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SAPERE PER CONDIVIDERE

EV break-even point

Sono i chilometri che un veicolo elettrico deve percorrere per compensare completamente le sue maggiori emissioni di produzione

AUTORE: **Gemini, Perplexity, Copilot, ChatGPT, McKinsey, WSJ**

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Definizione

The **break-even point** is the point at which an electric vehicle (EV) has fully offset its higher manufacturing emissions—often called its "carbon debt"—and becomes cleaner than an equivalent internal combustion engine (ICE) vehicle over its lifetime.

Calcolo del break-even point (caso della Germania)

$$Breakeven\ Point = \frac{EVmanufacturing\ emission - ICEmanufacturing\ emission}{ICE\ emission\ per\ km - EV\ emission\ per\ km}$$

Step 1: Determine the Manufacturing Emissions (Carbon Debt)

- EV Manufacturing: producing a mid-sized EV with a 60-kWh battery emits approximately 14 tons of CO2
- ICE Manufacturing: producing a similar gasoline cars emits approximately 7 tons of CO2
- Manufacturing Gap (Carbon Debt): 14 tons - 7 tons = 7 tons of CO2. This is the initial deficit the EV must overcome.

Step 2: Determine the Operational Emissions per Kilometer

- ICE Car Emissions: A modern gasoline car emits, on average, about 170 grams of CO_2 per kilometer (this includes fuel production and combustion).
- EV Emissions (Germany): The German electricity mix has a carbon intensity that results in lifecycle emissions of about 90 grams of CO_2 per kilometer driven for an EV (this accounts for power plant emissions, transmission losses, etc.).
- Per-Kilometer Savings: 170 g/km (ICE) - 90 g/km (EV) = 80 grams of CO_2 saved per kilometer.

Step 3: Calculate the Break-Even Point

$$Breakeven\ Point = \frac{7{,}000{,}000\ g\ CO2}{80\ g\ CO2/km} = 87{,}500\ km$$

Break-even point delle BEV in Europa e Cina

Paese/Regione	Mix Energetico Prevalente	Stima del Break-Even Point (km)
Francia	Nucleare e Rinnovabili	~ 25.000 - 40.000 km
Italia / Spagna	Gas Naturale e Rinnovabili	~ 60.000 - 90.000 km
Germania	Rinnovabili e Carbone/Gas	~ 80.000 - 110.000 km
Cina	Carbone	> 120.000 km

Il punto di pareggio (break-even point) delle emissioni di CO2 di una EV varia molto a seconda del "mix energetico" del paese in cui viene prodotta la batteria e, soprattutto, in cui l'auto viene usata.

Break-even point delle BEV in Europa, USA e Cina

Region / Grid	Approx. Breakeven Distance	Notes
France (low-carbon grid)	~25,000 km	Very quick due to nuclear/renewables. (NenPower)
Europe average	18,000–50,000 km	Depends on exact mix and vehicle. (NenPower)
United States (mixed grid)	~41,000 km	~2 years at ~19,000 km/yr. (BloombergNEF)
China (coal-heavy grid)	~118,000–153,000 km	Longer because grid is more carbon-intensive. (QualEnergia.it)
Canada (low-carbon)	~18,000 km (varies by province)	Cleaner grids shorten breakeven. (MDPI)

Stage	EV vs ICE
Production CO_2	EV greater due to battery manufacturing
Operational CO_2	EV lower (no tailpipe), depends on grid carbon
Breakeven distance	Region-dependent: ~18,000–150,000 km
Breakeven time	~1–4+ years depending on country/grid
Lifetime total CO_2	EV usually 30–70% lower

Break-even point delle BEV in Europa e Cina

Tabella Comparativa delle Distanze di Pareggio

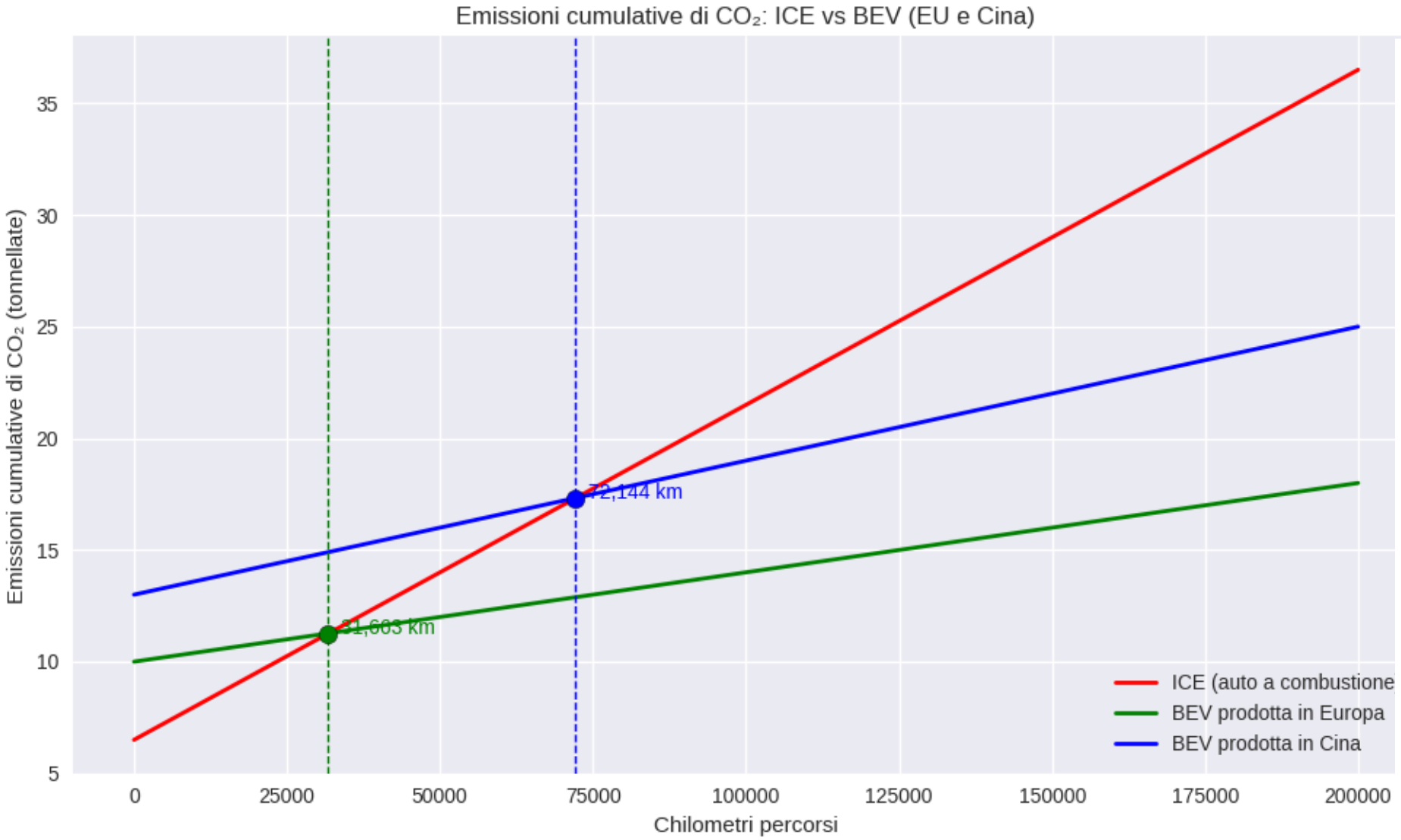
Paese	Carbon Intensity (g CO2/kWh)	Distanza Breakeven (km)	Tempo Breakeven (anni)*	Riduzione Lifecycle (%)	Status
Francia	55	**22.000**	1.1	-75%	Ottimale
Spagna	190	**48.000**	2.4	-65%	Buono
Italia	270	**65.000**	3.3	-58%	Moderato
Germania	329	**78.000**	3.9	-52%	Moderato
Cina	575	**118.000**	5.9	-40%	Critico

*Tempo calcolato su percorrenza media di 20.000 km/anno

Nota importante: Tutti i veicoli elettrici raggiungono il breakeven entro la loro vita utile (200.000 km)

Le valutazioni di Gemini, Chat-GPT e Perplexity non sono perfettamente allineati. Ma è comprensibile visto che i dati di partenza non sono così solidi.

Break-even point delle BEV in Europa e Cina



In **Europa**, una BEV diventa più vantaggiosa già dopo pochi anni di utilizzo medio (40.000 km ≈ 3–4 anni).

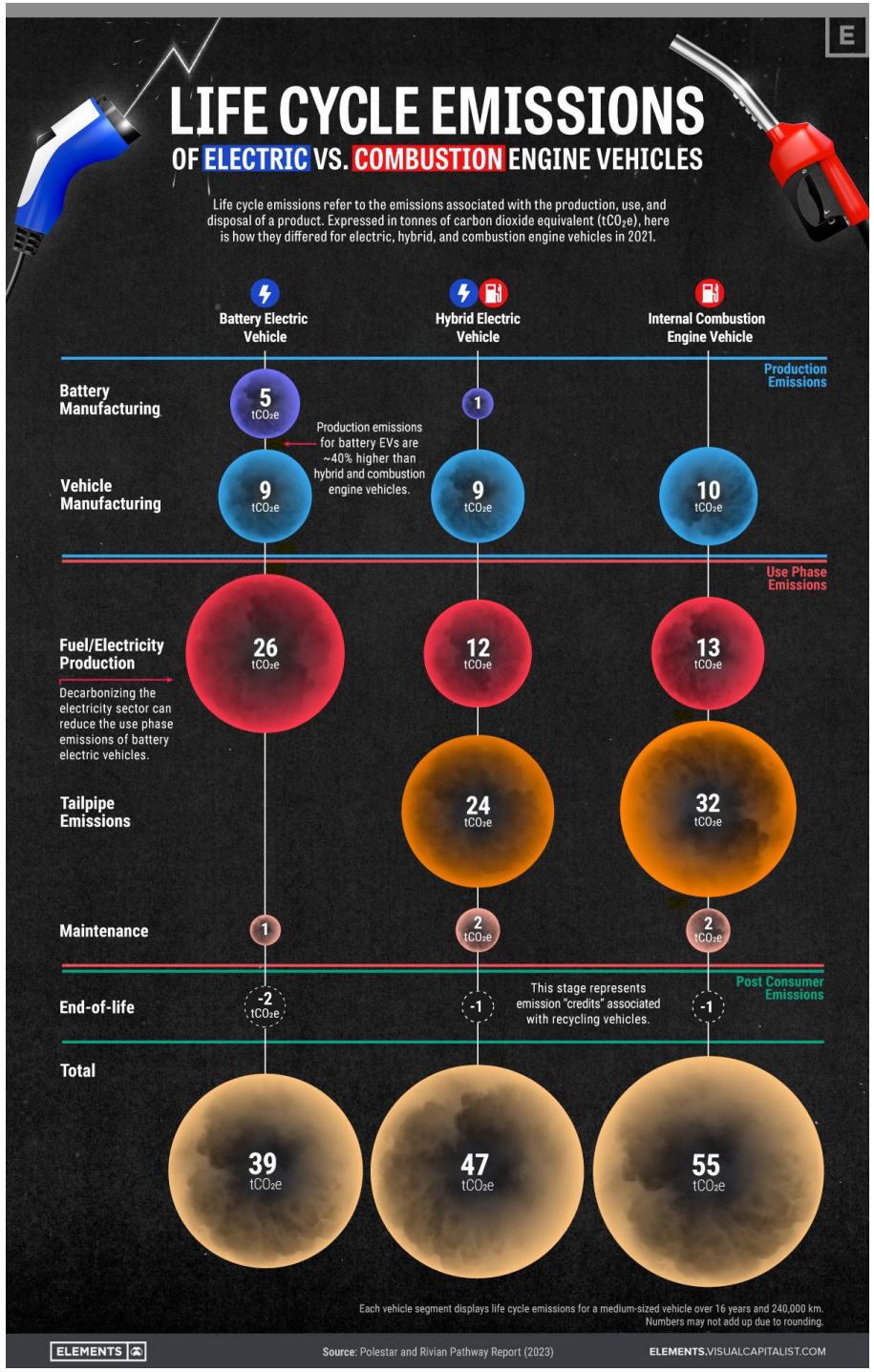
In **Cina**, il vantaggio arriva più tardi, ma comunque entro la vita utile del veicolo (70–80.000 km ≈ 6–7 anni).

Su un ciclo di vita completo (200.000 km), la BEV europea emette circa **50% meno CO_2** rispetto a un'ICE, mentre la BEV cinese riduce le emissioni di circa **25–30%**.

https://copilot.microsoft.com/chats/wJsWsp9cP2cyztKq6wNLL

Life Cycle Emission

These numbers consider a use phase of 16 years and a distance of 240,000 km.



https://elements.visualcapitalist.com/life-cycle-emissions-of-electric-hybrid-and-combustion-engine-vehicles/

Aspetti fondamentali

Grid mix matters a *lot*
An EV charged on a coal-heavy grid could approach similar lifecycle emissions to an ICE car — and in extreme cases need **very high mileage** to break even.

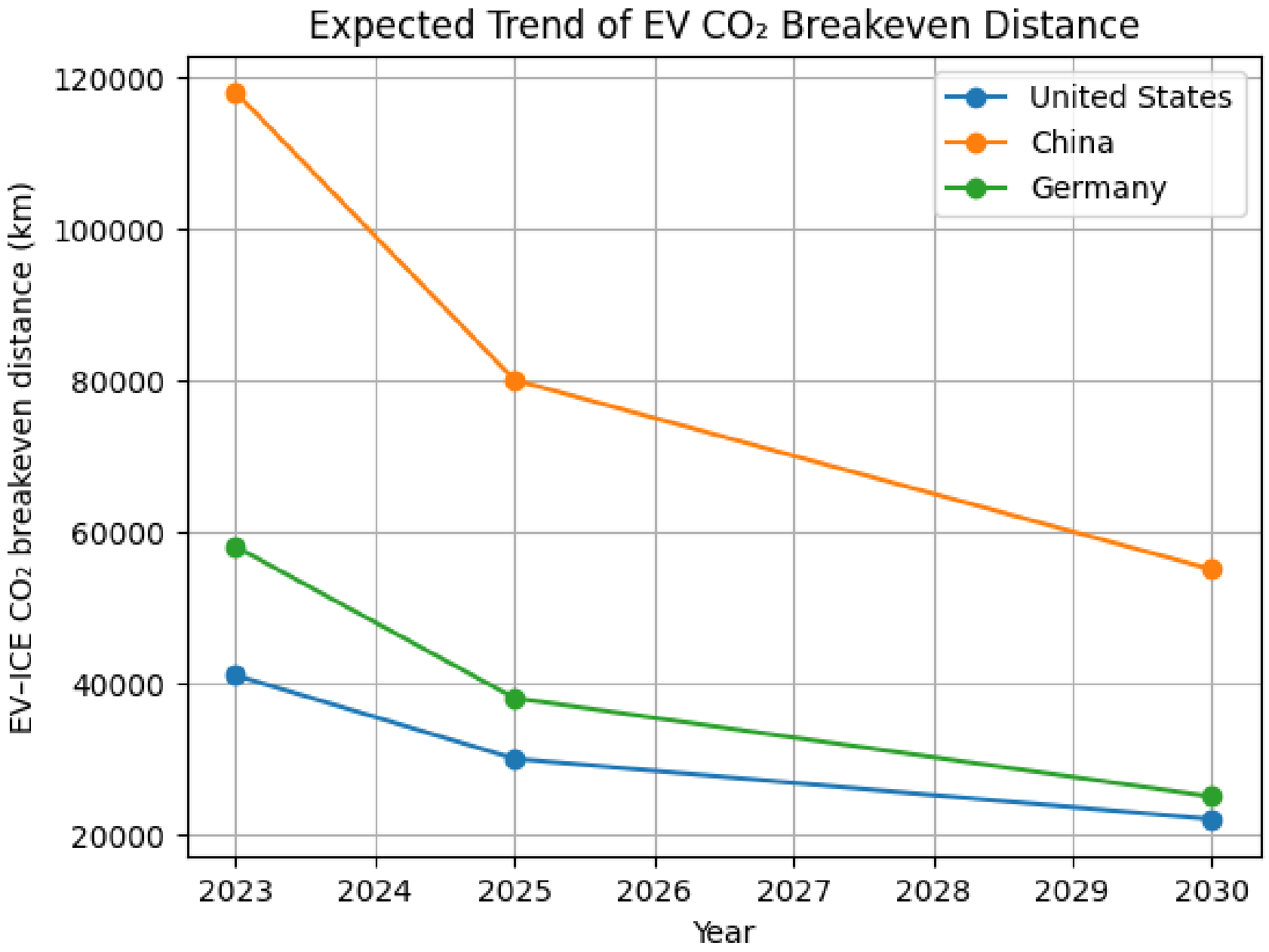
Battery production location matters
If an EV's battery is made in a *high-carbon manufacturing grid* (e.g., coal-based China) and then driven in another high-carbon electricity country, breakeven distances increase.

Recycling & future grids
Battery recycling and decarbonization of manufacturing supply chains will shorten breakeven distances in coming years.

Trend atteso

Region	Approx. Breakeven Today (2023)	Approx. Breakeven by 2030	Expected Lifetime CO_2 Gap by 2030
United States	~41,000 km (~2 yrs)	~20,000 – 25,000 km (~1 yr)	~75 % less CO_2 lifetime for EVs vs ICE (Clean Future)
China	~118,000 km (~9-10 yrs)	~50,000-ish km (projection)	~50-60 % less cumulative CO_2 (improving) (Springer Nature)
Germany	~58,000 km (~5 yrs)	~25,000 km (~2 yrs)	~70 %+ less CO_2 lifetime for EVs (isdo.ch)

Trend atteso



Life Cycle Emission

Life Cycle Assessment: Cradle-to-Grave Analysis

A Life Cycle Assessment (LCA) measures the environmental impact of a product, service or process:

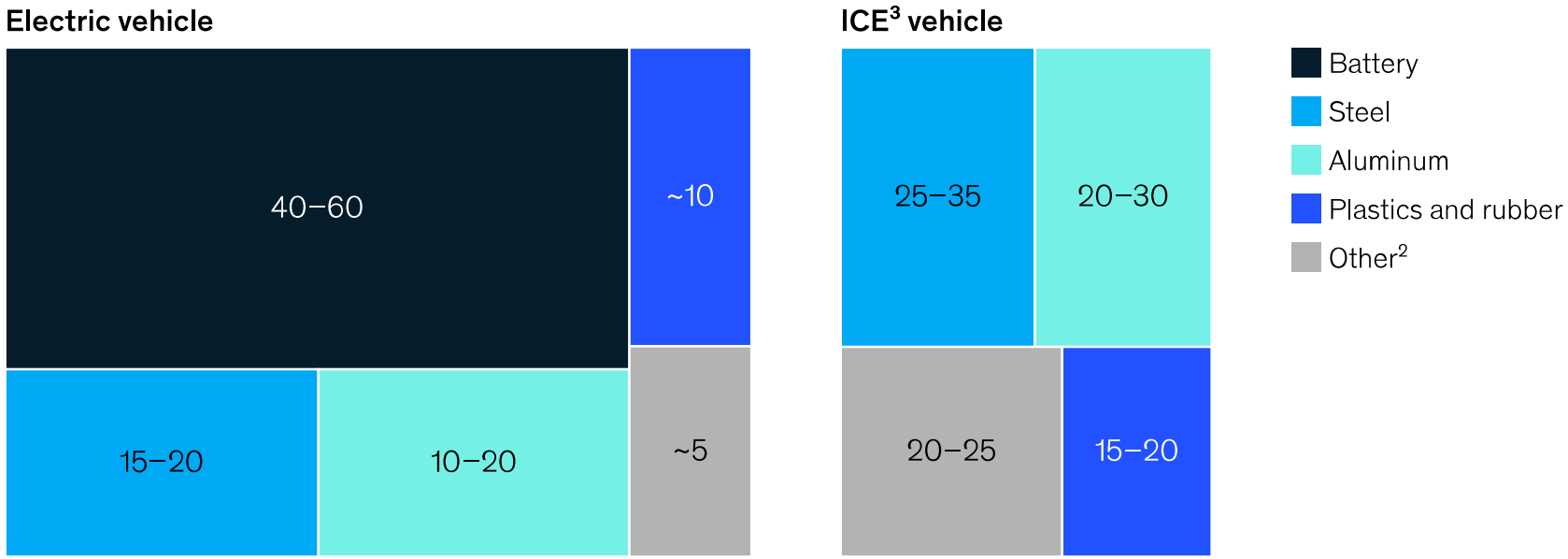
- **Raw material extraction:** Spotting energy usage and resource depletion in material procurement.
- **Manufacturing and processing:** Analyzing emissions and waste generated during production.
- **Transportation and distribution:** Assessing the carbon footprint associated with logistics.
- **Usage phase:** Measuring energy and water consumption during product use.
- **End-of-life disposal:** Understanding the impact of recycling, landfilling or incineration.

https://www.tunley-environmental.com/en/insights/life-cycle-assessment-of-electric-vehicles

CO2 emission in EV and ICE production

Batteries account for up to 60 percent of embedded greenhouse-gas emissions in electric-vehicle production.

Typical upstream battery-electric-vehicle emissions,[1] %



[1]Including all upstream emissions from raw material extraction to the OEM, including logistics.
[2]Including glass, copper, electronics, textiles, and logistics.
[3]Internal-combustion engine.
Source: McKinsey analysis

McKinsey & Company

https://www.mckinsey.com/industries/automotive-and-assembly/our-insights/the-race-to-decarbonize-electric-vehicle-batteries

Materials and energy to produce EV batteries in various countries

Emissions in the battery value chain are primarily driven by production location and sources of raw materials and energy.

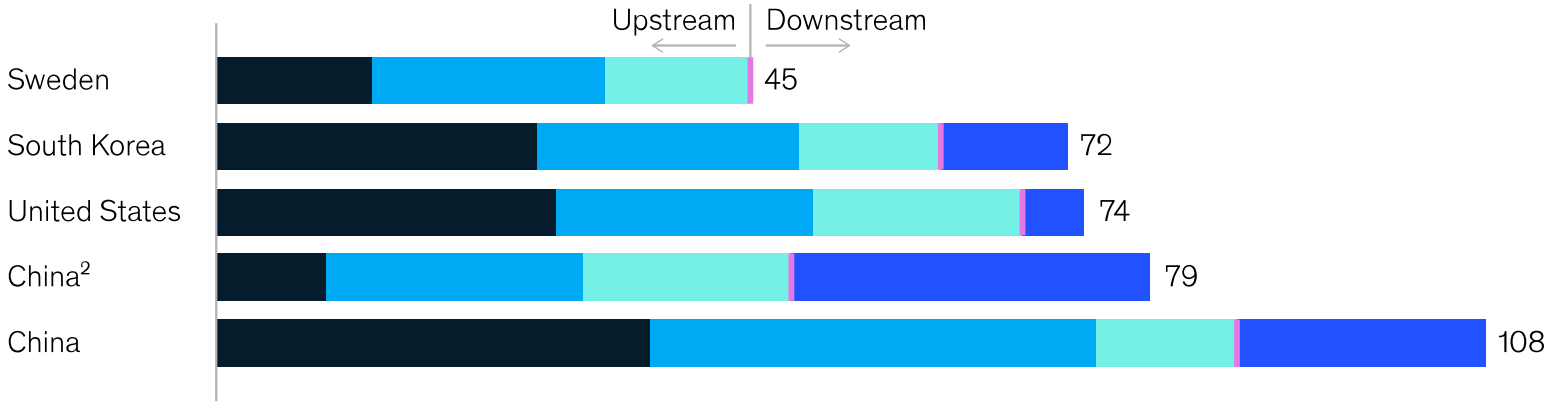
1. Mining and refining
Highly individual for each material; emissions from energy and from use of chemicals

2. Active-material production
Emissions from high energy usage in chemical processes

3. Other components and logistics
Emissions from energy and reagents for manufacturing and from burning fossil fuels in transport

4. Cell production
Emissions from energy used in the battery manufacturing process

Emission intensities, kg CO_2e/kWh[1]

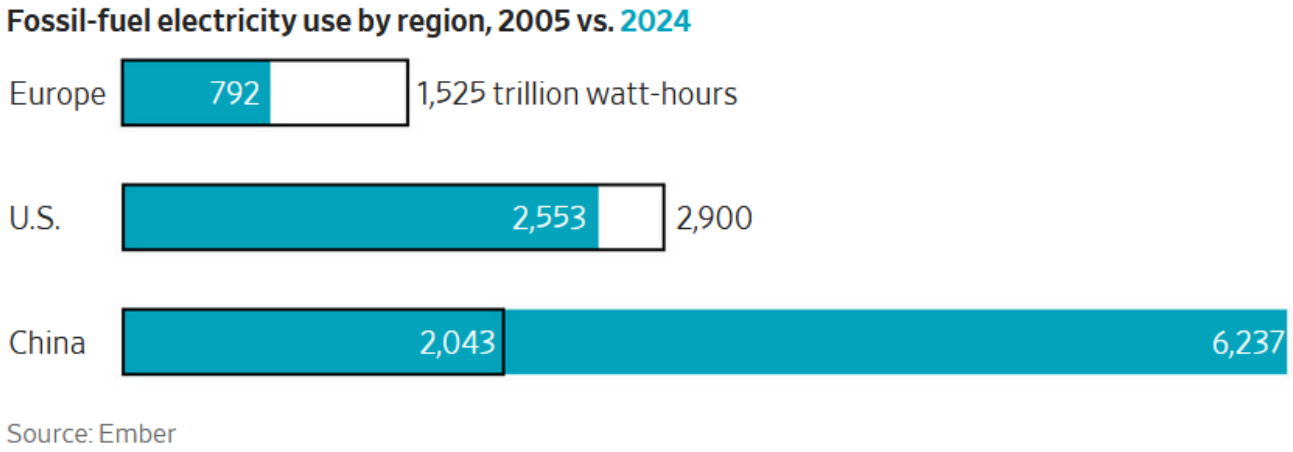


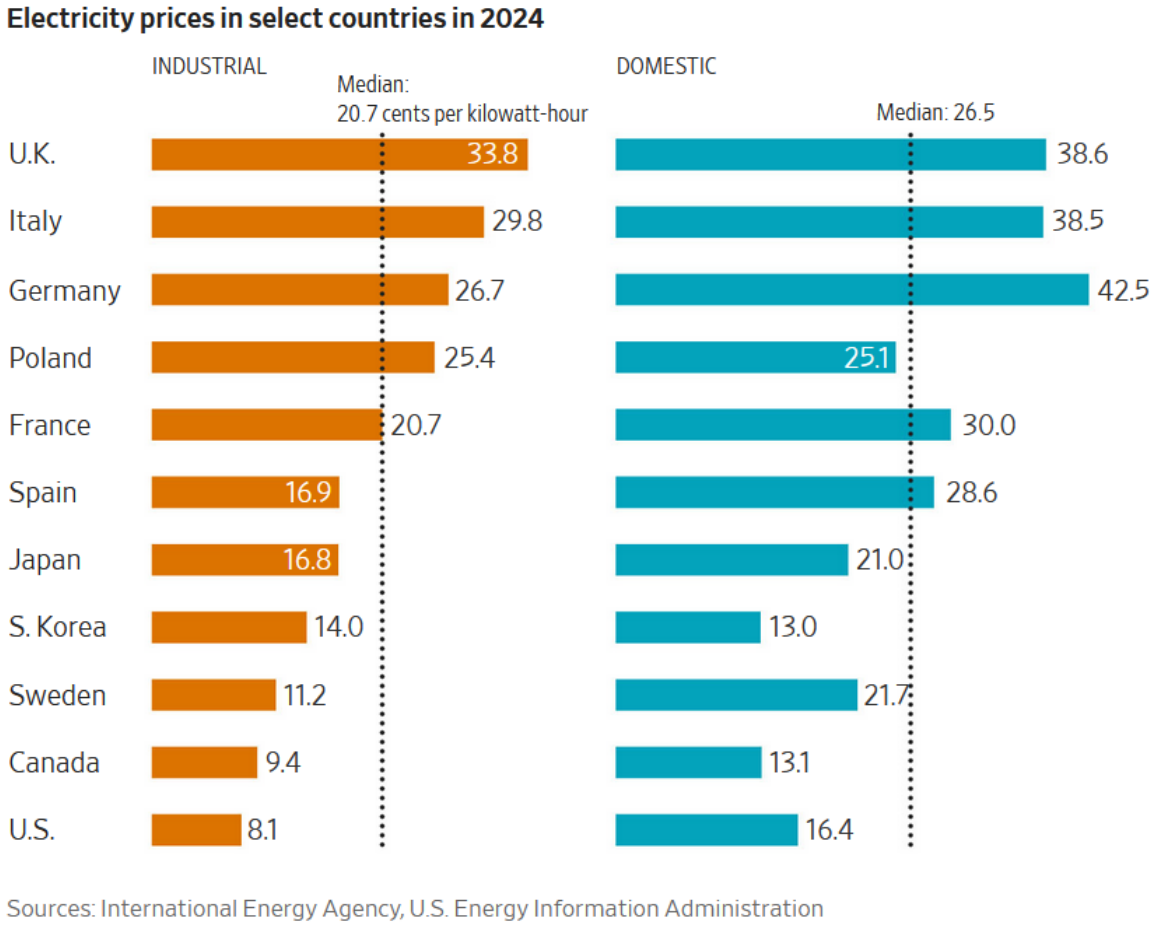
[1]Bottom-up modeling of cell-level emission intensities in individual "gigafactories." Emission intensities were estimated based on existing supply agreements with providers of raw materials, active materials, and energy. Market average has been taken where no information on the source of raw materials or energy was available.
[2]Based on a nickel-free battery; all other examples are based on nickel-rich batteries.
Source: Greenhouse gases, Regulated Emissions, and Energy use in Technologies (GREET); MineSpans by McKinsey; McKinsey Battery Insights

https://www.mckinsey.com/industries/automotive-and-assembly/our-insights/the-race-to-decarbonize-electric-vehicle-batteries

McKinsey & Company

Uso dei combustibili fossili per produrre elettricità. Costo dell'elettricità





Europe has succeeded in slashing carbon emissions more than any other region—by 30% from 2005 levels, compared with a 17% drop for the U.S.

But along the way, the rush to renewables has helped drive up electricity prices in much of the continent.

https://www.wsj.com/business/energy-oil/europes-green-energy-rush-slashed-emissionsand-crippled-the-economy-e65a1a07?mod=hp_lead_pos7

Back up

Emisssioni gas serra per produzione e uso di ICE e EV in paesi diversi

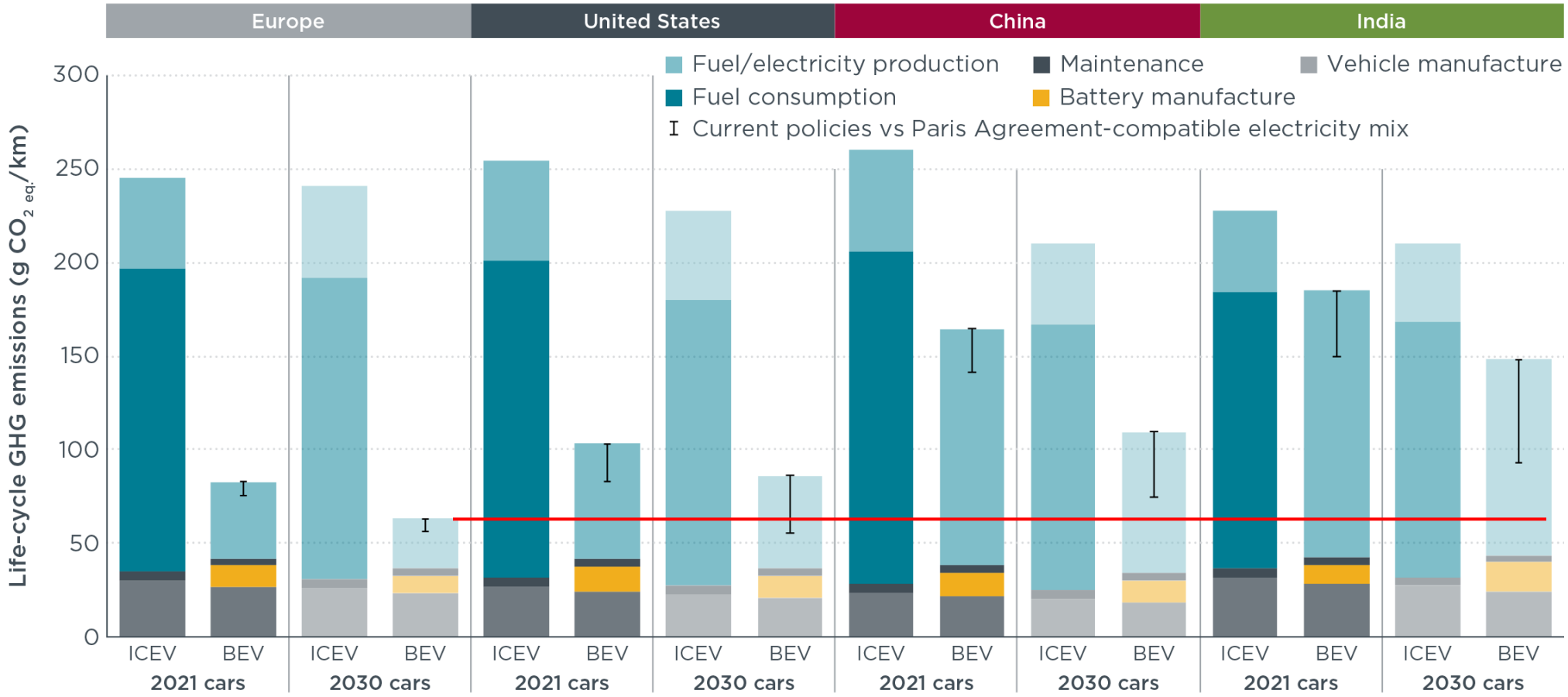


Figure ES.1. Life-cycle GHG emissions of average medium-size gasoline internal combustion engine (ICEVs) and battery electric vehicles (BEVs) registered in Europe, the United States, China, and India in 2021 and projected to be registered in 2030. The error bars indicate the difference between the development of the electricity mix according to stated policies (the higher values) and what is required to align with the Paris Agreement.

L'Europa la virtuosa produce e vende poche BEV.

GHG: Greenhouse Gas

Documento del 2021

https://theicct.org/publication/a-global-comparison-of-the-life-cycle-greenhouse-gas-emissions-of-combustion-engine-and-electric-passenger-cars/