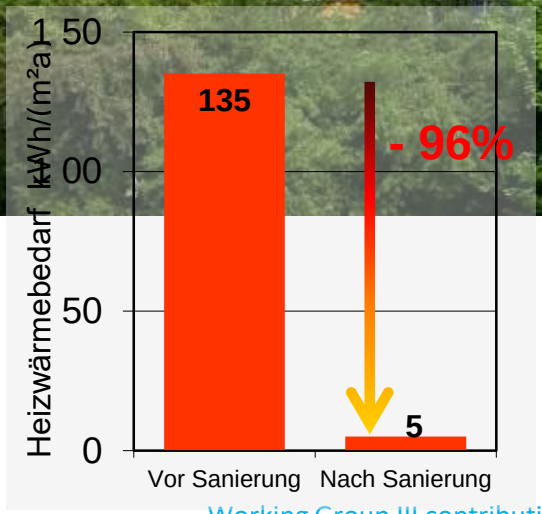
Geschosswohnungsbau Passivhaus Altbausanierung in Graz / Steiermark

Bauträger: GIWOG

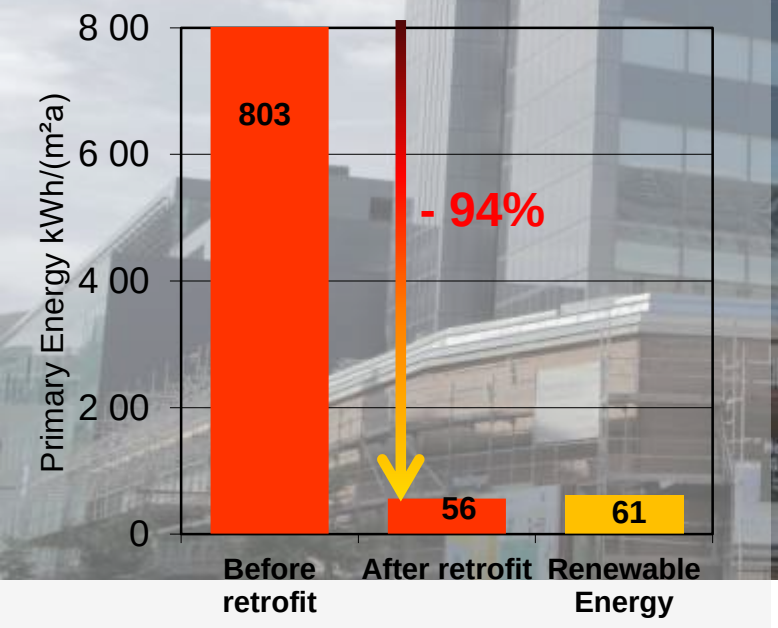
Generalunternehmer: GAP-Solution GmbH



First retrofit to Passive House Plus

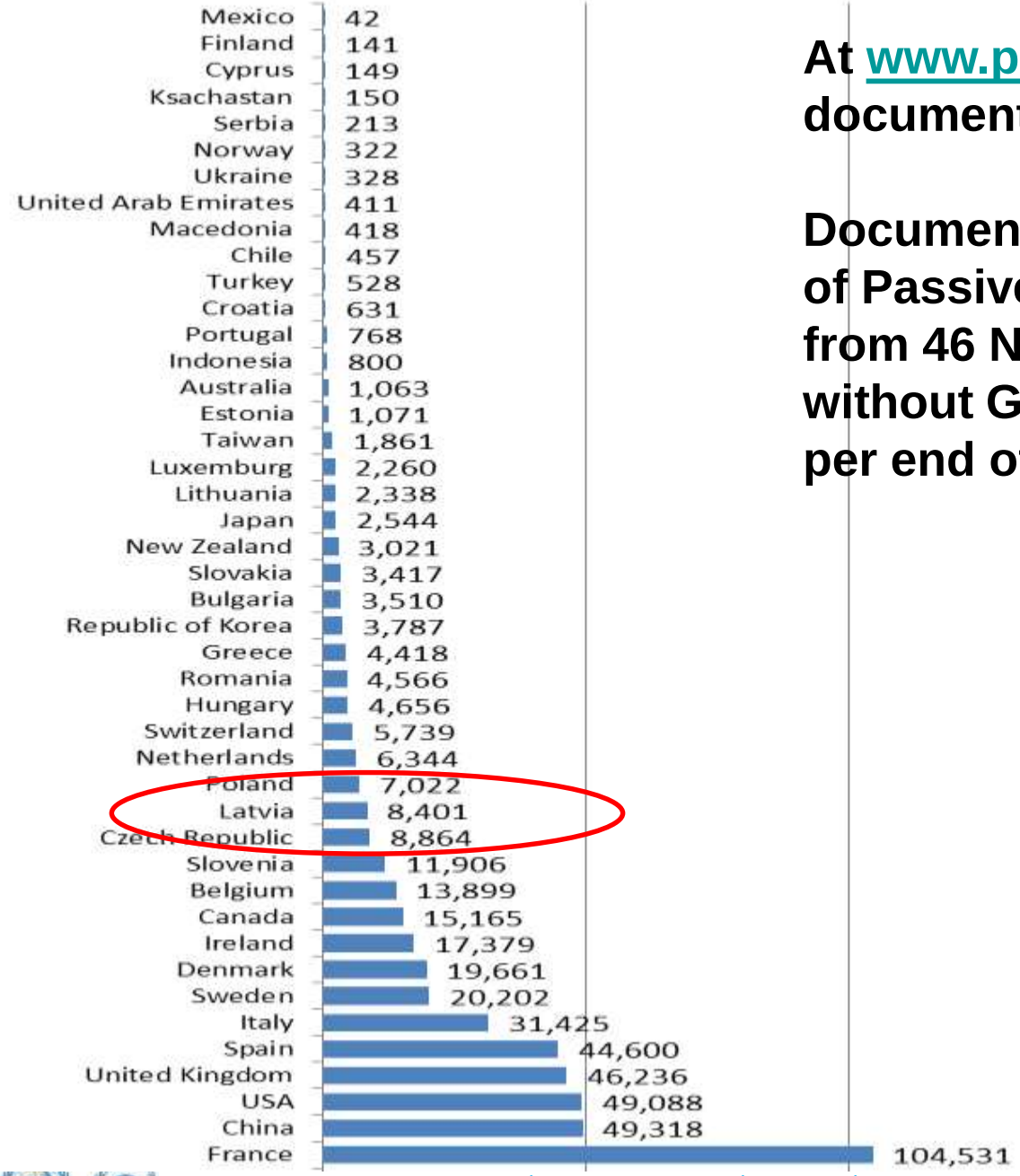
Office building **Technical University Vienna**
Architect: Arch. DI Gerhard Kratochwil
Building physics: Schöberl & Pöll GmbH
Owner: BIG Bundesimmobilien gesmbH

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



PASSIVHAUS Austria
PASSIVE HOUSE IPHA
Passive House Institute

Gründerzeitwohnhaus Mariahilfer Straße, 1150 Wien
Generalsanierung und Aufstockung schweren Gasexplosion
Architektur Trimmel Wall Architekten ZTGmbH Bauphysik Schöberl & Pöll GmbH



At www.passivhausprojekte.de documented Passive houses:

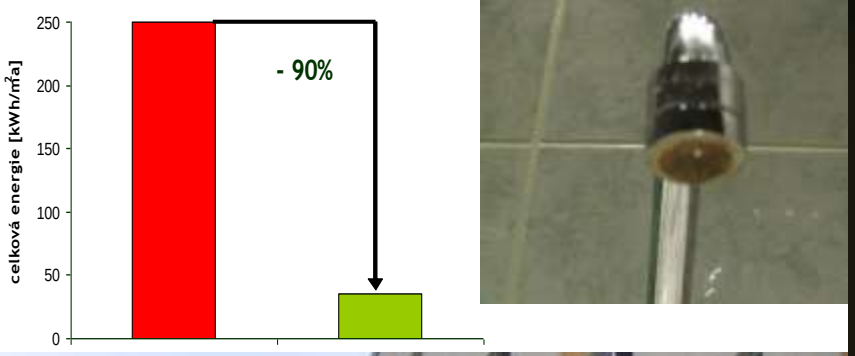
Documented Treated Floor Area of Passive houses from 46 Nations without Germany and Austria per end of April 2017


Zéró Energiás 4 lakásos társasház

Brussels Mandated Passive House in January 2015

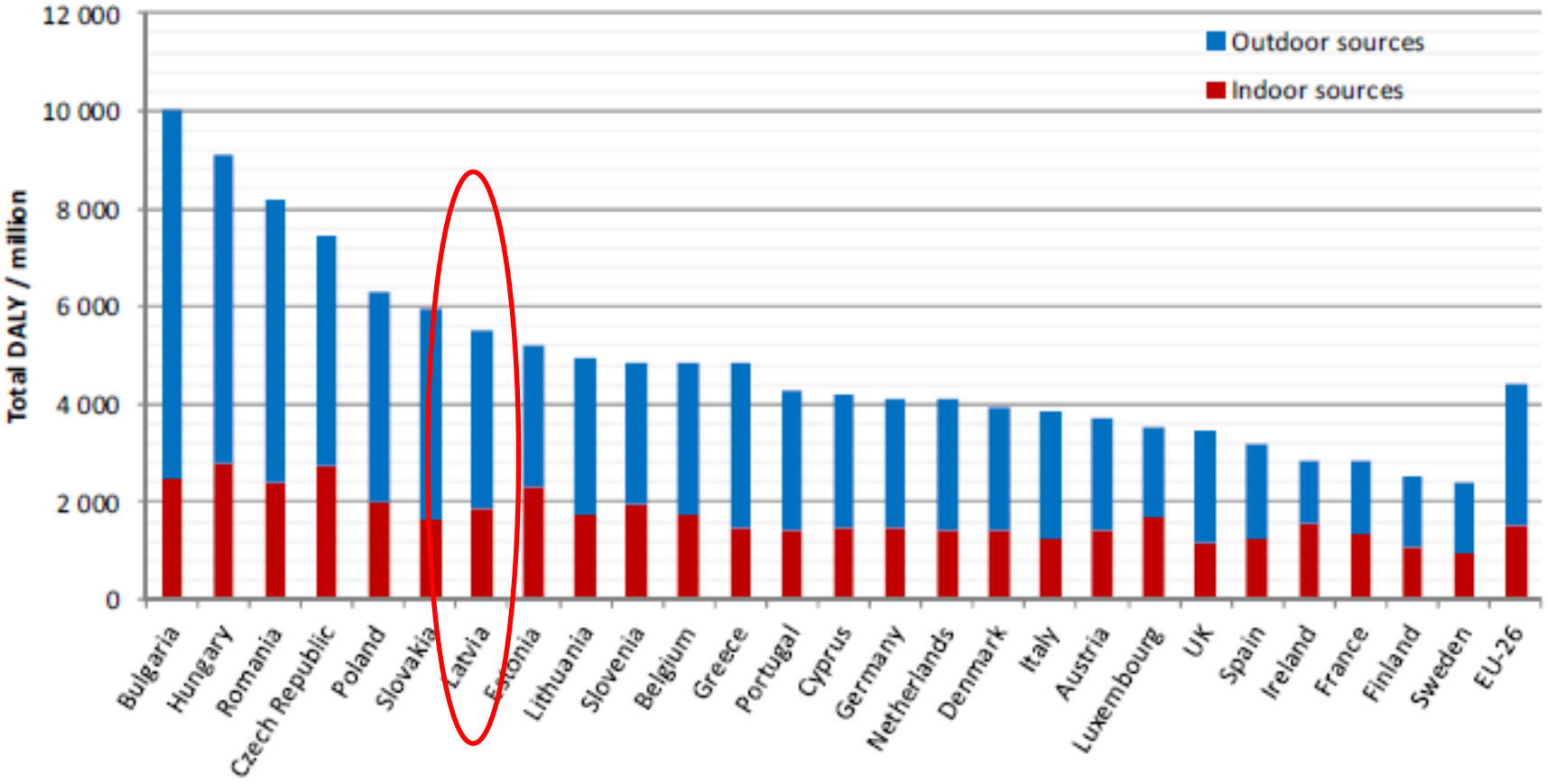
1,280,000 m² completed in the previous 5 years!

Celine Fremault, Brussels Minister for Environment


celková energie [kWh/m²a]
250
200
150
100
50
0
- 90%

Total burden of disease from indoor exposures in European countries

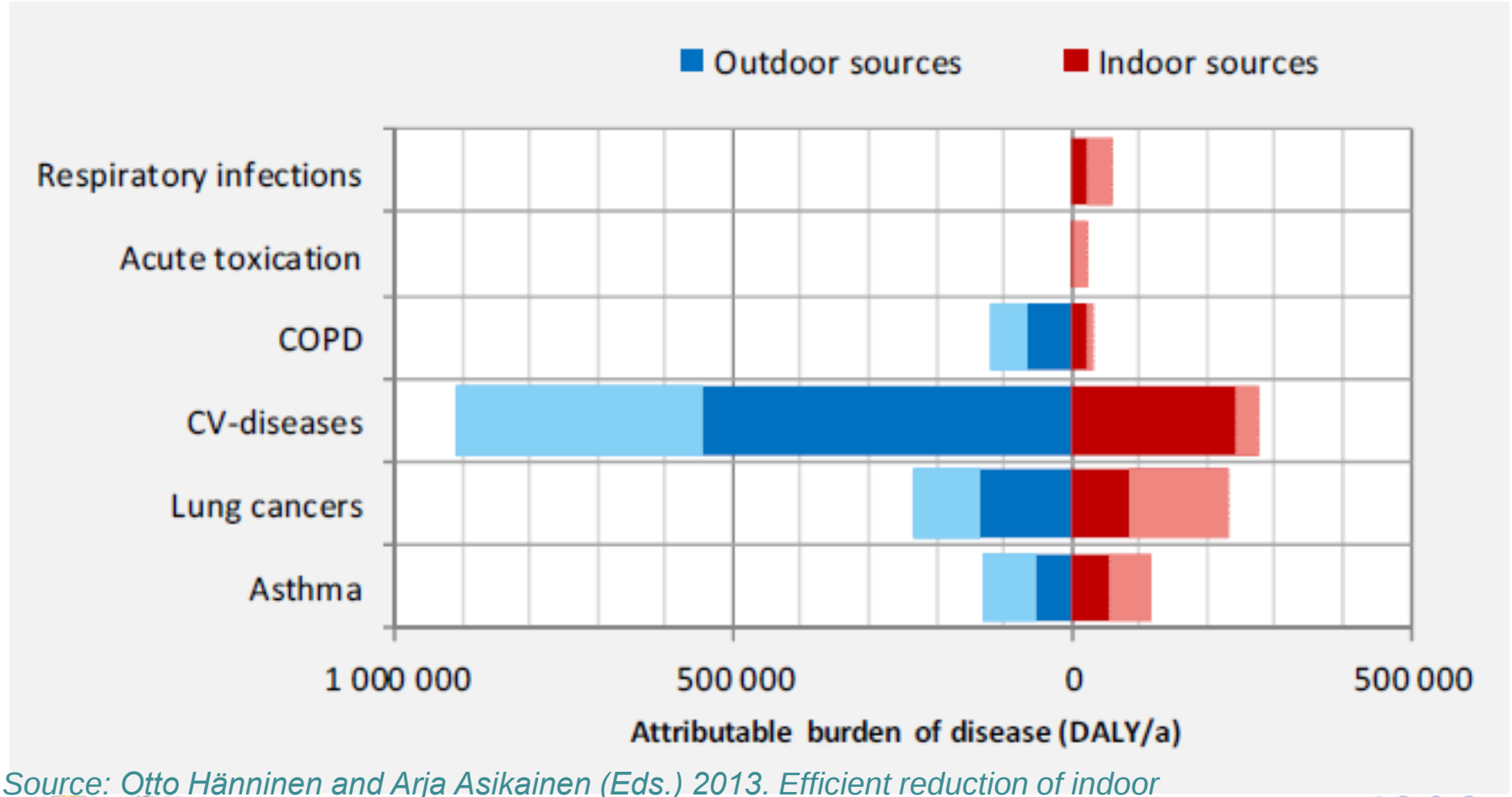
as DALY/million population with division to indoor and outdoor sources in the 2010 building stock



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

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 in high-efficiency buildings



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

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

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The elements of the solution: Mobility

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

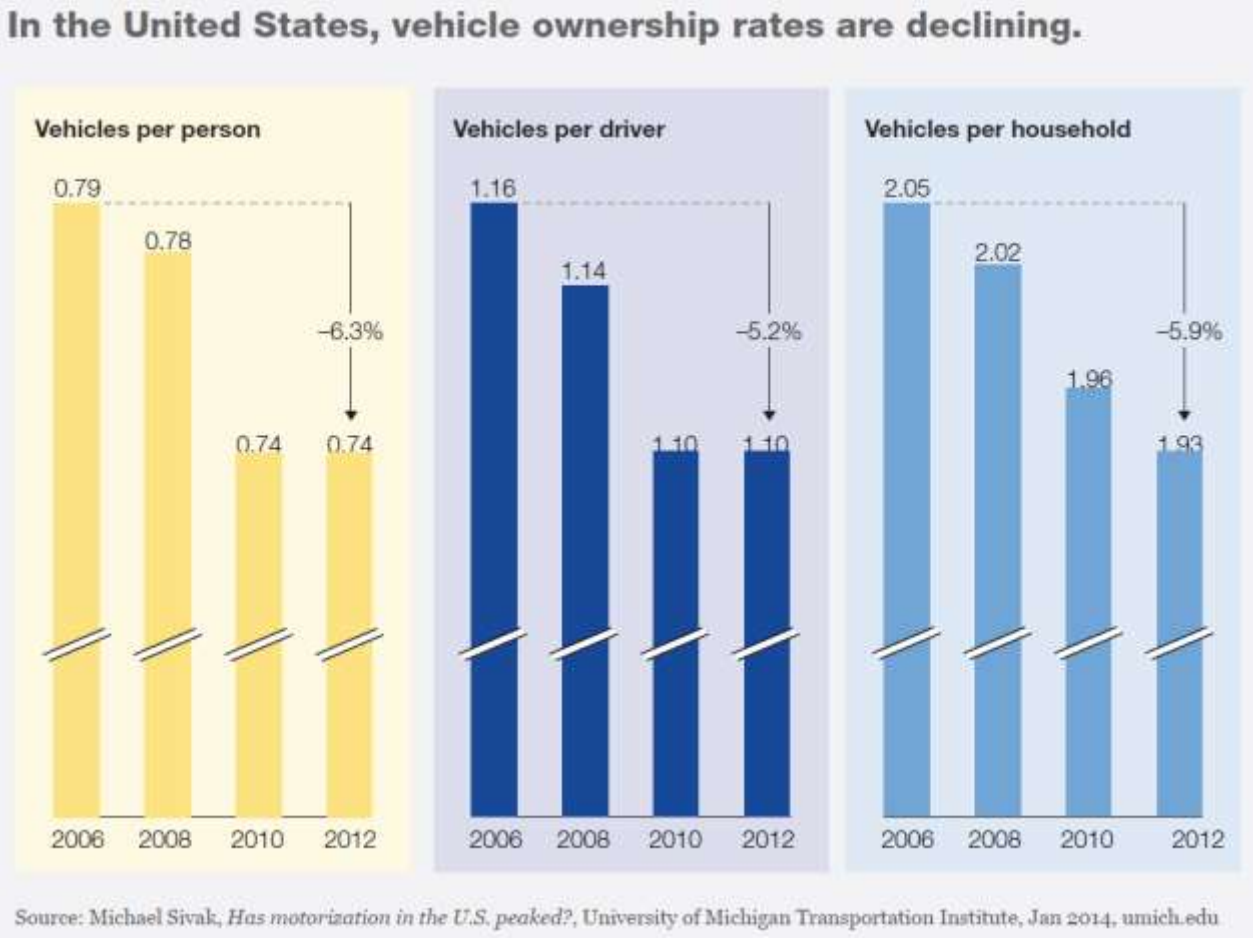
findings: a completely transformed city

- 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)

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



Summary

- Municipalities/cities can play a major role in strong climate action
- Urban planning and green infrastructure
- High-efficiency or energy plus buildings and retrofits
- Construction from low-carbon building materials (e.g. timber)
- Shared urban mobility schemes
- For many projects the co-benefits may exceed the climate benefits

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

Sept. 2019

Oceans and cryosphere

April 2021

The Physical Science Basis

October 2021

Climate Change Impacts, Adaptation and Vulnerability

April 2022

The Synthesis Report

Talanoa dialogue UNFCCC

Land

Aug. 2019

Mitigation of Climate Change

July 2021

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***

www.citiesipcc.org

Thank you for your attention

With permission from HVG

They keep promising this global warming, they keep promising, but you will see that they will not keep this promise of theirs either!

hvg.hu hírek szünet nélkül

orts

Ürge-Vorsatz Diana

Center for Climate Change and Sustainable Energy Policy (3CSEP)

CEU, and

Working Group III

IPCC

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Supplementary slides

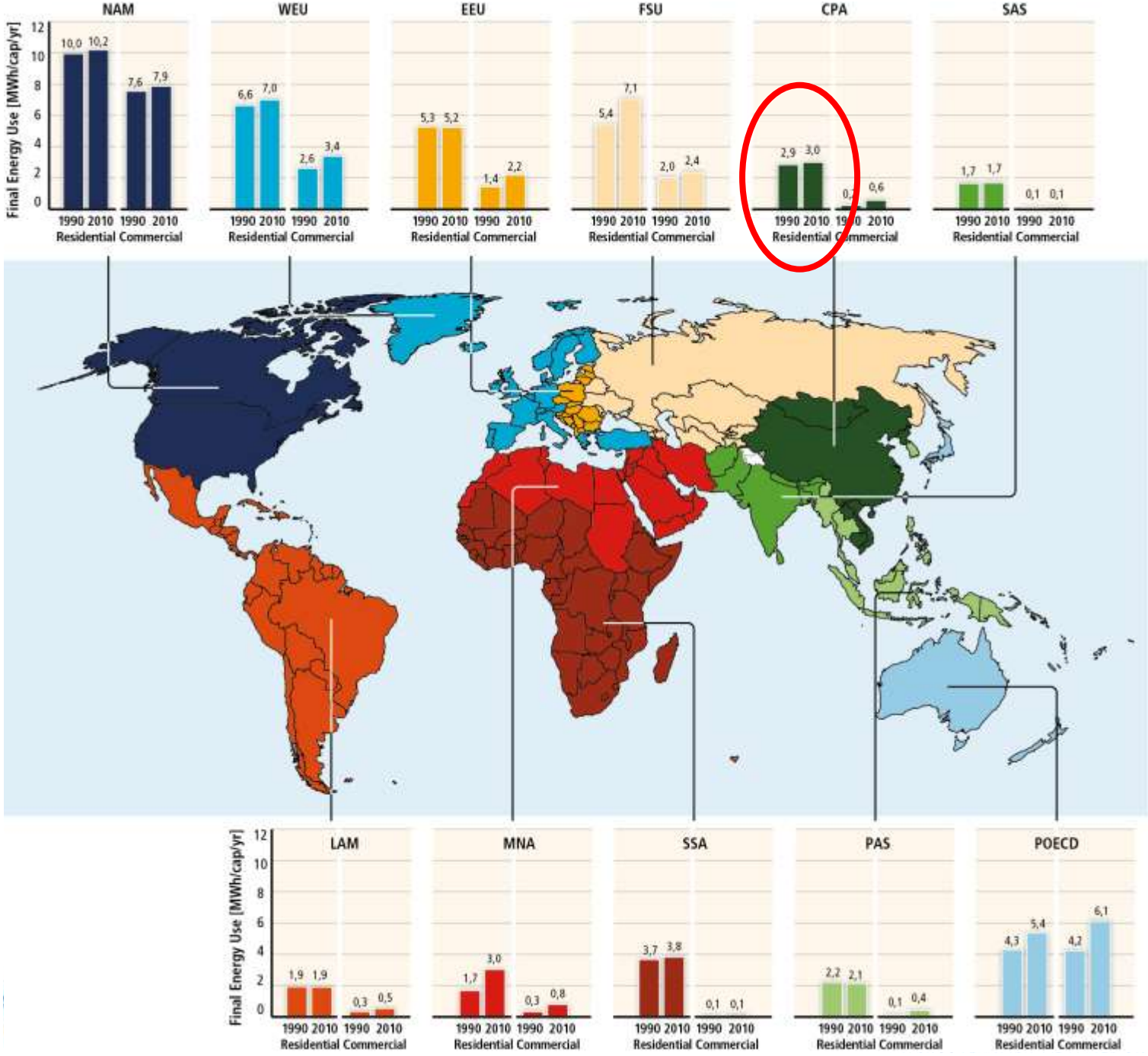
Outline of AR5 WG-III Report

1	Introductory Chapter
2	Integrated Risk and Uncertainty Assessment of Climate Change Response Policies
3	Social, Economic and Ethical Concepts and Methods
4	Sustainable Development and Equity
5	Drivers, Trends and Mitigation
6	Assessing Transformation Pathways
7	Energy Systems
8	Transport
9	Buildings

10	Industry
11	Agriculture, Forestry and Other Land Use (AFOLU)
12	Human Settlements, Infrastructure and Spatial Planning
13	International Cooperation: Agreements and Instruments
14	Regional Development and Cooperation
15	National and Sub-National Policies and Institutions
16	Cross-cutting Investment and Finance

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



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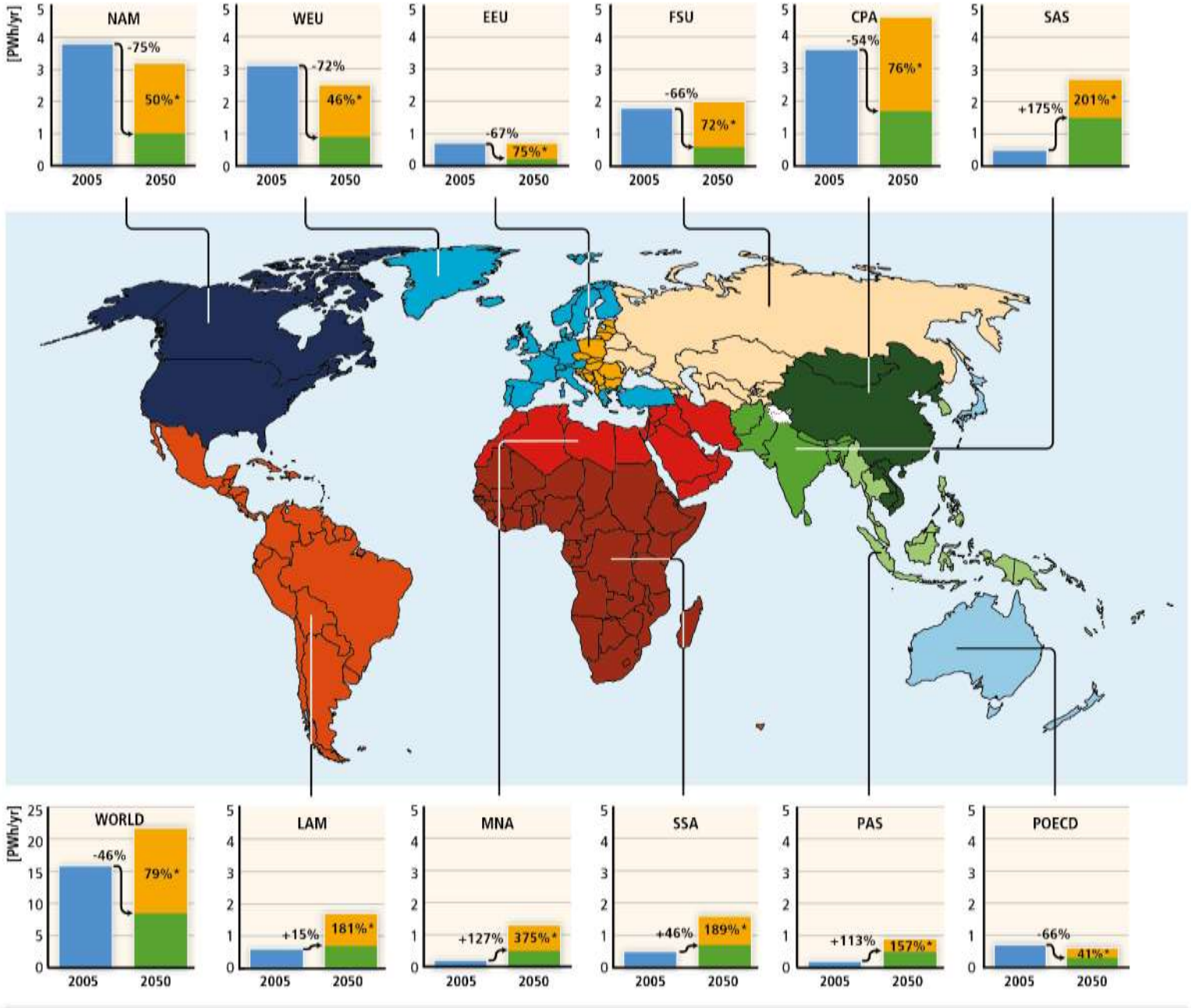
The lock-in risk: heating and cooling energy demand by two scenarios



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

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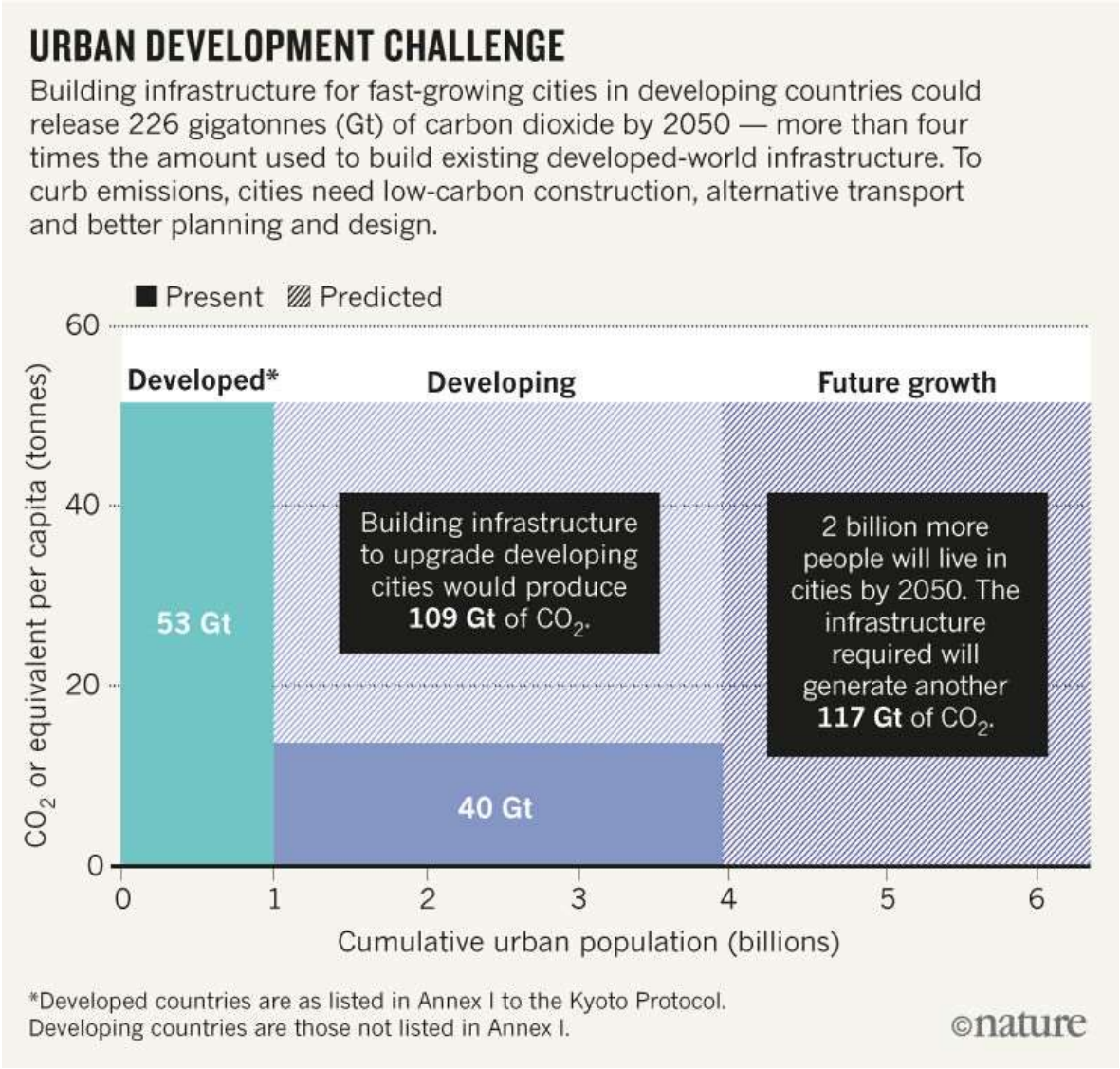
ate change

Urban infrastructure development can consume all of our remaining carbon budget to a 1.5C target?



Source: Bai, X. et al. Six Research Priorities for Cities and Climate Change. Nature, Mar 1, 2018.

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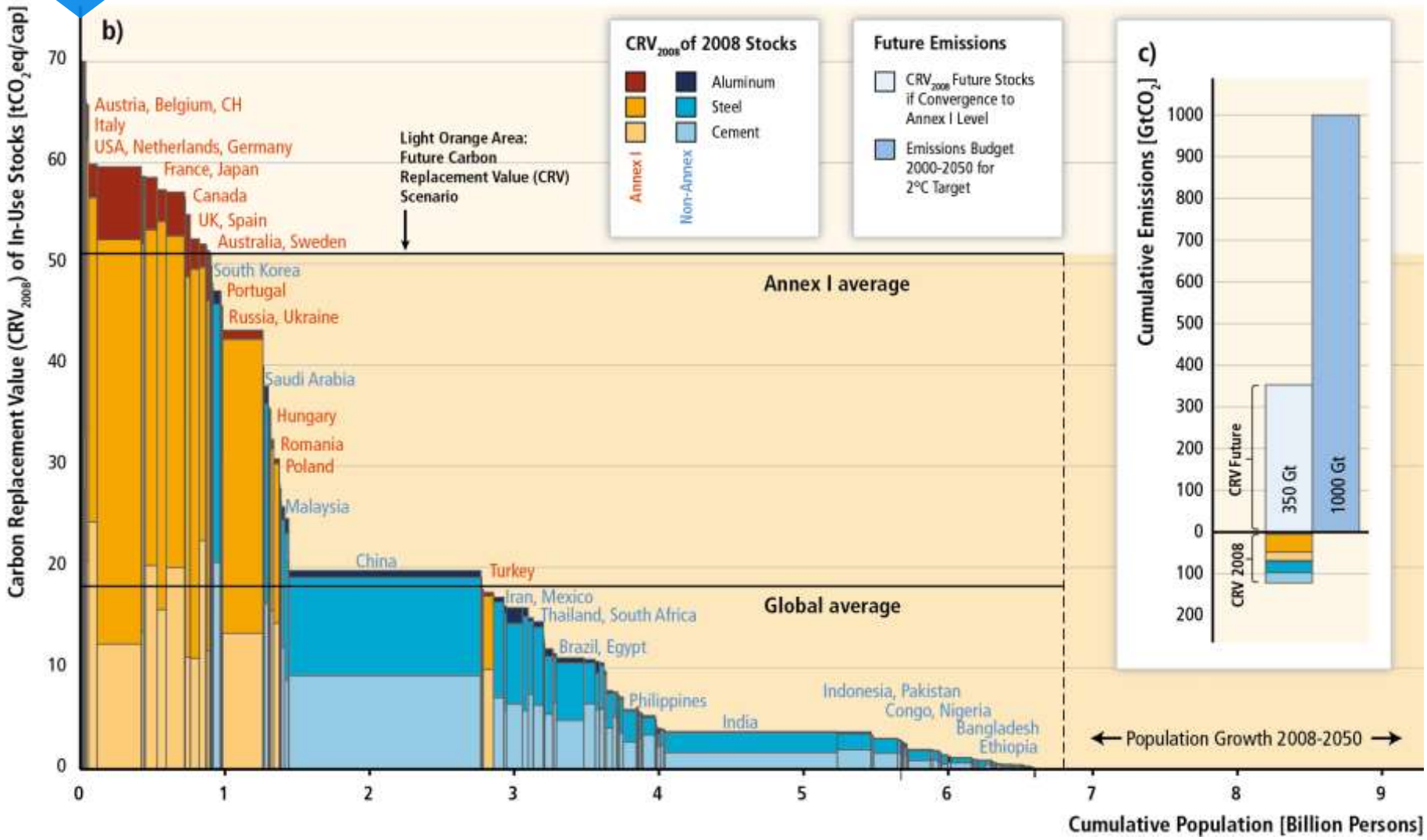
Infrastructure build-up over the next few decades will result in significant emissions

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



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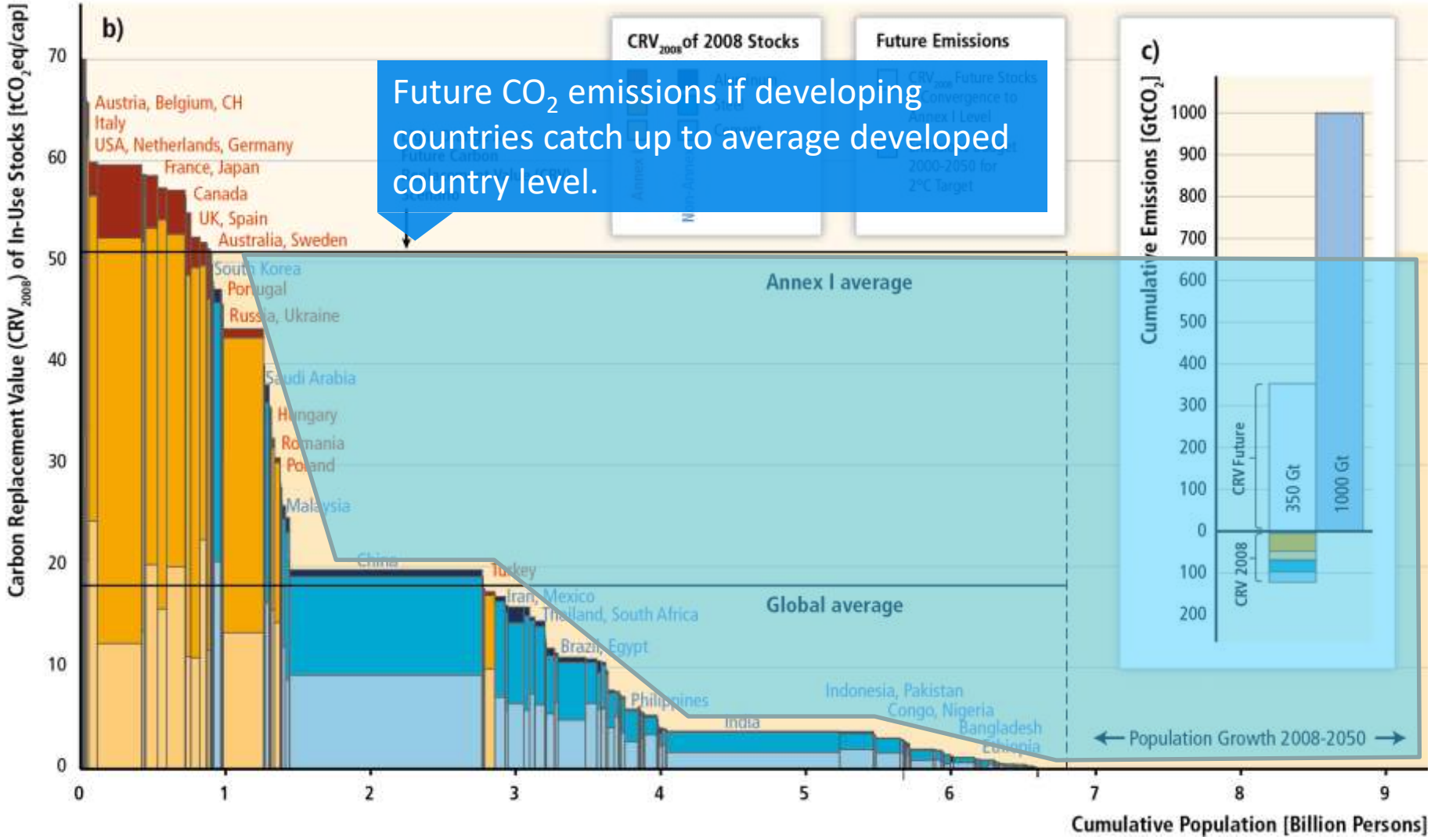


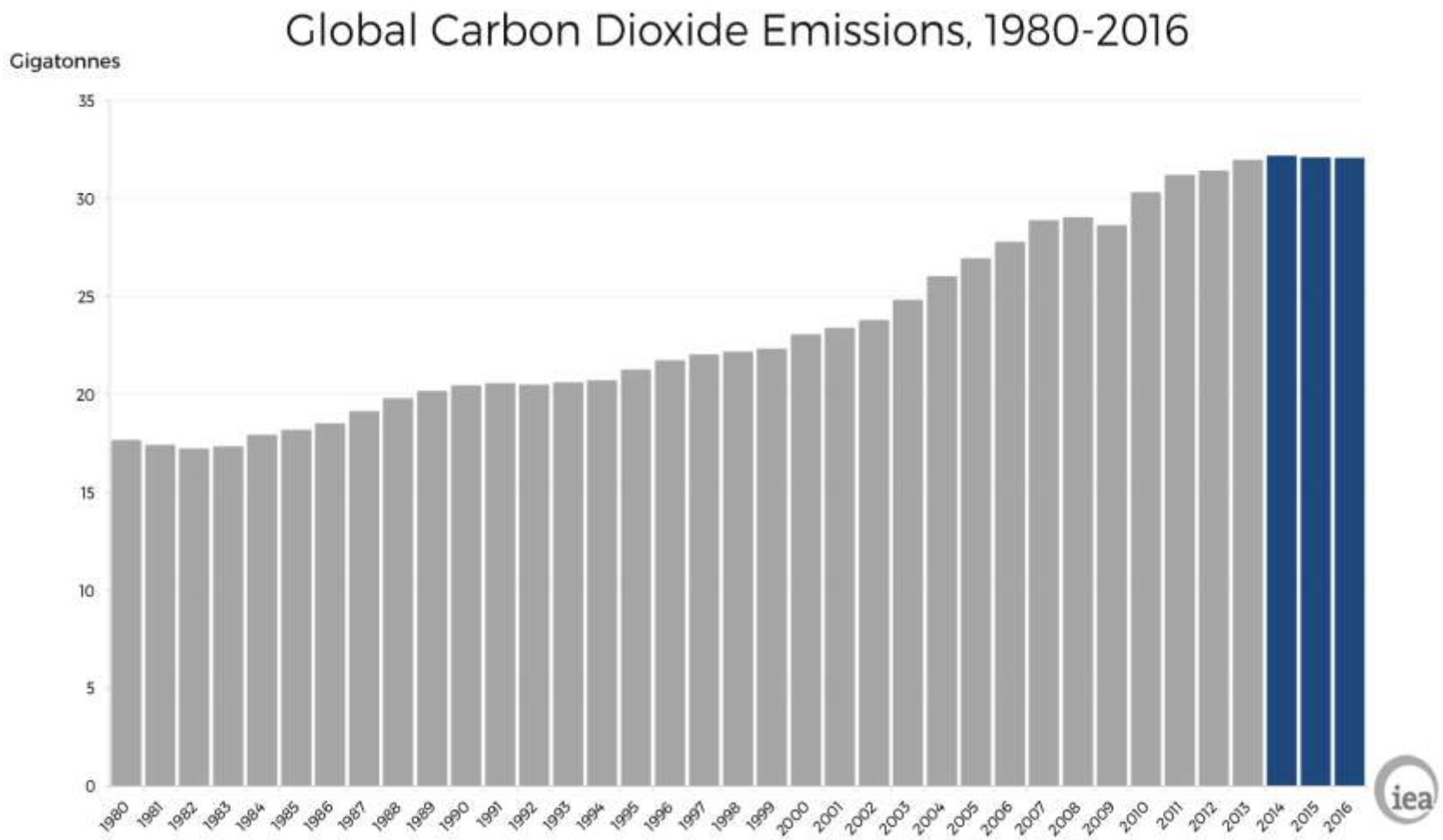
There are several mitigation options that can also contribute towards development goals

CENTER FOR CLIMATE CHANGE AND SUSTAINABLE ENERGY POLICY

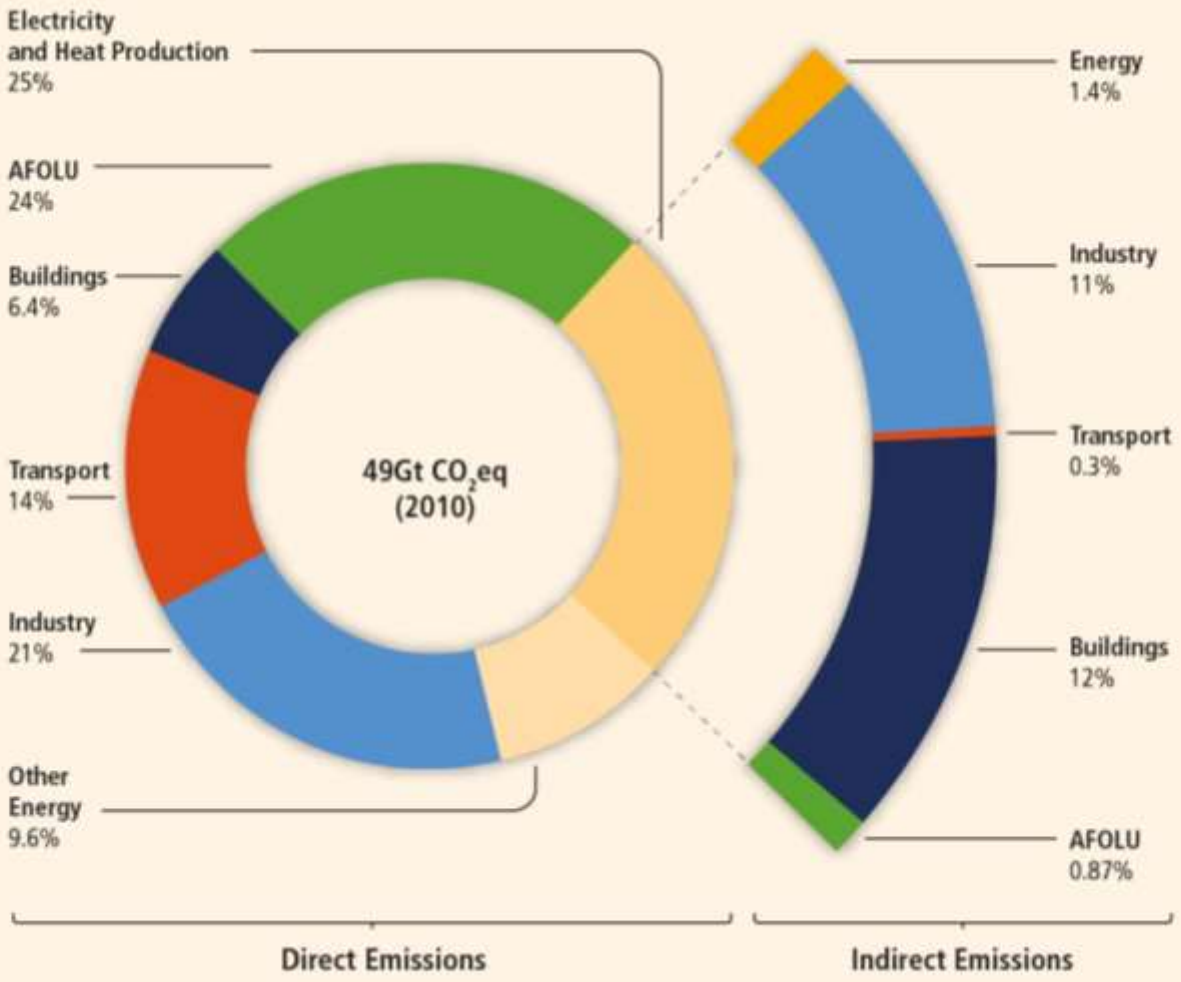
CENTRAL EUROPEAN UNIVERSITY

"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)

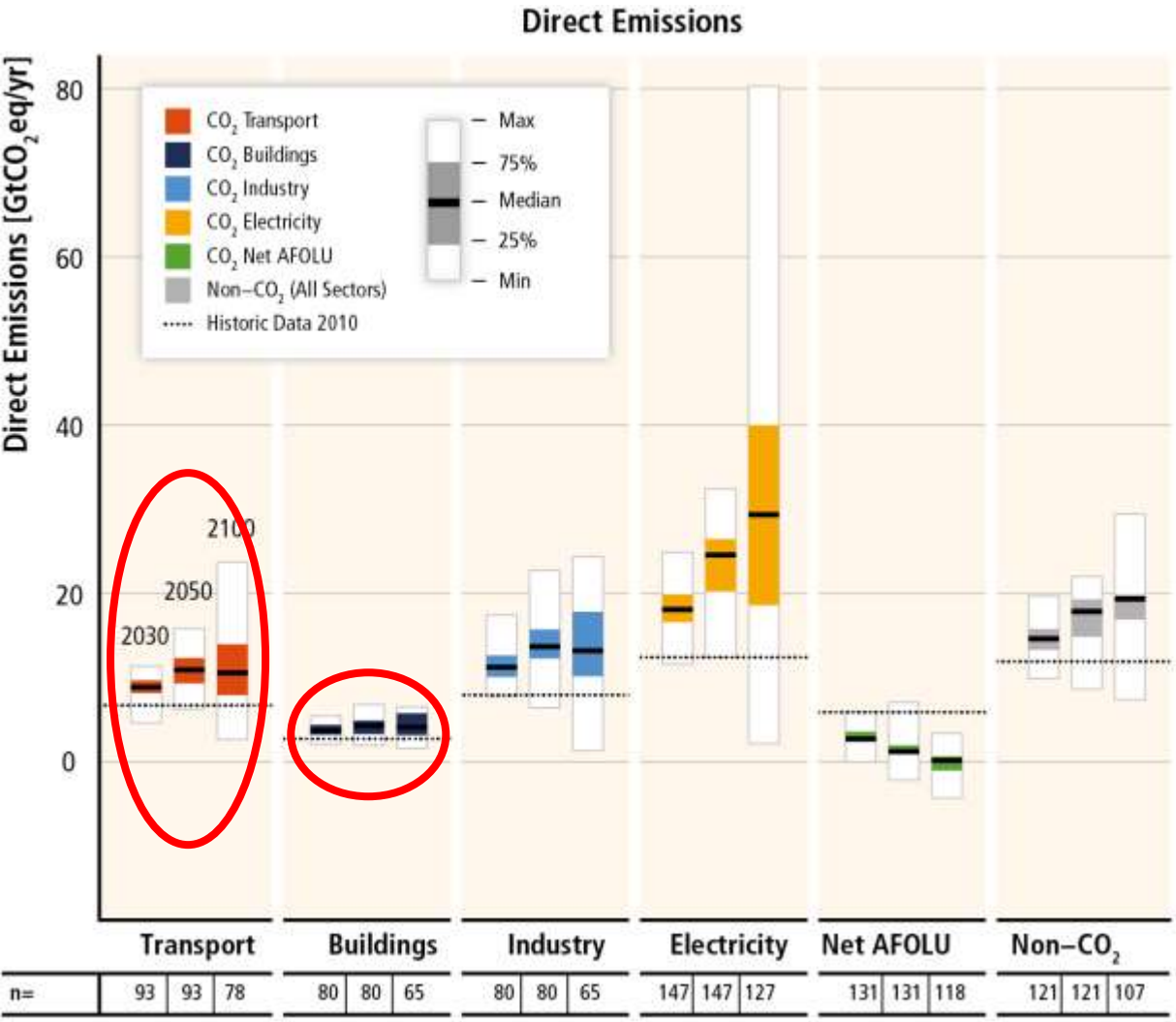
Developments since AR5: global emissions have been level for 3 years despite GDP growth (IEA)



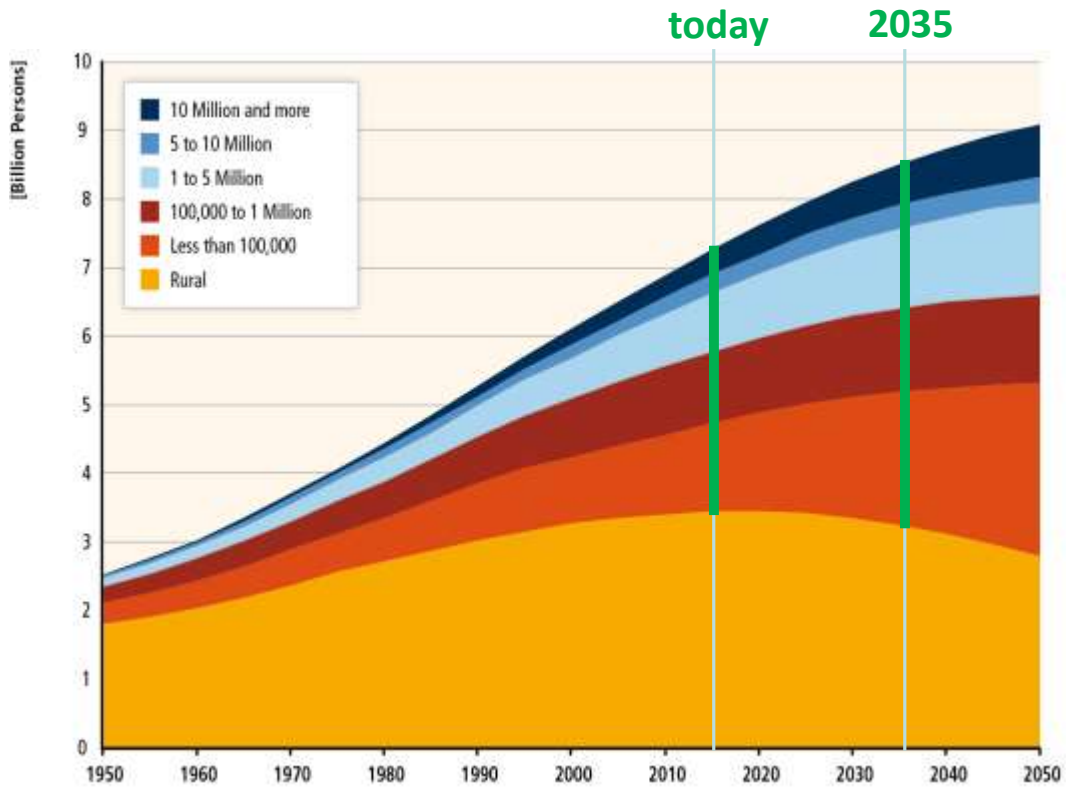
Accounting for indirect emissions has key implications on mitigation strategy!



Baseline Scenarios: Direct vs. Indirect Emission Accounting



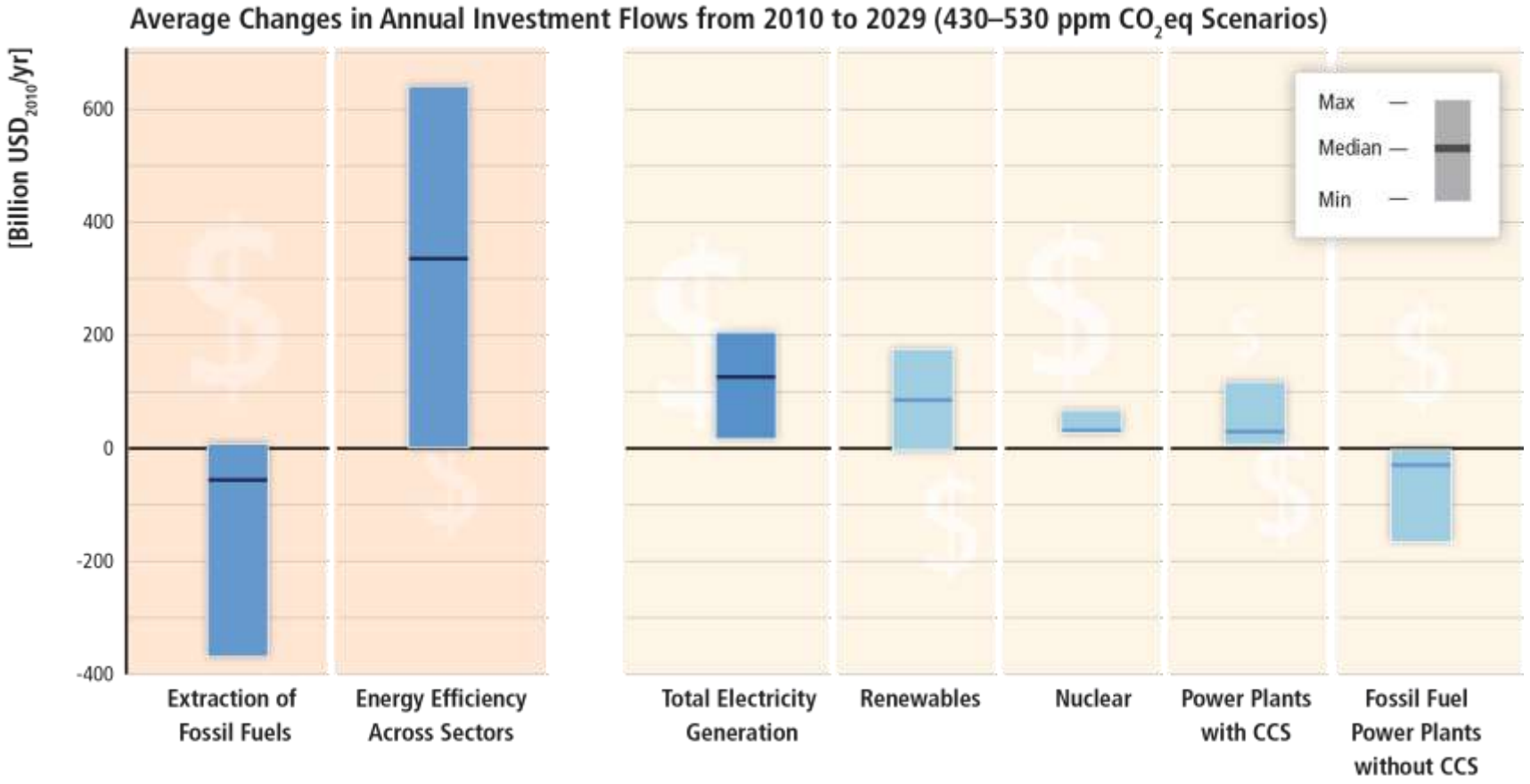
Source: Volker Krey, using IPCC AR5 Figure SPM.10,



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

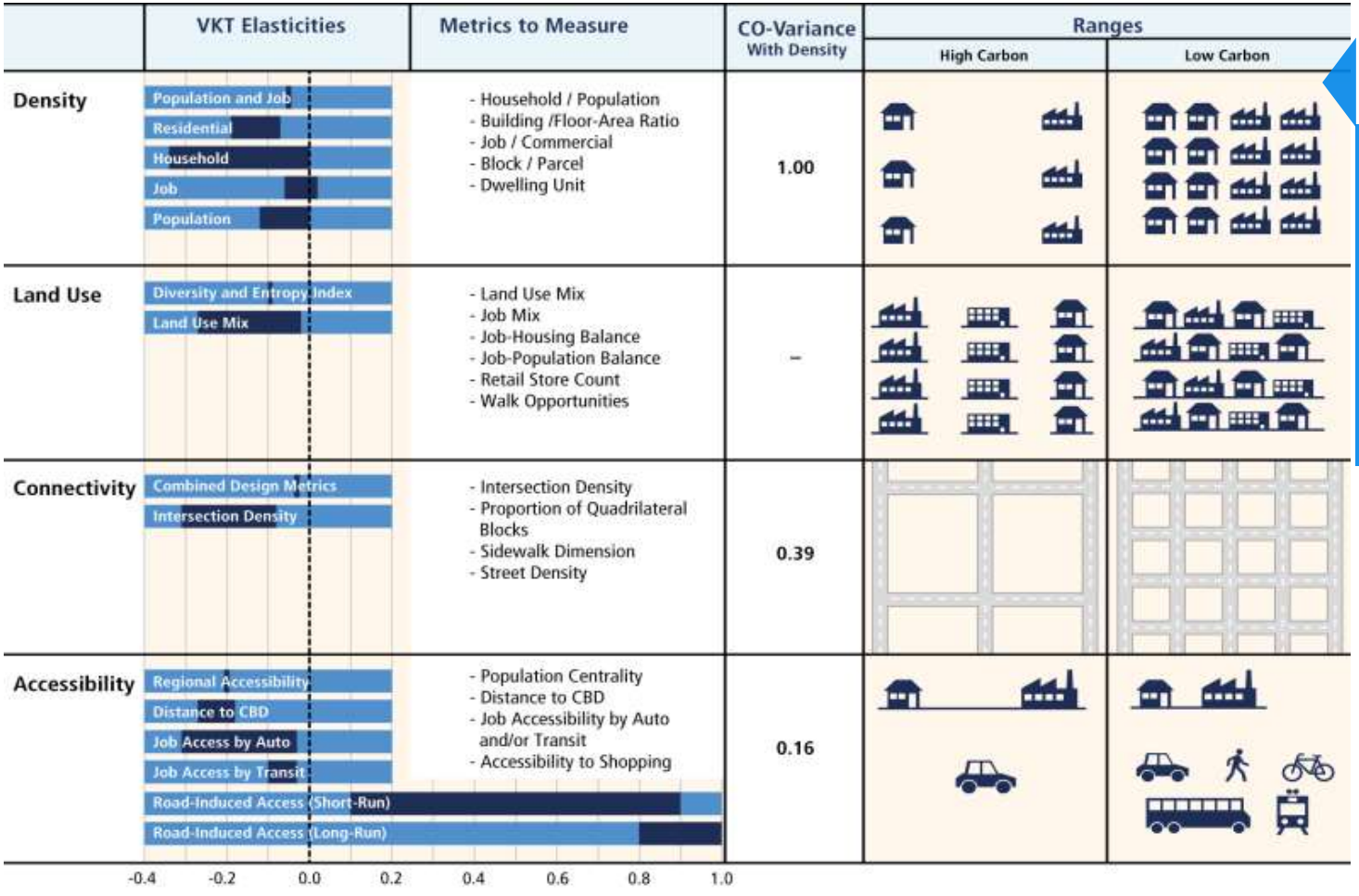
- Urban areas generate 80% of GDP and 71% - 76% of CO2 emissions from global energy use
- Each week the urban population increases by 1.3 million
- By 2050 urban population is to increase by up to 3 billion
- Over 70% of global building energy use increase will take place in developing country cities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

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



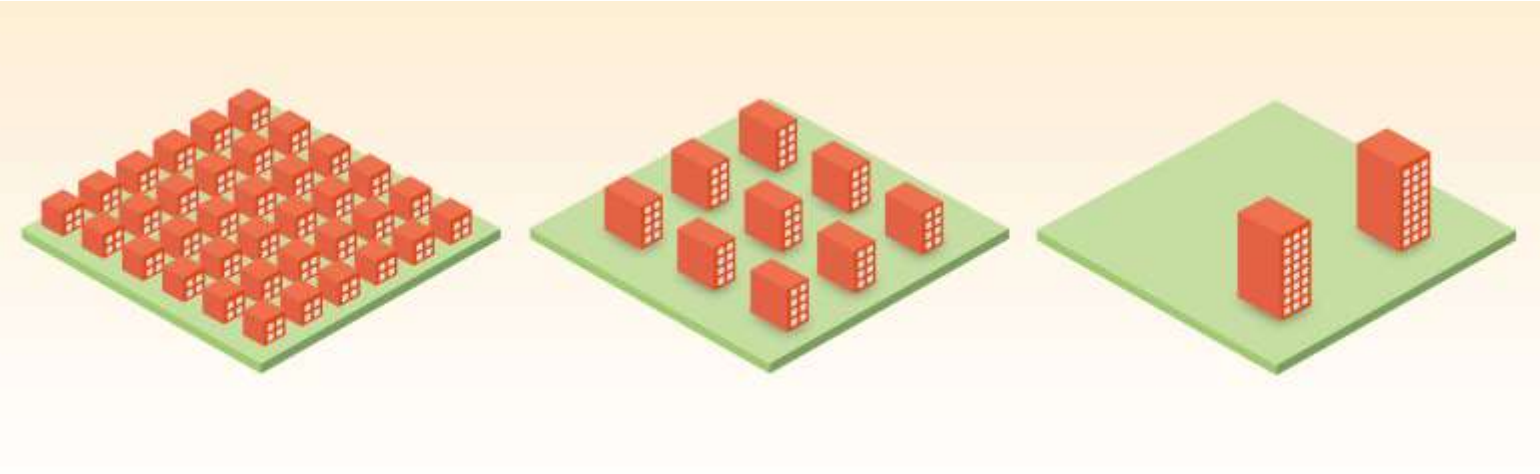
Based on Figure 16.3

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



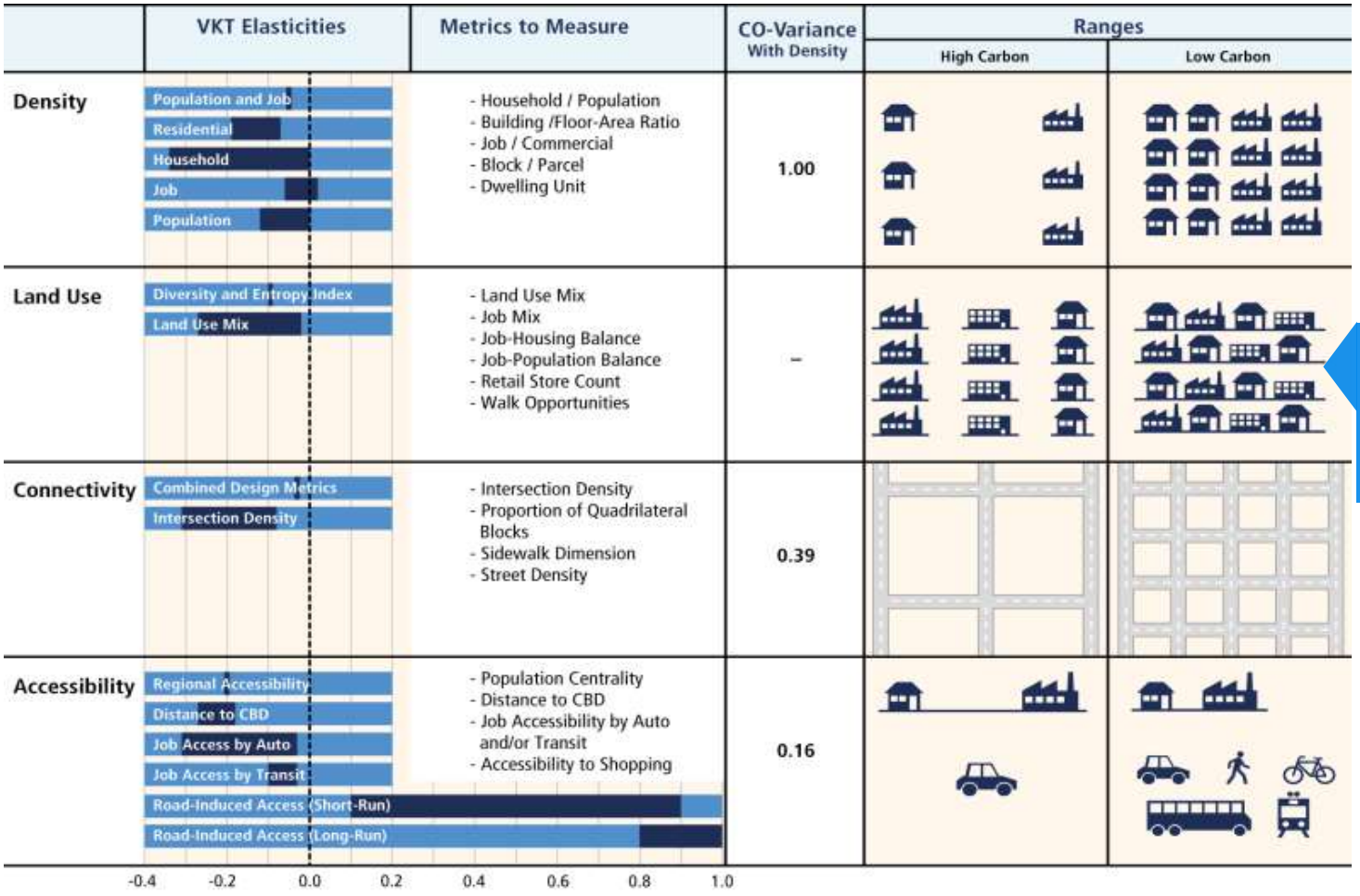
Higher density leads to less emissions (i.a. shorter distances travelled).

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



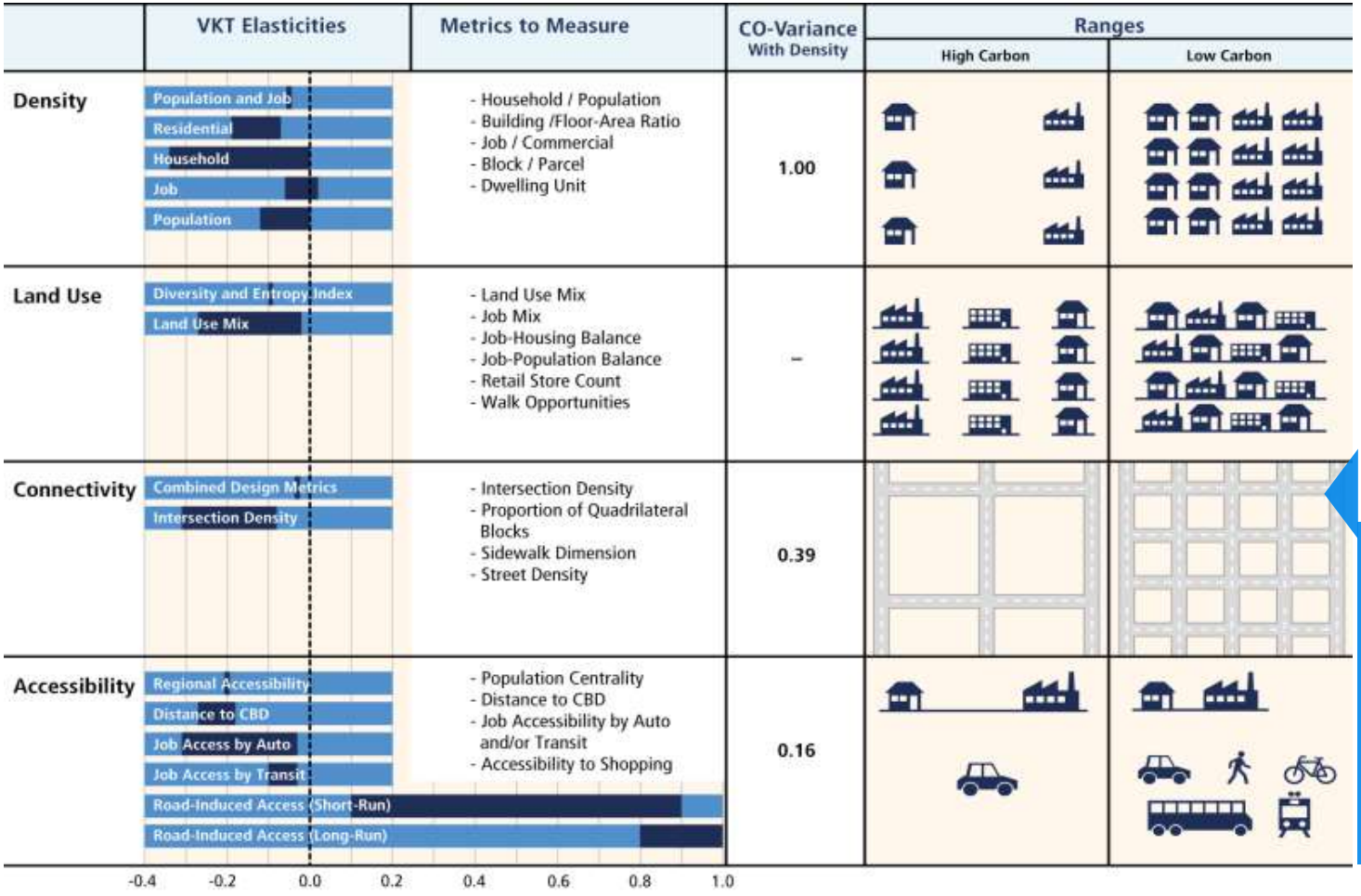
Working Group III contribution to the IPCC Fifth Assessment Report, courtesy of Karen Seto

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.

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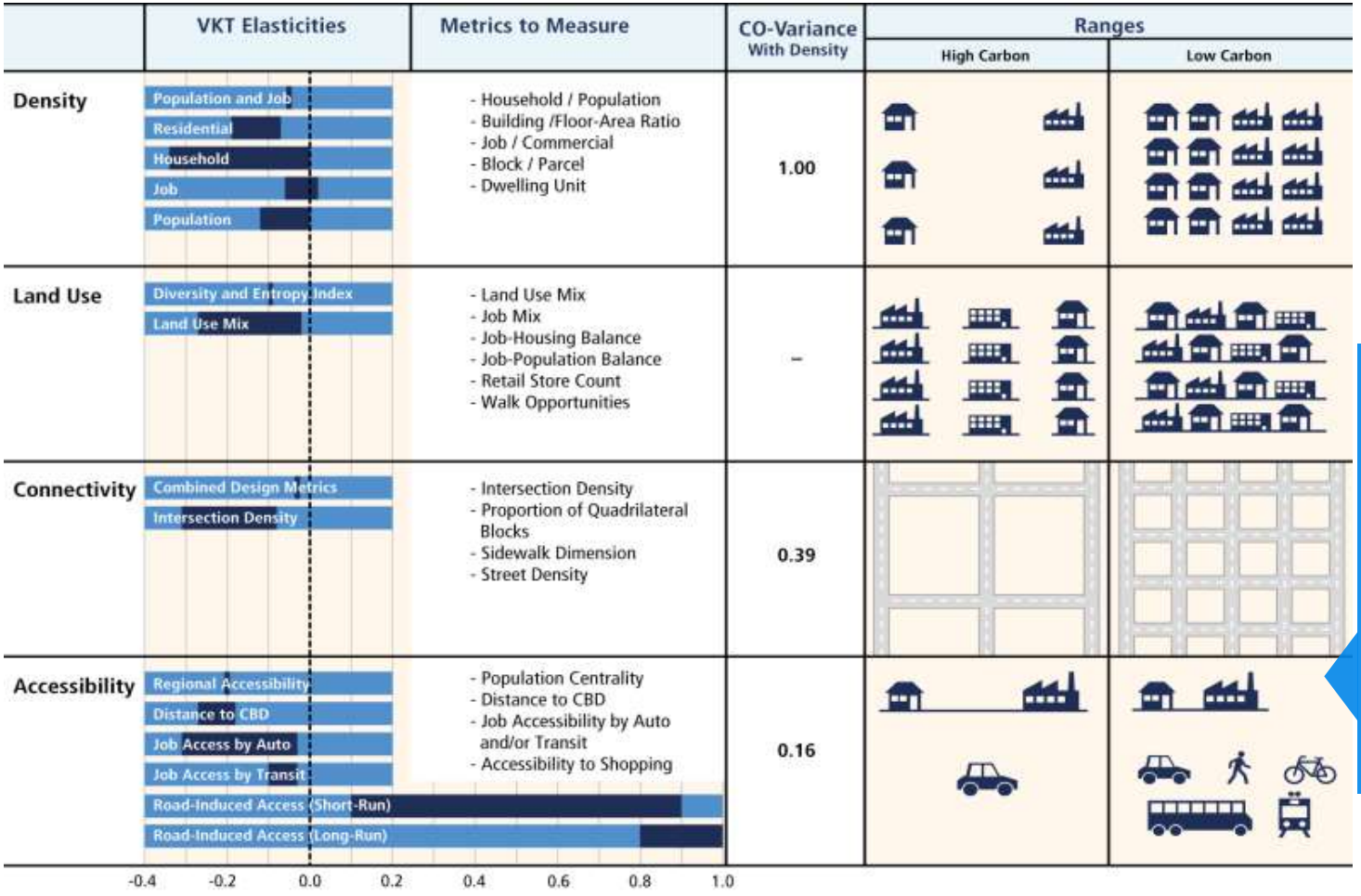
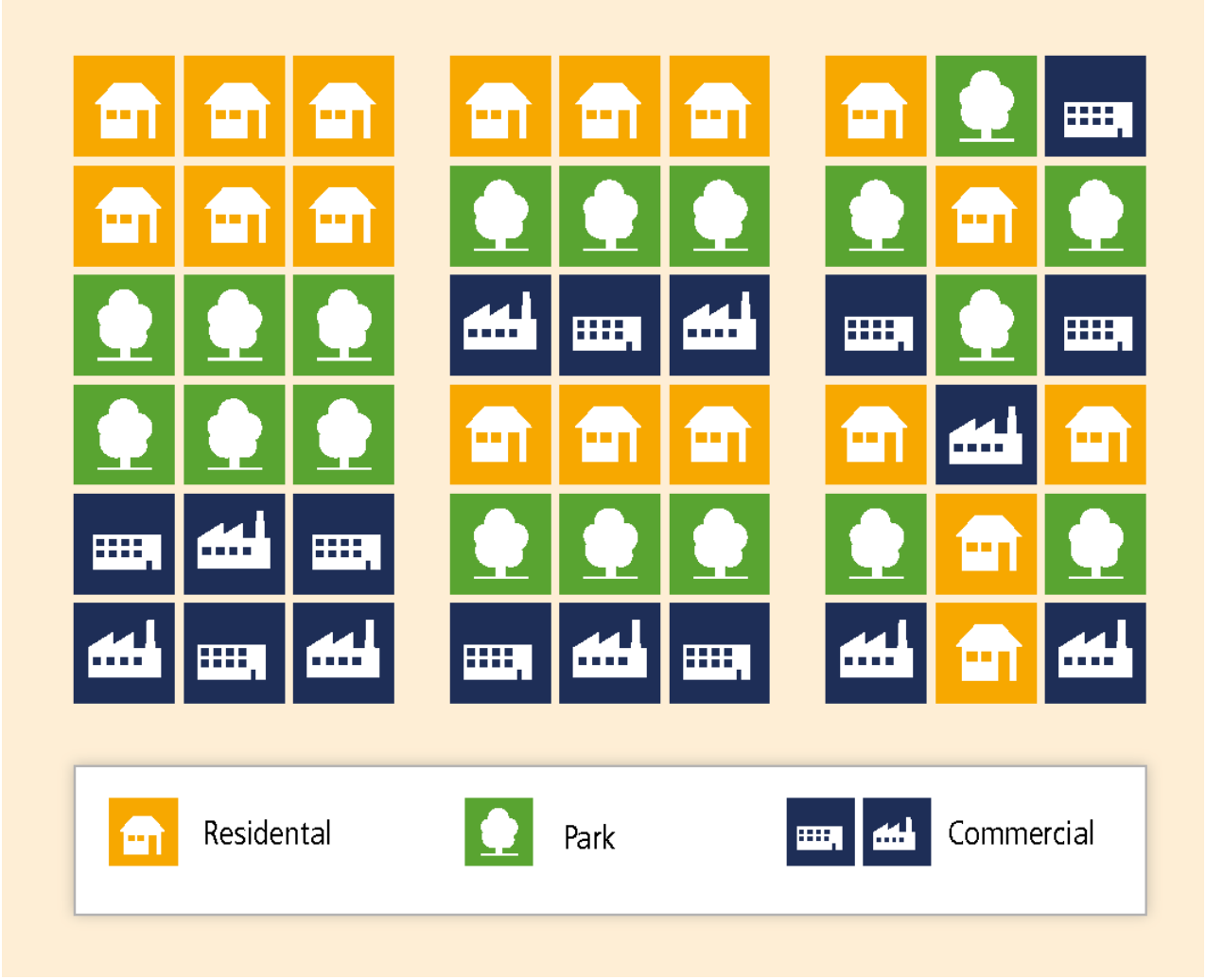
Co-location of activities reduces direct and indirect GHG emissions



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

To lower urban emissions, need diverse urban land use mix



60,000 Passive Houses exist in 28 European member countries

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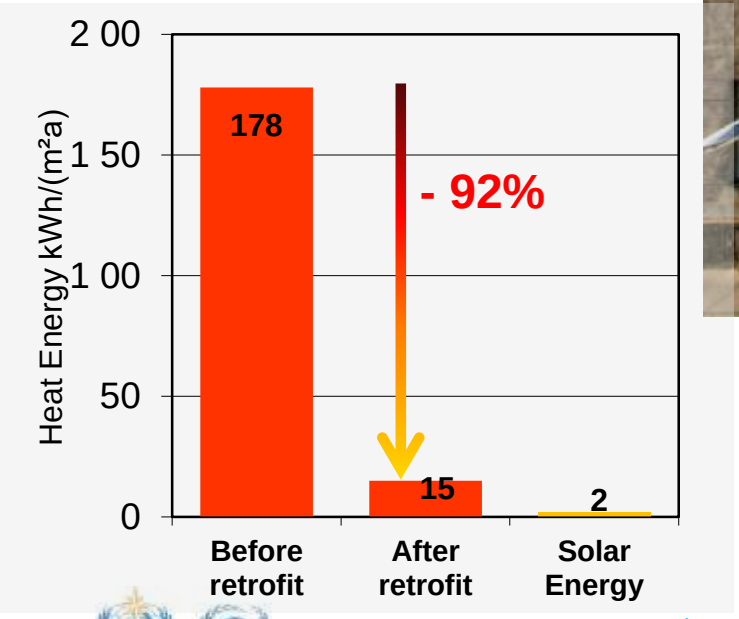
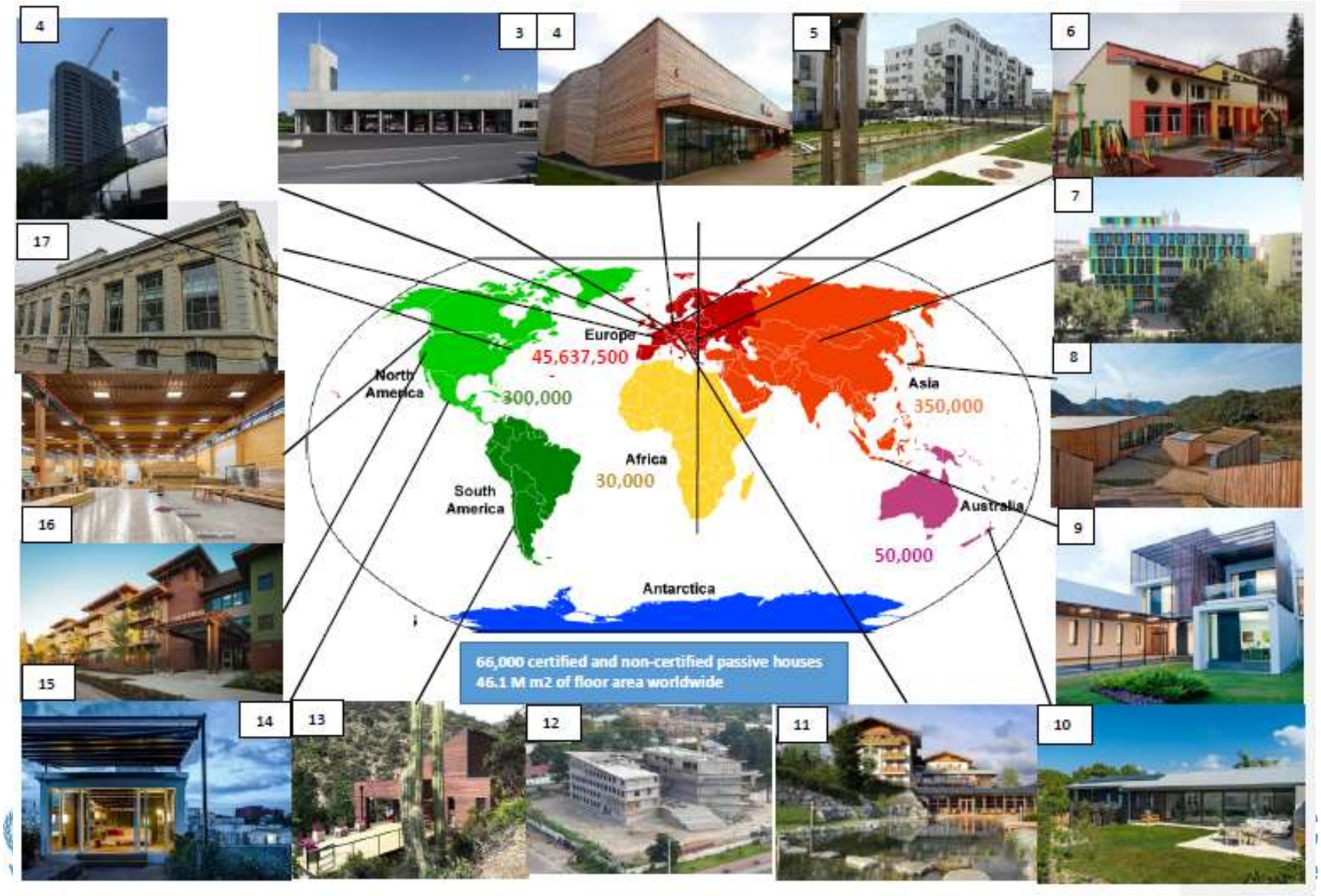


Gründerzeitbau 1020 Wien, Eberlgasse

Bauherr: Andreas Kronberger Unternehmensberatung
Bauphysik: Schöberl & Pöll GmbH

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

PASSIVHAUS Austria

PASSIVE HOUSE

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Passive House Institute

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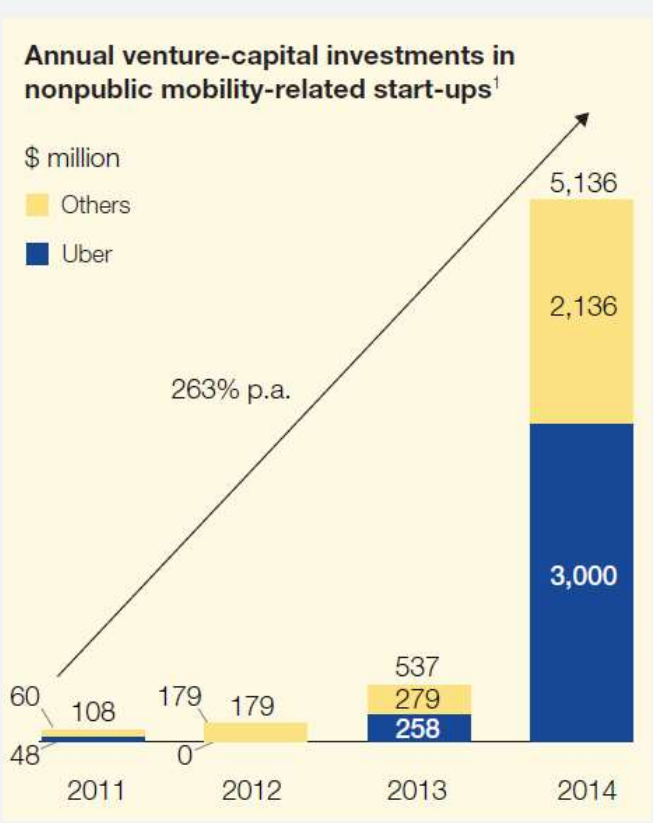
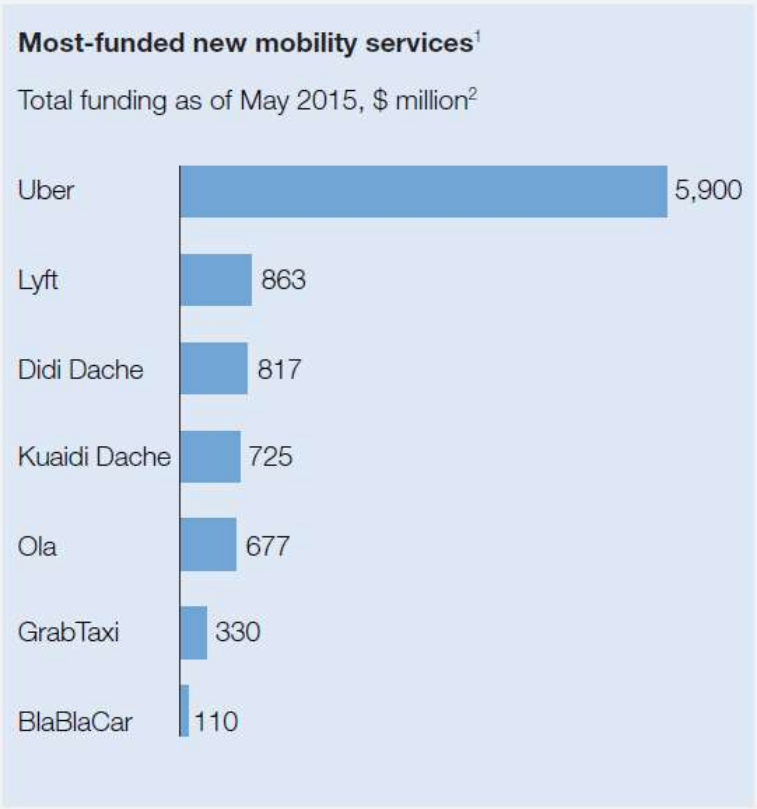
How mitigation options can go hand-in-hand with development goals (co-benefits)

- 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

TreEhugger daydream…?





[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

The technologies are available in all cities