Sixth Assessment Report

WORKING GROUP III – MITIGATION OF CLIMATE CHANGE

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INTERGOVERNMENTAL PANEL ON climate change

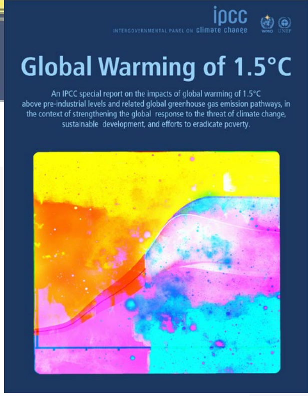
WMO UNEP

Climate Change 2022

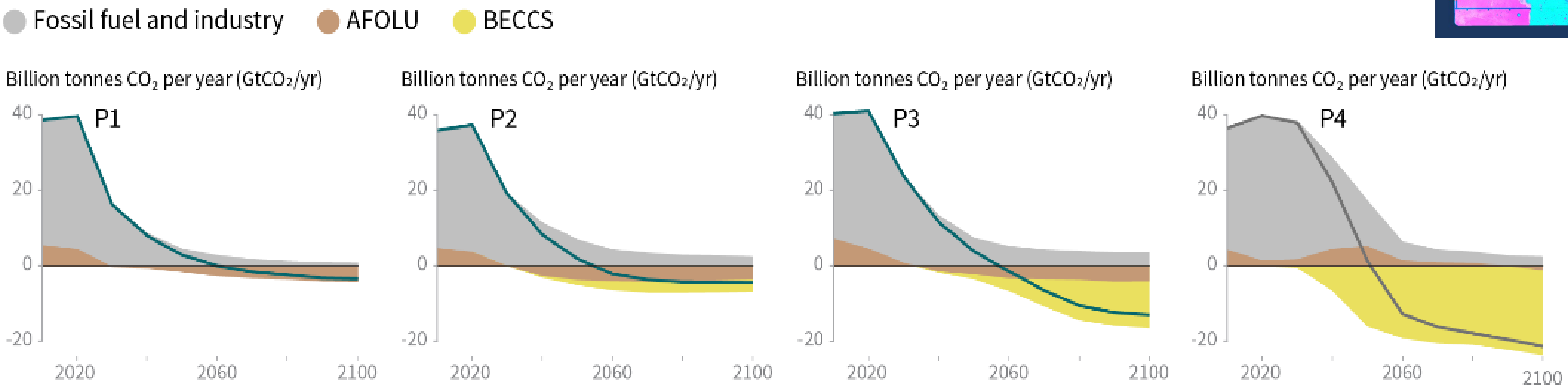
Mitigating climate change through demand-side opportunities: a novelty in AR6

[Matt Bridgestock, Director and Architect at John Gilbert Architects]

Characteristics of four illustrative model pathways



Breakdown of contributions to global net CO_2 emissions in four illustrative model pathways

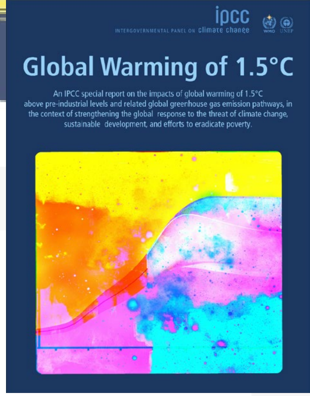


P1: A scenario in which social, business and technological innovations result in lower energy demand up to 2050 while living standards rise, especially in the global South. A downsized energy system enables rapid decarbonization of energy supply. Afforestation is the only CDR option considered; neither fossil fuels with CCS nor BECCS are used.

P2: A scenario with a broad focus on sustainability including energy intensity, human development, economic convergence and international cooperation, as well as shifts towards sustainable and healthy consumption patterns, low-carbon technology innovation, and well-managed land systems with limited societal acceptability for BECCS.

P3: A middle-of-the-road scenario in which societal as well as technological development follows historical patterns. Emissions reductions are mainly achieved by changing the way in which energy and products are produced, and to a lesser degree by reductions in demand.

P4: A resource- and energy-intensive scenario in which economic growth and globalization lead to widespread adoption of greenhouse-gas-intensive lifestyles, including high demand for transportation fuels and livestock products. Emissions reductions are mainly achieved through technological means, making strong use of CDR through the deployment of BECCS.



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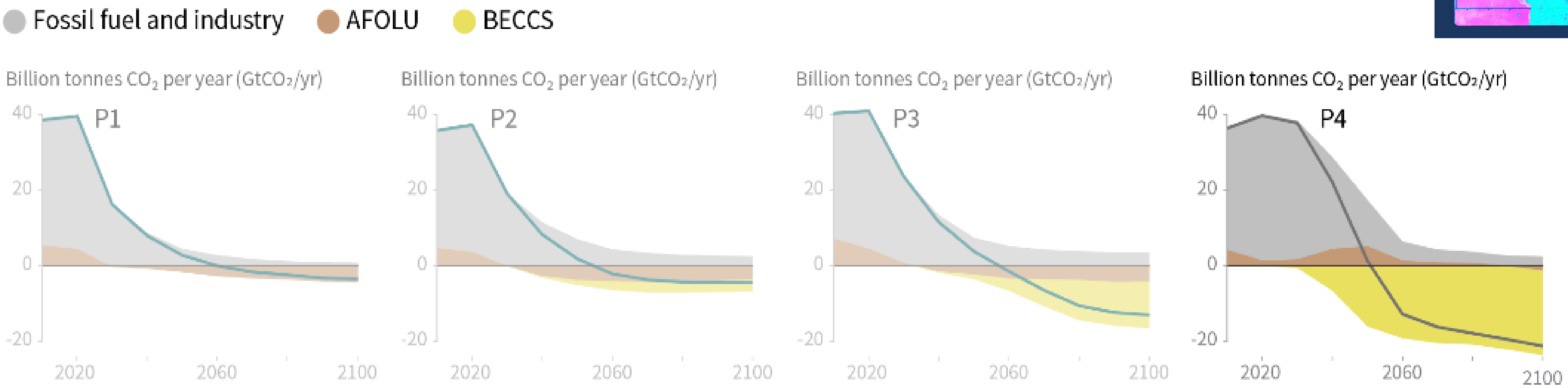

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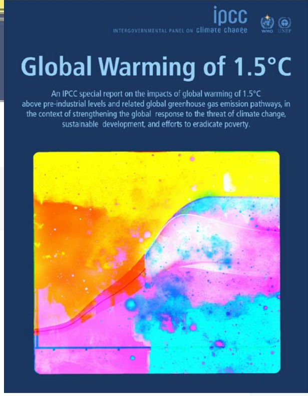

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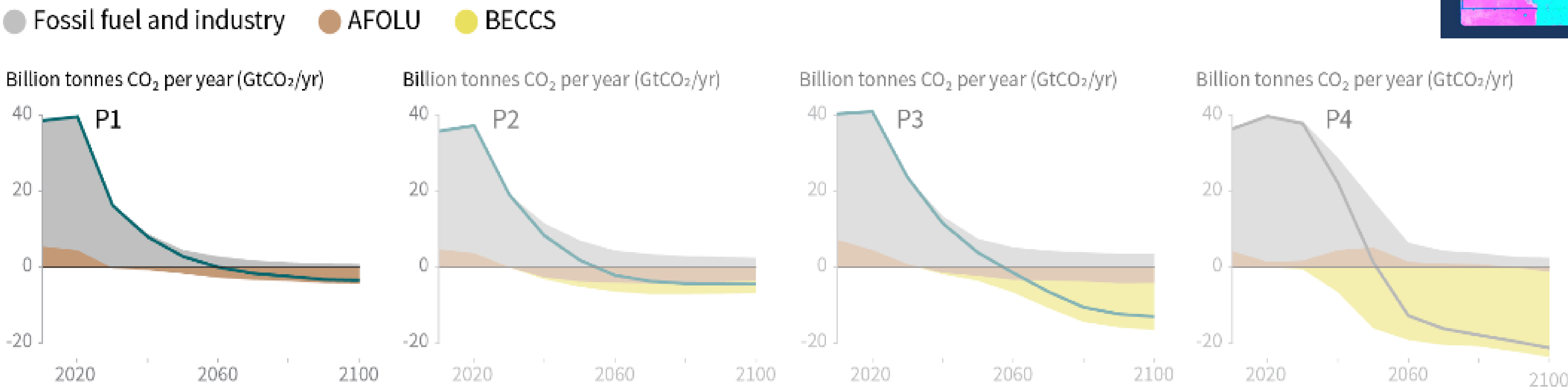

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There are options available **now** in every sector that can at least **halve** emissions by 2030

Demand and services

Energy

Land use

Industry

Urban

Buildings

Transport

C.4 Reducing GHG emissions across the full energy sector requires major transitions, including a substantial reduction in overall fossil fuel use, the deployment of low-emission energy sources, switching to alternative energy carriers, and energy efficiency and conservation. The contin
emissi

C.5 Net-zero CO_2 emissions from the industrial sector are challenging but possible. Reducing industry emissions will entail coordinated action throughout value chains to promote all mitigation options, including demand management, energy and materials efficiency, circular
ction
the
and

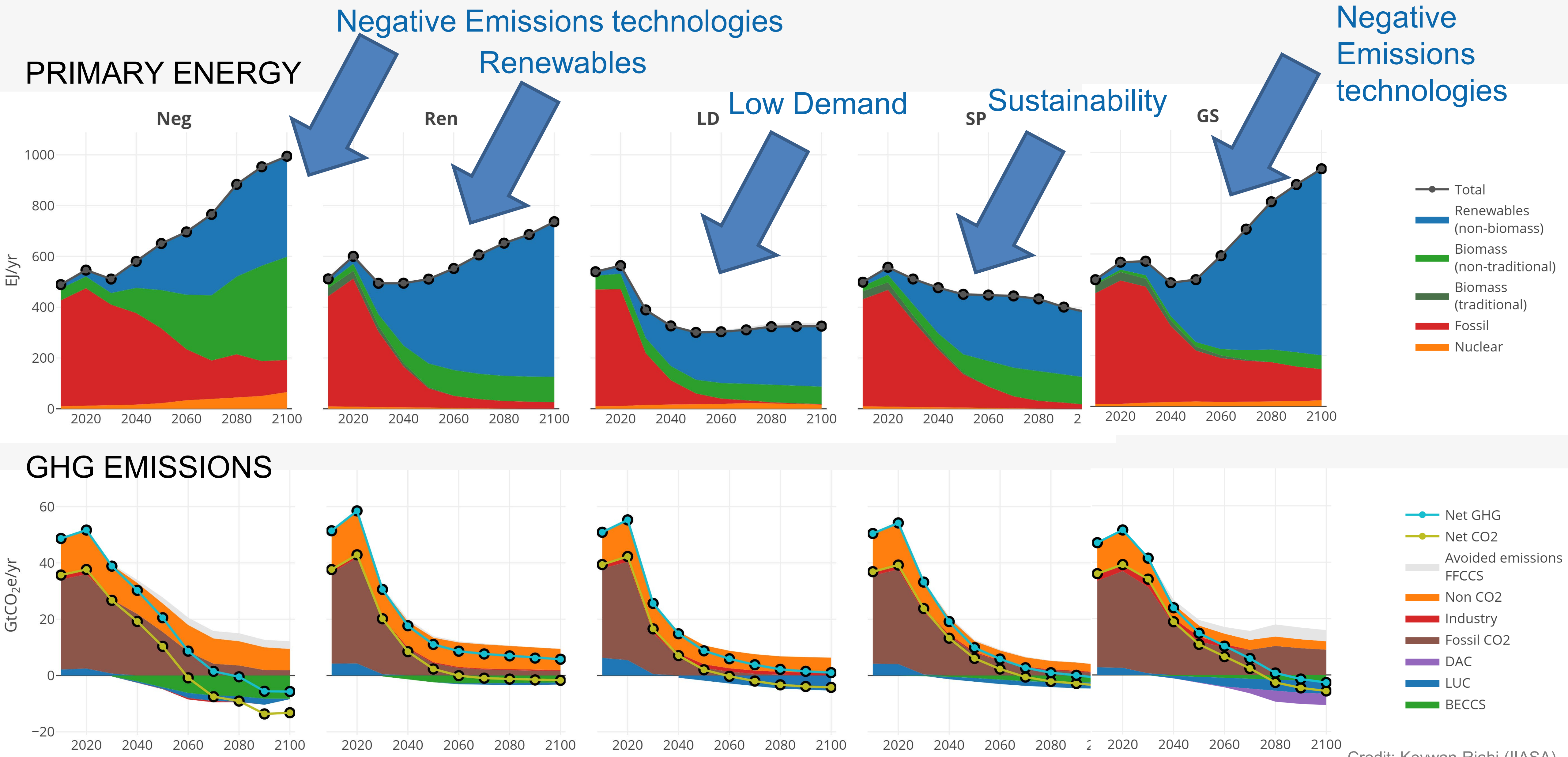
most
regions. There are many sustainable options for demand management, materials efficiency, and circular material flows that can contribute to reduced emissions, but how these can be applied will vary across regions a
and wou
technolog
scenarios
underestimated compared to bottom-up industry-specific models. (*high confidence*) {3.4, 5.3, Figure

C.6 Urban areas can create opportunities to increase resource efficiency and significantly reduce GHG emissions through the systemic transition of infrastructure and urban form through low-emission development pathways towards net-zero emissions. Ambitious mitigation efforts for established, rapidly growing and emerging cities will encompass 1) reducing or changing energy and material consumption, 2) electrification, and 3) enhancing carbon uptake and storage in the urban environment. Cities can achieve net-zero emissions, but only if emissions are reduced

C.7. In modelled global scenarios, existing buildings, if retrofitted, and buildings yet to be built, are projected to approach net zero GHG emissions in 2050 if policy packages, which combine ambitious sufficiency, efficiency, and renewable energy measures, are effectively implemented and barriers to decarbonisation are removed. Low ambitious policies increase the

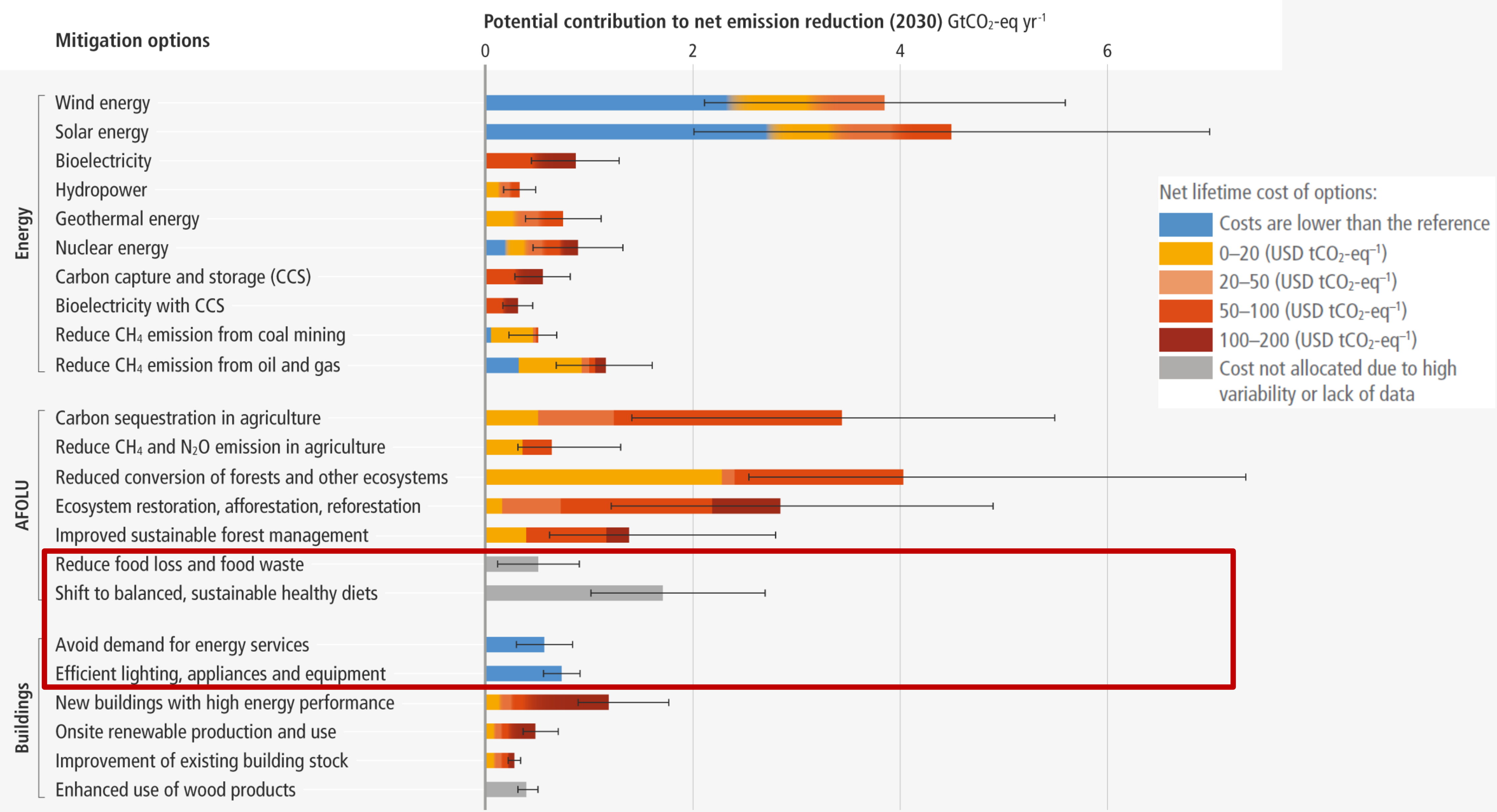
Illustrative Mitigation Pathways (IMPs) =>

There are many ways to achieve net zero … with benefits and risks to each.



Credit: Keywan Riahi (IIASA)

The total emission mitigation potential by 2030 is sufficient to reduce global greenhouse gas (GHG) emissions to half of the current level or less



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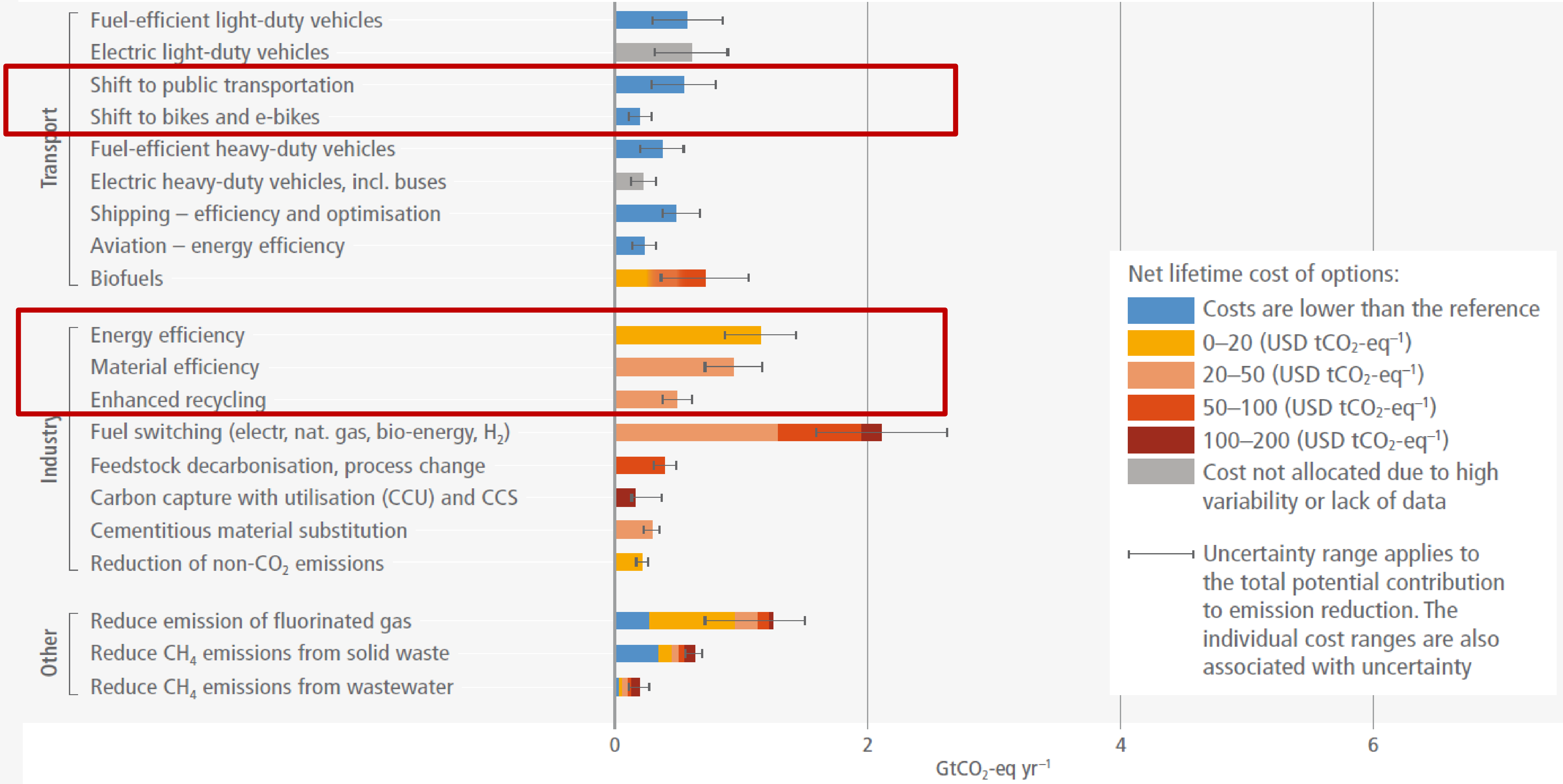


Granular technologies and decentralised energy end-use, characterised by modularity, small unit sizes and small unit costs, diffuse faster into markets and are associated with faster technological learning benefits, greater efficiency, more opportunities to escape technological lock-in, and greater employment

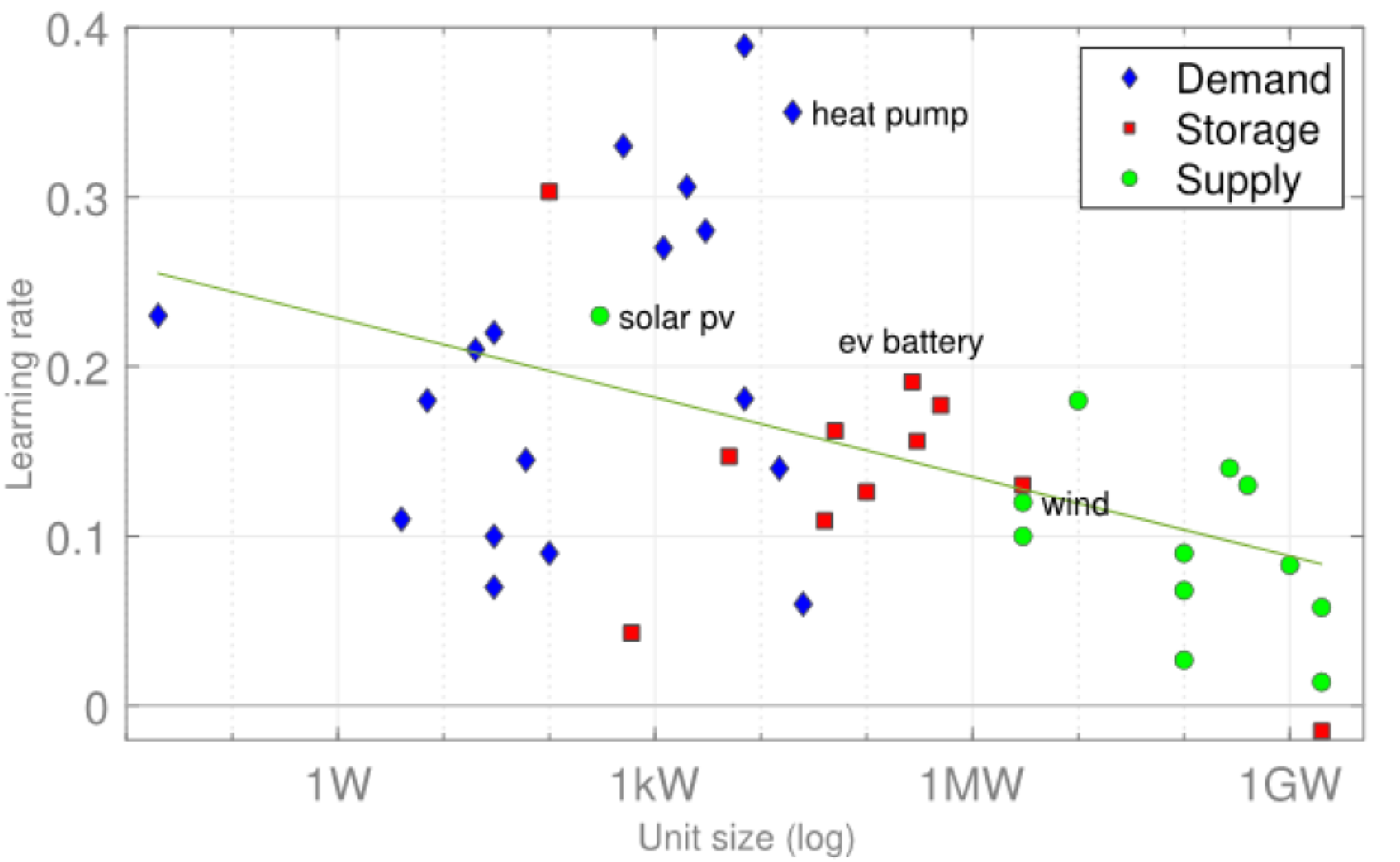
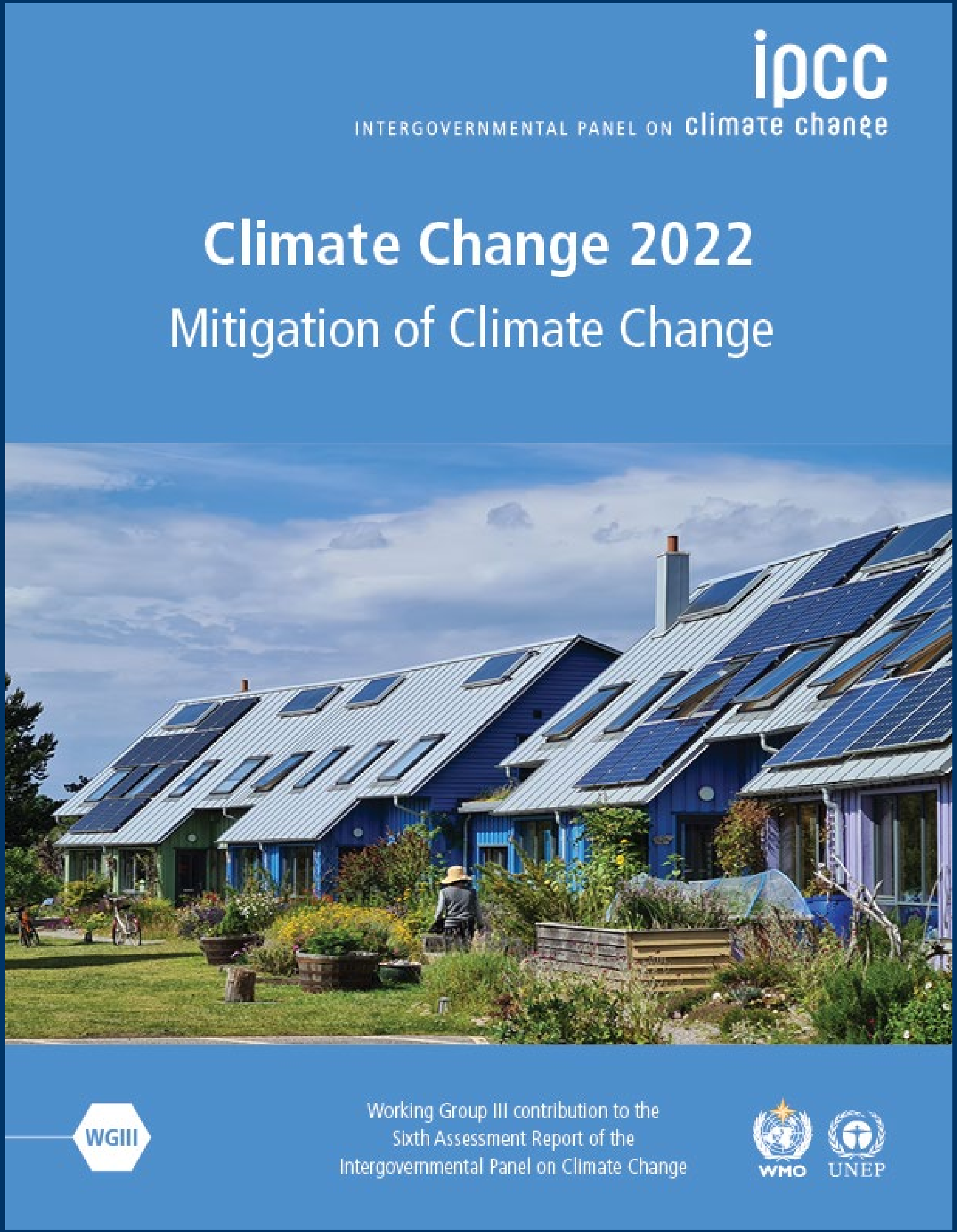


Figure 5.15 Demand technologies show high learning rates. Learning from small-scale granular technologies outperforms learning in larger supply side technologies. Line is linear fit of log unit size to learning rate for all 41 technologies plotted.



[Matt Bridgestock, Director and Architect at John Gilbert Architects]

Demand is especially important in developed countries

In developed countries, most technological, social, business (model) innovations are needed for **rethinking** and **restructuring** existing urban space, **repurposing**, **retrofitting** and **reusing existing** infrastructure, vehicle stocks and equipment rather having to build/produce new




Demand and services

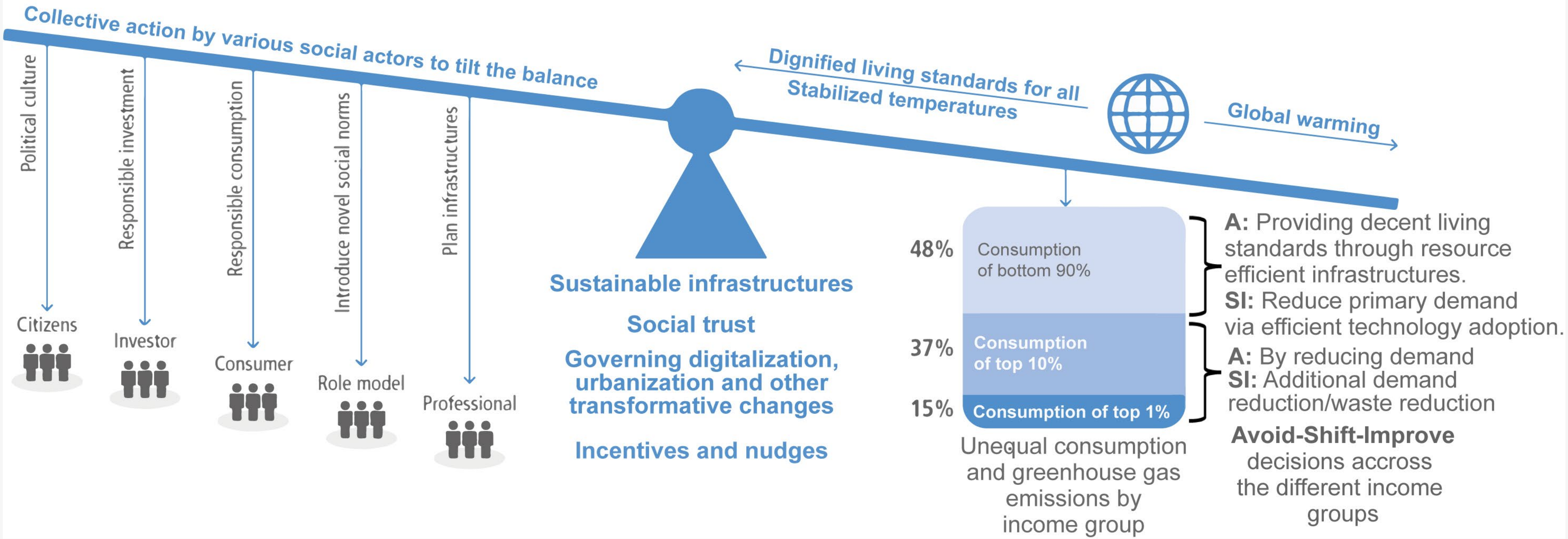
- potential to **bring down** global **emissions** by **40-70%** by 2050
- walking and cycling, electrified transport, reducing air travel, and adapting houses make large contributions
- **lifestyle changes** require **systemic changes** across all of society
- **some** people require additional **housing**, **energy** and **resources** for human wellbeing

[Bosch, Unsplash/Yoav Aziz, Adam Bartoszewicz, Victor Hernandez]

Individuals are important, but people alone cannot bring in change: need infrastructure, technology access, incentives, equity

Demand side mitigation is about more than behavioural change. Reconfiguring the way services are provided while simultaneously changing social norms and preferences will help reduce emissions and access. Transformation happens through societal, technological and institutional changes.

Tilting the balance towards less resource intensive service provisioning

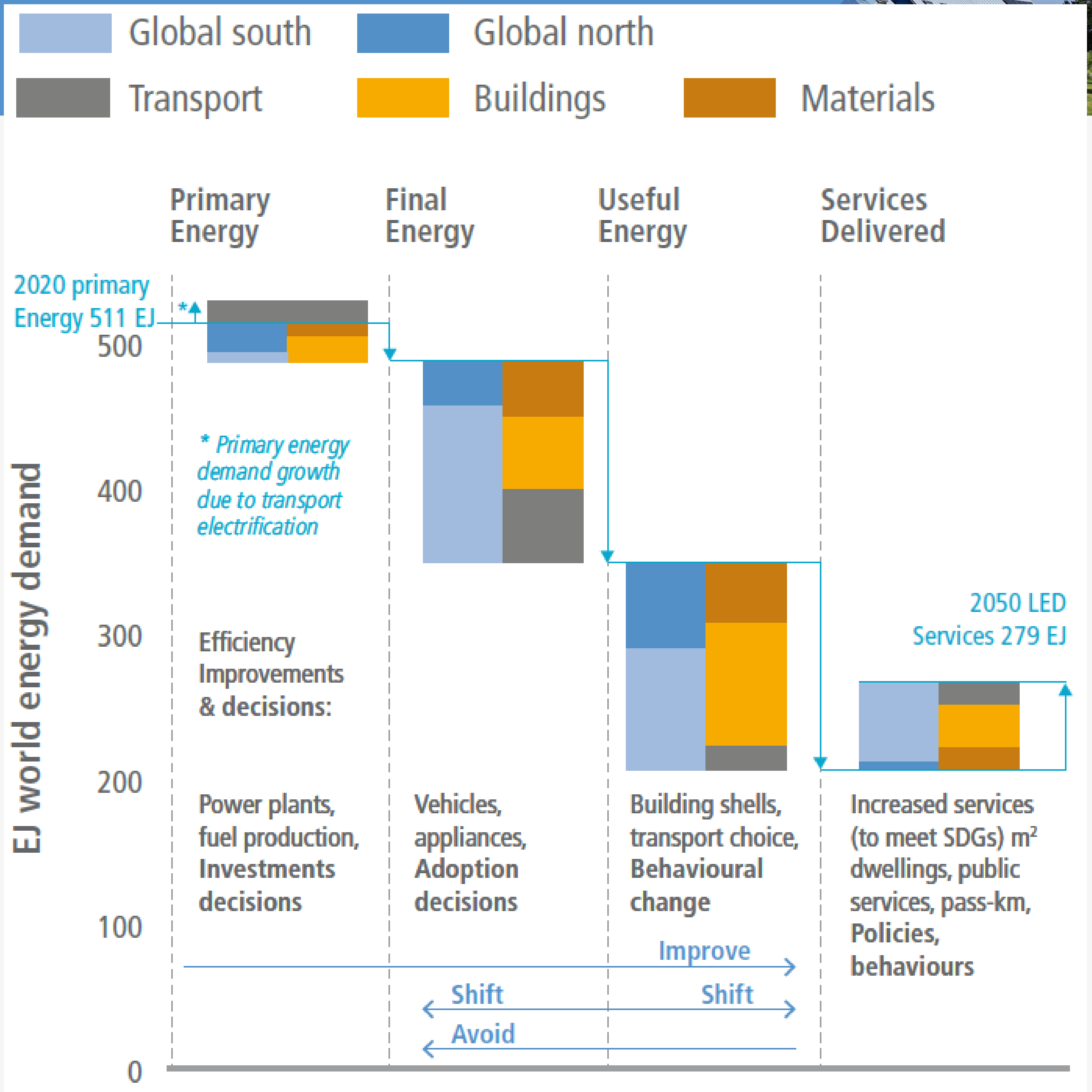


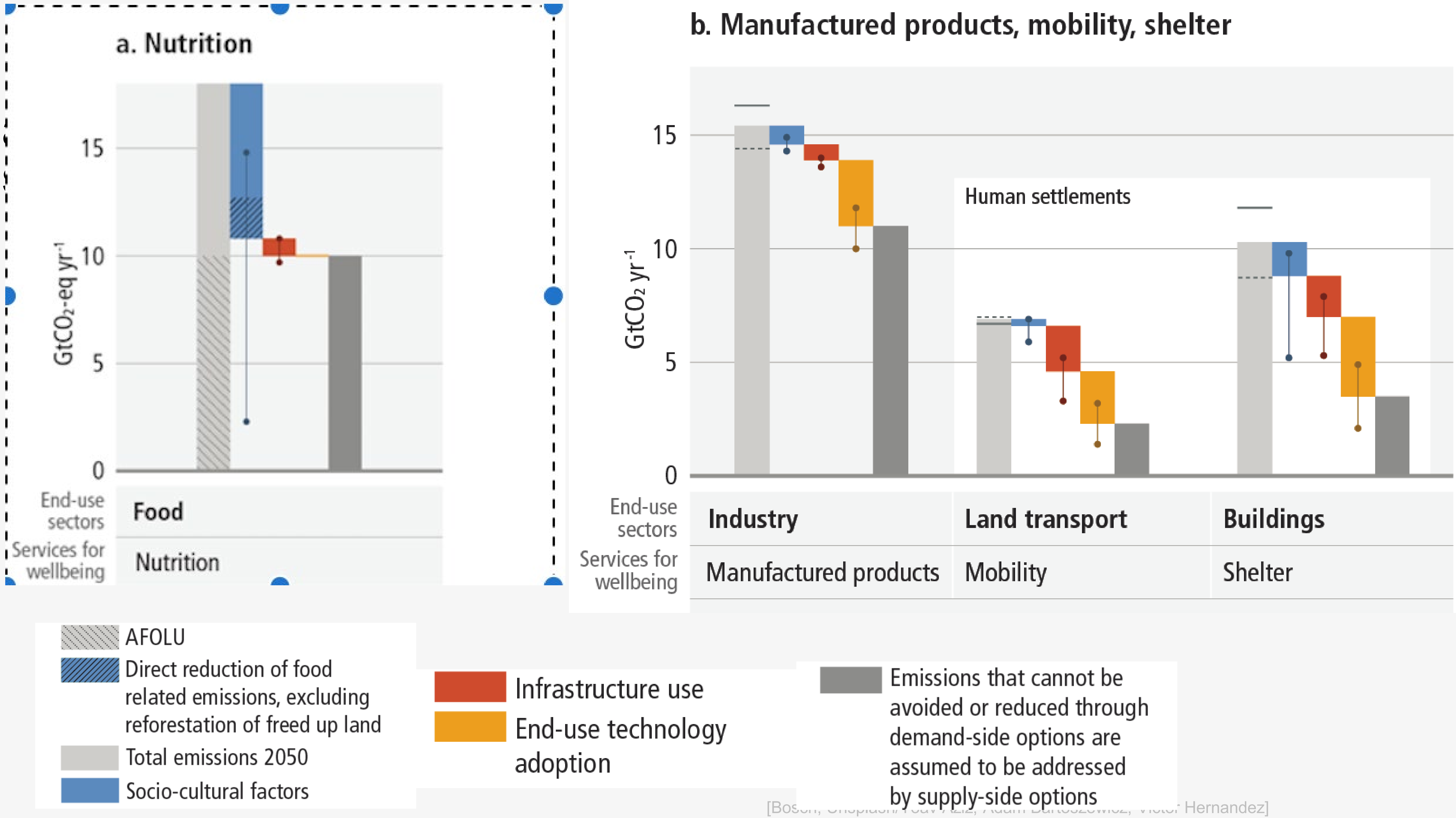
Demand and services

more efficient end-use energy conversion can improve services while reducing the need for upstream energy by 45% by 2050 compared to 2020

Demand-side mitigation encompasses changes in infrastructure, end-use technology adoption, service provision, and socio-cultural and behavioural change.

Lowest quartile of population **require additional** housing, nutrition, energy and resources for human wellbeing





a. Nutrition
GtCO2-eq yr-1
15
10
5
0
End-use sectors
Food
Services for wellbeing
Nutrition
b. Manufactured products, mobility, shelter
GtCO2 yr-1
15
10
5
0
Human settlements
End-use sectors
Industry
Land transport
Buildings
Services for wellbeing
Manufactured products
Mobility
Shelter
AFOLU
Direct reduction of food related emissions, excluding reforestation of freed up land
Total emissions 2050
Socio-cultural factors
Infrastructure use
End-use technology adoption
Emissions that cannot be avoided or reduced through demand-side options are assumed to be addressed by supply-side options

End-use sectors	Food	Industry	Aviation	Shipping	Land transport	Buildings	Electricity
Services for well-being	Nutrition	Manufactured products	Mobility			Shelter	
	Socio-cultural factors	Socio-cultural factors					Additional electrification (+60%)
	Dietary shift (shifting to balanced, sustainable healthy diets), avoidance of food waste and over-consumption	Shift in demand towards sustainable consumption, such as intensive use of longer-lived repairable products	Avoid long-haul flights; shift to trains wherever possible	Currently not applicable	Teleworking or telecommuting; active mobility through walking and cycling	Social practices resulting in energy saving; lifestyle and behavioural changes	Additional emissions from increased electricity generation to enable the end-use sectors' substitution of electricity for fossil fuels, e.g. via heat pumps and electric cars {Table SM5.3; 6.6}
	Infrastructure use	Infrastructure use					
	Choice architecture[1] and information to guide dietary choices; financial incentives; waste management; recycling infrastructure	Networks established for recycling, repurposing, remanufacturing and reuse of metals, plastics and glass; labelling low-emissions materials and products	Currently not applicable	Currently not applicable	Public transport; shared mobility; compact cities; spatial planning	Compact cities; rationalisation of living floor space; architectural design; urban planning (e.g., green roof, cool roof, urban green spaces etc.)	Industry Land transport Buildings Load management[2] **Demand-side measures −73%**
	End-use technology adoption	End-use technology adoption					Reduced emissions through demand-side mitigation options (in end-use sectors: buildings, industry and land transport) which has potential to reduce electricity demand[3]
	Currently estimates are not available (for lab-based meat and similar options – no quantitative literature available, overall potential considered in socio-cultural factors)	Green procurement to access material-efficient products and services; access to energy-efficient and CO_2 neutral materials	Adoption of energy-efficient technologies; technologies with improved aerodynamics	Adoption of energy-efficient technology/ systems	Electric vehicles; shift to more efficient vehicles	Energy-efficient building envelopes and appliances; shift to renewables	

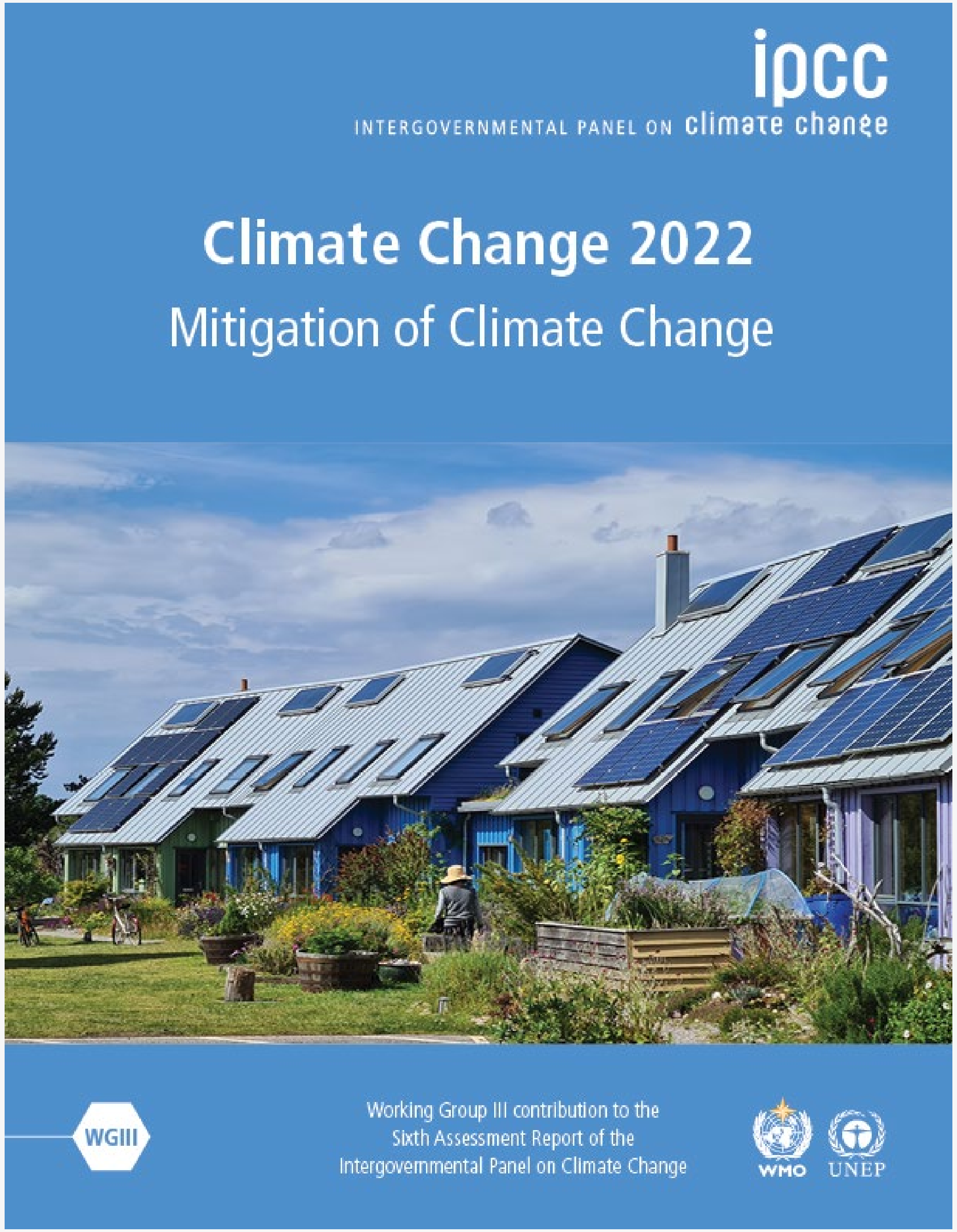
• Demand side options improve wellbeing

Legend
- High positive impact [+3]
- Medium positive impact [+2]
- Low positive impact [+1]
- Overall Neutral
- No impact
- Low negative impact [-1]
- Medium negative impact [-2]
- ★ Confidence level

Sectors	Mitigation strategies / Wellbeing dimensions	Food	Water	Air	Health	Sanitation	Energy	Shelter	Mobility	Education	Communication	Social protection	Participation	Personal Security	Social cohesion	Political stability	Economic stability	Material provision	Supply side / incumbents
	SDGs	2	6	7,11	3	6	7	11	11	4		1,2,8,10	5,10,16	5,16	10,16	11,16	8	9,12	8,12
Building	Sufficiency	[+1] ★★★	[+2] ★★★★	[+2] ★★★★★	[+3] ★★★★★	[+1] ★	[+3] ★★★★	[+1] ★	[+1] ★★	[+1] ★★	[+2] ★★★	[+1] ★★	[+1] ★★		[+2] ★★★★★		[+2] ★★★★	[+2] ★★★★	[-2] ★★★
	Efficiency	[+2] ★	[+2] ★★★★	[+3/-1] ★★★★	[+3/-1] ★★★★★	[+1] ★	[+3] ★★★★	[+2] ★★★★		[+1] ★★★	[+1] ★★★		[+1] ★★★★	[+1] ★★★	[+2/-1] ★★★★		[+2] ★★★★★	[+2/-1] ★★★★	[+2/-2] ★★★
	Lower carbon and renewable energy	[+2/-1] ★★★	[+2/-1] ★★★★	[+3] ★★★★★	[+3] ★★★★★		[+3] ★★★★	[+1] ★★★	[+1] ★★★	[+1] ★★★	[+2] ★★★		[+1] ★★★	[+1] ★★★	[+2/-1] ★★★★		[+2/-1] ★★★★★	[+2] ★★★★	[+2/-2] ★★★
Food	Food waste	[+1] ★★★	[+2] ★★★★	[+2] ★★★★	[+2] ★★★	[+1] ★★	[+1] ★★★★				[+1] ★★	[-1/+1] ★★★	[+1] ★★★			[+1] ★	[+1] ★★		[-1] ★★★
	Over-consumption	[+1] ★	[+1/-1] ★	[+1/-1] ★	[+3] ★★★★		[+1/-1] ★						[+2] ★★★★			[+1] ★			[+1/-2] ★
	Animal free protein	[+2] ★★★	[+2] ★★★★	[+3] ★★★★★	[+3] ★★★						[-1] ★★★	[+3] ★★★★★	[+1] ★★★★		[-1] ★	[+2] ★			[-1] ★★★
Transport	Teleworking and online education system	[+1] ★★		[+3] ★★★★	[+2] ★★★★		[+2] ★★★★	[+1] ★★	[+2] ★★★★	[-1] ★★★	[+2] ★★★★	[+1] ★★★★	[+2] ★★★★	[+1/-1] ★★★★	[+2] ★★★★	[+2] ★★★	[+2] ★★★		[+1] ★★★★
	Non-motorized transport	[+2] ★★	[+1] ★★	[+1] ★★★★★	[+3] ★★★★★		[+2] ★★★★		[+3] ★★★★★	[+1] ★★★★	[+3] ★★★	[+1] ★★★	[+1] ★★	[+2] ★★★★	[+2] ★★★	[+2] ★★	[+2] ★★★		[+1] ★★★
	Shared mobility	[+1] ★★		[+3] ★★★	[+2] ★★★★		[+1] ★★★		[+2] ★★★★		[+1] ★★★	[+2] ★★★	[+1] ★★★	[+1/-1] ★★★	[+1/-1] ★★★★	[-1] ★★★★	[+2] ★★★★	[+2] ★★★★	[-1] ★★
	Evs	[+1] ★★★		[+2] ★★★★	[+1] ★★★★	[+1] ★★★★	[+3 ★★★★		[+2] ★★★★			[+3] ★★★★★	[+2] ★★★				[+2] ★★★★	[-1] ★★	[+1] ★★★
Urabn	Compact city	[+2/-1] ★★★	[+1] ★★	[+2/-1] ★★★	[+3/-1] ★★★★	[+1] ★★	[+3/-1] ★★★★★	[-1] ★★★★★	[+3] ★★★★★	[+1] ★★★★★	[+1/-1] ★★★	[+2] ★★	[+1] ★★	[+1] ★★★★	[+1/-1] ★★★★★		[+1] ★★★★	[+1] ★★	[+1/-2] ★★★
	Circular and shared economy	[+2] ★★★★	[+1] ★★★	[+2] ★★★	[+2] ★★★		[+3] ★★★	[+2/-1] ★★★	[+3] ★★★★★	[+1] ★★★★	[+1] ★★★★	[+1] ★★★	[+1] ★★★	[+2] ★★★★	[+1] ★★	[+1] ★★	[+2] ★★	[+3] ★★★	[-1] ★★★★
	Systems approach in urban policy and practice	[+1] ★★★	[+2] ★★★	[+2] ★★★	[+3] ★★★	[+1] ★★★	[+3] ★★★	[+2] ★★★	[+3] ★★★		[+1] ★★	[-1] ★★	[+1] ★★★	[+2] ★	[+1] ★★		[+1] ★★	[+3] ★★★★★	[+2/-2] ★★
	Nature based solutions	[+2] ★★★	[+1/-1] ★★★★★	[+3/-1] ★★★★	[+3] ★★★★★	[+1] ★★★	[+3] ★★★	[+1/-1] ★★★	[+1] ★★★	[+2] ★★★★		[+2] ★★	[+3] ★★	[+1] ★★★	[+2/-2] ★★★		[+3] ★★★★	[+1] ★★	[+1] ★★
Industry	Using less material by design	[+2] ★★	[+2] ★★★	[+3] ★★★	[+2] ★★	[+2] ★★★	[+3] ★★★★	[+2] ★★★★	[+2] ★★★★	[+1] ★★	[+2] ★★★	[+1] ★★	[+1] ★★★	[+1] ★★	[+1] ★★	[+1] ★★	[+2] ★★★	[+3] ★★	[-2] ★★
	Product life extension	[+2] ★★	[+2] ★★★	[+3] ★★★	[+2] ★★	[+2] ★★★	[+3] ★★★★	[+2] ★★★★	[+2] ★★★★	[+1] ★★	[+2] ★★★	[+1] ★★	[-1] ★★★★	[+1] ★★	[+1] ★★	[+1] ★★	[+2] ★★★	[+3] ★★	[-2] ★★
	Energy Efficiency	[+2] ★★	[+2] ★★★	[+3] ★★★	[+1] ★★	[+2] ★★★	[+3] ★★★★	[+2] ★★★★	[+2] ★★★★	[+1] ★★	[+2] ★★★	[+2] ★★★★	[+2] ★★★	[+1] ★★		[+1] ★★	[+2] ★★★	[+2] ★★	[-2] ★★
	Circular economy	[+2] ★★★	[+2] ★★★	[+3] ★★★	[+1] ★★	[+2] ★★★	[+3] ★★★★	[+2] ★★★★	[+2] ★★★★	[+1] ★★	[+2] ★★★	[+1] ★★	[+1] ★★★	[+2] ★★	[+1] ★★		[+2] ★★★	[+3] ★★	[-2] ★★

Conclusion

- Minimising energy and material demand while keeping service levels equal or higher is key to more flexible mitigation pathways
- 40 – 70% of emissions in sectors could be avoided through demand side opportunities..
- …but this requires systemic changes to enable the more sustainable choices
- Demand-side opportunities are often low-cost or even have negative carbon costs
- Demand-side technologies have higher learning rates and reduce negative lock-ins
- Demand-side mitigation options have more synergies with SDGs than supply-side ones and improve well-being



Thank you for your attention

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