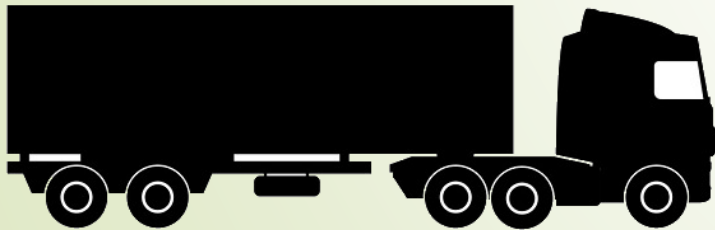


Road Transport Energy Transitions

Fadiel Ahjum
University of Cape Town

SA-TIED Energy Symposium, Pretoria
28th August, 2019

fadiel.ahjum@gmail.com



Global trends

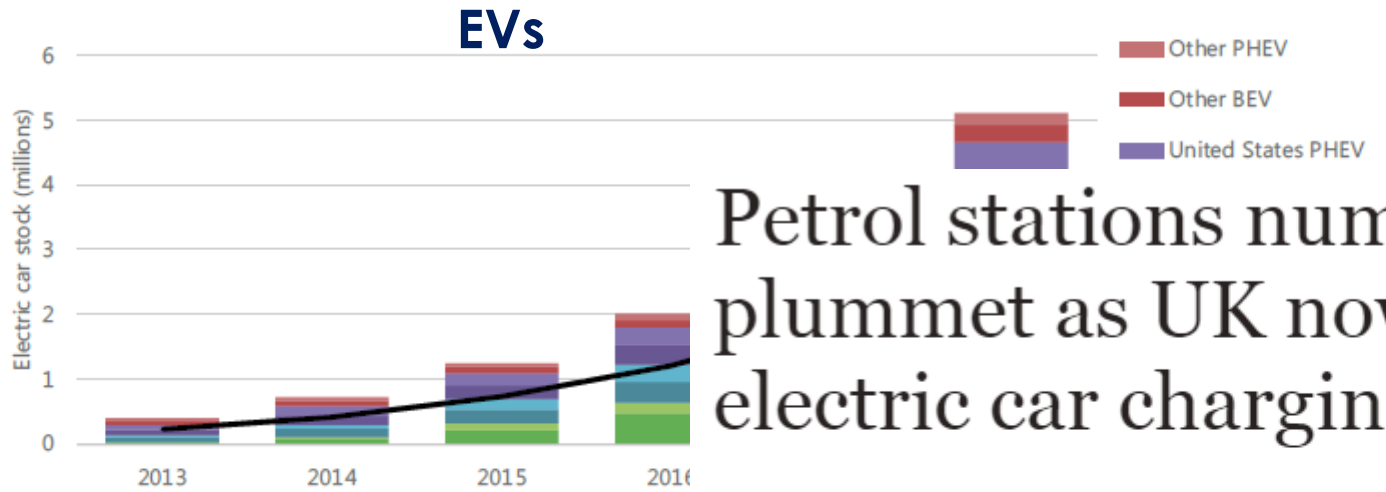
Petrol stations numbers plummet as UK now has more electric car charging points

THE UK now has more public places to charge electric cars than it does petrol stations.

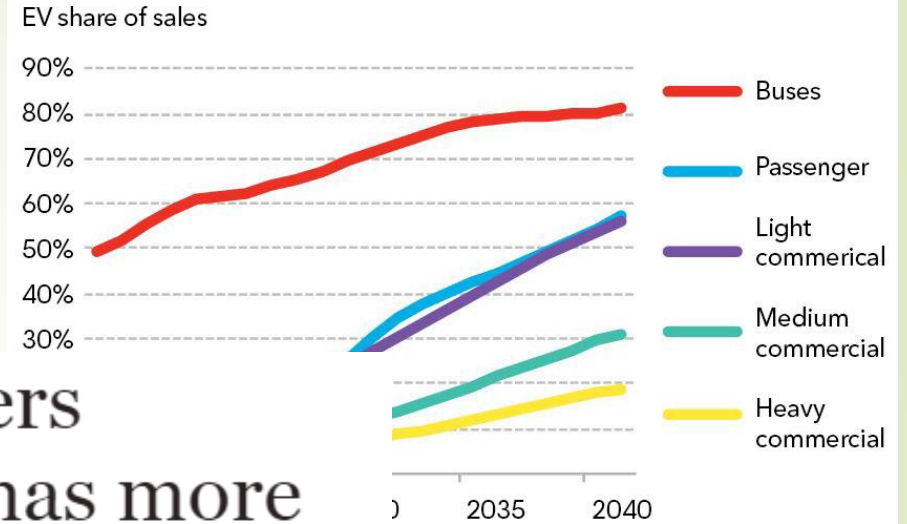
By LLOYD JOHNSON

PUBLISHED: 06:45, Thu, Aug 15, 2019

<https://www.express.co.uk/life-style/cars/1165595/petrol-station-near-me-electric-car-charging-points-UK>

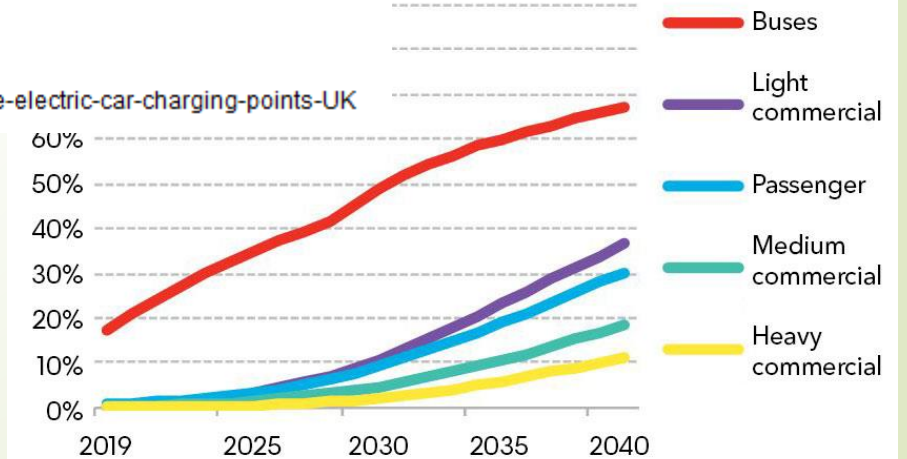


EV share of annual vehicle sales by segment

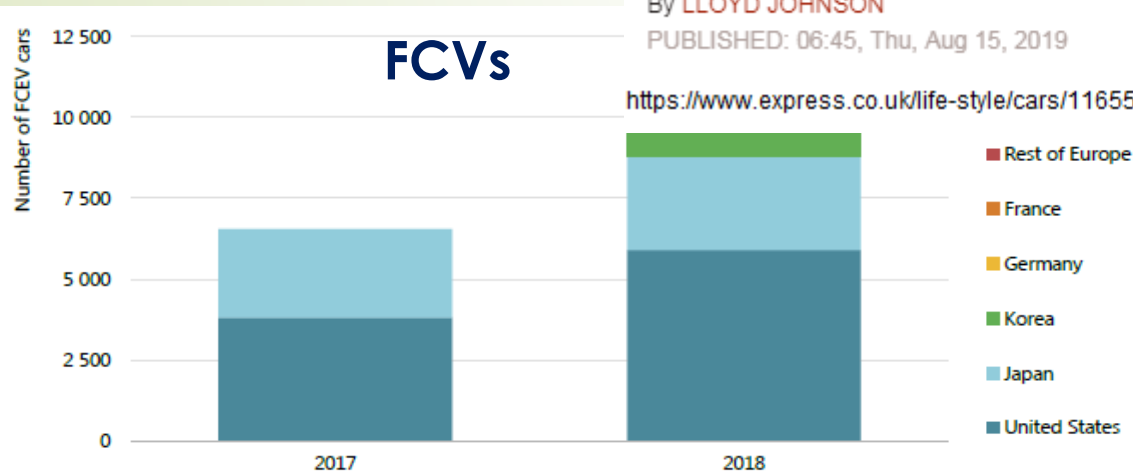


Truck and bus figures are global. Commercial vehicle segment adoption figures in both charts cover the main markets of China, Europe and the U.S.

by segment



Source: BloombergNEF. Note: Passenger car and bus figures are global. Commercial vehicle segment adoption figures in both charts cover the main markets of China, Europe and the U.S.



Source: AFC TCP (2019), AFC TCP Survey on the Number of Fuel Cell Electric Vehicles, Hydrogen Refuelling Stations and Targets.

South African Road Transport Sector

32% of the South African GDP that emanates from agriculture, mining, manufacturing and utilities

Refinery capacity ~788,000 bbl/day

- Crude oil : 513,000 bbl/day
- CTL: 150,000 bbl/day
- GTL: ? bbl/day

National CO₂e emissions ~ 430 Mt

- Power Sector responsible for 60%
- CTL coal-synfuel facility responsible for 10%
- Transport direct emissions ~60 Mt (14%)
(similar to industrial emissions)

Global Context

- Ton-km ~1.0%
- ~ 1 billion passenger vehicles - South Africa: 0.7%

South African Vehicle Parc

- 12,46 million registered vehicles at the end of 2018
- 7,34 million passenger cars: 58,9% of parc.
- 176 vehicles per 1000 persons

Energy utilisation

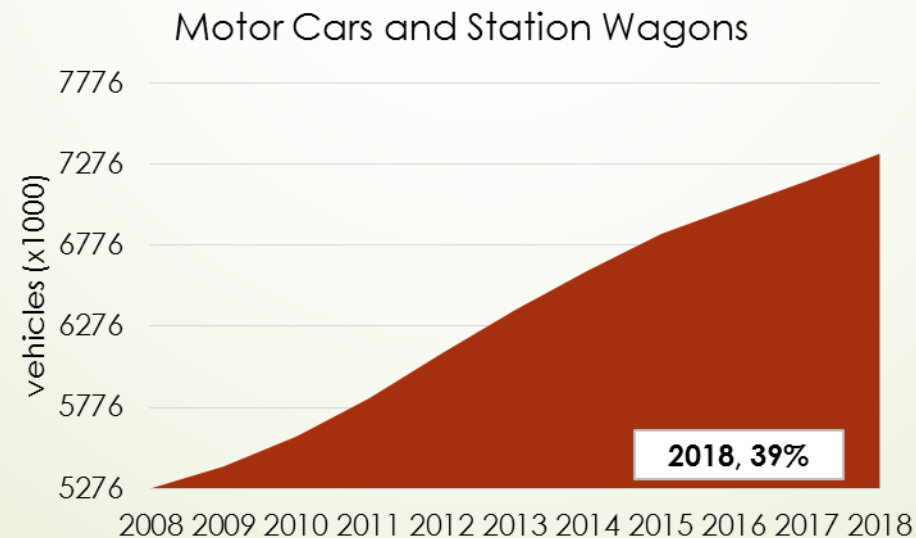
- ~ 894 PJ, comparable to industrial utilisation (1294 PJ).
Larger if emissions attributed to transport fuel supply are included (i.e. Refineries)

South African Passenger Travel

Population expected to grow from 55 million (2015) to about 65 million people by 2050

NHTS (2013)		Modal share 2003	Modal share 2013	Change 2003 - 2013
Public transport	Train	7.1%	6.6%	-0.5%
	Bus	7.5%	6.2%	-1.3%
	Taxi	22.5%	25.1%	2.6%
	TOTAL	37.1%	37.9%	0.8%
Private transport	Car	28.5%	34.2%	5.8%
	Walk	32.3%	25.8%	-6.5%
	Other	2.2%	2.0%	-0.1%
	TOTAL	62.9%	62.1%	-0.8%
Total daily trips		100.0%	100.0%	100%

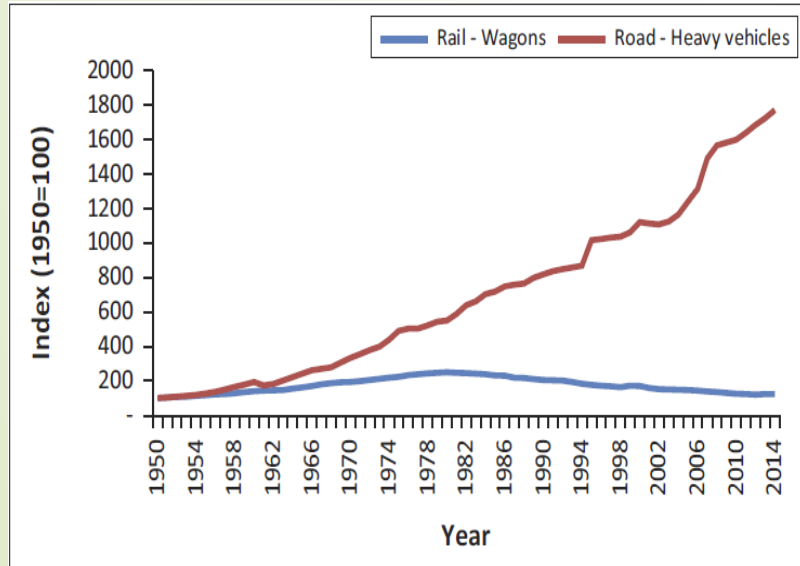
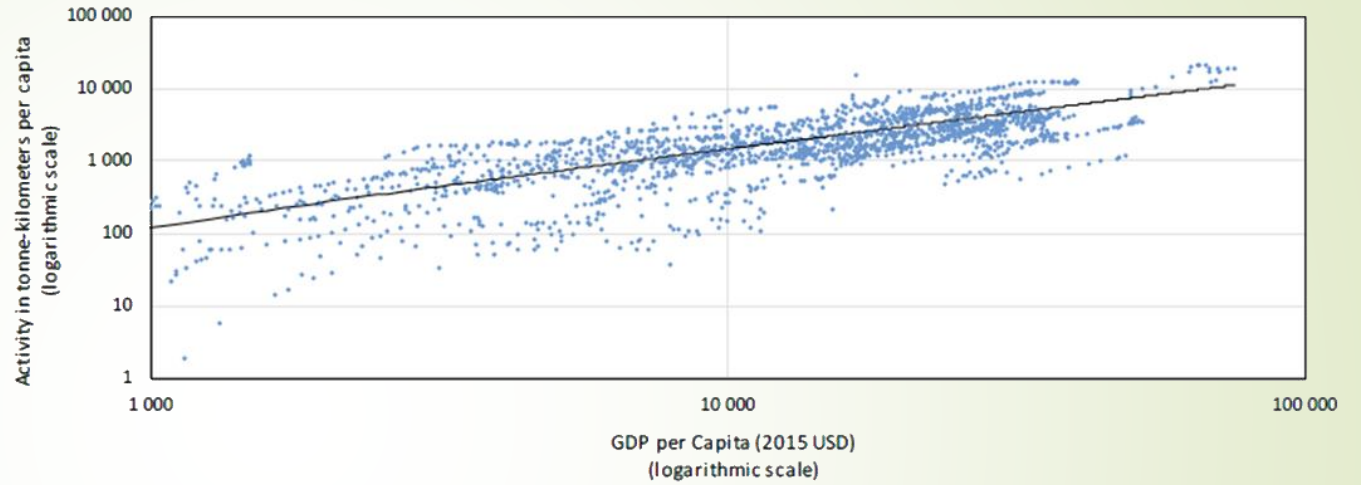
Passenger transport mainly by private car with increasing shift away from public modes



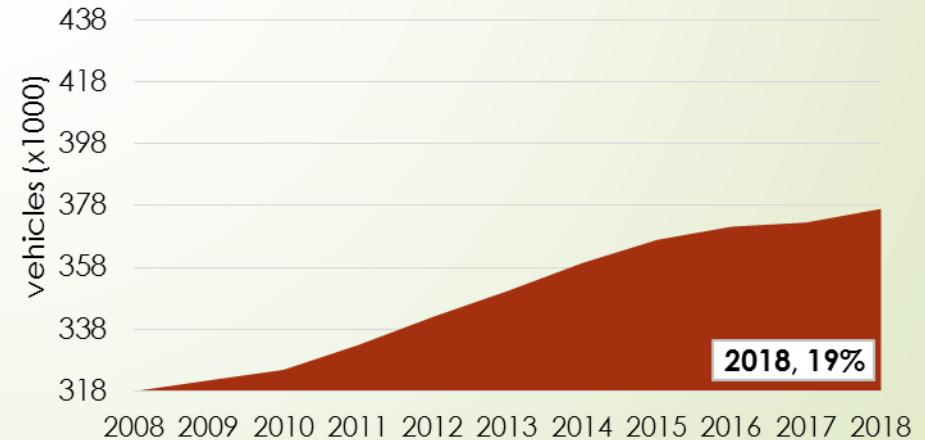
South African Freight

Majority of freight transport via road

Road freight activity (tkm per capita) plotted against GDP per capita



Trucks

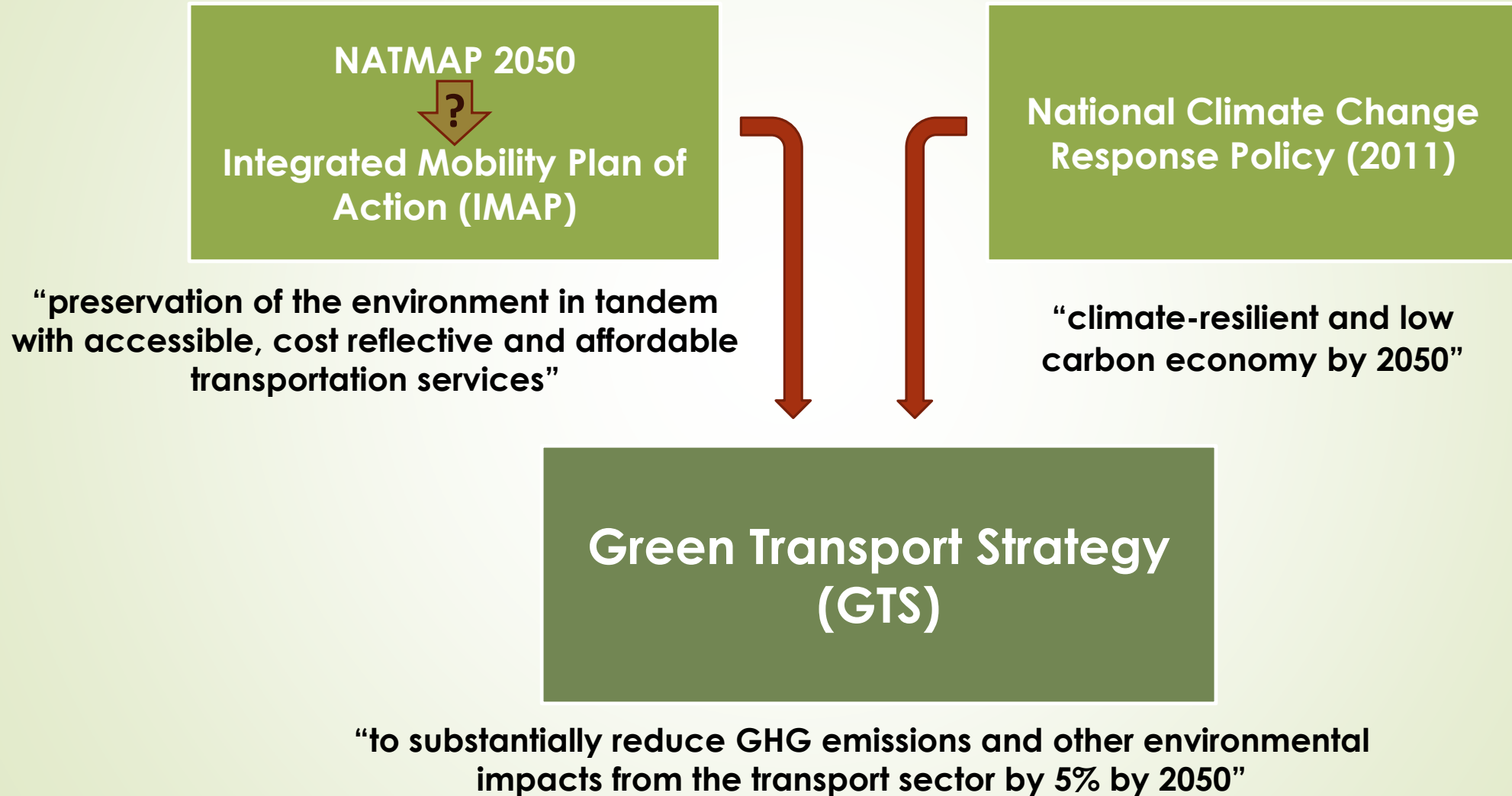


Domestic Transport Futures: 2050?

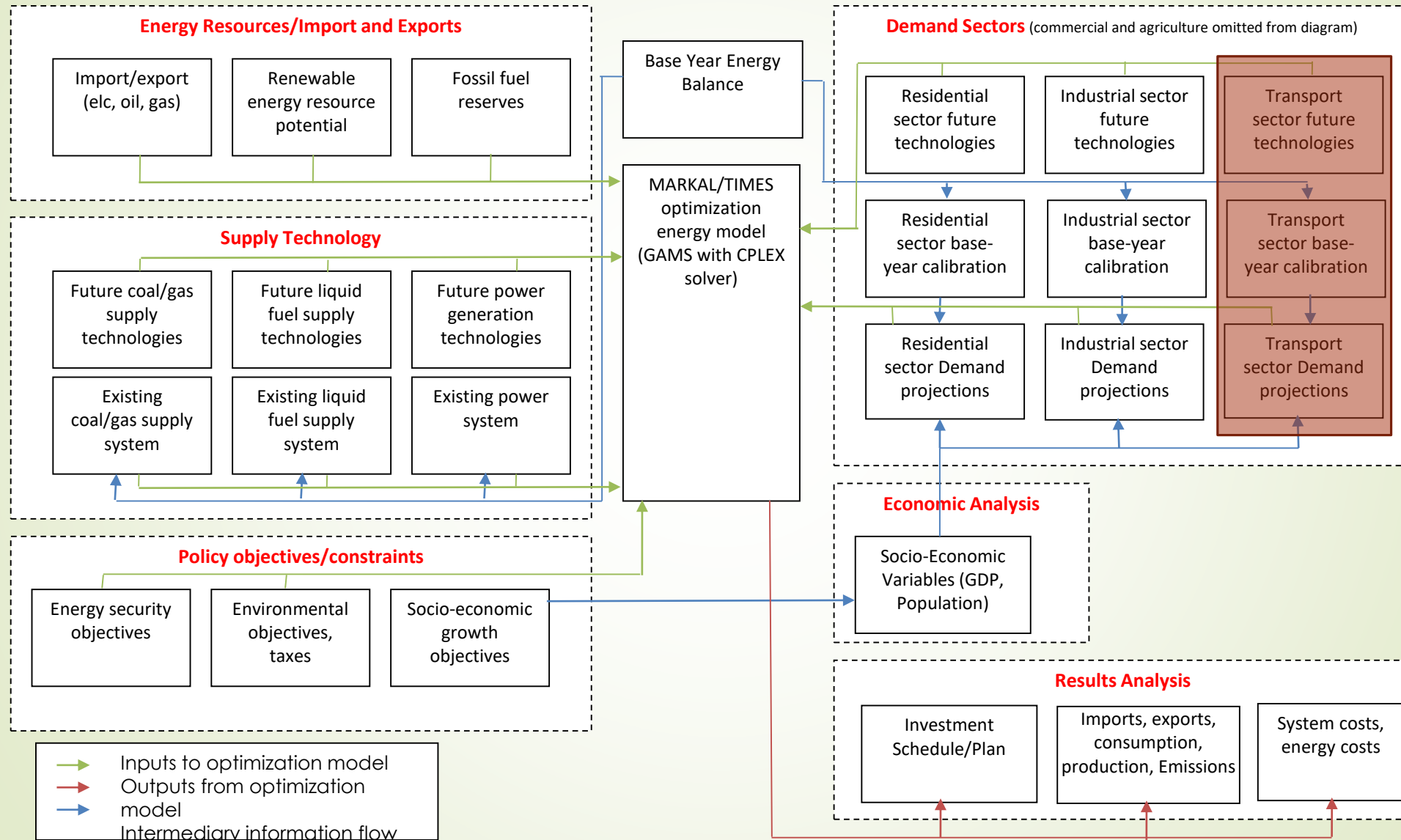
- ❖ Electricity/hydrogen fuel cells are the primary fuels displacing petroleum product
- ❖ 13 million passenger vehicles:
 - 80%-90% of vkms via BEV
 - No Hydrogen FC passenger cars
- ❖ 6 million freight vehicles:
 - 75% of v-kms via BEV
 - Primarily Light Commercial Vehicles & Light Trucks
 - 90% of corridor v-kms Hydrogen FC

- ❖ GHG emissions reduction in road transport ~70%; emissions reduction in national total ~18%
- ❖ 60 TWh: 30 GW of additional generation capacity: Wind, Solar PV and Batteries (... smart charging)
- ❖ Crude oil refinery capacity would commence retirement by 2030 with practically no domestic production by 2050
- ❖ CTL retired by 2040

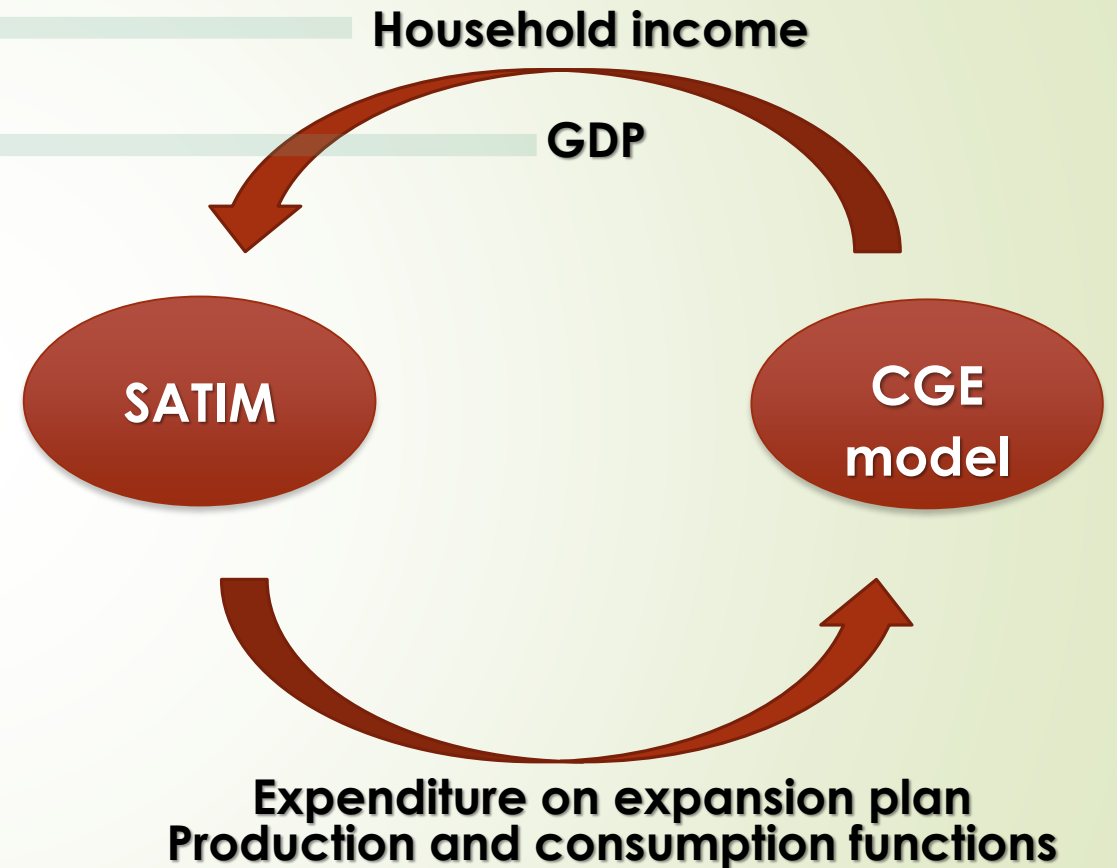
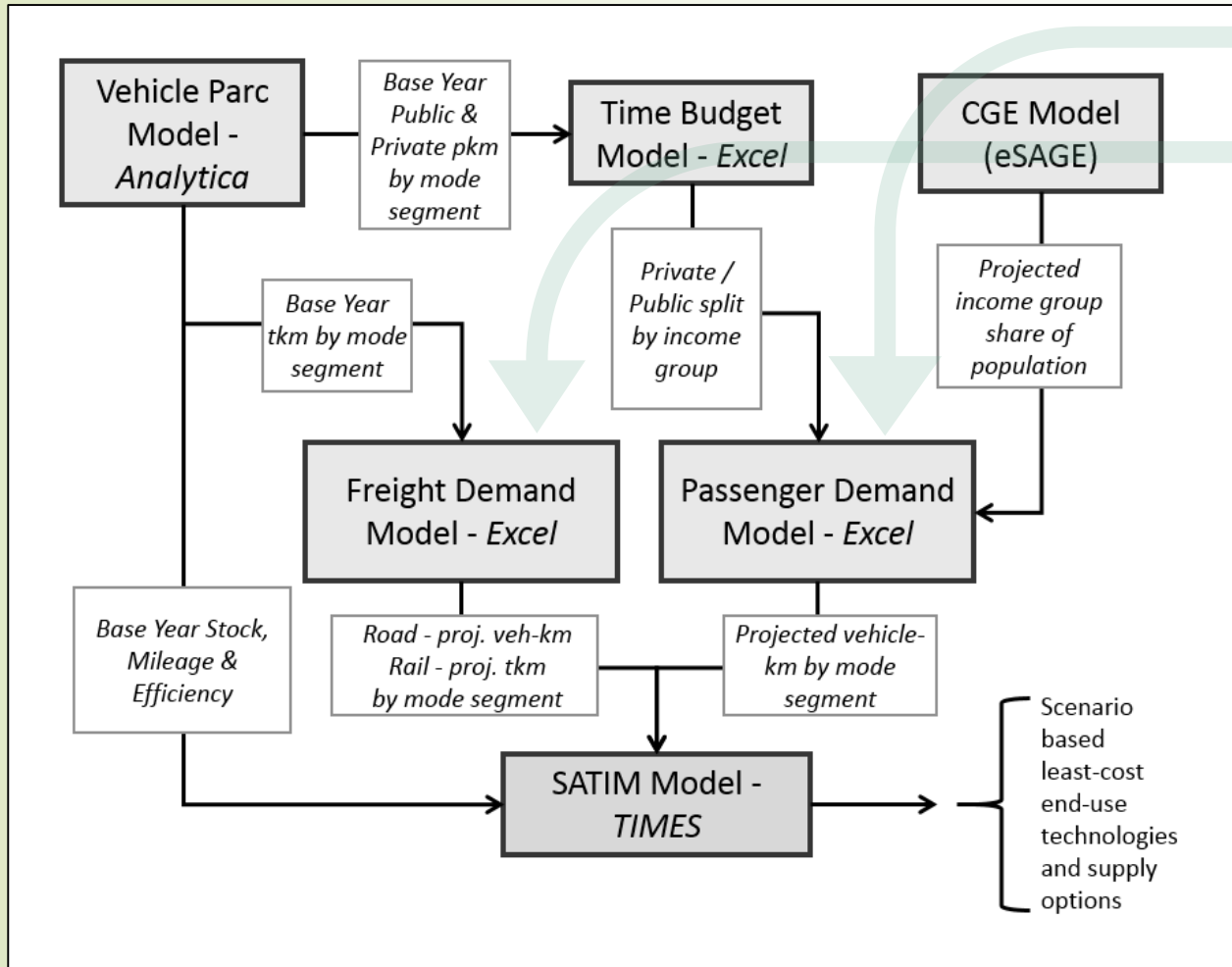
Framing the Modelling



Overview of SATIM

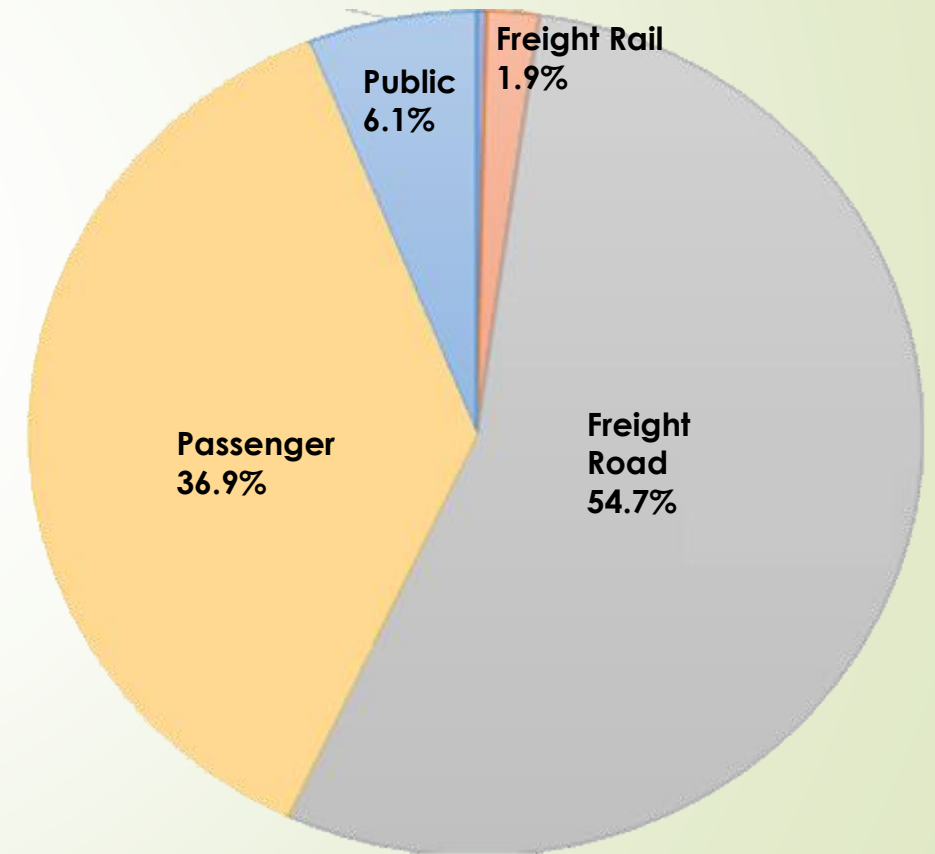
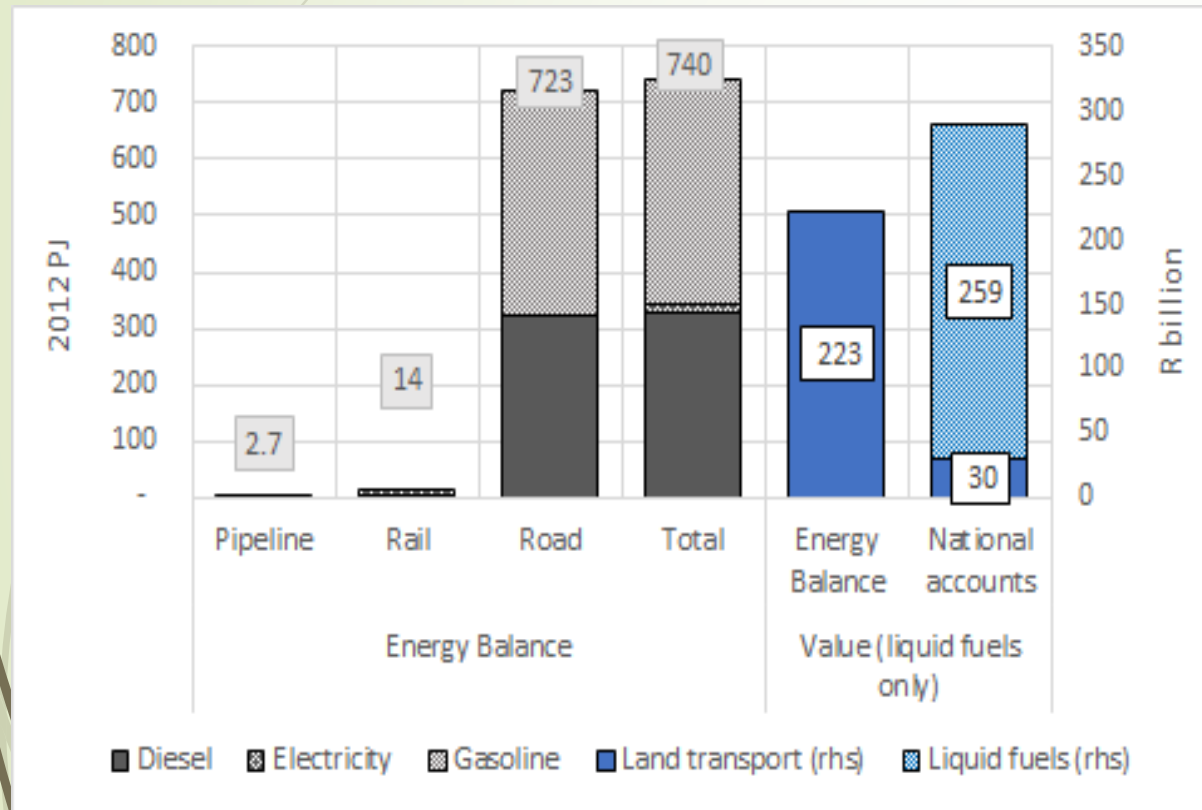


Transport Demand Model



Fuel Consumption Calibration

Fuel consumption by land transport type (PJ)

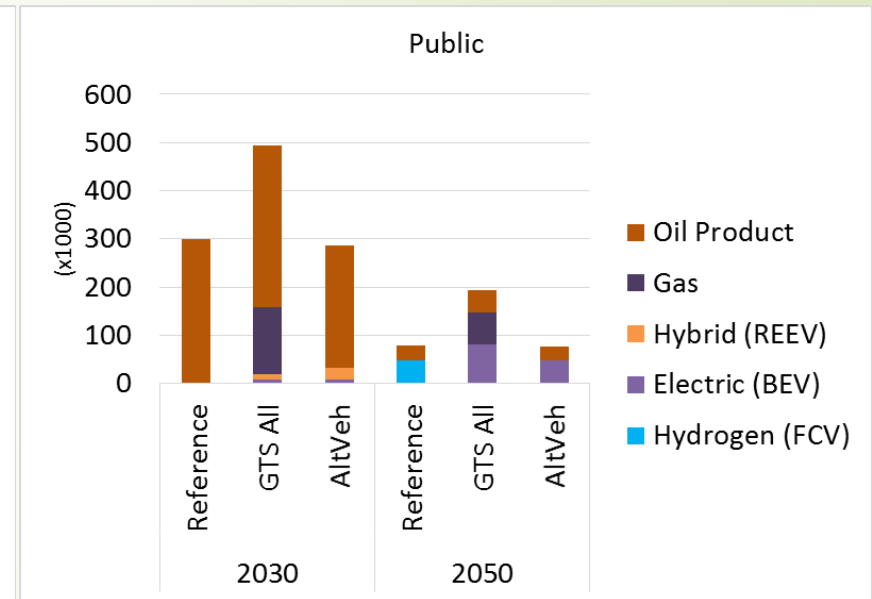
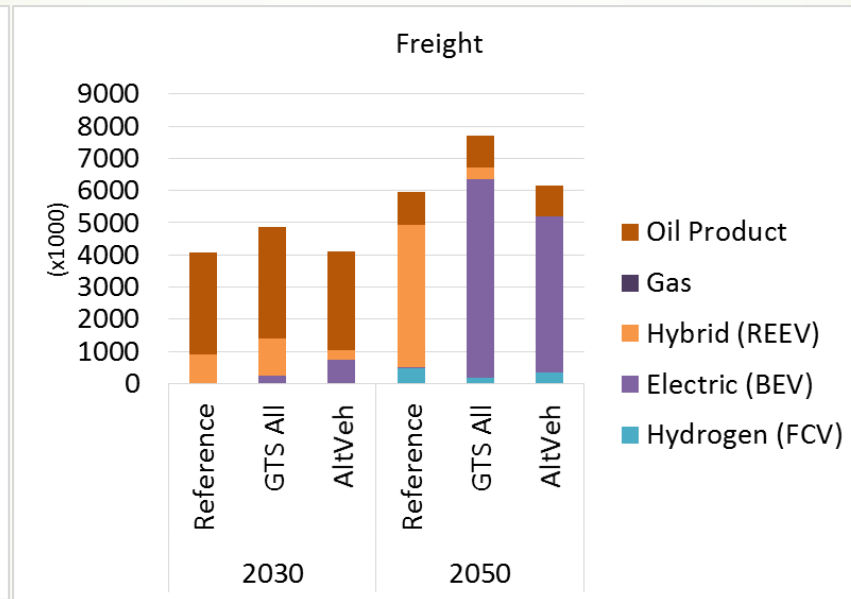
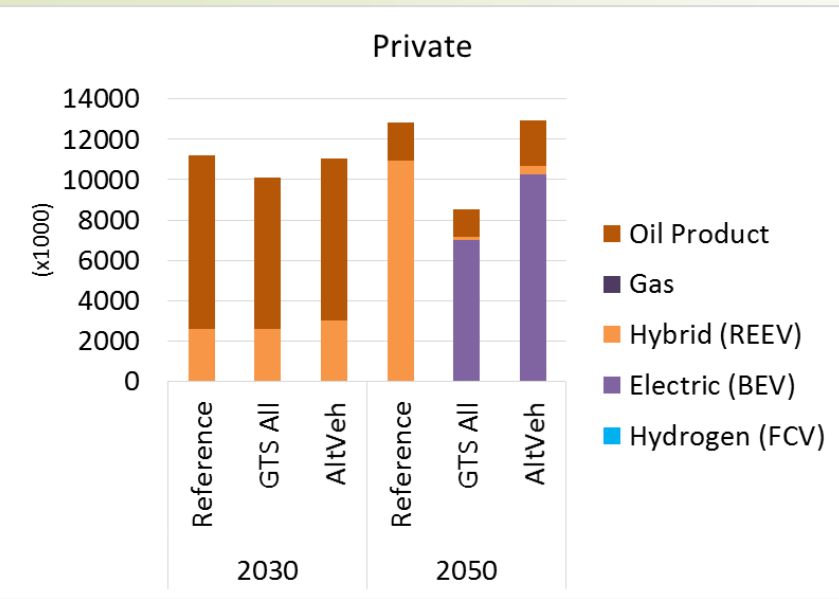


Modelling Transport Scenarios

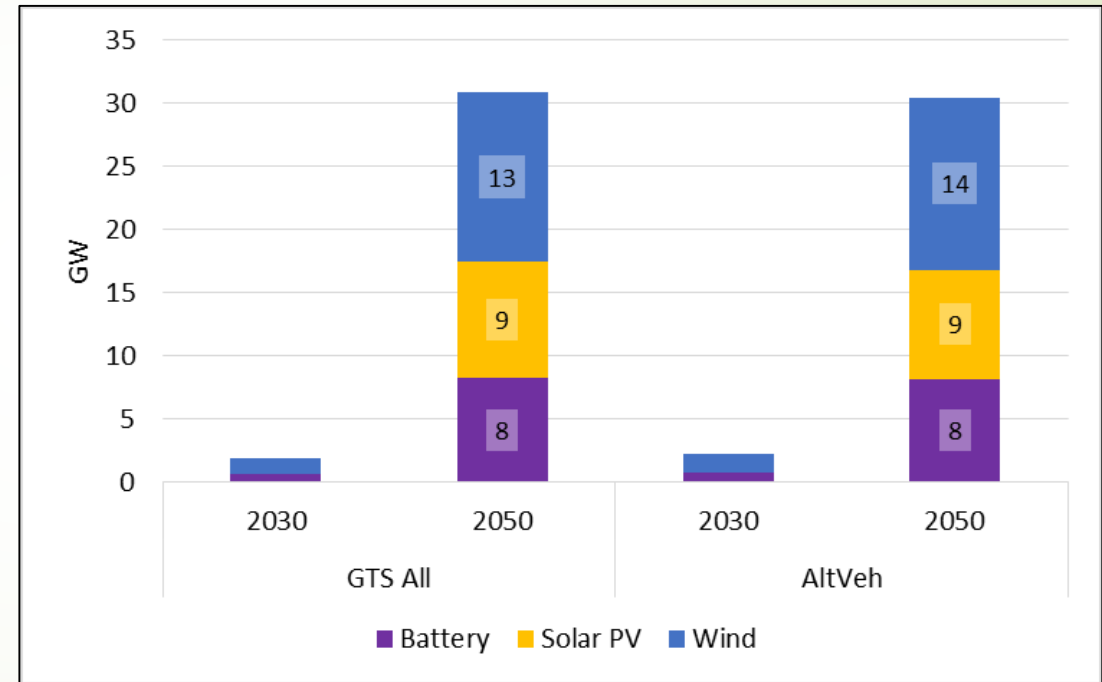
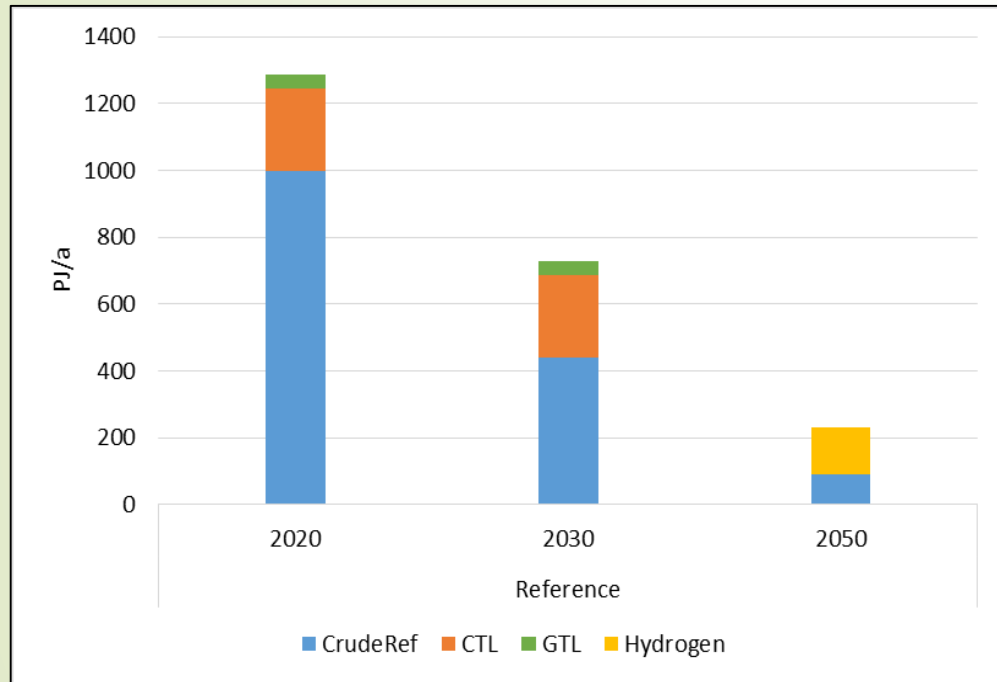
GTS 2018	Scenario Name	Key Feature
	Reference	Baseline scenario with EV premium at 25% relative to conventional present-day technology. Rail share of land corridor freight constant (2016 share)
1	FreiRail	30% road corridor migration to rail by 2030 reaching 50% by 2045
2	PassMode	20% relative shift to public transport by 2030 reaching 50% by 2050
3	AltVeh	Cost parity for all alternate vehicle technologies by 2030 (e.g. electric or fuel-cell)
4a	MinBusDual	Minibus taxi fleet converted to bi-fueled gas-petrol by 2030
4b	MetBusGas	Urban bus fleet converted to gas only fleet by 2030

Clean Fuels Phase 2 with the option to refurbish the crude-oil refineries, invest in new capacity or retire domestic production

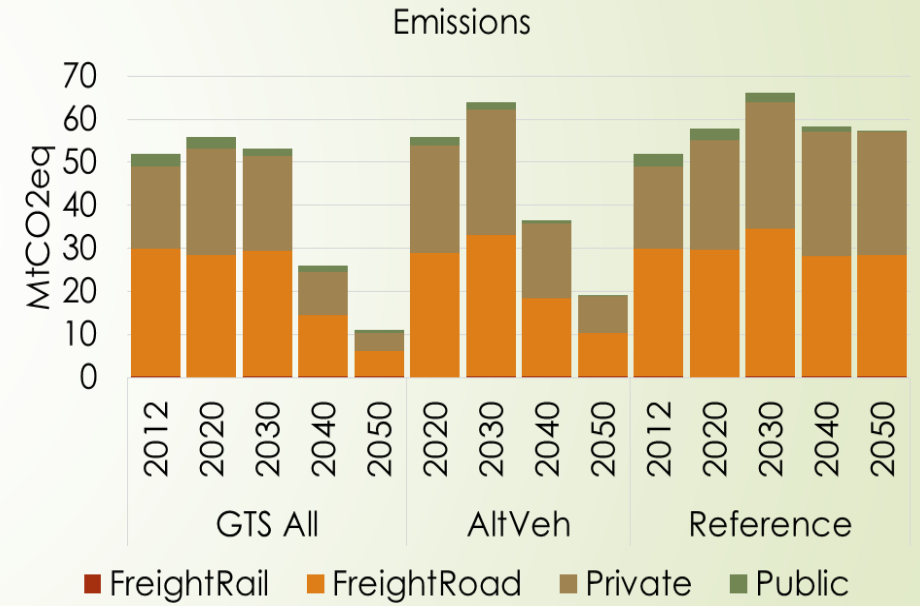
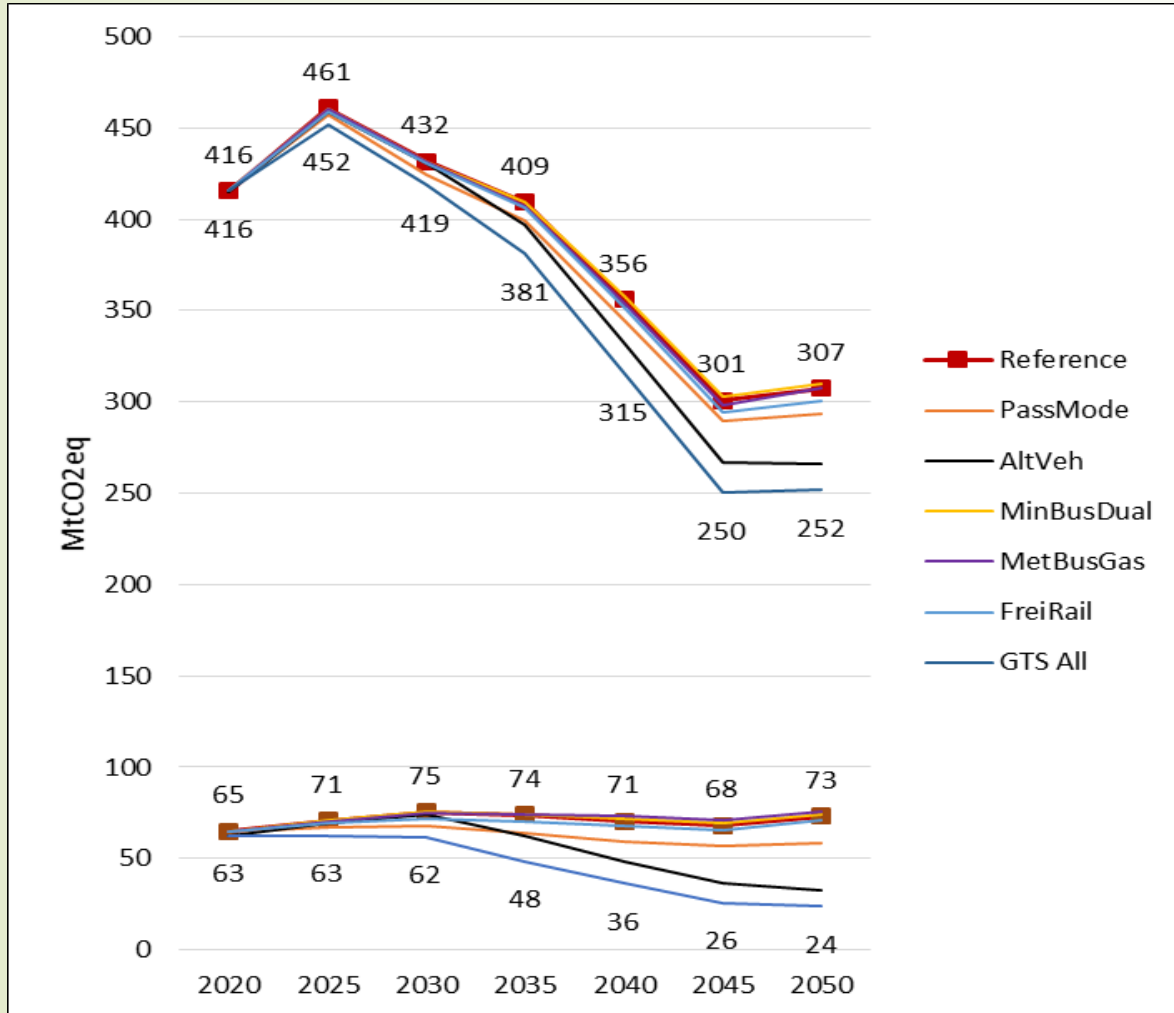
Transport Futures: Private and Freight Vehicles



Transport Futures: Fuel Supply



Transport Futures: Emissions



Automotive Industry: Domestic/Export

Year	Trade surplus/(deficit) (R billion)
2012*	(42,3)
2013	(63,8)
2014	(62,2)
2015	(45,2)
2016	(32,9)
2017	(43,5)
2018	(40,3)
Vehicles	67,6
Automotive components (including aftermarket parts)	(107,9)

	PASSENGER CARS				LIGHT COMMERCIAL VEHICLES			
	Market			Exports as a % of total	Market			Exports as a % of total
	Domestic	Exports	Total		Domestic	Export	Total	
2012	120 417	151 659	272 076	55,7	121 638	123 443	245 081	50,4
2013	113 356	151 893	265 249	57,3	127 051	121 345	248 396	48,9
2014	122 610	154 920	277 530	55,8	137 044	118 585	255 629	46,4
2015	112 576	228 459	341 035	67,0	140 790	102 664	243 454	42,2
2016	97 824	237 715	335 539	70,8	130 364	104 987	235 351	44,6

	MEDIUM AND HEAVY COMMERCIAL VEHICLES AND BUSES			
	Market			Exports as a % of total
	Domestic	Exports	Total	
2012	27 841	1 076	28 917	3,7
2013	30 924	1 206	32 130	3,8
2014	31 558	1 414	32 972	4,3
2015	30 469	1 124	31 593	3,6
2016	27 010	1 104	28 114	3,9
MCV	8 432	198		
HCV	5 452	127		
XHCV	11 850	725		
BUSES	1 276	54		

Transport Model Caveats

- ❖ Infrastructure costs (e.g. roads, railways)?
- ❖ Chemicals sector linkage to refineries?
- ❖ Air Quality (PM, SO_x, NO_x)?
- ❖ Fuel tax revenue (linkage in CGE model) ?
- ❖ Spatial nuance of transport demand?
- ❖ No timeslice characterisation for EVs
 - peak shaping and smart charging (driver behaviour and charging habits)
not gauged
- ❖ Residential solar-pv with storage and its effects on the supply sector ?
- ❖ Vehicle-to-grid services?

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Thank You



