

# CLIMATE CHANGE 2014

## *Mitigation of Climate Change*

**Igor Bashmakov**

CLA, Chapter 7, WGIII, IPCC  
Center for Energy Efficiency

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1 Summary for Policymakers

1 Technical Summary

16 Chapters

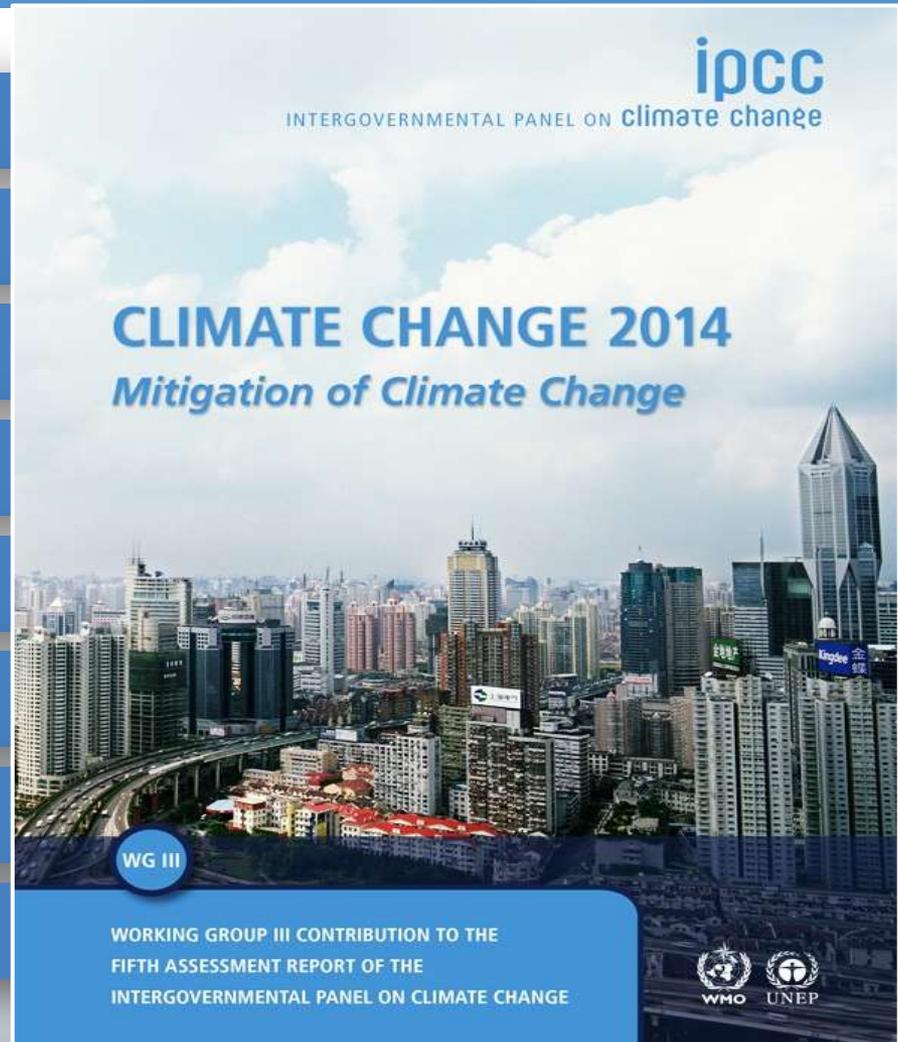
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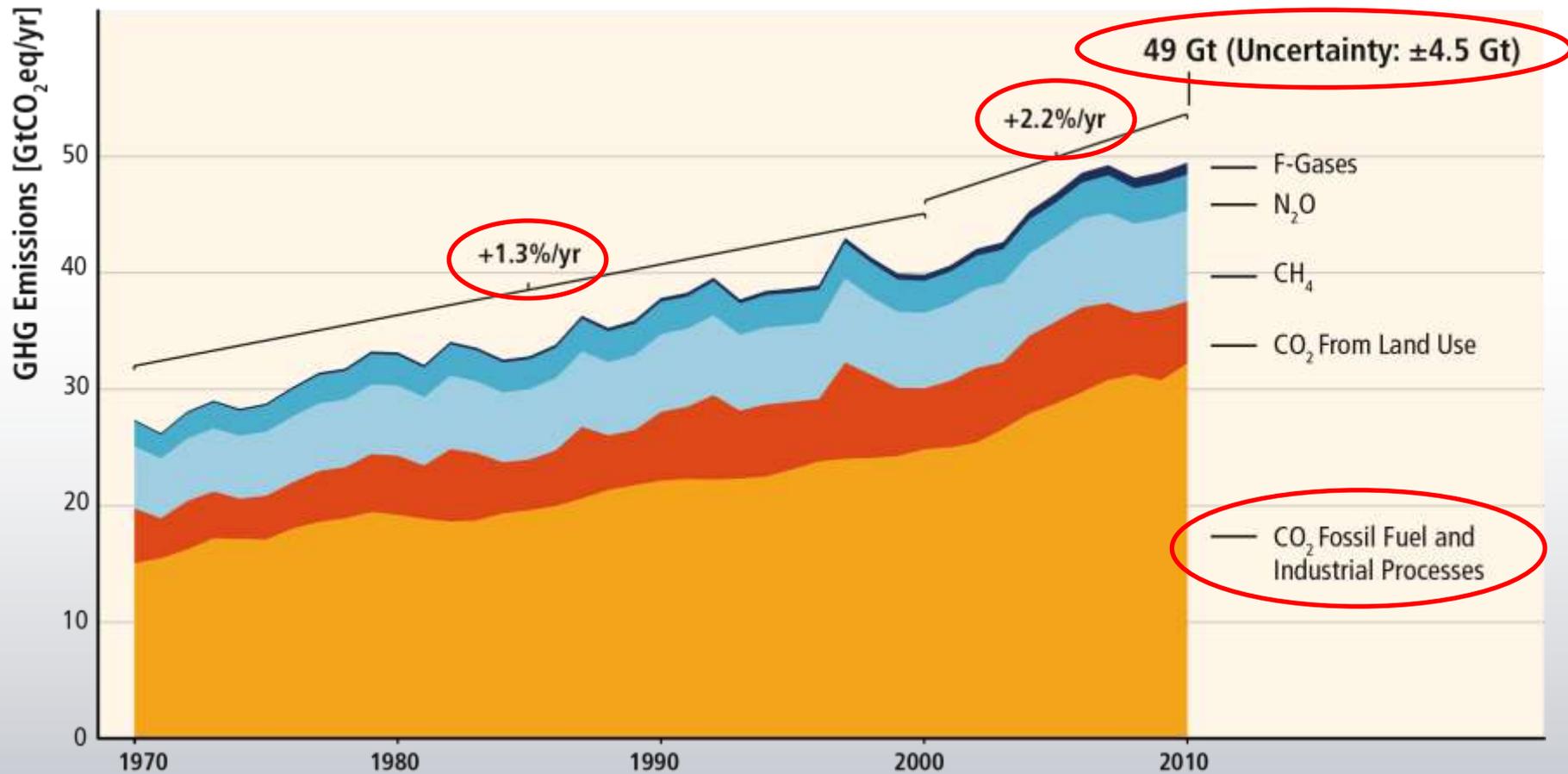
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A yellow bulldozer is shown from a high-angle perspective, working on a large pile of earth or sand. The bulldozer is positioned in the upper right quadrant of the frame, with its blade lowered. In the foreground, a wooden structure, possibly a conveyor belt or a walkway, is visible, extending from the bottom left towards the center. The overall scene is dimly lit, with a blueish tint, suggesting an indoor or nighttime setting. The text is overlaid in the center of the image.

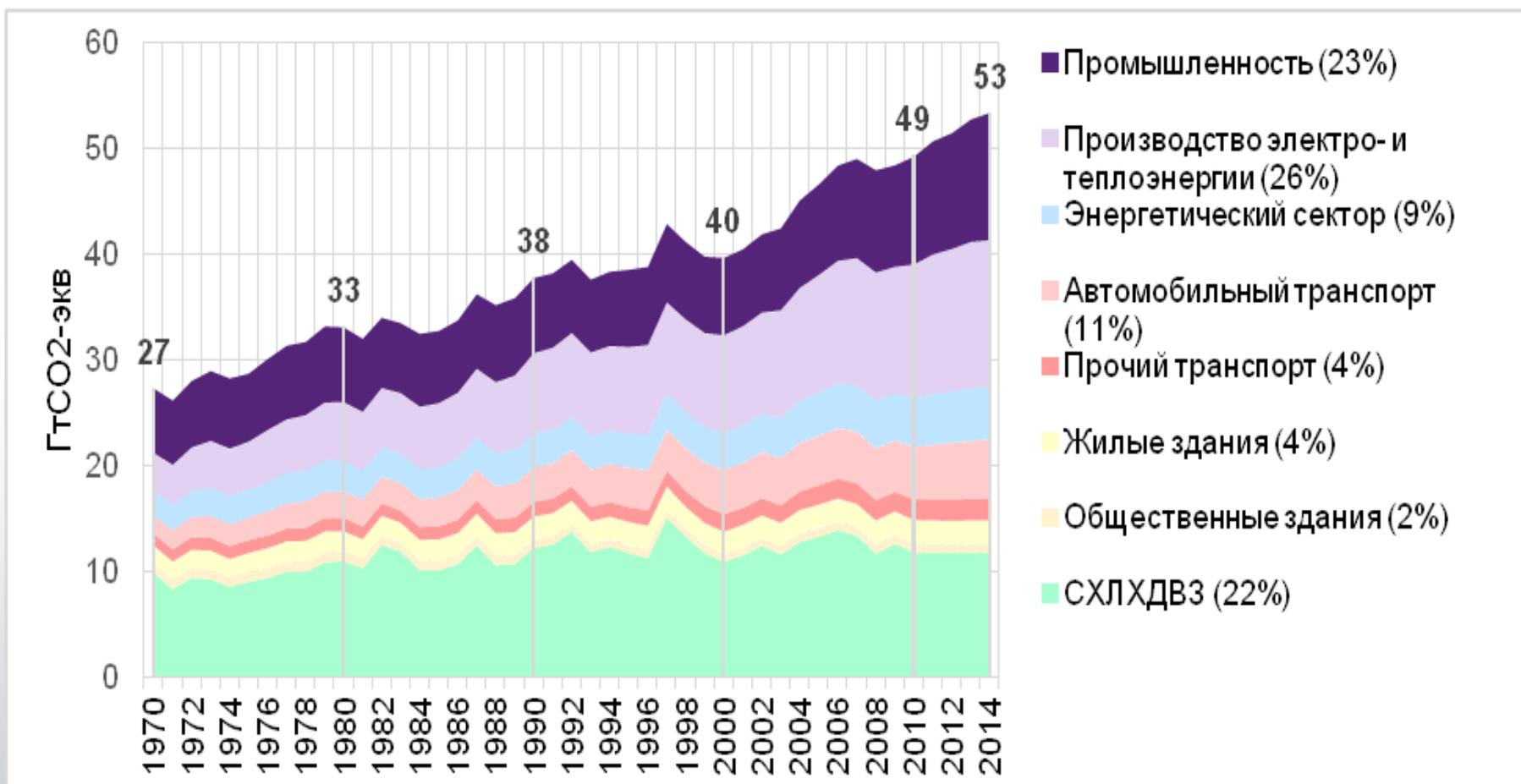
**GHG emissions growth has accelerated despite reduction efforts.**

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



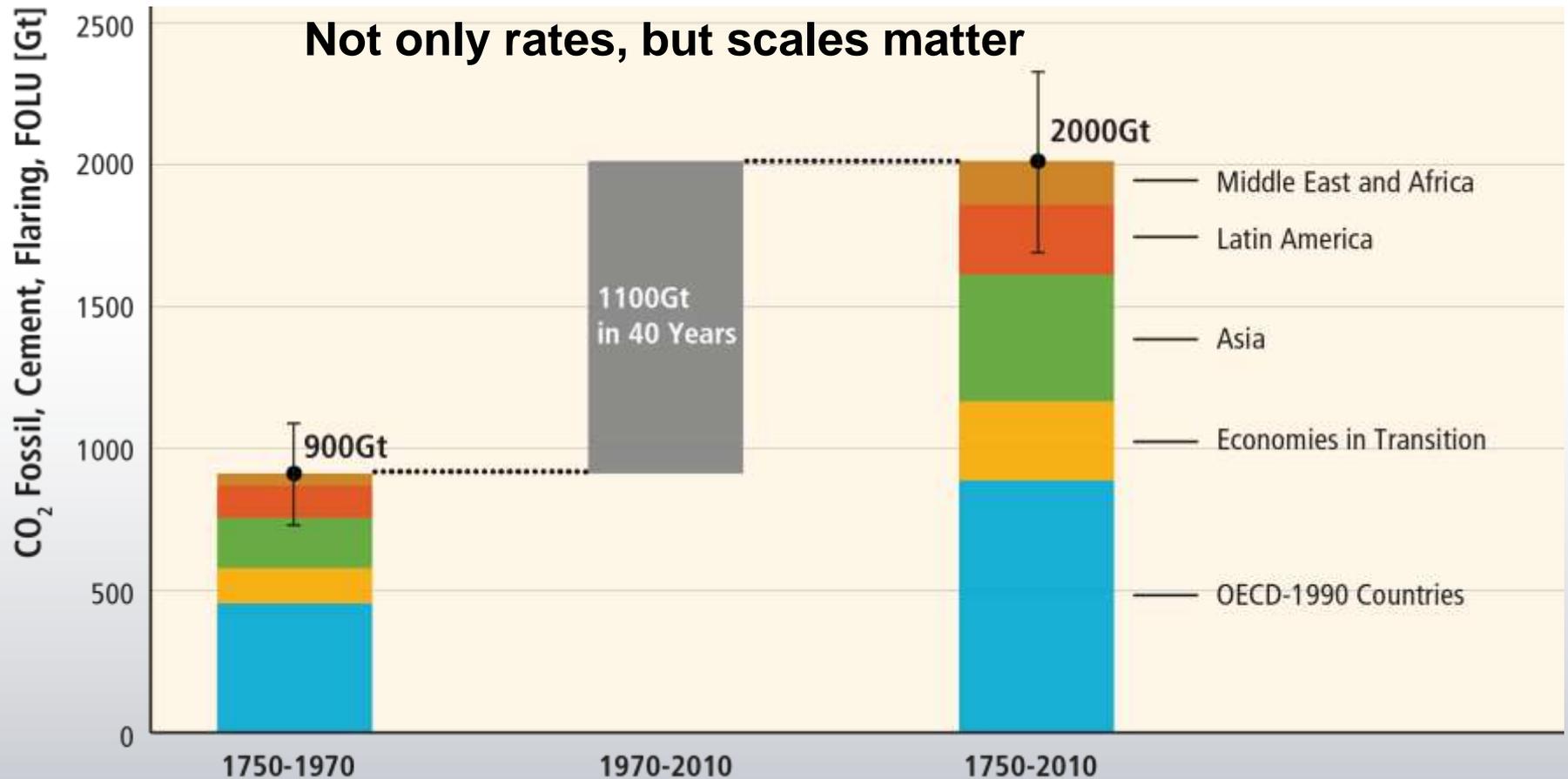
Based on Figure 1.3

# В 2011-2014 гг. антропогенная глобальная эмиссия ПГ росла примерно такими же темпами, как и в 2001-2010 гг., и к 2014 г. превысила 52 млрд т CO<sub>2</sub>экв



В 2014 г. при росте мирового ВВП на 3% выбросы ПГ не выросли

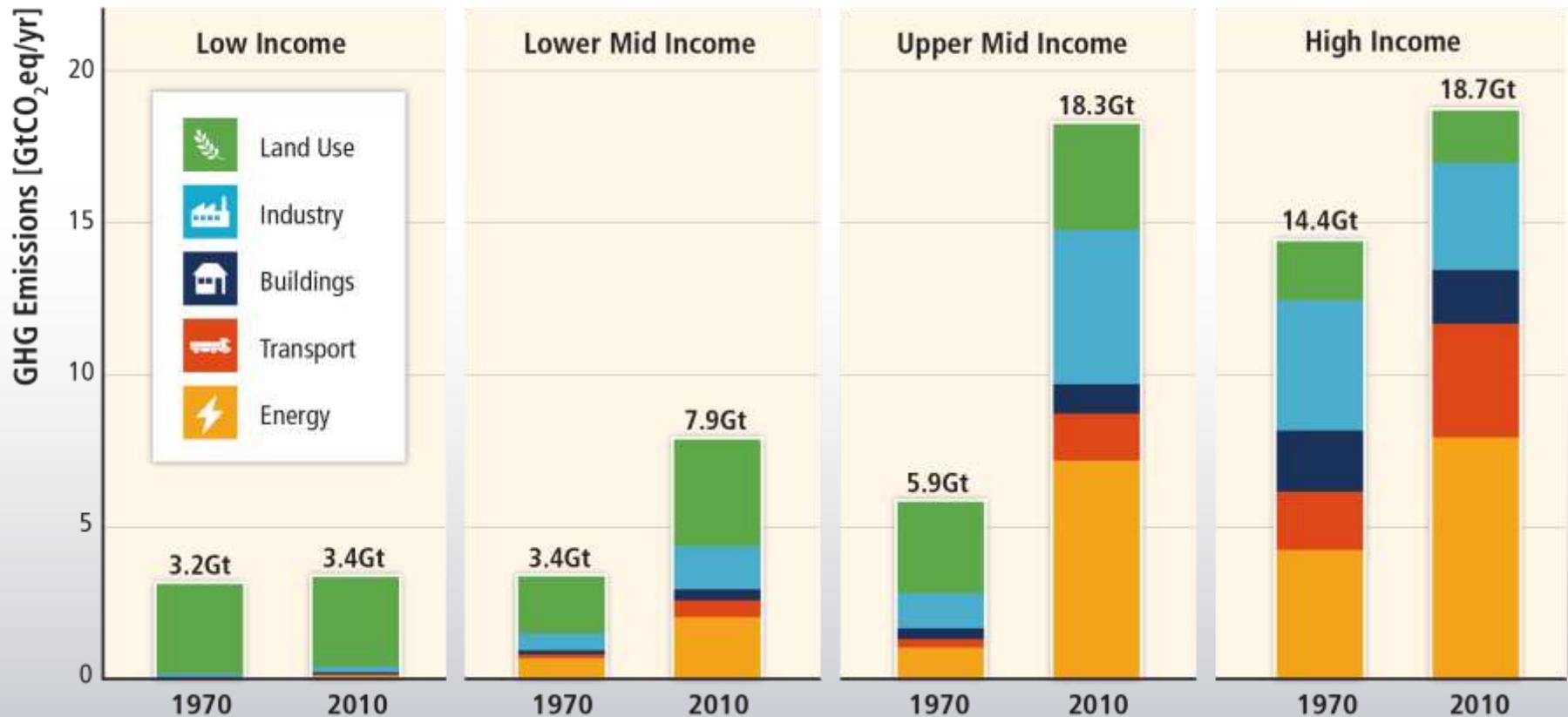
# About half of cumulative anthropogenic CO<sub>2</sub> emissions between 1750 and 2010 have occurred in the last 40 years.



Based on Figure 5.3

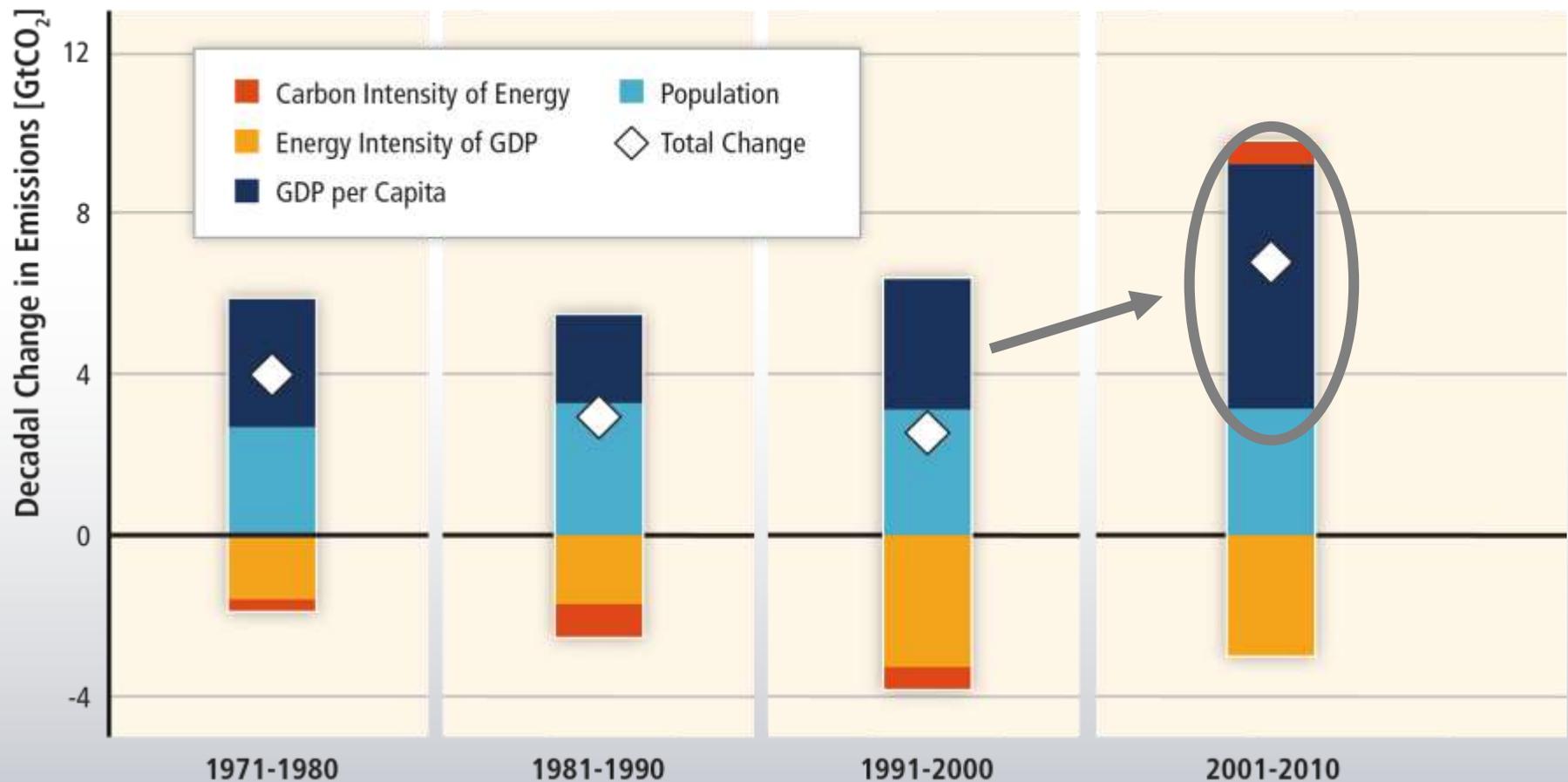
# Regional patterns of GHG emissions are shifting along with changes in the world economy.

## GHG Emissions by Country Group and Economic Sector



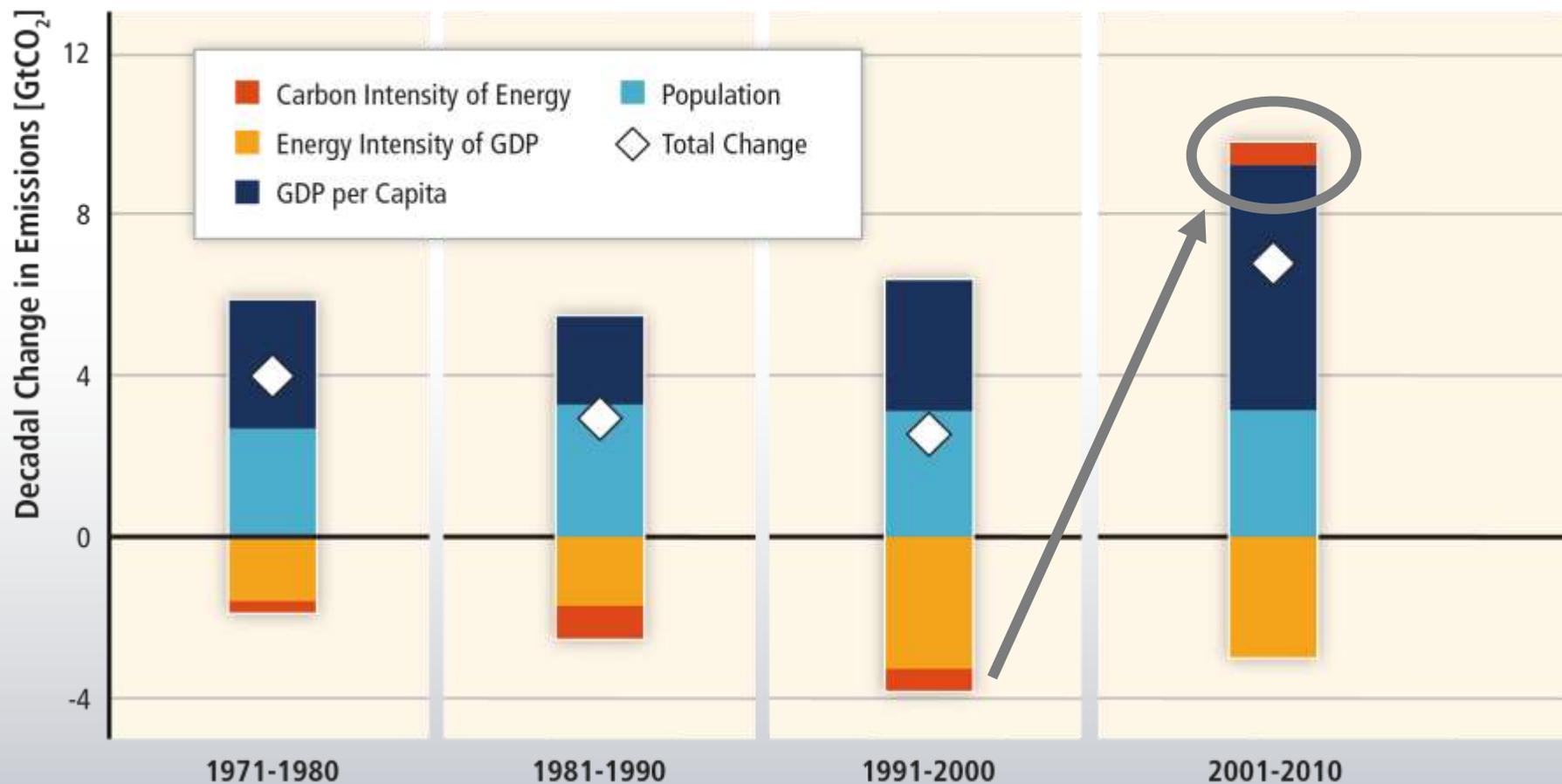
Based on Figure 1.6

# GHG emissions rise with growth in GDP and population; long-standing trend of decarbonisation of energy reversed.



Based on Figure 1.7

# GHG emissions rise with growth in GDP and population; long-standing trend of decarbonisation of energy reversed.

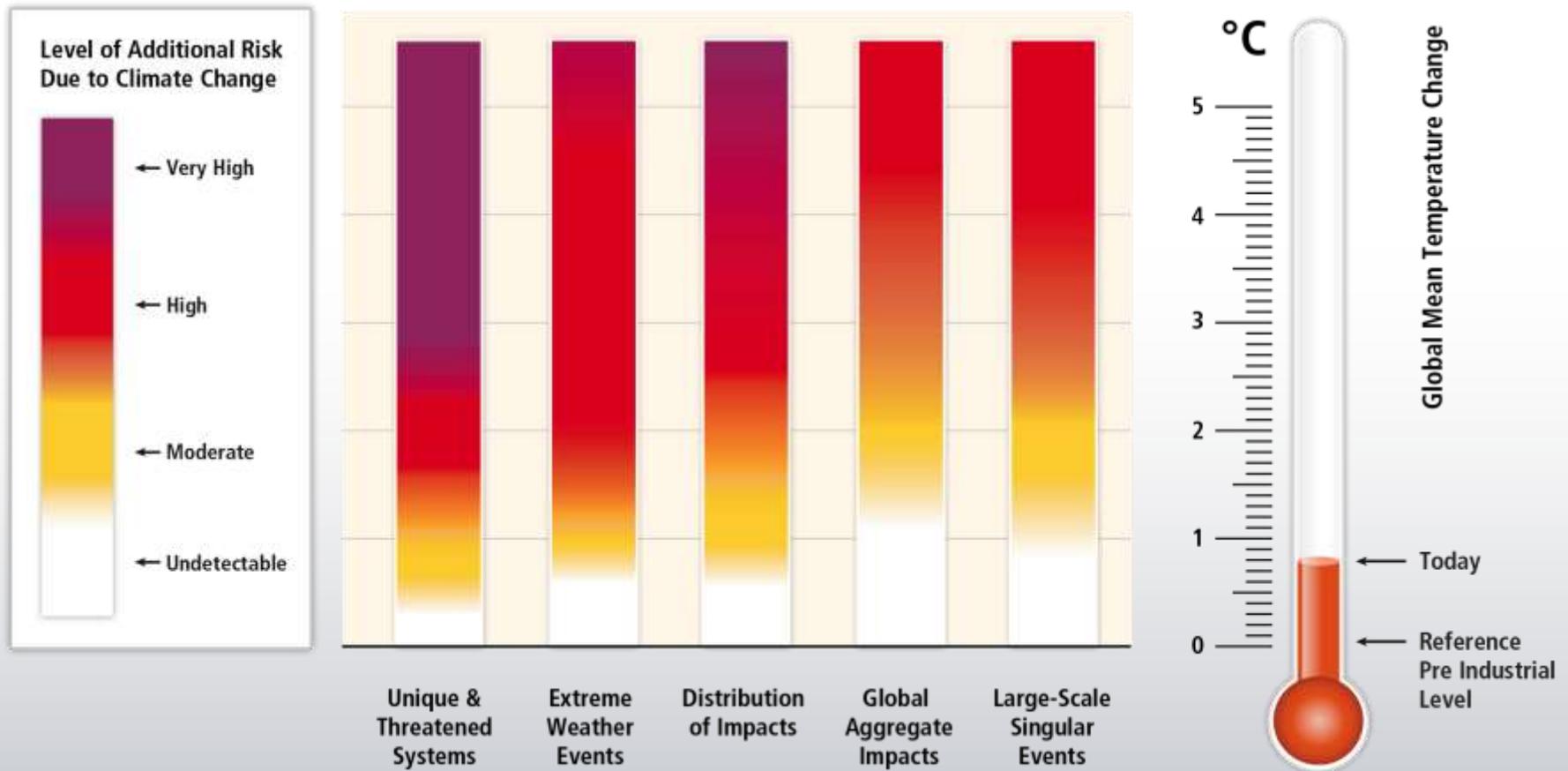


Based on Figure 1.7

An aerial photograph of a dense urban landscape, likely a major city like Hong Kong or Singapore. The image shows a complex network of multi-level highways and bridges weaving through a dense forest of skyscrapers and high-rise apartment buildings. The sky is a deep, clear blue. The overall scene conveys a sense of a highly developed, modern metropolis.

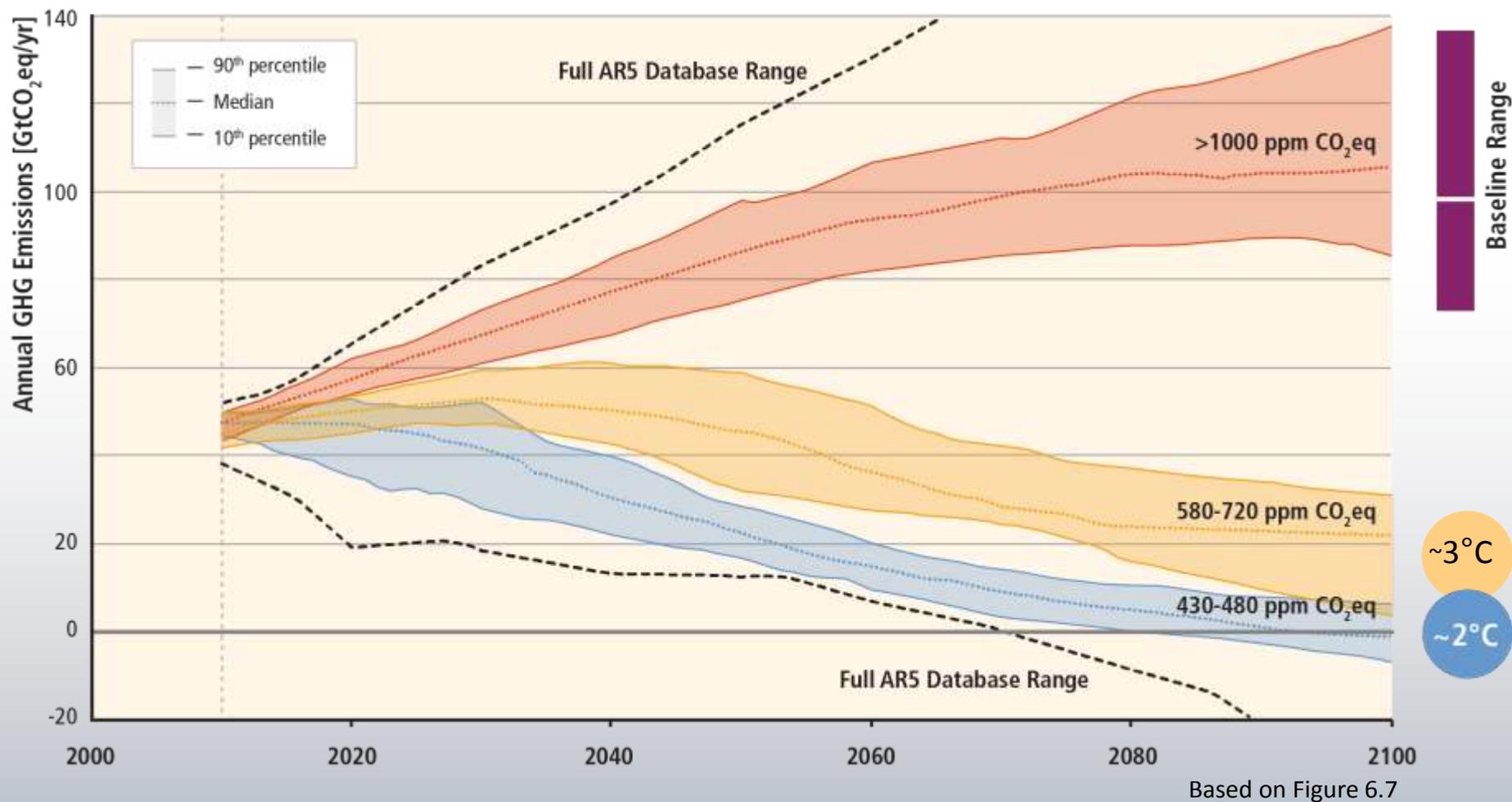
**Limiting warming to 2°C involves substantial technological, economic and institutional challenges.**

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

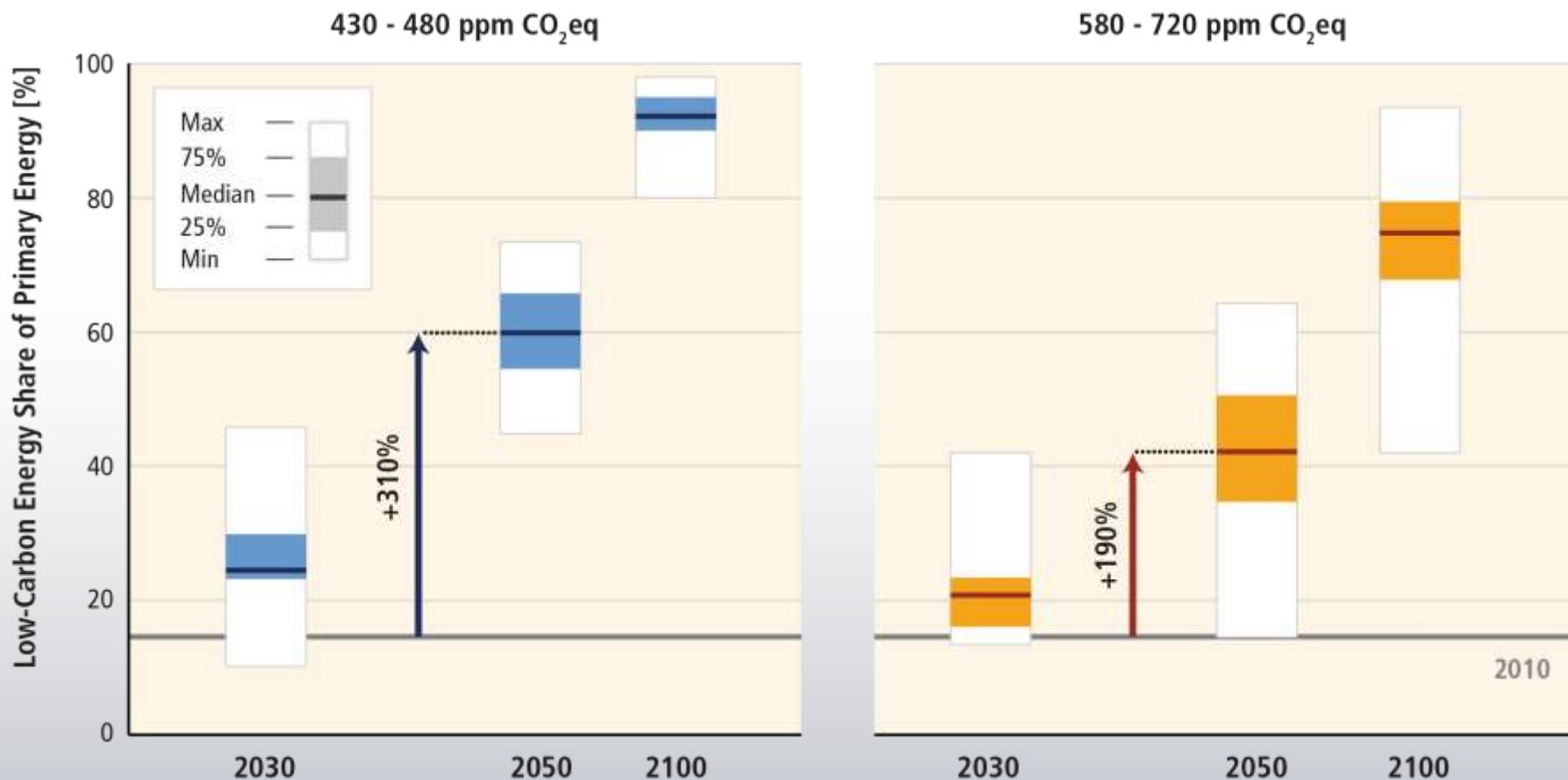


Based on WGII AR5 Figure 19.4

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



# Mitigation involves substantial upscaling of low-carbon energy.

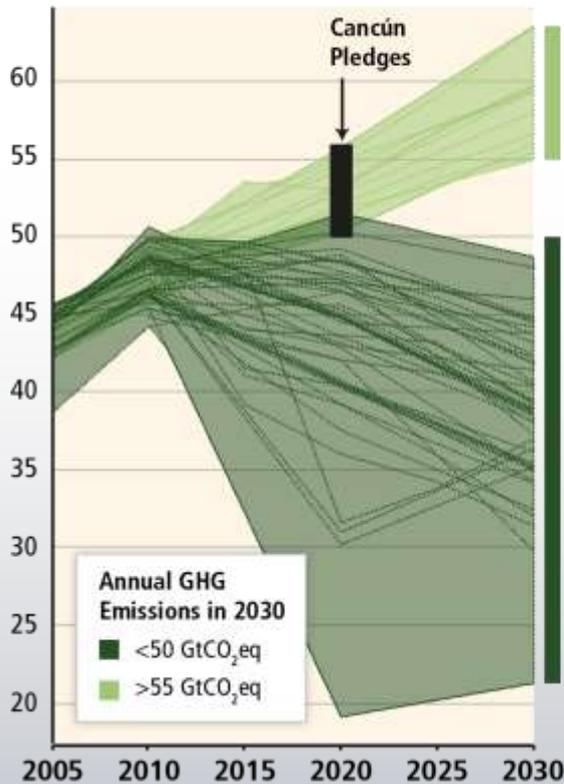


Based on Figure 7.16

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

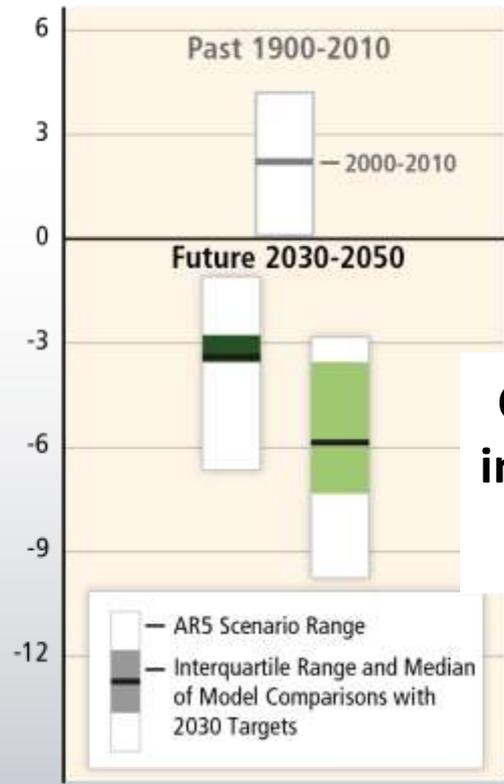
## Before 2030

GHG Emissions Pathways [GtCO<sub>2</sub>eq/yr]

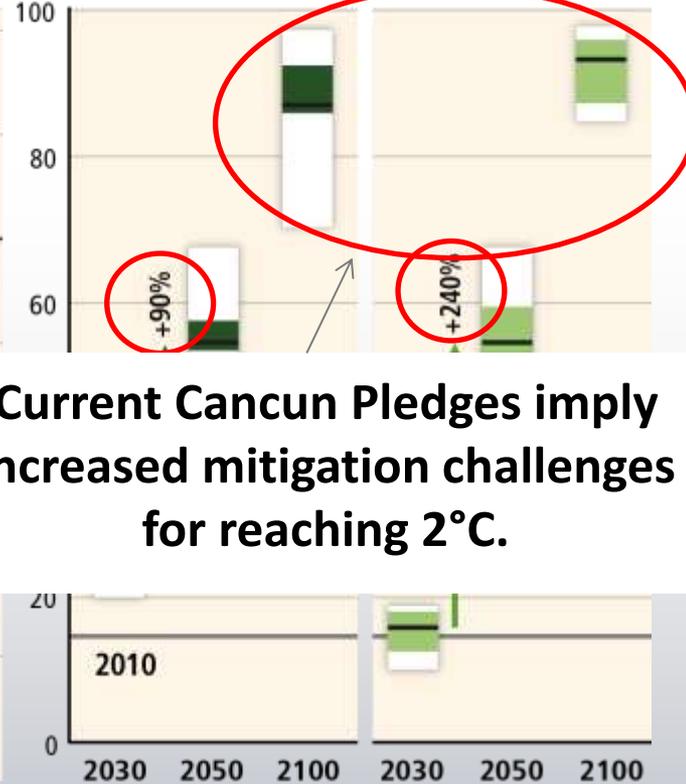


## After 2030

Rate of CO<sub>2</sub> Emission Change [%/yr]



Share of Low Carbon Energy [%]



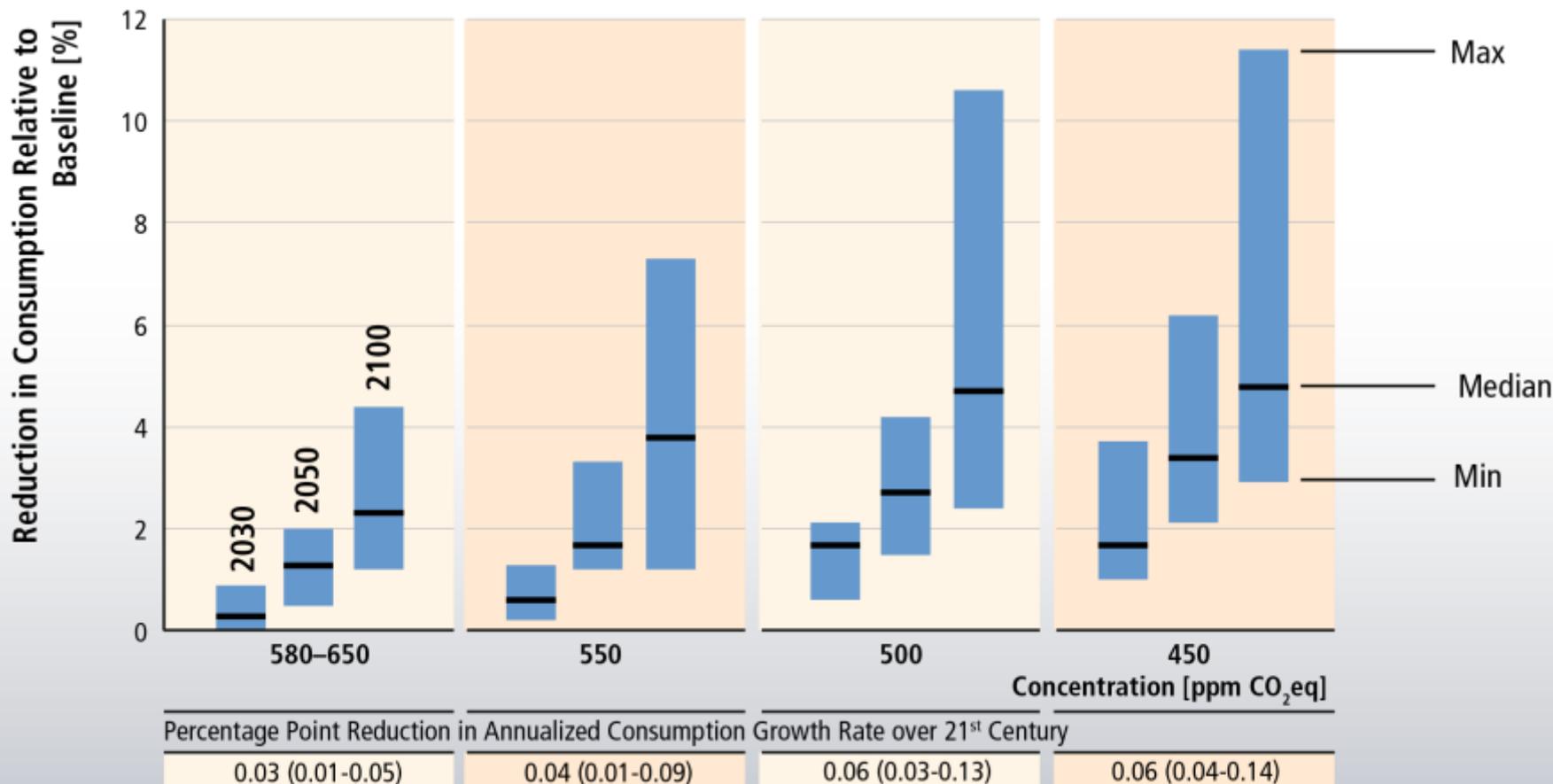
**Current Cancun Pledges imply increased mitigation challenges for reaching 2°C.**

Based on Figures 6.32 and 7.16

A large container ship is shown from an elevated perspective, sailing on a dark blue ocean. The ship is white with a red hull and is heavily loaded with colorful shipping containers. The text is overlaid in the center of the image.

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

# Global costs rise with the ambition of the mitigation goal.



on Table SPM.2

**Global military expenditures – 2.5% GDP**

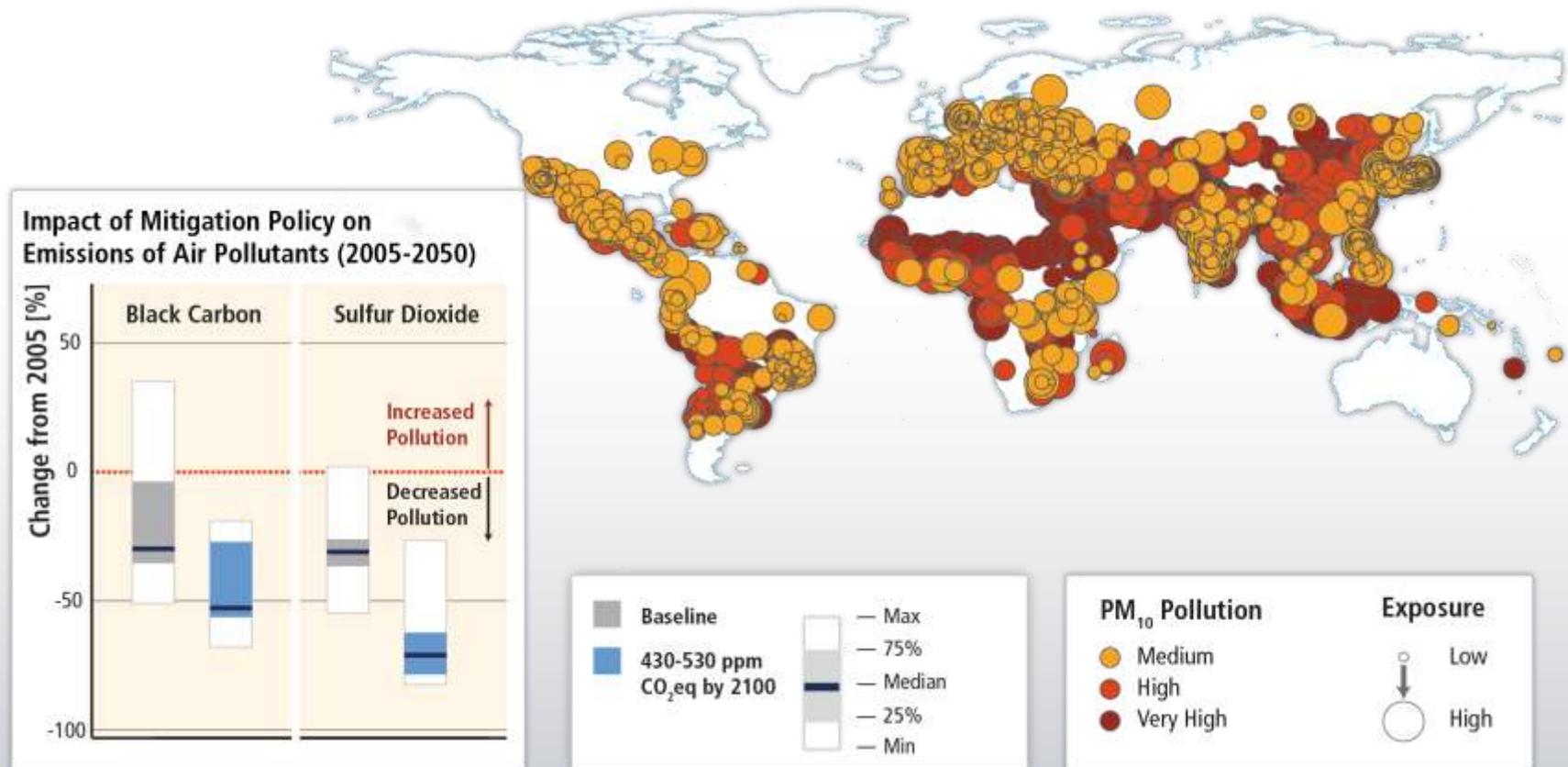
**2009 economic crisis – absolute loss of 2.2% GDP, or loss of 6.1% comparing with 2007 growth (BAU)**

# Availability of technology can greatly influence mitigation costs.

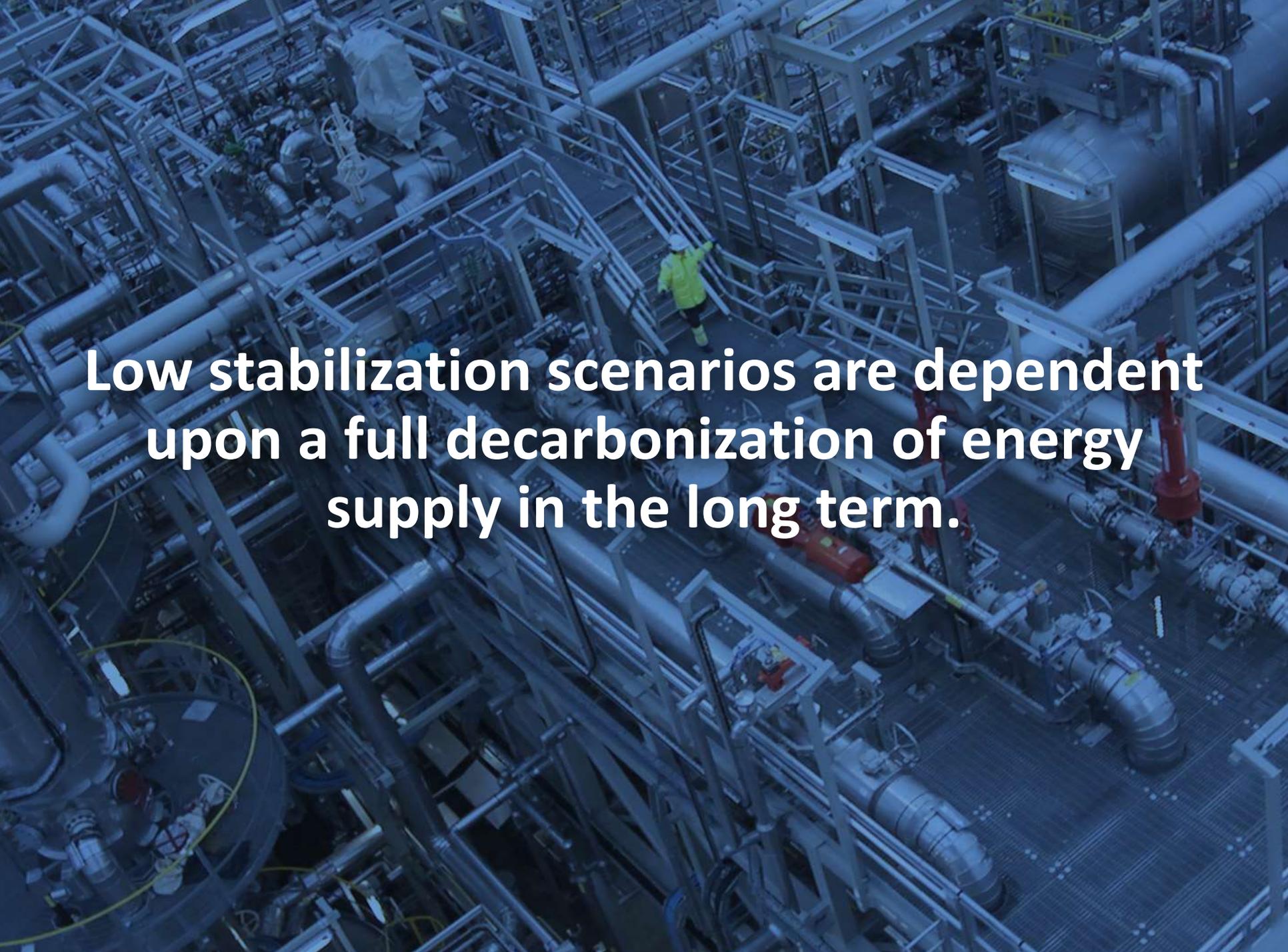


Based on Figure 6.24

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



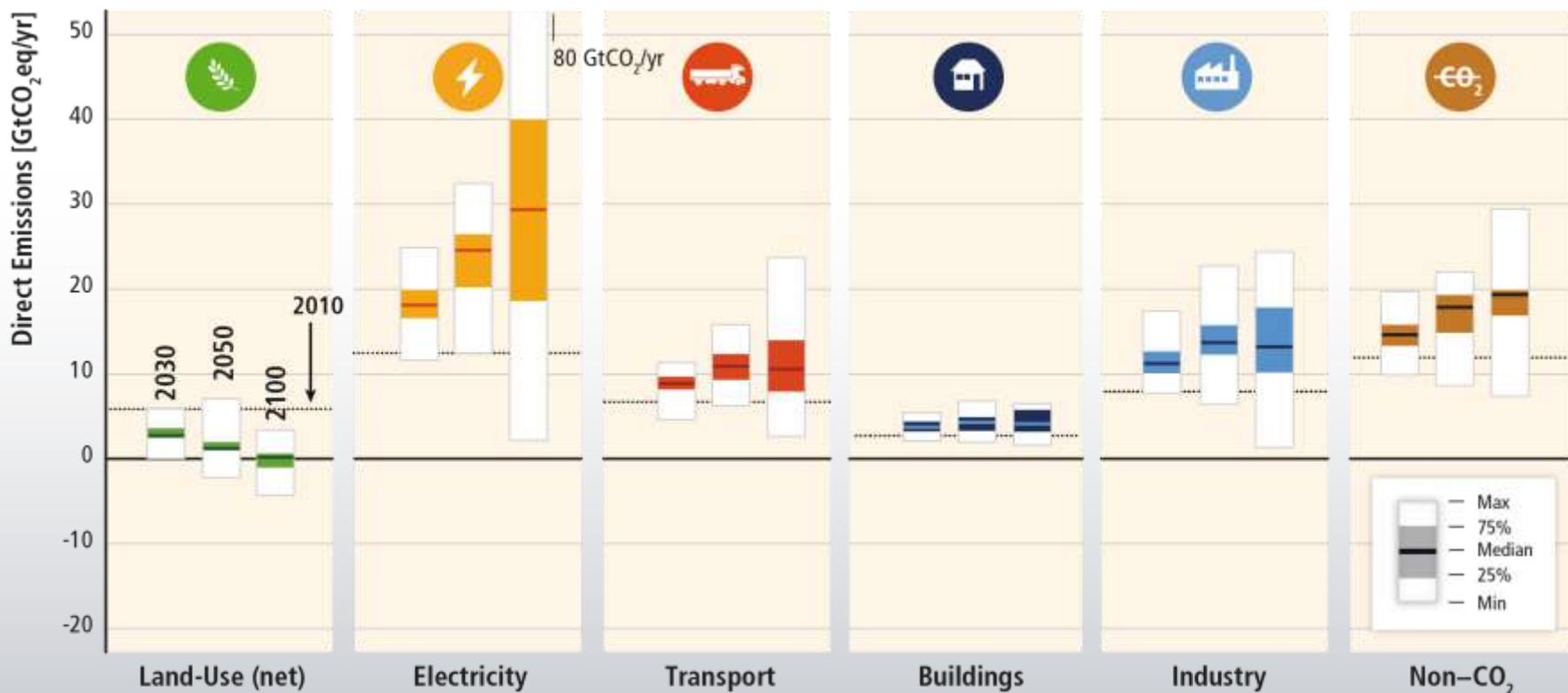
Based on Figures 6.33 and 12.23

An aerial, high-angle photograph of a complex industrial facility, likely a refinery or chemical plant. The scene is dominated by a dense network of silver-colored metal pipes, walkways, and structural beams. A single worker in a bright yellow safety jacket and white hard hat is visible in the center, providing a sense of scale to the massive infrastructure. The lighting is somewhat dim, and the overall color palette is a mix of metallic greys and the vibrant yellow of the worker's jacket. The text is overlaid in the center of the image.

**Low stabilization scenarios are dependent upon a full decarbonization of energy supply in the long term.**

# Baseline scenarios suggest rising GHG emissions in all sectors, except for CO<sub>2</sub> emissions in the land-use sector.

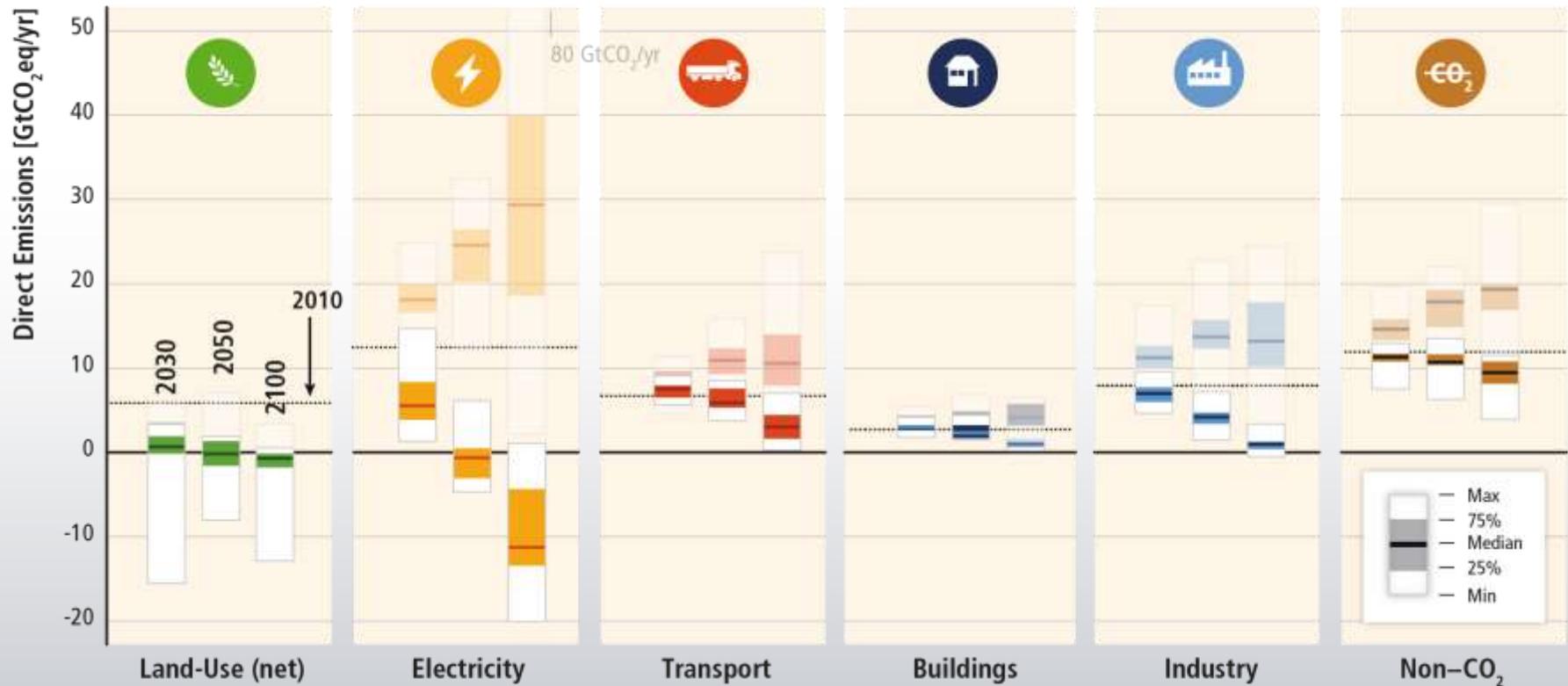
## BASELINES



Based on Figure TS.17

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

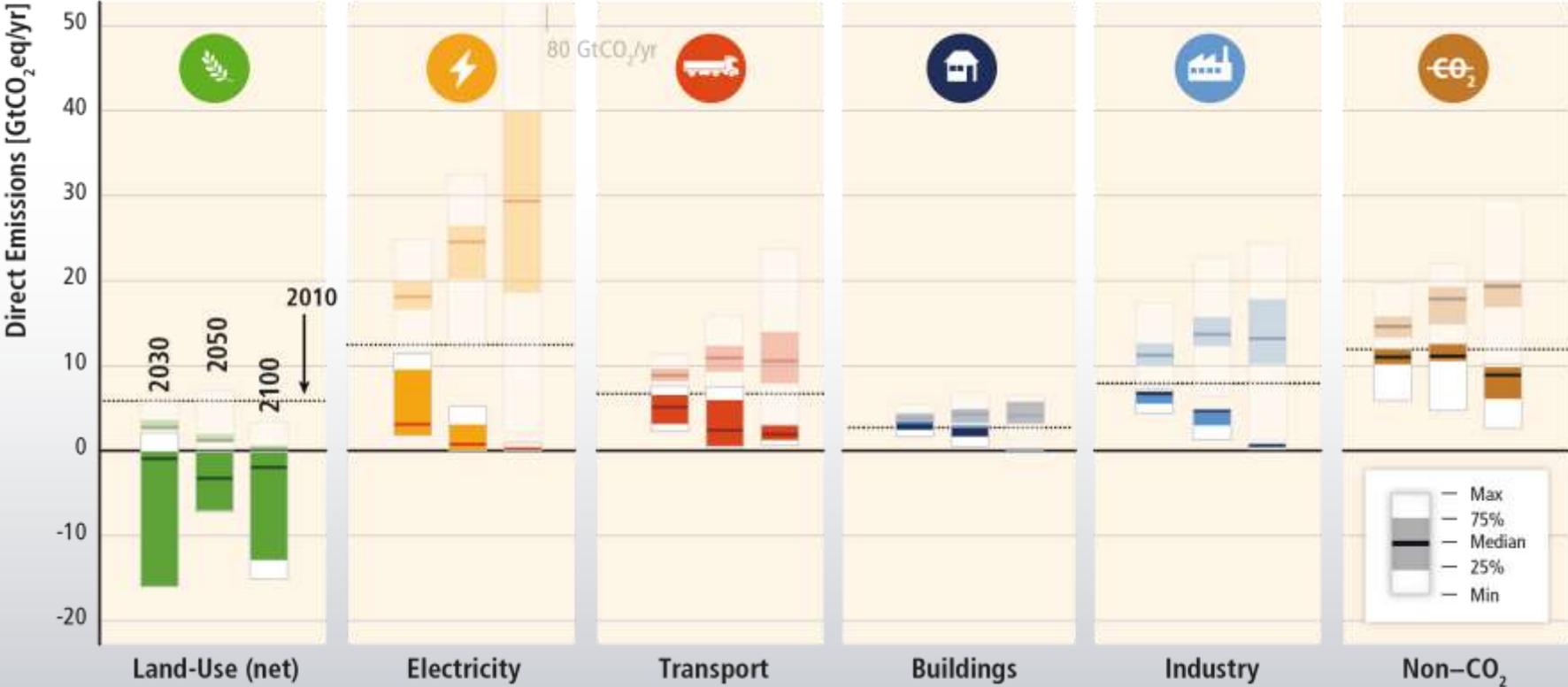
## 450 ppm CO<sub>2</sub>eq with Carbon Dioxide Capture & Storage



Based on Figure TS.17

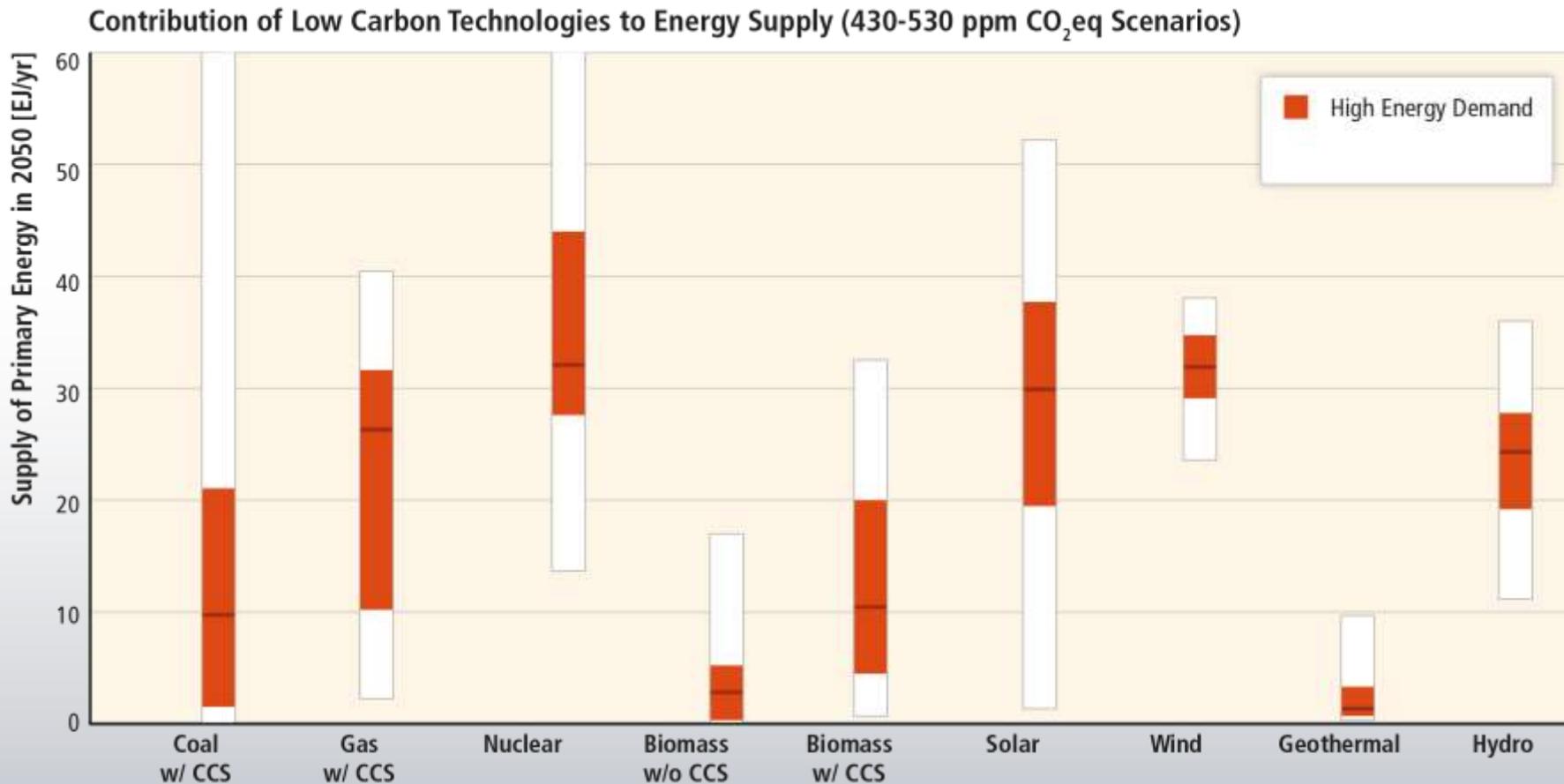
# Mitigation efforts in one sector determine efforts in others.

450 ppm CO<sub>2</sub>eq without Carbon Dioxide Capture & Storage



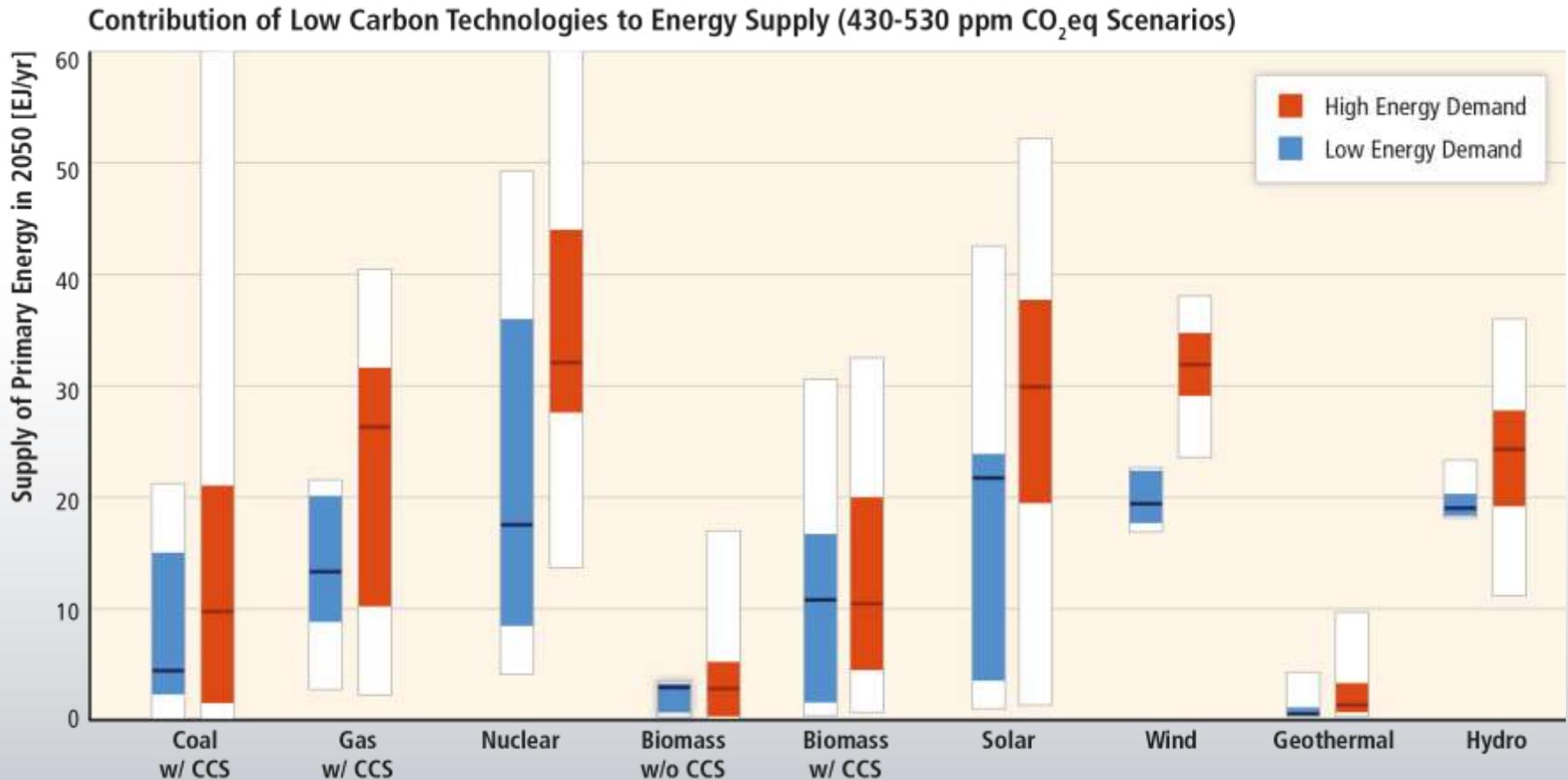
Based on Figure TS.17

# Decarbonization of energy supply is a key requirement for limiting warming to 2°C.



Based on Figure 7.11

# Energy demand reductions can provide flexibility, hedge against risks, avoid lock-in and provide co-benefits.



Based on Figure 7.11

# Reducing energy demand through efficiency enhancements and behavioural changes are a key mitigation strategy.



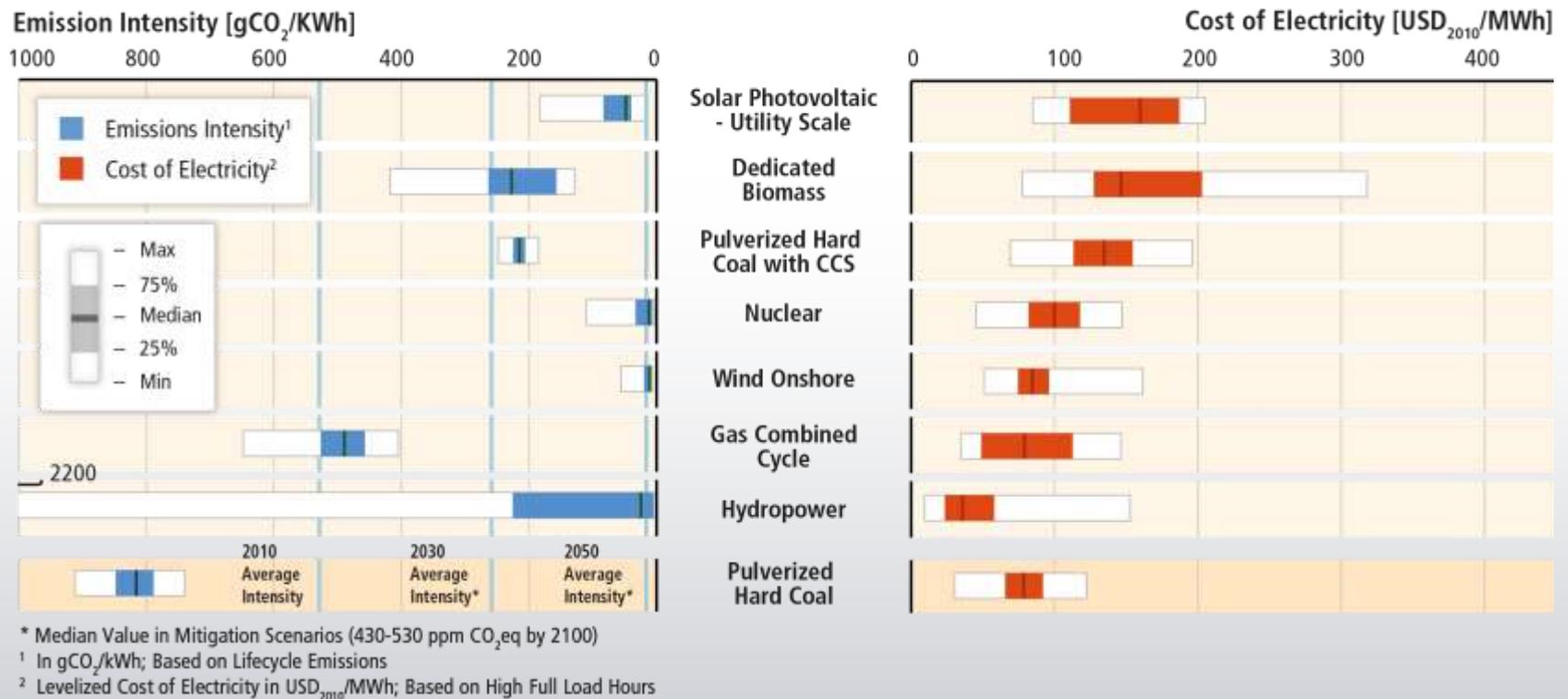
Based on Figure 6.37

An aerial photograph of an offshore wind turbine in the ocean. A large service vessel is positioned directly below the turbine's tower, likely performing maintenance or construction. The scene is captured in a blue-tinted, low-light environment, possibly at dusk or dawn. The text is overlaid in the center of the image.

**The wide-scale application of available best-practice low-GHG technologies could lead to substantial emission reductions**

# Costs of many power supply technologies decreased substantially, some can already compete with conventional technologies.

## Some Mitigation Technologies for Electricity Generation

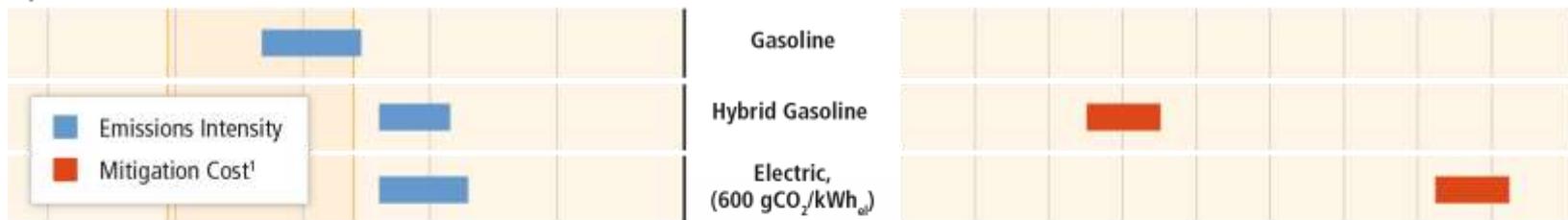


Based on Figure 7.7

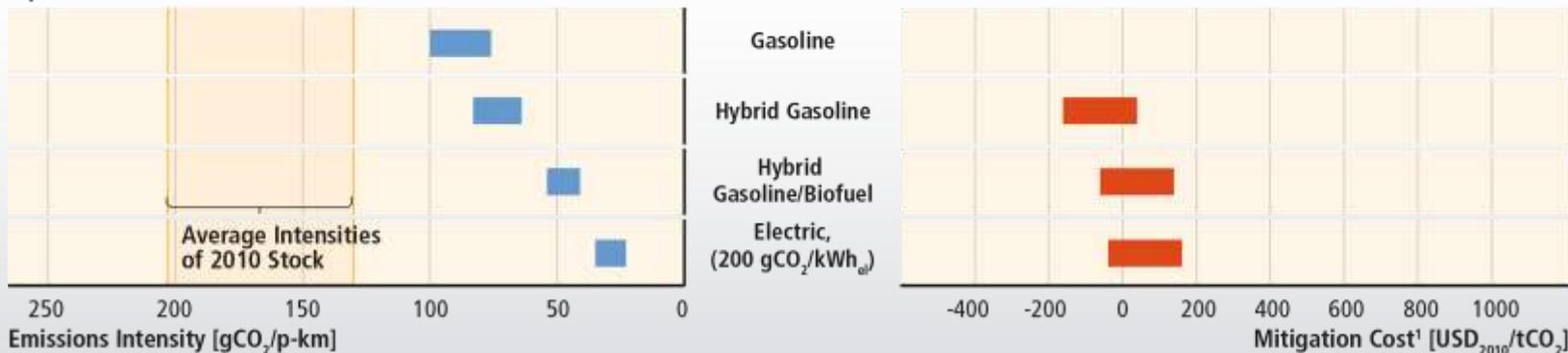
# Private costs of reducing emissions in transport vary widely. Societal costs remain uncertain.

## Some Mitigation Technologies for Light Duty Vehicles

### Options in 2010



### Options in 2030



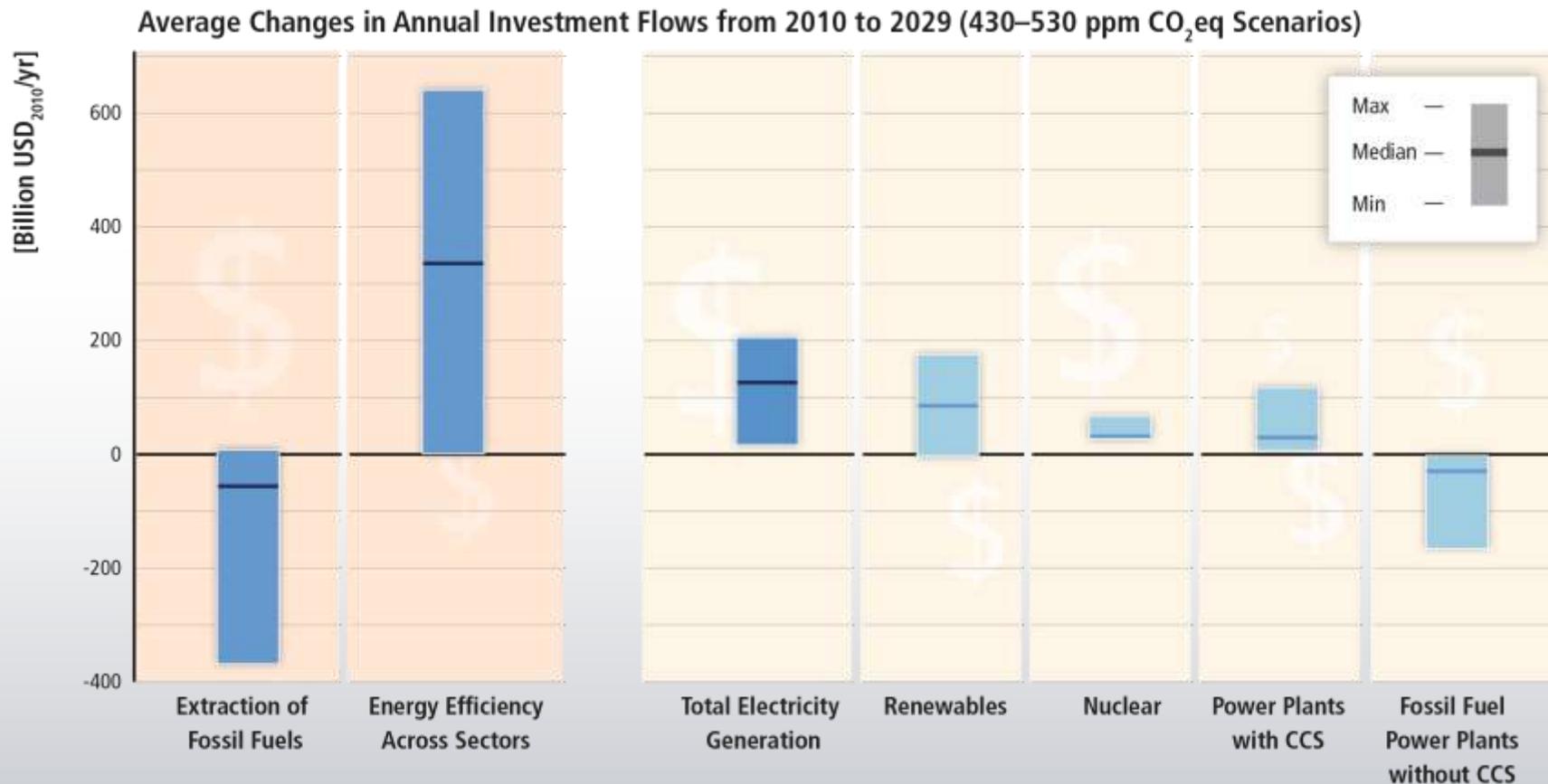
<sup>1</sup> Levelized cost of conserved carbon; calculated against 2010 new gasoline (2030 optimized gasoline) for 2010 (2030) options. Mitigation cost are based on point estimates  $\pm 100$  USD<sub>2010</sub>/tCO<sub>2</sub> and are highly sensitive to assumptions.

Based on Figure TS.21

A close-up photograph of a wooden gavel resting on a stack of books. The gavel is positioned diagonally, with its head in the foreground and its handle extending towards the background. The books are stacked horizontally, and the scene is lit with a cool, blue-toned light, creating a professional and serious atmosphere. The text is overlaid in the center of the image.

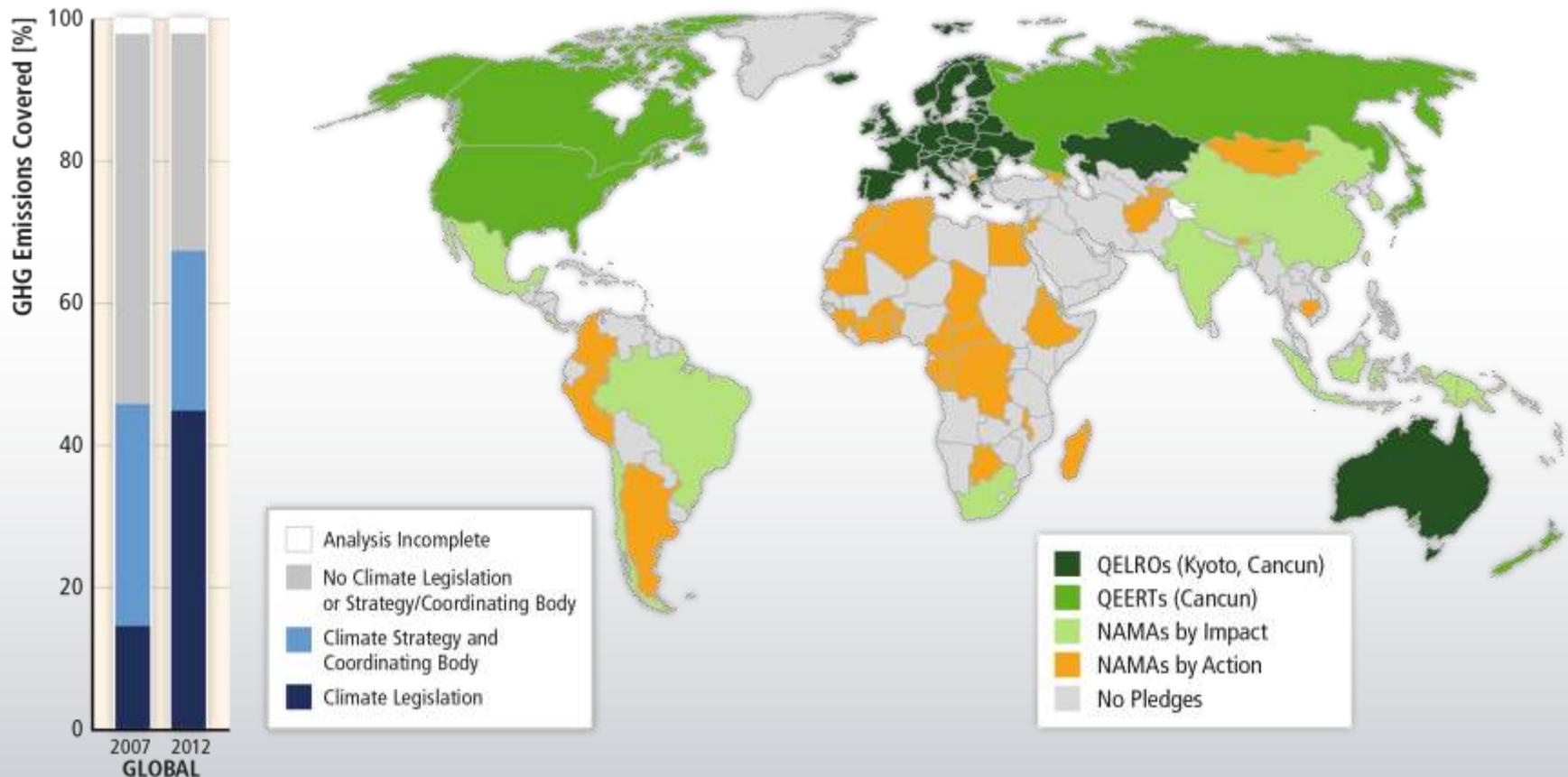
**Effective mitigation will not be achieved if individual agents advance their own interests independently.**

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



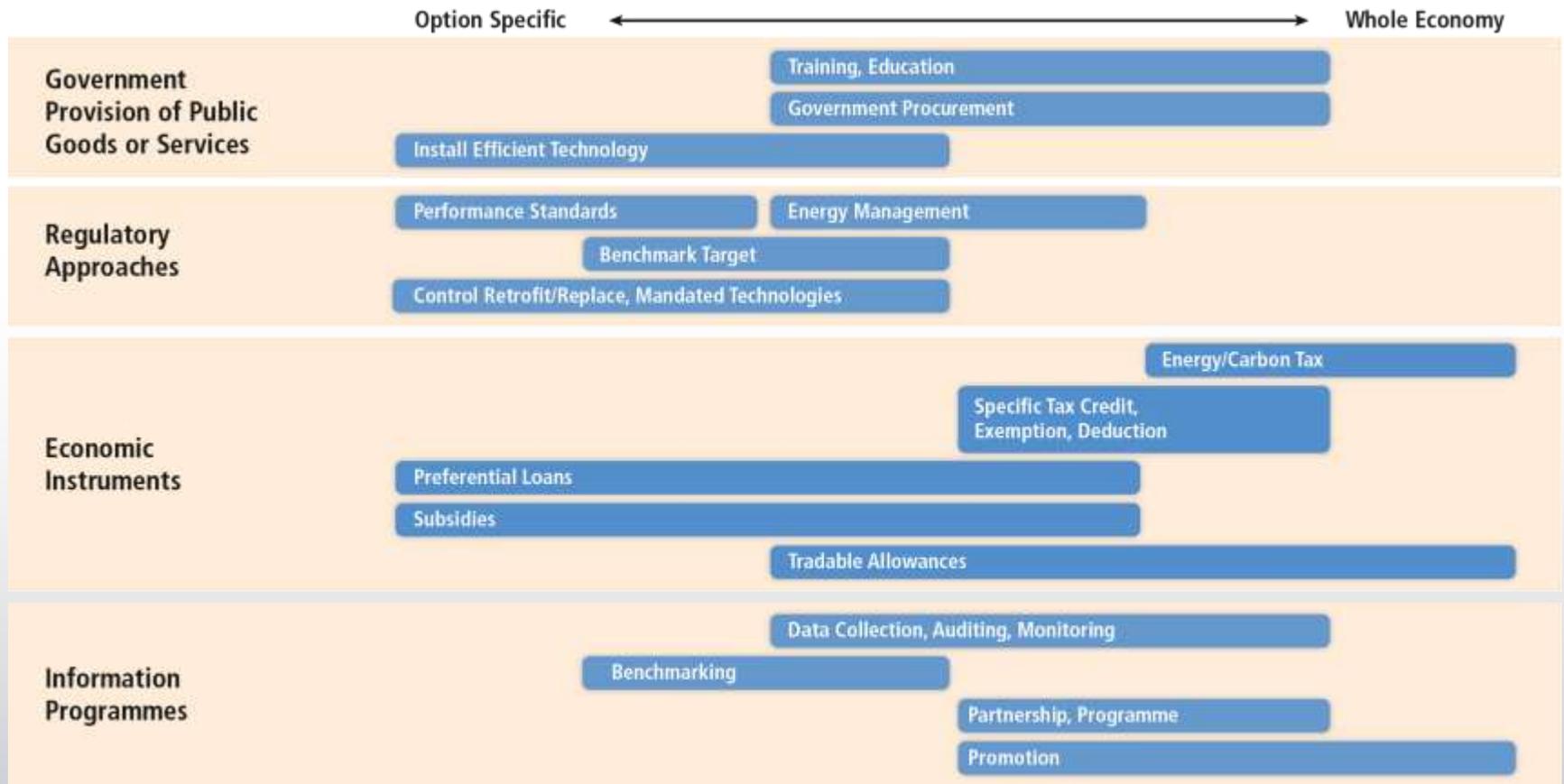
Based on Figure 16.3

# There has been a considerable increase in national and sub-national mitigation policies since AR4.



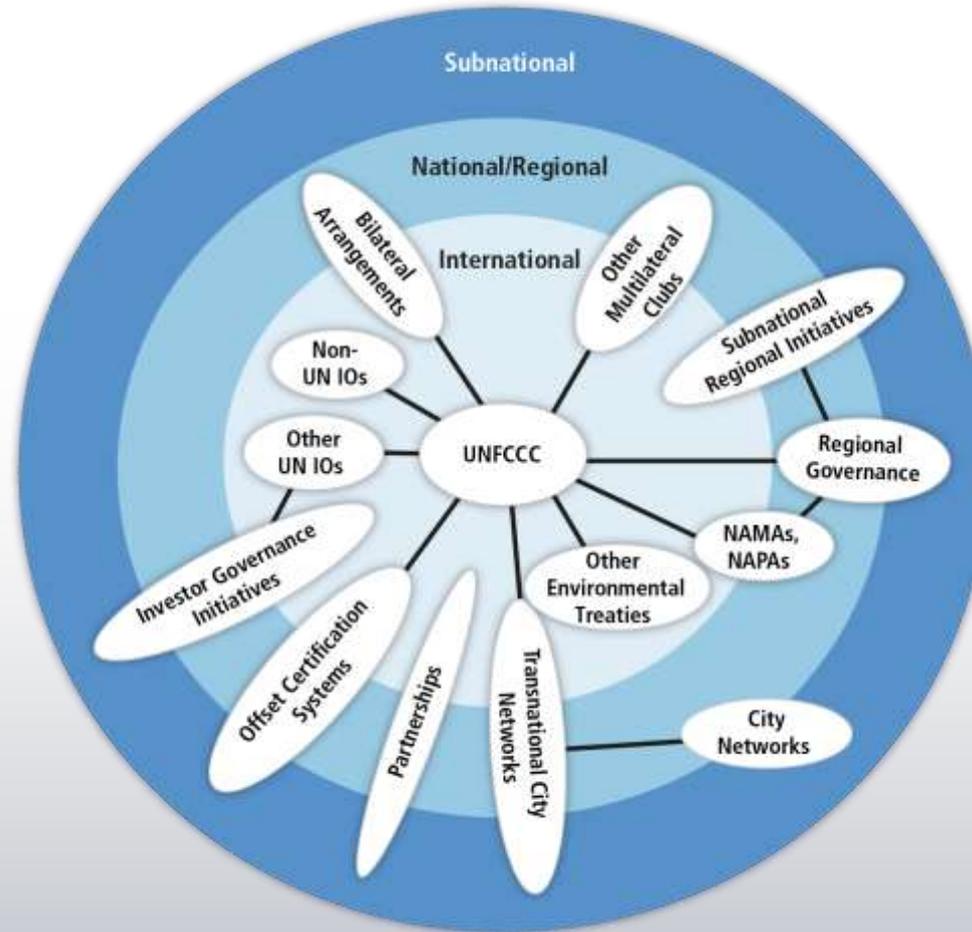
Based on Figures 15.1 and 13.3

# Sector-specific policies have been more widely used than economy-wide policies.



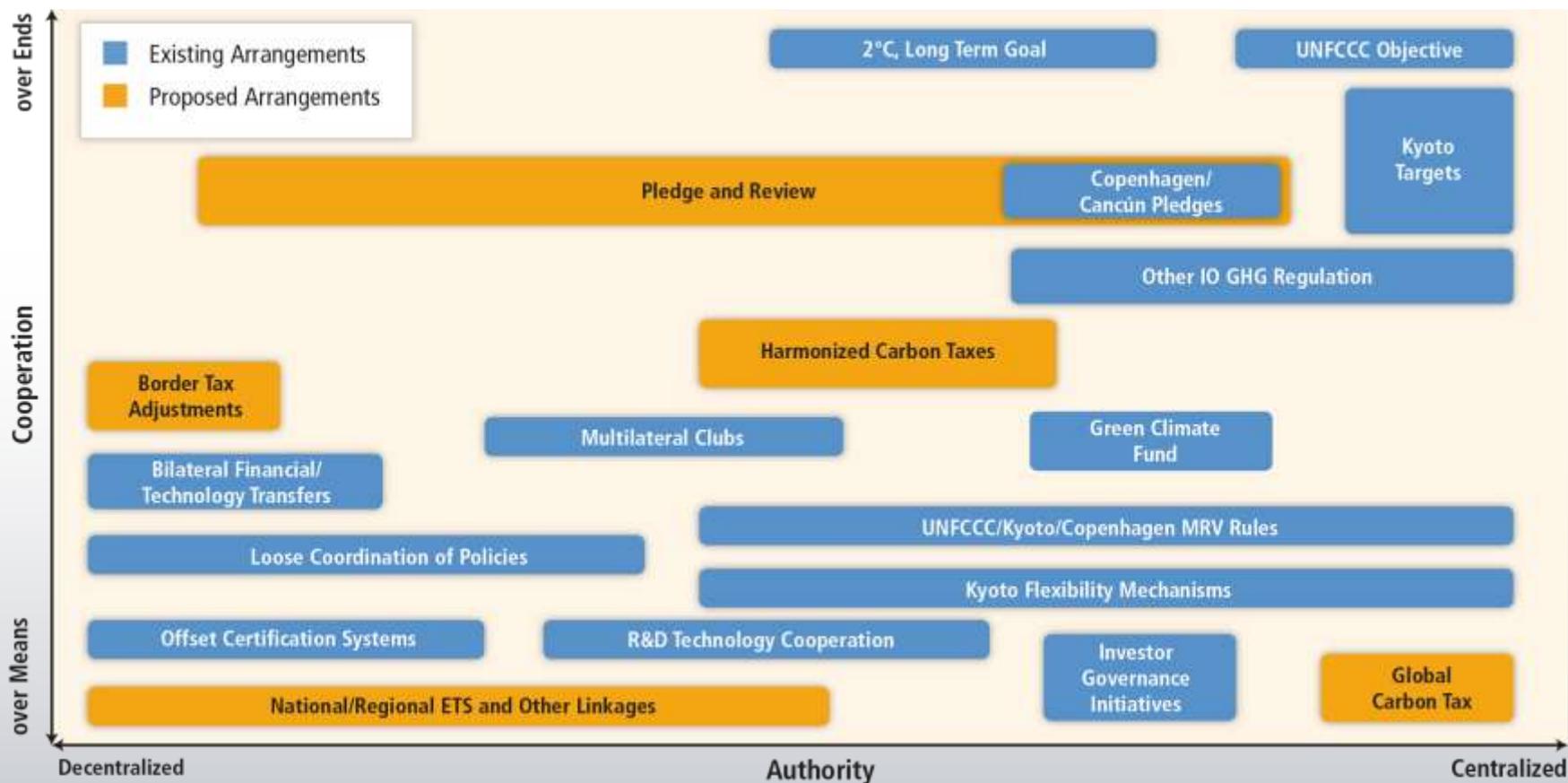
Based on Figure 10.15

# Climate change mitigation is a global commons problem that requires international cooperation across scales.



Based on Figure 13.1

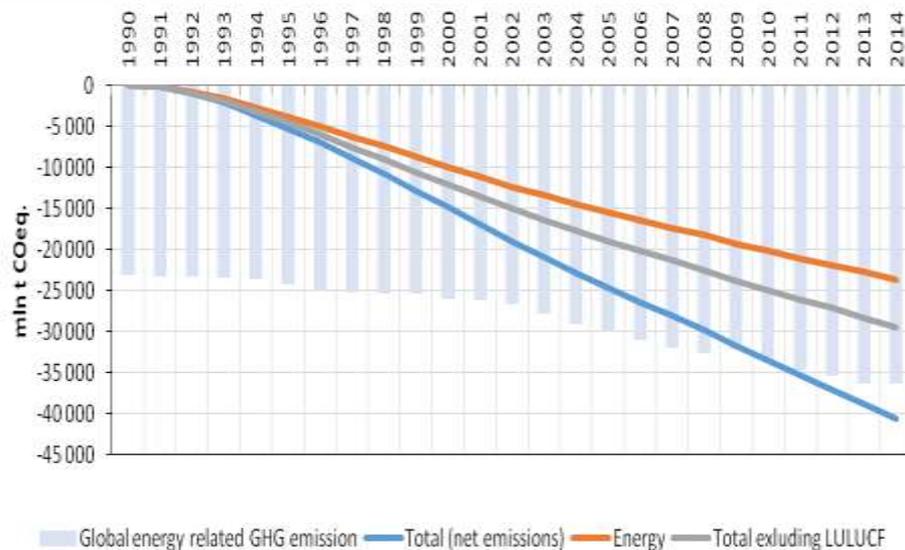
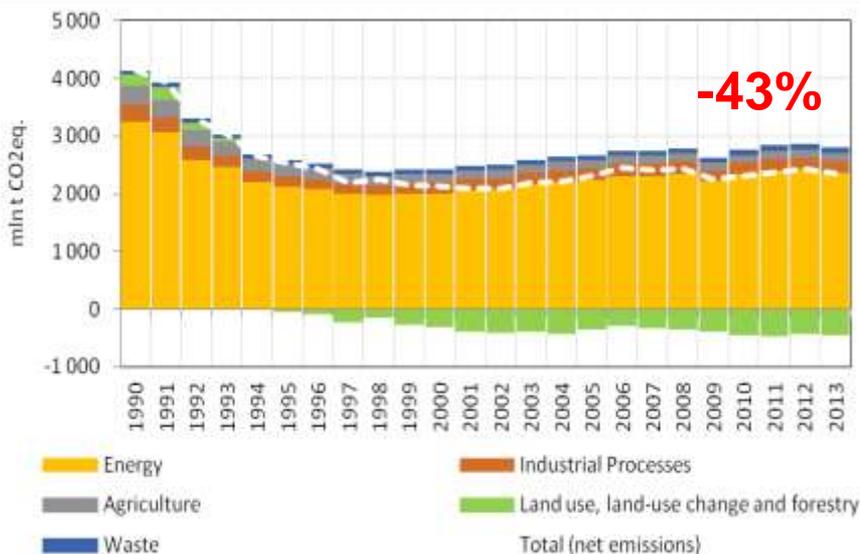
# Effective mitigation will not be achieved if individual agents advance their own interests independently.



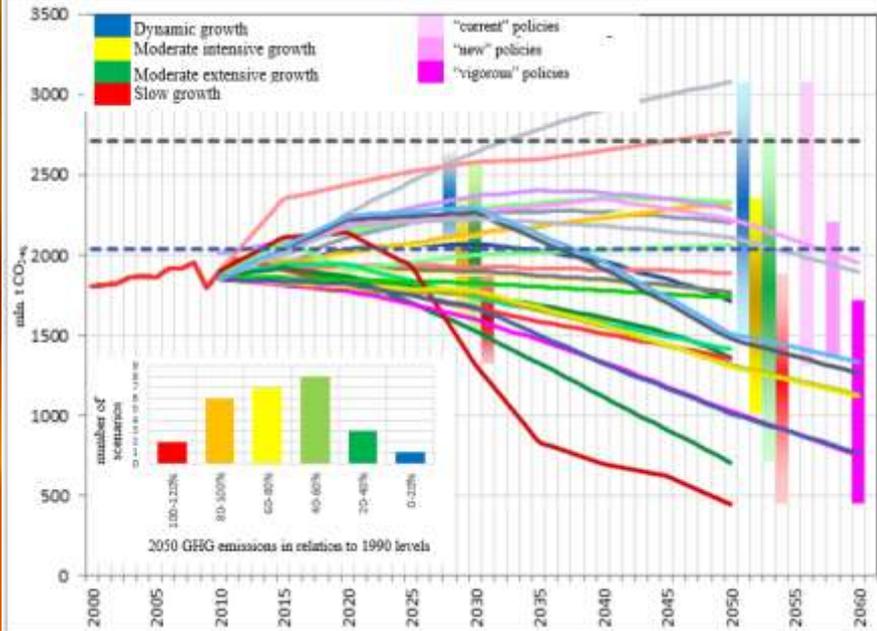
Based on Figure 13.2

During 1991-2014, Russia was the global leader in cumulative reduction of GHG emission. Russia alone managed to impede the negative anthropogenic impact for a whole year!

- ➔ Cumulative reduction of anthropogenic GHG emission in Russia over 1991-2013 exceeds 7 years' EU energy related emission, 5 years' emission of the U.S. and 3 years' emission of China
- ➔ In 1991-2013, cumulative GHG emission reduction in Russia (incl. sinks) equaled 40 bln. t CO<sub>2-eq</sub>. This is more than the current global annual energy-related GHG emissions (about 36 bln. t CO<sub>2-eq</sub>.)



# It is very likely that Russia's energy-related emissions of three greenhouse gases will approach the absolute upper limit (peak) before 2060 at a level at least 11% below the 1990 emissions



It was not GHG emission control that hampered economic growth; vice versa, economic growth slowdown, determined by entirely different reasons, and re-evaluated economic development perspectives became a many-fold contributor to the reduction in the upper range estimates of future GHG emission

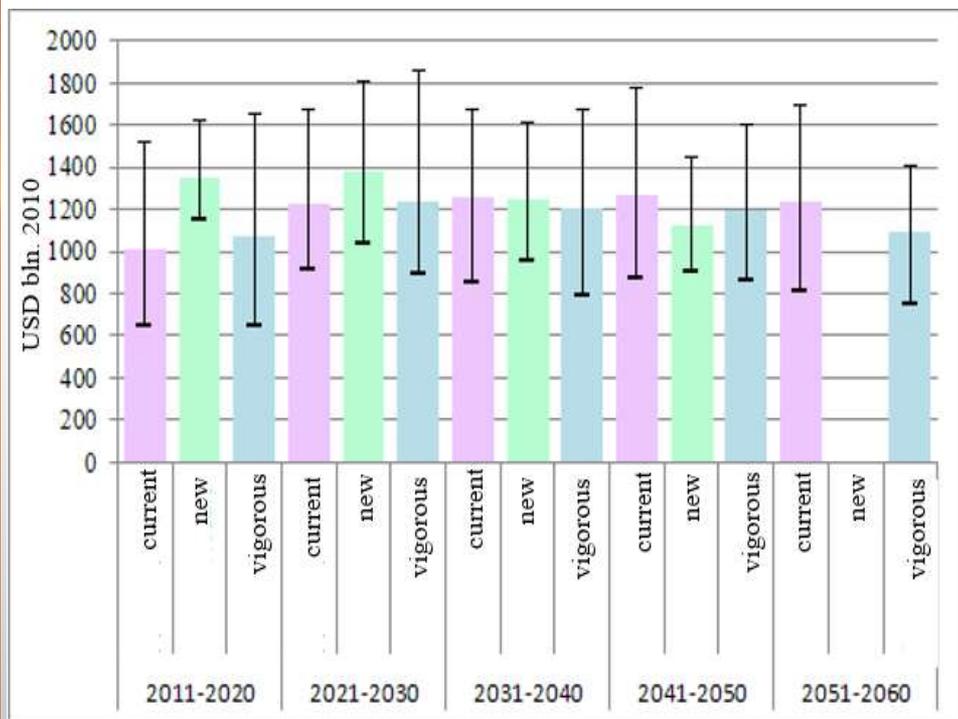
The larger package of emission control policies is used, the lower absolute upper limits (peaks) of Russia's energy-related greenhouse gas emissions will be

Russian commitments may be formulated in a way different from that of many other countries:

- ➔ not to “reduce *GHG emission by xx%*”, but
- ➔ “to sustain *GHG emissions by xx% below 1990 level*”

# Investments in low-carbon technologies and energy efficiency improvements do not provide any significant investment load on the economy

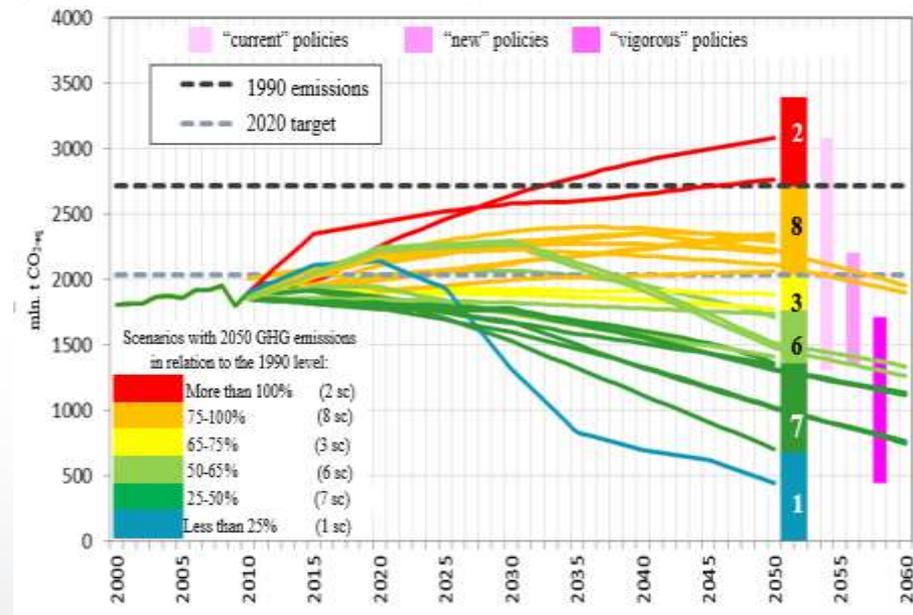
The available estimates do not provide any grounds to claim that investments in low-carbon and energy efficiency technologies will be distracting resources from, and hamper, the economic growth



- ➔ Investments in low-carbon technologies and energy efficiency improvements allow for savings on investments in very capital-intensive oil&gas sector and fossil fuel energy generation.
- ➔ Additional total discounted investments in low-carbon technologies and energy efficiency improvements do not exceed 0.8% of discounted GDP in 2014-2050.
- ➔ This figure is similar to the estimated share of capital investments required to control emission in 2030-2050 in industrial countries (not more than 1% of GDP)

# What GHG emission control commitments can Russia make to 2030 and to 2050?

- ➔ Most likely are moderate growth scenarios with “new” and “vigorous” policy packages or slow growth scenarios with “current” and “new” policies
- ➔ More studies are needed to provide more robust results
- ➔ In the 2050 perspective, Russia can make either “soft” or “tough” emission control commitments:



- ➔ “Soft” long-term commitments can be formulated as follows:
  - ➔ cap emission at maximum 75% of the 1990 level; or
  - ➔ cap average annual emission in 2021-2050 at maximum 75% of the 1990 level.
- ➔ “Tough” long-term commitments can be formulated as follows:
  - ➔ cap the 2050 emission at maximum 50% of the 1990 level; or
  - ➔ cap average annual emission in 2021-2050 at no more than 67% of the 1990 level.

# CLIMATE CHANGE 2014

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