TNO innovation for life

Consultancy and Engineering

Cost Effectiveness Study for CNG in Transportation

Assignment Description

Estimate the cost effectiveness for the replacement of Diesel vehicles with CNG vehicles in the Israeli vehicle fleet

Estimate the effect on direct emissions:

- NO_x (including NO_2)
- Particulate Matter (PM_{10} , $PM_{2.5}$)
- HC
- Greenhouse Gases (CO_2, CH_4)

Target Fleets

- Buses
- Taxis
- Light Commercial Vehicles (LCVs)

Methodology

Economic inputs:

- cost assumptions re vehicles and infrastructure

Environmental inputs:

- emission factors
- external cost factors

Scenario definition:

- fleet composition
- infrastructure

Cost calculation model:

- TCO

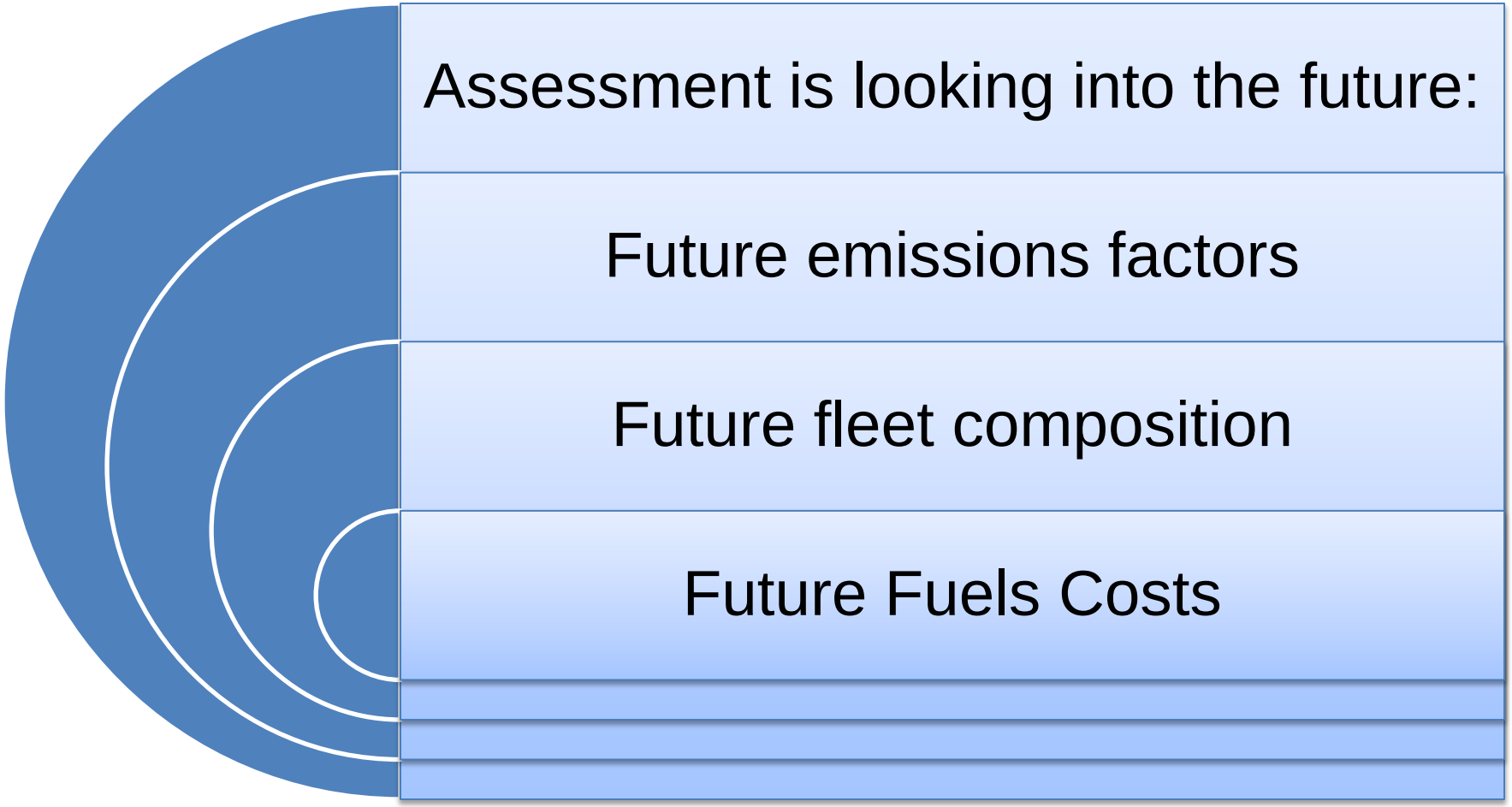
Environmental impacts:

- External costs
- Emissions

Cost-benefit analysis:

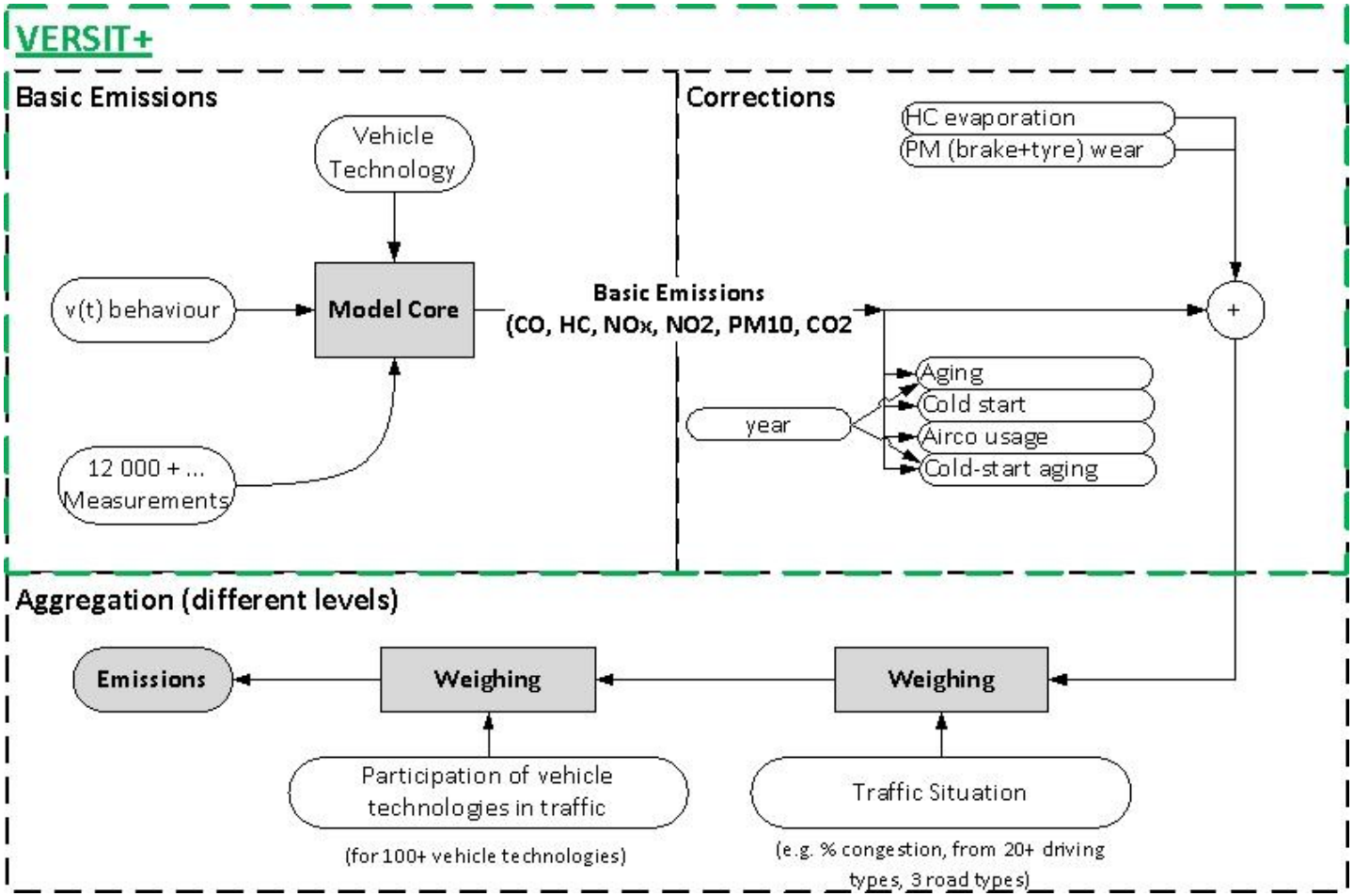
- comparing BAU and CNG scenarios in terms of vehicle TCO, infrastructure costs, and external costs

Methodology (Cont.)



Emissions Modeling

TNO VERSIT+ Model



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Scenario – Share of CNG

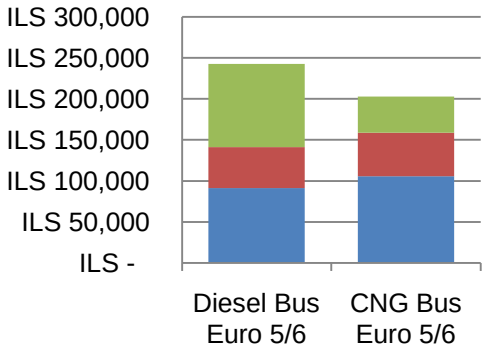
	2015		2020	
	% of Vehicle Category	# of CNG Vehicles	% of Vehicle Category	# of CNG Vehicles
Taxies	0.3%	57	5%	1,188
LCVs	0.04%	119	0.70%	2,314
Buss	1.20%	195	7.00%	1,231
Total	**0.01%***	**371**	**0.13%***	**4,733**

* Of total Israeli fleet

Economic Inputs

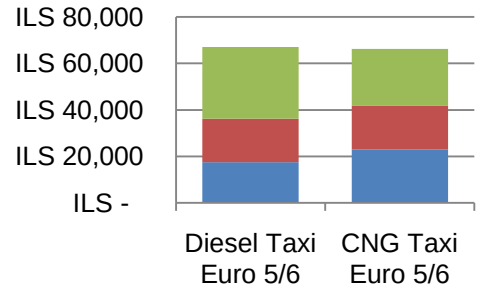
Vehicles	• Israeli and international inputs
Fuel	• Diesel prices according to current price in Israel and future development according to the EIA • CNG prices based on **assumptions**
Infrastructure	• Grids infrastructure not included • Fueling station – additional costs vs. Diesel stations
External Costs	• Israeli external costs for emissions from transportation • External costs factors for NO_x, $PM_{2.5}$ and CO_2 • Separate factors for urban and intercity emissions

Outcomes – TCO (Graphs of 2020)

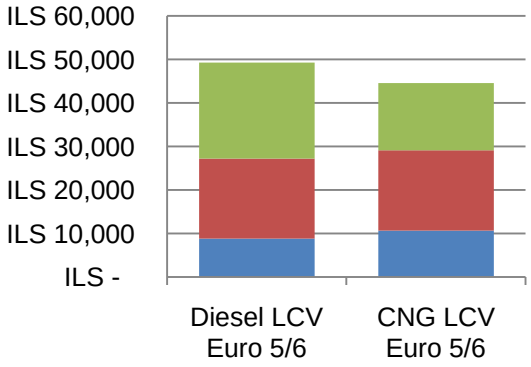


Buses – TCO of CNG buses is lower than Diesel buses

- fuels costs calculated without marketing costs



Taxis – TCO of CNG taxis is similar/higher than Diesel taxies



LCVs – TCO of CNG LCV's is similar/lower than Diesel LCV

Fuel Costs Maintenance Depreciation

Outcomes – Environmental Effects

Greenhouse gases (GHG)

- balance between reduced engine efficiency, increased H/C ratio of fuel and GWP of direct CH_4 emissions
- influenced by level of optimisation for fuel economy of diesel vs. CNG engines

Taxis and LCV – reduction in direct emissions of GHG in urban driving cycle.

Buses – no reduction in direct emission of GHG

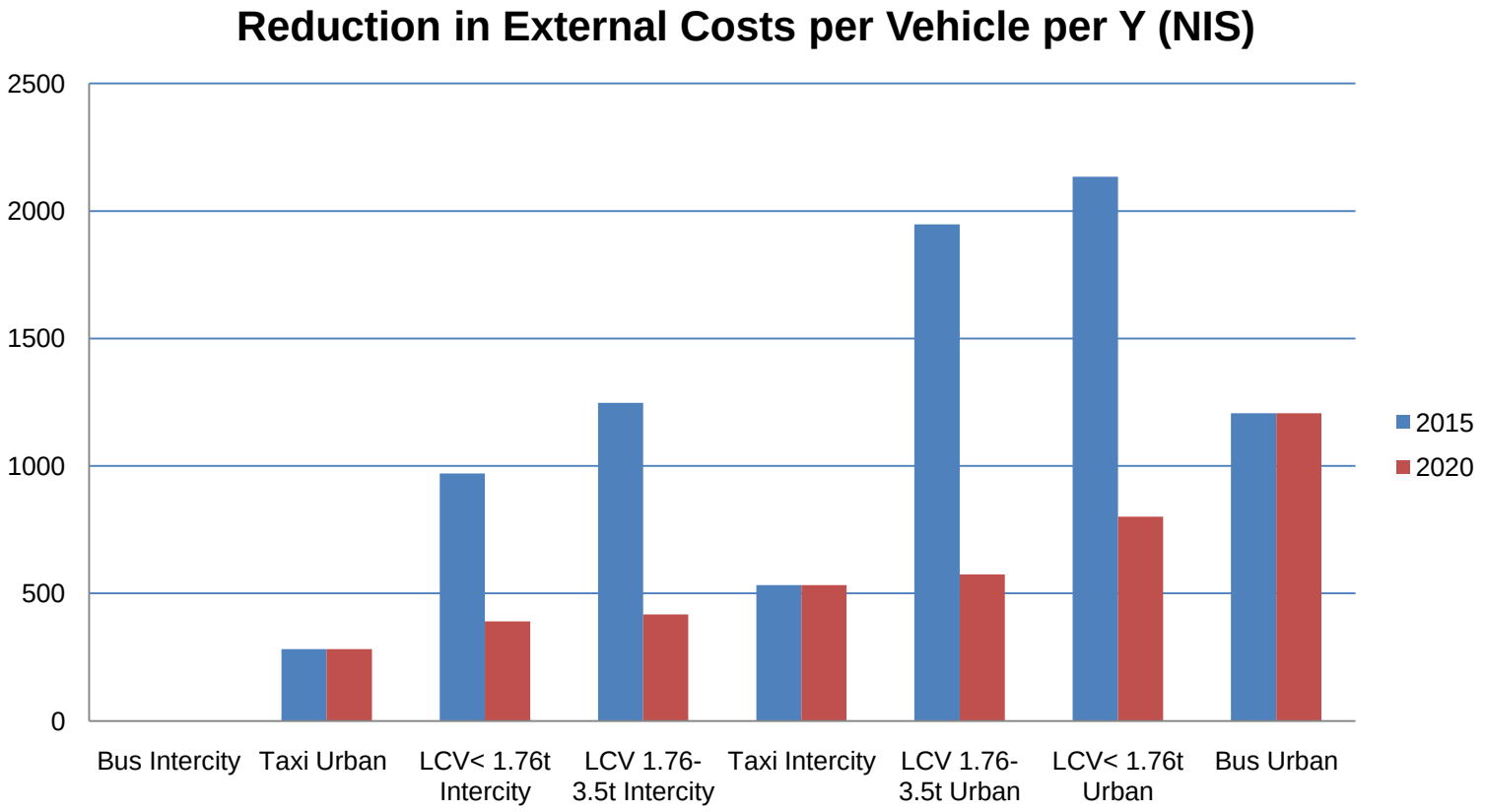
Reduction is expected in WTW cycle (initial assessment, further research is needed)

Outcomes – Environmental Effects

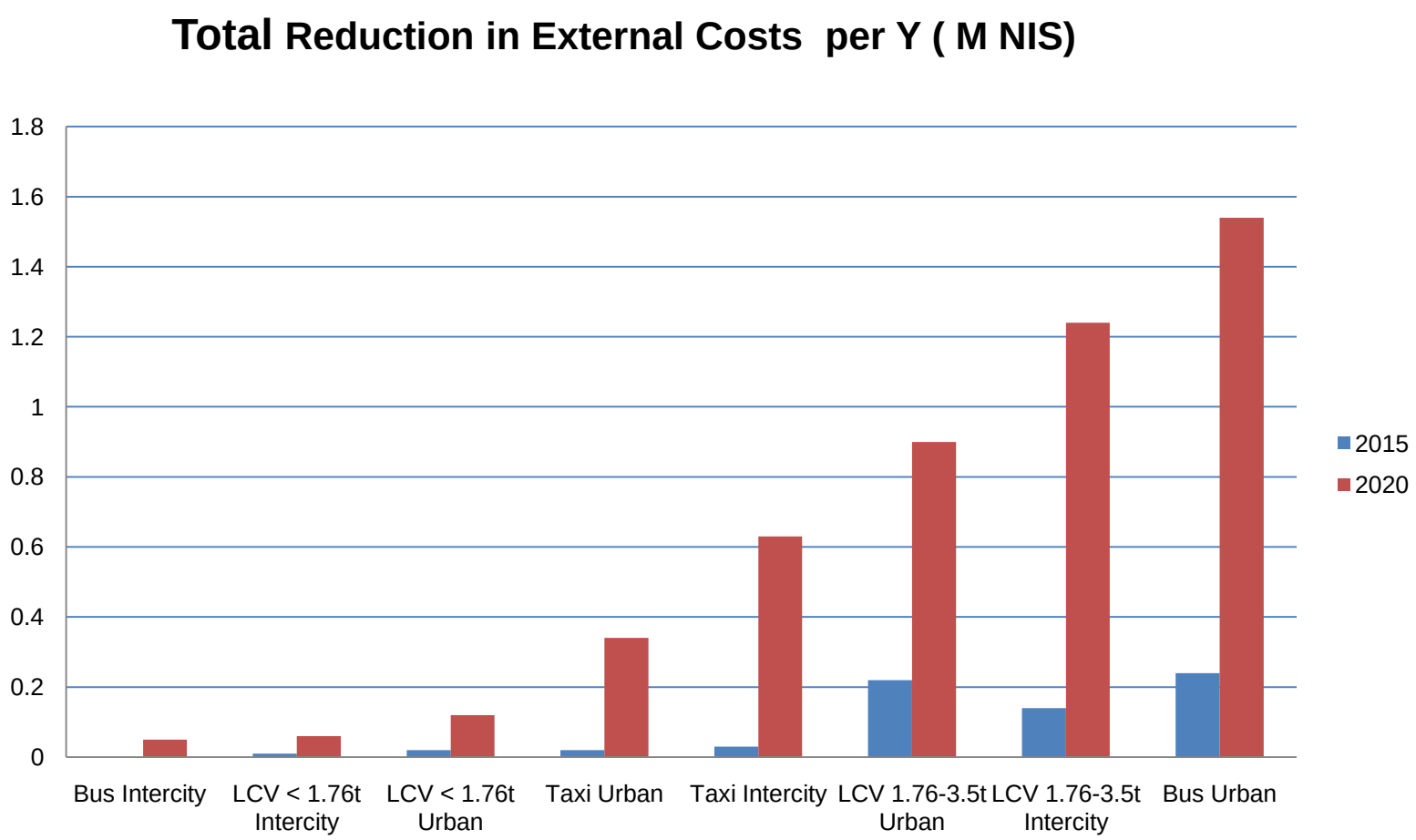
Air Pollutants

- Reduction in NO_x emissions, urban and intercity driving cycle, The reduction is less significant in Euro 6 standard.
- Major reduction in NO_2 emissions
- Limited reduction in PM emissions, urban and intercity driving cycles, mainly in $PM_{2.5}$.
- Increasing in HC emissions, mainly due to CH_4 emissions

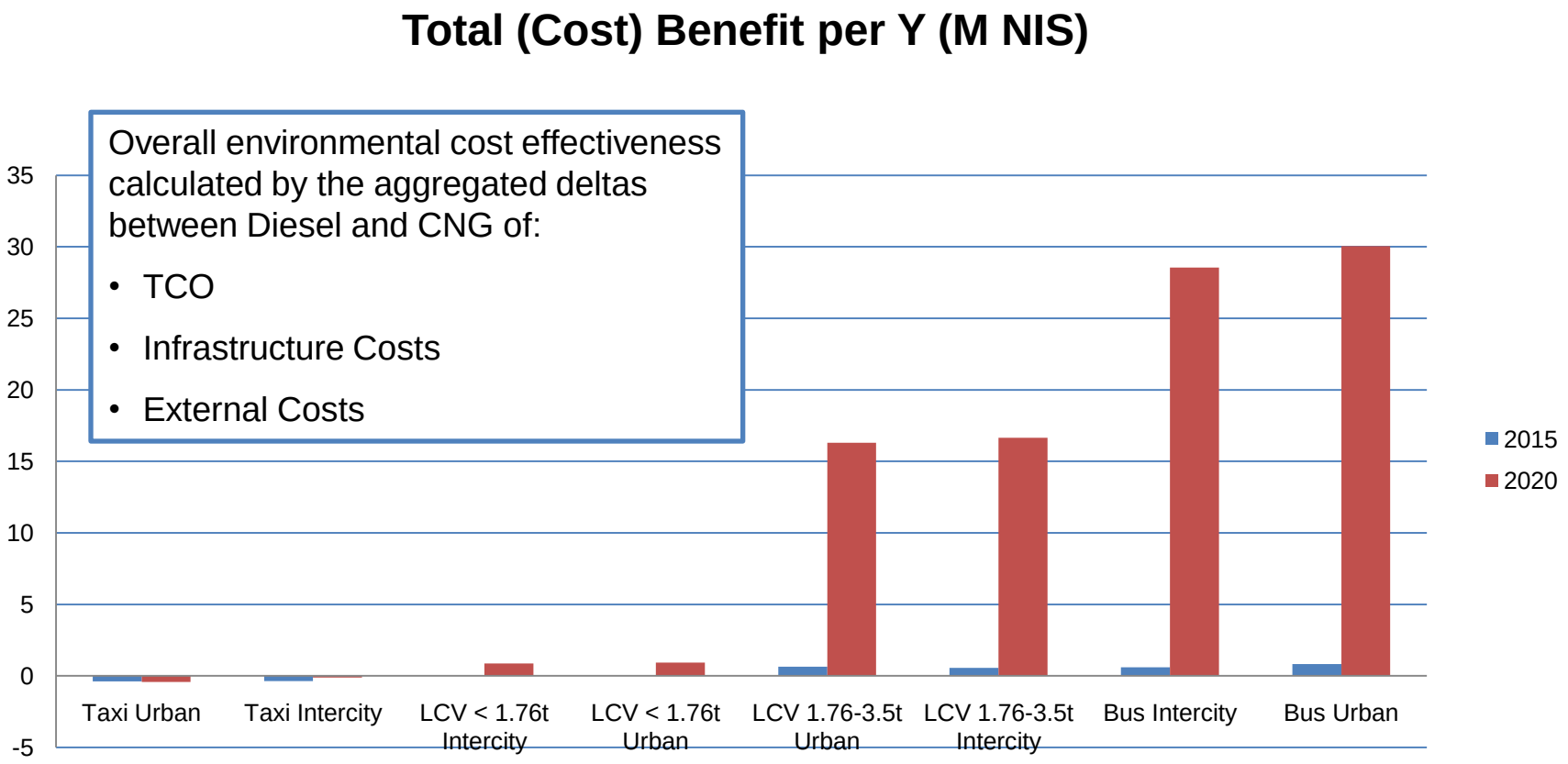
Conclusions – Environmental Effects



Conclusions – Environmental Effects



Conclusions – Cost Effectiveness



Recommendations

- Act Fast to harvest net environmental benefits
- Focus in Urban Buses and LCV 1.76-3.5t
- Focus in governmental , municipal or large commercial fleets (in first stage)
- Coordinate between relevant stake holders
- Stimulate CNG vehicles in monetary and other incentives