

Decarbonization of transport

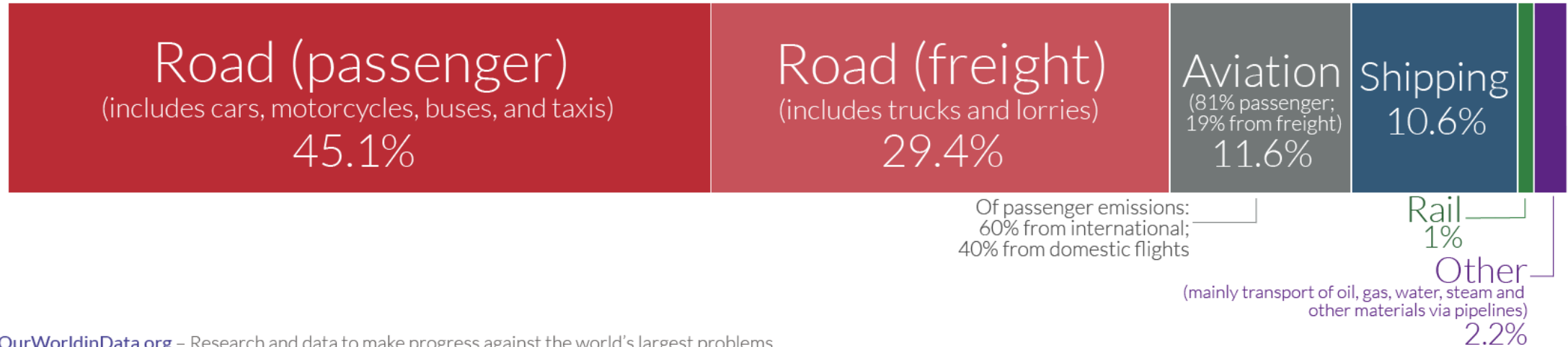
Jan Osička

Global CO₂ emissions from transport

This is based on global transport emissions in 2018, which totalled 8 billion tonnes CO₂.
Transport accounts for 24% of CO₂ emissions from energy.



74.5% of transport emissions
come from road vehicles



OurWorldinData.org – Research and data to make progress against the world's largest problems.

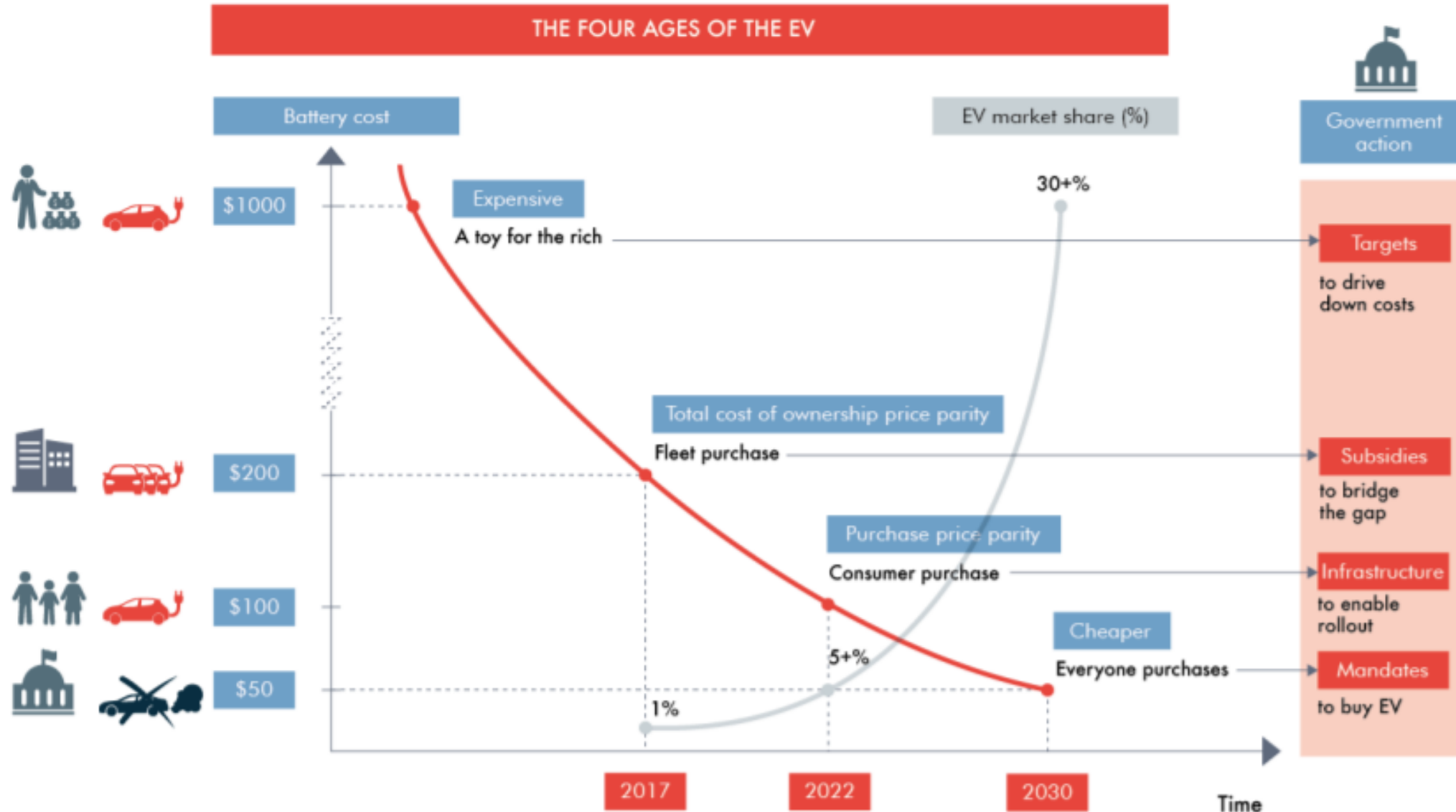
Data Source: Our World in Data based on International Energy Agency (IEA) and the International Council on Clean Transportation (ICCT).

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Step 1: Electrification of transport



ICEVs and EVs reached cost parity between 2017 and 202x

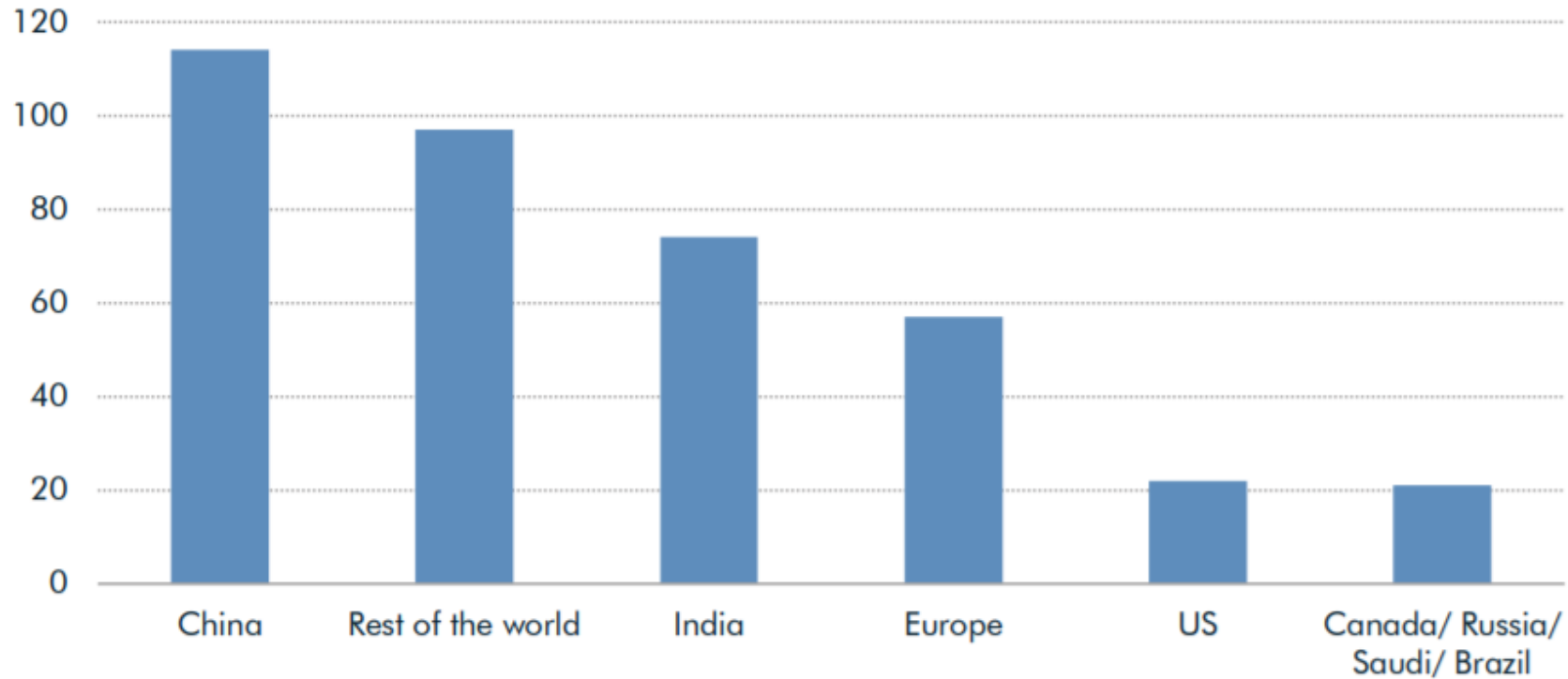


Source: [Carbon Tracker](#)

As a policy-maker, why should you want EVs?

Air pollution kills

FIGURE 9: TRANSPORT RELATED DEATHS FROM AIR POLLUTION 2015 (TH)



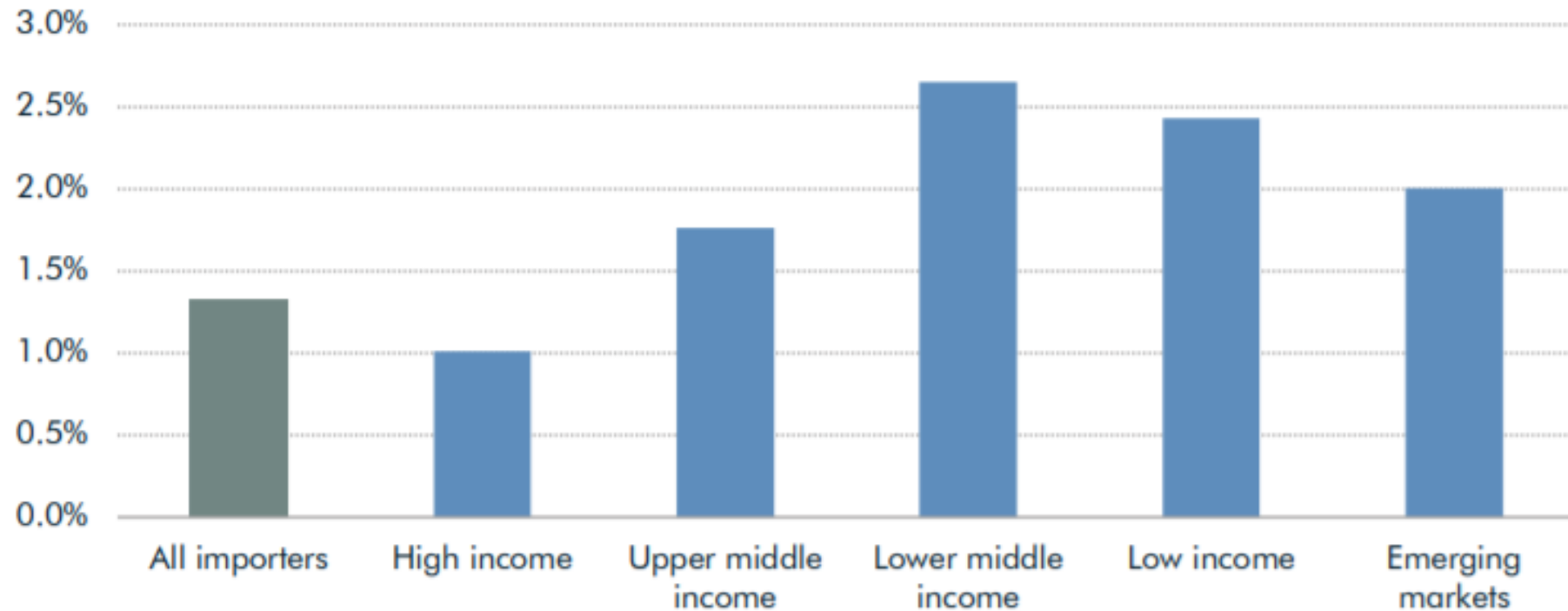
Source: ICCT

Note: there are other significant sources of traffic pollution, e.g., resuspension and wear

Source:
[Carbon Tracker](#)

Billions of dollars saved by removing import

FIGURE 5: OIL IMPORTS AS % OF GDP 2017



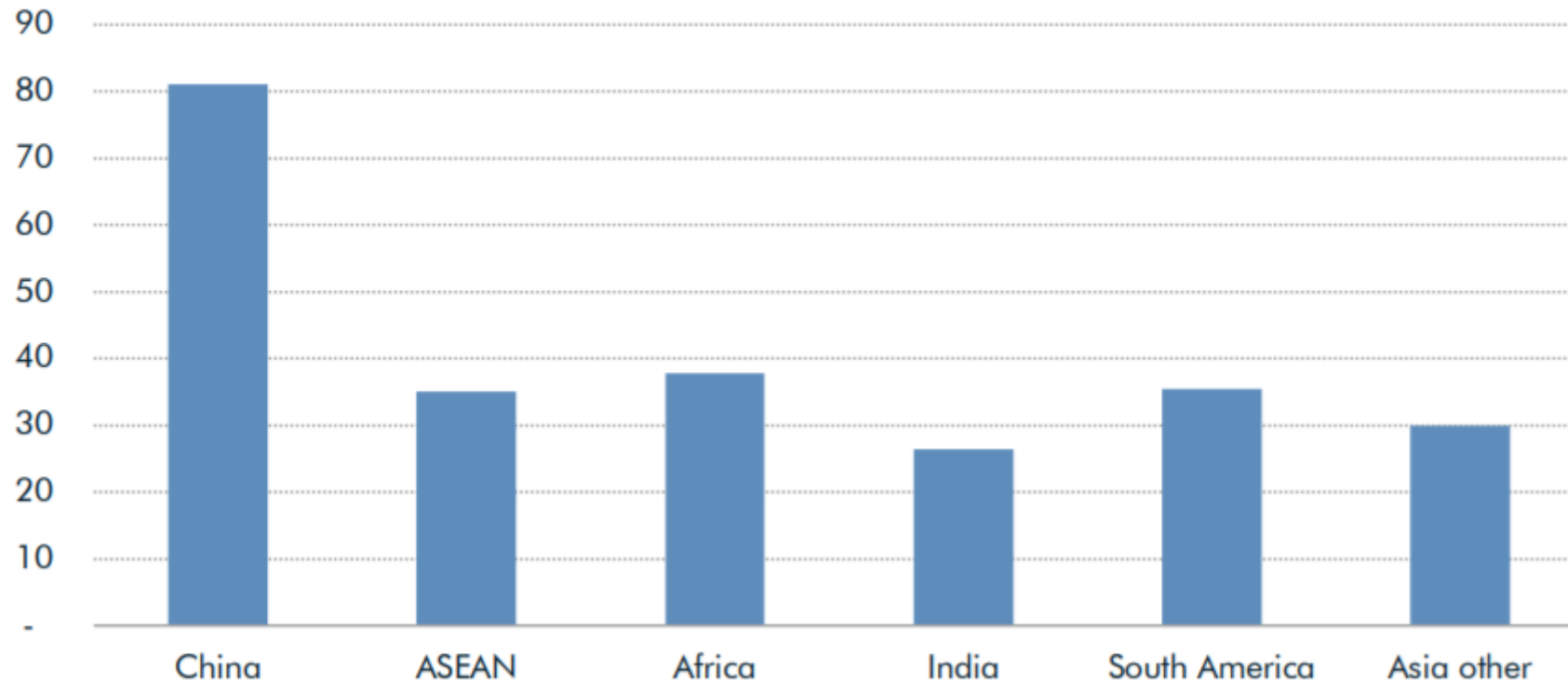
Source: World Bank

=> More than enough to finance the e-mobility infrastructure

Source:
[Carbon Tracker](#)

Billions of dollars saved by removing import

FIGURE 11: 2030 ANNUAL SAVINGS ON OIL IMPORTS FROM A SWITCH TO ELECTRICITY (\$BN)

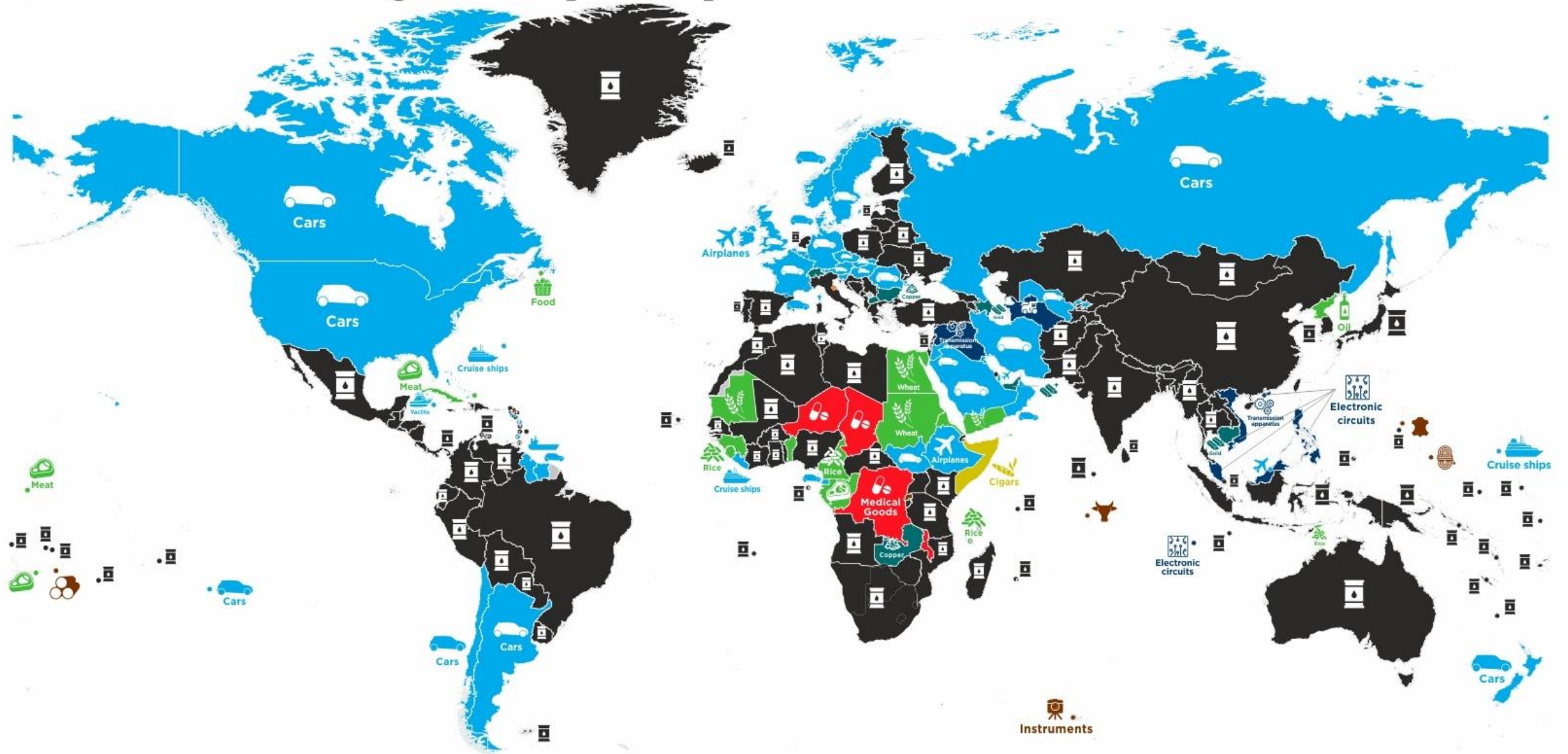


Source: IEA WEO 2020, Carbon Tracker estimates.

Owning an ICEV assumes importing ca. 10,000 USD worth of gasoline
Owning an EV assumes procuring ca 1,000 USD worth of solar generation equipment

Source:
[Carbon Tracker](#)

Each Country's Top Import in World

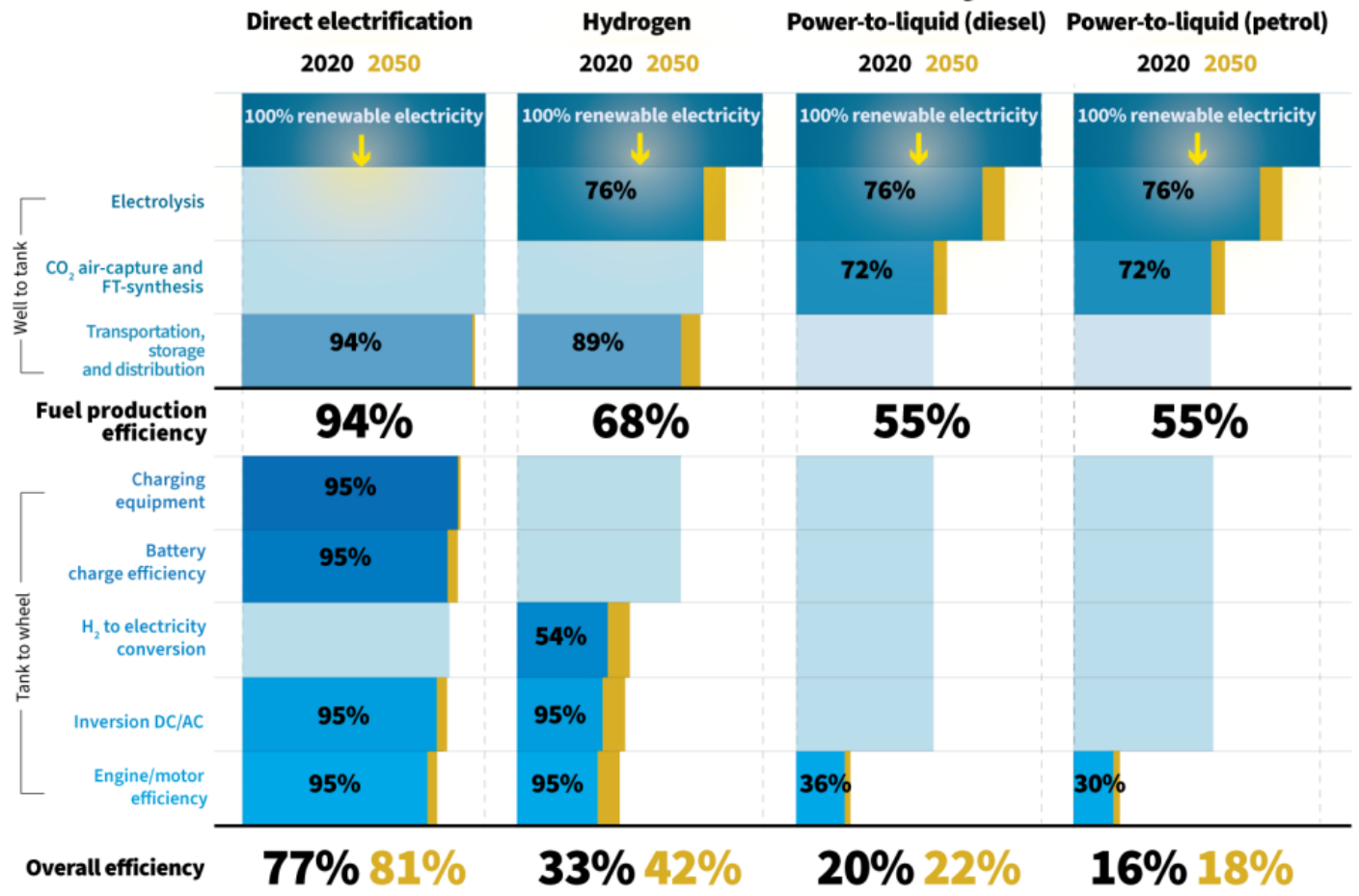


Product Category ■ Drugs & Beverages ■ Electrical Energy ■ Food ■ Machinery ■ Medical Goods ■ Oil ■ Ores ■ Vehicles ■ Other ■ N/A

Article & Sources:
<https://howmuch.net/articles/top-import-around-the-world>
 UN Comtrade Database 2018 - <https://comtrade.un.org>
 CEPII - BACI - <http://www.cepii.fr/CEPII/>

Efficiency gains

Cars: direct electrification most efficient by far



Notes: To be understood as approximate mean values taking into account different production methods. Hydrogen includes onboard fuel compression. Excluding mechanical losses.

A thought experiment: Energy return on capital investment

How much transportation energy can we get if we invest USD 100 bn in:

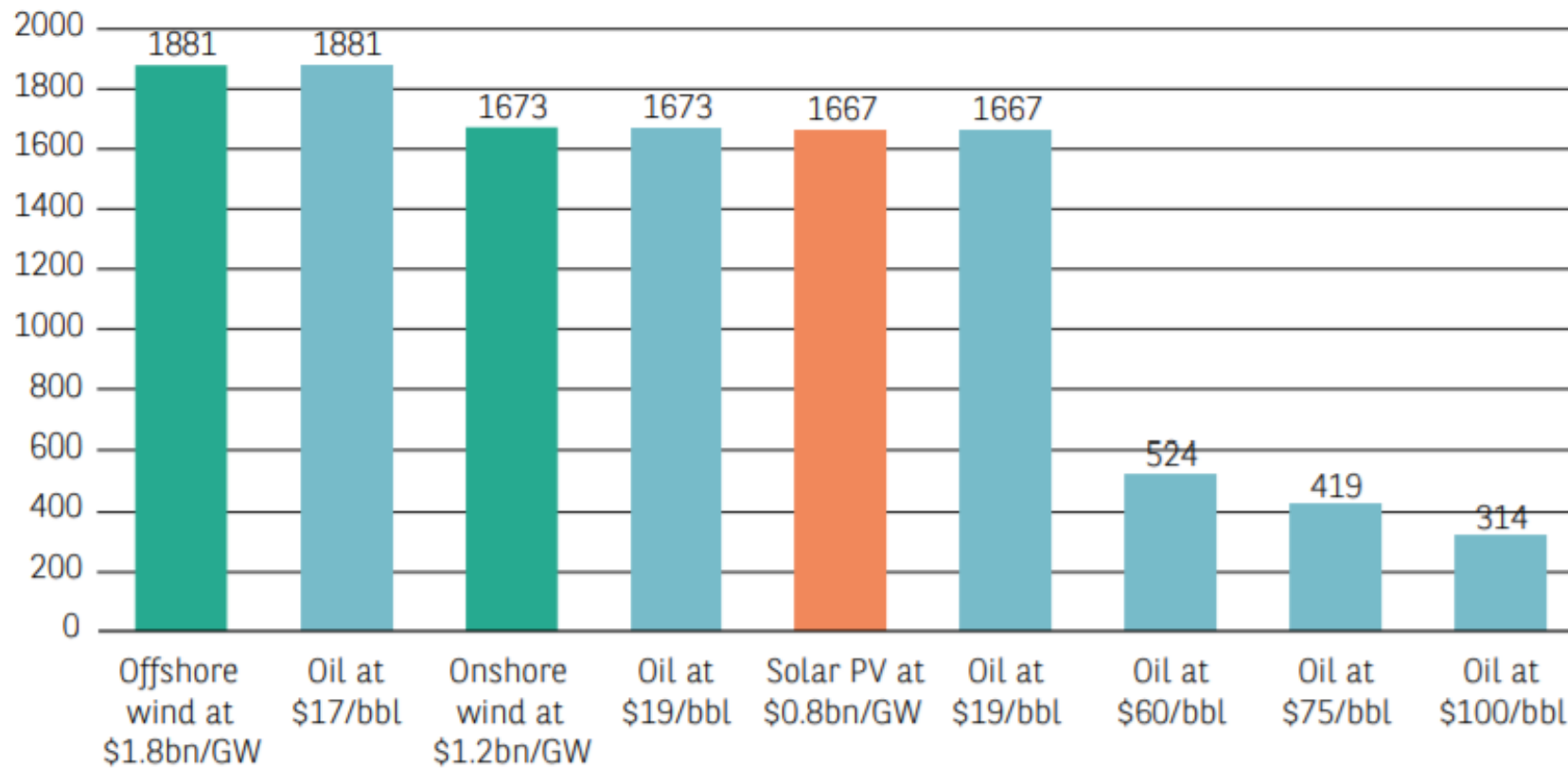
- a) Oil supply, refining, retail + ICEV (diesel– and gasoline–powered)
- b) vRES electricity supply (solar, onshore wind, offshore wind) + BEV

Assumptions:

- Light duty vehicles (~36% of the market)
- Timeframe: 25 yers
- LCOE solar: 65 USD/MWh
- LCOE wind: 60 USD/MWh
- LCOE offshore wind: 70 USD/MWh
- Oil price: 60 USD/b
- Supply and conversion efficiency (G): 10%
- Supply and conversion efficiency (D): 19%
- Supply and conversion efficiency (E): 50%

A thought experiment: Energy return on capital investment

Figure 28: Net EROCI from new renewables projects in tandem with EVs versus oil used for diesel LPVs (TWh)



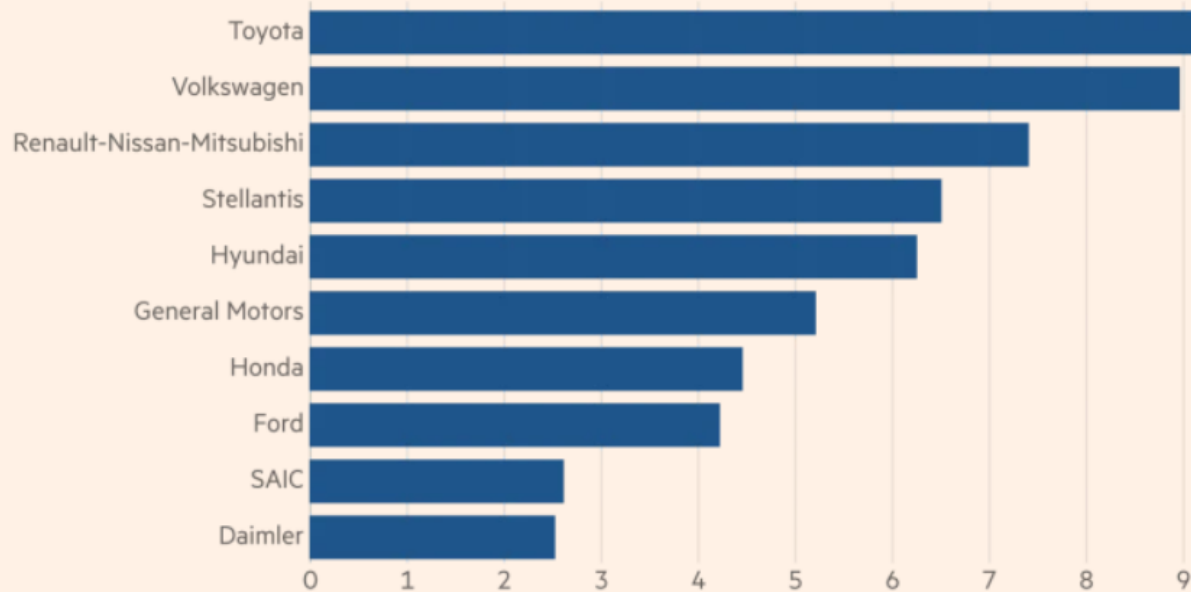
Source: BNP Paribas Asset Management estimates.

[Source: BNP Paribas](#)

Carmakers already know...

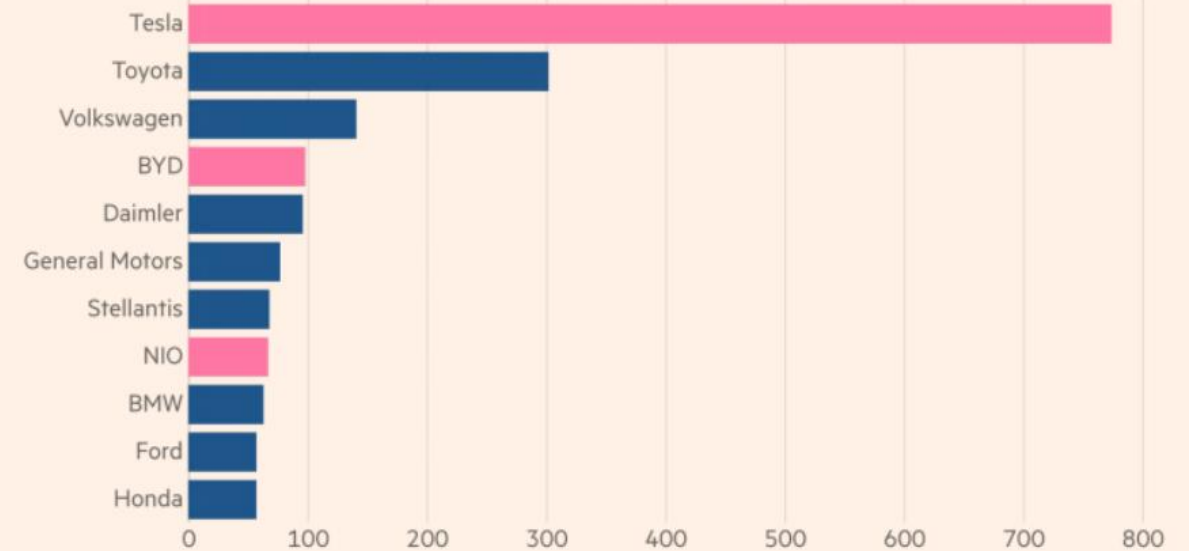
The world's biggest car companies

By unit sales in 2020 (m)



Leading car companies by market capitalisation (\$bn)

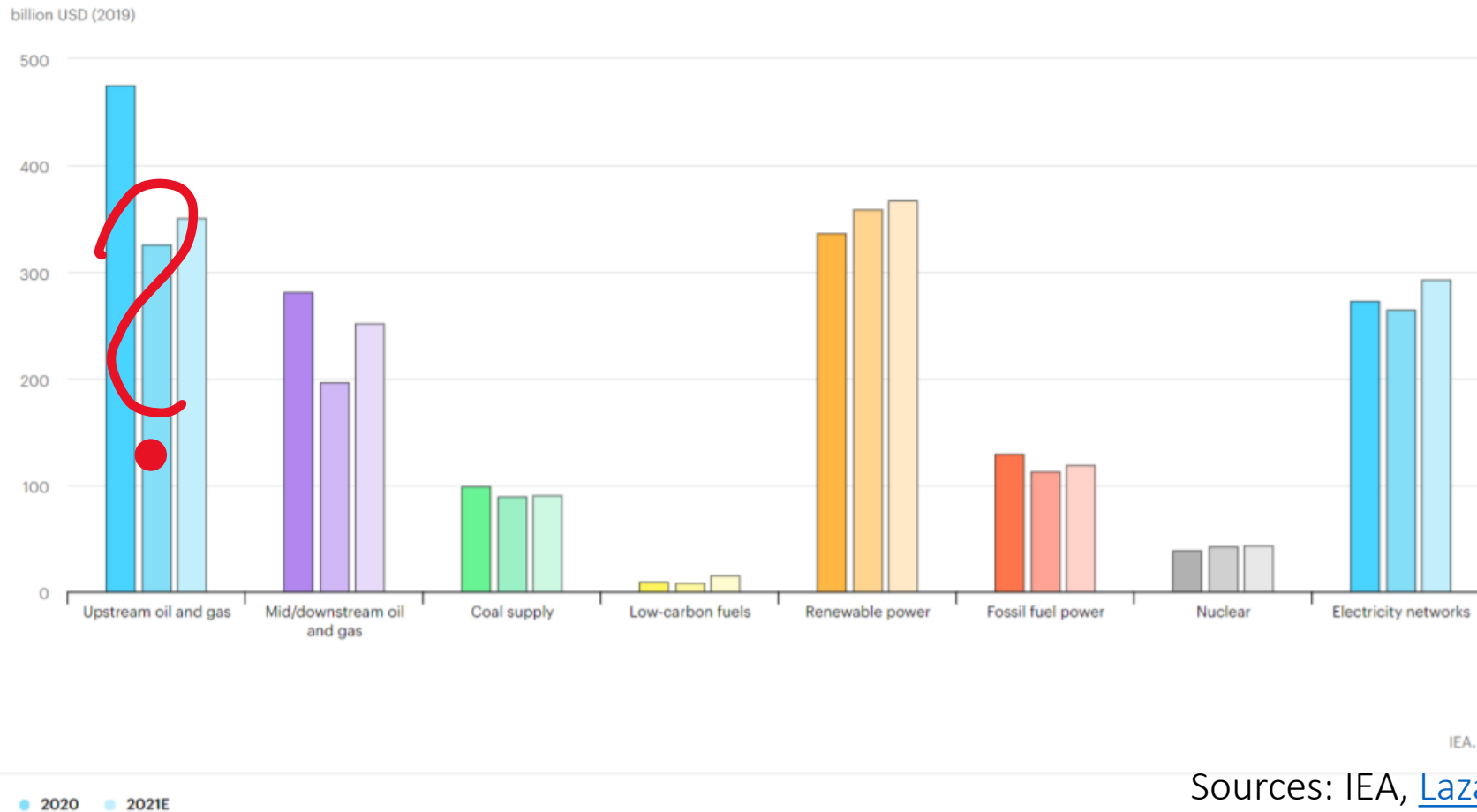
Electric/hybrid vehicles-only



Source: Sentieo
© FT

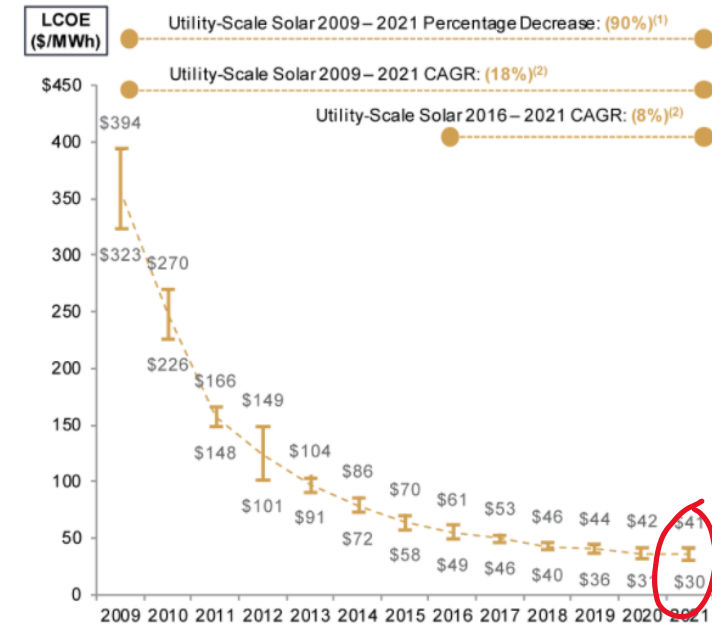
...O&G industry does not

Global energy supply investment by sector, 2019-2021

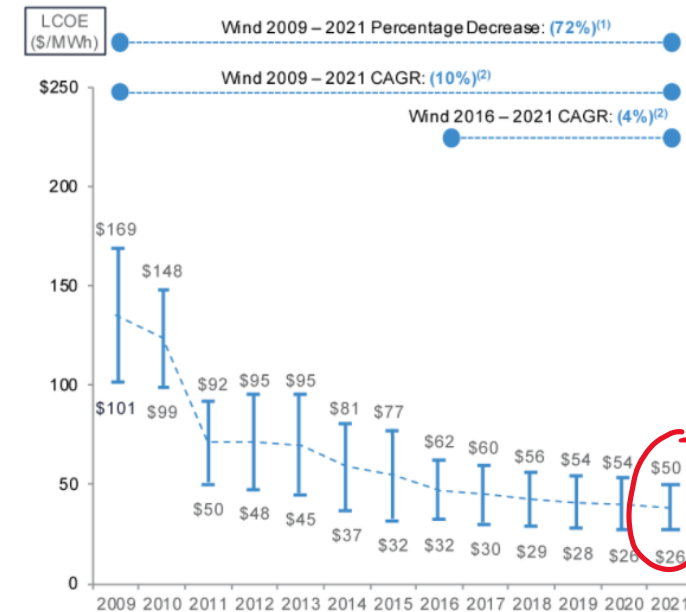


Sources: IEA, [Lazard](#)

Unsubsidized Solar PV LCOE



Unsubsidized Wind LCOE



EVs widely underestimated by the O&G industry

Consensus thinking stemming from:

- A generations-long growth of demand
- Supplier-based thinking instead of consumer-based thinking
- Past and present earnings hide loss of value of the core assets
- Expectations of business as usual
- Incumbency treated as an advantage

Source: [Carbon Tracker](#), [Mattioli 2020](#)

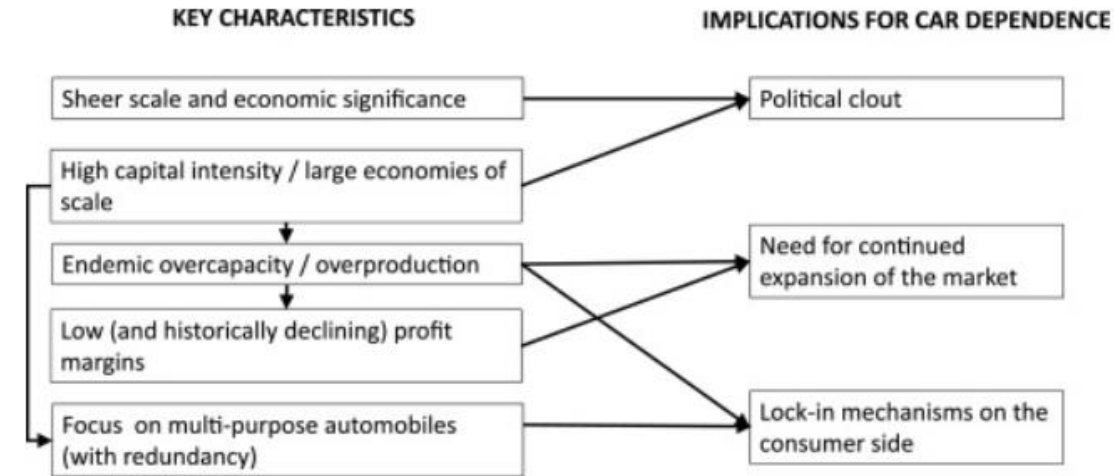
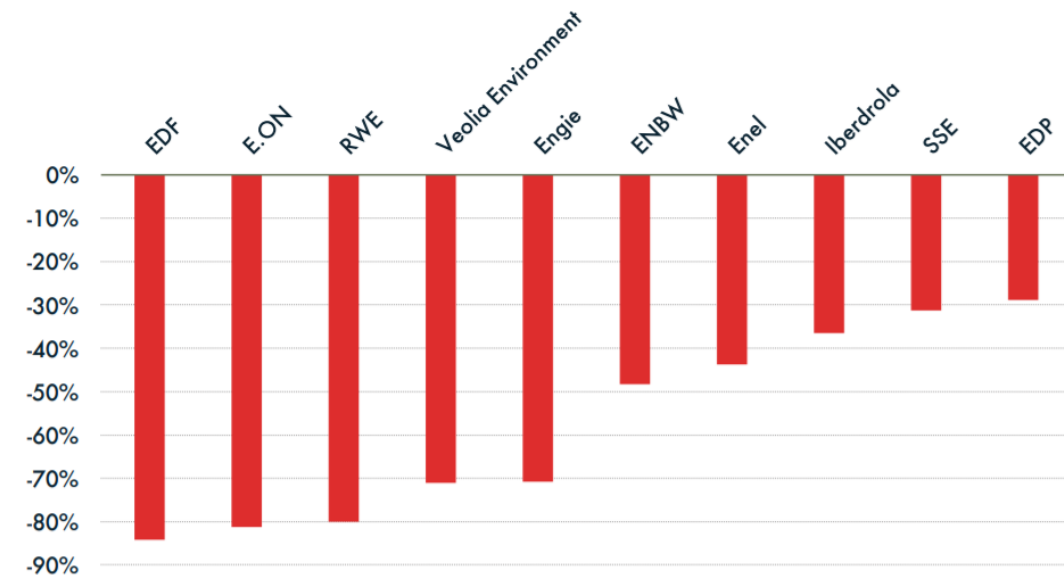


FIGURE 5 - PERFORMANCE OF EUROPEAN ELECTRICITY STOCKS DEC. 2007 - DEC. 2018



Step 2: What is step 2, actually?

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- Cars are great individually but terrible collectively
- E-mobility is a critical juncture in the development of transportation
- Much more profound changes are desirable
- (The car) culture being the biggest obstacle

Cars kill

- 1.3 million killed annually in road accidents
- Road traffic injuries leading cause of death for people aged 5-29
- More than half of all road traffic deaths are among vulnerable road users

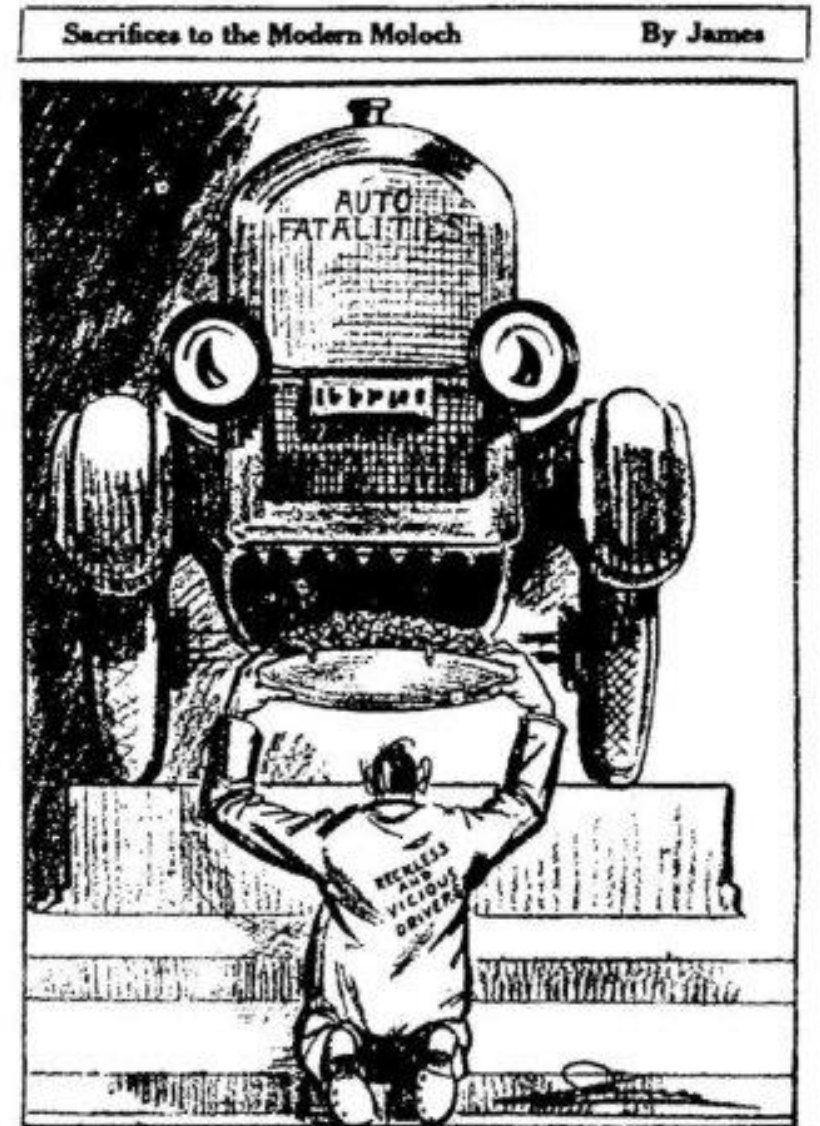
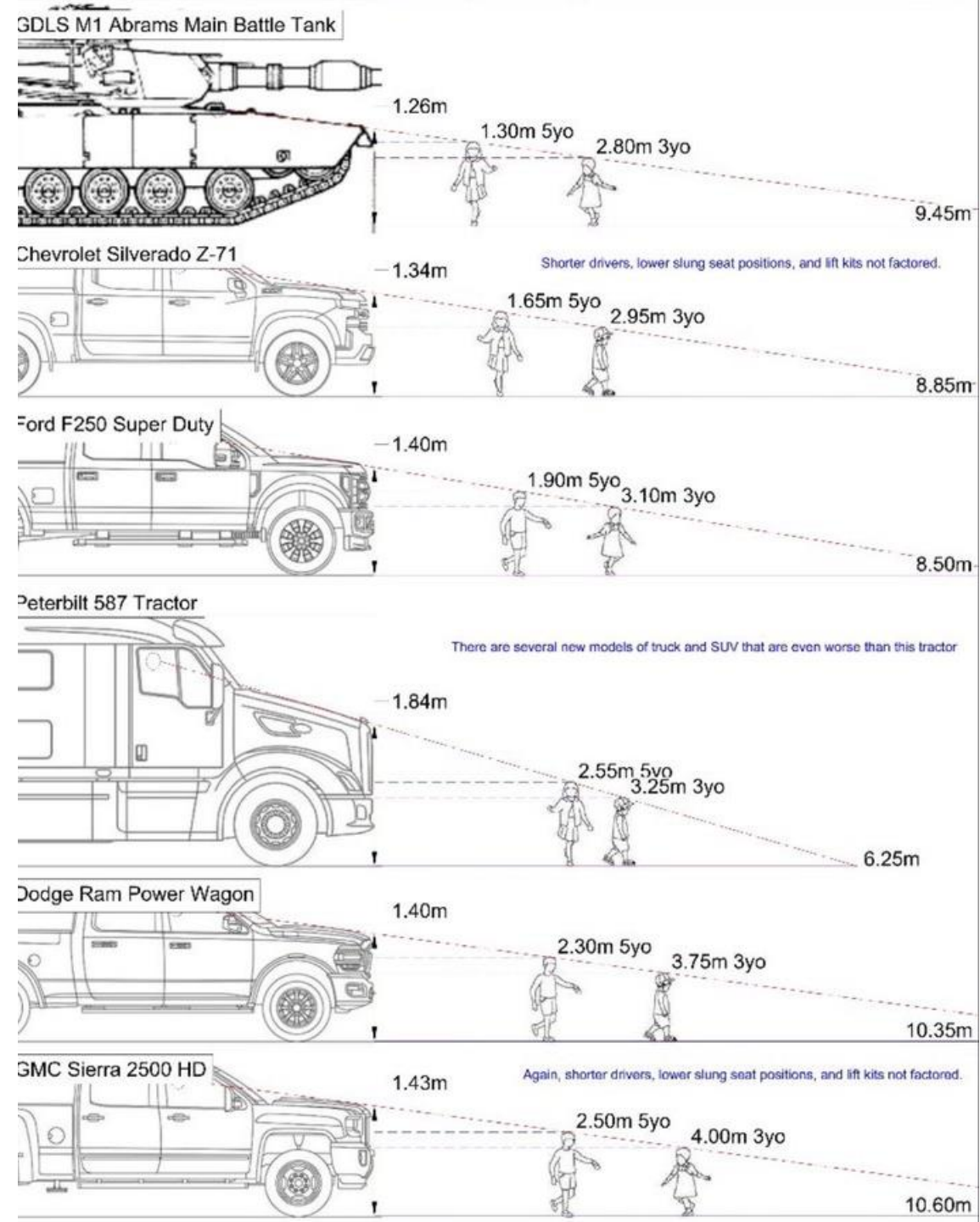


Figure 1.3

Cartoon by "James," *St. Louis Star*, November 6, 1923, p. 14.

Cars kill

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Cars are energy- and space-inefficient

STRUCTURAL WASTE IN THE MOBILITY SYSTEM

CAR UTILISATION¹



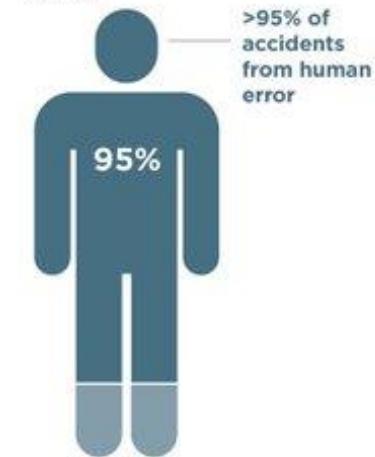
TANK-TO-WHEEL ENERGY FLOW - PETROL



● Productive use

DEATHS AND INJURIES/ YEAR ON ROAD

30,000 deaths in accidents and 4X as many disabling injuries²



LAND UTILISATION:

5%

Road reaches peak throughput only 5% of time and only 10% covered with cars then

50%

50% of most city land dedicated to streets and roads, parking, service stations, driveways, signals, and traffic signs

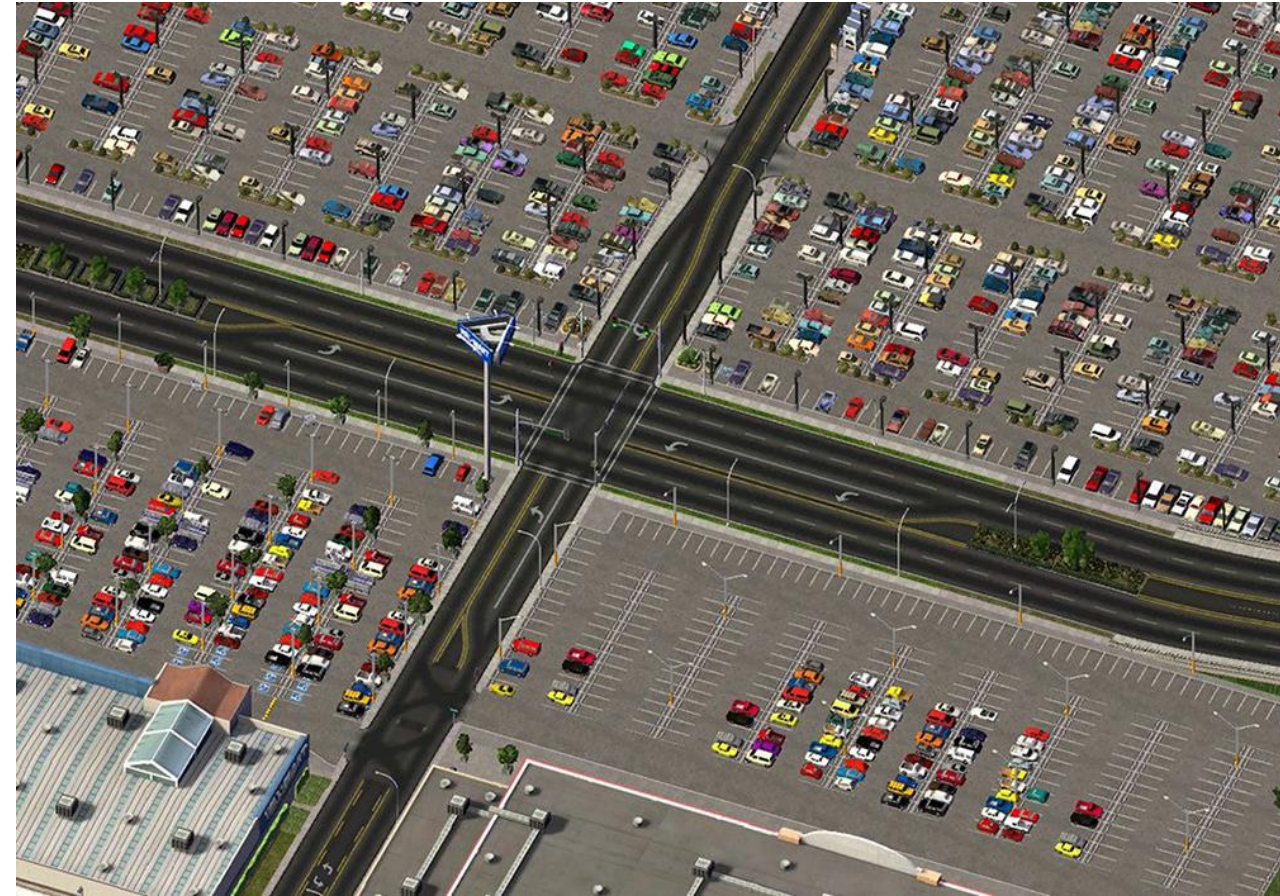
¹ Based on car parked number for France and productive vs. unproductive driving time in US. ² For every death on Europe's roads there are an estimated four permanently disabling injuries. ³ Based on average car weight of 1.4 tonnes and average occupation of 1.5 passengers of 75 kg.

Source: EU Commission mobility and transport, accident statistics; www.fueleconomy.gov; EEA car occupancy rates data; S. Heck and M. Rogers, *Resource revolution: How to capture the biggest business opportunity in a century*, 2014; Centre d'études sur les réseaux, les transports, l'urbanisme et les constructions publiques.

Cars (not people) define cities



SimCity: tweaked vs. realistic



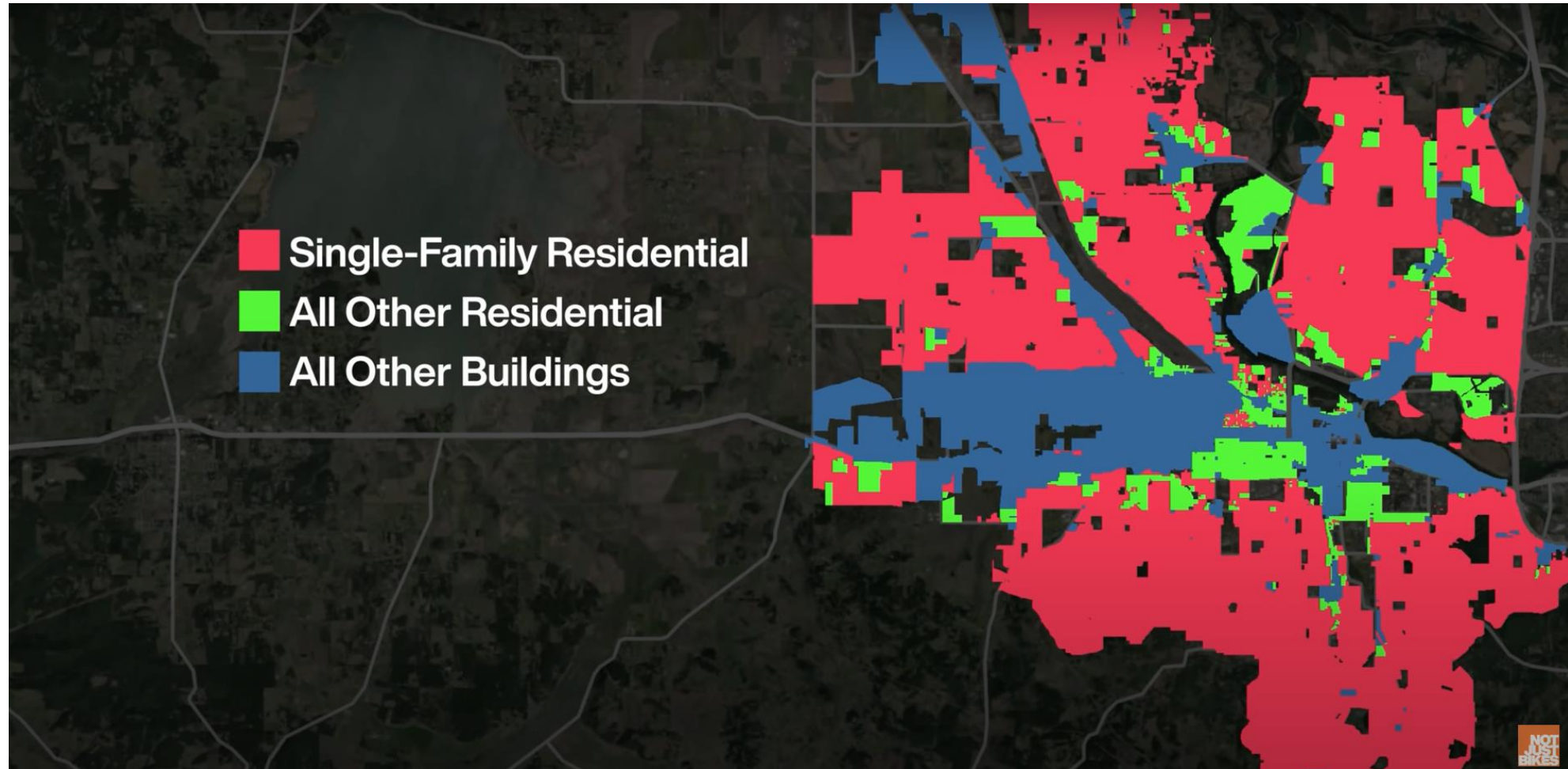
Cars make suburban neighborhoods possible



Property revenues for the city (Eugene, OR)

	LOW DENSITY	MEDIUM DENSITY	HIGH DENSITY
RESIDENTIAL	 <p>-\$1,381</p>	 <p>\$1,498</p>	 <p>\$3,061</p>
MIXED-USE	 <p>\$2,540</p>	 <p>\$3,515</p>	 <p>\$10,472</p>
COMMERCIAL	 <p>\$551</p>	 <p>\$9,614</p>	 <p>\$12,051</p>

Suburbia makes cities poor (Eugene, OR)



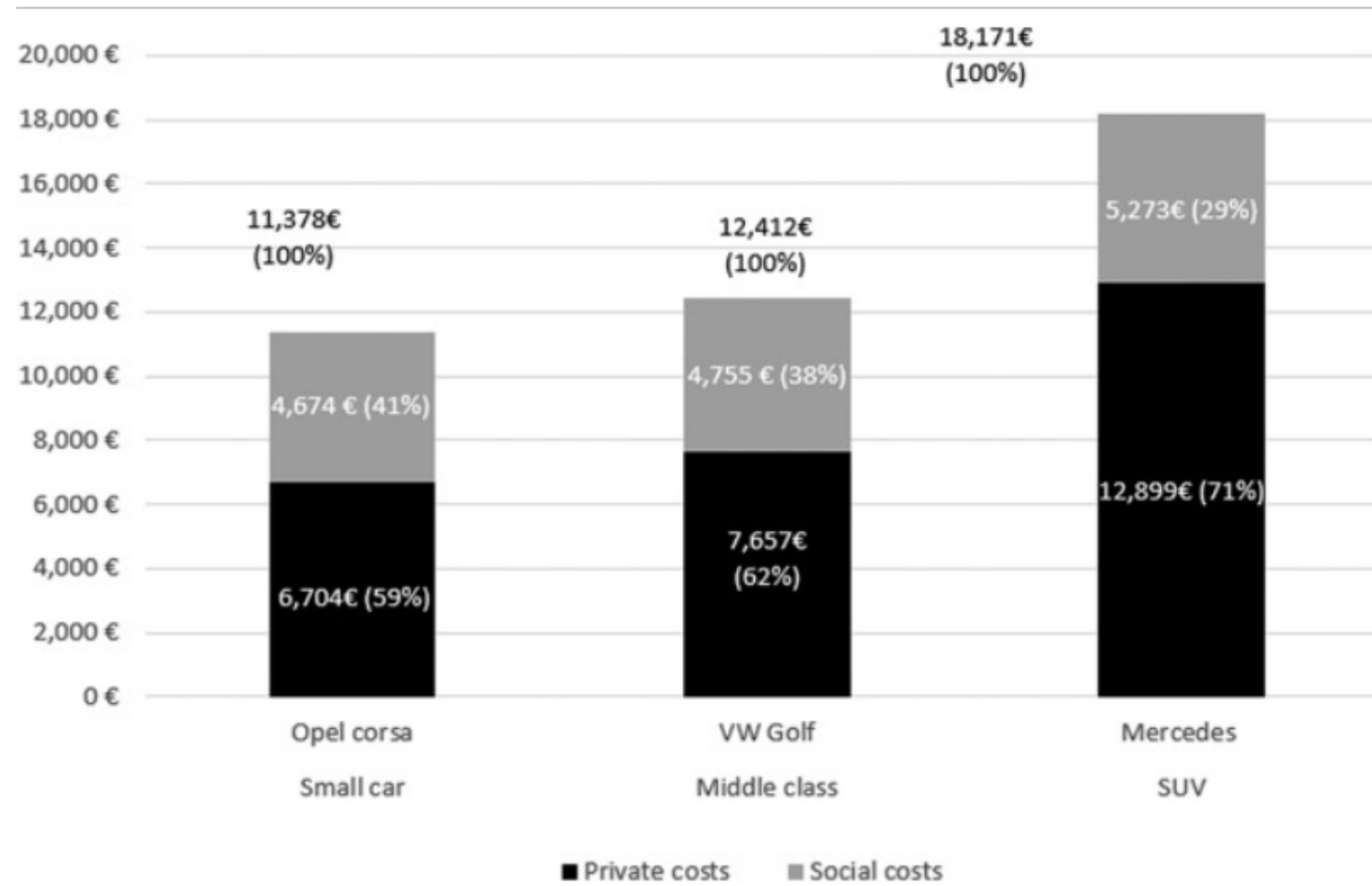
Source: [Not Just Bikes](#)

Car dependency causes transport poverty

Lifetime car costs as percentage of net income/wealth				
Net income - 1-Person Household		Opel Corsa	VW Golf	Mercedes GLC
		352,974	403,179	679,167
Wealthy	52,654,323 €	1%	1%	1%
Millionaires	5,265,432 €	7%	8%	13%
Senior employee	2,726,707 €	13%	15%	25%
Outstanding specialist	1,857,901 €	19%	22%	37%
Specialist	1,372,493 €	26%	29%	49%
Semi-skilled worker	1,118,376 €	32%	36%	61%
Unskilled worker	990,982 €	36%	41%	69%

Source: [Gössling et al. 2022](#)

Car dependency causes transport poverty



Source: [Gössling et al. 2022](#)

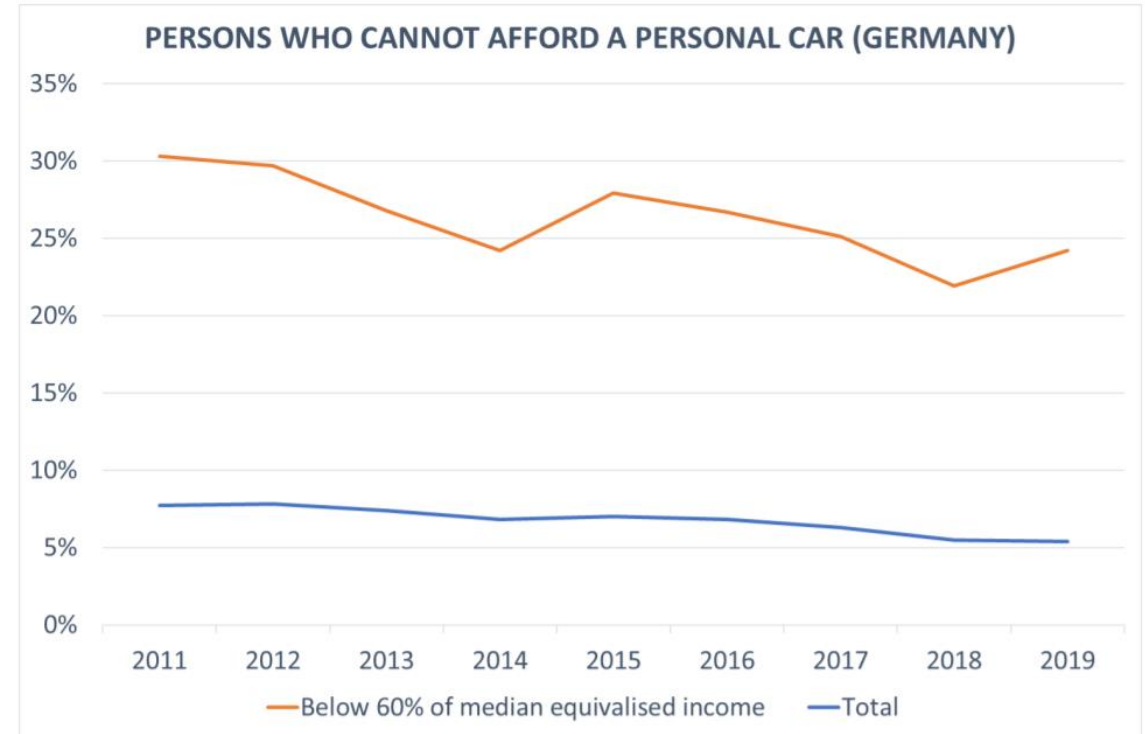
Car dependency causes transport poverty

Lifetime car costs as percentage of net income/wealth				
Net income - 1-Person Household		Opel Corsa	VW Golf	Mercedes GLC
		599,082	653,561	956,798
Wealthy	52,654,323 €	1%	1%	2%
Millionaires	5,265,432 €	11%	12%	18%
Senior employee	2,726,707 €	22%	24%	35%
Outstanding specialist	1,857,901 €	32%	35%	51%
Specialist	1,372,493 €	44%	48%	70%
Semi-skilled worker	1,118,376 €	54%	58%	86%
Unskilled worker	990,982 €	60%	66%	97%

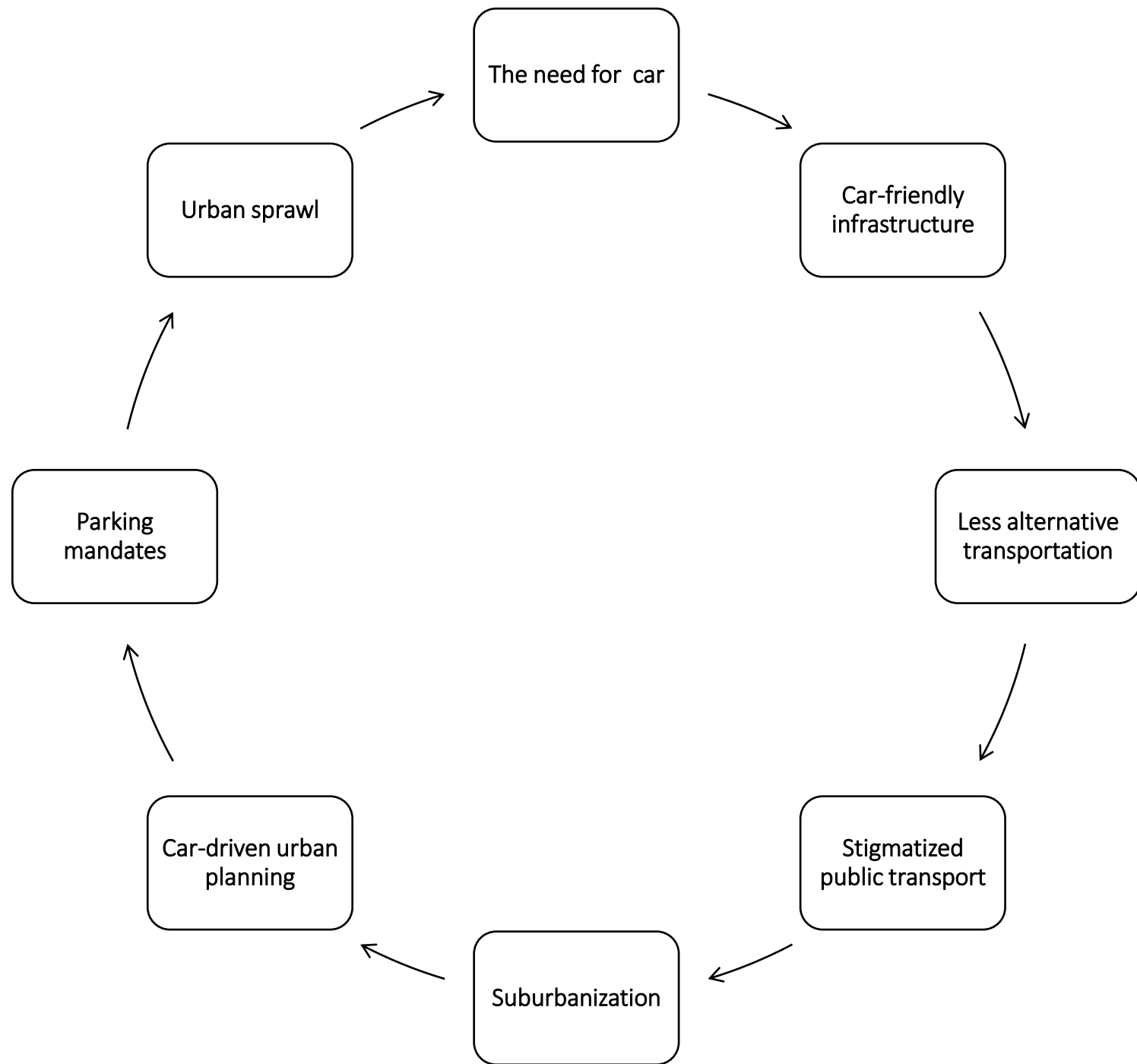
Source: [Gössling et al. 2022](#)

Car dependency causes transport poverty

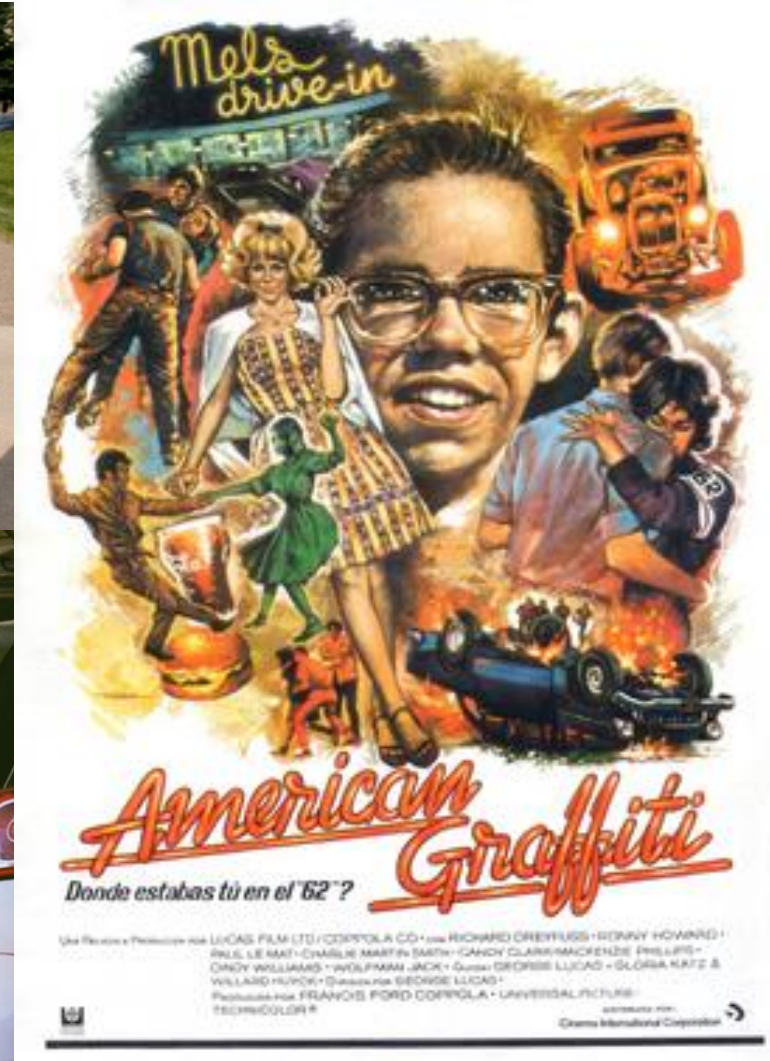
Notion	Definition
Mobility poverty	A systemic lack of (usually motorised) transport that generates difficulties in moving, often (but not always) connected to a lack of services or infrastructures
Accessibility poverty	The difficulty of reaching certain key activities – such as employment, education, healthcare services, shops and so on – at reasonable time, ease and cost
Transport affordability	The lack of individual/household resources to afford transportation options, typically with reference to the car (in developed countries) and/or public transport
Exposure to transport externalities	The outcomes of disproportionate exposures to the negative effects of the transport system, such as road traffic casualties and chronic diseases and deaths from traffic related pollution. Often considered within the US literature from an environmental justice perspective



Sources: [Mattioli 2016](#), [Mattioli 2021](#)



Car culture: restricting cars is difficult



Step 2: What is step 2, actually?