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INTERGOVERNMENTAL PANEL ON climate change

CLIMATE CHANGE 2014

Mitigation of Climate Change

Sectoral and Cross Sectoral Mitigation

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Working Group III contribution to the
IPCC Fifth Assessment Report

WMO UNEP

GHG emissions continue to rise in
Energy supply and Energy End use sectors
Which imply wide spread mitigation actions
to be consistent with low stabilisation scenarios

Almost 80% of the GHG emission growth between 2000 and 2010 comes from the energy supply and industry sectors.

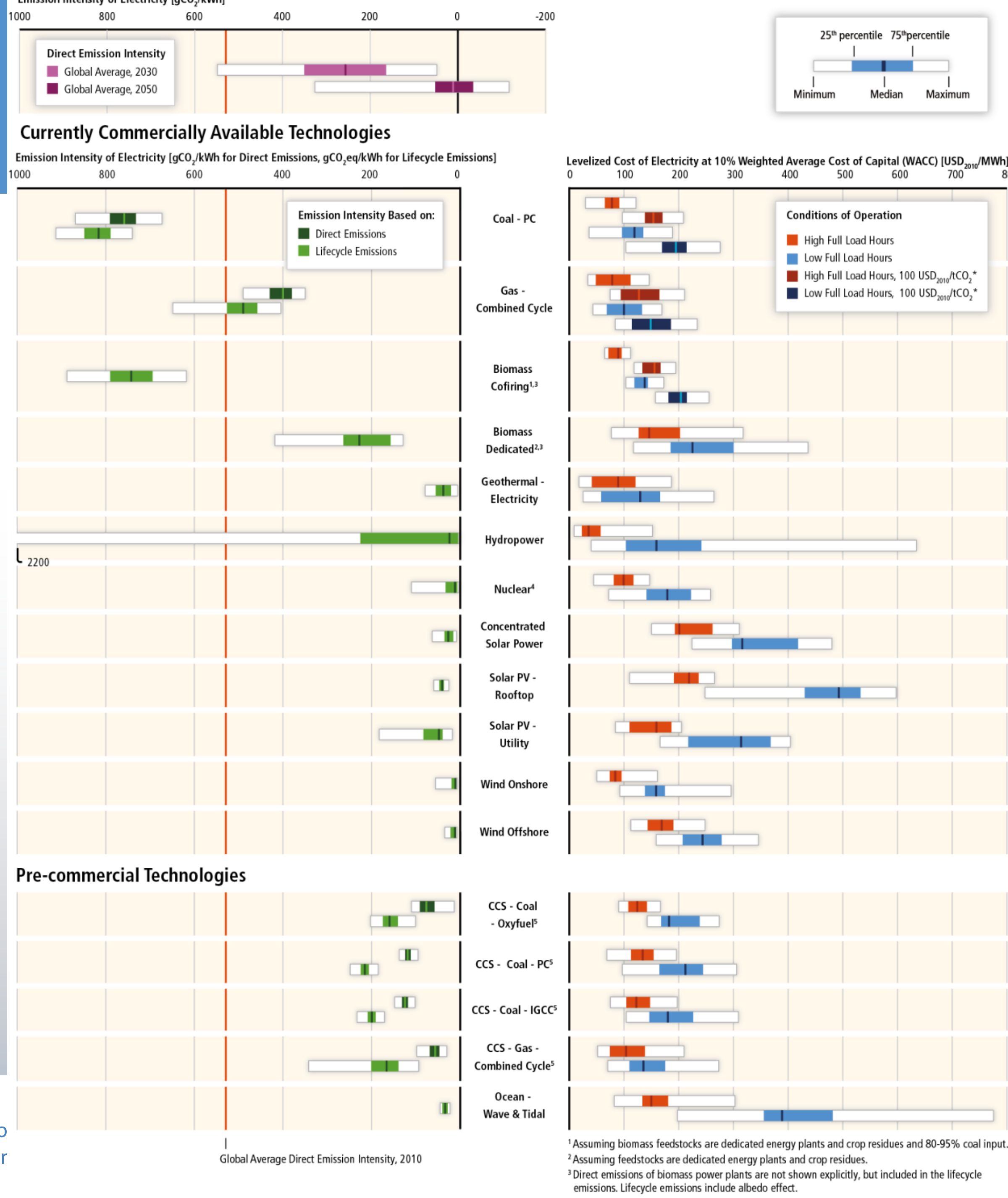
Energy supply

Range of technologies Identified .

Currently Commercially available

And pre commercial

with emission intensity And levelised cost of electricity

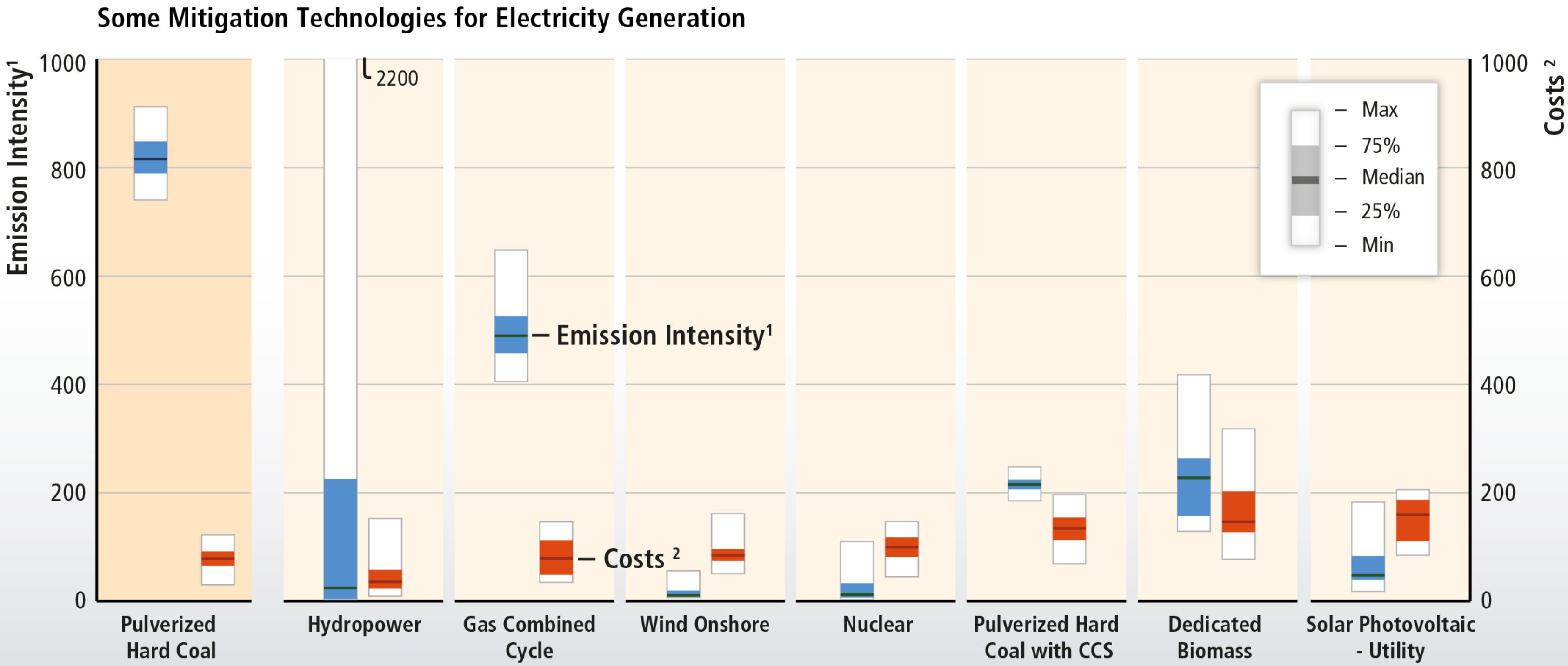


Energy Supply-Mitigation Options

In the majority of low-stabilization scenarios **(430–530 ppm CO_2eq)**, the share of low-carbon electricity supply (comprising renewable energy (RE), nuclear and CCS) increases from the current share of approximately 30% to more than 80 % by 2050, and fossil fuel power generation without CCS is phased out almost entirely by 2100.

In mitigation scenarios reaching about 450 ppm CO_2eq concentrations by 2100, natural gas power generation without CCS acts as a bridge technology peaking before and reaching below current levels by 2050 and declining further in the second half of the century

Some already cost-competitive with conventional fossil technologies.



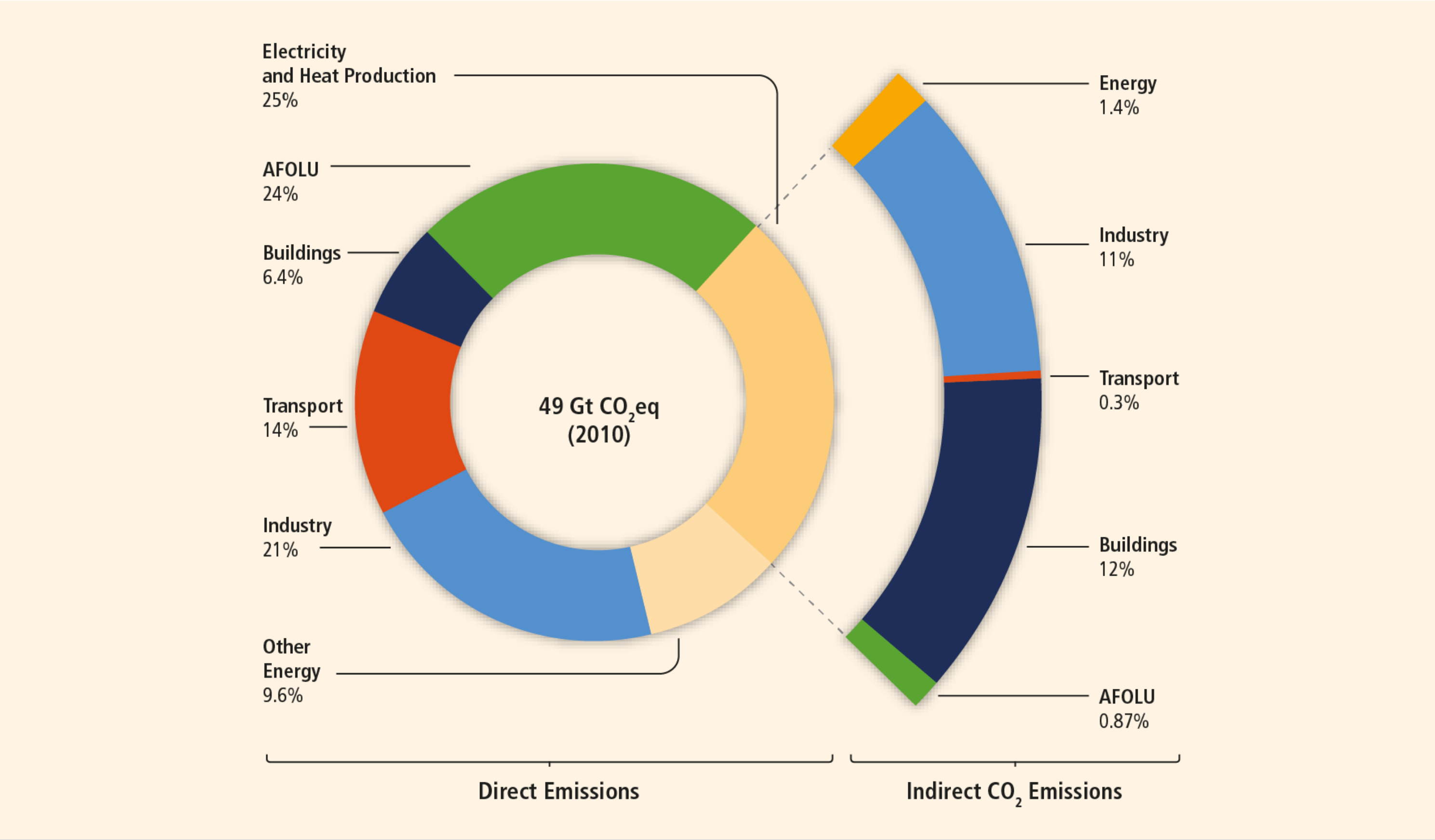
* Median Value in Mitigation Scenarios (430-530 ppm CO_2eq by 2100)

[1] in gCO_2/kWh; Based on Lifecycle Emissions

[2] Levelized Cost in USD_{2010}/MWh; Based on High Full Load Hours

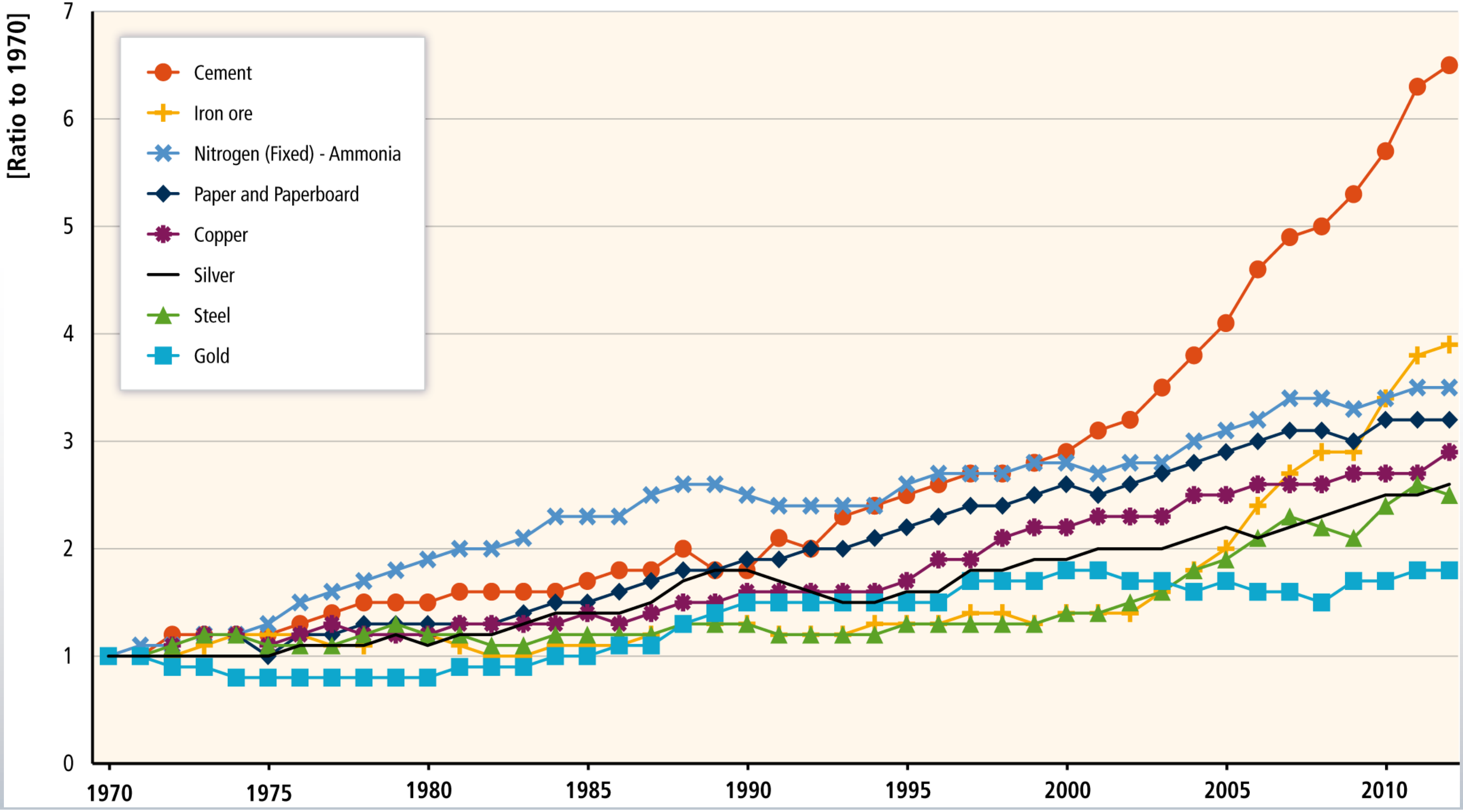
Energy sector was the largest GHG emitter in 2010, but importance of industry and buildings rise as indirect emissions are accounted for.

Greenhouse Gas Emissions by Economic Sectors

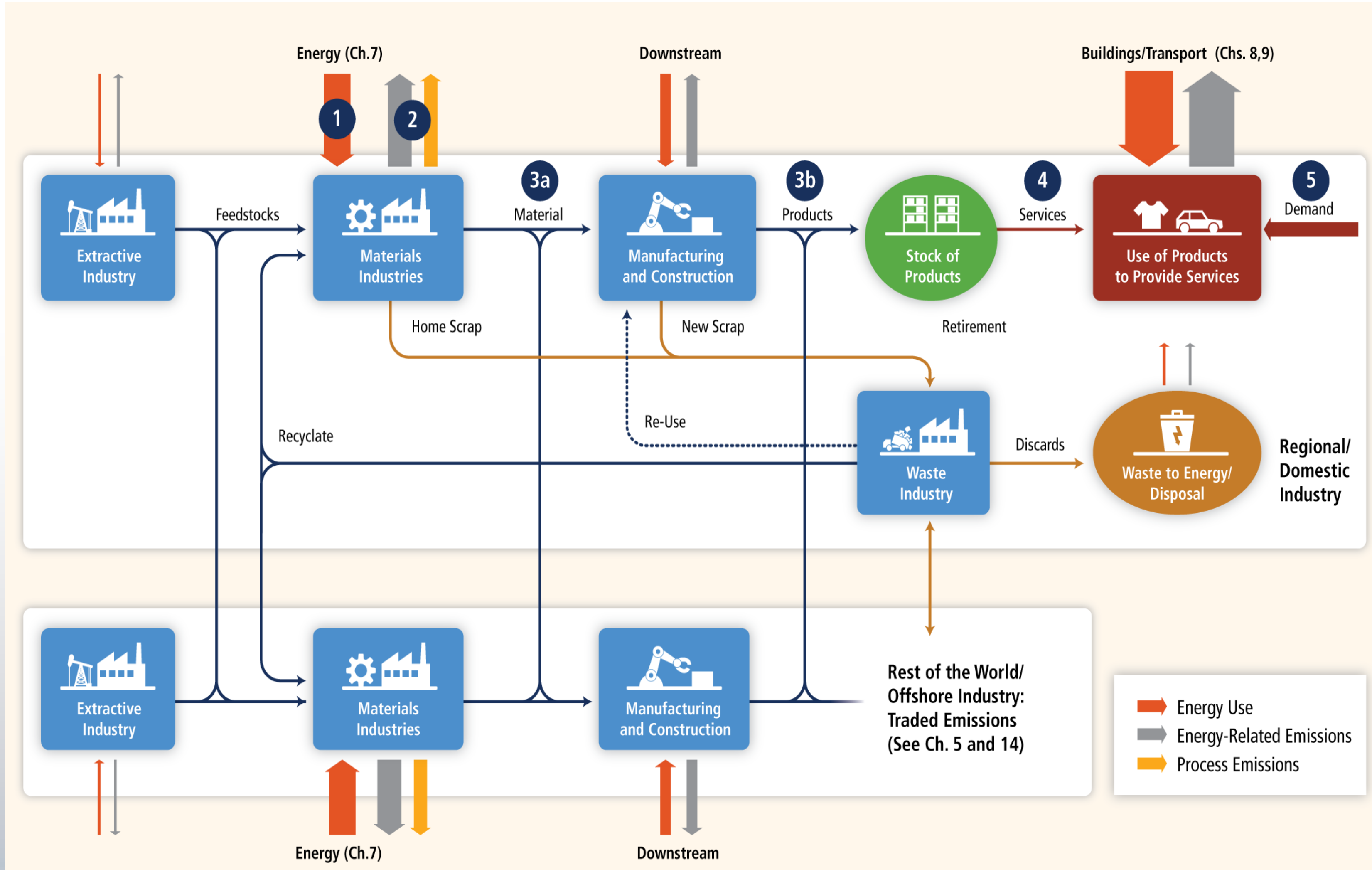


There are several End Use sector specific mitigation actions to be consistent with low stabilisation scenarios

World production of minerals and manufactured products is growing steadily driving GHG emissions



Industrial activity: seen over the supply chain



Five main options for reducing GHG emissions

(1) Energy efficiency (e.g., through furnace insulation, process coupling, or increased material recycling);

(2) Emissions efficiency (e.g., from switching to non-fossil fuel electricity supply, or applying CCS to cement kilns);

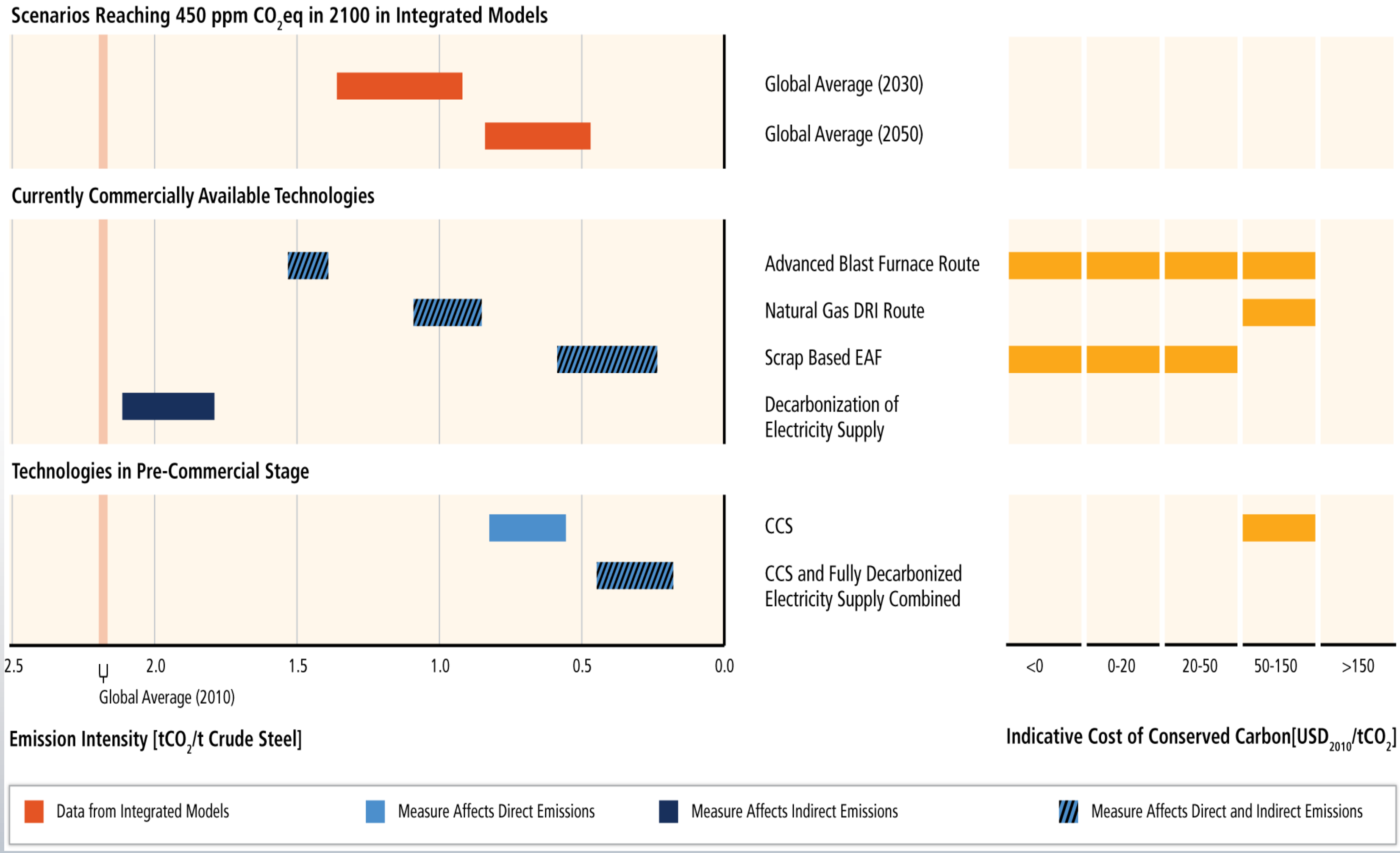
(3) Material efficiency

- (3a) Material efficiency in manufacturing (e.g., through re-use of old structural steel without melting);
- (3b) Material efficiency in product design (e.g., light-weight car design,);

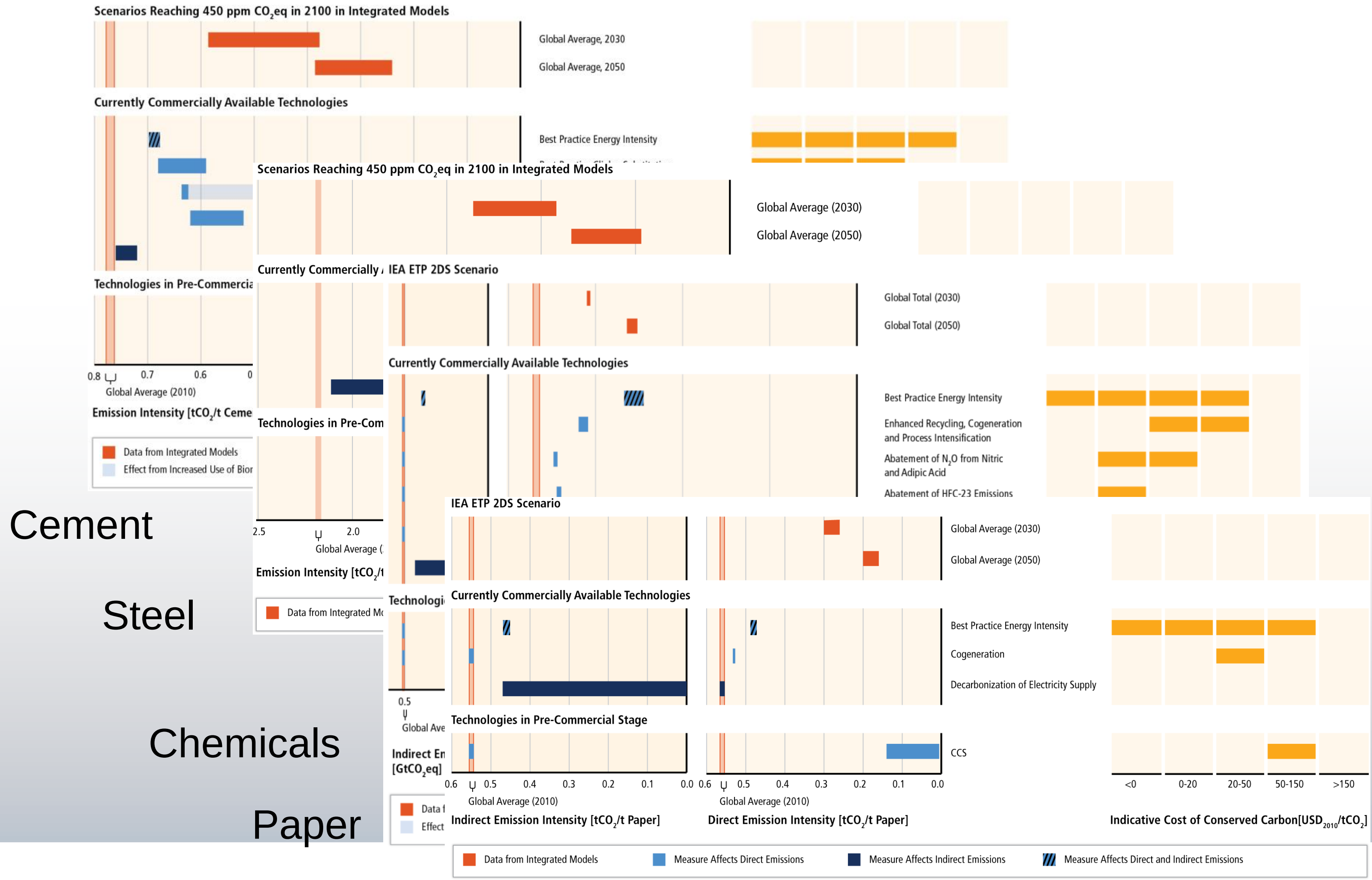
(4) Product-Service efficiency (e.g., through car sharing, or higher building occupancy);

(5) Service demand reduction (e.g., switching from private to public transport, new product design with longer life)

Significant mitigation potentials exist in various cost ranges including cost effectives measures (case study of steel)



Attractive mitigation potentials exist in all areas



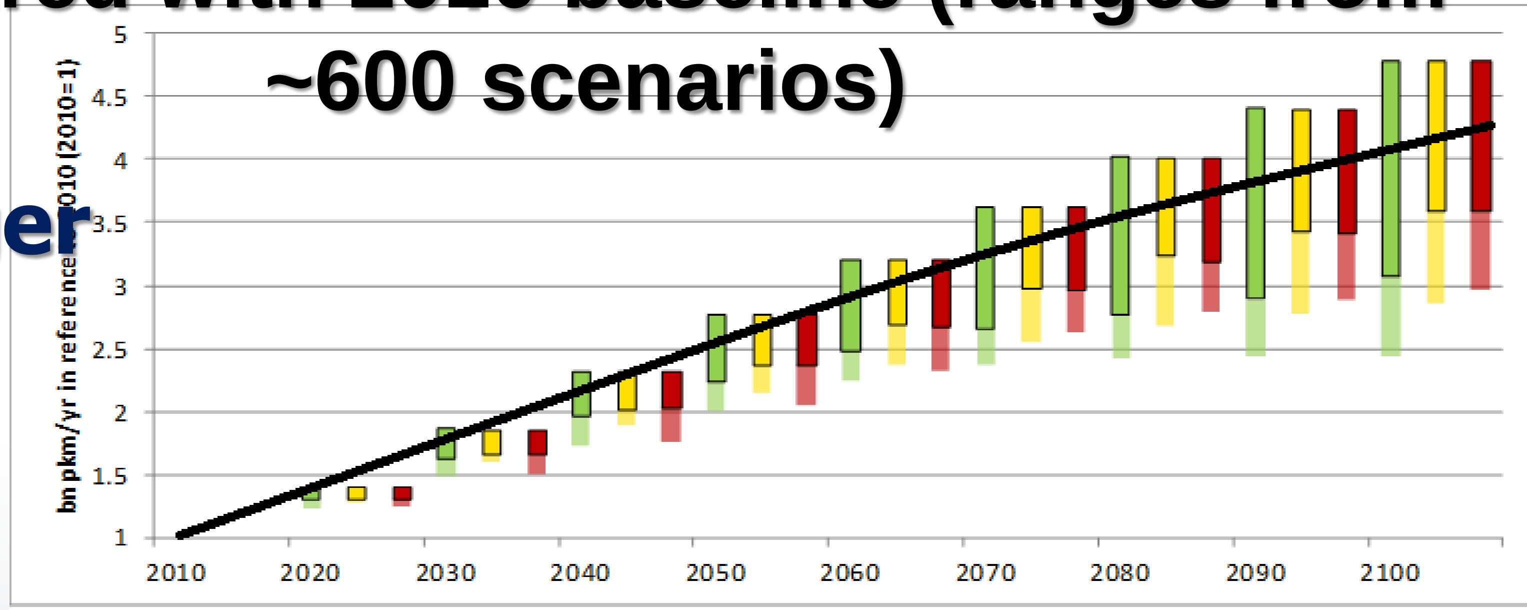
Emissions from the ***waste sector*** have doubled since 1970 – mitigation measures can follow waste hierarchy

In Building sector Advances in technologies, lifestyle change can reduce emission by mid century

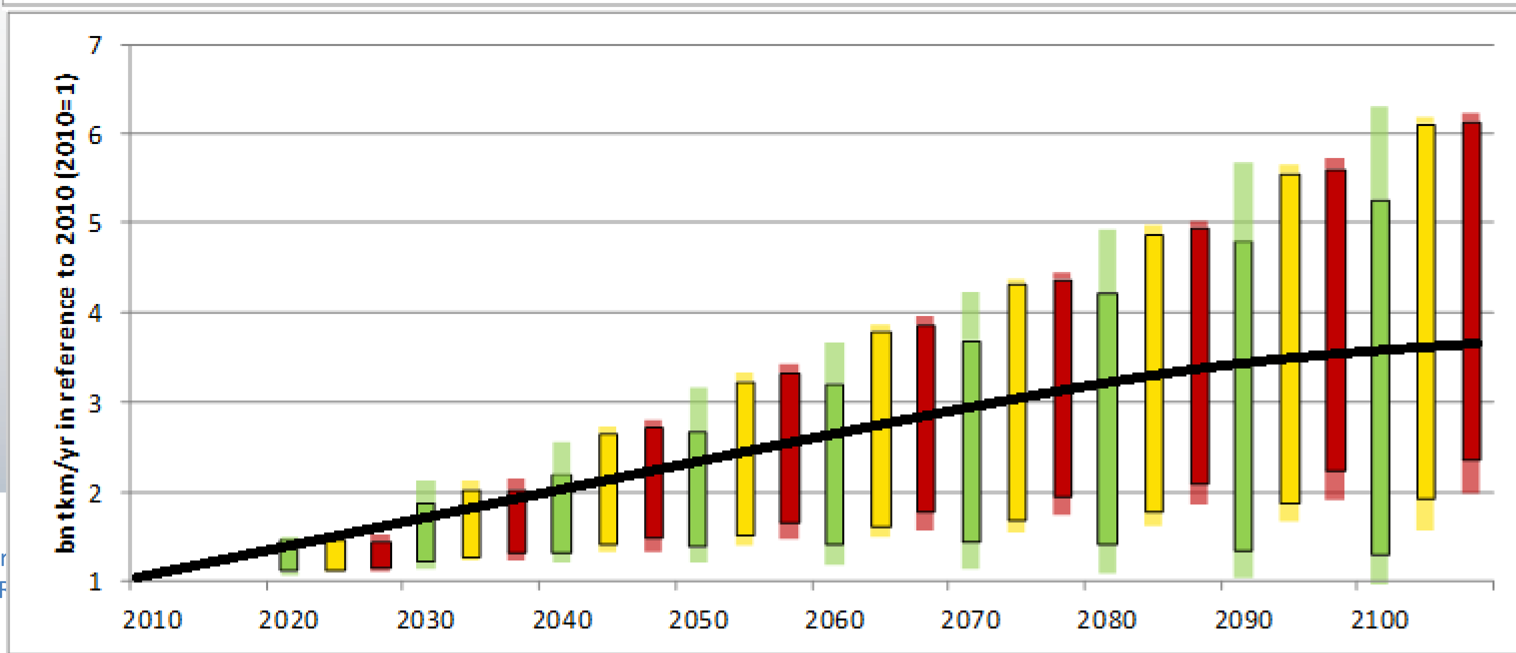
- 25–30% efficiency improvements are available at costs substantially lower than marginal energy supply costs
- Low energy building codes to avoid lock in
- Retrofit with 50-90% reduction potential for existing building stocks.
- Lifestyle change, better architecture, practices can reduce 20-50% during near term to mid century. A three- to five-fold difference in energy use exist for provision of similar building-related energy service levels in buildings.

BAU global transport demand projections compared with 2010 baseline (ranges from ~600 scenarios)

Billion passenger km /yr



Freight billion t-km/yr



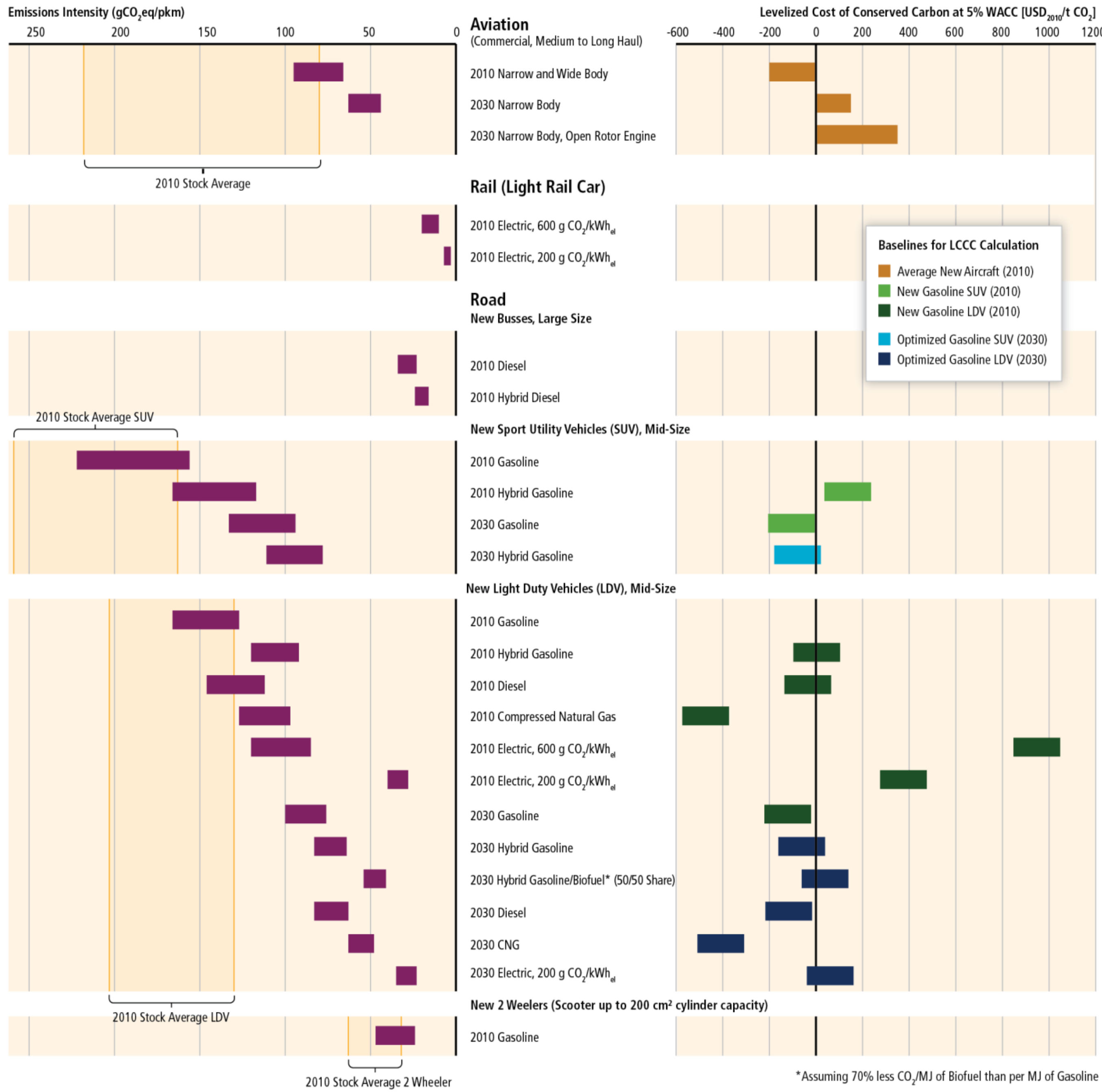
Potential emission reductions ($g\ CO_2$ / km) and mitigation costs ($/$tCO_2$) for various modes of transport.

Stock average vehicle fleet compared with:

2010 new vehicles;

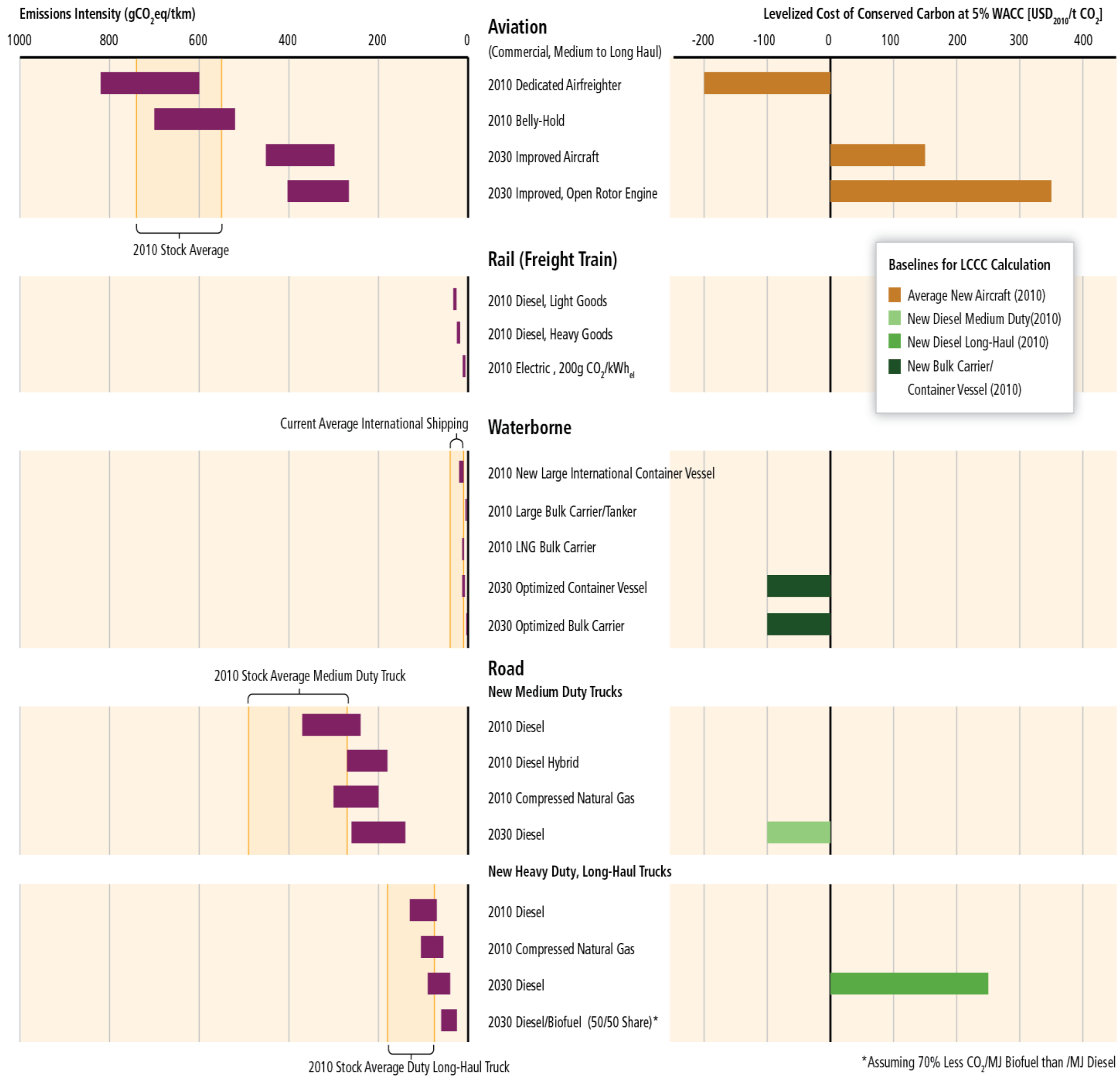
projected 2030 new vehicles and fuels.

Passenger transport



Potential emission reductions (g CO_2 / km) and mitigation costs ($/t$CO_2$) for various modes of transport.

Freight transport

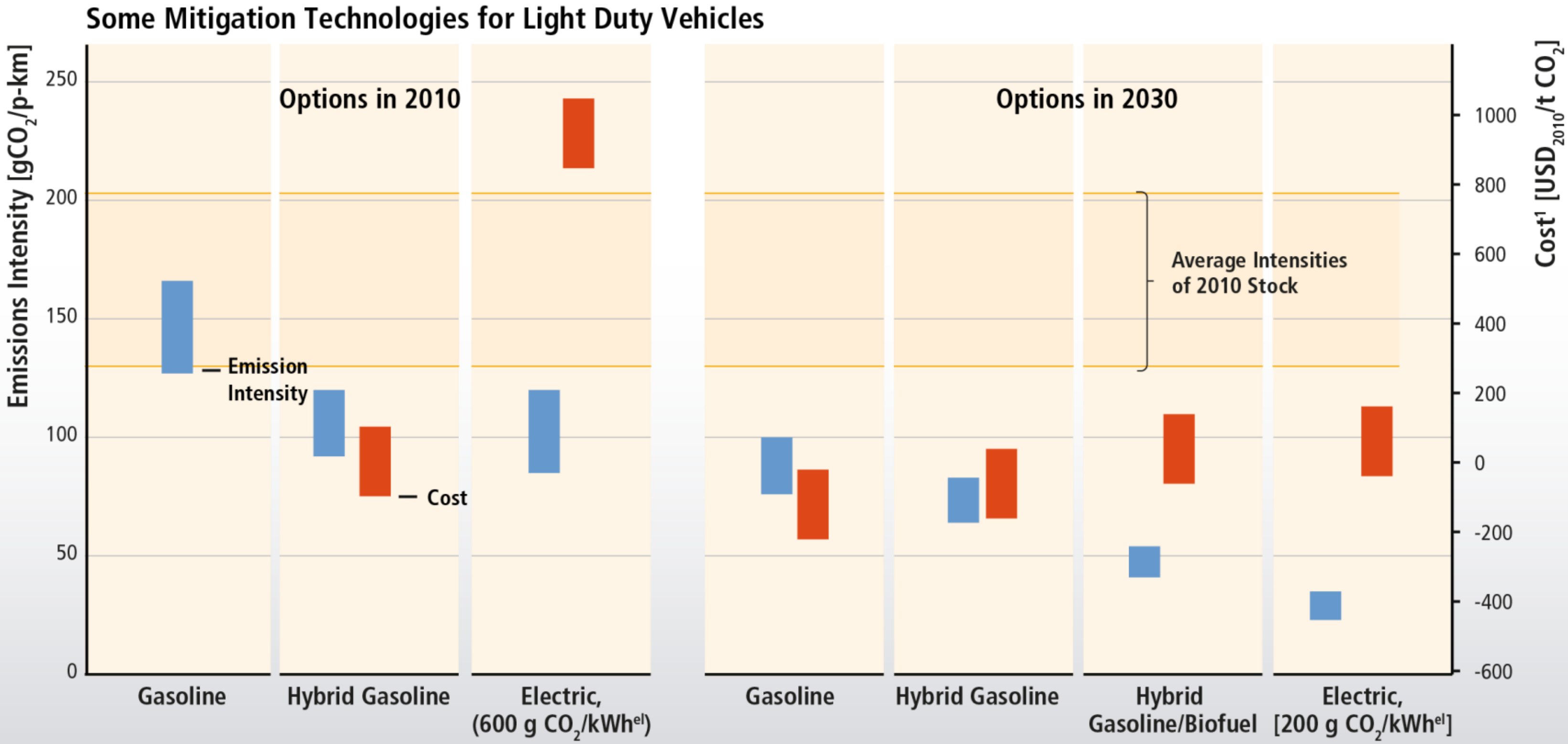


Stock average vehicle fleet compared with:

2010 new vehicles;

projected 2030 new vehicles and fuels.

But some of the more efficient technologies have higher levelized costs of conserved carbon.



[1] Levelized cost of conserved carbon at 5% weighted average cost of capital; calculated against 2010 new gasoline (2030 optimized gasoline) for 2010 (2030) options

Human Settlements, Infrastructure, and Spatial Planning

- Urban areas account for more than half of global primary energy use and energy-related CO_2 emissions

- Infrastructure and urban form are strongly interlinked, and lock-in patterns of land use, transport choice, housing, and behaviour

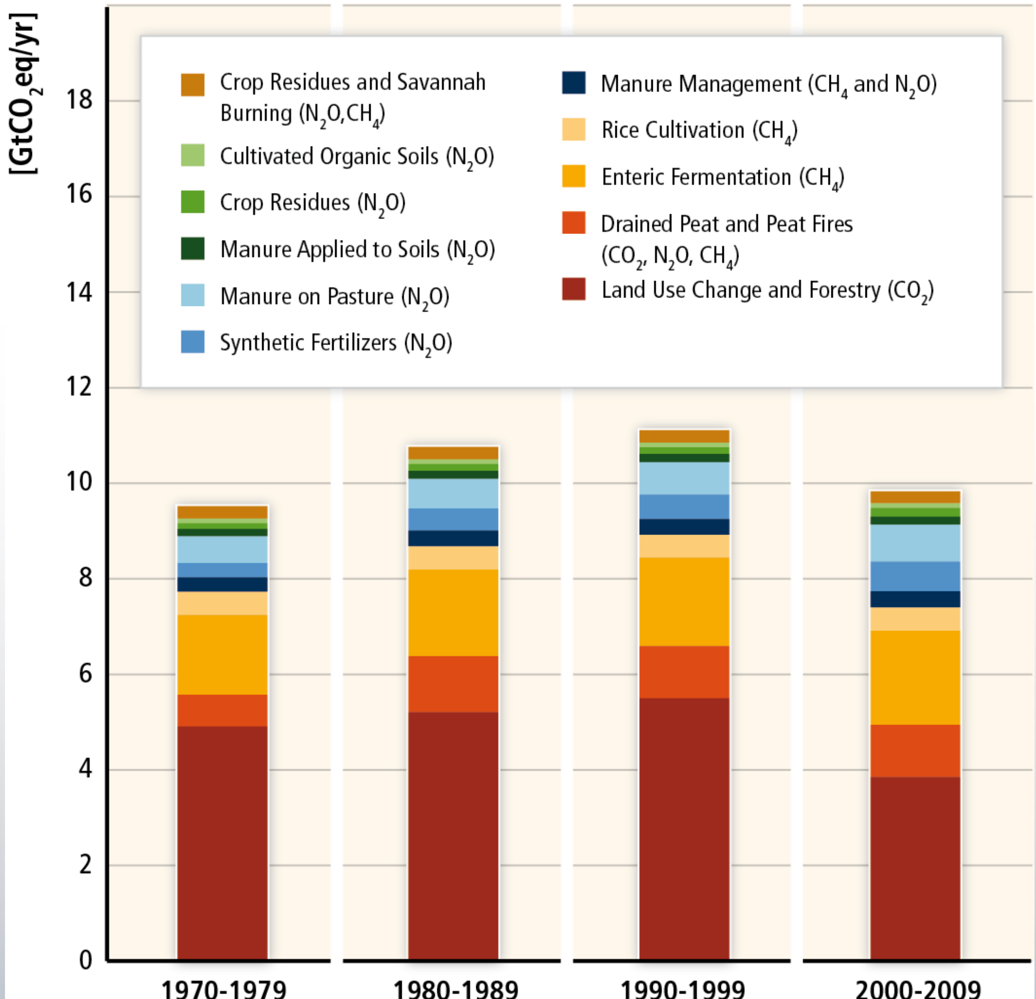
- The largest opportunities for future urban GHG emissions reduction might be in rapidly urbanizing countries where urban form and infrastructure are not locked-in. But there are often limited governance, technical, financial, and institutional capacities

- There are significant differences in per capita GHG emissions between cities within a single country . The majority of infrastructure and urban areas have yet to be built so provide enough scope.

Agriculture, Forestry and Other Land Use (AFOLU) is a unique sector

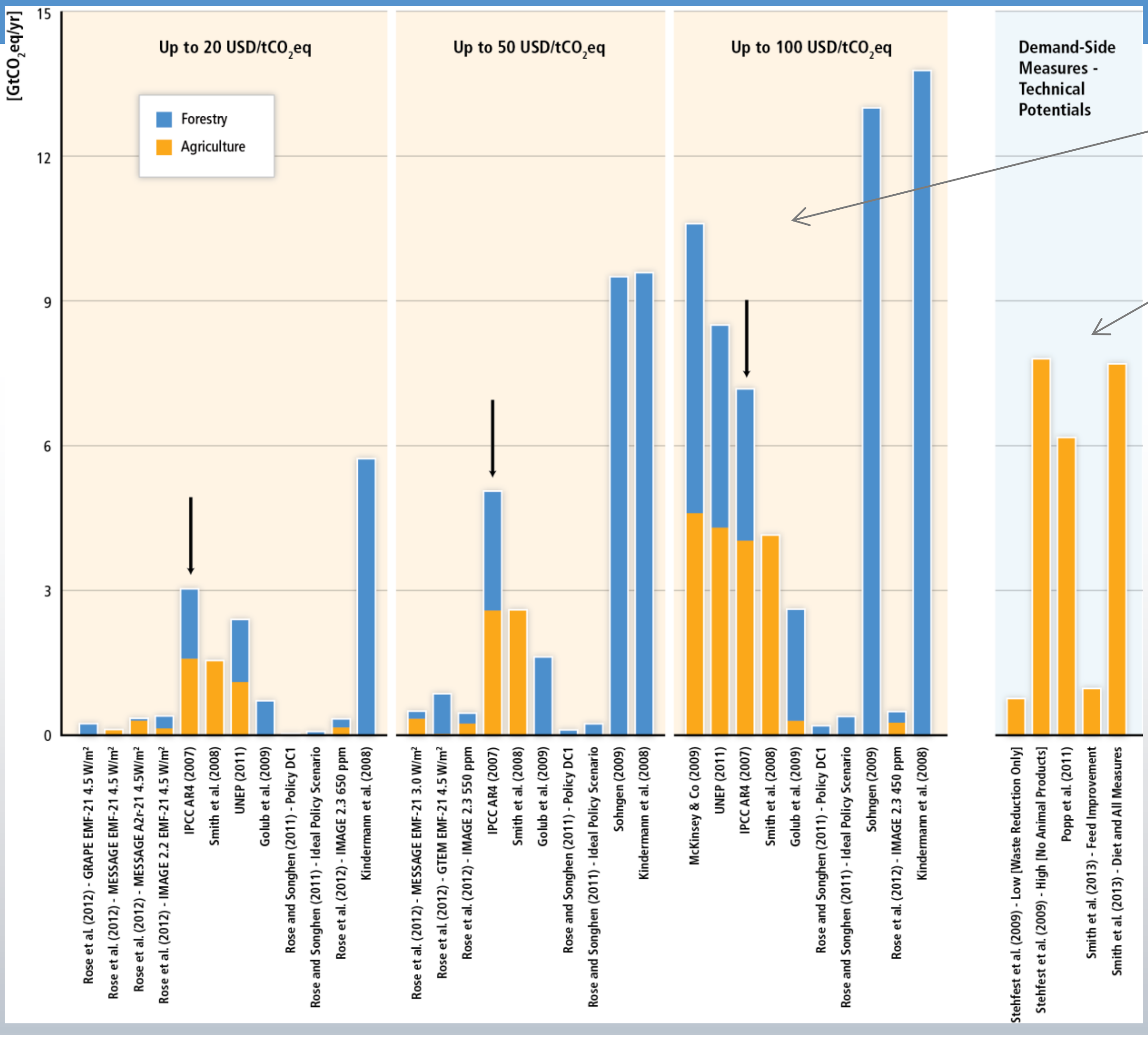
- AFOLU accounts for 24% of total anthropogenic GHG emissions
- AFOLU is the only sector where net emissions fell in the most recent decade

Agricultural emissions are increasing, but *net* forestry CO_2 emissions have fallen recently



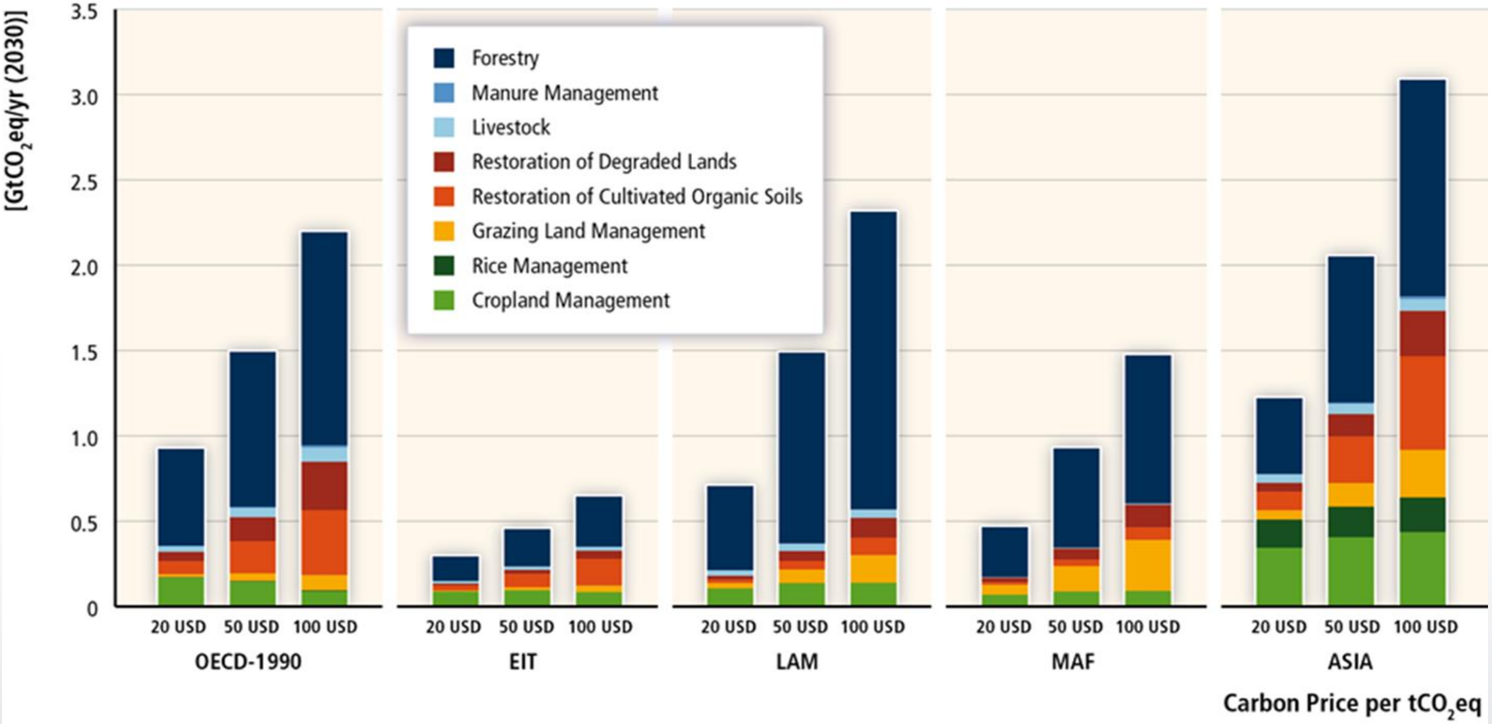
- Whilst agricultural non-CO_2 GHG emissions increased, *net* CO_2 emissions fell, mainly due to decreasing deforestation, and increased afforestation rates

Demand- and supply-side measures need to be considered



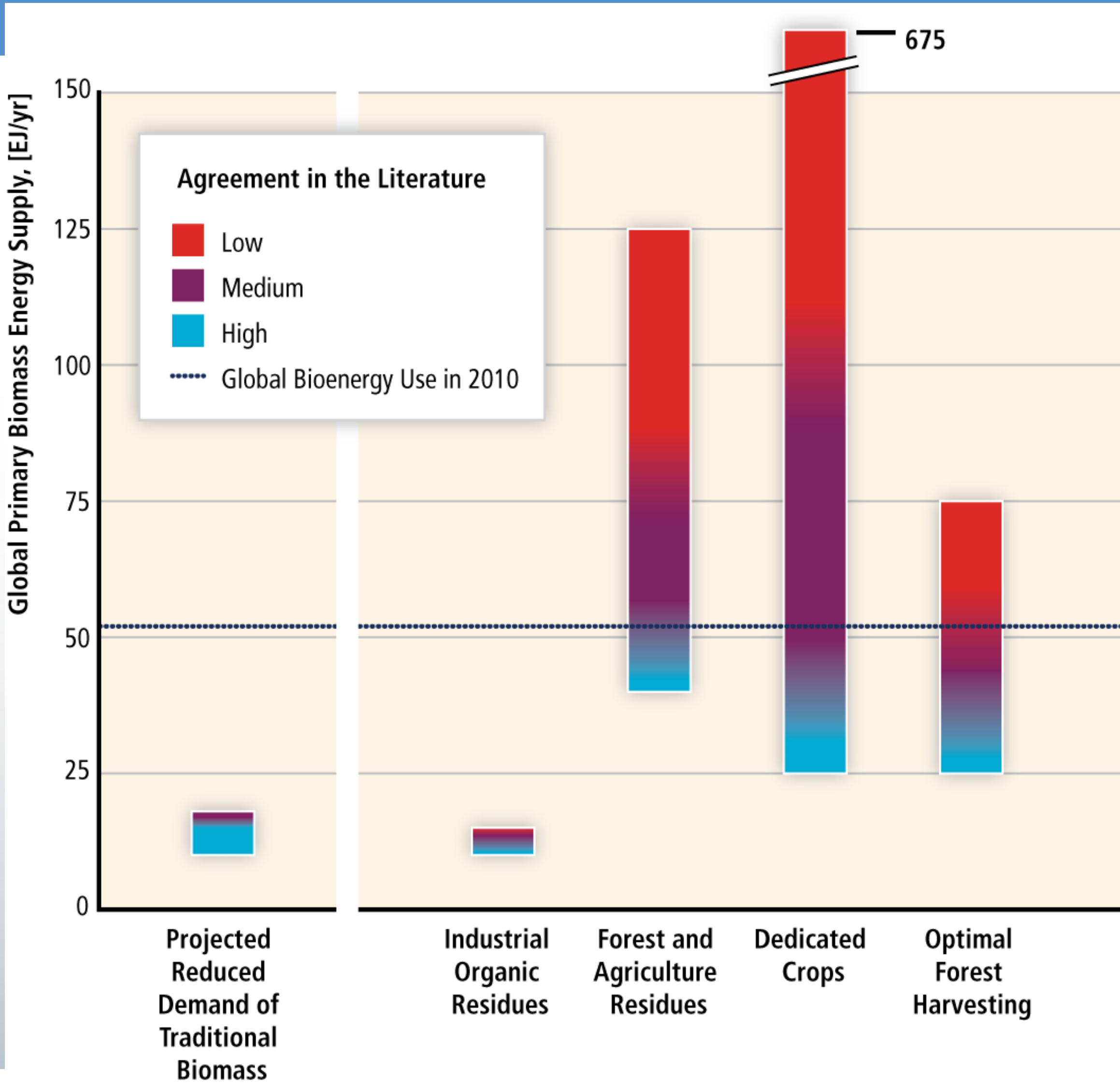
- Supply-side measures in the AFOLU sector are large & cost-competitive
- Demand-side measures such as dietary change and waste reduction also have large, but uncertain, mitigation
- Demand-side measures may be difficult to implement, but are worthy of further research
- Other options in the AFOLU sector include bioenergy

What is the potential of the mitigation options for reducing GHG emissions in the AFOLU Sector?



- Global economic mitigation potentials in agriculture in 2050 are estimated to be 0.5–10.6 $GtCO_2eq/yr$.
- Reducing food losses & waste: GHG emission savings of 0.6–6.0 $GtCO_2eq/yr$.
- Changes in diet: GHG emission savings of 0.7–7.3 $GtCO_2eq/yr$.
- Forestry mitigation options are estimated to contribute 0.2–13.8 $GtCO_2/yr$.

Global Technical Primary Biomass Potential in 2050

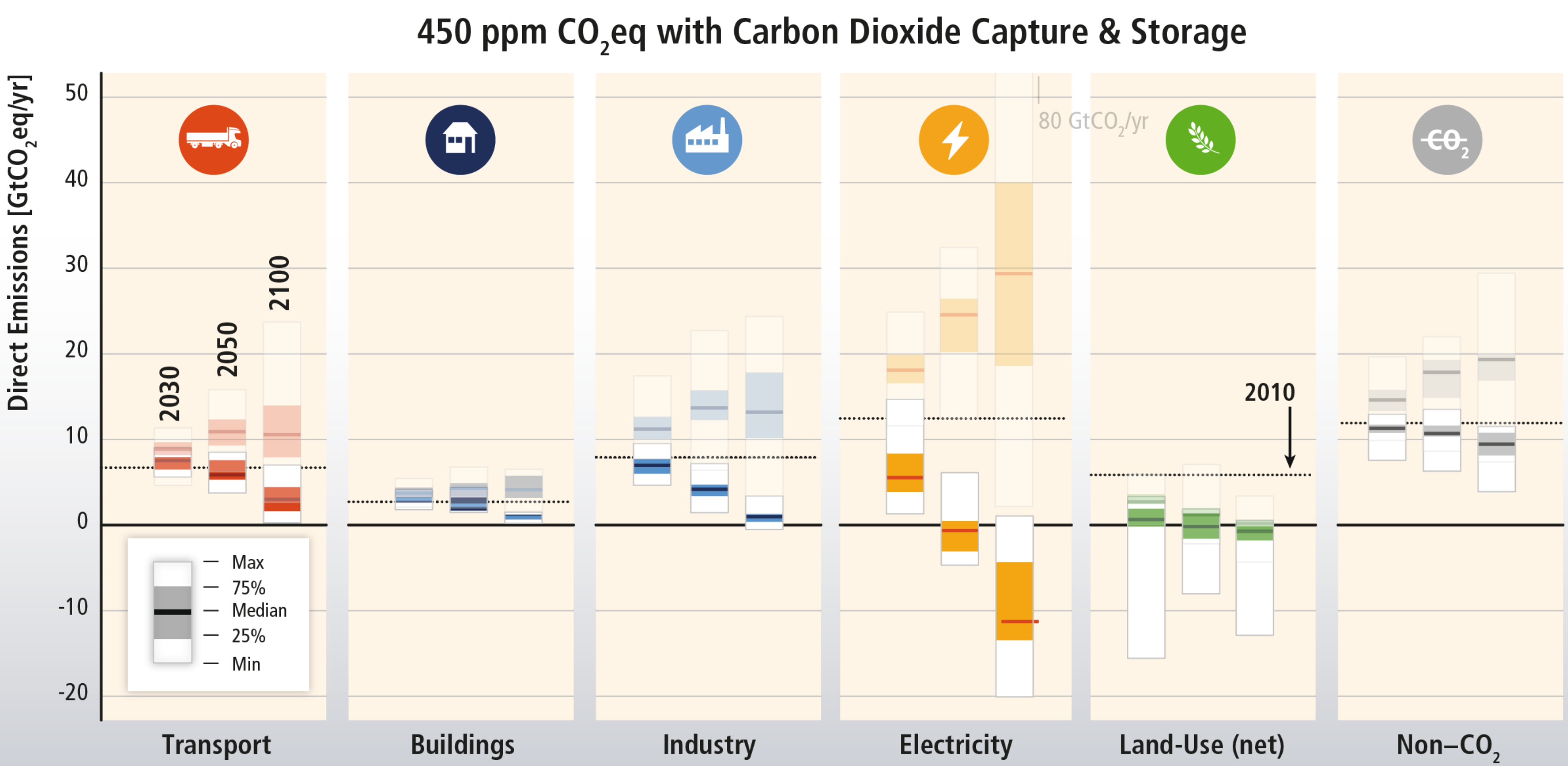


- Ranges in the estimates by major resource category.
- Colour grading shows qualitatively the degree of agreement in the estimates:
  - blue (all researchers agree that this level can be attained)
  - purple (medium agreement)
  - red (few researchers agree that this level can be attained).
- Reducing traditional biomass demand by increasing its use efficiency could release the saved biomass for other energy purposes with large benefits from a sustainable development perspective.

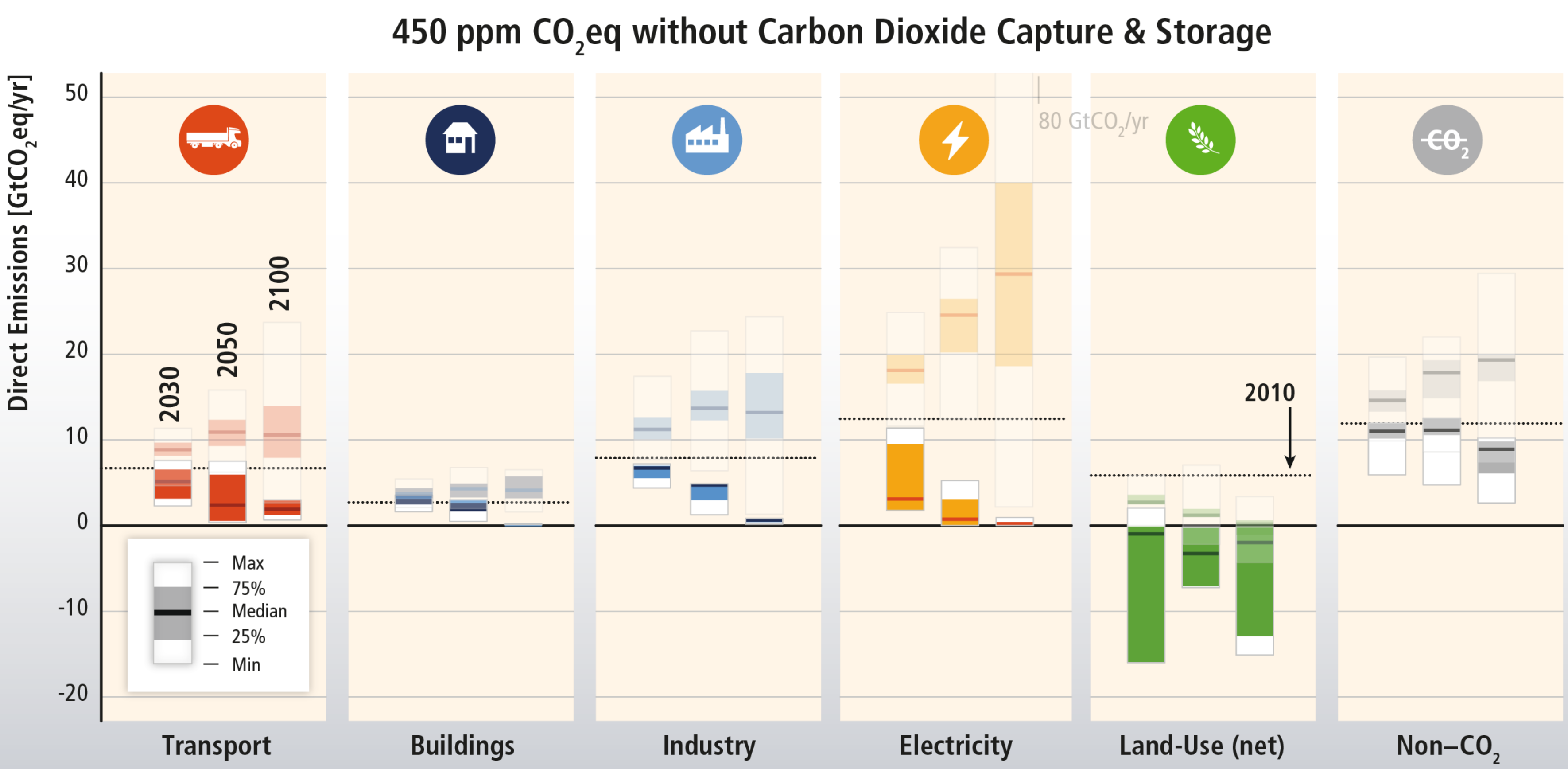
Energy system wide mitigation actions

Provide flexibility consistent with low stabilisation scenarios

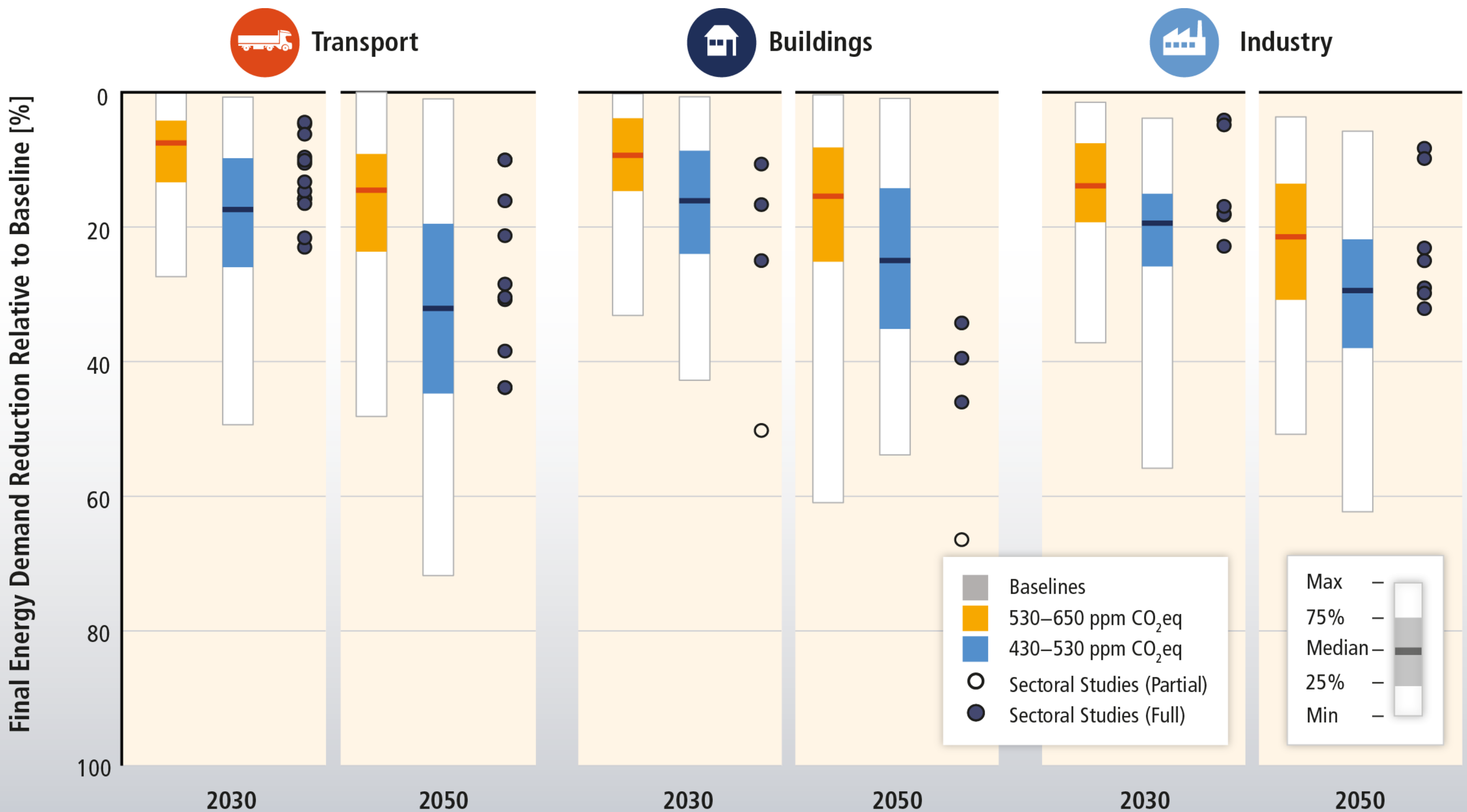
Systemic approaches to mitigation across the economy are expected to be most environmentally as well as cost effective.



Efforts in one sector determine mitigation efforts in others. Importance of negative emission option in ambitious mitigation scenarios.



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



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

Financial and institutional barriers may be overcome by packages of complementary policies that take regional specificities into account.

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Mitigation Options

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Many RE technologies have demonstrated substantial performance improvements and cost reductions.

Nuclear energy could make an increasing contribution to low-carbon energy supply, but a variety of barriers and risks exist

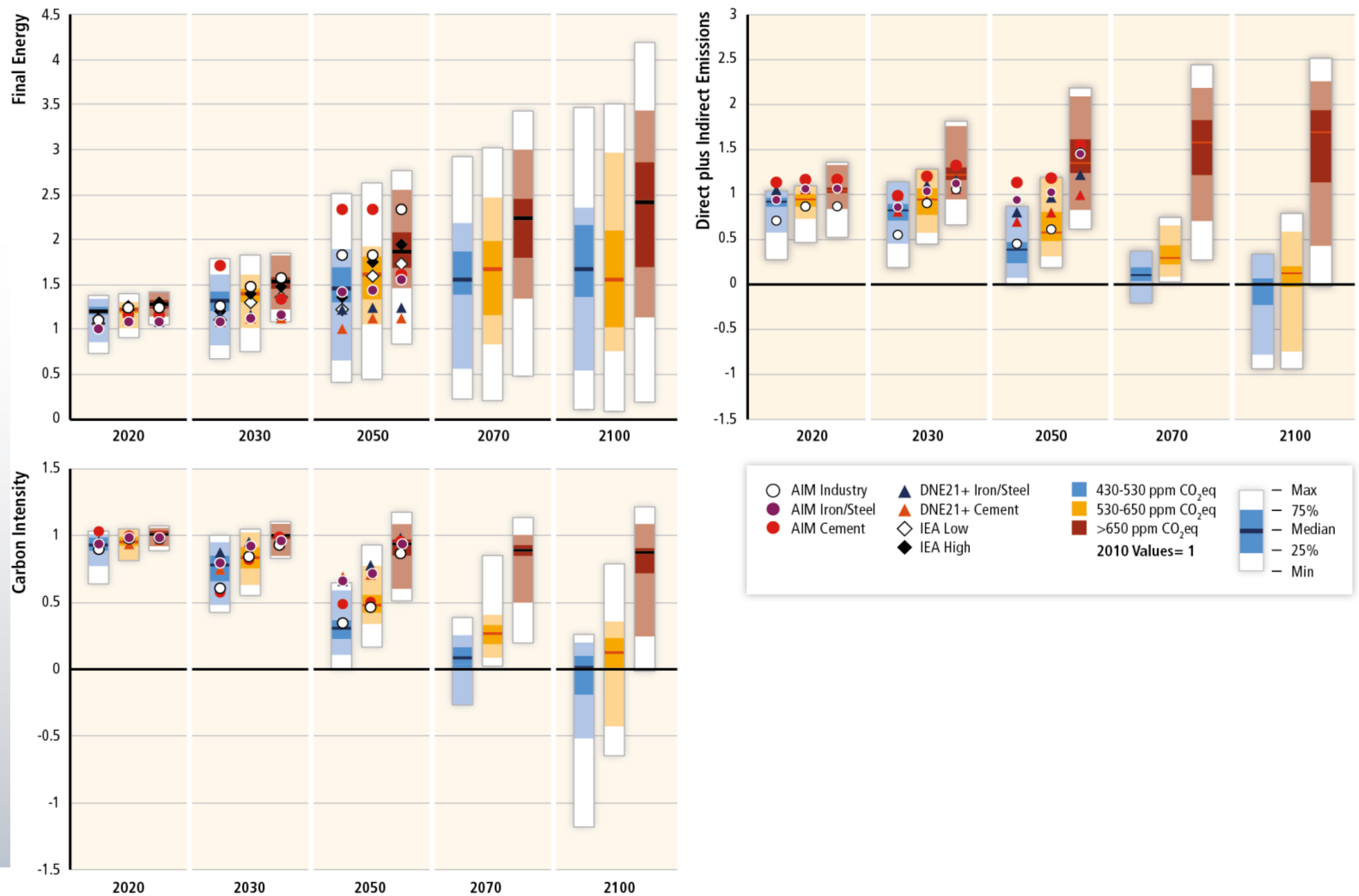
In mitigation scenarios reaching about 450 ppm CO_2eq concentrations by 2100, natural gas power generation without CCS acts as a bridge technology peaking and reaching below current levels by 2050 and declining further in the second half of the century

Components of integrated CCS system exist and could reduce lifecycle emissions CCS has not yet been applied at scale to a large, commercial fossil-fuel power plant but components of integrated CCS system exist and barriers are to be overcome

Combining bioenergy with CCS (BECCS) offers the prospect of energy supply with large-scale net negative emissions, which plays an important role in many low-stabilization scenarios, while it entails challenges and risks.

Until 2050, bottom-up studies estimate the economic potential to be between 2–10 GtCO_2 per year. Some mitigation scenarios show higher deployment of BECCS towards the end of the century.

Long-term scenarios for industry point towards emissions efficiency as key mitigation strategy and decreasing carbon intensity through use of low carbon electricity



AFOLU

- The most cost-effective mitigation options
- In forestry are afforestation, sustainable forest management and reducing deforestation, with large differences in their relative importance across regions.
- In agriculture, the most cost-effective mitigation options are cropland management, grazing land management, and restoration of organic soils
- The economic mitigation potential is estimated to be 7.2 to 11 GtCO_2eq/year in 2030 for mitigation efforts consistent with carbon prices up to 100 USD/tCO_2eq, about a third of which can be achieved at a <20 USD/tCO_2eq (*medium evidence, medium agreement*).
- Demand-side measures, such as changes in diet and reductions of losses in the food supply chain, have a significant, but uncertain, potential roughly 0.76–8.6 GtCO_2eq/yr by 2050 .