Renewable Energy in the Transport Sector

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Content

- Introduction
- Alternative fuels
  - - Biofuels, electricity, hydrogen
- Policy framework
- Zero-emission vehicles
  - - EV and solar energy
- Conclusions

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Amount of transport services per capita

Horse power

Sailing ship

Steam machine, steam railway

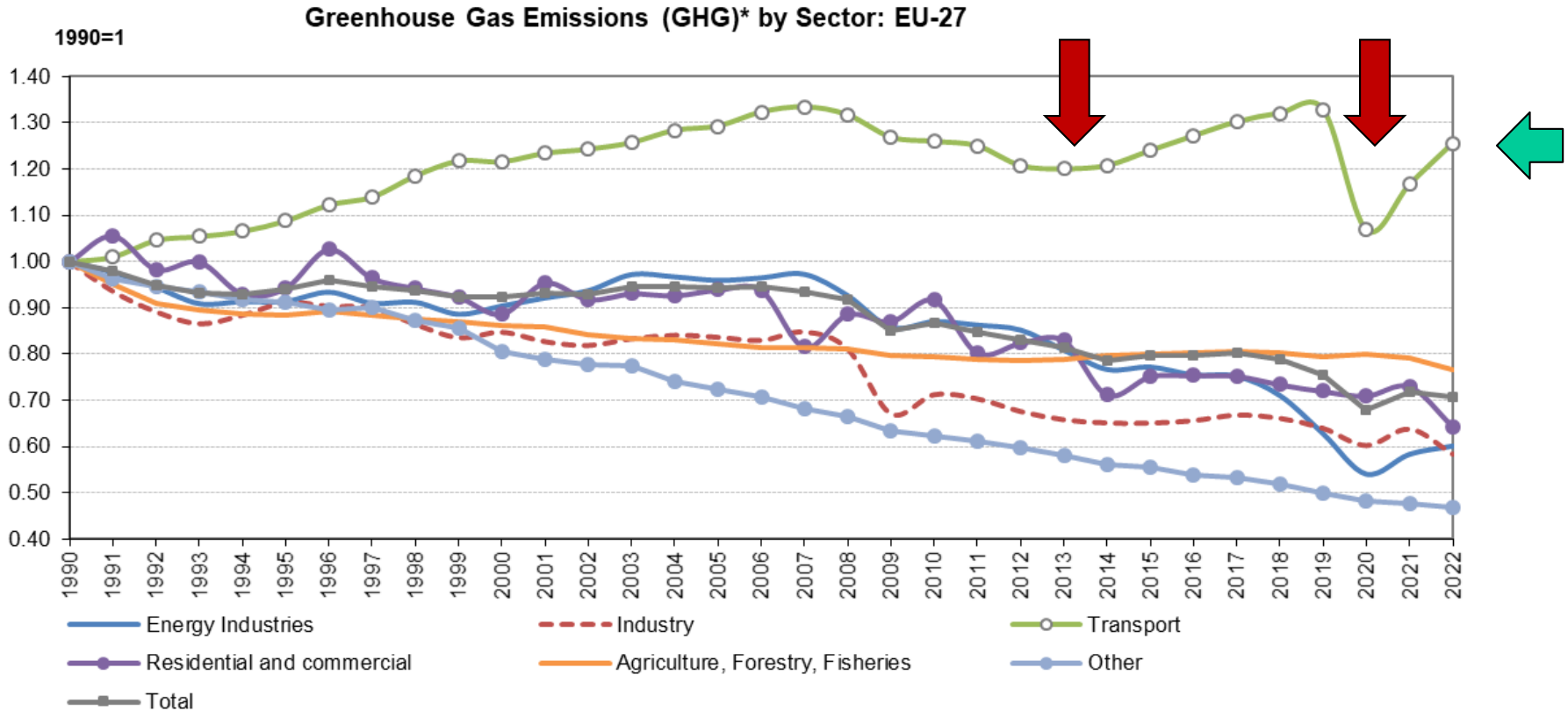
Electricity, combustion engine

based on commercial energy

based on non-commercial renewable energy

time

GHG


Greenhouse Gas Emissions (GHG)* by Sector: EU-27
1990=1
1.40
1.30
1.20
1.10
1.00
0.90
0.80
0.70
0.60
0.50
0.40
1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022
Energy Industries
Industry
Transport
Residential and commercial
Agriculture, Forestry, Fisheries
Other
Total

Introduction

Basic principle:

$$S = f(E, \eta(Tc), \eta(Tis))$$

Service:
km driven

Fuel mix,
Fuel demand

Biofuels

Electricity

Hydrogen

Efficiency:
Liter/100 km

ICE

BEV

FCV

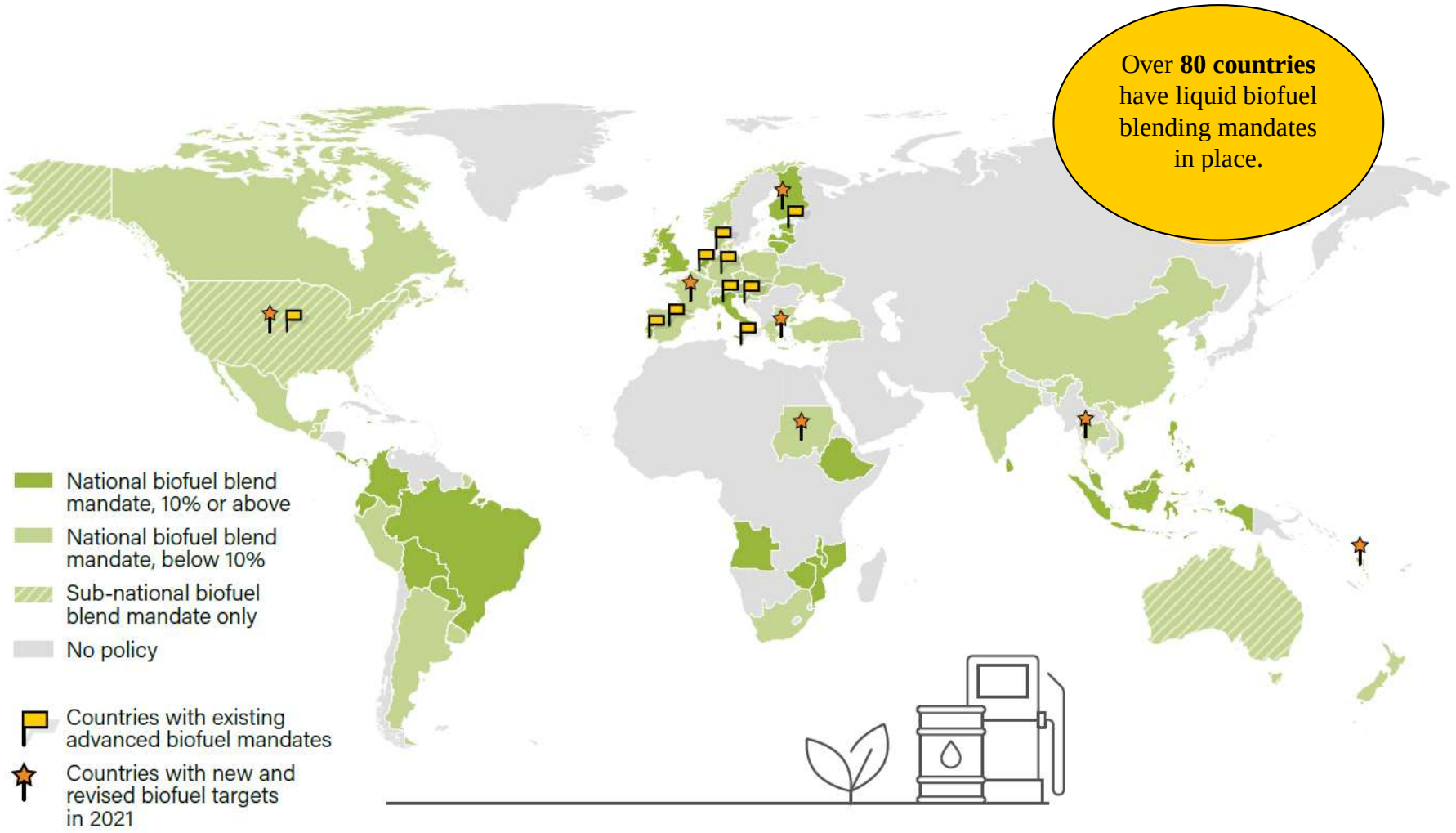
Infrastructur

CRS

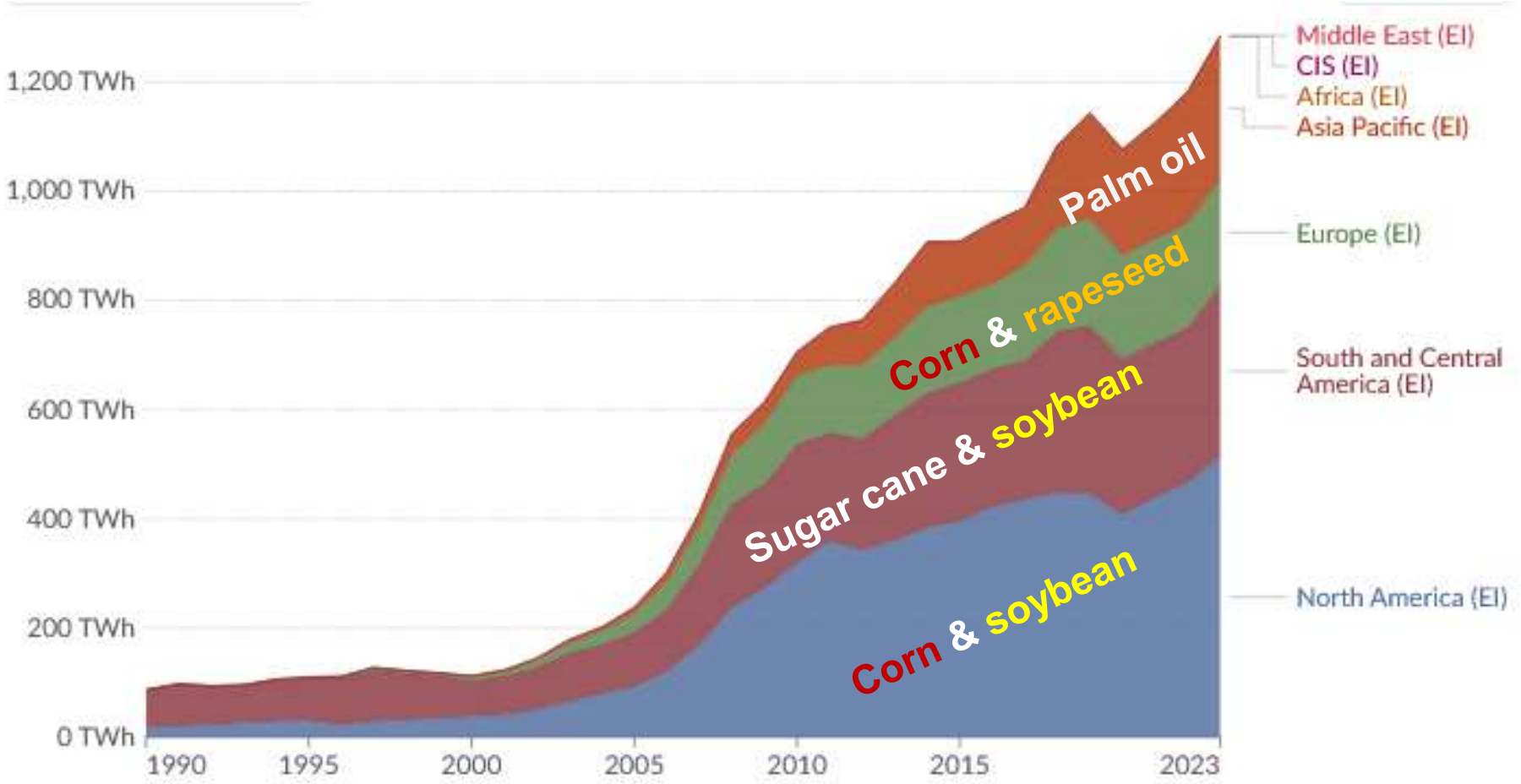
ECS

HRS

Biofuel Mandates and Targets

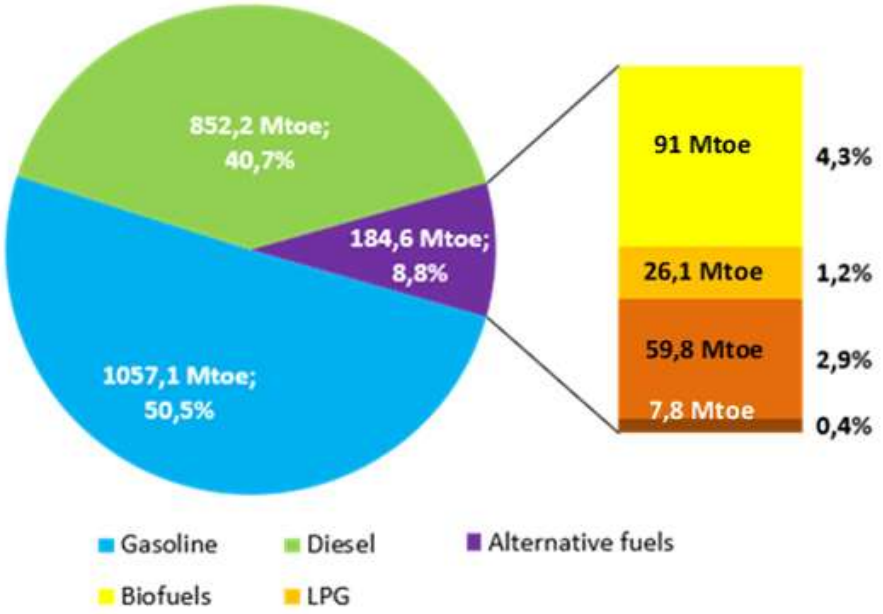


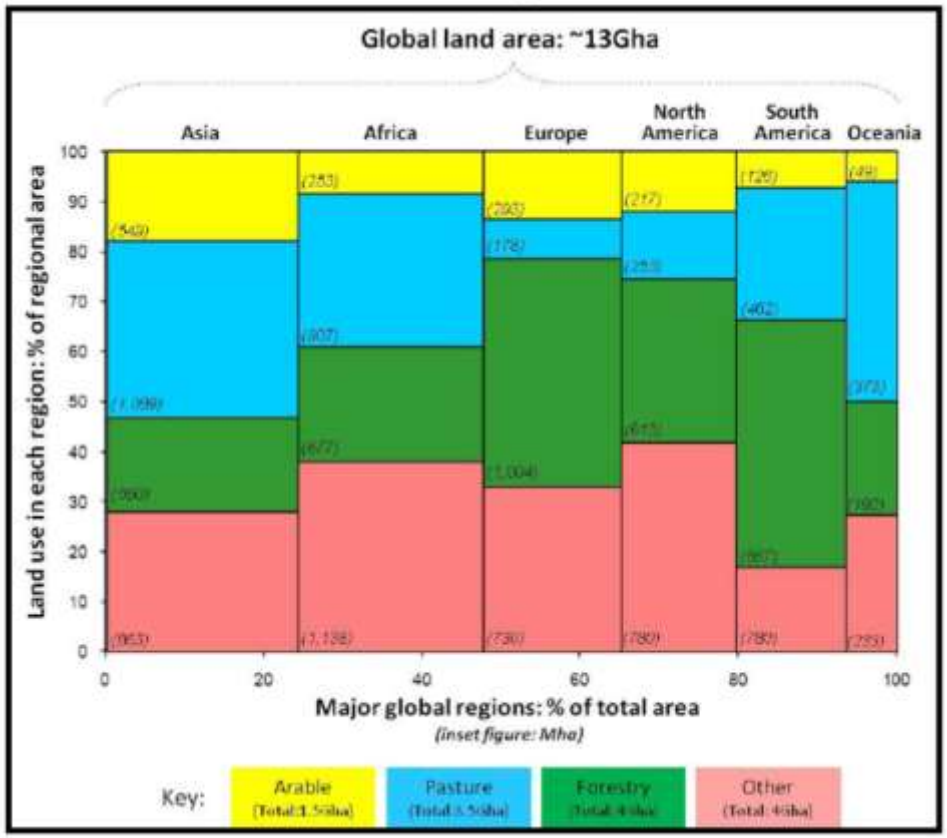
Biofuel production by region



Our World in Data

Share of biofuels





Global energy consumption in the road transport sector in 2021

Advantages/ risks

+ Reduction of GHG emissions

+ Energy security

+ Rural development

- Food and fuel competition

- Sustainability….risk of increase in GHG emissions – LUC

- Risks of degradation of land, forests, water resources and ecosystems - associated with use of freshwater, fertilizers and pesticides

Perspectives for biofuels

- Optimistic estimates – biofuels contribute ca. one-third of global fuel supply in 2050
  - 2nd generation and 3rd generation –commercially available by 2030
- Incentives for the development of 2 gen. biofuels…especially from wastes and residues
- Biofuel – dependent on markets created by government policy
- Biofuels…in aviation, shipping and heavy goods vehicles

EU policy

EU - the first climate-neutral continent by 2050

European Green Deal

RED III: at least **29%** renewables in the final energy consumption in the transport sector by 2030

Sustainable and Smart Mobility Strategy

at least 30 million zero-emission cars will be in operation on European roads

nearly all cars, vans, buses as well as new heavy-duty vehicles will be zero-emission.

2009 2010 2015 2020 2025 2030 2050

ICE -50% in city

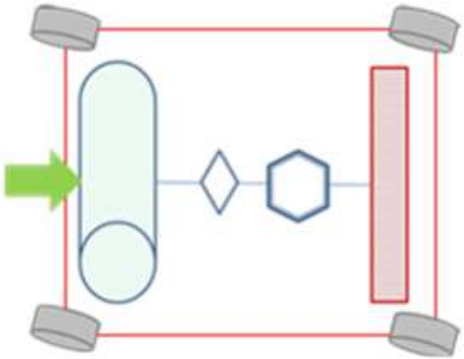
20% GHG (2008)

No ICE in city

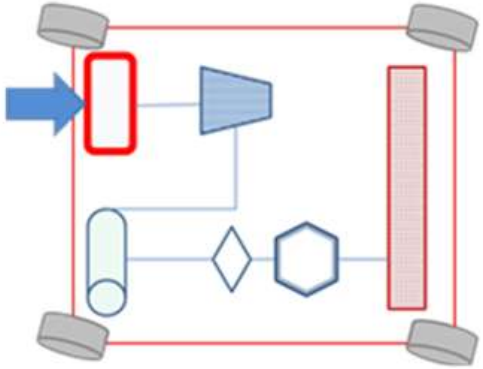
60% GHG (1990)

Transport White Paper

Zero-emission cars



BEV



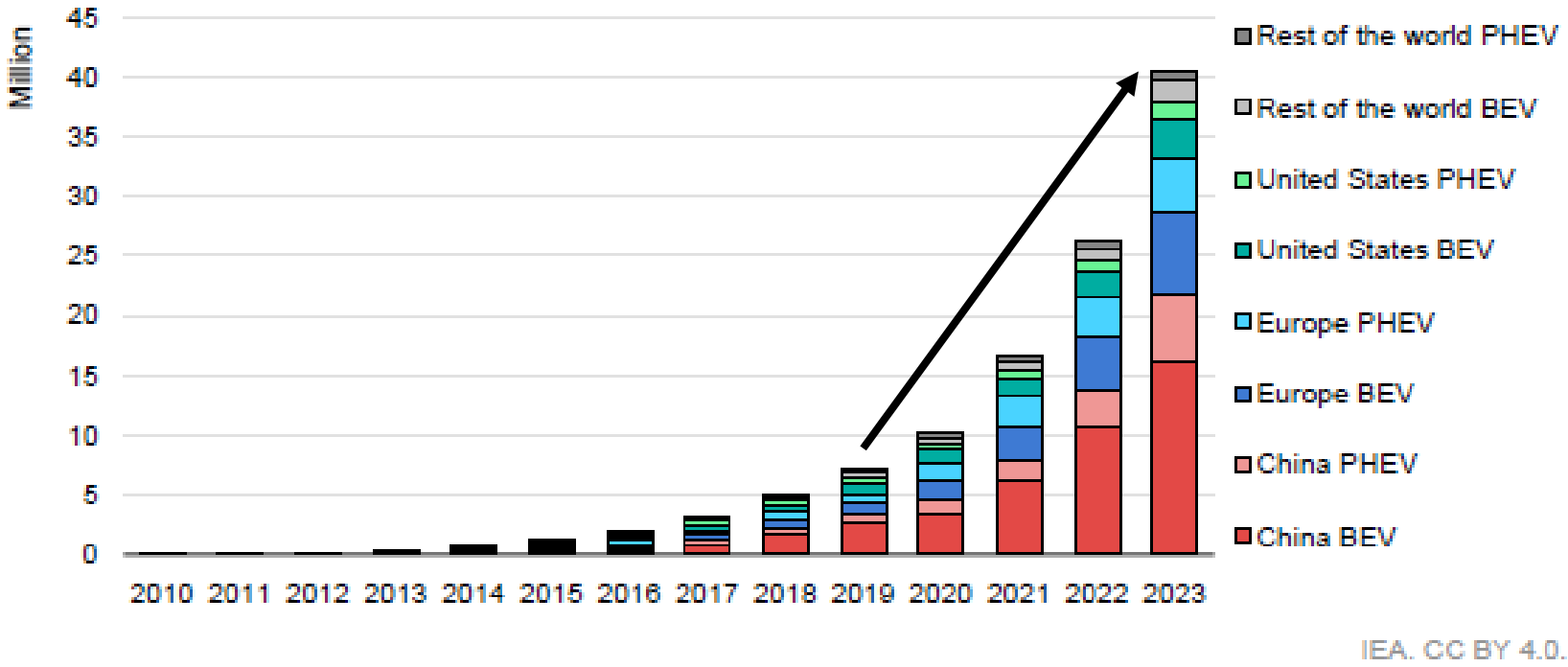
FCV

ZEV

BEV: 28 000 000
FCV: 70 000

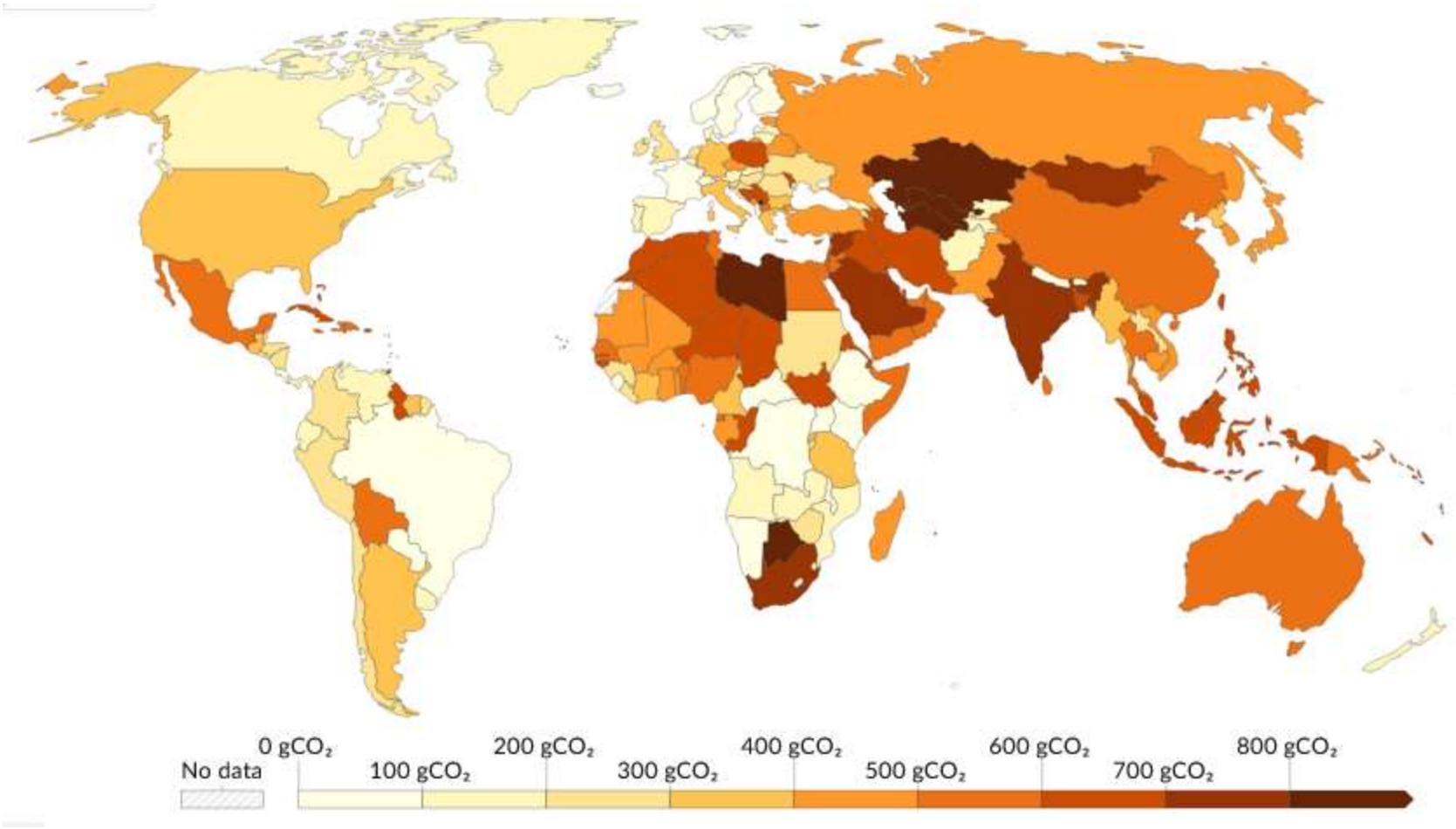
Electric vehicles

BEV: 28 000 000
PHEV: 12 000 000



Over 40 million electric cars were on the road in 2023

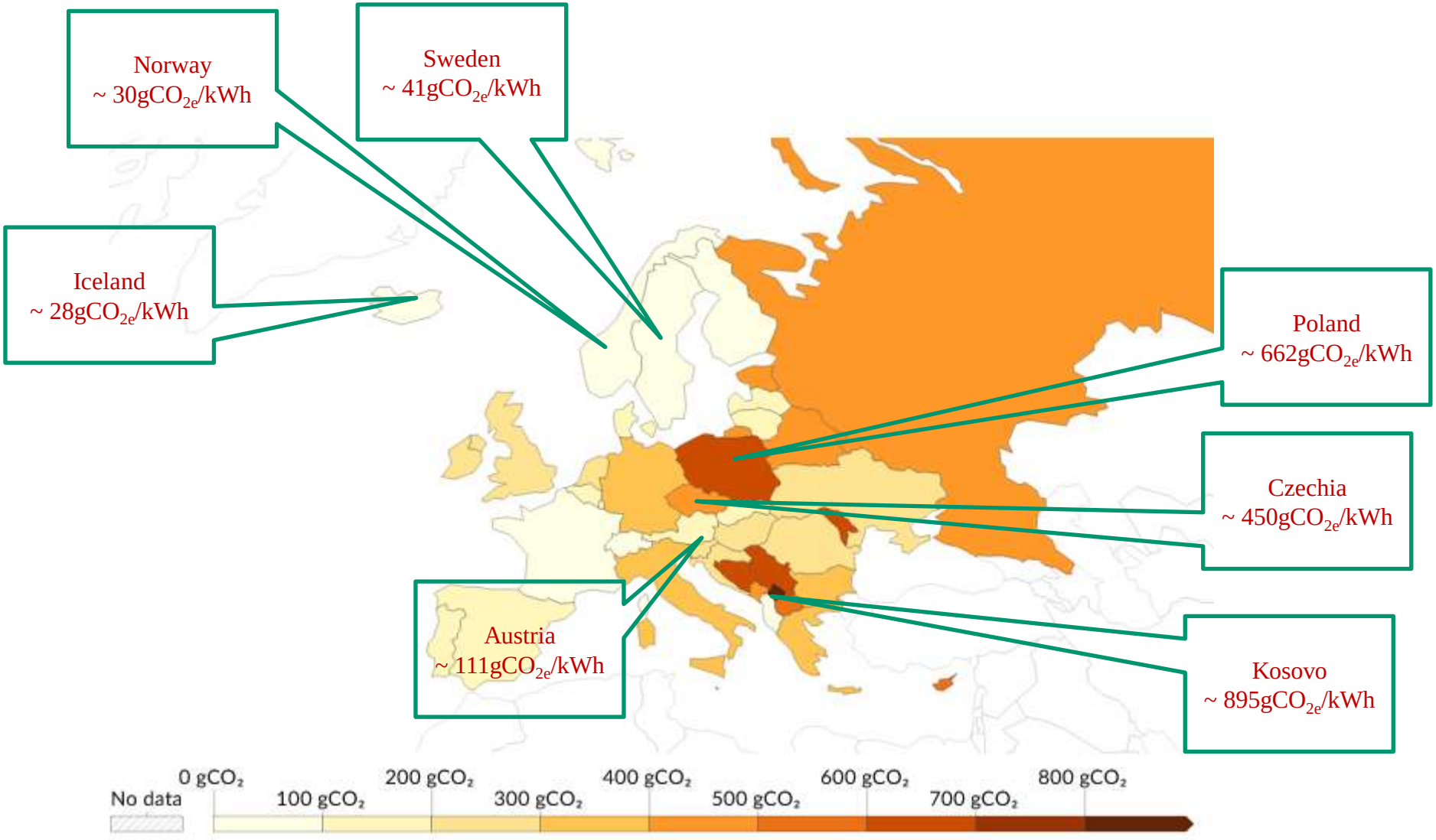
Carbon intensity of electricity, 2023



Carbon intensity is measured in grams of carbon dioxide-equivalents emitted per kilowatt-hour of electricity.

OWiD, 2024

Carbon intensity of electricity, 2023



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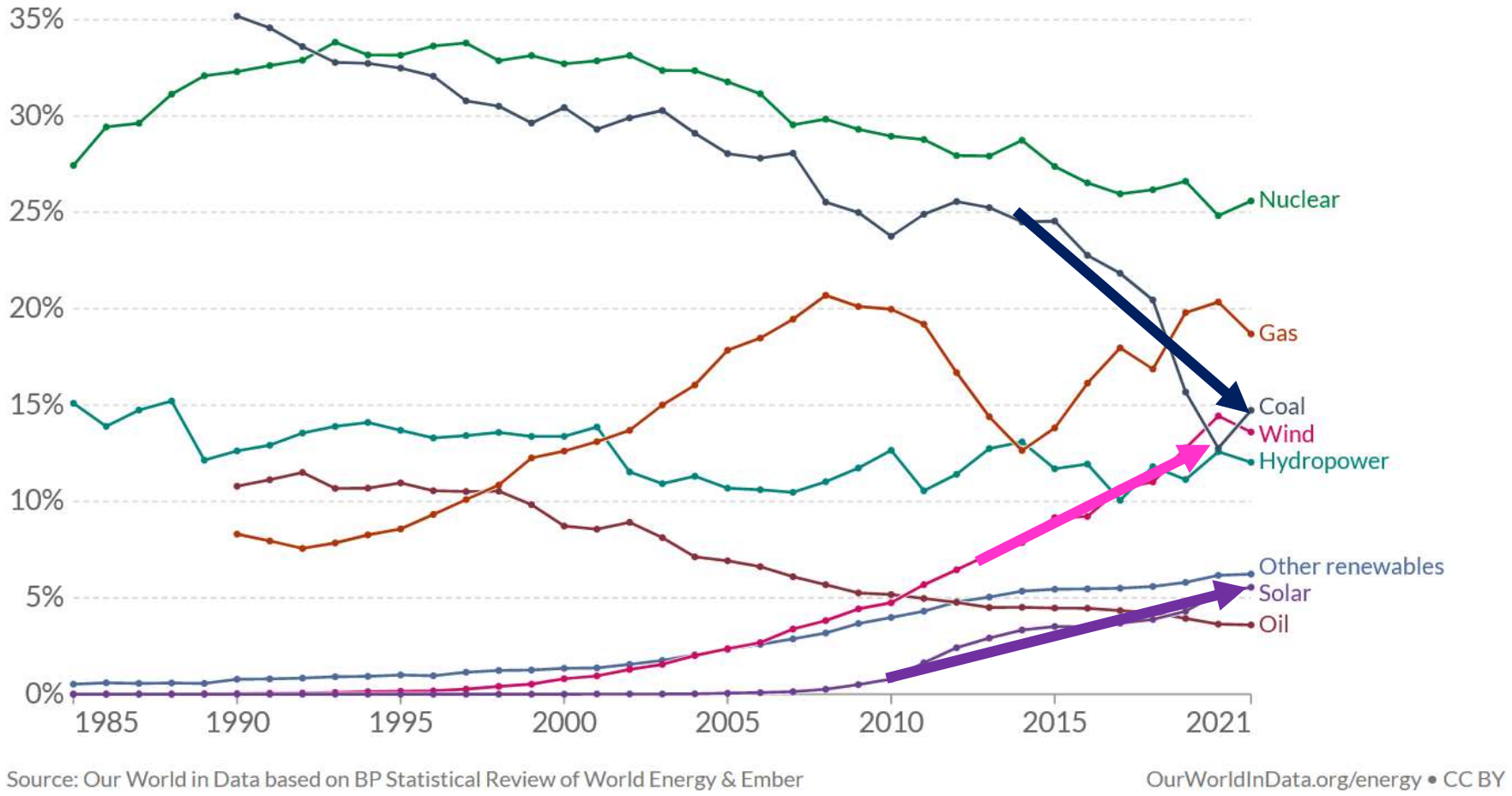
OWiD, 2024

Share of electricity production by source, EU-27



Solar panel EV charging at home

- Solar panels
- Solar inverter
- Battery storage (optional)

Solar panel EV charging at home

The number of solar panels needed to charge an electric vehicle depends on several factors:

- **Energy consumption of the EV**
  - …depends on factors such as the size of the EV's battery, its efficiency and driving habits.
- **Solar panel efficiency and output**
  - …depending on factors such as technology, size, orientation, tilt angle and local weather conditions.
- **Available sunlight**
  - …. the amount of sunlight the location receives affects the energy production of solar panels.
- **Charging patterns**
  - …influence the size and configuration of the solar panel system.

Solar power & parking lots

- Decreased usage of fossil fuels … emission reduction
- Lower electricity costs
- Utilization of existing land
- More revenue from covered parking spots
- Enabling greater energy independence
- Enhancing convenience for drivers of electric cars
- Creating shadier spaces

Tindo electric bus

- … the world's first 100% solar-powered electric bus…service is offered free of charge.
- Tindo is recharged using a unique solar PV system at the Adelaide Central Bus Station
- The solar PV system is generating almost 70,000 kWh of electricity each year

Solar-powered public transport system

- Munich… a hybrid bus partially powered by solar energy
- …possible savings up to 2,500 liters of diesel per year and an annual local CO2 savings potential of more than 6.5 metric tons per bus
- 20 specialty semi-flexible photovoltaic modules provide more than 2,000 watts to power the vehicle's battery

Electric Cars With Solar Panel Roofs

Hyundai Ioniq 5

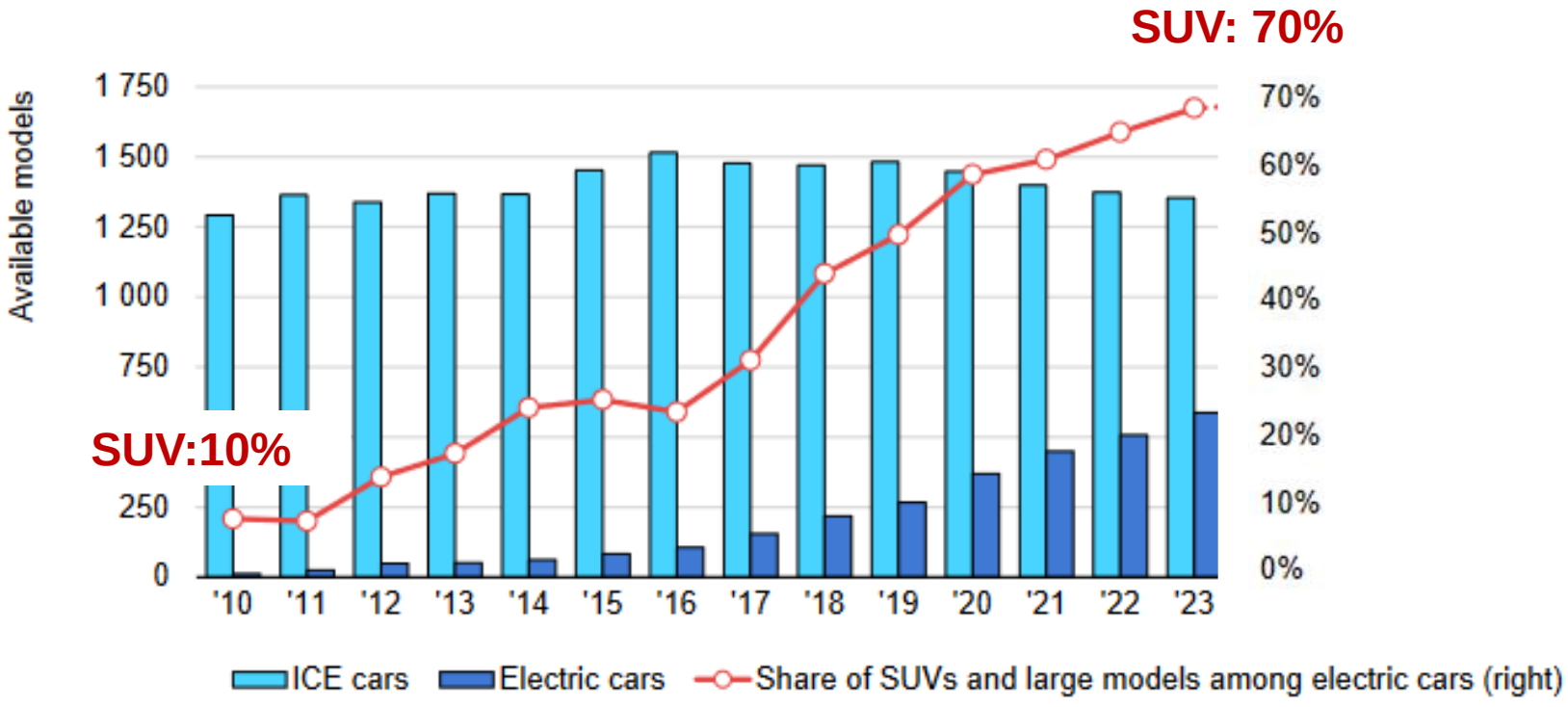
Fisker Ocean Extreme

Squad Mobility Solar City Car

Toyota bZ4X

Mercedes Vision EQXX

Car model availability



Conclusions

Integrating renewables into the transport sector

…challenges

… offers substantial benefits by creating a cleaner, more resilient, and sustainable system

- Reducing greenhouse gas emissions
- Enhancing energy security
- Decarbonization
- Diversification

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