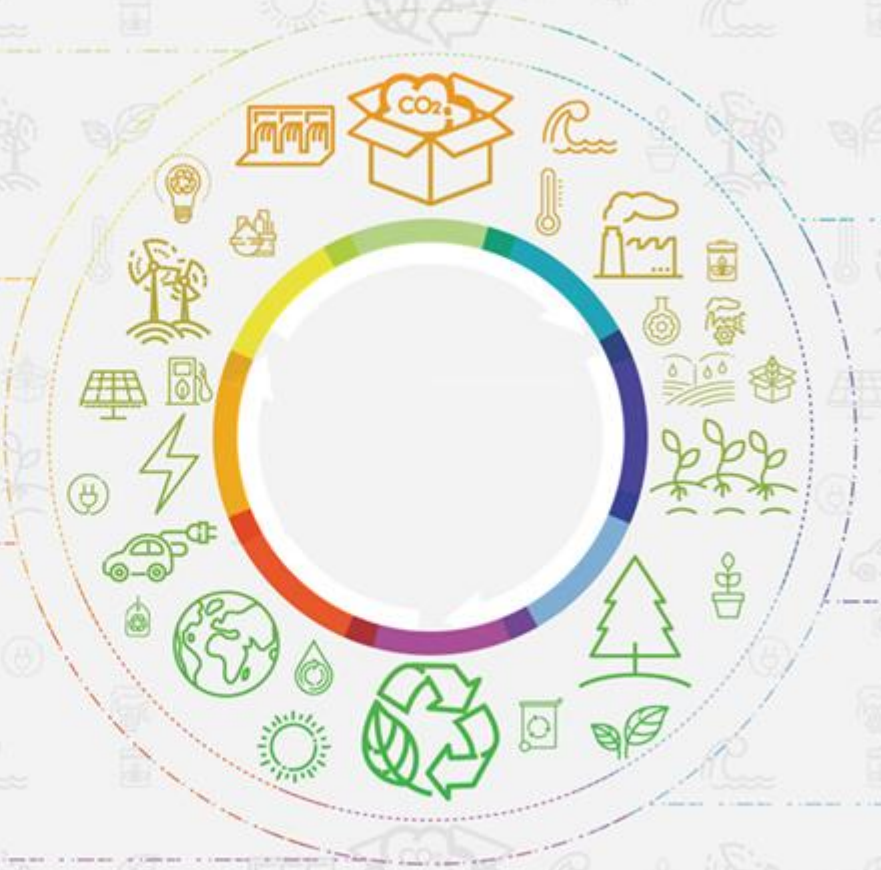
A Clean Planet for all

A European strategic long term vision for a prosperous, modern, competitive and climate neutral economy



SET-Nav Final Conference

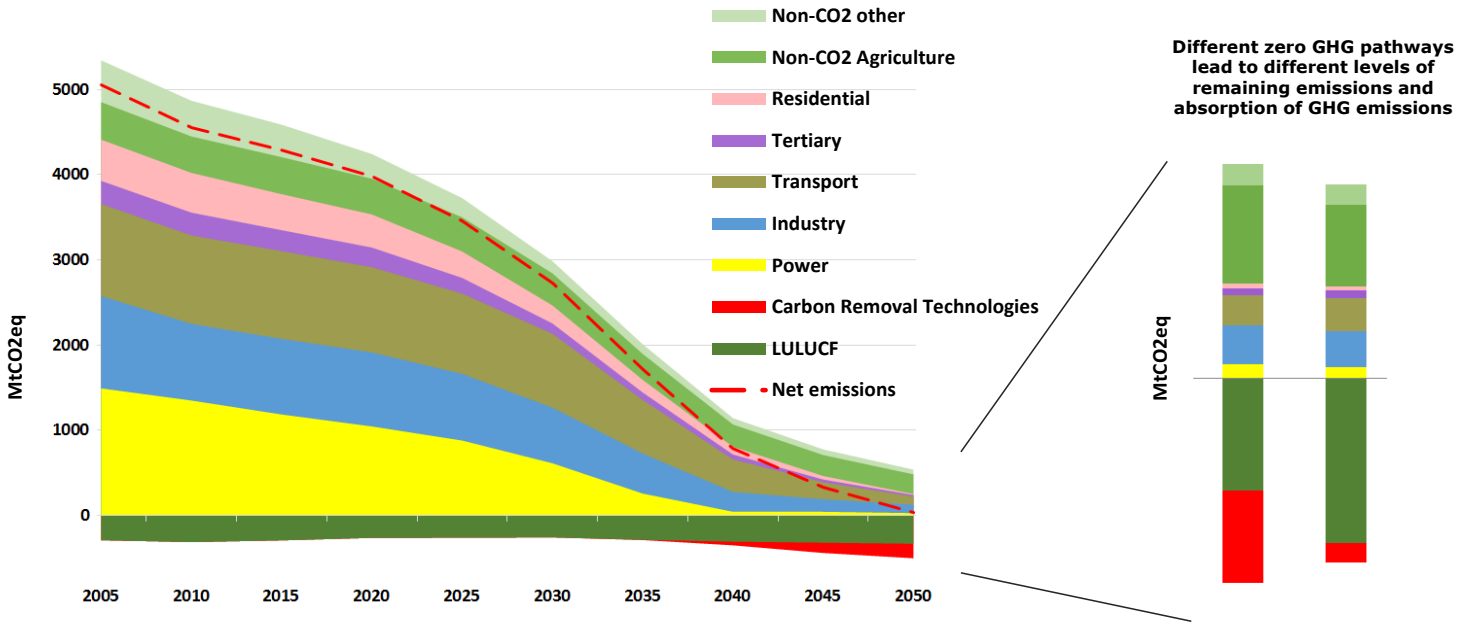
Thursday, 21st March 2019

Our Vision for a Clean Planet by 2050

- The Paris Agreement objective is to keep temperature increase to well below 2°C and to pursue efforts to limit it to 1.5°C
- But the IPCC report confirms that limiting climate change to 1.5°C has to be pursued to avoid these worst impacts
- For the EU to lead the world in climate action, it means achieving net-zero greenhouse gas emissions by 2050
- The EU with this vision can inform others how we can deliver collectively a clean planet.
- The Long Term Strategy shows transforming our economy is possible and beneficial.
- It sets the direction of travel. No intention to revise the 2030 targets.

Our Vision for a Clean Planet by 2050

- EU leads in clean energy transition and GHG emissions reduction. Ambitious 2030 targets. 60% reductions in 2050 with current policies – not in line with the Paris Agreement.
- Radical transformations necessary: central role of energy system, buildings, transport, industry, agriculture.
- There are a number of pathways for achieving a climate neutral EU, challenging but feasible from a technological, economic, environmental and social perspective.



Global context and mega-trends

- All regions across the globe are facing major mega-trends: climate change, digitalisation, change in population, fast growing economies, emergence of a global middle class..
- Some of these trends are independent from the energy transition and will continue regardless of EU policies.
- However, others will interact with the energy transition, through technological changes, evolving trade patterns or diffusion of social values.
- Europe should prepare for the changes and
  - adapt its energy and economic system
  - continue EU concerted action to place multilateralism at the core of global responses.
- This may be through research and innovation programmes, large-scale flagship technology projects, the development of new industrial strategies and market designs or simply by its ambition.

Sectoral analysis and modelling

- Comprehensive review of technology and options to transform the economy and reduce greenhouse gas emissions (e.g. ASSET project).
- Technologies considered can be found in the mainstream research and innovation from academia or stakeholders, but do not include low technological readiness options.
- Analysis complemented by modelling, mainly using the PRIMES-GAINS-GLOBIOM model suite and by developing multiple and differentiated scenarios. FORECAST model also used for industry sector analysis.
- Modelling useful to look in detail at the interactions between the energy sector and other sectors such as industry, waste, agriculture and land-use.
- Associated macro-economic analysis rely on GEM-E3, E3ME and QUEST models.
- Associated global energy and GHG analysis relies on POLES-JRC model.

Detailed assessment supported by scenario analysis

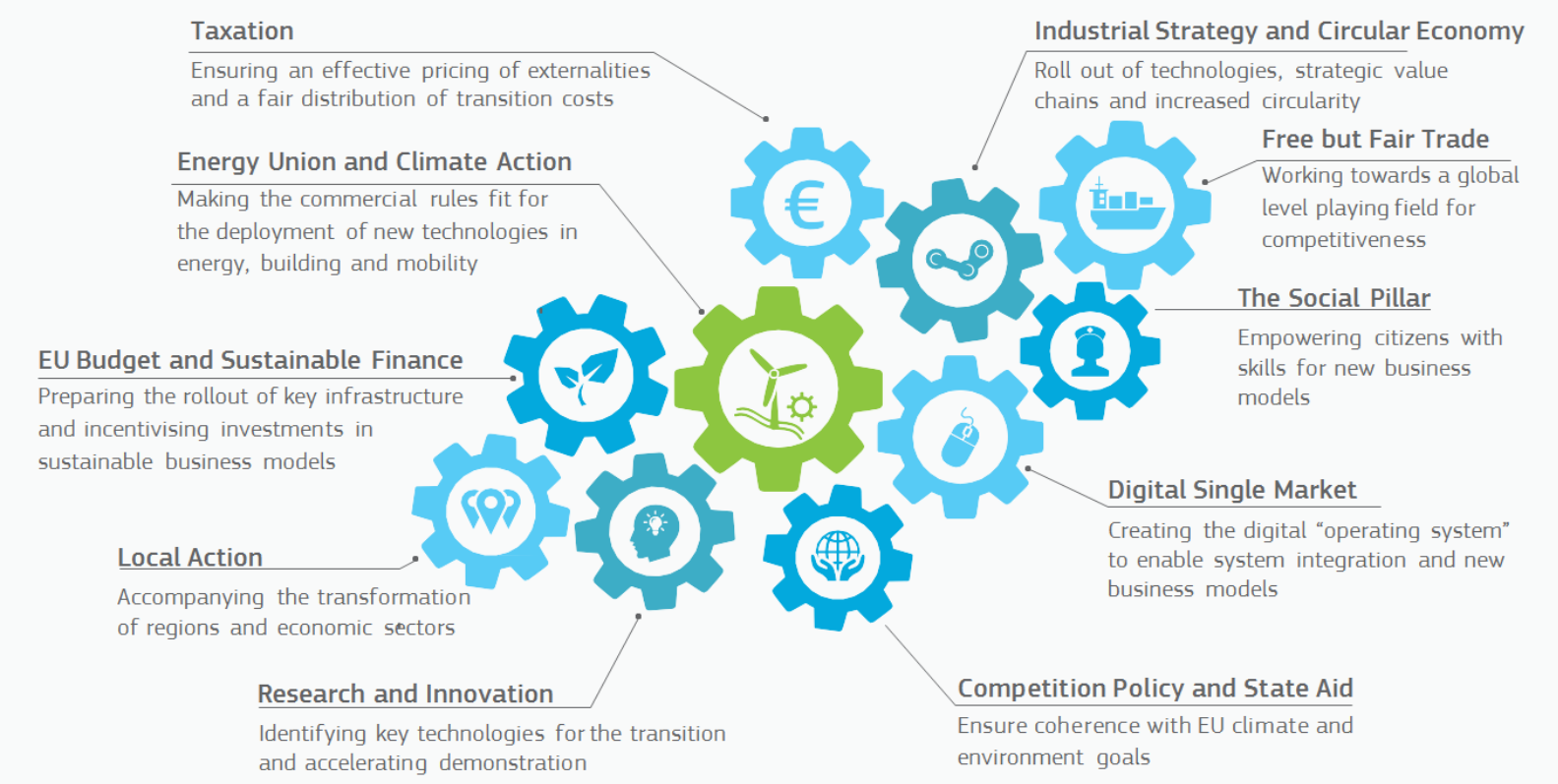
Long Term Strategy Options

	Electrification (ELEC)	Hydrogen (H2)	Power-to-X (P2X)	Energy Efficiency (EE)	Circular Economy (CIRC)	Combination (COMBO)	1.5°C Technical (1.5TECH)	1.5°C Sustainable Lifestyles (1.5LIFE)
Main Drivers	Electrification in all sectors	Hydrogen in industry, transport and buildings	E-fuels in industry, transport and buildings	Pursuing deep energy efficiency in all sectors	Increased resource and material efficiency	Cost-efficient combination of options from 2°C scenarios	Based on COMBO with more BECCS, CCS	Based on COMBO and CIRC with lifestyle changes
GHG target in 2050	-80% GHG (excluding sinks) ["well below 2°C" ambition]					-90% GHG (incl. sinks)	-100% GHG (incl. sinks) ["1.5°C" ambition]	
Major Common Assumptions	• Higher energy efficiency post 2030 • Deployment of sustainable, advanced biofuels • Moderate circular economy measures • Digitilisation					• Market coordination for infrastructure deployment • BECCS present only post-2050 in 2°C scenarios • Significant learning by doing for low carbon technologies • Significant improvements in the efficiency of the transport system.		
Power sector	Power is nearly decarbonised by 2050. Strong penetration of RES facilitated by system optimization (demand-side response, storage, interconnections, role of prosumers). Nuclear still plays a role in the power sector and CCS deployment faces limitations.							
Industry	Electrification of processes	Use of H2 in targeted applications	Use of e-gas in targeted applications	Reducing energy demand via Energy Efficiency	Higher recycling rates, material substitution, circular measures	Combination of most Cost-efficient options from "well below 2°C" scenarios with targeted application (excluding CIRC)	COMBO but stronger	CIRC+COMBO but stronger
Buildings	Increased deployment of heat pumps	Deployment of H2 for heating	Deployment of e-gas for heating	Increased renovation rates and depth	Sustainable buildings			CIRC+COMBO but stronger
Transport sector	Faster electrification for all transport modes	H2 deployment for HDVs and some for LDVs	E-fuels deployment for all modes	Increased modal shift	Mobility as a service			• CIRC+COMBO but stronger • Alternatives to air travel
Other Drivers		H2 in gas distribution grid	E-gas in gas distribution grid				Limited enhancement natural sink	• Dietary changes • Enhancement natural sink

7 Building Blocks

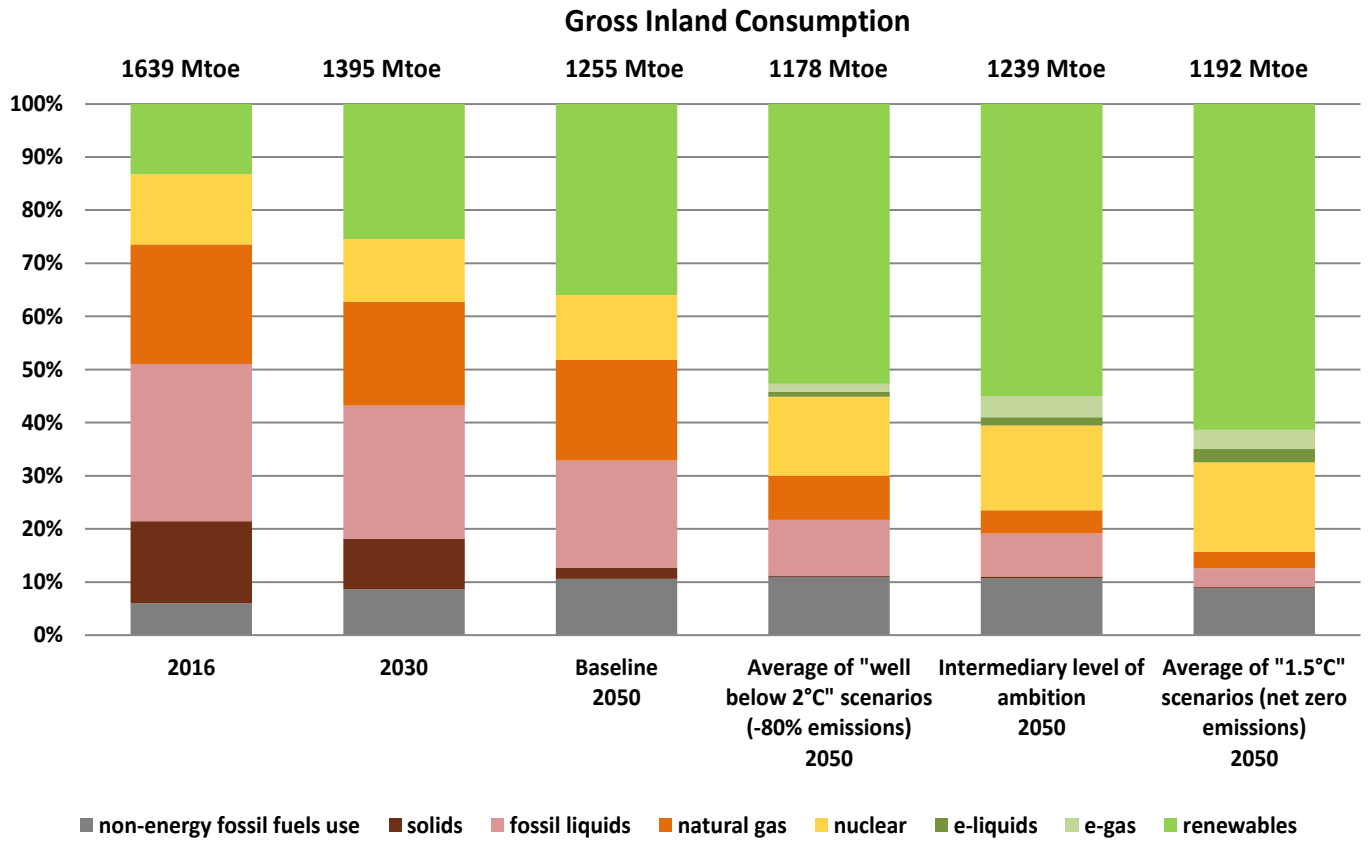
1. Energy efficiency
2. Deployments of renewables
3. Clean, safe & connected mobility
4. Competitive industry and circular economy
5. Infrastructure and inter-connections
6. Bio-economy and natural carbon sinks
7. Tackle remaining emissions with carbon capture and storage

Enabling framework crucial to deliver transformation

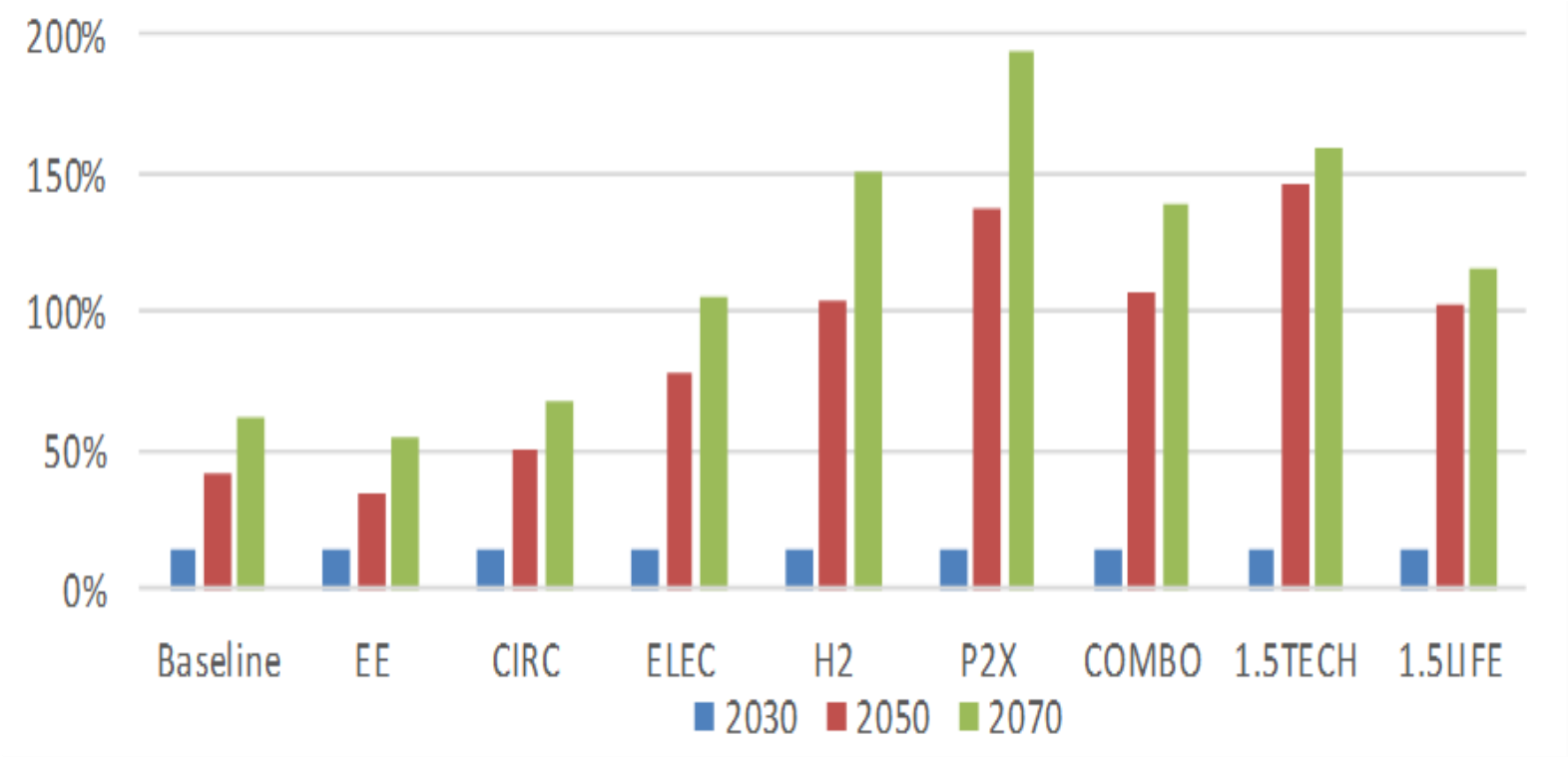


Building Block 1 & 2
Energy efficiency & Deployment of renewables

Primary energy in 2050 largely coming from renewable sources

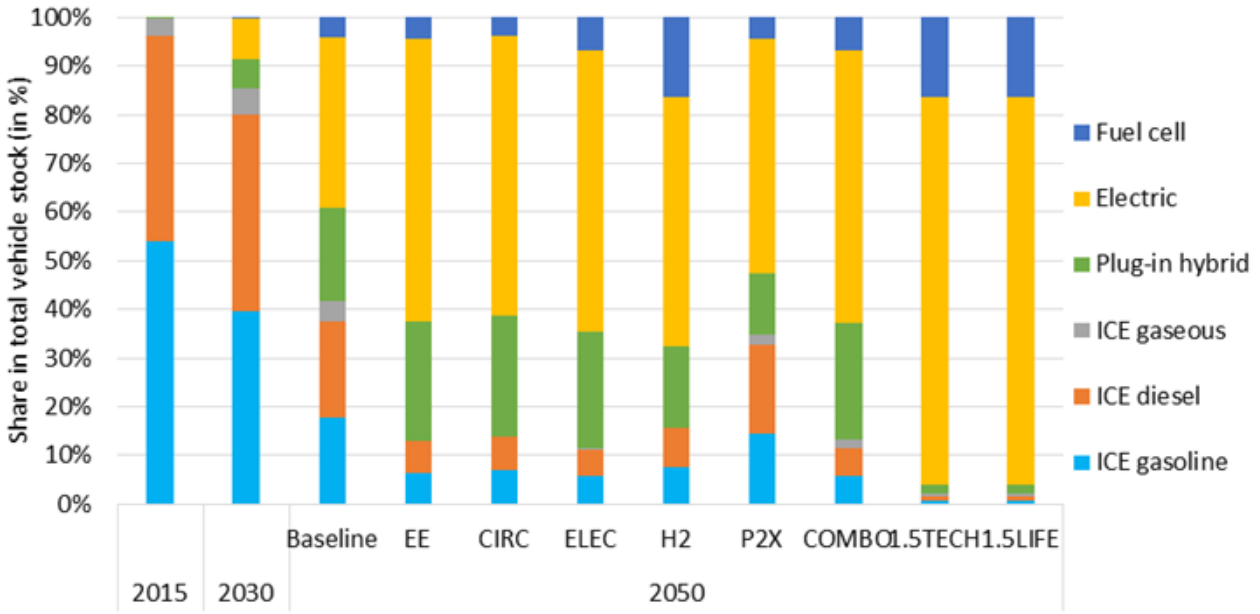


Increase in gross electricity generation compared to 2015



Building block 3
clean, safe and connected vehicles

Example of in depth analysis: Shares in total cars stock by drivetrain technology in the Baseline and scenarios reaching -80% to net zero emissions by 2050



Source: PRIMES.

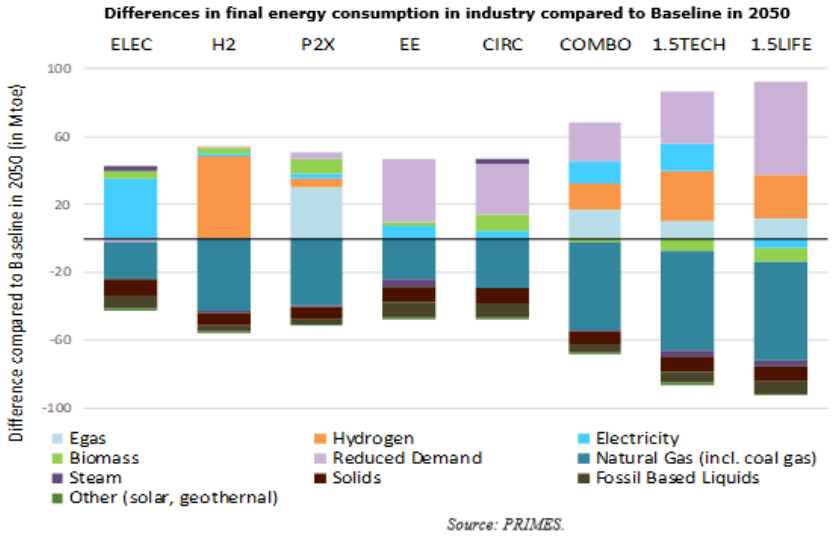
Building block 4 Competitive industry

Competitive resource-efficient industry and circular economy, increased recovery and recycling of raw materials (including critical materials), new materials and business concepts.

Electrification, energy efficiency, hydrogen, biomass and renewable synthetic gas to reduce energy emissions in the production of industrial goods.

Process-related reductions more difficult. Biomass and hydrogen can reduce certain emissions (steel production, some chemicals), others will require CO2 to be captured and stored or used.

In the next 10 to 15 years, technologies that are already known will need to demonstrate that they can work at scale.



Building Block 5 Network infrastructure

Integrated and interconnected smart infrastructure.

Completion of the Trans-European Transport and Energy Networks.

Smart electricity and data/information grids, hydrogen pipelines, further sector integration.

Smart charging or refuelling stations for transport. Increased synergy between transport and energy systems.

Retrofitting existing infrastructure and assets and timely replacement of ageing infrastructure compatible with the deep decarbonisation objective.

Building Block 6
Agriculture, forest and bio-economy

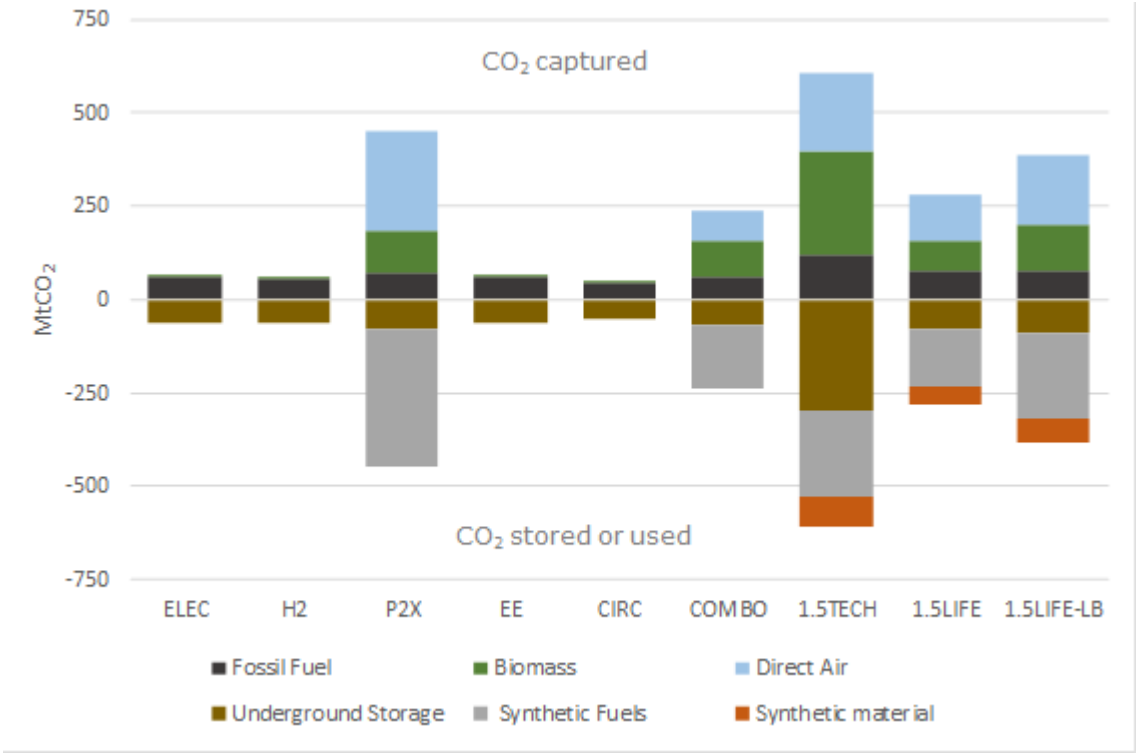
Agriculture to provide sufficient food, feed and fibre. Agricultural non-CO2 emissions can be reduced (but not to zero) and soil carbon can be increased through improved farming techniques.

Biomass is multipurpose: supply direct heat, biogas, biofuels, alternative to carbon intensive materials and generate negative emissions when coupled with carbon capture and storage; therefore increased demand (up to 80%).

Key role of energy crops to avoid unsustainable use of forests, maintain the natural carbon sink while preserving ecosystems.

Natural carbon sink can be enhanced through afforestation and restoration of degraded forest lands and other ecosystems (benefiting biodiversity, soils and water resources and increase biomass availability over time).

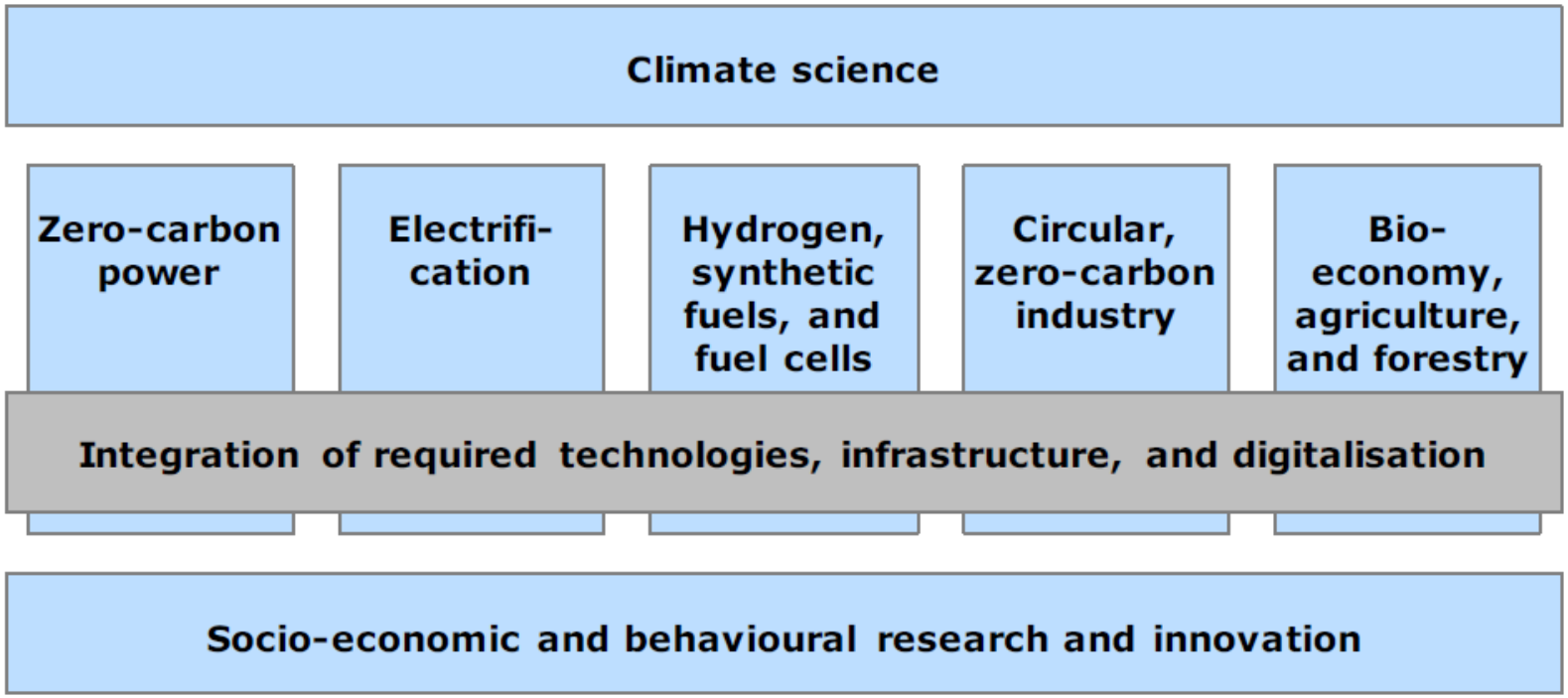
Building Block 7 Carbon Capture and Storage



- Rapid deployment of renewable energy and new options to decarbonize industry reduced the need for CCS.
- Coordinated action needed on demonstration and commercial facilities to overcome the obstacles
- CCS will be required to reduce emissions of any remaining fossil fuels use (power sector, industry)
- In the case of higher ambition targets, CCS combined with biomass is required to generate negative emissions.

Research and Innovation

The key to success is to develop a wide portfolio of cost-effective and efficient carbon-free alternatives for each GHG-emitting activity



Future EU R&I strategy for supporting its greenhouse gas emissions reduction should be inspired by the following guiding principles

- Keep Europe's fundamental research's excellence and be active on global research cooperation
- Develop an innovation agenda motivated by a race to the top
- Explore and develop portfolios of technologies considering users' needs and avoiding technological lock-in
- Link R&I strategies with European industrial capacity and strengths
- Give priority to zero-carbon and GHG-neutral solutions
- Address system-level innovation and sector-coupling
- Review regulations in order to make them more innovation friendly

Conclusions on Options

- Both literature review and modelling performed indicate that technologies exist that can successfully contribute to the Paris objective.
- The objective of climate neutrality can be achieved if all options are exploited. The preferred mix of solutions are found to differ across subsectors and scenarios.
- It will require combining best available techniques and the further development of innovative low carbon production technologies and energy efficiency, together with circular economy, material efficiency and substitution, new business models and possibly CCUS.
- The full decarbonisation of the power sector will be critical in this sense, as well as the capability to replace the remaining natural gas by renewable or carbon neutral gases.
- Not all is about technology though. Lifestyle and consumer choices will greatly influence and help diversify the decarbonisation pathways.