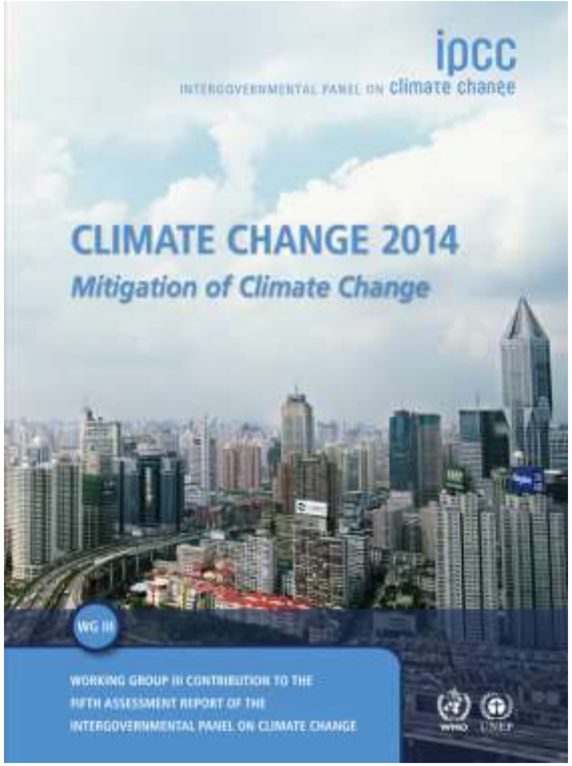
# **Human Settlements and Climate Change Mitigation:** *Key findings from AR5 WG3*

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# Chapter 12: Human Settlements, Infrastructure, and Spatial Planning → A new chapter in AR5

**2** Coordinating Lead Authors
**30** Authors
**2** Review Editors
**2** Chapter Science Assistants

More than **110** pages
Nearly **700** references
More than **3,000** comments

12

## Human Settlements, Infrastructure, and Spatial Planning

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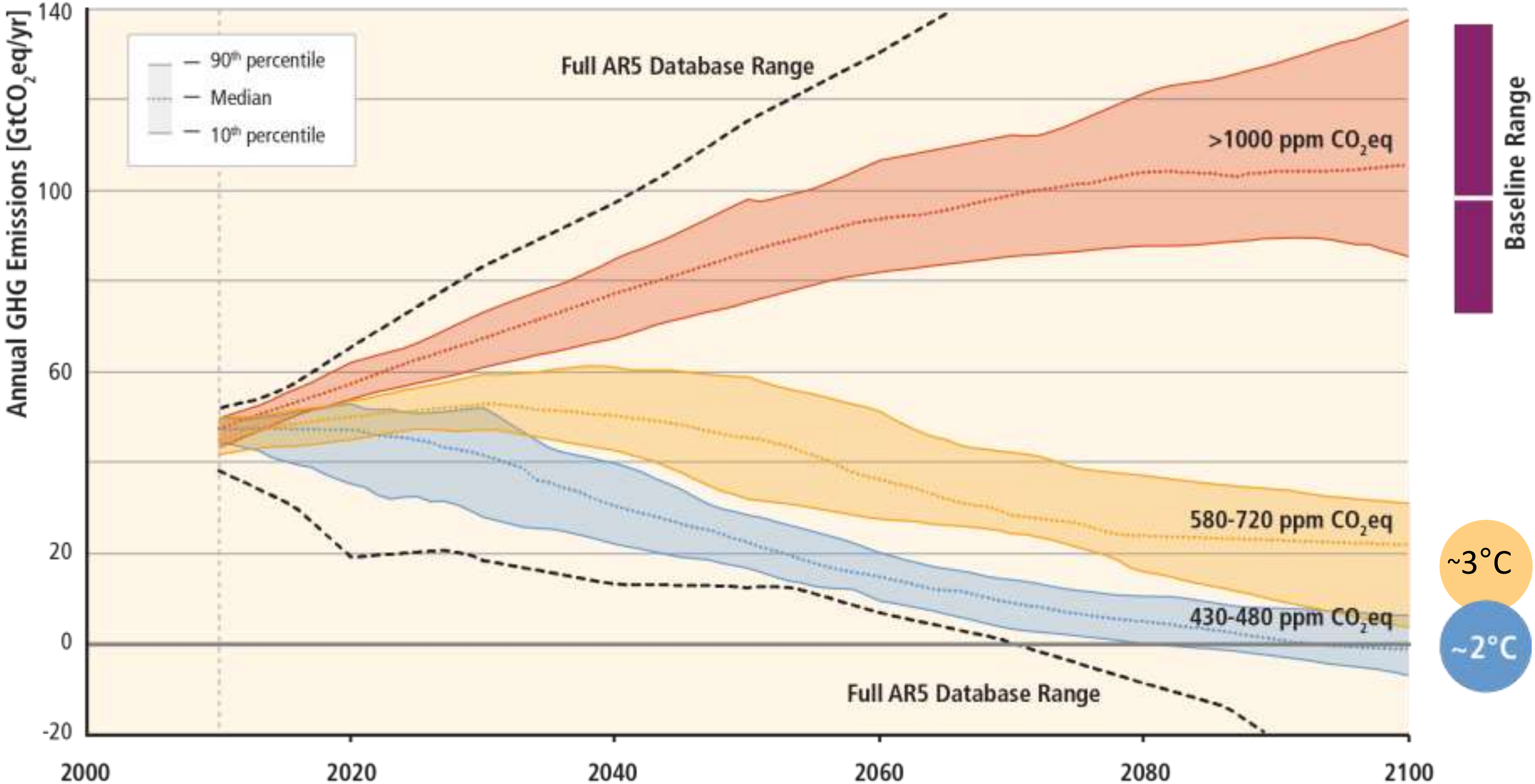
# Stabilization of atmospheric concentrations requires moving away from the baseline – regardless of the mitigation goal.

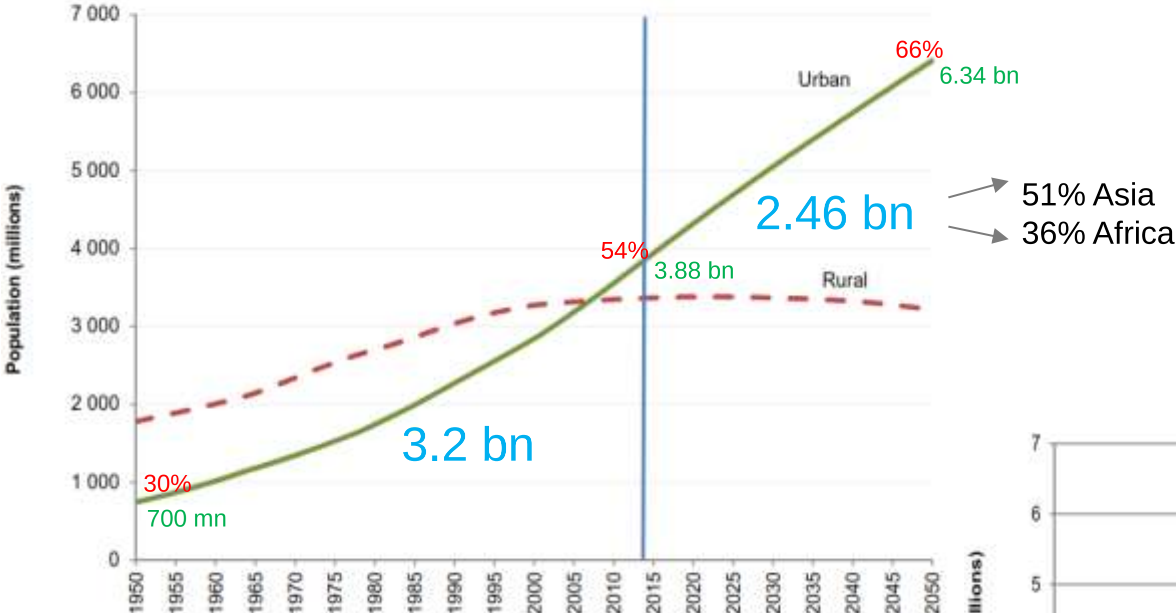



Based on Figure 6.7

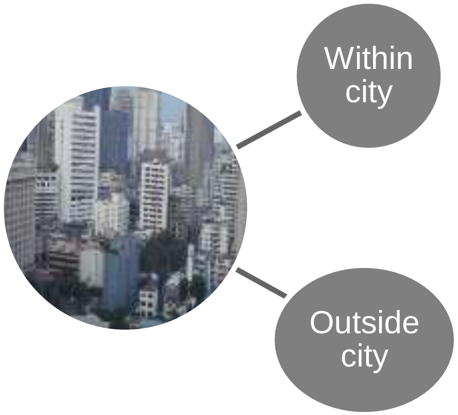
# Urbanisation

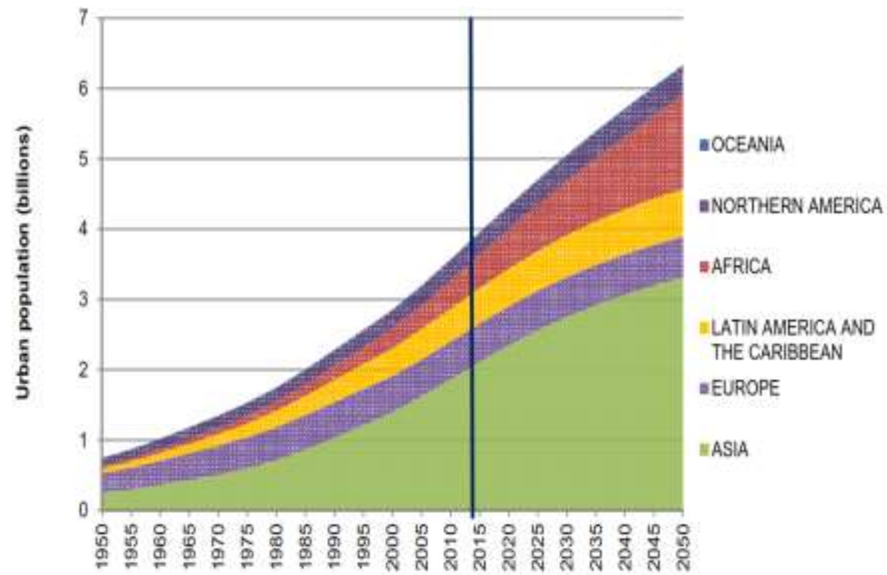
- **For most of human history:** The world population mostly lived in rural areas and in small urban settlements, and growth in global urban population occurred slowly
- **1800:** World population was around one billion, only 3% of the total population lived in urban areas and only one city—Beijing—had a population greater than one million (Davis, 1955; Chandler, 1987; Satterthwaite, 2007)
- **1900:** Global share of urban population 13%; **1950:** 29%
- **1960:** Global urban population surpassed one billion (UN DESA, 2012)
- It took only additional 26 years to reach two billion; time for additional billion is decreasing

# Global urbanization trends



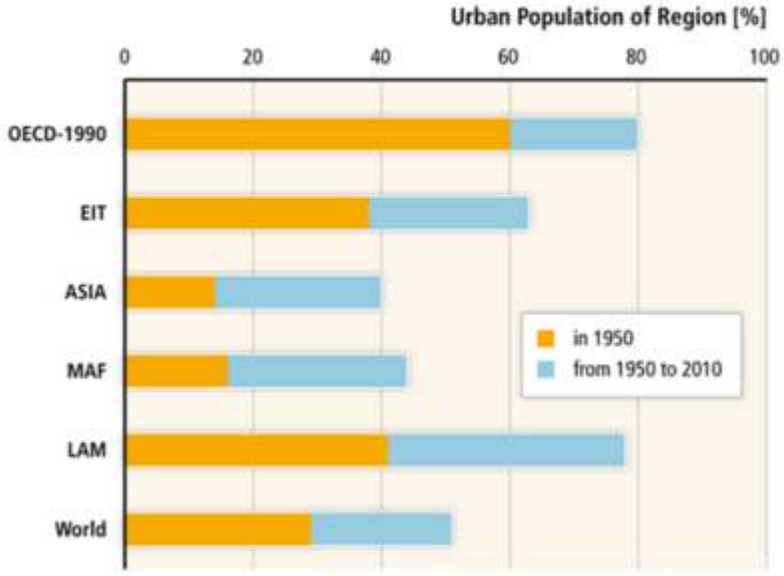

Source: UN DESA World Urbanization Prospects 2014
Schneider et al., 2009; Angel et al., 2011; Seto et al., 2011, 2012



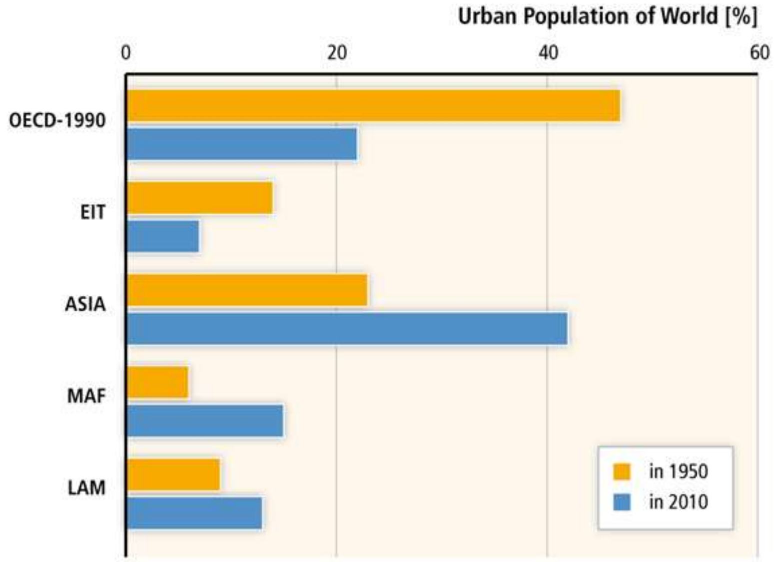




- Urban land could expand up-to 3 times in 2000-30
- 55% of global land in 2030 is expected to be developed in 2000-30
- Nearly half of the global growth in urban land is forecasted to occur in Asia; 55% of the regional growth to take place in China and India

# Urbanization is associated with increases in income and higher urban incomes correlated with higher energy and GHG emissions




*Urbanization rates in developed regions are higher compared to Asia and Africa, but developing regions are catching up*



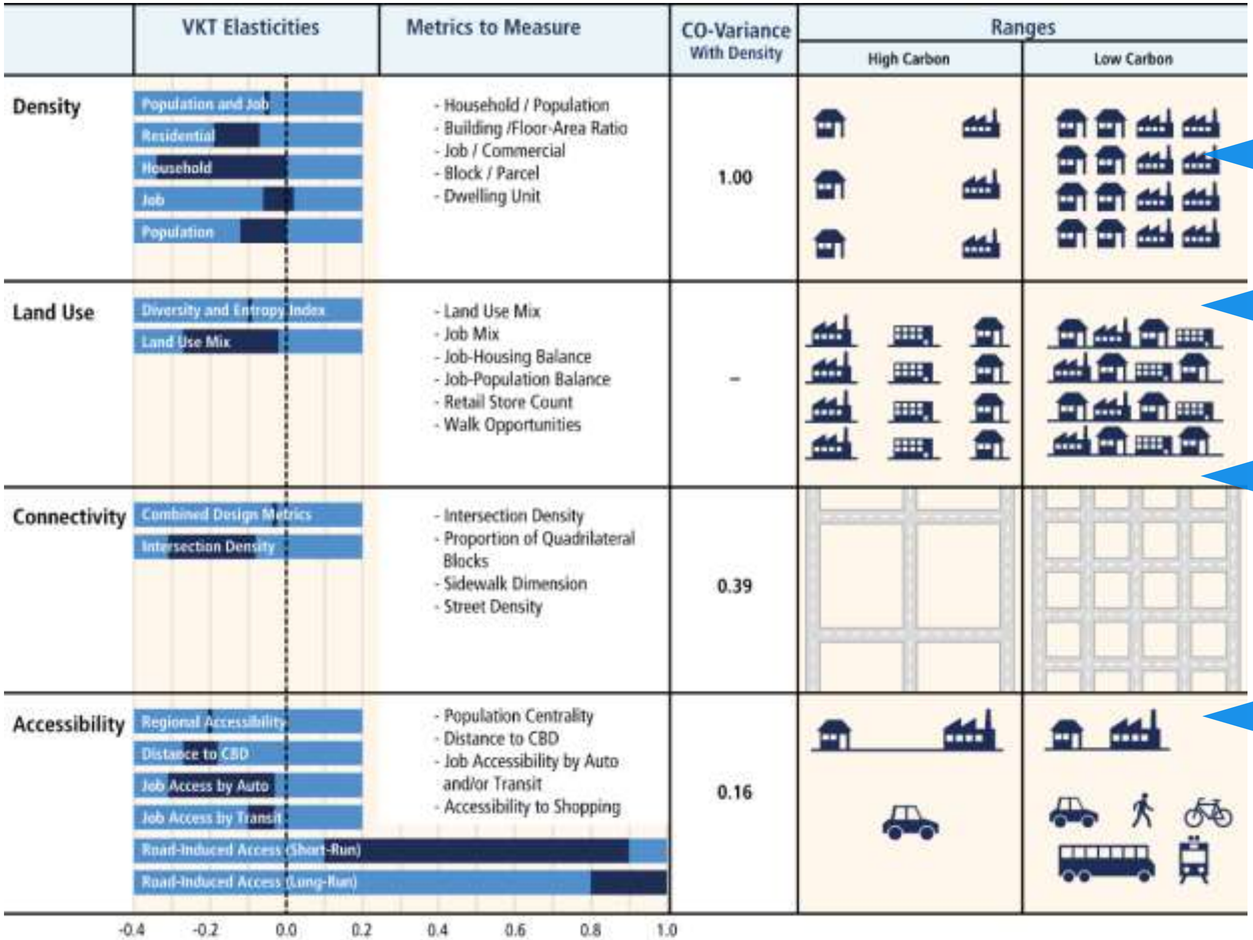

*The overall share of developed and developing regions in the global urban population have gone through a structural change in recent decades*

- **Urban areas account for between 71% and 76% of CO2 emissions from global final energy use and between 67-76% of global energy use**
- **Cities in non-Annex I countries have generally higher per capita final energy use and CO2 emissions than national averages**

# No single factor explains variations in per-capita emissions across cities, and there are significant differences within and across countries

- A variety of physical, economic, social factors, and urbanization histories specific to each city affect emissions
- Key factors include income, population dynamics, urban form, locational factors, economic structure, and market amongst others
- Key urban form drivers of energy and GHG emissions are density, land use mix, connectivity and accessibility
- A complex mix of drivers determines emissions

# Key drivers for emissions from urban form are density, land use, connectivity and accessibility




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

Mix of land-use reduces emissions.

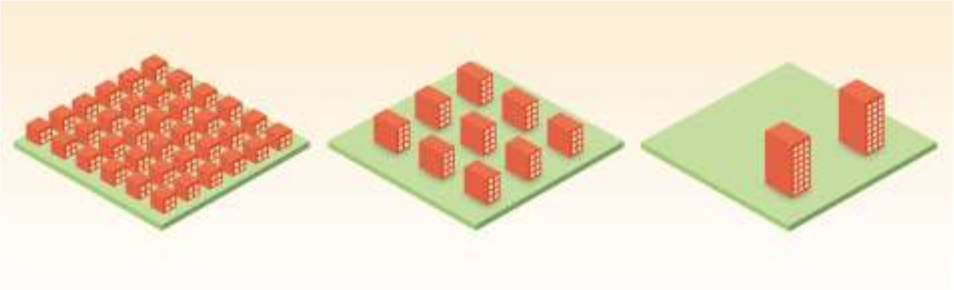
Improved connectivity through infrastructural density and design (e.g. streets) reduces emissions.

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

**Low carbon cities need to consider urban land use mix**

**Density is necessary but not sufficient condition for lowering urban emissions**


Manaugh and Kreider, 2013

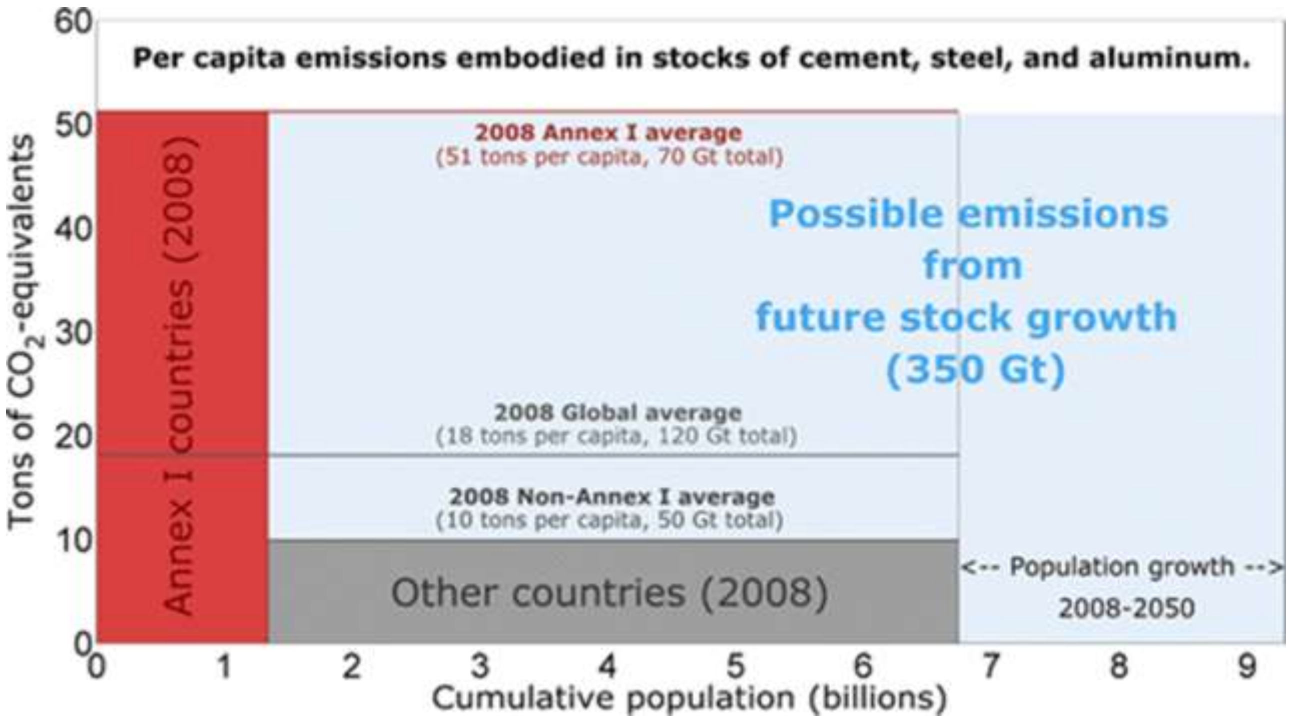


Adapted from (Cheng, 2009)

Mitigation options vary by urbanization trajectories and are expected to be most effective when policy instruments are bundled

- The existing infrastructure stock of the average Annex I resident
  - 3 times that of the world average
  - about 5 times higher than that of the average non-Annex I resident

- The build-up of massive infrastructure in developing countries will result in significant future emissions

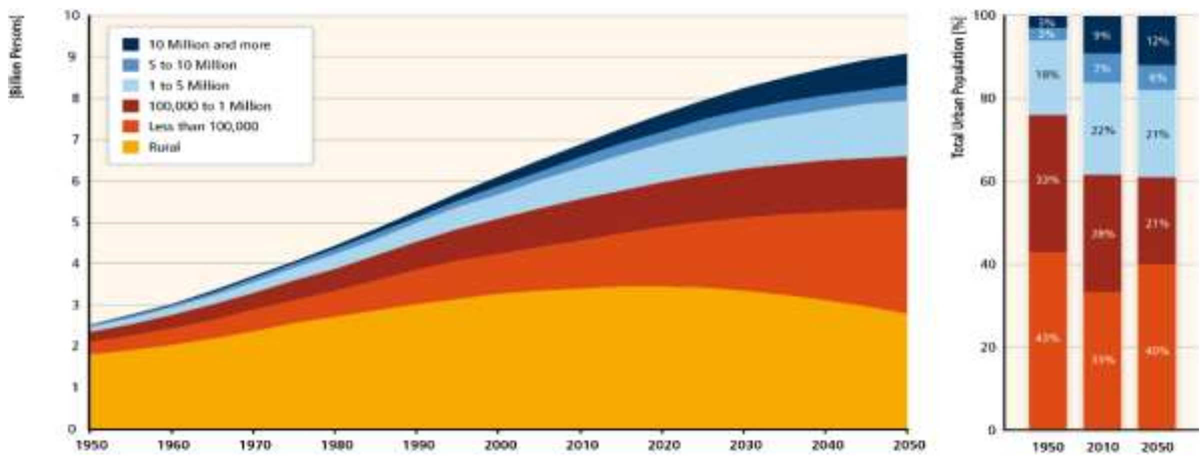





Müller et al., 2013

# The next two decades present a window of opportunity for mitigation as a large portion urban areas will be developed during this period.

- The kinds of towns, cities, and urban agglomerations that ultimately emerge over the coming decades will have a critical impact on energy use and carbon emissions



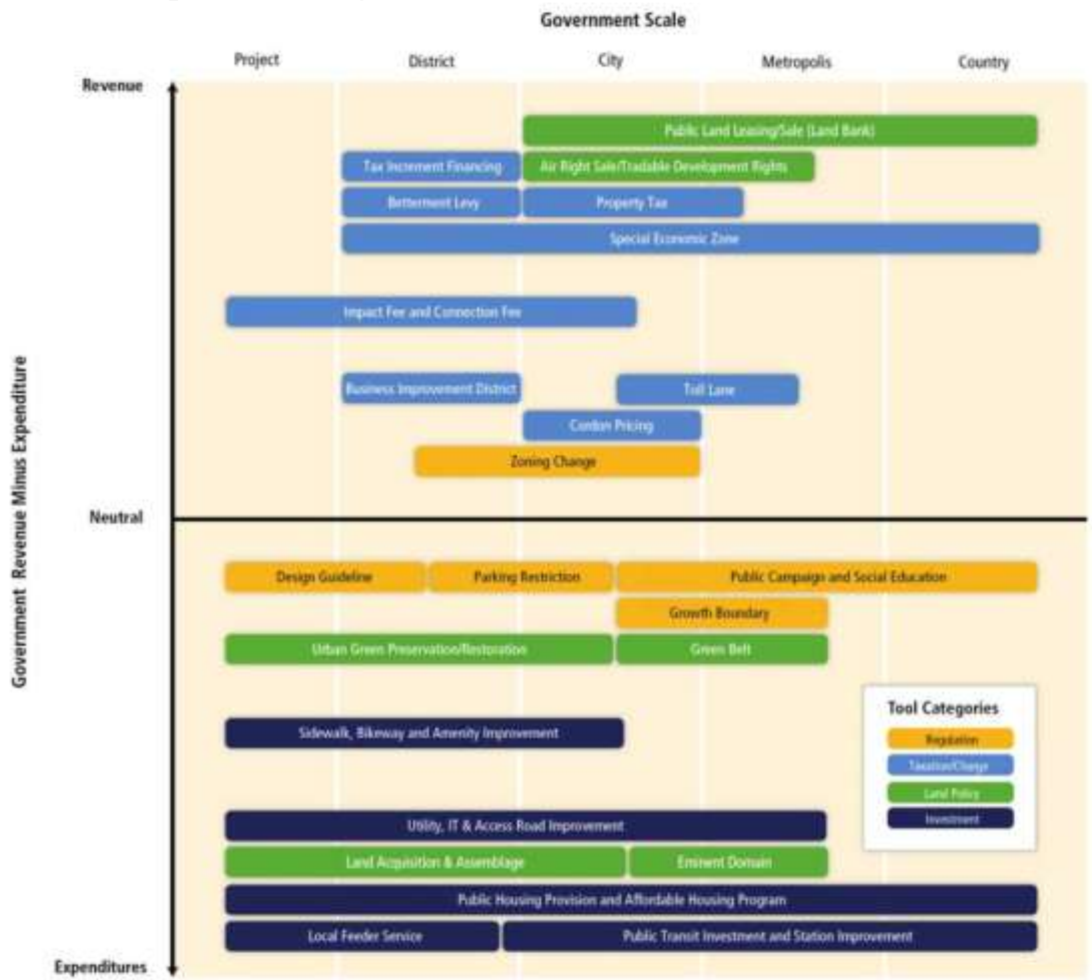

UN DESA, (2010), GEA (2012)

- **Two sources of emissions**: Construction of infrastructure and buildings, usage of infrastructure and buildings
- **Problem "Lock-in":** Long life of infrastructure and built environment determines energy and emissions pathways including lifestyles and consumption patterns

**The largest mitigation opportunities with respect to human settlements are in rapidly urbanizing areas with**

- **Small and mid-size cities**
- **Developing regions of the world**
- **Economical growing regions**
- **Infrastructure being built and yet not locked-in**

# The feasibility of spatial planning instruments for climate change mitigation is highly dependent on a city's financial and governance capability

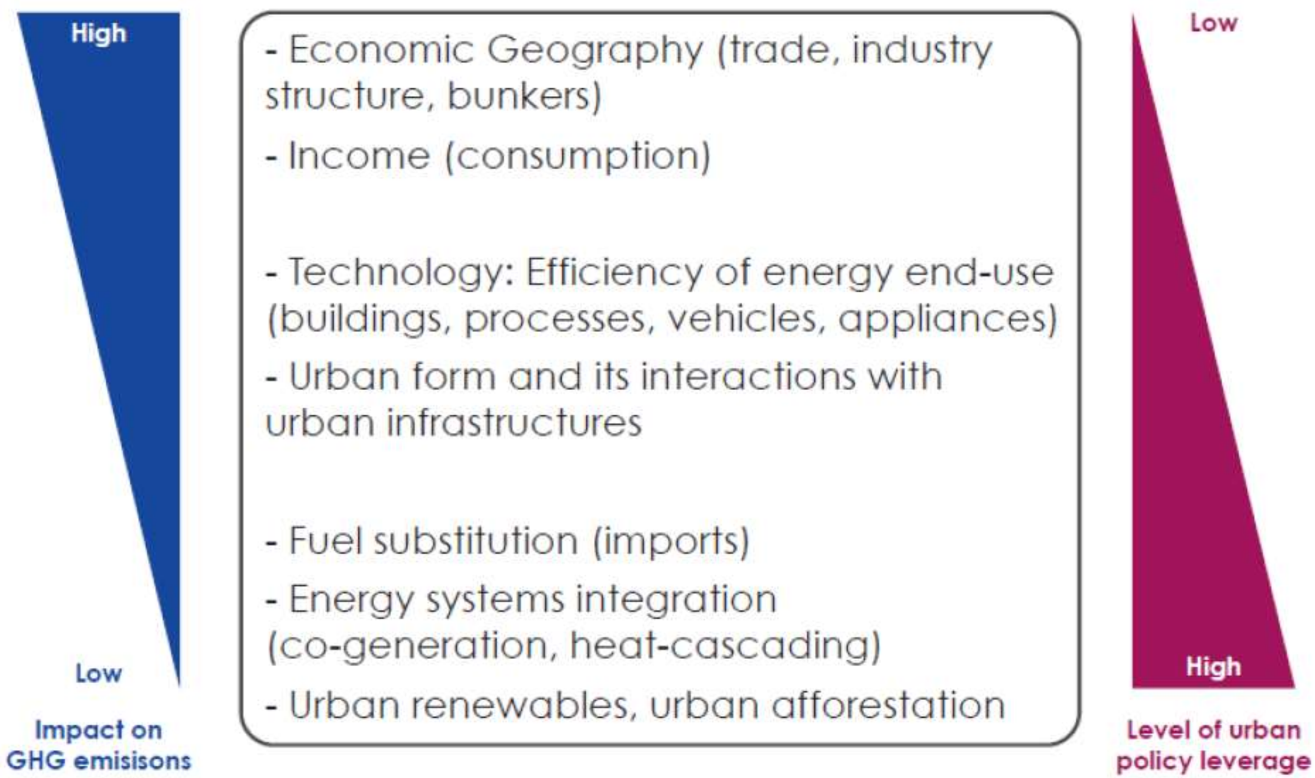





Sources: Bahl and Linn (1998); Bhatt (2011); Cervero (2004); Deng (2005); Fekade (2000); Rogers (1999); Hong and Needham (2007); Peterson (2009); Peyroux (2012); Sandroni (2010); Suzuki et al. (2013); Urban LandMark (2012); U.S. EPA (2013); Weitz (2003).

# In decisions making, the policy leverages do not often match with the largest mitigation opportunities

**Stylized Hierarchy of Urban Energy/GHG Drivers and Policy Leverages**




**Systemic changes have more mitigation opportunities but hindered by policy fragmentation**

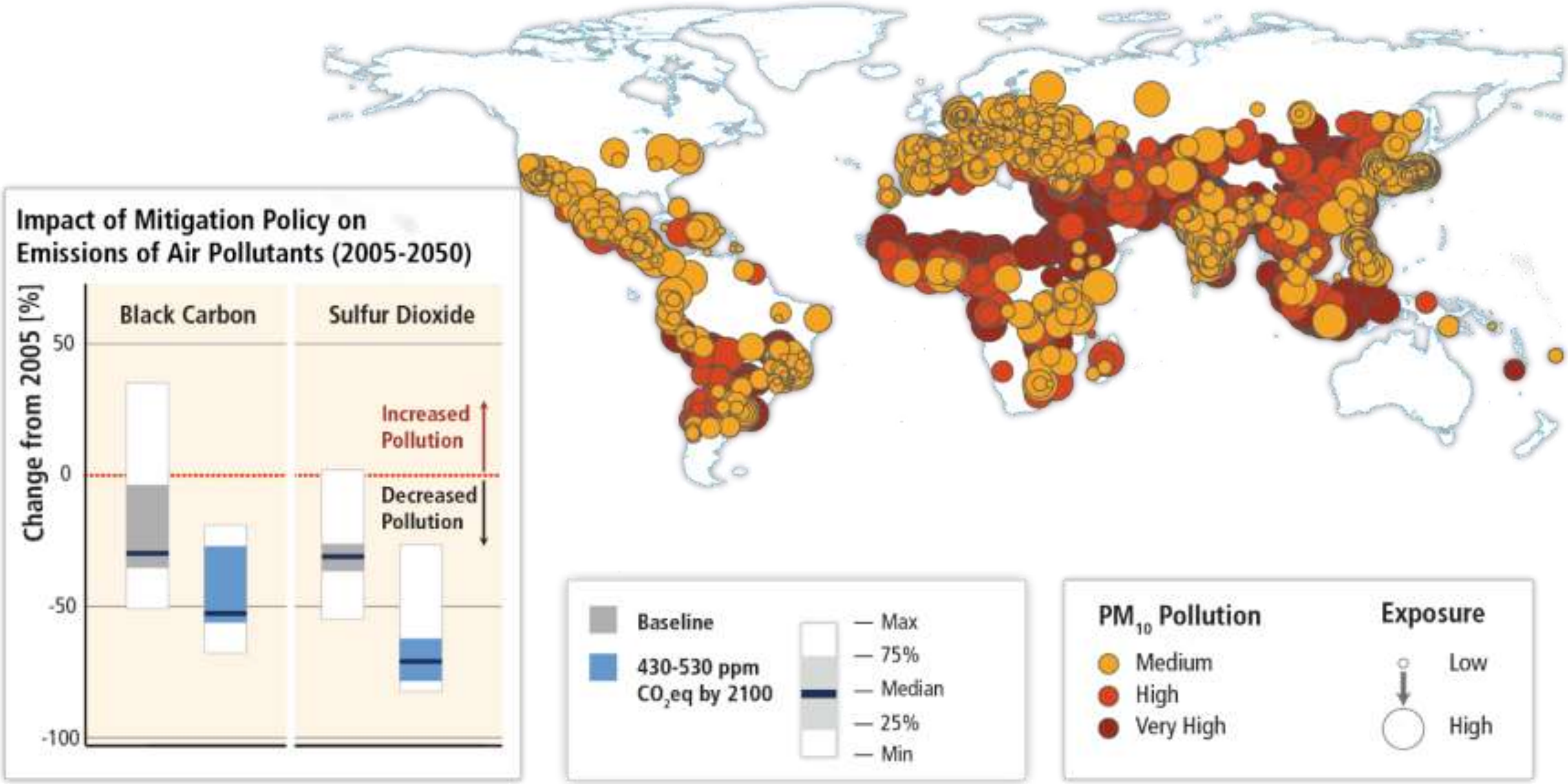
# Successful implementation of urban-scale climate change mitigation strategies can provide health, economic and air quality co-benefits

- Urban areas continue to struggle with challenges, including ensuring access to energy, limiting air and water pollution, and maintaining employment opportunities and competitiveness

- **Action on urban-scale mitigation often depends on the ability to relate climate change mitigation efforts to local co-benefits**

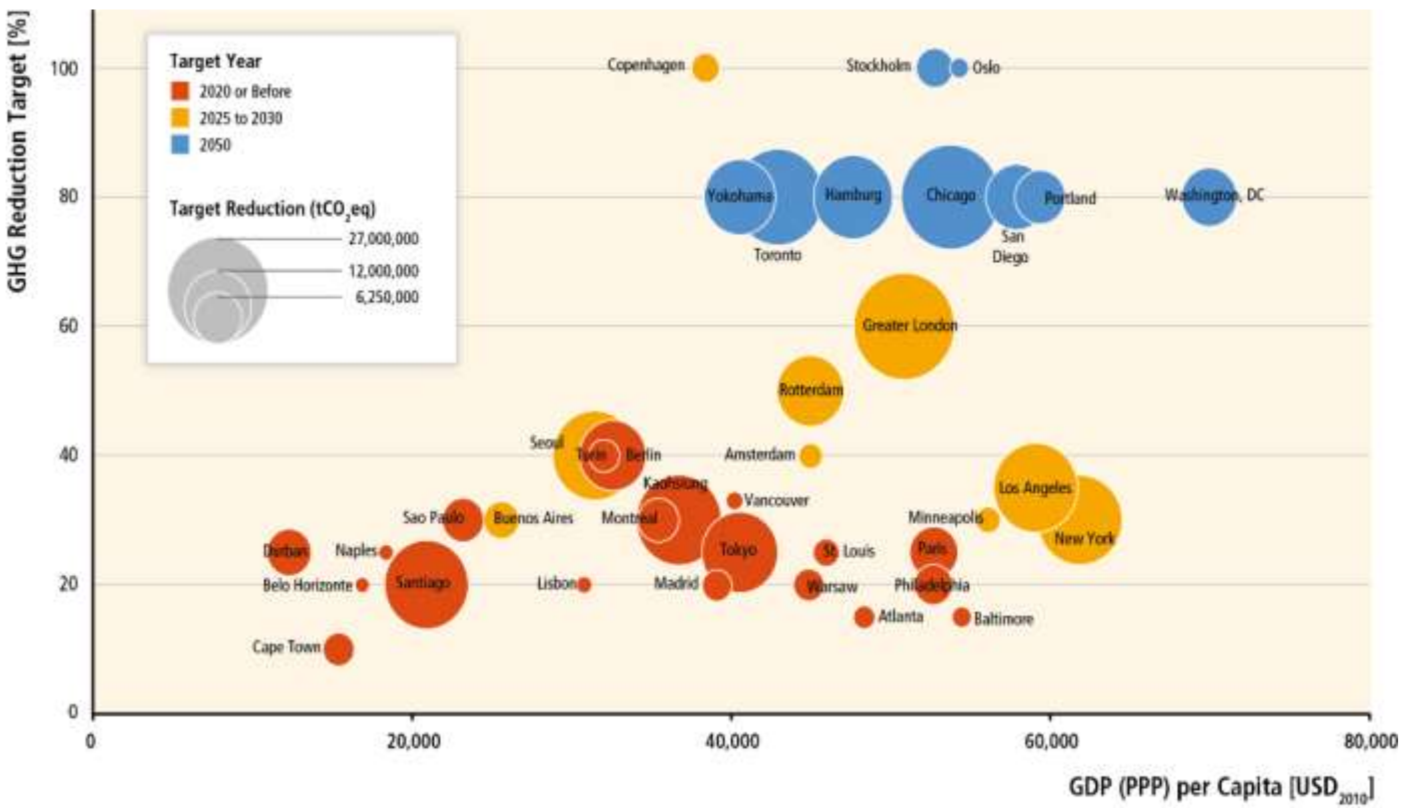
| Mitigation measures | Effect on additional objectives/concerns | | |
|---|---|---|---|
| | Economic | Social (including health) | Environmental |
| Compact development and infrastructure | ↑ Innovation and productivity[1]<br>↑↑ Higher rents & residential property values[2]<br>↑ Efficient resource use and delivery[5] | ↑ Health from physical activity[3] | ↑ Preservation of open space[4] |
| Increased accessibility | ↑ Commute savings[6] | ↑ Health from increased physical activity[3]<br>↑ Social interaction & mental health[7] | ↑ Air quality and reduced ecosystem/health impacts[8] |
| Mixed land use | ↑ Commute savings[6]<br>↑↑ Higher rents & residential property values[2] | ↑ Health from increased physical activity[3]<br>↑ Social interaction and mental health[7] | ↑ Air quality and reduced ecosystem/health impacts[8] |

# Mitigation can result in large co-benefits for human health and other societal goals.




Based on Figures 6.33 and 12.23

# Thousands of cities are undertaking Climate Action Plans and mitigation commitments




- Little systematic assessment on their level of implementation & the extent to which reduction targets are being achieved
- Focused largely on energy efficiency
- Limited consideration to land-use planning strategies and other cross-sectoral, cross boundary measures

**Yet, their aggregate impact on urban emissions is uncertain**

# ‘Governance paradox’ and need for a comprehensive approach

- ‘Systemic changes’ in urban areas have large mitigation opportunities but hindered by current patterns of urban governance, policy leverages and persisting policy fragmentation
- Governance and institutional capacity are scale and income dependent, i.e., tend to be weaker in smaller scale cities and in low income/revenue settings
  - However, the bulk of urban growth momentum is expected to unfold in small- to medium-size cities in non-Annex-I countries
  - The largest opportunities for GHG emission reduction might be precisely in urban areas where governance and institutional capacities to address them are weakest
- The feasibility of spatial planning instruments for climate change mitigation is highly dependent on a city’s financial and governance capability
- For designing and implementing climate policies effectively, institutional arrangements, governance mechanisms, and financial resources all should be aligned with the goals of reducing urban GHG emissions

# Knowledge gaps

1. Lack of consistent and comparable emissions and driver data at local scales
2. Little scientific understanding of the magnitude of the emissions reduction from altering urban form, and the emissions savings from integrated infrastructure and land use planning.
3. Lack of consistency and thus comparability on local emissions and accounting methods- and realistically comparing low carbon cities
4. Few evaluations of urban climate action plans and their effectiveness.
5. Lack of scientific understanding of how cities can prioritize climate change mitigation strategies, local actions, investments, and policy responses that are locally relevant for different city typologies
6. Large uncertainties as to how urban areas will develop in the future and implications of or opportunities for multiple pathways

For further information

www.mitigation2014.org

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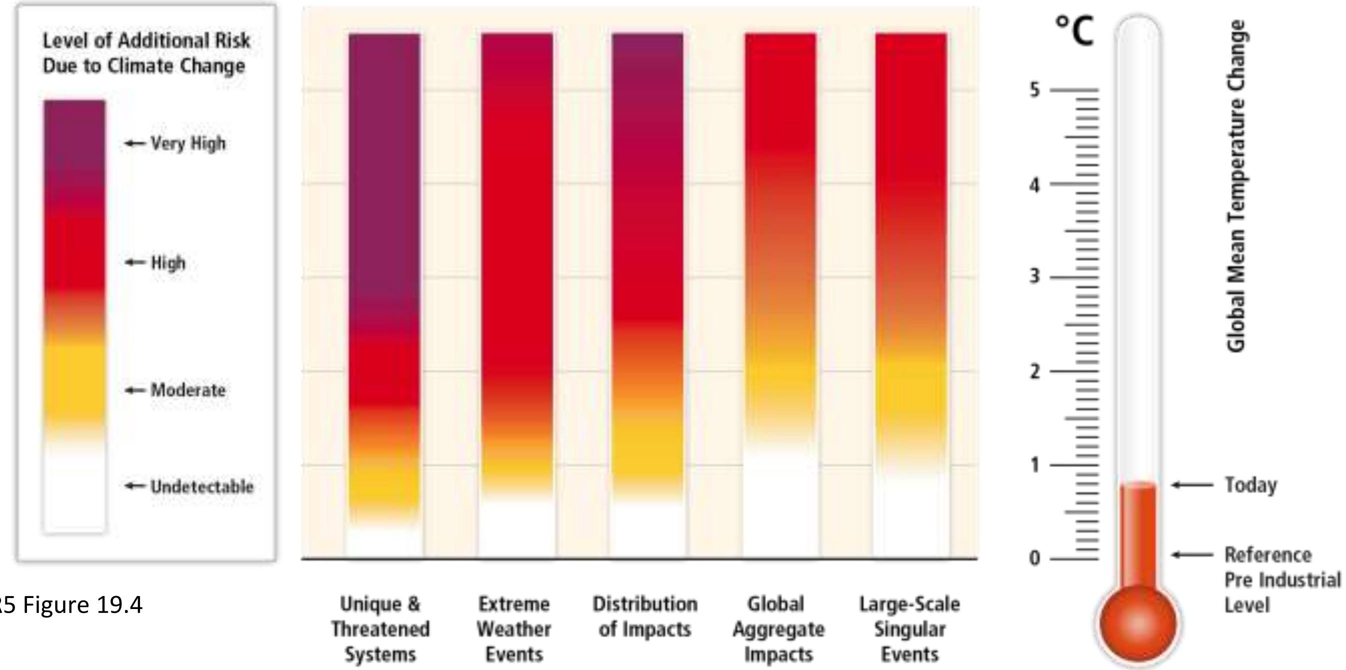
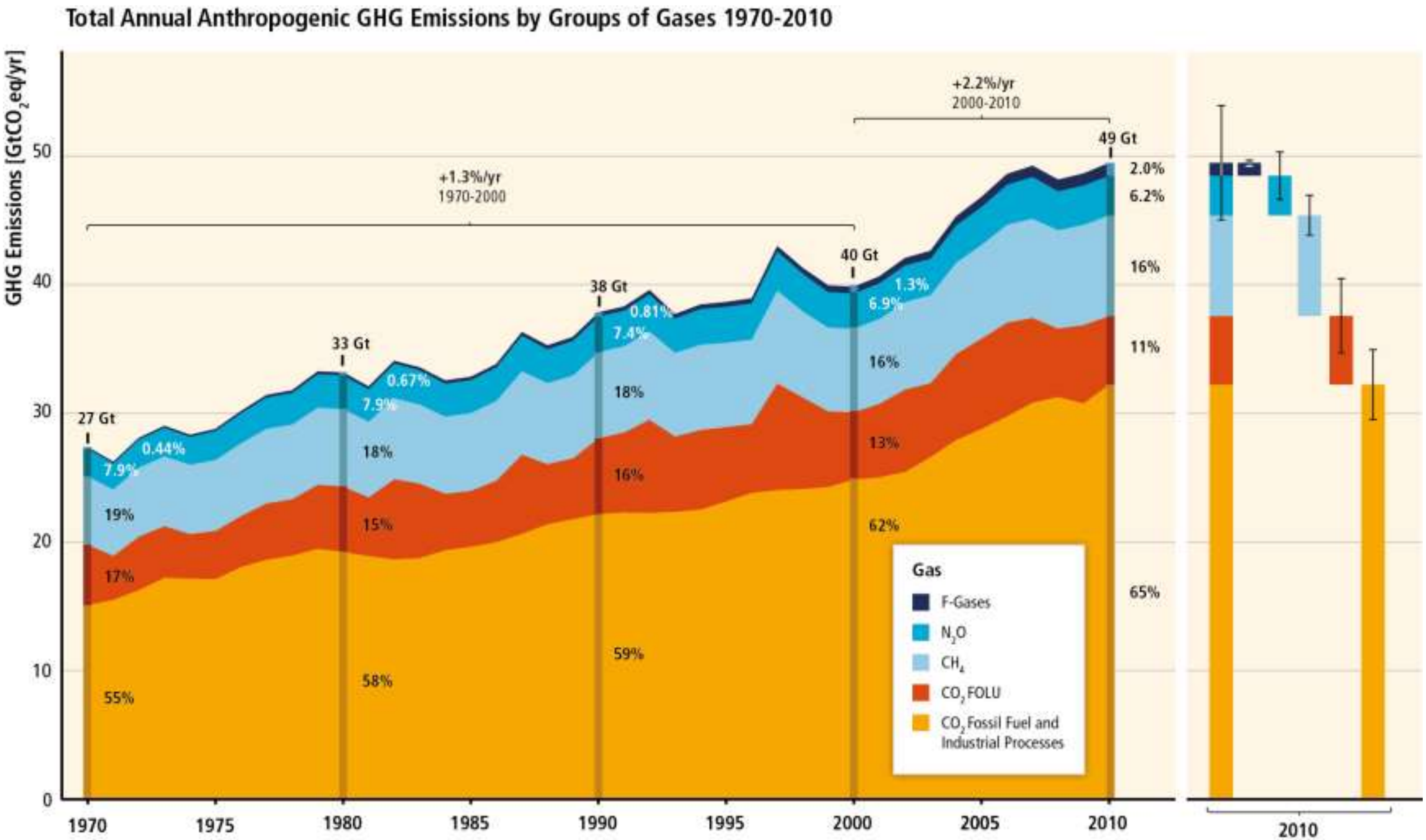
# Without additional mitigation, global mean surface temperature is projected to increase by 3.7 to 4.8°C over the 21st century.




Based on WGII AR5 Figure 19.4

- Increase the likelihood of severe, pervasive, and challenging impacts
- Potential adverse impacts on agricultural production, extensive ecosystem impacts, and increasing species extinction risk (high confidence), possible crossing of thresholds that lead to disproportionately large earth system responses (low confidence)

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

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Working Group III contribution to the
IPCC Fifth Assessment Report

INTERGOVERNMENTAL PANEL ON climate change