International Energy Agency

Tracking energy efficiency indicators in transport sector

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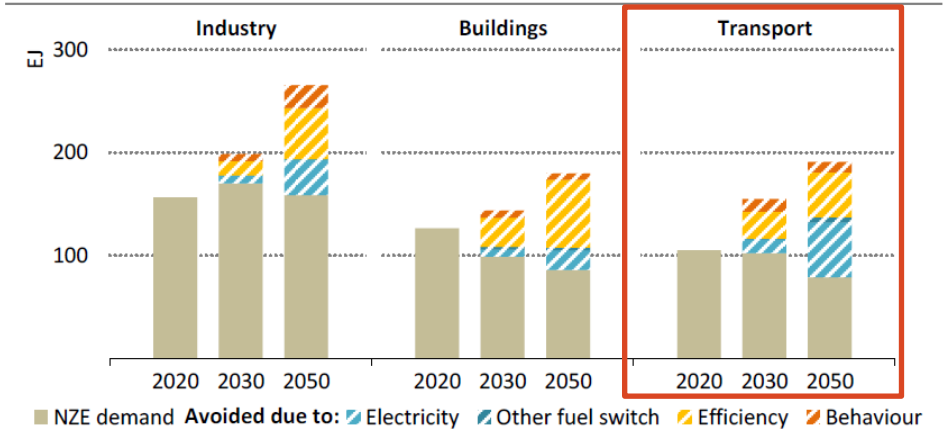
Why is the transport sector important?

Total final consumption and demand avoided by mitigation measures in the NZE



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

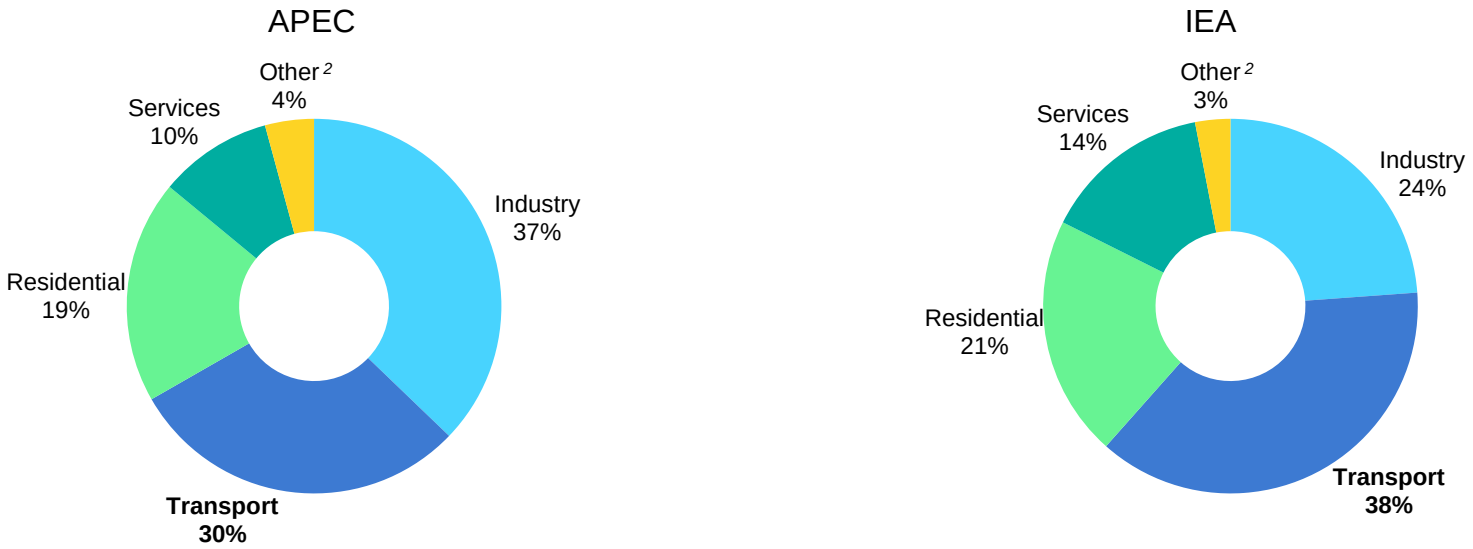
Transportation is important for multiple reasons such as economic activity and mobility.
Transport efficiency is the second driver (after electrification) to avoid emissions by 2050 towards global net zero.

Contents

What can we learn from energy balances?

Transport is the second largest sector in APEC, first in IEA

Total final energy consumption[1] in APEC economies and IEA economies in 2019



[1] Total final energy consumption excluding non-energy use
[2] Other includes agriculture, forestry, fishing and non-specified final consumption

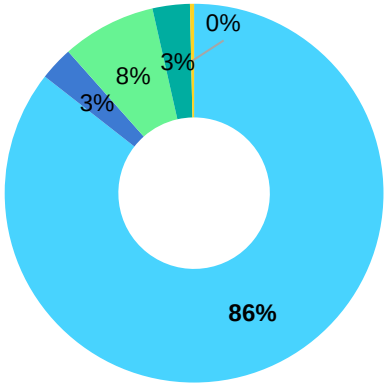
Source: IEA Energy Balances, 2021

In the APEC economies, the transport sector accounts for 30% of final energy consumption, that is, slightly less than industry and about the same as residential and commercial sectors together. In the IEA, it represents 38%.

Road transport consumes the most energy by far, mostly oil

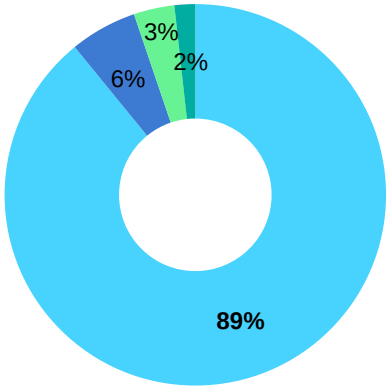
Energy consumption in transport sector[1] in APEC economies in 2019

By mode



Road
Rail
Domestic aviation
Domestic navigation
Other

By fuel



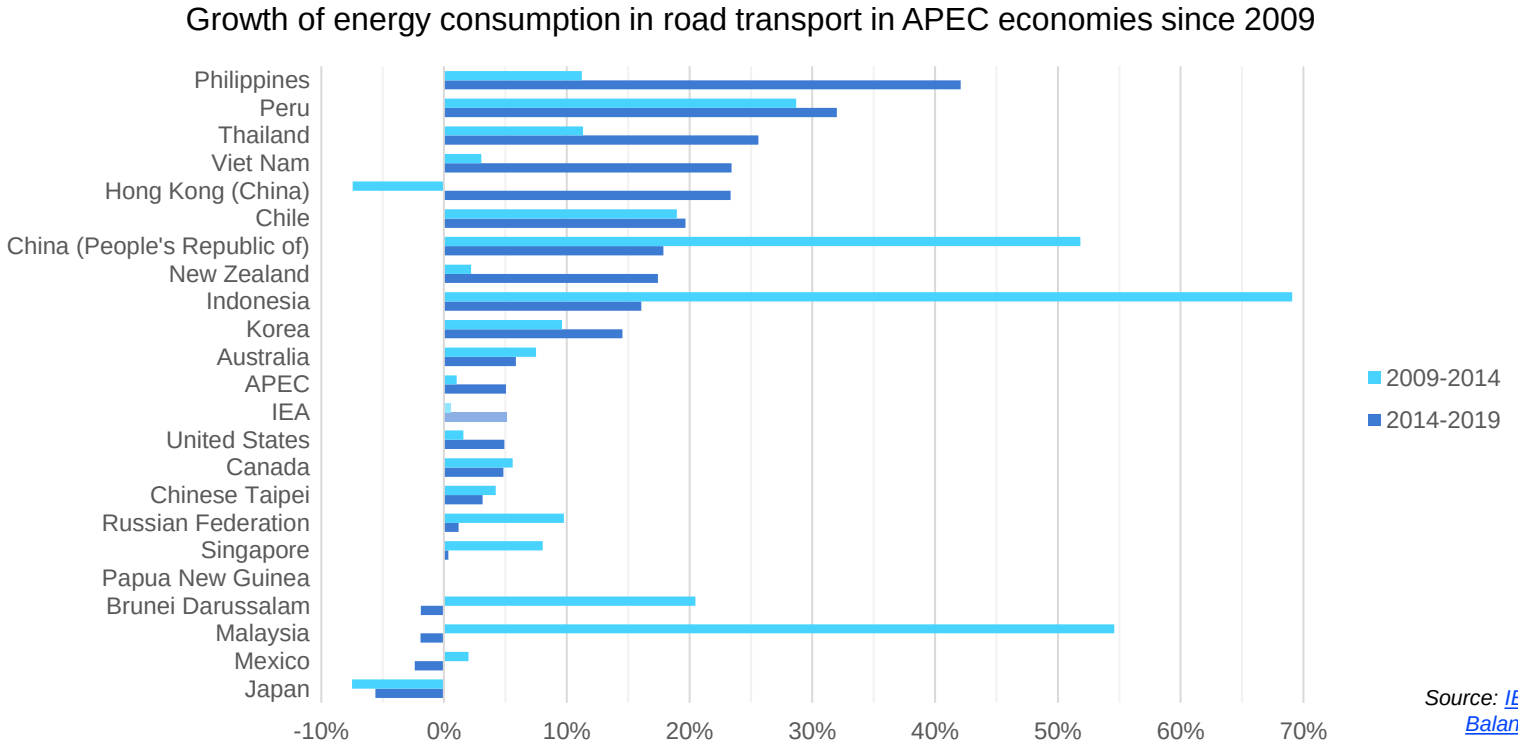
Oil products
Natural gas
Biofuels and waste
Electricity

[1] *Transport sector on these graphs follow energy efficiency definitions and exclude pipeline transport*

Source: IEA Energy Balances, 2021

Road transport represents the largest share, and transport consumption is heavily dependent on oil products.

Road transport plays uneven role within APEC economies



Source: IEA Energy Balances, 2021

Energy consumption in road transport grew faster in past 5 years than in the beginning of the decade, but with very different profiles depending on the economy.

What else do we need to know to track efficiency in transports?


- What is the share of **passenger vs. freight** transport?

- How much energy is needed to transport **one passenger over one kilometre**?



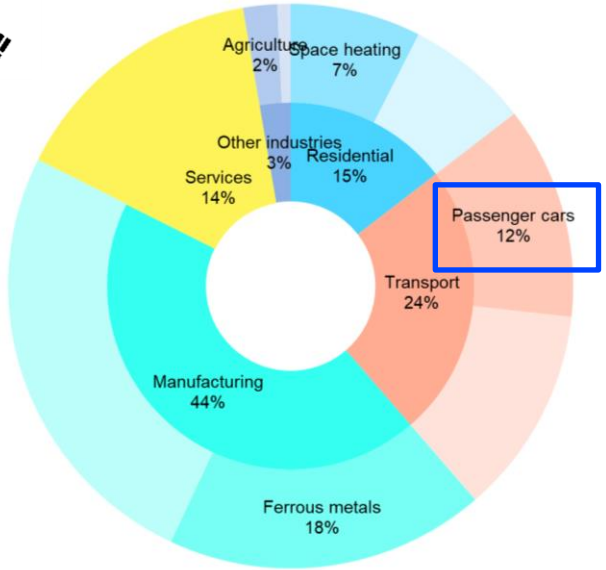

- Which **mode** is more **intensive**: train, bus or car?

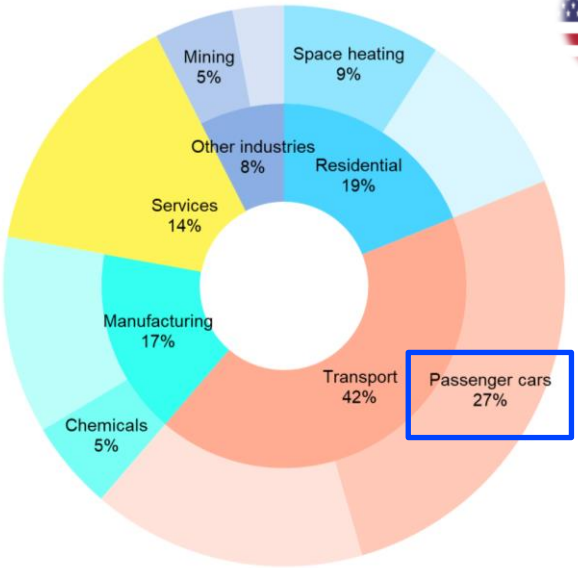
- How does it **compare** to other economies in the region?

Energy efficiency indicators: what can we learn and how to develop those?

Which end use is the most consuming in each sector – Examples

Largest end uses by sector in Korea (left) and the United States (right), 2019



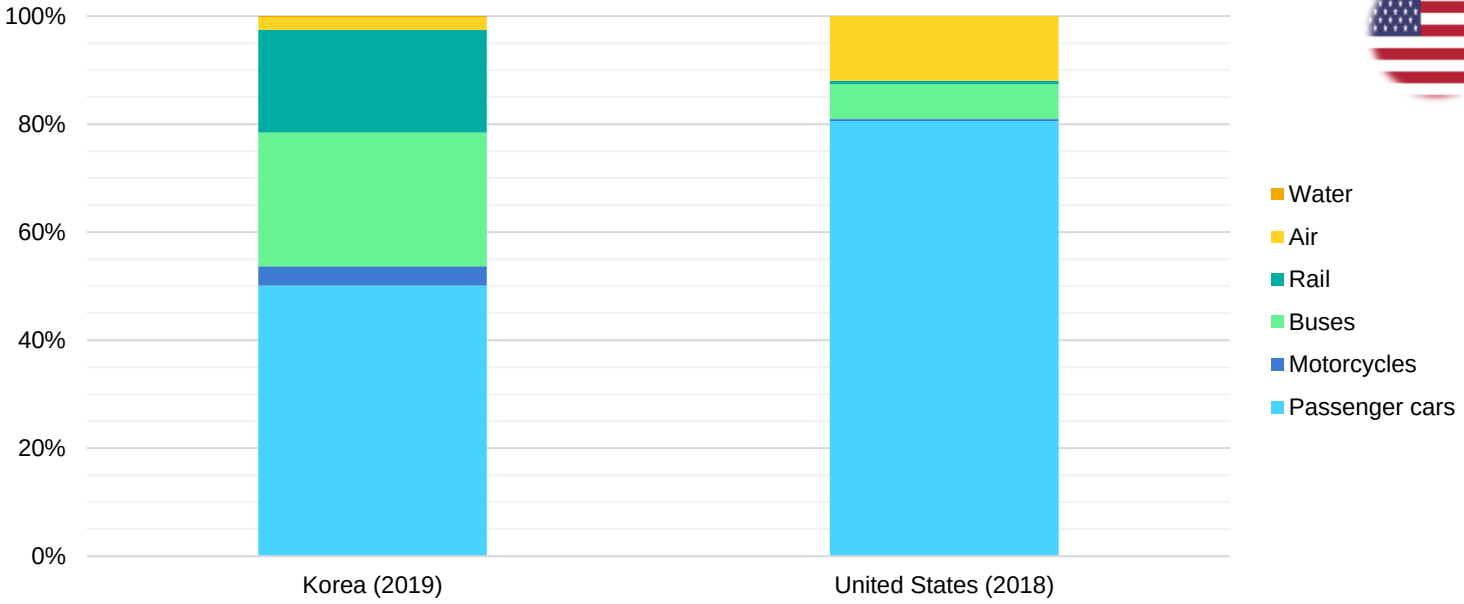


Source: IEA Energy Efficiency Indicators, 2021

More detailed data on energy consumption by end use / sub-sector allows to understand which segment and which mode consumes the most energy. Passenger cars account for half of Korea transport energy consumption, and nearly two third of USA's. What is the reason for that ?

Split into different modes and vehicle types – Examples

Activity share in passenger transport in Korea (2019, left) and United States (2018, right)

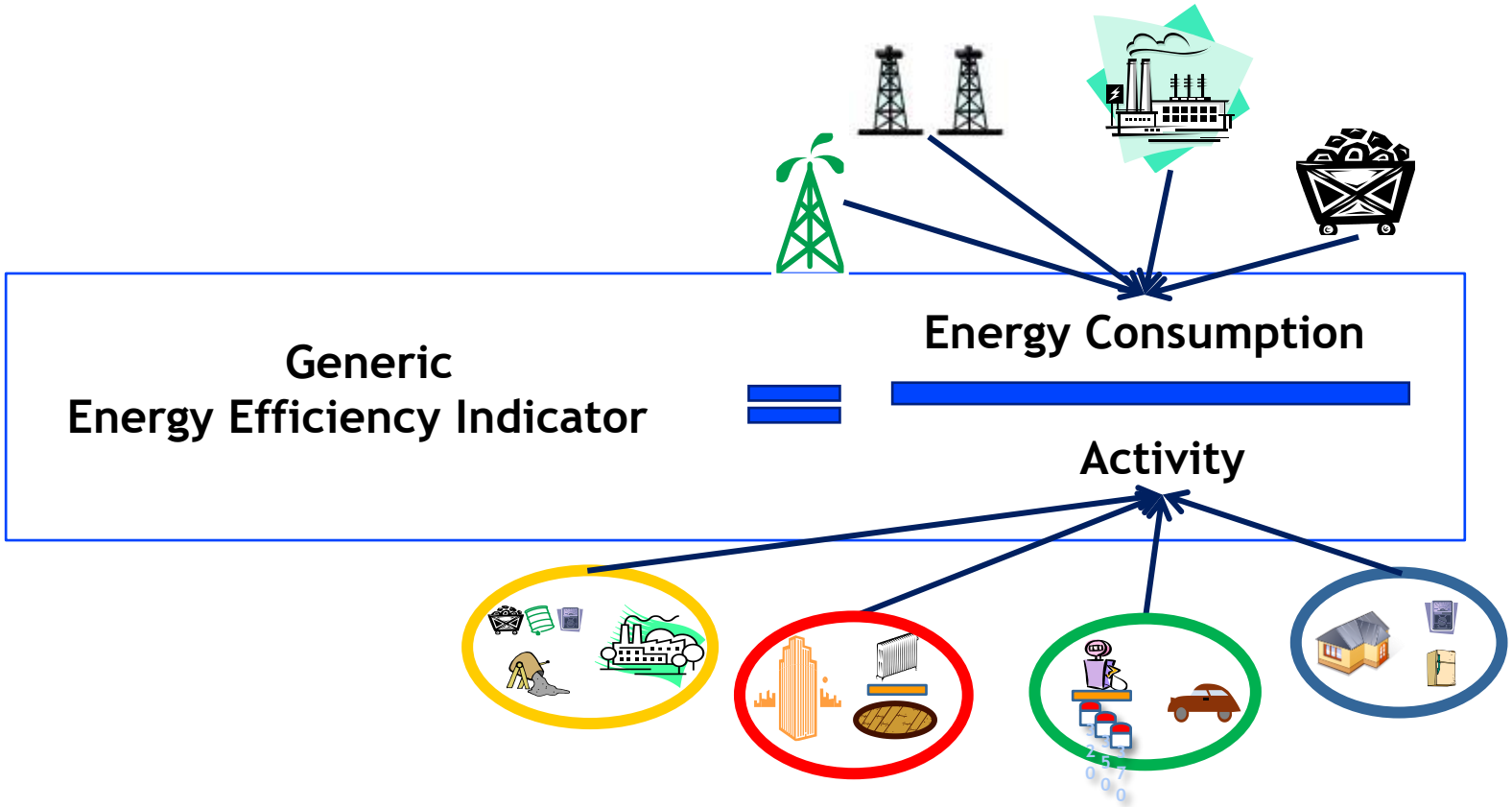


Source: IEA Energy Efficiency Indicators, 2021

Looking at activity data, the share of passenger cars mode in transport is significantly larger in the USA compared to Korea.

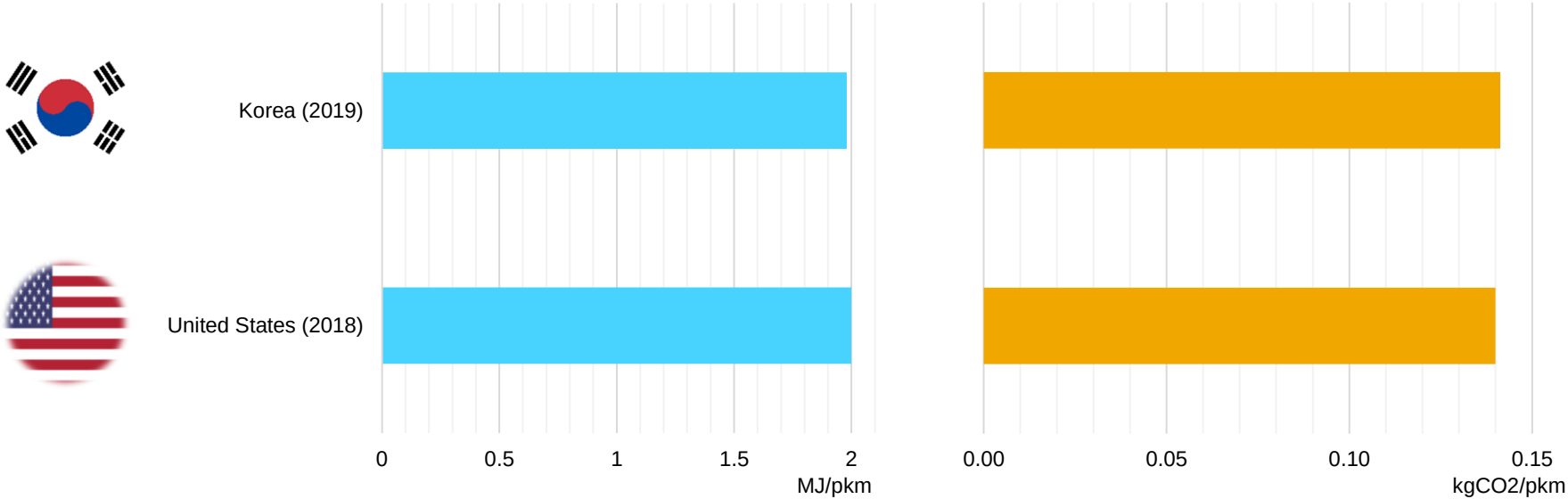
Activity share by mode varies significantly from one economy to the other.

Energy efficiency indicators – Definition



How intensive is passenger transport – Examples

Passenger transport energy intensity (MJ/pkm, left) and carbon intensity (kgCO2/pkm, right) in Korea (2019, top) and United States (2018, bottom)



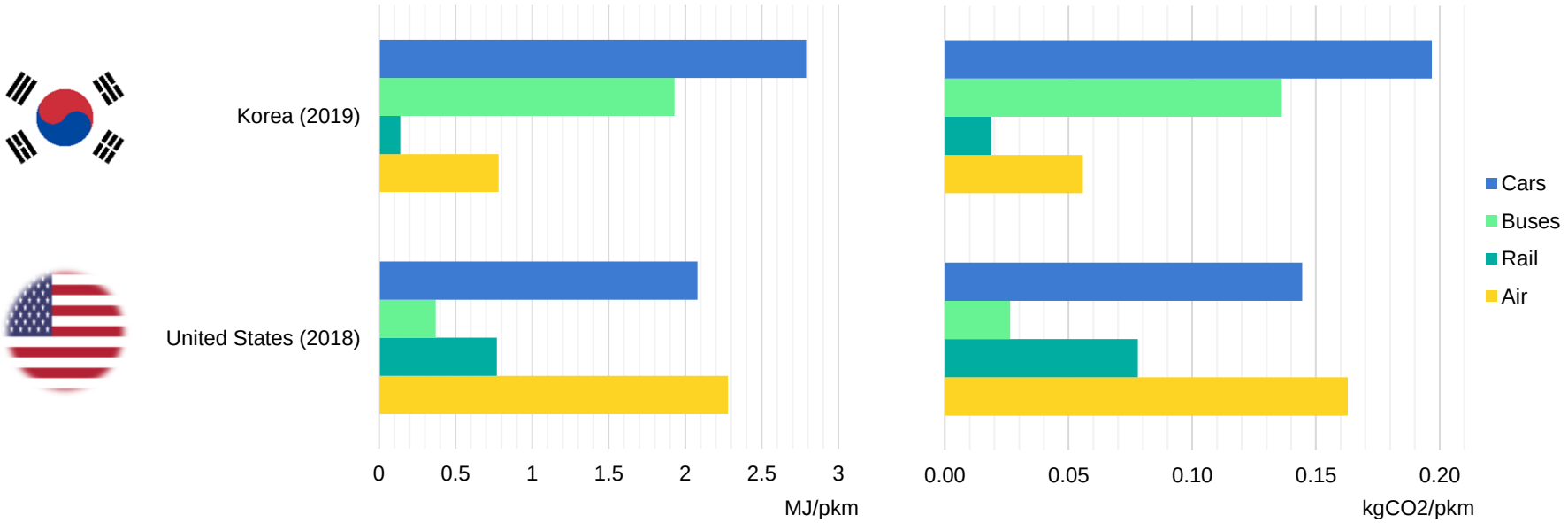
Pkm refers to passenger-kilometre, that is, the product of occupancy, vehicle stock and distance travelled.

Source: IEA Energy Efficiency Indicators, 2021

Surprisingly, energy and carbon intensities are very similar.
Larger passenger cars consumption share in the USA is due to higher share of activity for this mode in total transport.

Breaking into different intensity for each mode – Examples

Passenger transport energy intensity (MJ/pkm, left) and carbon intensity (kgCO2/pkm, right) in Korea (2019, top) and United States (2018, bottom)



Pkm refers to passenger-kilometre, that is, the product of occupancy, vehicle stock and distance travelled.

Source: IEA Energy Efficiency Indicators, 2021

Mode shares allow to break down energy and carbon intensities in each economy, providing key information to tailor different policies.

Activity data for efficiency indicators in transport

Passenger-km (pkm) or ***tonne-km (tkm)***

Vehicle-km (vkm)

Vehicle stock

×

Distance travelled

×

Occupancy

=

Passenger-km (pkm)

Load factor

=

Tonne-km (tkm)

Transport indicators – energy and activity data

Decomposition into drivers of energy consumption

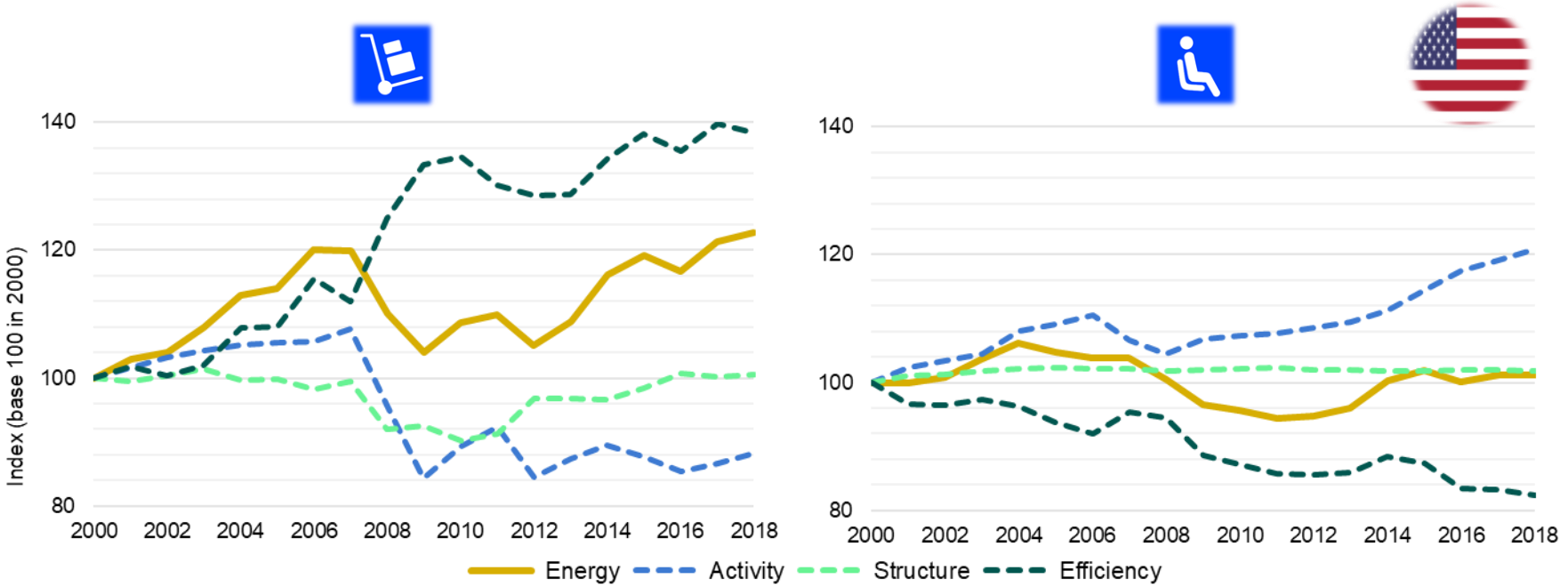
Segment	End use	Activity	Structure	Efficiency effect
Passenger transport	Cars/light trucks, buses, trains, domestic airplanes, domestic ships	Passenger-kilometres (pkm)	Share of pkm	Energy consumption per pkm
Freight transport	Trucks, trains, domestic airplanes, domestic ships	Tonne-kilometres (tkm)	Share of tkm	Energy consumption per tkm

Source: IEA Efficiency Indicators Documentation 2021

End use and activity data allow to analyse energy consumption and identify the impact of three main drivers.

Decomposition analysis for disentangling consumption drivers

Drivers of transport energy consumption – Freight (left) and passenger (right) segments – United States (2000-2018)



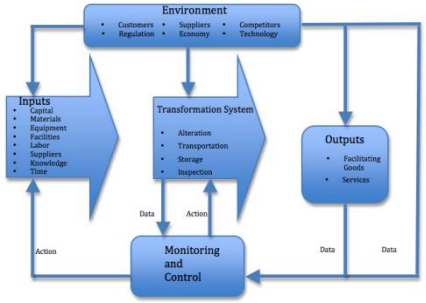
Source: IEA Energy Efficiency Indicators, 2021

The consumption of each segment is driven by very different factors, to be analysed to design performant policies.

How to collect data on transport?

Methods used to collect data for indicators

- Administrative sources
  - Basis as often gathers many data
  - To be consulted before starting new data collection
- Surveys
  - The key: a representative sample
  - Possibly expanding existing surveys
- Metering and measuring
  - Costly but very effective for monitoring specific equipment efficiency
- Modelling
  - Complementary to surveys or stand alone



Methods used to collect data – Which tool for which data

Type of data / Methodology	Consumption data		Macro-economic data	Activity data		
	Sectoral and sub-sectoral	Detailed by segment / vehicle type		Distance-related (vkm, pkm, tkm)	Vehicle stocks	Fuel economy
Administrative sources	National energy statistics and balances		National statistics offices	National / international databases	Statistics offices Manufacturers Regulating institutions	Manufacturers
Surveys	Consumers	Consumers		Transport ministries		
Measuring				Regulating institutions Transport authorities	Regulating institutions	
Modelling	*based on partial data*	*based on partial data*		Transport ministries		*based on partial data*

Source: Energy Efficiency Indicators - Fundamentals on Statistics

The best methodology depends on the economy and resources available.
It requires different data from different sets of consumers and institutions.

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