



APERC Workshop at EWG54

Wellington, New Zealand, 20 November, 2017

3-3. Outlook of Transportation Sector

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**Asia-Pacific
Economic Cooperation**

I. Transport sector overview

II. Transport model methodology

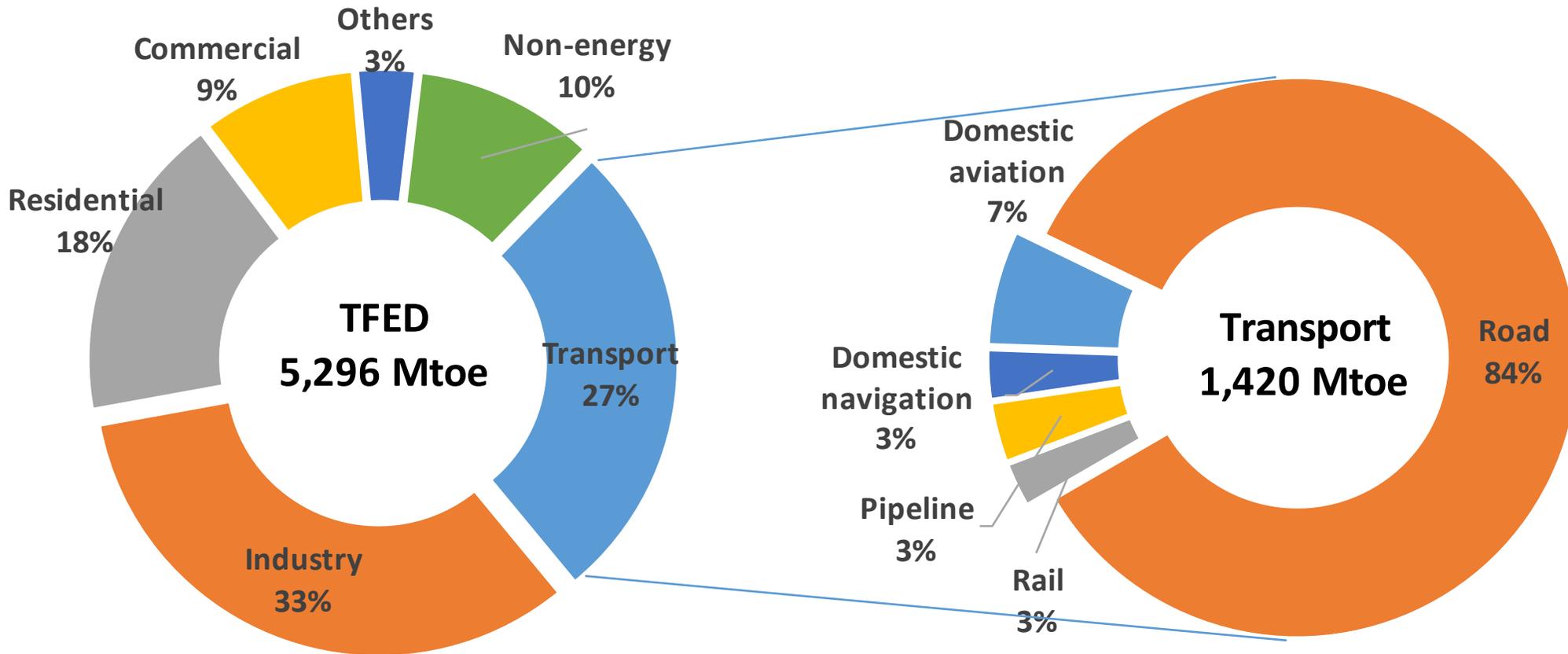
III. Preliminary results



I. Transport sector overview

Transport accounted for 27% of energy demand in 2015 – mostly from road

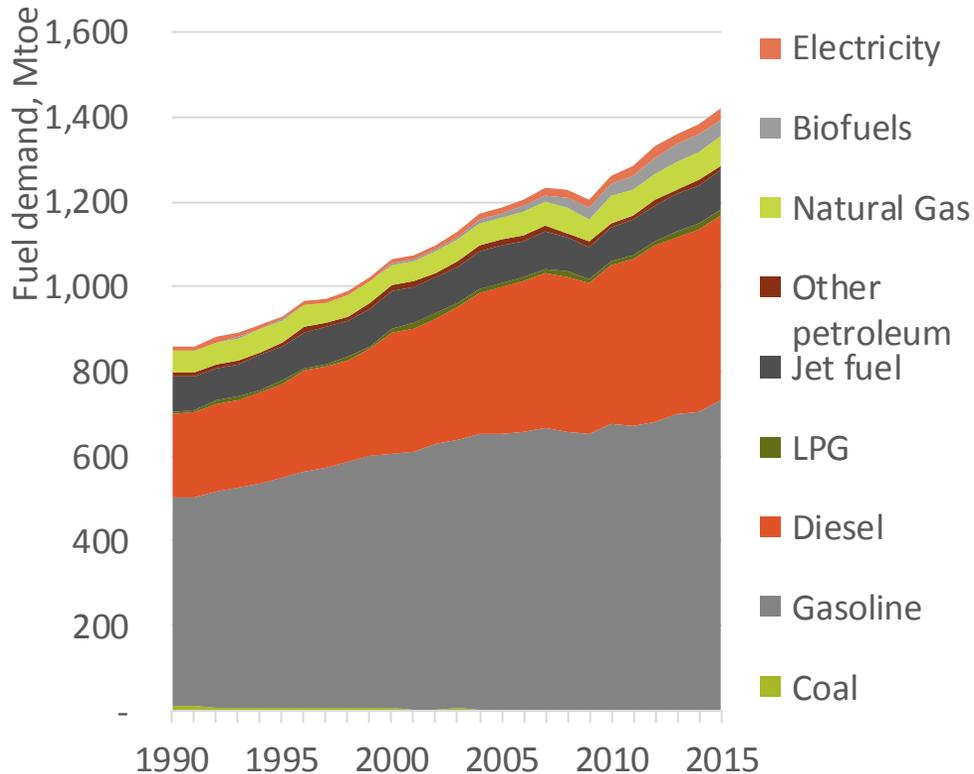
APEC's TFED and Demand for Transportation



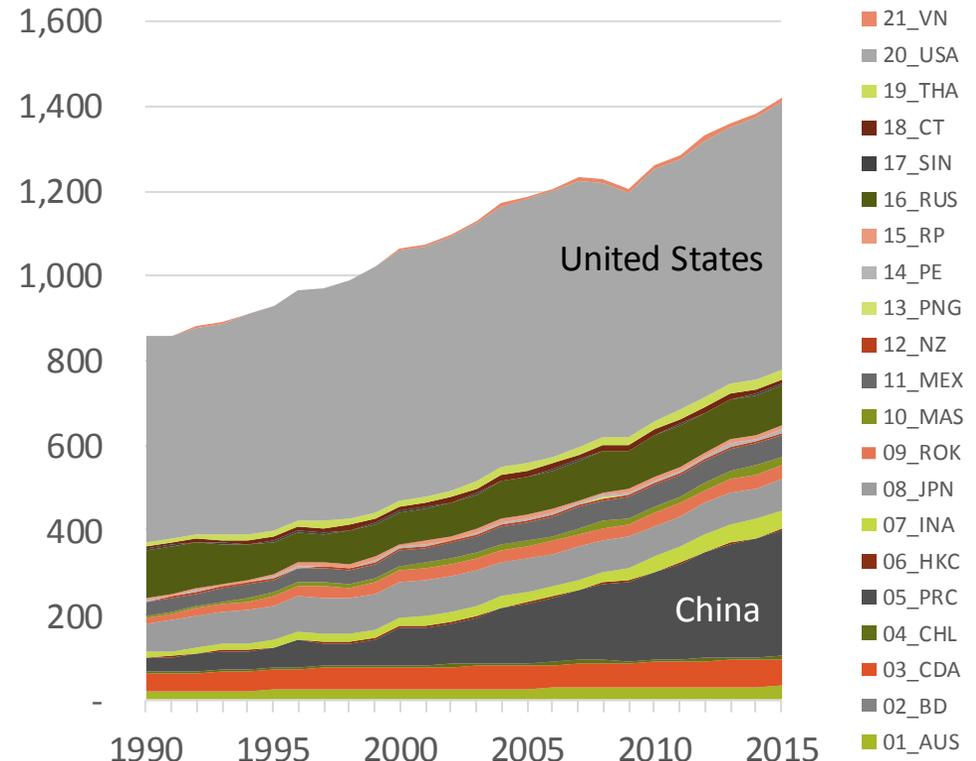
Source: IEA 2017

Domestic transportation: key fuels and key consumers

Gasoline and diesel were the key fuels



China and United States were the key consumers



- Since 1990 the share of gasoline declined from 57% to 51%,
- The share of diesel, however, grew from 23% to 31%

- In 2015, China and United States accounted for 65% of total transport energy demand
- Since 1990 China's share grew from 4% to 21%

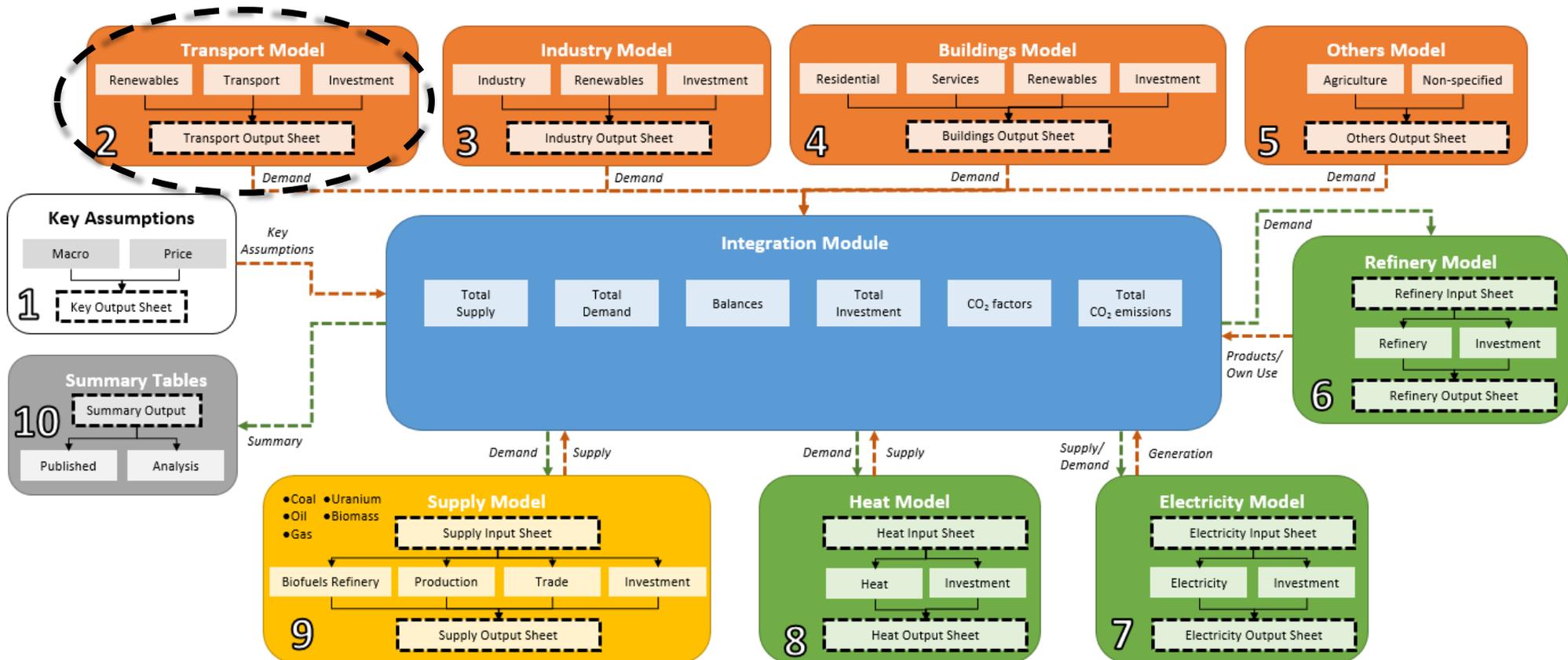
Source: IEA 2017



II. Transport model methodology

APERC Uses a Suite of 8 Models in its Outlook Research

APERC's energy demand and supply model structure

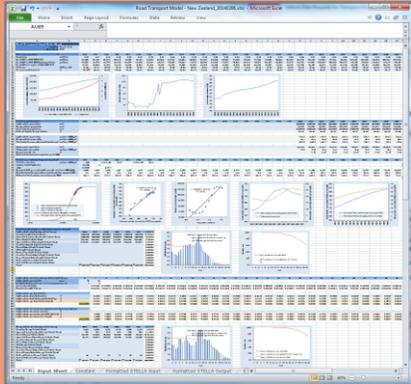


Transport Model Now Has More Technologies and Activity Information

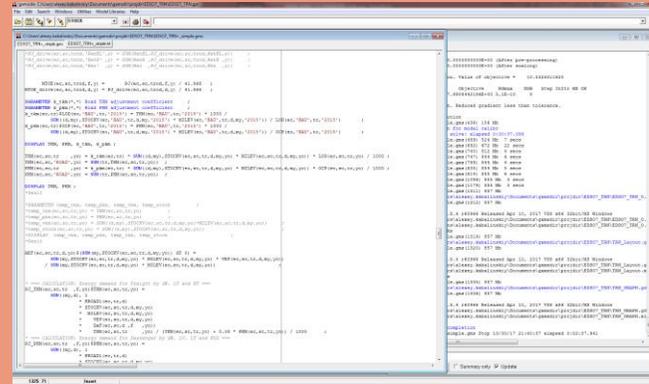
	EDSO6	EDSO7
Bunker Fuels	<ul style="list-style-type: none"> • Historical, • GDP and Population 	<ul style="list-style-type: none"> • Historical, • GDP and Population
Non-road transport	<ul style="list-style-type: none"> • Historical, • GDP and Population • (ktoe - Demand only) 	<ul style="list-style-type: none"> • TKM, PKM is f (GDP, POP), • Efficiency is f (year, policy)
Road transport	<ul style="list-style-type: none"> • Stock turnover • Consumer choice 	<ul style="list-style-type: none"> • Stock turnover • Consumer choice • Activity (TKM, PKM)
Road transport: vehicles	<ul style="list-style-type: none"> • Passenger: <ul style="list-style-type: none"> ○ 2-wlrs and LVs, • Freight: <ul style="list-style-type: none"> ○ HVs 	<ul style="list-style-type: none"> • Passenger: <ul style="list-style-type: none"> ○ 2W, LV, LT and BUS, • Freight: <ul style="list-style-type: none"> ○ 2W, LT and HT
Road transport: mileage	<ul style="list-style-type: none"> • Historical trend, • GDP and Population, • Fuel price, • Urbanisation 	<ul style="list-style-type: none"> • Historical trend, • GDP and Population, • Fuel price, • Activity (TKM, PKM and VKM), • Urbanisation

Transportation Energy Demand Model User Interface

(1990-2015)



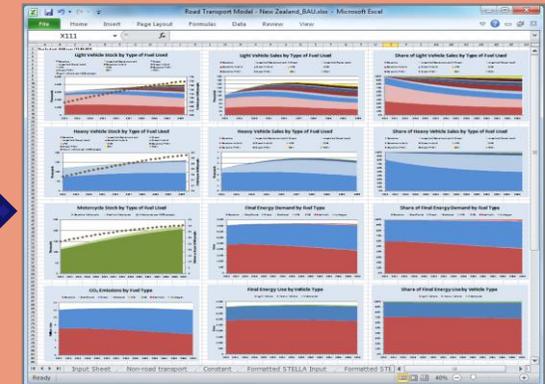
- ❖ **Macroeconomic data**
 - ✓ GDP & Population
 - ✓ Crude oil price
 - ✓ Urbanisation
- ❖ **Historical demand data**
- ❖ **Non-road demand preliminary analysis**
- ❖ **Vehicle data**
 - ✓ Vehicle population
 - ✓ Vehicle age distribution
 - ✓ Vehicle sales
 - ✓ Vehicle fuel economy
 - ✓ Vehicle travel distance



- **Vehicle ownership model** -> **vehicle stock**
(GDP per capita, vehicle ownership, stock)
- **Vehicle stock & flow model** -> **vehicle sales and vehicle retirement**
(vehicle age distribution, survival rate)
- **Vehicle consumer choice model** -> **share of vehicle technologies**
(fuel cost, purchase prices, driving range, refuelling infrastructure, etc..)
- **Vehicle travel model** -> **travel distance**
(fuel cost, income, vehicle ownership, efficiency improvement, urban density)



(1990-2050)



- **Results**
 - Vehicle ownership
 - Vehicle stock by technology & fuel
 - Vehicle sales by technology & fuel
 - Energy demand by vehicle type
 - Energy demand by fuel
 - Annual vehicle travel
 - Average energy intensity
 - etc.

Input
(Microsoft Excel)

Main Model
(GAMS – General Algebraic Modelling System)

Output
(Microsoft Excel)

Outlook 7th Edition Includes 3 Scenarios

- Business-as-usual (BAU) scenario:

The BAU scenario reflects current policies and trends within the APEC energy sector. In turn, it largely projects past trends into the future.

- APEC Target (TGT) scenario:

The TGT scenario is driven by APEC's goals of reducing energy intensity while increasing the share of renewables.

- Progressively improving Passenger and Freight transportation activity,
- Accelerated fuel efficiency improvement, and
- Increased share of biofuels.

- 2 Degree Scenario (2DS) scenario:

2DS follows the carbon emissions reductions included in the ETP by IEA.

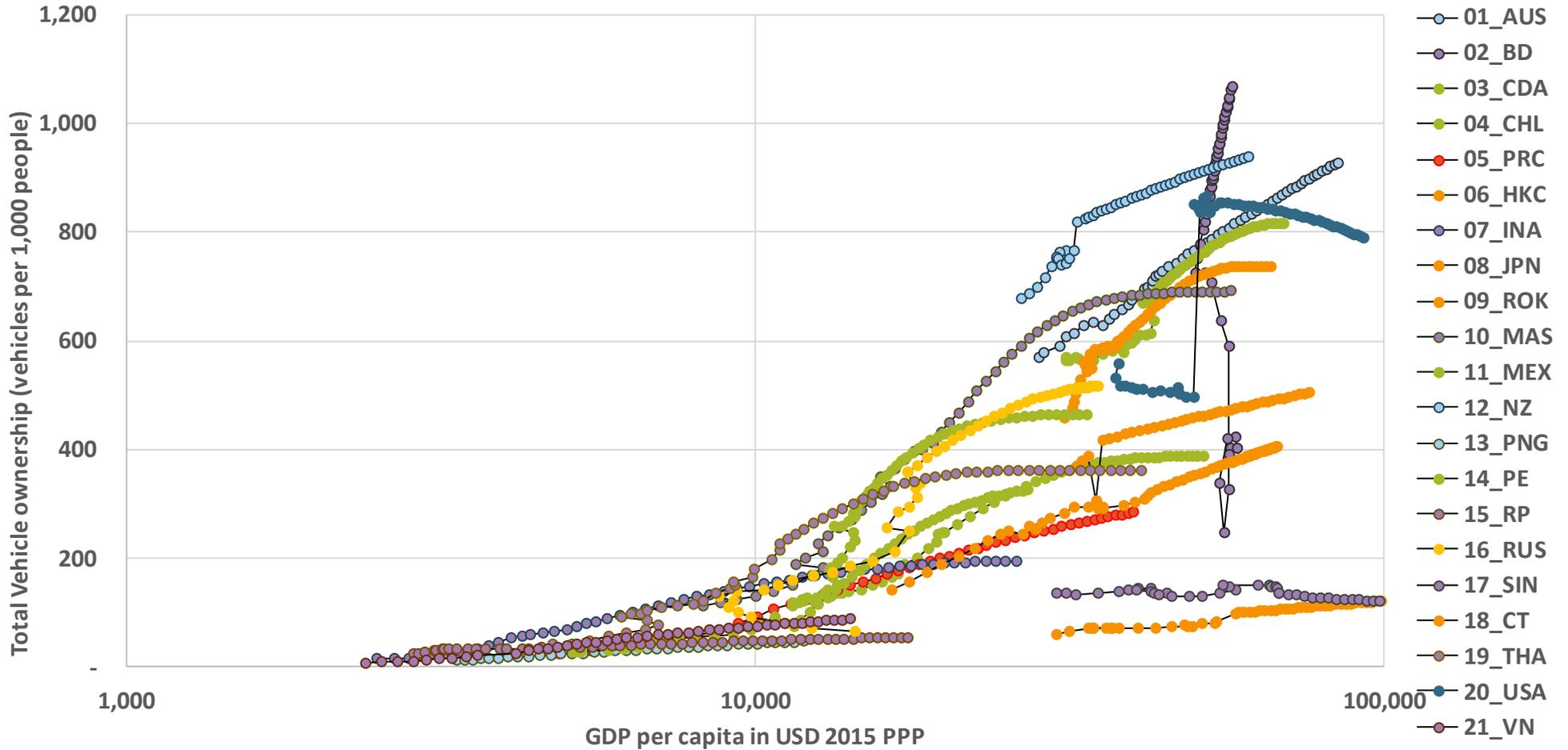
- Further decoupling the transportation activity and economic growth,
- Reduced vehicle ownership and vehicle mileage compared to TGT,
- Fuel efficiency and energy intensity consistent with TGT,
- Support for advanced fuels and vehicles, mode/technology shifting.



III. Preliminary results

APEC's vehicle ownership (1990-2050) shows strong role of GDP

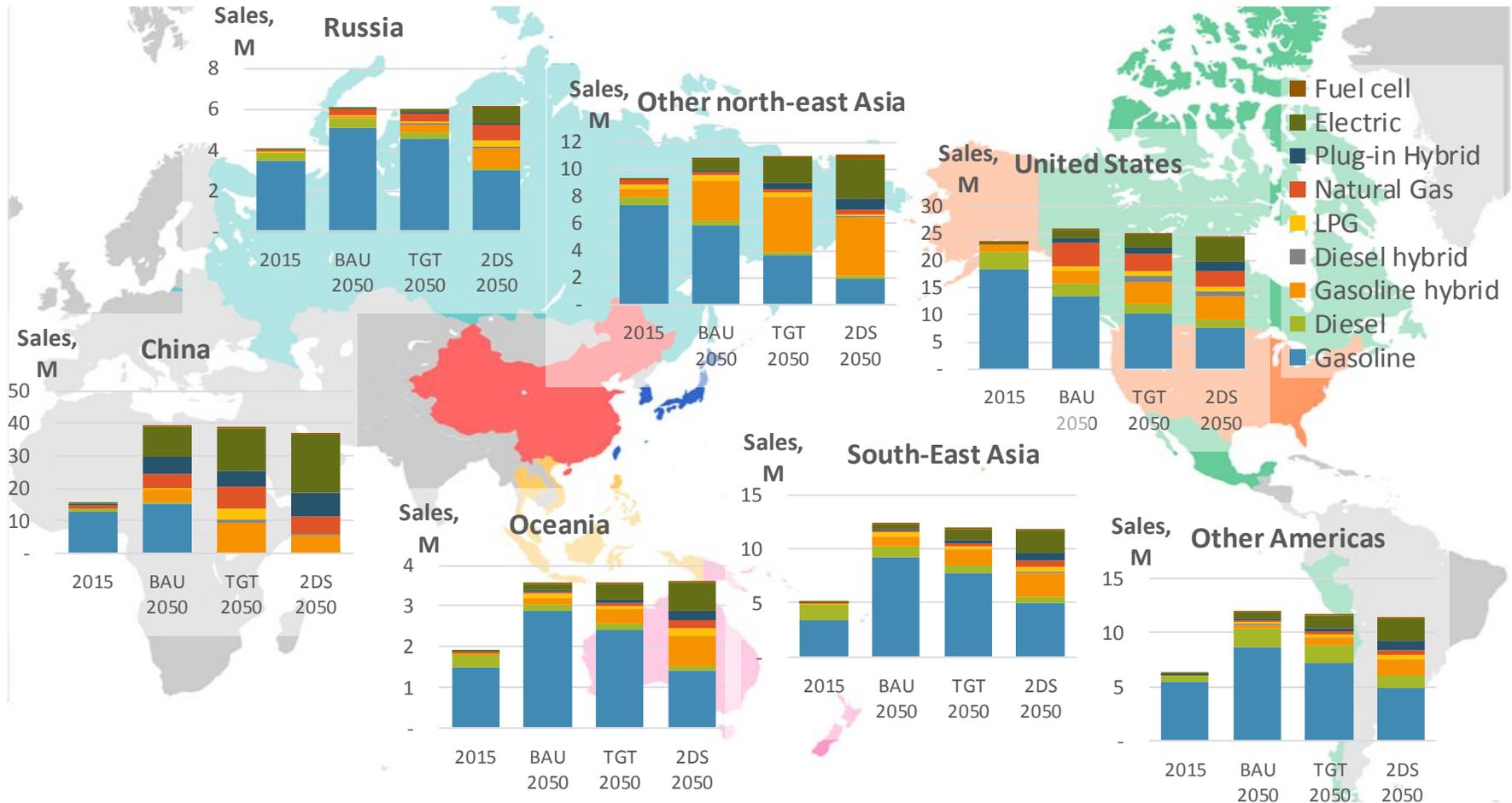
Vehicle ownership vs GDP per capita



Source: IEA 2017, OICA 2017 and APERC analysis

In 2050, APEC's Vehicles are More Diverse

APEC's Regional Road Vehicle Markets



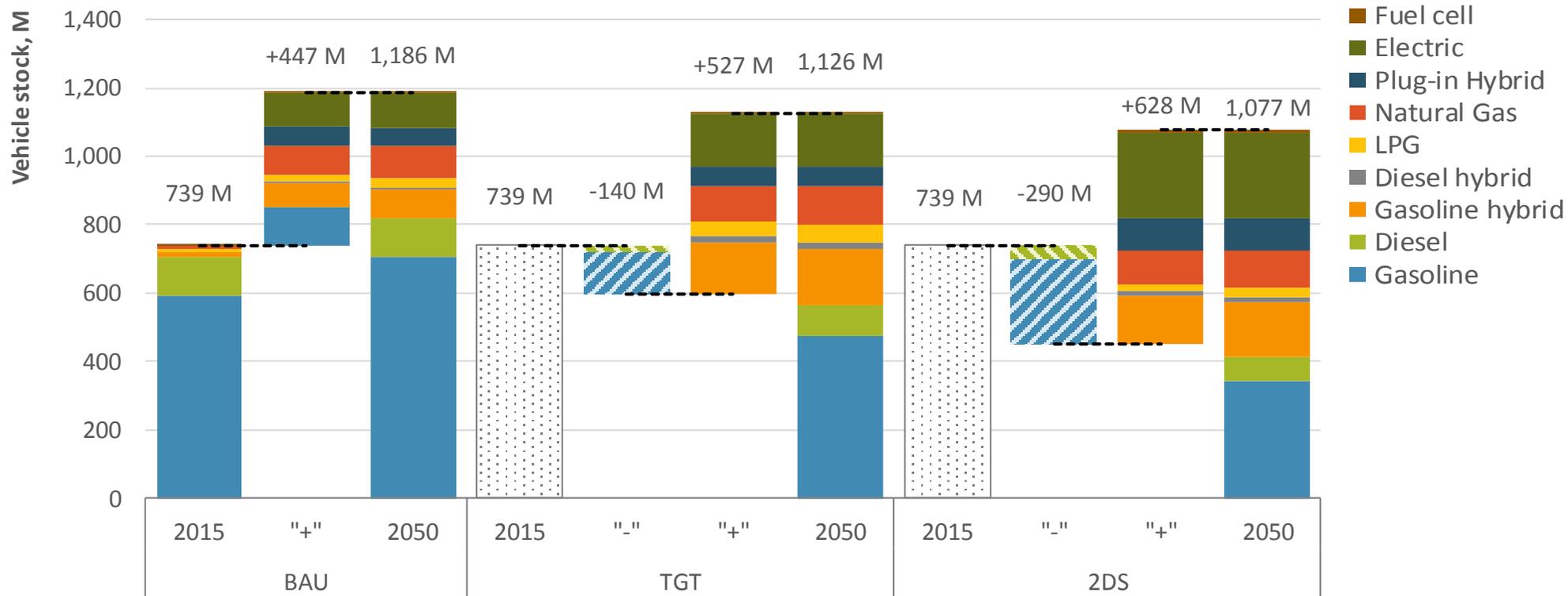
- **China and SEA markets increase three times in all scenarios**

Source: APERC analysis

Note: **Other north-east Asia** includes Hong Kong, China; Japan and Korea; **Oceania** includes Australia; New Zealand; Papua New Guinea; **South-East Asia** includes Brunei Darussalam; Indonesia; Malaysia; The Philippines; Thailand and Viet Nam; **Other Americas** include Canada; Chile; Mexico and Peru.

Bright Futuer for Electric Vehicles, Uncertain for Gasoline

Vehicle Stock (except 2-Wheelers) by drivetrain technology

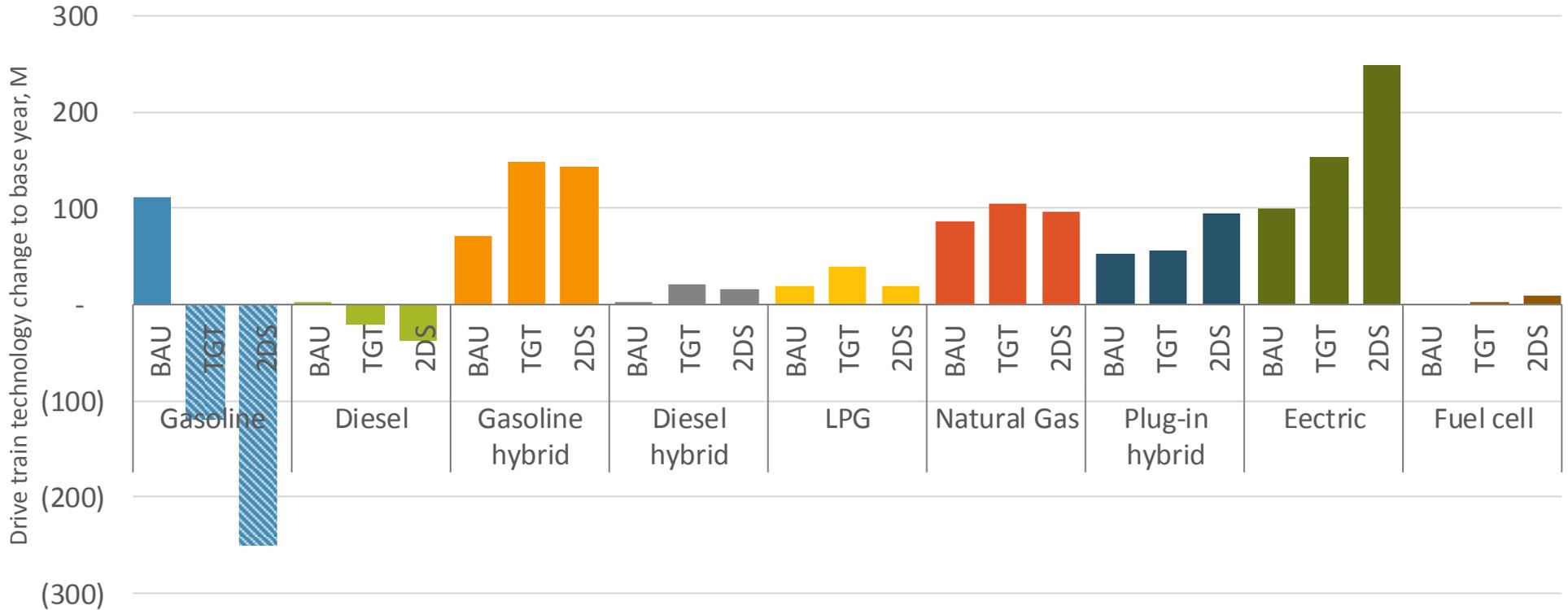


- **Electric vehicle stock grows from 1M (2015) to 100-250M (2050)**
- **Gasoline vehicle stock increases in the BAU, but significantly decreases in both the TGT and 2DS scenarios**

Source: APERC analysis

Hybrids and Natural Gas Vehicles Provide Transition

Drivetrain technology stock change (2015-2050), M



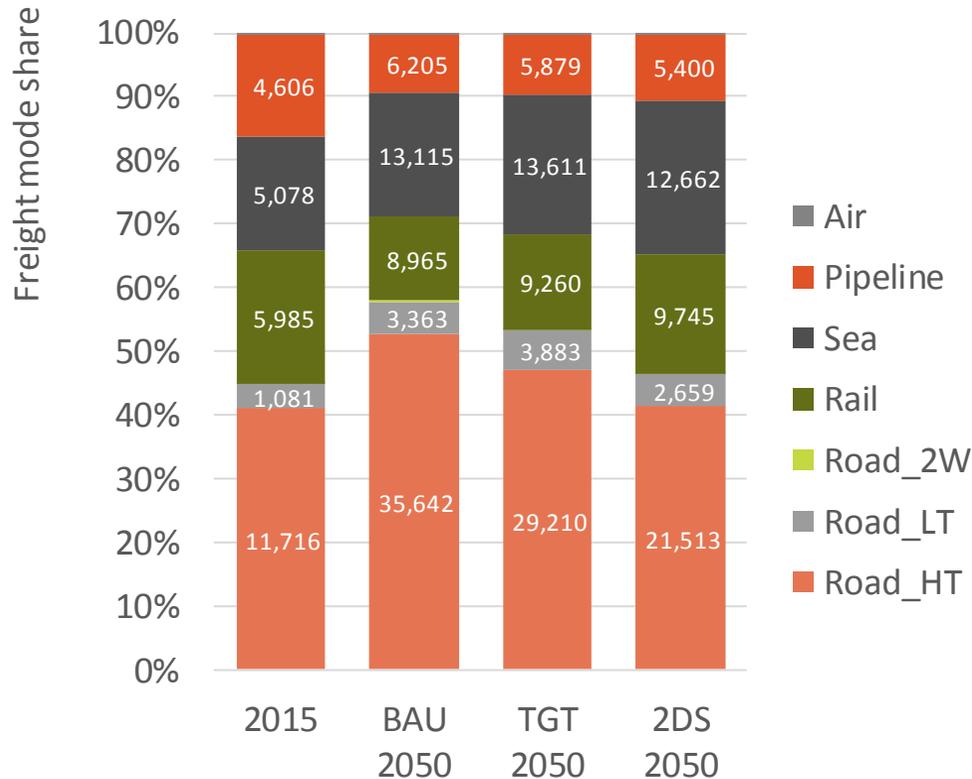
- **Plug-in hybrid, gasoline hybrid and natural gas Light Vehicles provide transition from conventional to advanced fuels.**
- **Fuel cell vehicles reach 9.5M (0.9% of total stock, excl. 2-wheelers).**

Source: APERC analysis

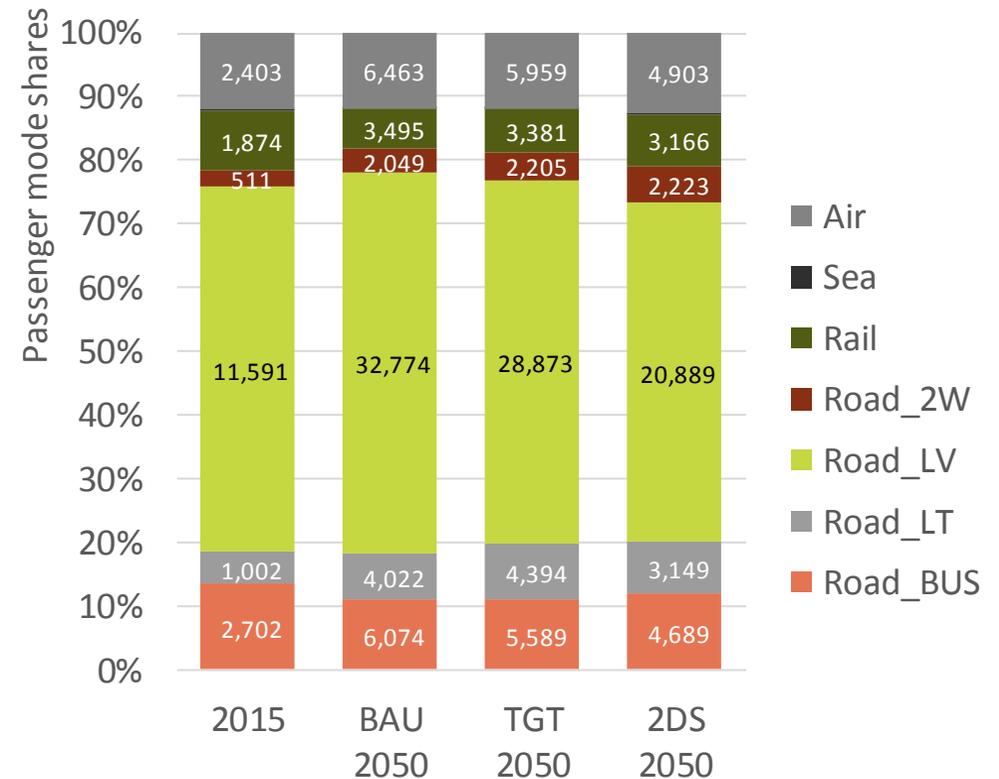
Road Freight Shifts Toward Sea and Rail

APEC's Freight and Passenger activity indicators

Freight activity, % and Gtkm



Passenger activity, % and Gpkm



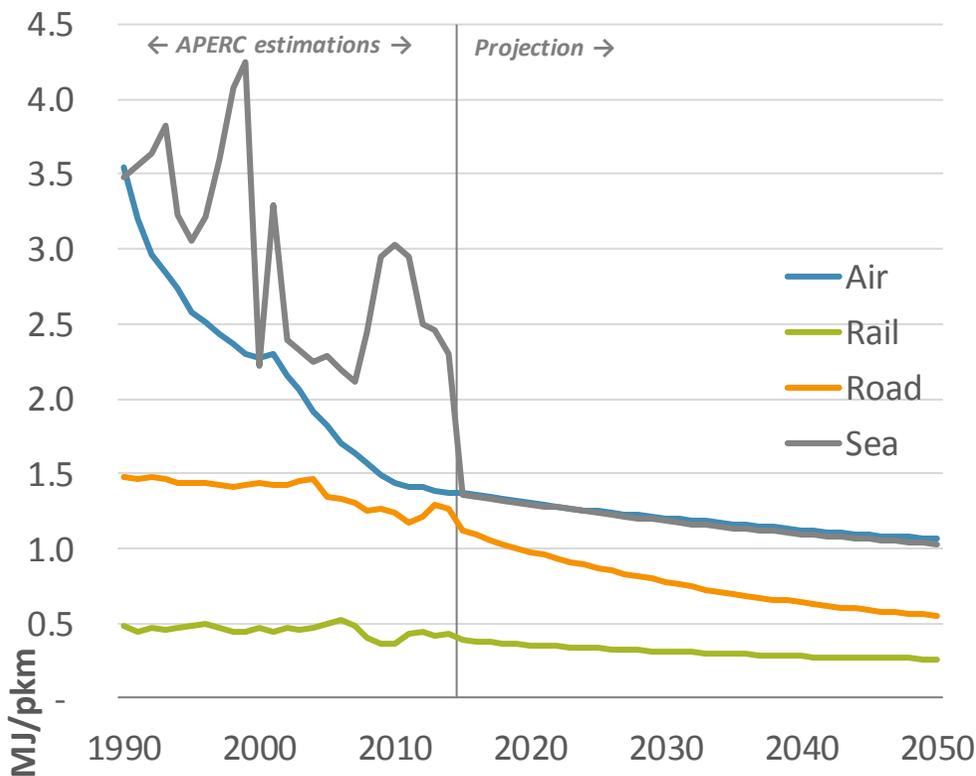
- **The share of Road passenger transport remains at about 80% in all scenarios**

Source: APERC analysis

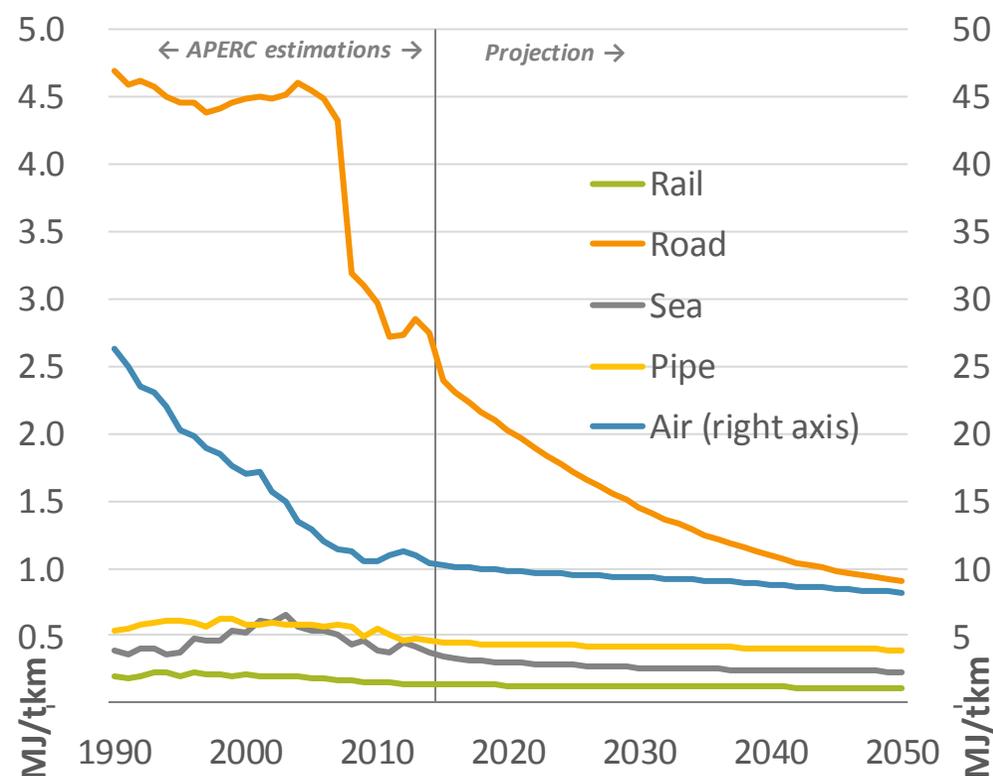
Improved fuel efficiency and logistics halves Road's freight intensity

Transport: energy intensity

Passenger transport energy intensity in BAU, MJ/pkm



Freight transport energy intensity in BAU, MJ/tkm



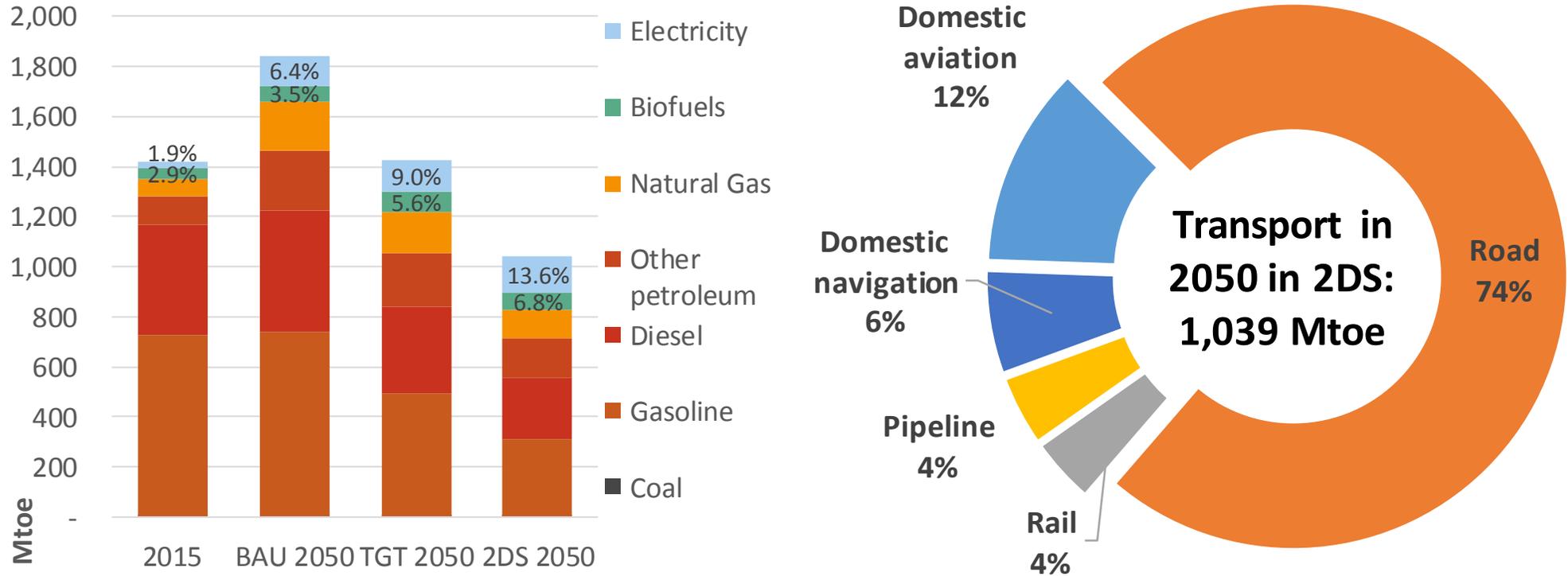
- **Rail remains the most efficient mode for both passenger and freight**

Source: IEA 2017, APERC analysis

Note: historical numbers are estimated based on IEA energy statistics and economies' passenger and freight activity indicators

Fossil Fuels Still Major in 2050

Transportation energy demand by fuel and by type of transport (2015-2050)

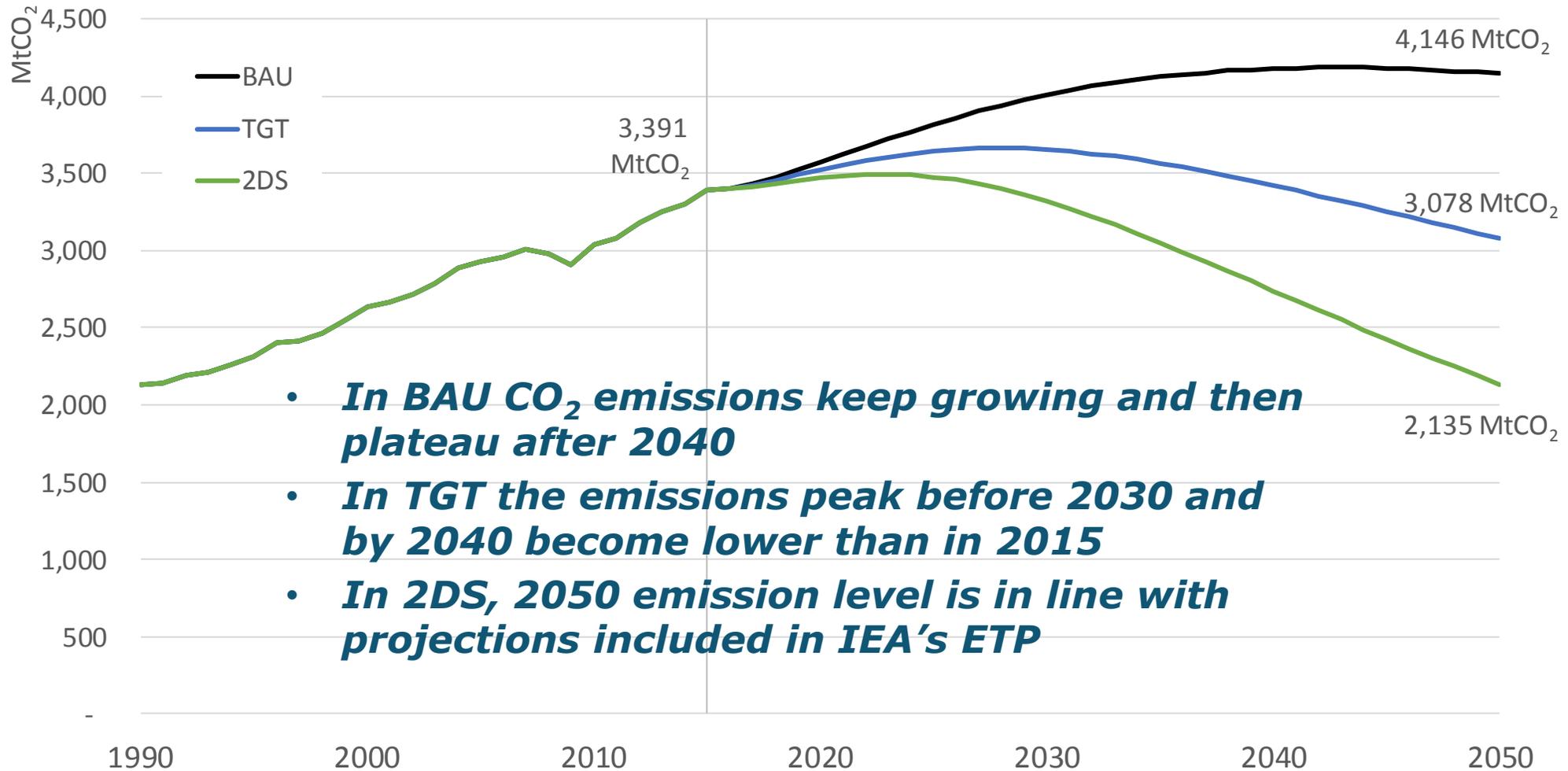


- ***In BAU demand grows by 30% to 2050***
- ***In 2DS demand reduces by 27% and electricity share reaches 13.6%***

Source: APERC analysis

Increasing Efficiency Leads to Emissions Peak in 2030

APEC's Transport CO₂ emissions



- ***In BAU CO₂ emissions keep growing and then plateau after 2040***
- ***In TGT the emissions peak before 2030 and by 2040 become lower than in 2015***
- ***In 2DS, 2050 emission level is in line with projections included in IEA's ETP***

Source: IEA 2017, APERC analysis

Preliminary conclusions and future work

- Transportation sector remains a heavy energy user in all three scenarios developed by APERC
- In the 2DS, electric vehicle deployment is more than 2x other scenarios, indicating a significant impact on the vehicle manufacturing industry in order to supply this demand
- Rapidly growing economies might avoid “lock-in” effect by adopting advanced vehicles in the first place
- Non-road transport plays an important role in decarbonization strategies, and becomes especially important in 2DS
- Future work includes:
 - ✓ Improving the road vehicle market analysis,
 - ✓ Improving vehicle mileage and fuel efficiency assumptions, and
 - ✓ Top-down analysis for the overall transportation system.



**Tēnā koutou, tēnā koutou,
tēnā koutou katoa!**

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