IEA Bioenergy
Technology Collaboration Programme

Role of sustainable biomass in the global energy transition

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Gasification - a key technology in the energy transition and for the circular economy

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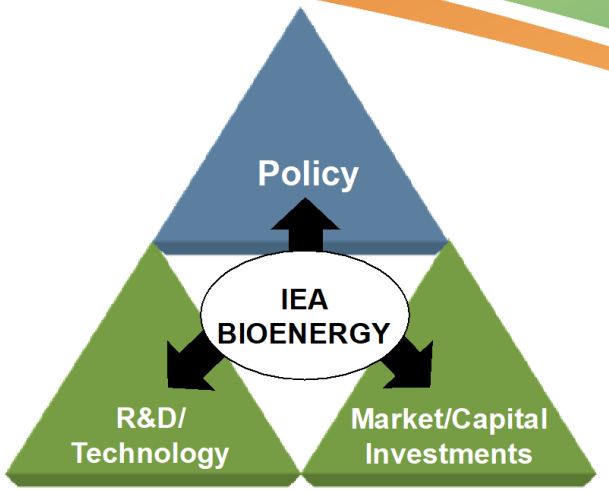
IEA Bioenergy

Technology Collaboration Programme (TCP), functioning within a framework created by the International Energy Agency (IEA)



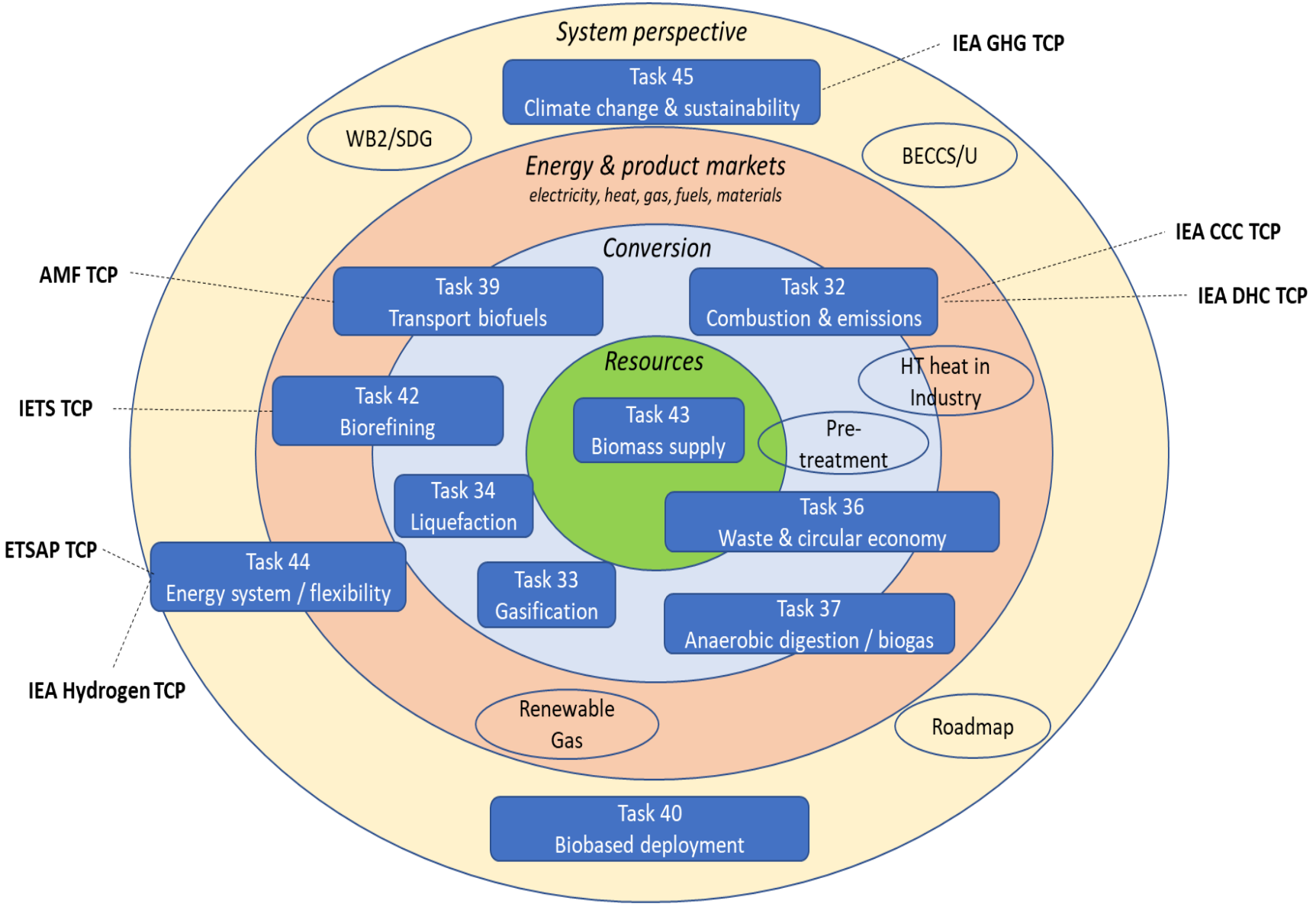
Goal:

- International **collaboration** and **info exchange** on bioenergy research, technology development, demonstration, and policy analysis
- Facilitate the commercialization and market deployment of sustainable bioenergy systems = **climate positive, environmentally sound**, **socially acceptable** and **cost-competitive** (incl. external costs)

26 members: *15 European countries + EC, US, CND, BR, India, China, Japan, Korea, AUS, NZ, SAfr*

Work programme carried out through **Tasks** and **Special Projects**, covering the full value chain from feedstock to final energy product

Activities in IEA Bioenergy



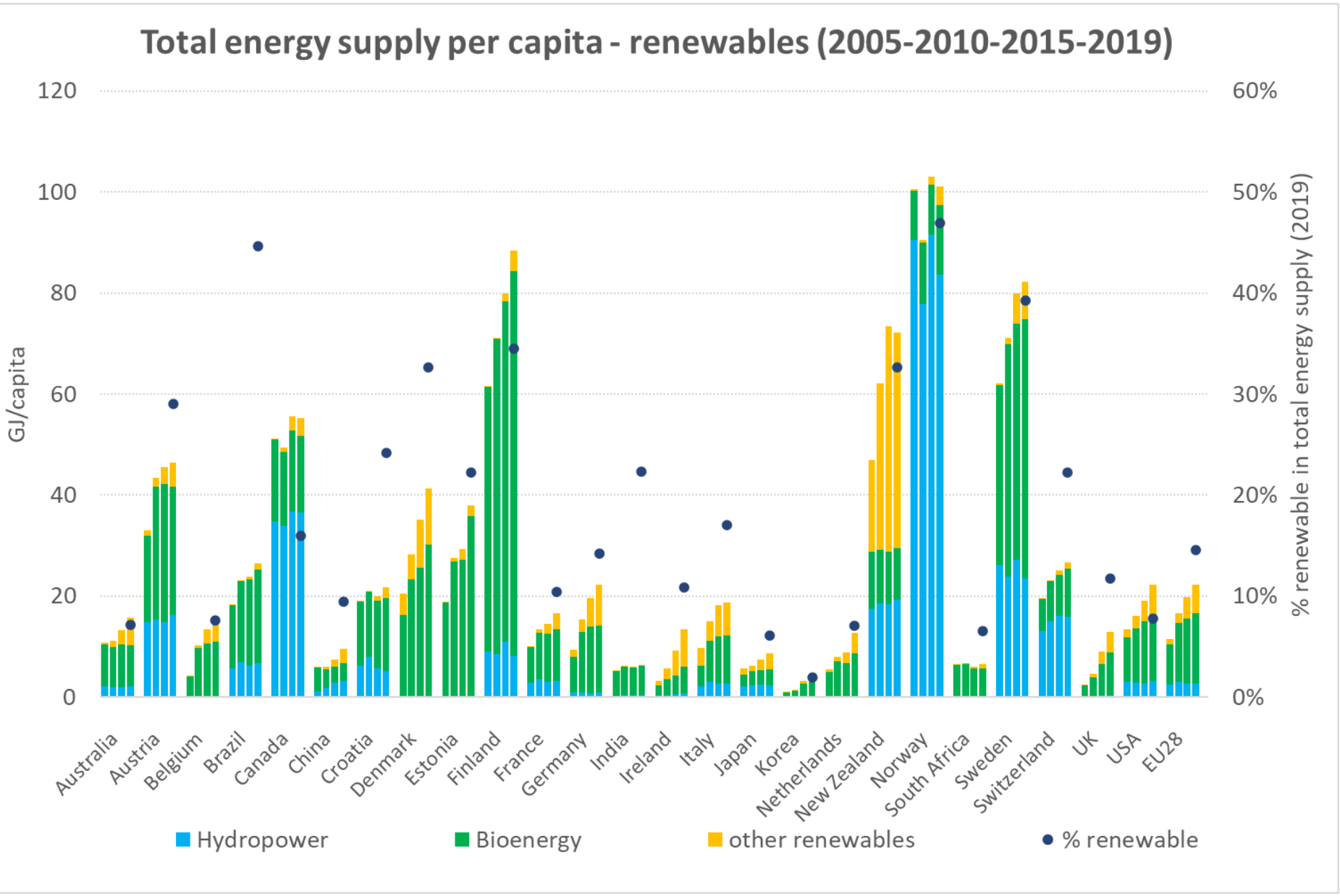
Unique role for sustainable bioenergy

- **Available** now to phase out fossil fuels in existing energy infrastructure
- **Versatile**: role in different sectors – heat, power, transport fuels
- **Storable:** complements intermittent renewables in power systems
- Can **remove atmospheric CO2** ("negative emissions") via deployment of Carbon Capture & Storage (CCS) : BECCS / Bio-CCS

Bioenergy contributes to climate change mitigation when:

- Biomass is grown **sustainably** or based on waste/residues
- **Converted** to energy products **efficiently** (often together with other biobased products)
- Used to **displace fossil fuels**

Evolution of renewables in the past decade



Apart from countries with elevated levels of hydropower, bioenergy represents more than half of renewable energy supply in most countries.

While for electricity generation different types of renewables (hydropower, wind, solar, biomass) play a role, bioenergy is the dominant renewable energy type for heat provision and for transport energy use.

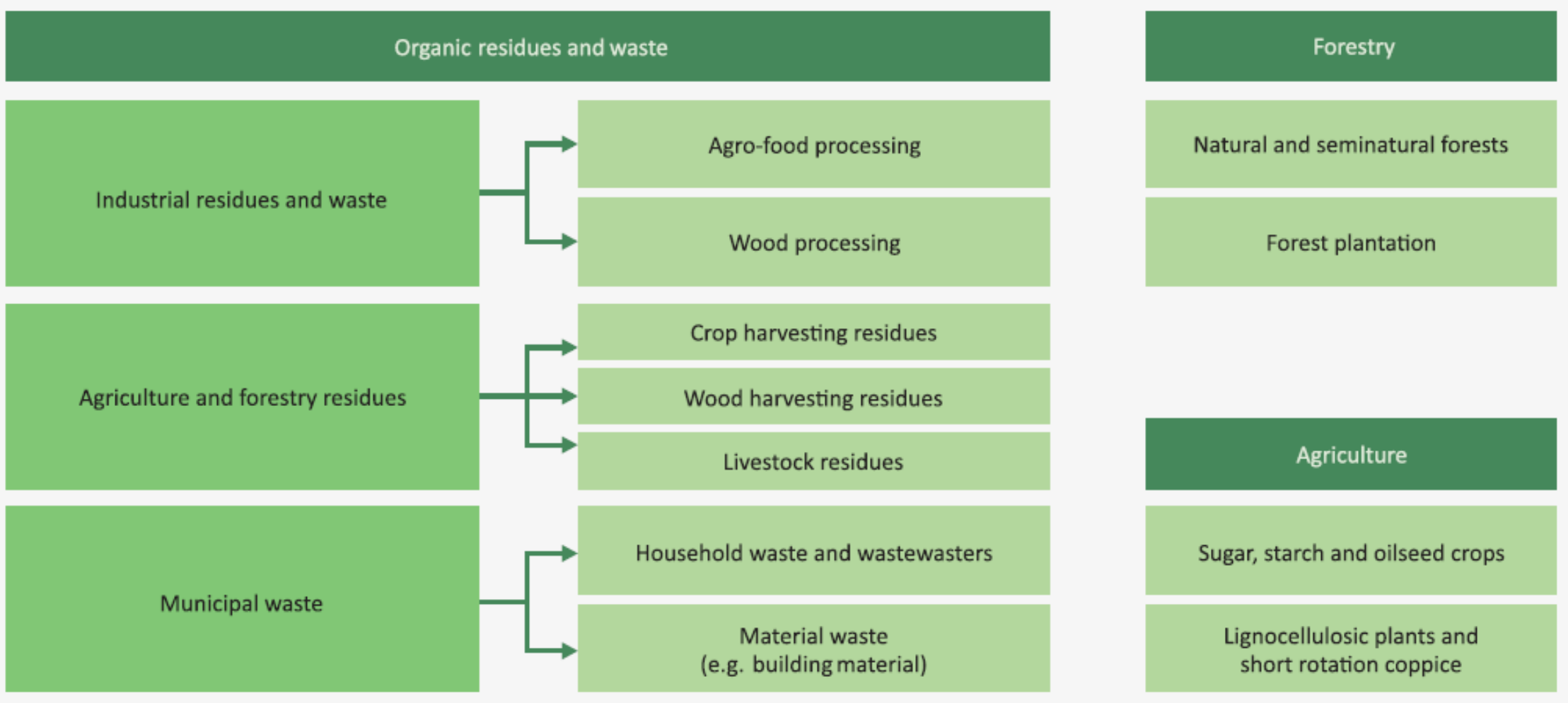
Source: 2021 country reports, IEA Bioenergy

https://www.ieabioenergy.com/blog/publications/iea-bioenergy-countries-report-update-2021/

Is there a long term role for bioenergy?

- Commonly **important roles** in pathways keeping global warming below 1.5/2°C
- **No silver bullets but mix of options** including energy conservation and efficiency measures, bioenergy and other renewables, and carbon dioxide removal (CDR) options.
- Particularly relevant in **difficult to abate sectors** (e.g., long distance transport, industry heat) and in association with CDR (BECCS) to counteract residual GHG emissions
- Biomass use for energy **needs to be balanced** with provision of food and biomass for bio-based products; commonly co-production of bioenergy and other bioproducts, or cascading use.
- Nevertheless there are **limits to biomass & land availability** and rapid expansion is challenging due to trade-offs (not unique for bioenergy).

Multiple sources of biomass

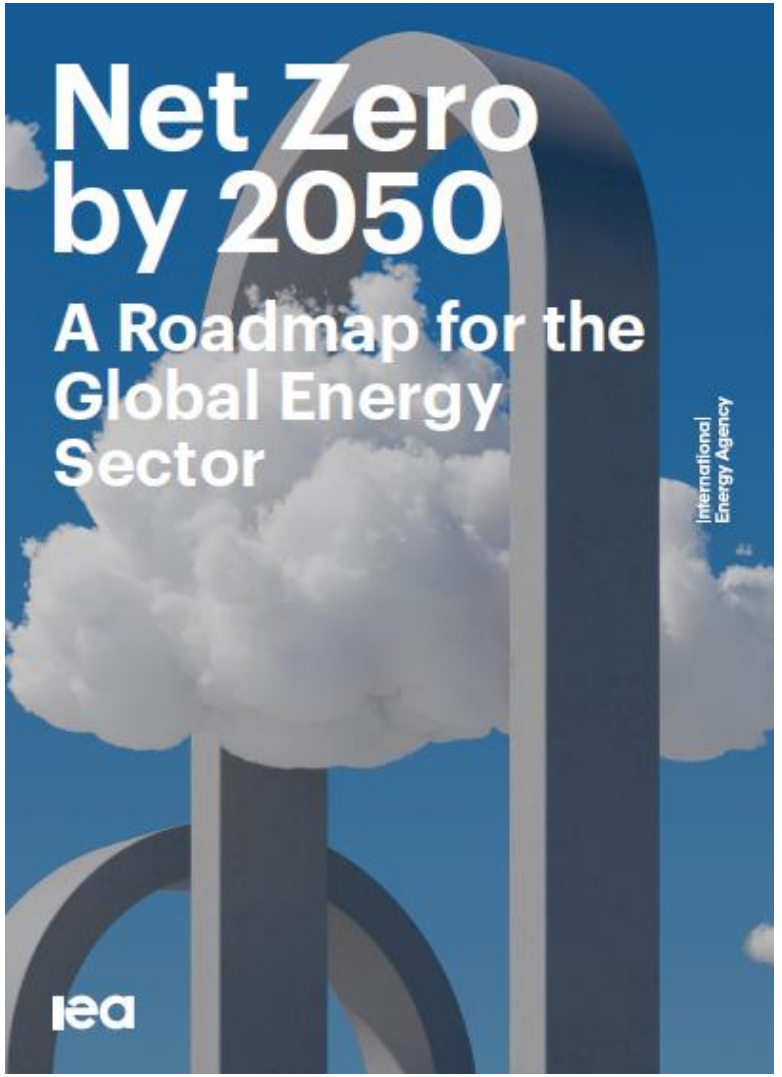


Source: IEA ETP 2017

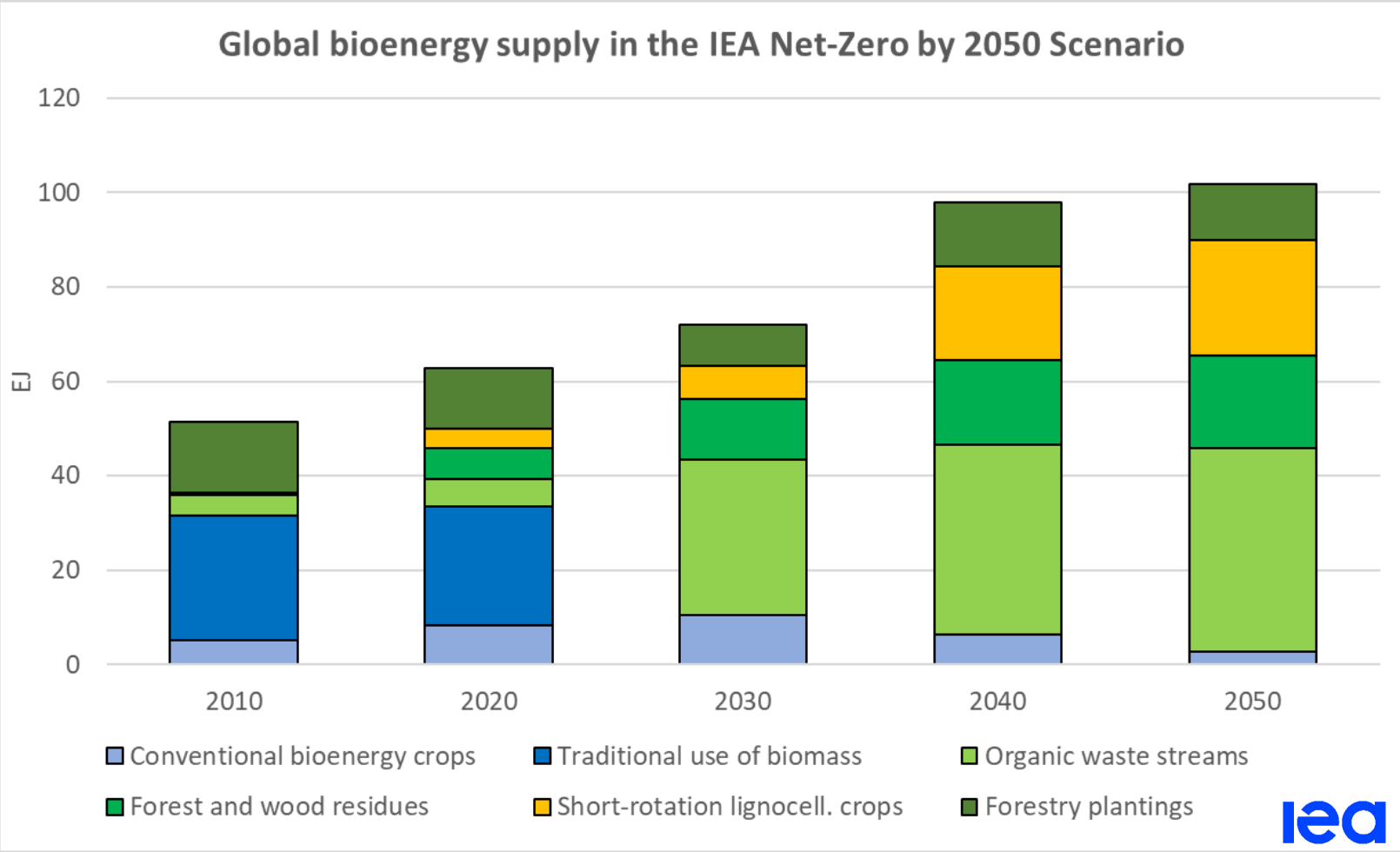
Bioenergy's role in future energy transition

IEA 'Net Zero by 2050' roadmap (18 May 2021)

https://www.iea.org/reports/net-zero-by-2050



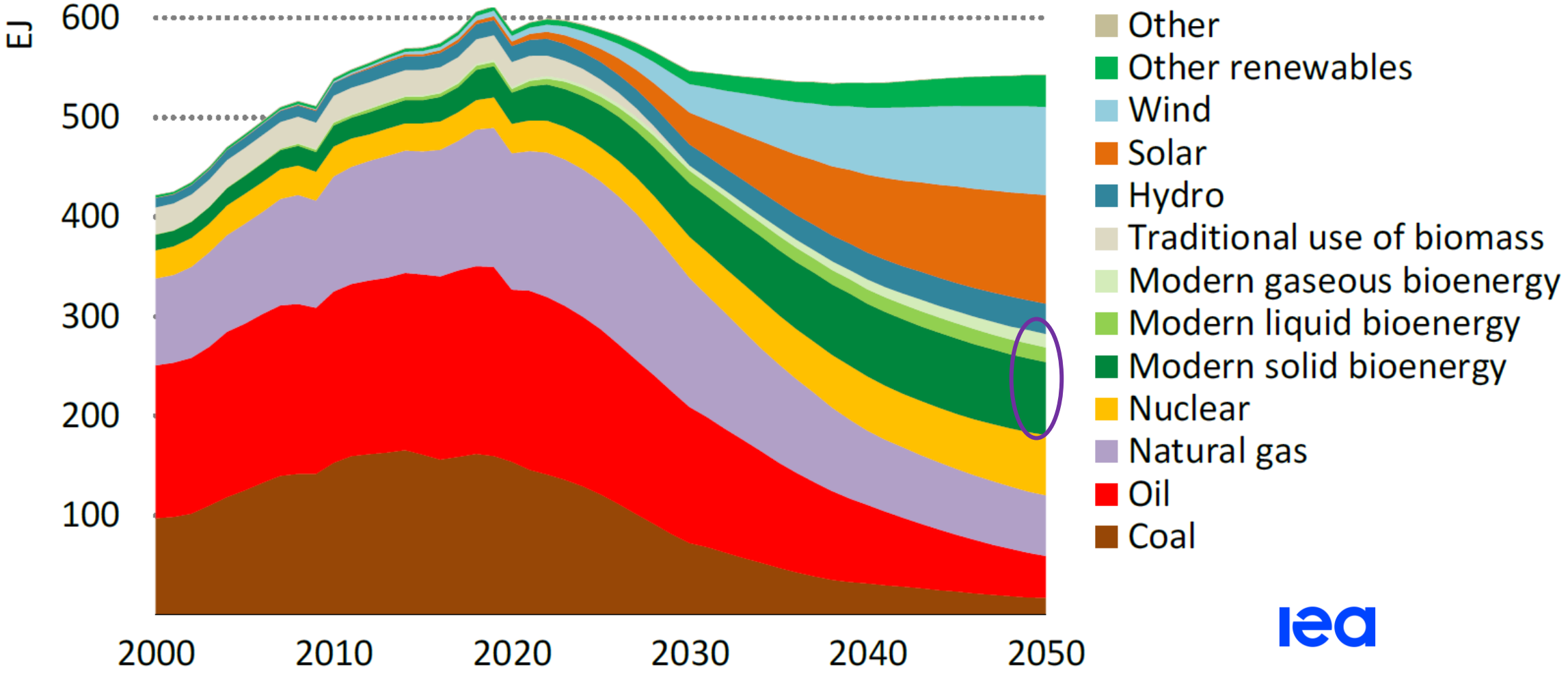
Biomass use in IEA Net Zero by 2050 roadmap



- Limited to **100 EJ** (*conservative*)
- 60 EJ from agri, forestry & industry residues & wastes
- 40 EJ cultivation for bioenergy
  - Conventional bioenergy crops (food & feed crops) – declining role
  - Short-rotation lignocell. crops
  - Forestry plantings, e.g., forestry & agroforestry
  - 140 Mha land use for bioenergy crops (70 Mha marginal lands – 70 Mha croplands ~ *equivalent to current land use for biofuels*)

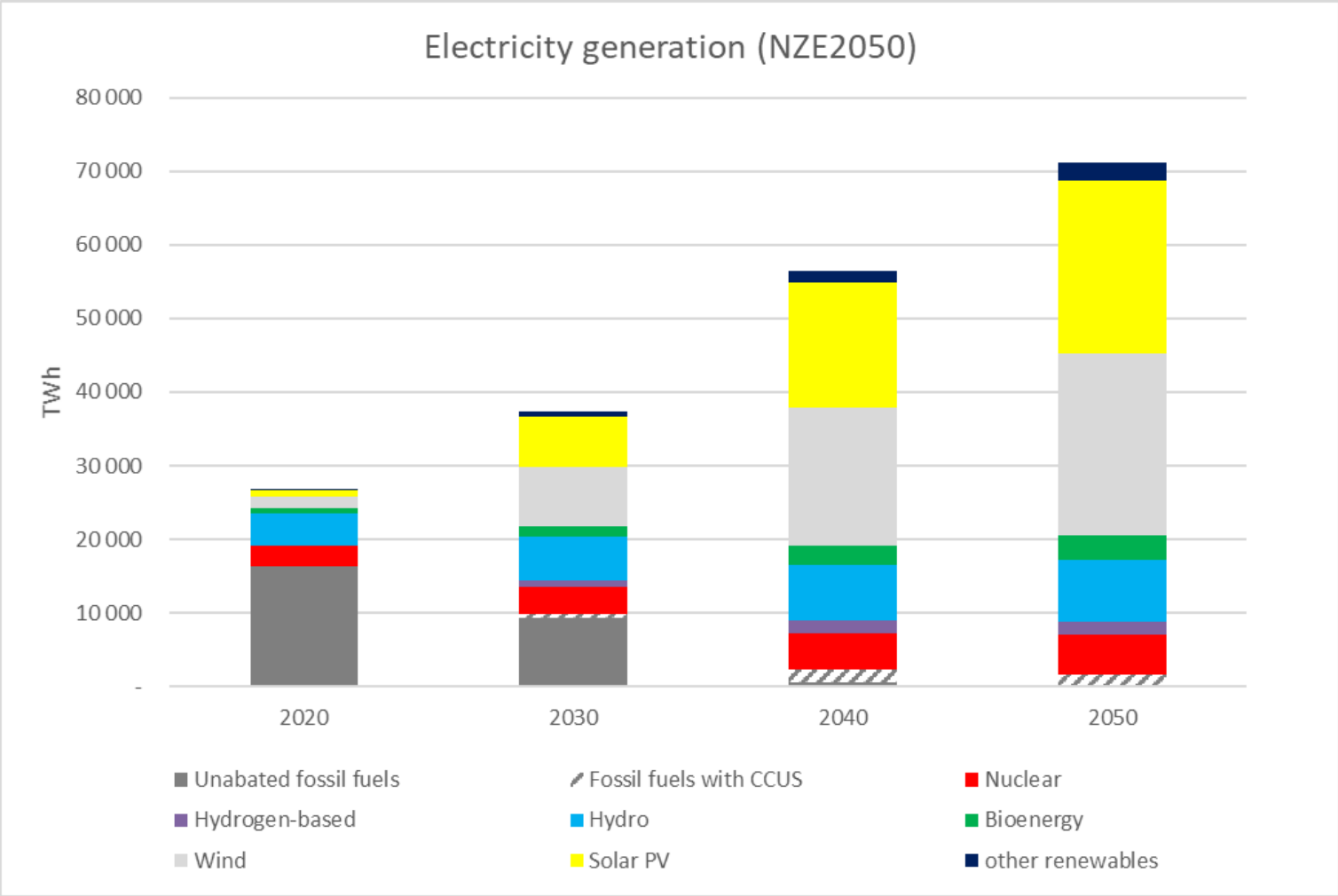
https://www.iea.org/reports/net-zero-by-2050

Evolution of total energy supply in the IEA NZE roadmap



Bioenergy represents 18% of total energy supply in 2050

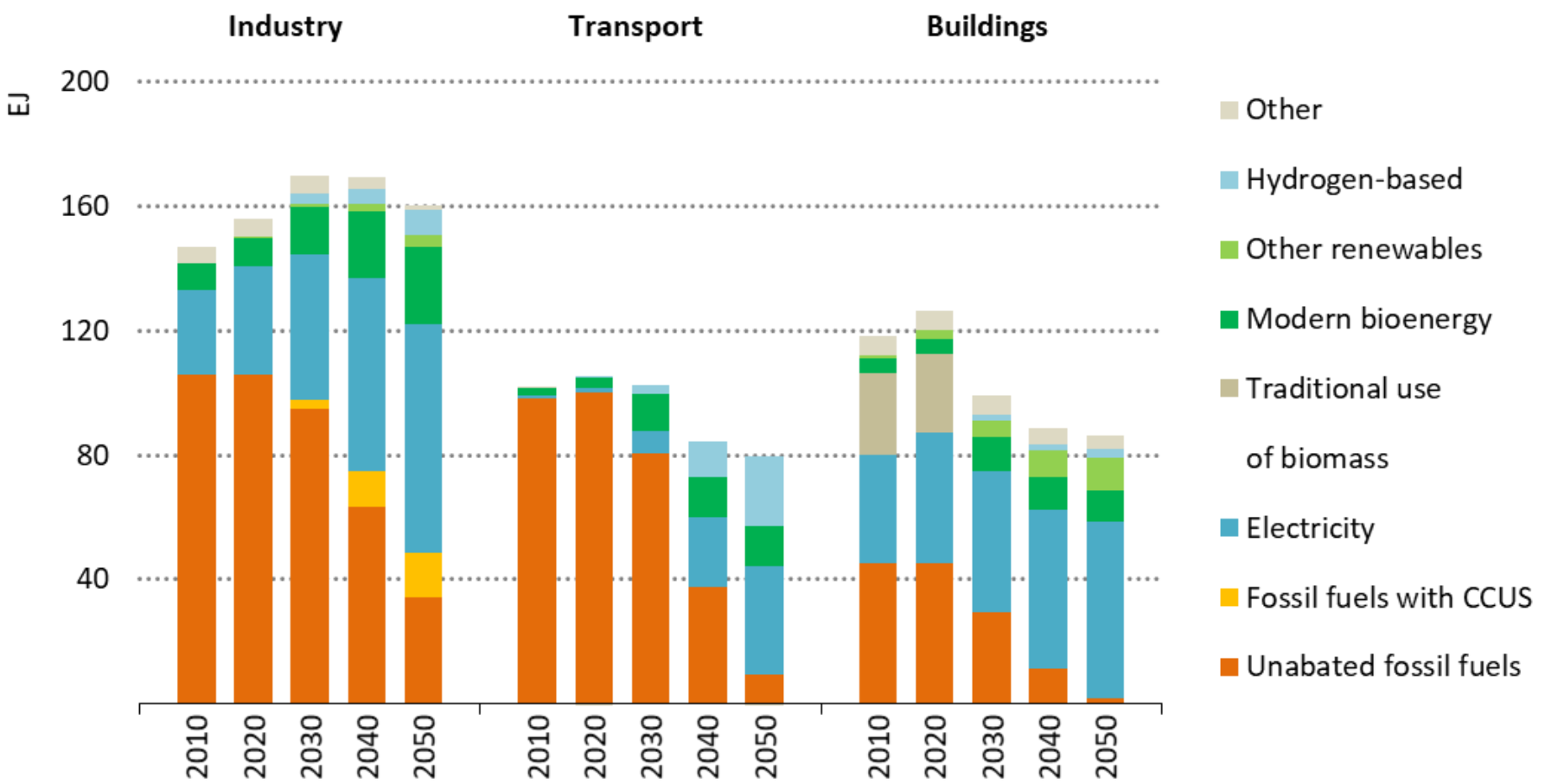
Global electricity generation in IEA NZE2050 roadmap



- Electricity x 2.5 by 2050 due to increased electrification
- Dominated (70%) by **variable & seasonal renewables** (solar, wind) => other components needed to **provide flexibility, dispatchability, grid inertia!**
- Bioelectricity equals 5% of total electricity generation in 2050 (also producing heat in CHP), of which one quarter is equipped with CCS

International Energy Agency (2021), Net Zero by 2050, IEA, Paris

Global final energy use by sector and fuel in the IEA NZE2050



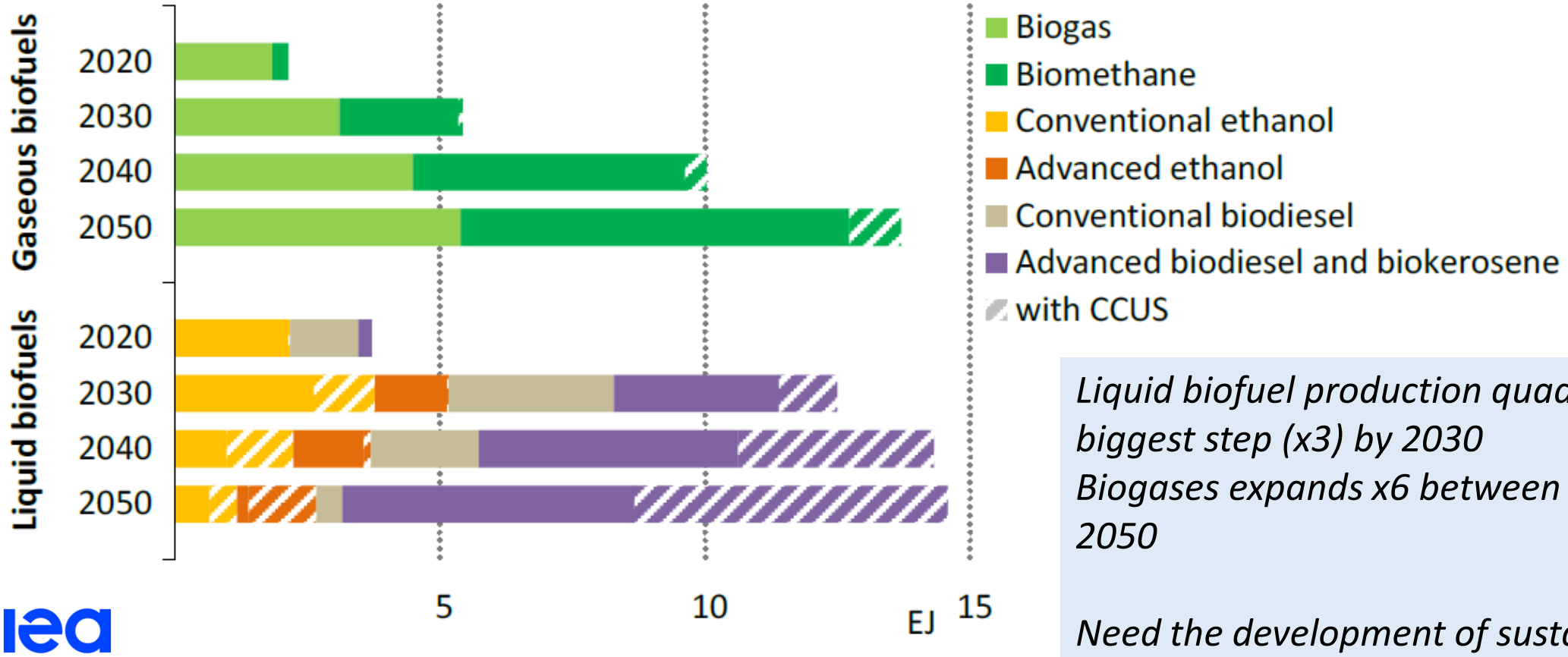
2050 role bioenergy:

- 15% of industry energy use (mainly high temperature heat)
- 16% of transport energy use
- 10% of energy use in buildings
- Negative emissions through BECCS of 1.3 billion tons CO_2
  - 45% in biofuel production
  - 40% in power production
  - rest in heavy industry

There is a wholesale shift away from unabated fossil fuel use to electricity, renewables, hydrogen and hydrogen-based fuels, modern bioenergy and CCUS in end-use sectors

International Energy Agency (2021), Net Zero by 2050, IEA, Paris

Evolution of gaseous and liquid biofuels in the IEA NZE



Liquid biofuel production quadruples with biggest step (x3) by 2030
Biogases expands x6 between 2020 and 2050

Need the development of sustainable biomass supply chains!

Conclusions

- Sustainable bioenergy is an **essential** element in the portfolio of measures needed for a low carbon scenario. In the IEA NZE scenario bioenergy represents 20% of total energy supply in 2050.
- Biofuels can play a particularly important role in the transport sector (*complementing energy efficiency measures and electrification, and with a special role in aviation, shipping and other long haul transport*), but also grows in electricity and industry.
- The combination with CCS can provide negative emissions (carbon extraction from atmosphere.
- **Progress** in bioenergy is much slower than needed; need to
  - Expand deployment of existing technologies
  - Commercialise new technologies
  - Develop sustainable supply chains and appropriate sustainability governance systems
  - Build technical and regulatory capacity in a much wider range of countries and regions

Thanks for your attention

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