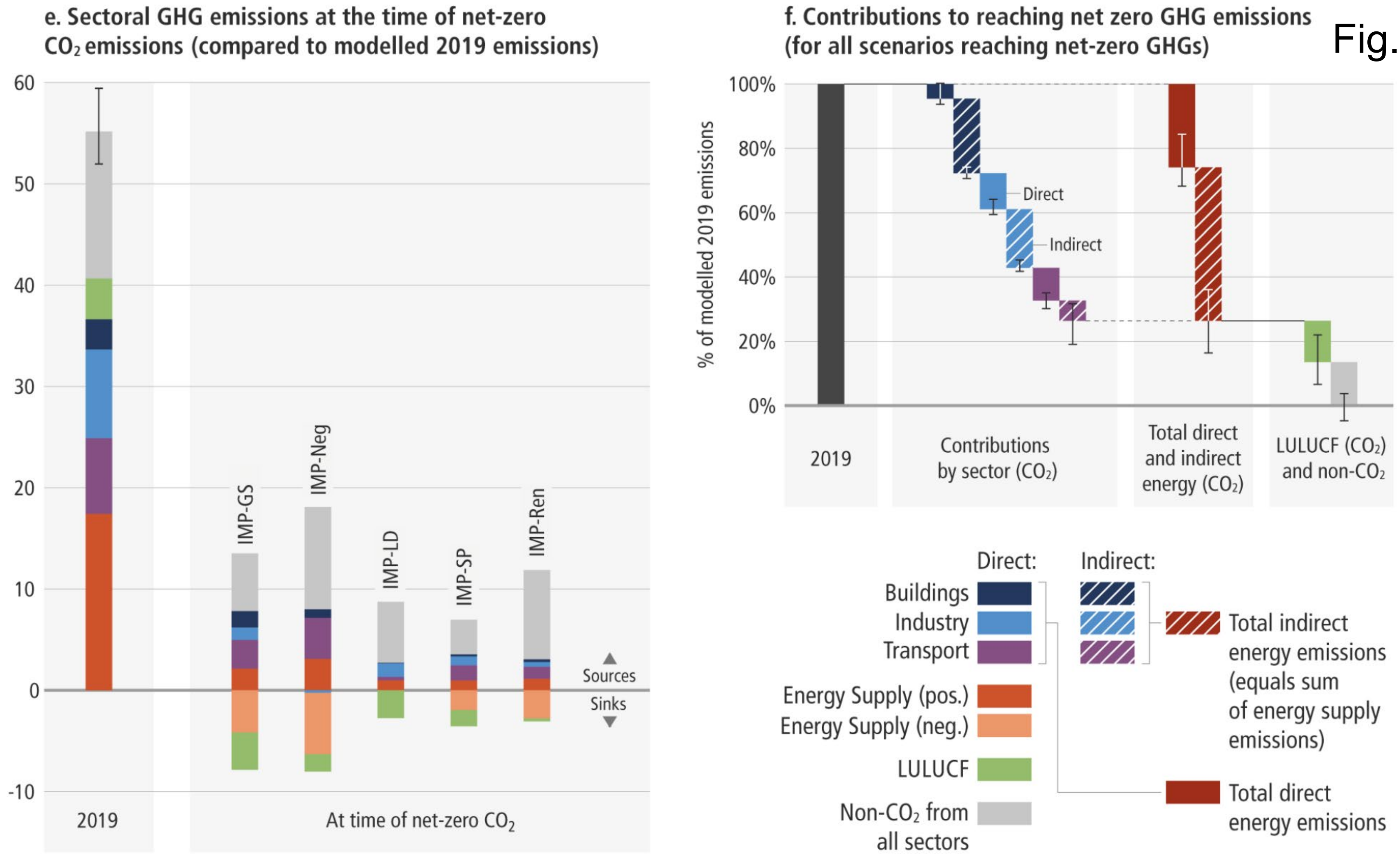
The side-event at the Japan pavilion for the COP27
Emission Reduction Paths in the Road Transport Sector
toward Carbon Neutrality –Concepts in the IPCC AR6–
November 12, 2022

The Pathways of Automobiles toward Carbon Neutrality–Synergies and Trade-offs of SDGs

Keigo Akimoto, Ph.D, Prof.
Systems Analysis Group
Research Institute of Innovative Technology for the Earth (RITE)
(Lead Author, Chapter 17, IPCC WG3 AR6)

Several opportunities to achieve CN

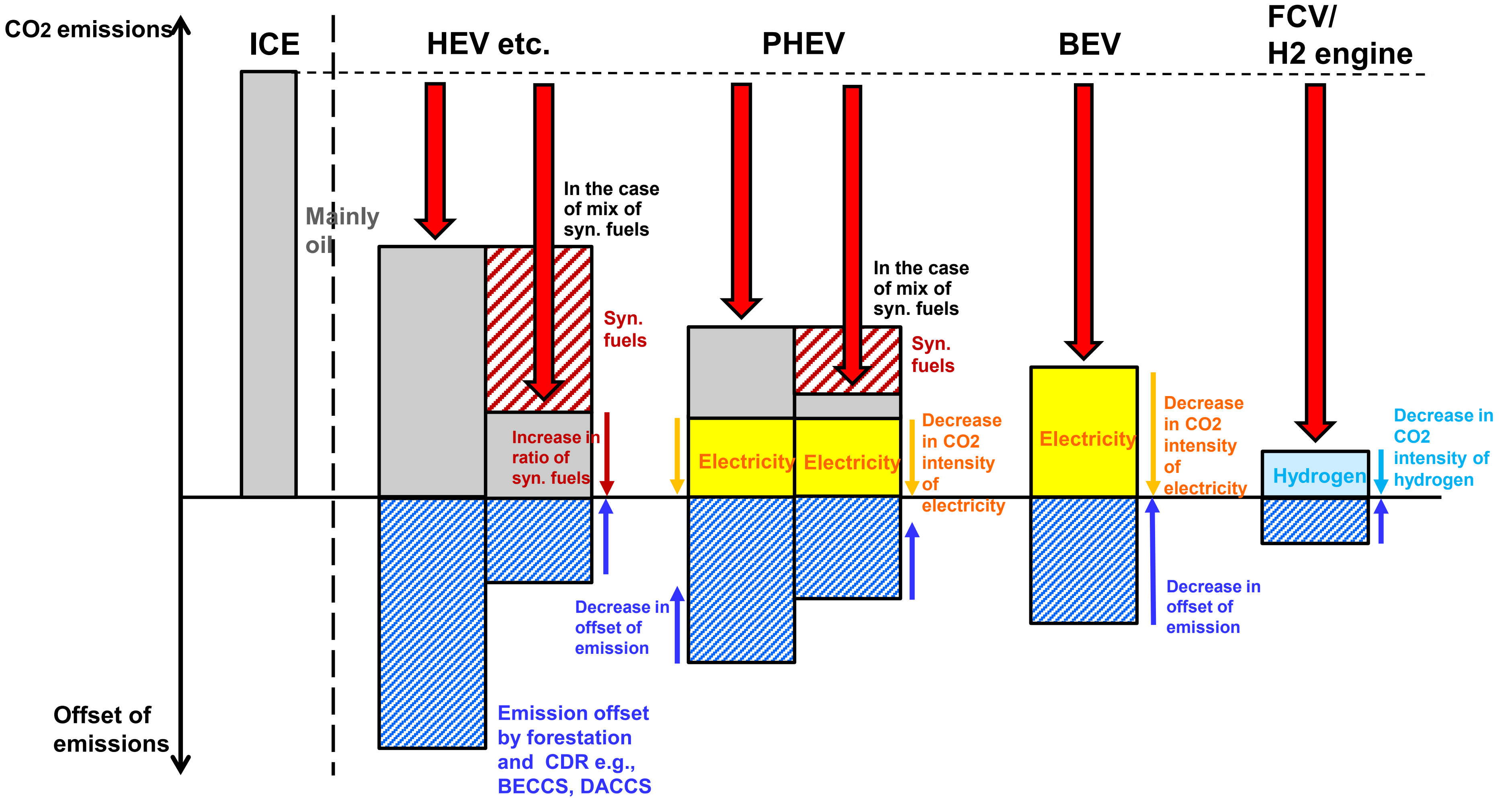
Fig. SPM.5



"The deployment of CDR to counterbalance hard-to-abate residual emissions is unavoidable if net zero CO2 or GHG emissions are to be achieved." (SPM C.11)

Even for achieving CN, large amounts of CDR deployment are estimated in many scenarios, and a certain amount of CO2 emissions in transport sector can be allowed and more economical.

Carbon neutrality options for automobile fuels



- ✓ There are several kinds of options for the carbon neutrality, and the BEV (+ zero CO2 intensity of electricity) is not the sole option.
- ✓ Higher cost-effective measures should be implemented, and this will also help reduce poverty and hunger basically.

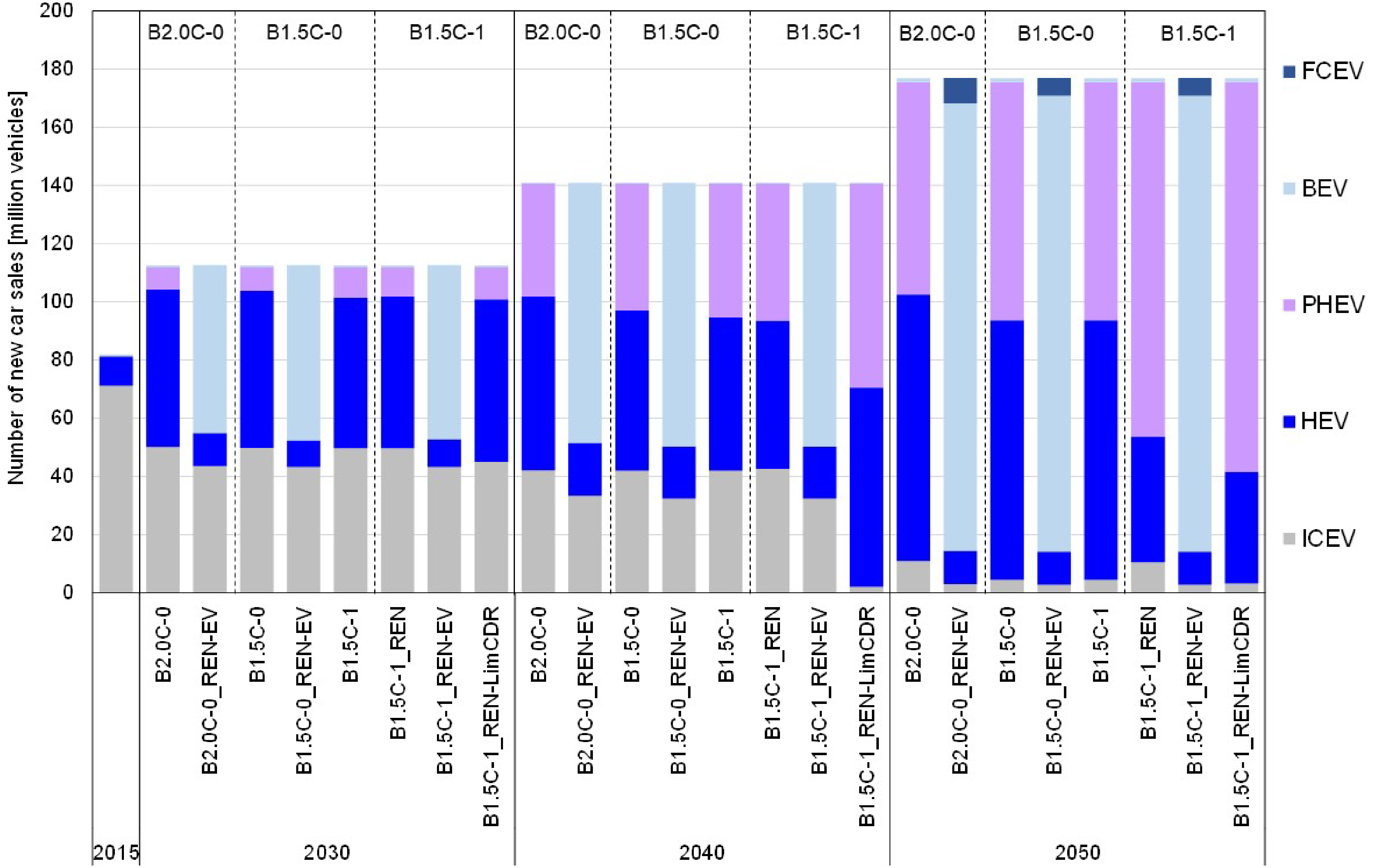
Assumed scenarios for GHG emissions reductions and technology improvements

The comprehensive and quantitative scenarios are estimated under different outlooks of technologies and different emissions scenarios through a technology-rich global energy systems model DNE21+.

	Emission reductions	Costs and potentials of VRE	Prices of passenger cars	CDR – biomass availability and DAC costs
B2.0C-0	2 °C, >66% (equal MAC)	Standard	Standard	Standard
B2.0C-0_ REN-EV		Low cost of VRE	Low cost of BEV and FCEV	Standard
B1.5C-0	1.5 °C, >66% (equal MAC)	Standard	Standard	Standard
B1.5C-0_ REN-EV		Low cost of VRE	Low cost of BEV and FCEV	Standard
B1.5C-1	1.5 °C, >66% (CN by 2050 in major developed countries)	Standard	Standard	Standard
B1.5C-1_ REN		Low cost of VRE	Standard	Standard
B1.5C-1_ REN-EV		Low cost of VRE	Low cost of BEV and FCEV	Standard
B1.5C-1_ REN-LimCDR		Low cost of VRE	Standard.	Limitation of CDR

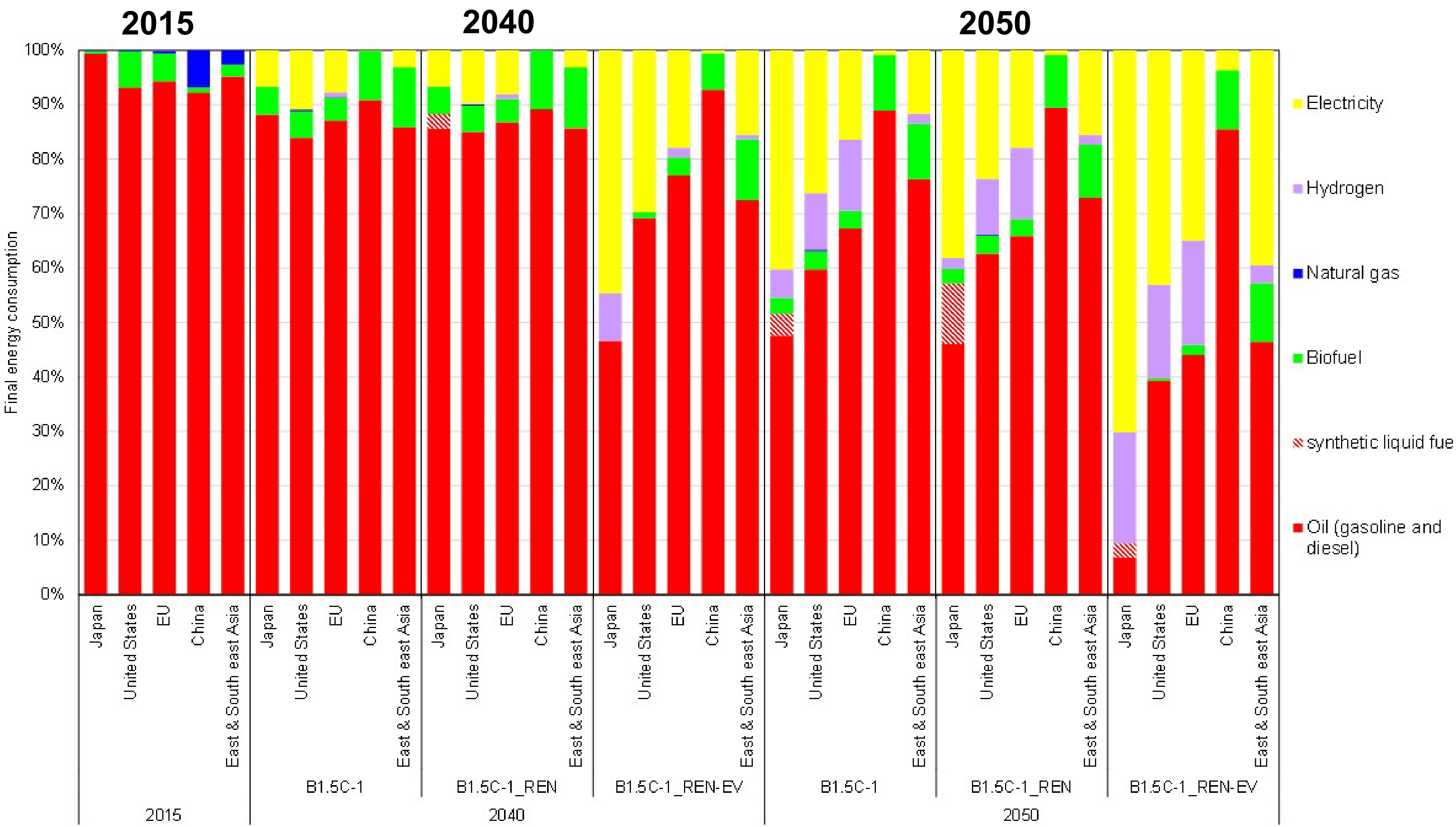
Source: K. Akimoto et al., Assessments of road transportation sector considering comprehensive energy systems toward carbon neutrality, Transportation Research Part D (2022).

RITE estimates using an IAM: Global sales of new cars under different scenarios



✓ **HEV and PHEV dominate the global sales of new passenger cars in all scenarios except REN-EV. In the REN-EV scenarios, the share of BEV in the total number of new car sales will reach around 90% in 2050。**

RITE estimates using an IAM: Final energy consumption for different countries under different scenarios

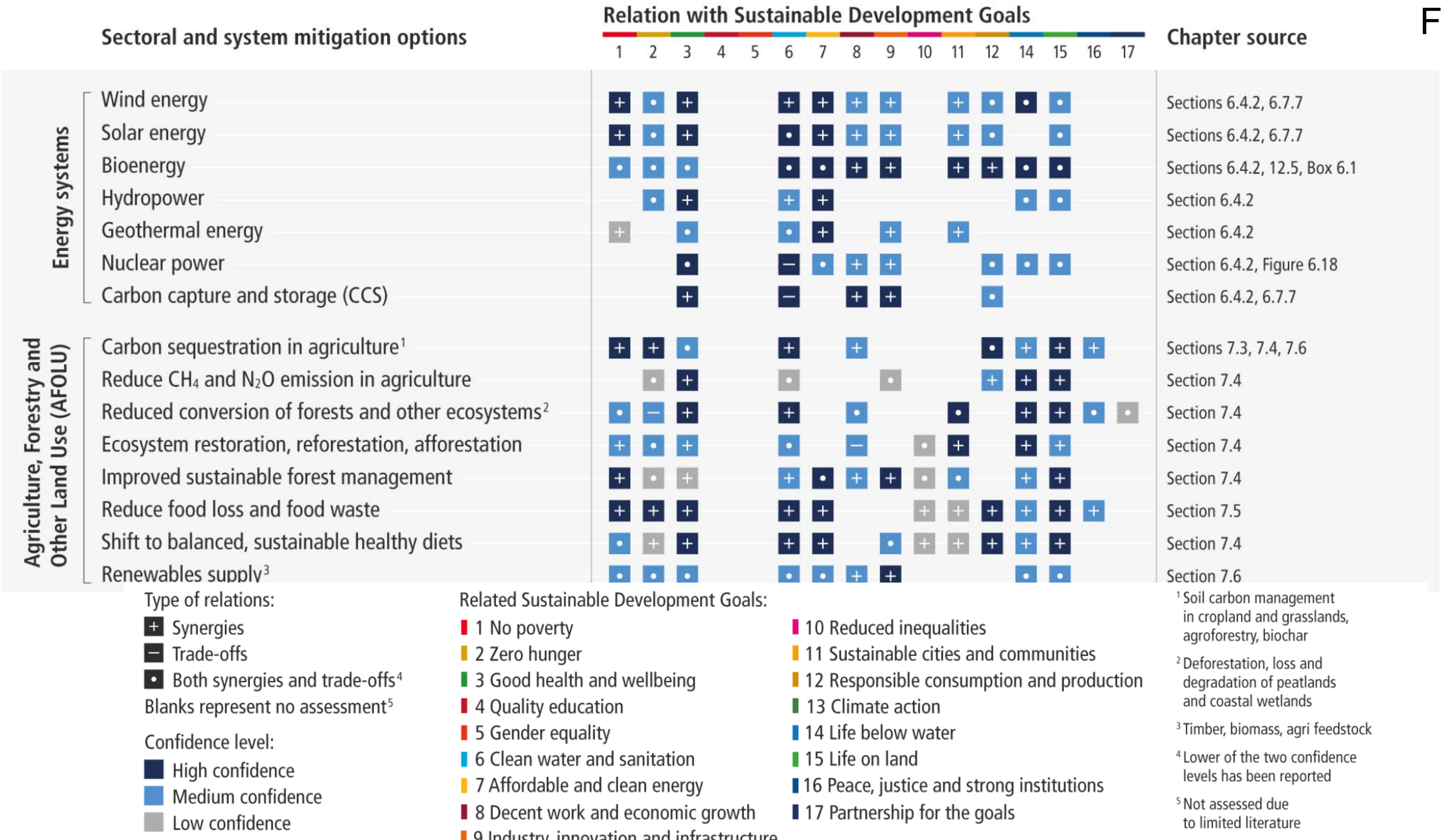


- ✓ **The cost-effective measures differ among countries, depending on the differences in the implicit discount rate by income level, annual travel distance, secondary energy prices, carbon prices to meet the emissions reductions.**

Synergies and trade-offs of climate change mitigation

"Accelerated and equitable climate action in mitigating, and adapting to, climate change impacts is critical to sustainable development. Climate change actions can also result in some trade-offs. The trade-offs of individual options could be managed through policy design." (D.1)

Fig. SPM.8



In principle, these assessments were summarized from the underlying texts in the sectoral chapters including qualitative assessments. There could be also other synergies or trade-offs. Also these synergies and trade-offs could be changed depending on the intensity of the mitigation options (i.e. level of utilization of each technology).

Synergies and Trade-offs of SDGs in Transport

Fig. SPM.8

[Chapter 17]

- ✓ **The mitigation options in the transportation sector are assessed as having synergies with SDG 1 'no poverty' and SDG 3 'good health and well-being' due to reduced environmental pollution, with exceptions in relation to pollution from biofuels and the risks of traffic accidents.**
- ✓ **Trade-offs are also mentioned in relation SDG 2 'zero hunger' where the production of biofuels takes land away from food production.**
- ✓ **Synergies are assessed in relation to SDG 7 'affordable and clean energy', SDG 8 'decent work and economic growth' and SDG 9 'industry, innovation and infrastructure'.**
- ✓ **Some mitigation options, like the increased penetration of electric vehicles, require innovative business models, and digitalization and automatic vehicles will support the socio-economic structures that impede adoption of EV's and the urban structures that enable reduced car dependence.**

Synergies and Trade-offs of SDGs in Transport

[Electric light duty vehicles => SDG3]

- **Synergies**: BEVs have no tailpipe emissions, which further offsets the increased PM emissions from road and tire wear. (Section 10.4.1)
- **Trade-offs**: BEVs are generally heavier than their ICEV counterparts, which may potentially cause higher stress on the road surfaces and tires, with consequently higher PM emissions per kilometre driven. (Section 10.4.1)

[Electric light duty vehicles => SDG12]

- **Synergies and trade-offs**: Externalities from resource extraction are another concern, though current volumes of lithium are much smaller than other metals (steel, aluminium). (Section 10.3.2)

[Biofuels => SDG3]

- **Synergies**: Biofuels may also may offer a significant advantage in meeting ambitious sulphur emission reduction targets set by the sectoral organisations. (Section 10.3.1)

[Biofuels => SDG14/15]

- **Synergies**: Biofuels could be used in all segments of the transport sector, but there may be some concerns about their feasibility. Specifically, there are concerns about land use, water use, impacts on water quality and eutrophication, and biodiversity impacts.

Conclusions

- Electrification is a key measure for achieving carbon neutrality. Shifts from ICE to EV are also important.
- On the other hand, CDR such as DACCS and BECCS will contribute to offsetting the residual emissions of fossil fuels also in the transport sector. In addition, synthetic fuels based on renewables will play a certain role to achieve carbon neutrality in transport sector.
- The assessments of total energy systems in energy supply, transport, and CDR are important for cost-effective emission reduction measures. BEV-only will not be a dominant measure in the road transport sector. Several kinds of road transport measures have potential cost-effective reductions in different time points, different countries, and different perspectives in technologies.
- All of the options in the road transportation sector could have not only synergy effects on SDGs but also trade-off effects, depending on countries, scales of deployments, different time points, etc.
- Lower costs of emissions reduction with consideration of full spectrum options will be able to increase SDG1 (no poverty) and 2 (zero-hunger), for example, while the IPCC AR6 had not assessed sufficiently, and therefore, the balanced emissions reduction response measures toward carbon neutrality will be important also in road transport sector.