Power generation infrastructure-related emissions in energy pathways

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Evidence: The climate impact of nuclear and renewable electricity mainly consists of the emissions of constructing the power plants.

UNECE's life-cycle emission factors for the EU28

		Life-cycle GHG emissions [g CO_2e/kWh]	Share of power plant construction and grid connection
Non-renewable	Coal	1023	<1%
	Natural gas	434	<1%
	Nuclear	5.1	~25%
Renewable	Photovoltaic (PV)	36.7	~98%
	Wind, offshore	14.2	100%
	Wind, onshore	12.4	~98%
	Hydropower	10.7	100%

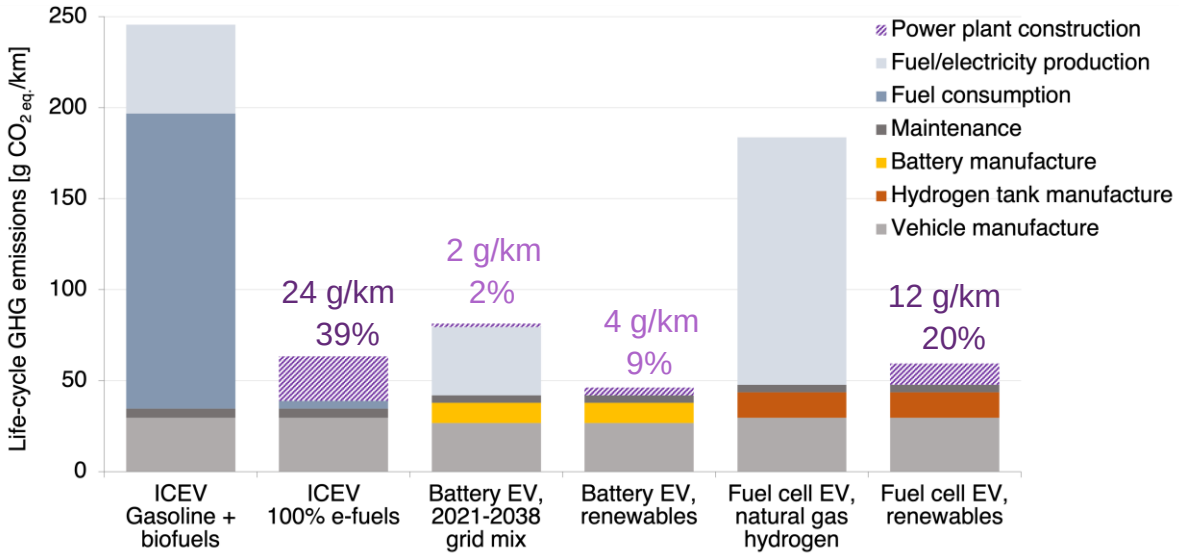
UNECE (2022) Carbon Neutrality in the UNECE Region: Integrated Life-cycle Assessment of Electricity Sources
https://unece.org/sed/documents/2021/10/reports/life-cycle-assessment-electricity-generation-options

Impact: Emissions of electricity generation infrastructure can correspond to a significant share of the life-cycle emissions of a vehicle.

Example:

For **fuel cell EVs** running on **renewable electricity-based hydrogen**, the emissions of electricity generation infrastructure correspond to **12 g/km**, or **20% of the life-cycle emission of the vehicle**.

Life-cycle emissions of passenger cars in Europe



Based on Bieker (2021). A global comparison of the life-cycle GHG emissions of combustion engine and electric passenger cars. https://theicct.org/publication/a-global-comparison-of-the-life-cycle-greenhouse-gas-emissions-of-combustion-engine-and-electric-passenger-cars/

Adjusted with UNECE life-cycle emission factors for electricity generation in EU (instead of IPCC values).

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Thank you!

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IPCC global average life-cycle emission factors are similar to UNECE values for Europe

IPCC's life-cycle emission factors for electricity generation technologies

Table A.II.4 | Aggregated results of literature review of LCAs of GHG emissions from electricity generation technologies as displayed in Figure 9.8 (g CO_2eq/kWh).

Values	Bio-power	Solar		Geothermal Energy	Hydropower	Ocean Energy	Wind Energy	Nuclear Energy	Natural Gas	Oil	Coal
		PV	CSP								
Minimum	-633	5	7	6	0	2	2	1	290	510	675
25th percentile	360	29	14	20	3	6	8	8	422	722	877
50th percentile	18	46	22	45	4	8	12	16	469	840	1001
75th percentile	37	80	32	57	7	9	20	45	548	907	1130
Maximum	75	217	89	79	43	23	81	220	930	1170	1689
CCS min	-1368								65		98
CCS max	-594								245		396

Note: CCS = Carbon capture and storage, PV = Photovoltaic, CSP = Concentrating solar power.

IPCC Special report on renewable energy sources and climate change Mitigation. Annex II: Methodology. (2011)
https://www.ipcc.ch/site/assets/uploads/2018/03/Annex-II-Methodology-1