Fuel Economy policies and how to quantify their impacts?

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GFEI workshop

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What is fuel economy?

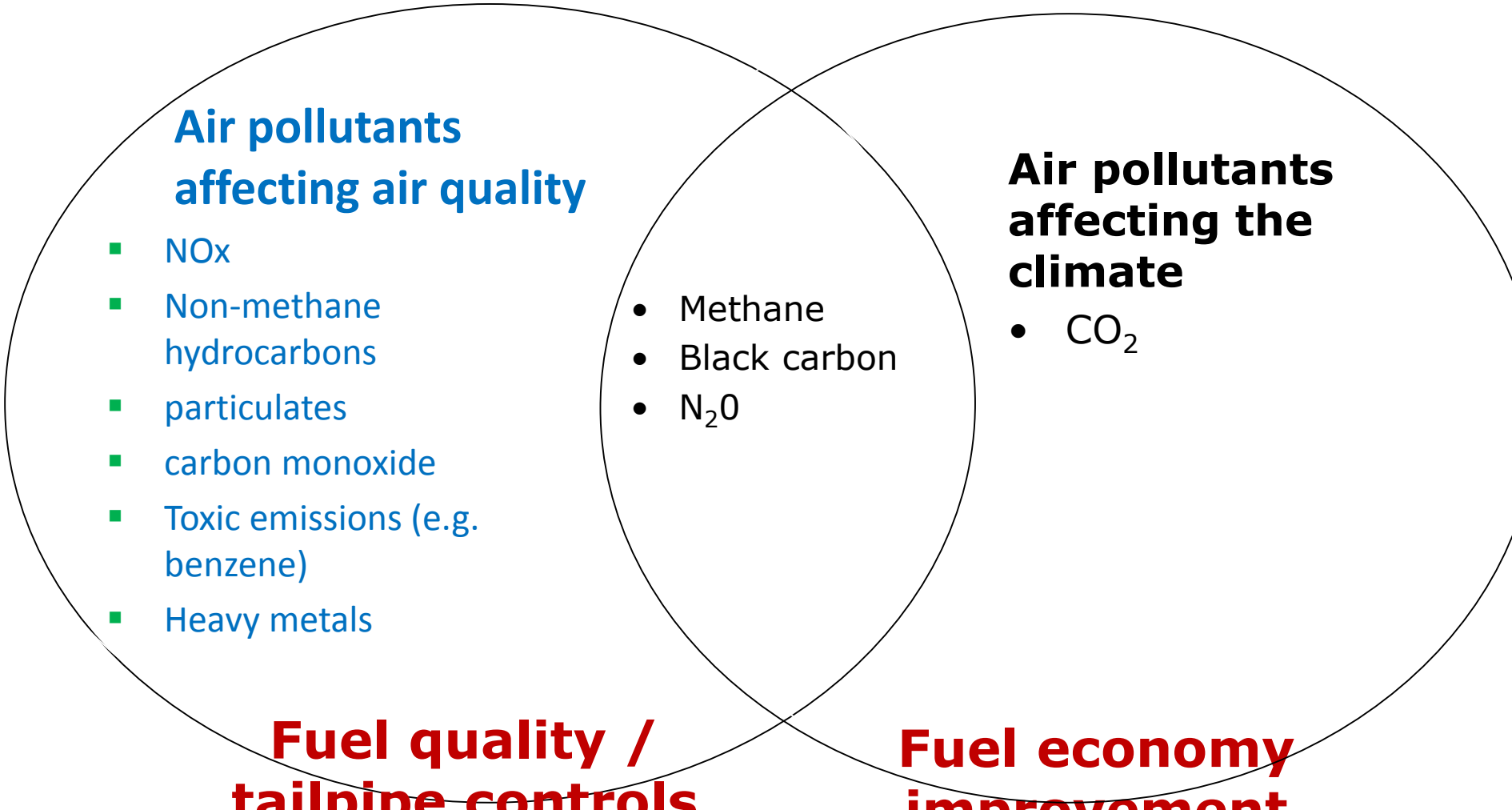
- Vehicles use energy, and fuel economy measures energy per unit of vehicle travel. It is the RATE of energy use.
  - Litres per 100km (Europe)
  - Km per litre (Japan)
  - Miles per gallon (United States)

- Fuel economy, fuel efficiency, fuel intensity are all fairly interchangeable terms. But fuel economy always refers to fuel use relative to distance travelled.

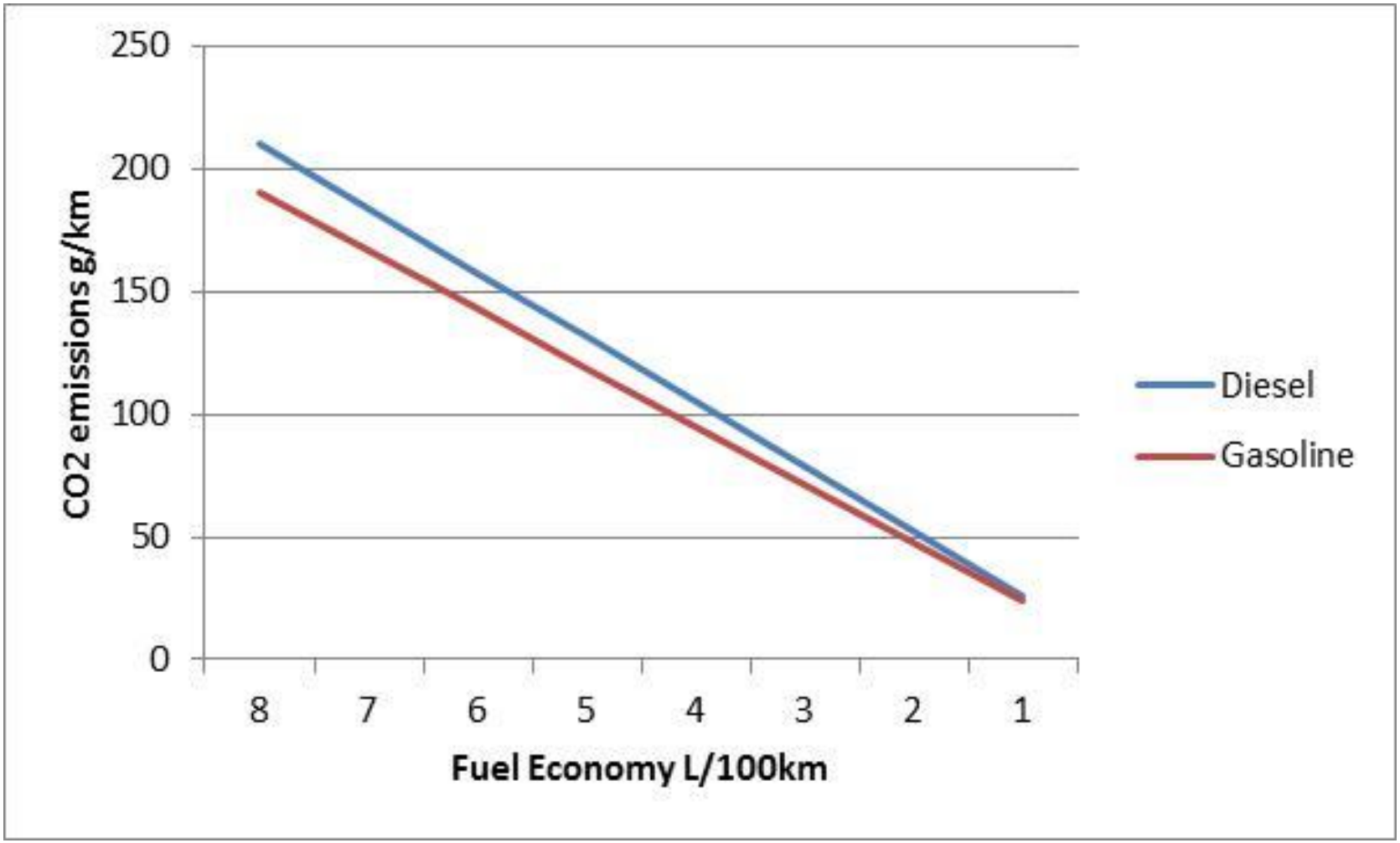
What is fuel economy? (2)

- Important relationship: there is about 2.4 kg of CO_2 emitted per litre of gasoline burned, 2.6 for diesel.
  - The only way to cut CO_2 emissions is to burn less fuel (you can't capture it at the tailpipe).
  - For gasoline vehicles, 8 L/100 km = 189 g/km CO2 emissions, 7 L/100 km = 165 L/100km, etc. It's a fixed relationship.
- If you reduce improve vehicle fuel economy, you:
  - Save fuel
  - Reduce costs
  - Cut CO_2 emissions
  - **Don't** help air quality very much (though complex and important topic)

Types of Air Pollutants



Gasoline and Diesel fuel CO_2 emissions v. fuel economy

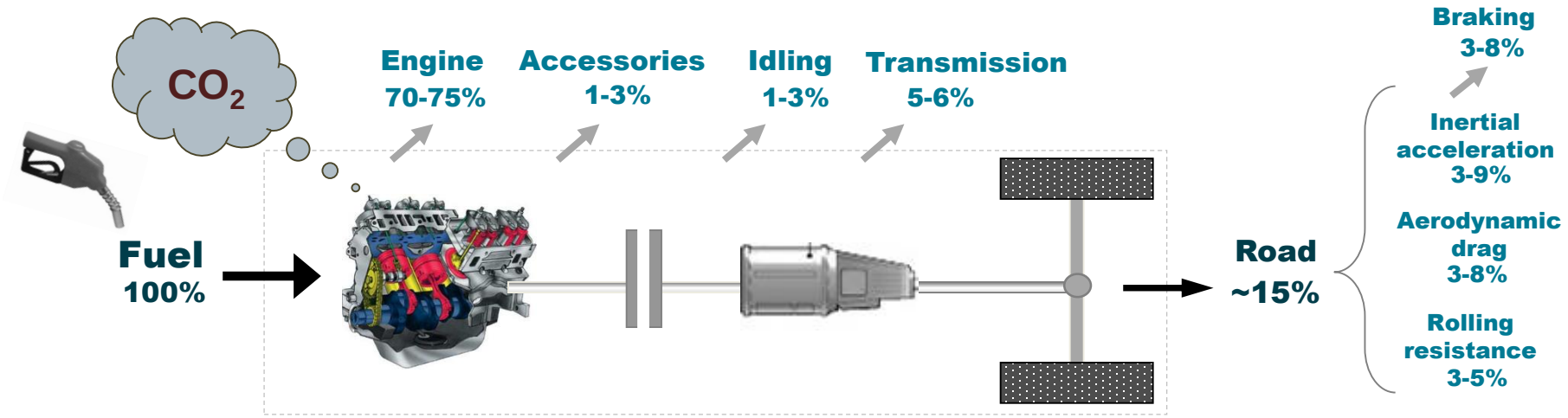


What is fuel economy? (3)

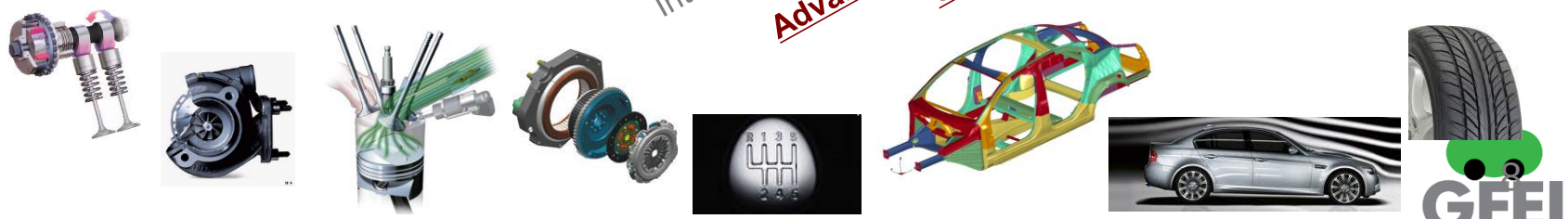
- Fuel economy improvement can be achieved through
  - Technical changes to vehicles
  - Changing the types of vehicles bought
  - Improving vehicle maintenance
  - Changing the way vehicles are driven (ecodriving)
  - Reducing traffic congestion
- Fuel economy improvement to vehicles should be part of a broader strategy:
  - Traffic management
  - City and regional planning
  - Promotion of public transit
  - Etc.

How to improve vehicle fuel economy?

- The average 2010 car, at 15-20% efficiency, has many efficiency losses – and many efficiency opportunities



Variable valve timing
Low friction lubrication
Cylinder deactivation
Cooled exhaust gas recirculation
Direct injection
Turbocharging
Lean-burn
Compression ignition
Electric power steering
Efficient air conditioning
Efficient alternator
6-8 speed transmission
Integrated starter "Stop-start"
Dual-clutch transmission
Advanced lightweight materials
Optimized vehicle design
Low drag brakes
Improved aerodynamics
Low rolling resistance tires



Sources: Lutsey, 2012; Kromer and Heywood, 2007; U.S. EPA (http://www.fueleconomy.gov/feg/atv.shtml)

Fuel economy policies – 4 keys

- Fuel economy labeling
  - Widely based on tested fuel economy
  - Need to make available to consumers before purchase (internet, car window stickers)
- Fuel pricing
  - Taxation system should at least internalize externalities
  - CO2 tax will help differentiate fuels as well as encourage fuel economy

Fuel economy policies – 4 keys

- Fuel Economy Standards
  - Typically corporate average standards
  - Typically either vehicle mass or size based
  - Could be applied to 2nd hand vehicles
- Vehicle purchase taxes
  - Sales tax, registration tax, import duties
  - Can be differentiated by fuel economy or CO2 emissions
  - Germany also differentiates by pollutant emissions levels

Fuel Economy Labels – “No Brainer”

- Informative, transparent, independent
- Need for representativeness
- Different metrics:
  - Absolute : Tested fuel economy
  - Relative: by segment/ vehicle mass
- Classification
  - No Classification/comparison
  - scaled results
    - Versus all other vehicles
    - Versus best in class

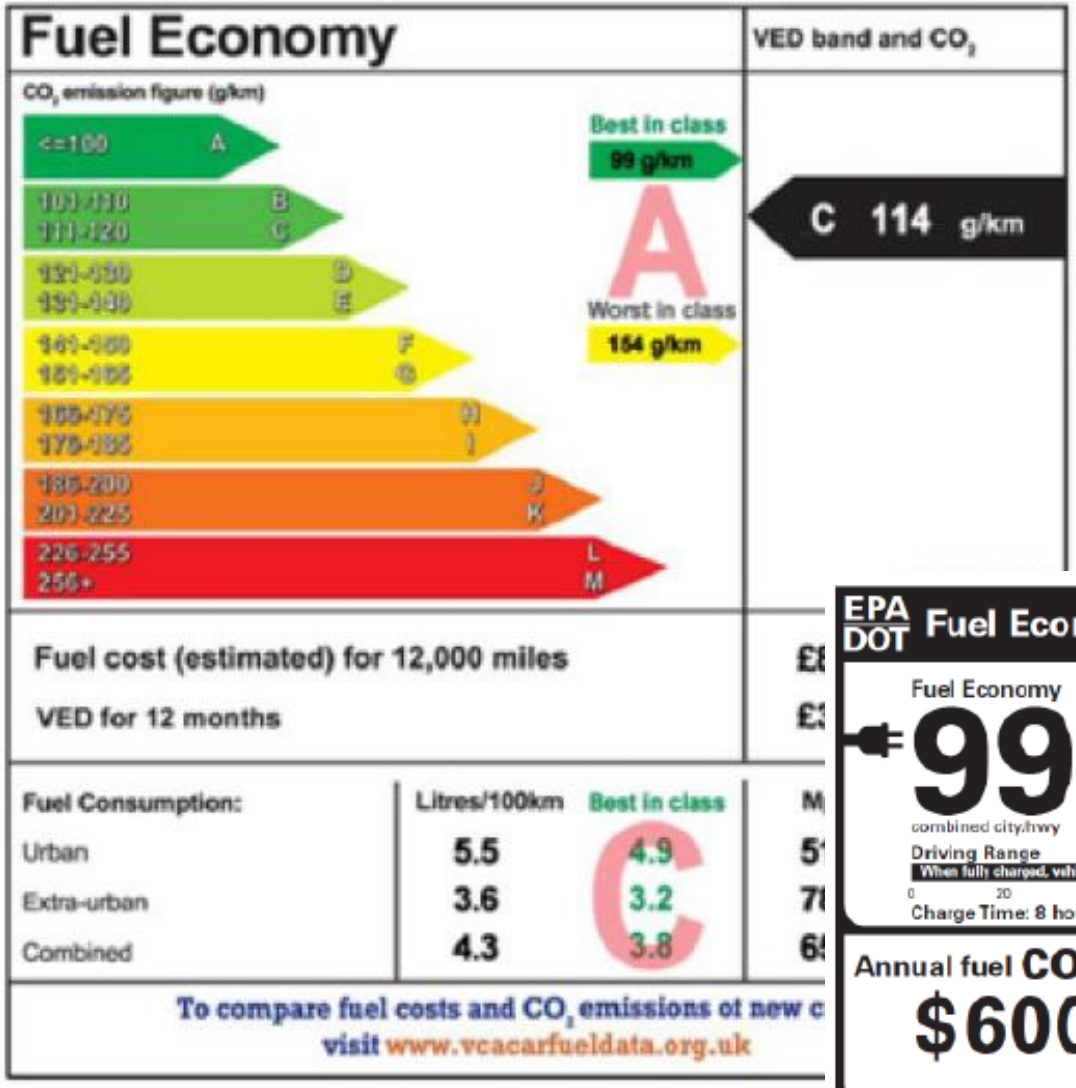
No scale

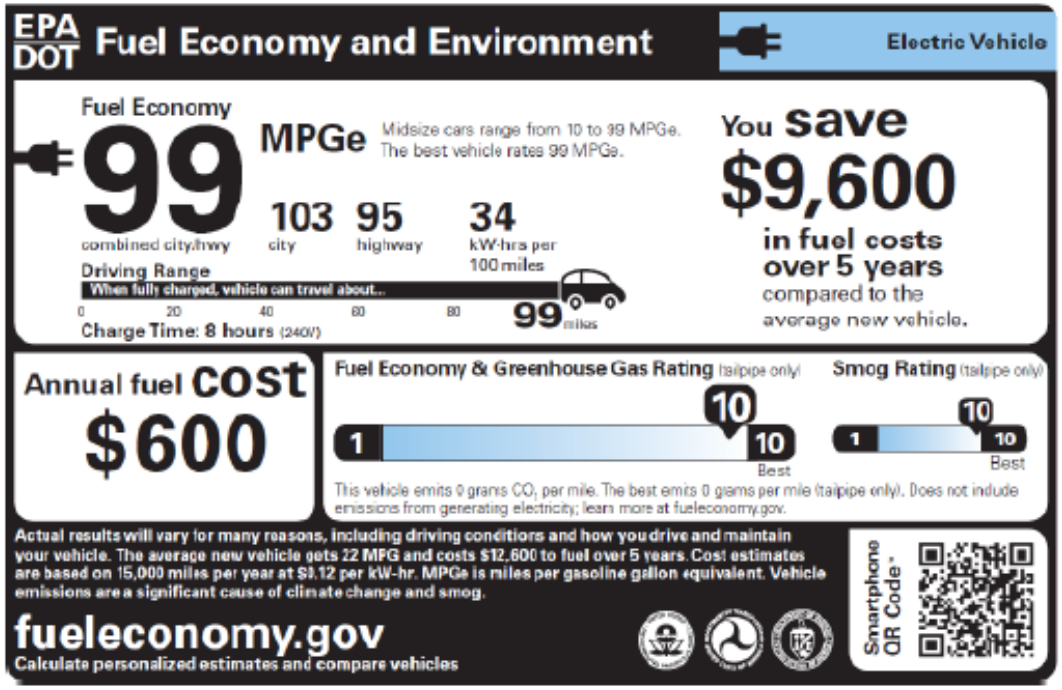
- Hard to know if good or not

Color scale

- Lettered, numbered or starred

Label of the future ?



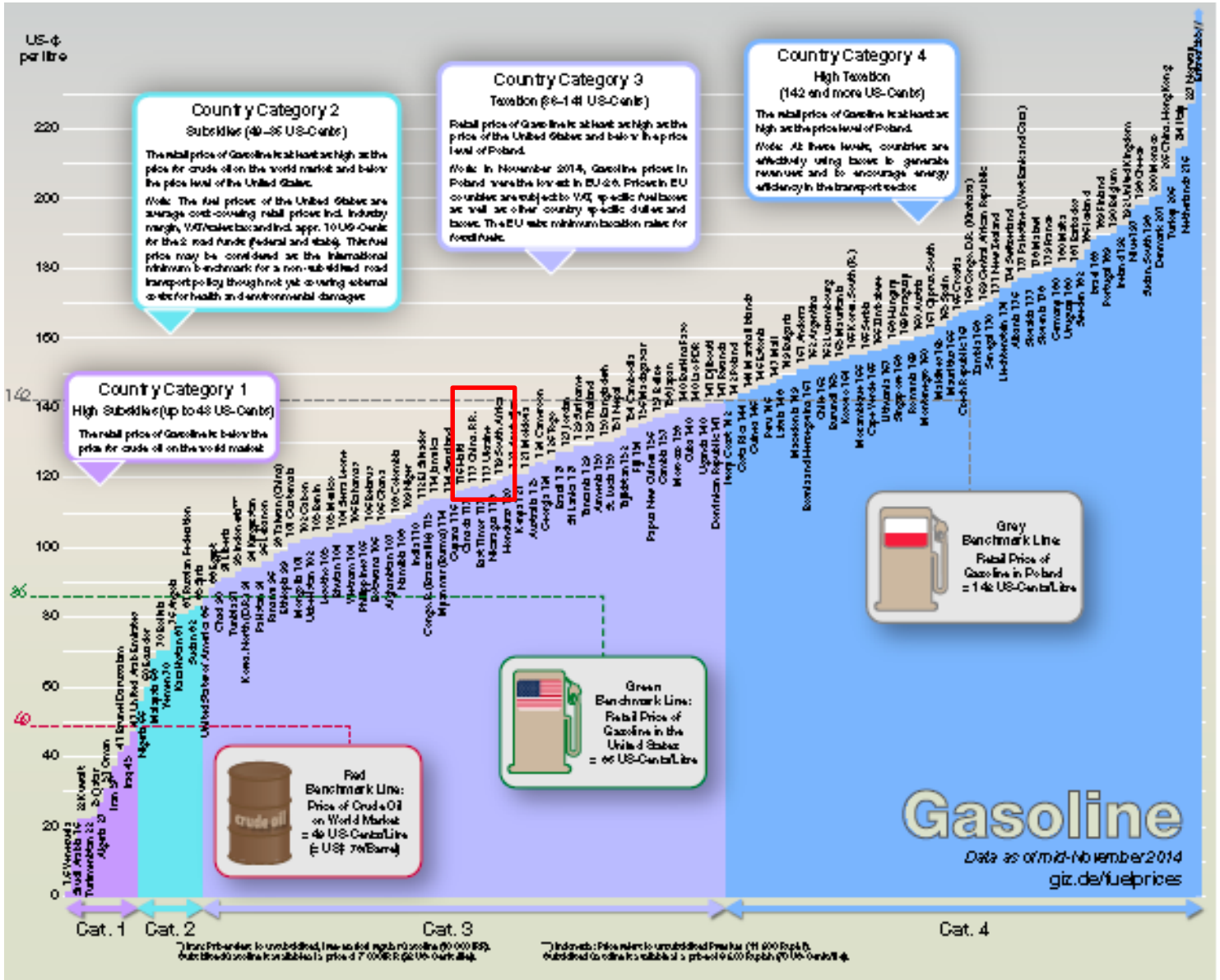


Fuel Pricing

Fuel tax as a key enabler

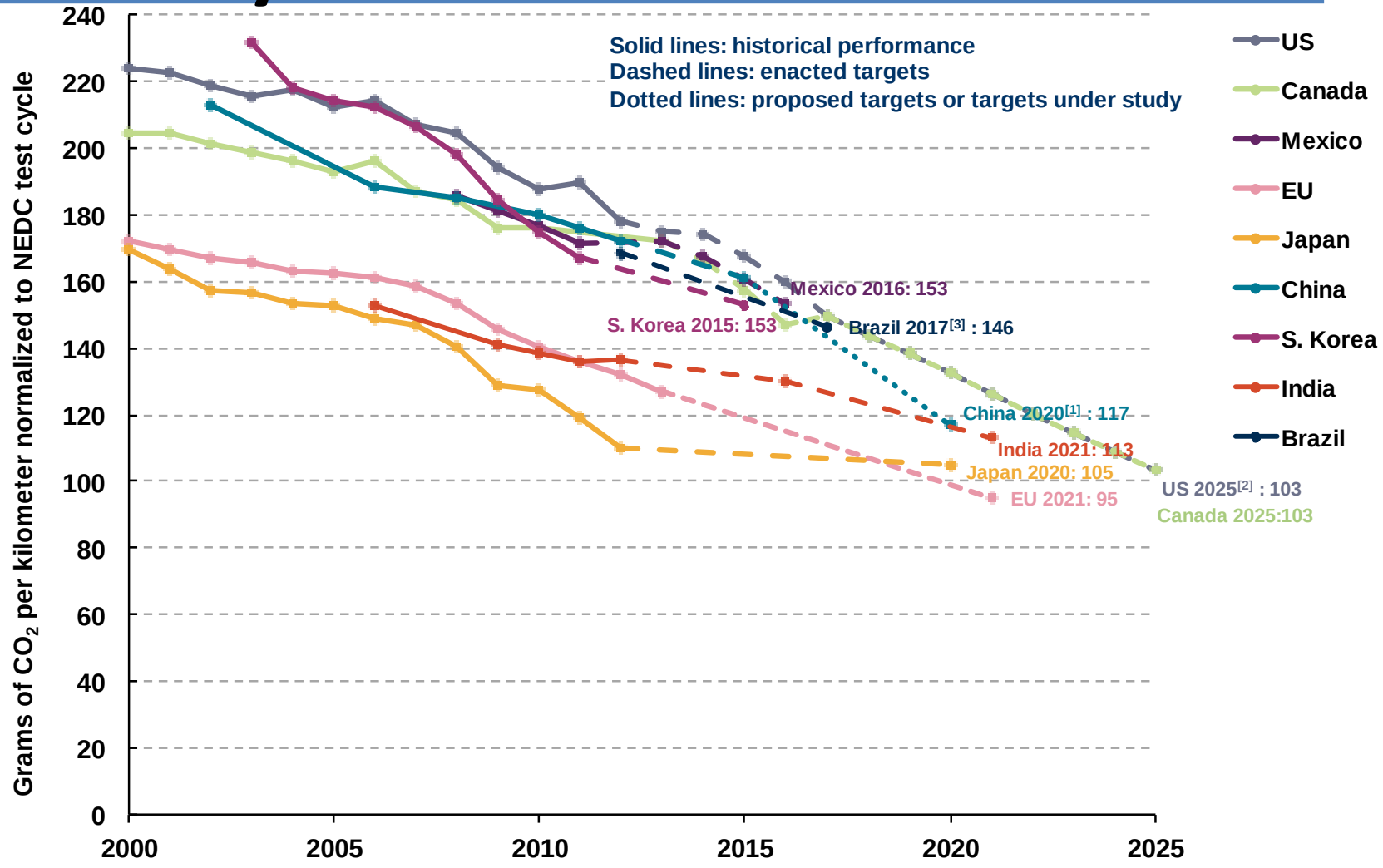
- Fuel tax policies around the world diverse and fast changing
- Fuel subsidies have been phased-out in many countries
  - Lower oil prices making the changes transparent to the end consumer
- Gasoline/Diesel tax difference tends to narrow in many countries, especially in Europe

GIZ international fuel price survey



Fuel Economy Standards

Passenger Car CO_2 Standards Globally



[1] China's target reflects gasoline vehicles only. The target may be higher after new energy vehicles are considered.
[2] US standards GHG standards set by EPA, which is slightly different from fuel economy stadards due to low-GWP refrigerant credits.
[3] Gasoline in Brazil contains 22% of ethanol (E22), all data in the chart have been converted to gasoline (E00) equivalent
[4] Supporting data can be found at: http://www.theicct.org/info-tools/global-passenger-vehicle-standards.

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Key elements to consider when introducing fuel economy standards

1. Regulated metric

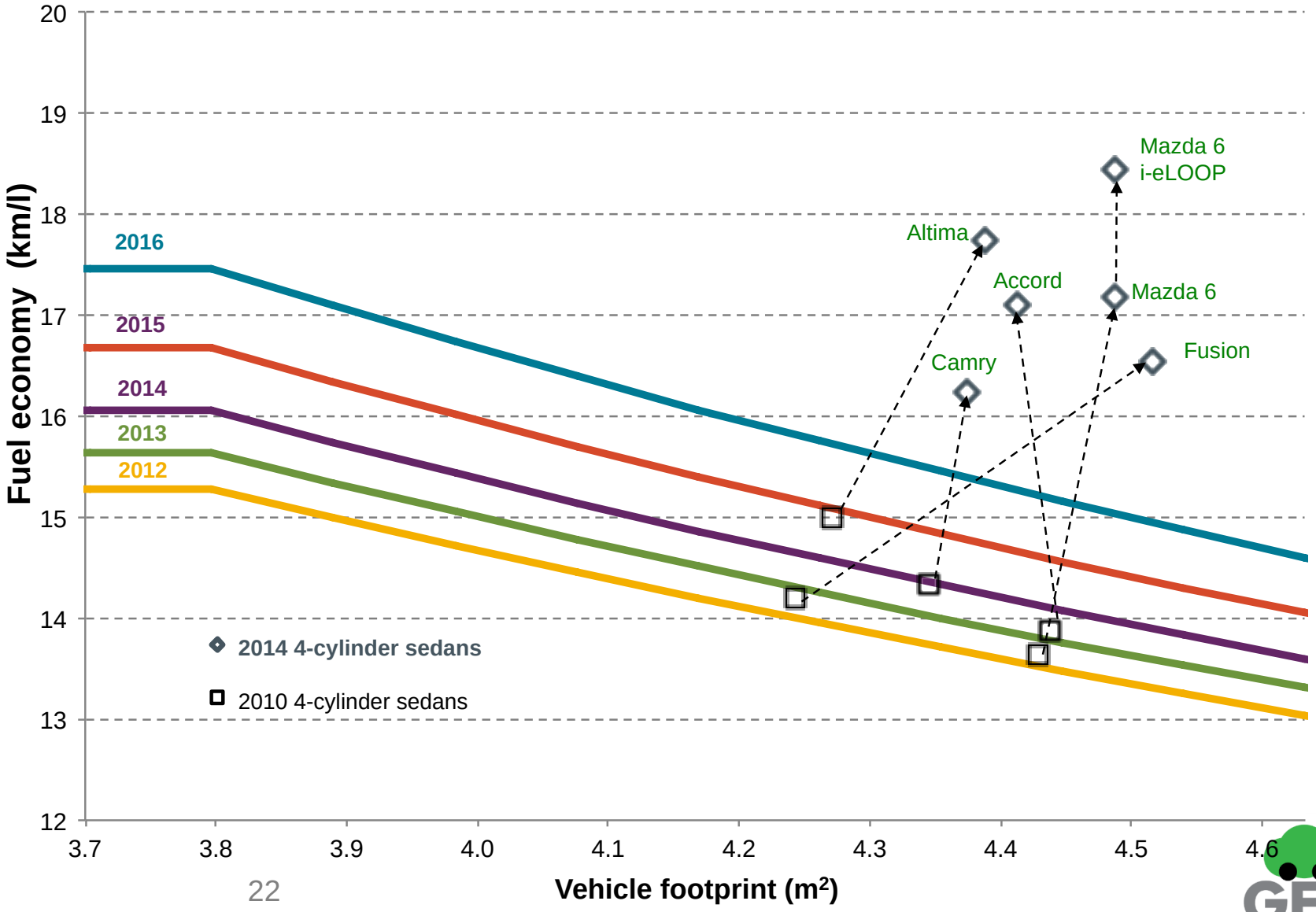
2. Form of target curve + underlying attribute

3. Target timeframe/limit value

1. Regulated metric

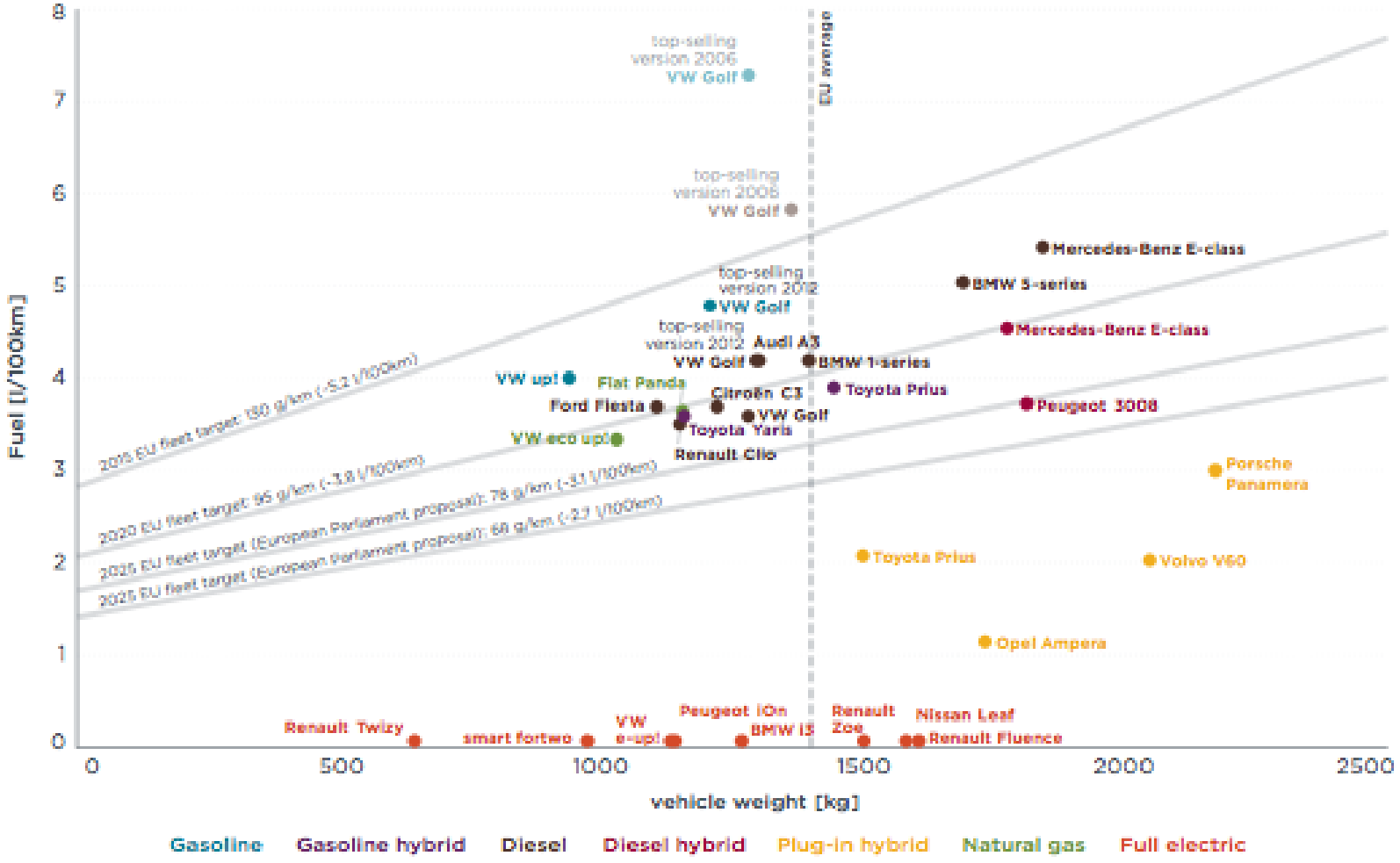
Country or Region	Target Year	Regulated metric	Unadjusted Fleet Target/Measure	Form of target curve	Test Cycle
EU	2015 2021	CO_2	130 gCO_2/km 95 gCO_2/km	Weight-based	NEDC
China	2015 2020	Fuel consumption	6.9 L/100km 5 L/100km	Weight-class based	NEDC
U.S.	2016 2025	Fuel economy/ GHG	36.2 mpg or 225 gCO_2/mi 56.2 mpg or 143 gCO_2/mi	Footprint-based	U.S. combined
Canada	2016 2025	GHG	217 gCO_2/mi N/A	Footprint-based	U.S. combined
Japan	2015 2020	Fuel economy	16.8 km/L 20.3 km/L	Weight-class based	JC08
Brazil	2017	Fuel consumption	1.82 MJ/km	Weight-based	U.S. combined
India	2017 2022	CO_2	130 g/km 113 g/km	Weight-based	NEDC for low-powered vehicle
South Korea	2015 2020	Fuel economy/GHG	17 km/L or 140 gCO_2/km 24 km/L or 97 gCO_2/km	Weight-based	U.S. combined
Mexico	2016	Fuel economy/GHG	39.3 mpg or 140 g/km	Footprint-based.	U.S. combined
Saudi Arabia	2020	Fuel economy	17 km/L	Footprint-based	U.S. combined

US fuel economy standard curves

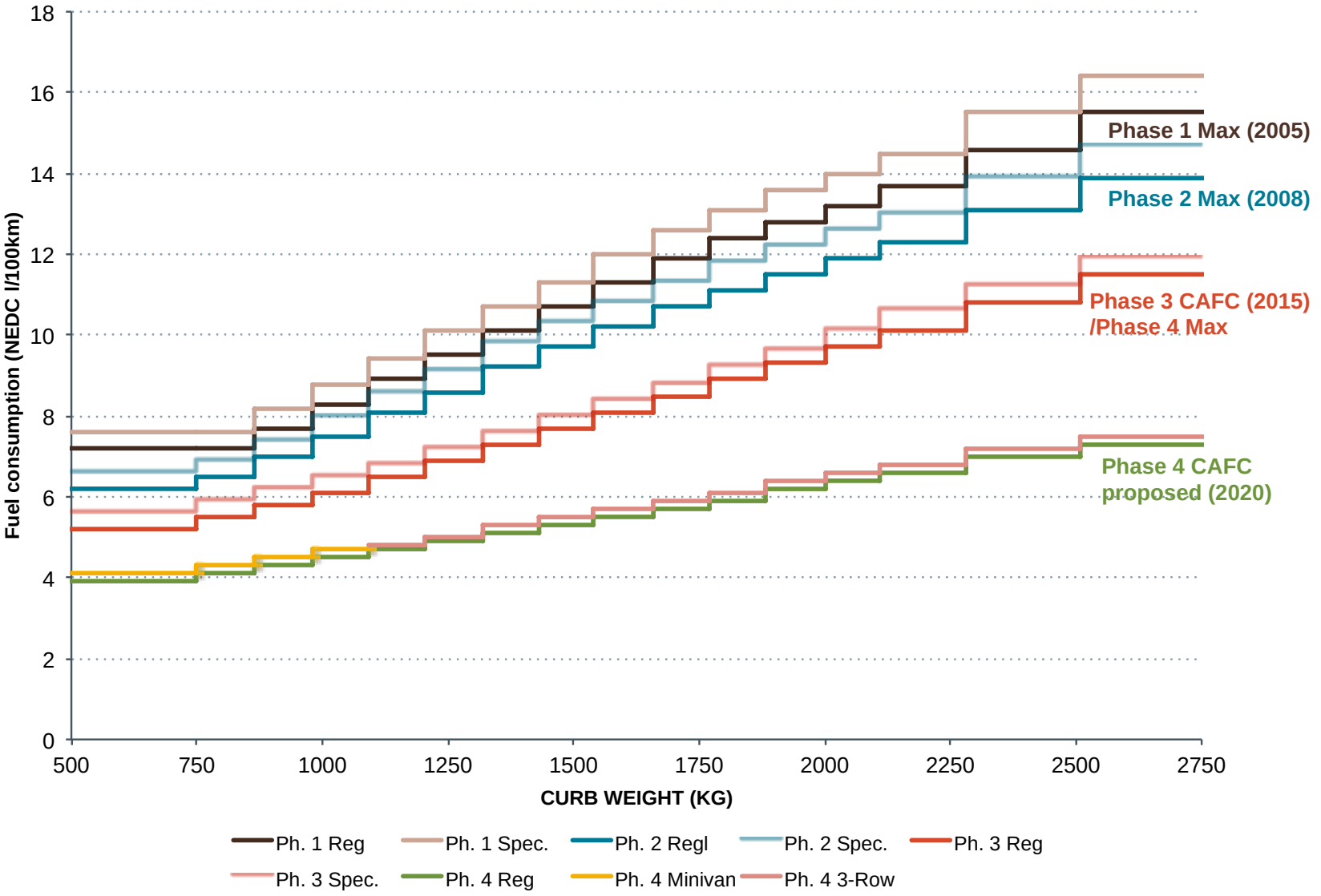


European Standards

CO_2 Emissions of Selected Vehicle Models by Technology (2013)



China standard curves



Fiscal Measures

Fiscal policy type	Characteristics
Fuel taxes, CO2 taxes	Set by fuel type; paid upon refueling
VMT taxes	Typically paid at annual registration; could be CO2-adjusted
Road pricing	Paid by km of driving or when passing a cordon line
Vehicle purchase taxes/feebates	Paid at time of purchase; can be differentiated by fuel economy or CO2

Role of fiscal policies in promoting fuel efficiency

- Encourage manufacturers to adopt technologies to improve fuel efficiency and reduce emissions
- Send consumers appropriate price signals to purchase fuel-efficient and low carbon vehicles
- Support fuel efficiency and emission regulatory targets
  - Regulatory standards set the minimum requirement and need to be strengthened overtime
  - Fiscal policies provide continuous incentive to improve
  - Easy to establish, does not require detailed knowledge of vehicles and technology costs, only needs to establish “rate, or value of fuel or GHG savings”, “revenue target”, and “test method and enforcement”

What is a Feebate?

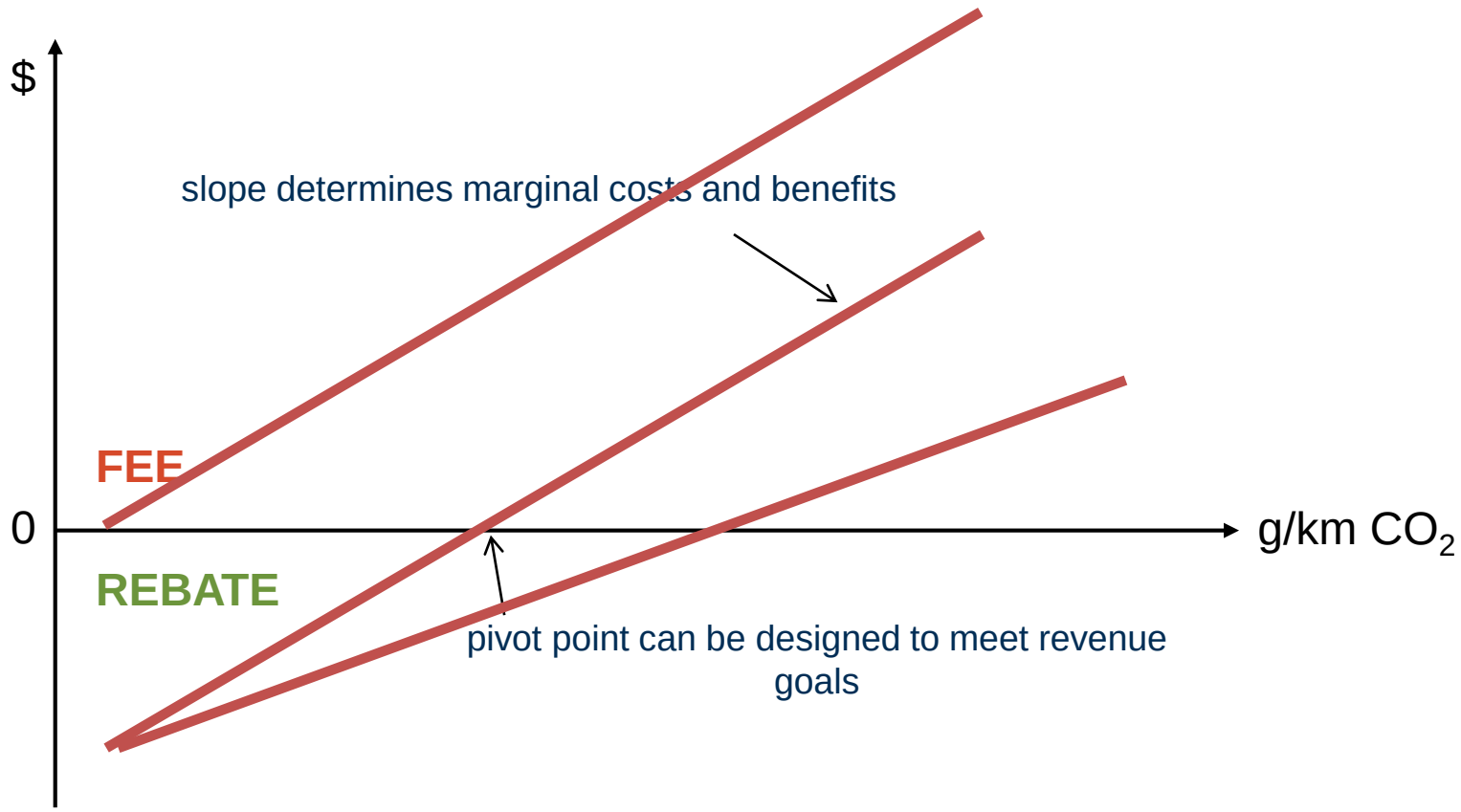
Feebate = Fee + Rebate

- Market-based policy that shifts consumer purchases (and potentially manufacturer production) by encouraging GHG reductions by placing a fee on higher-emitting vehicles and providing a rebate to lower-emitting vehicles

- Based on fuel economy or CO2 differential between vehicles

- Could also take into account vehicle attributes like size or weight

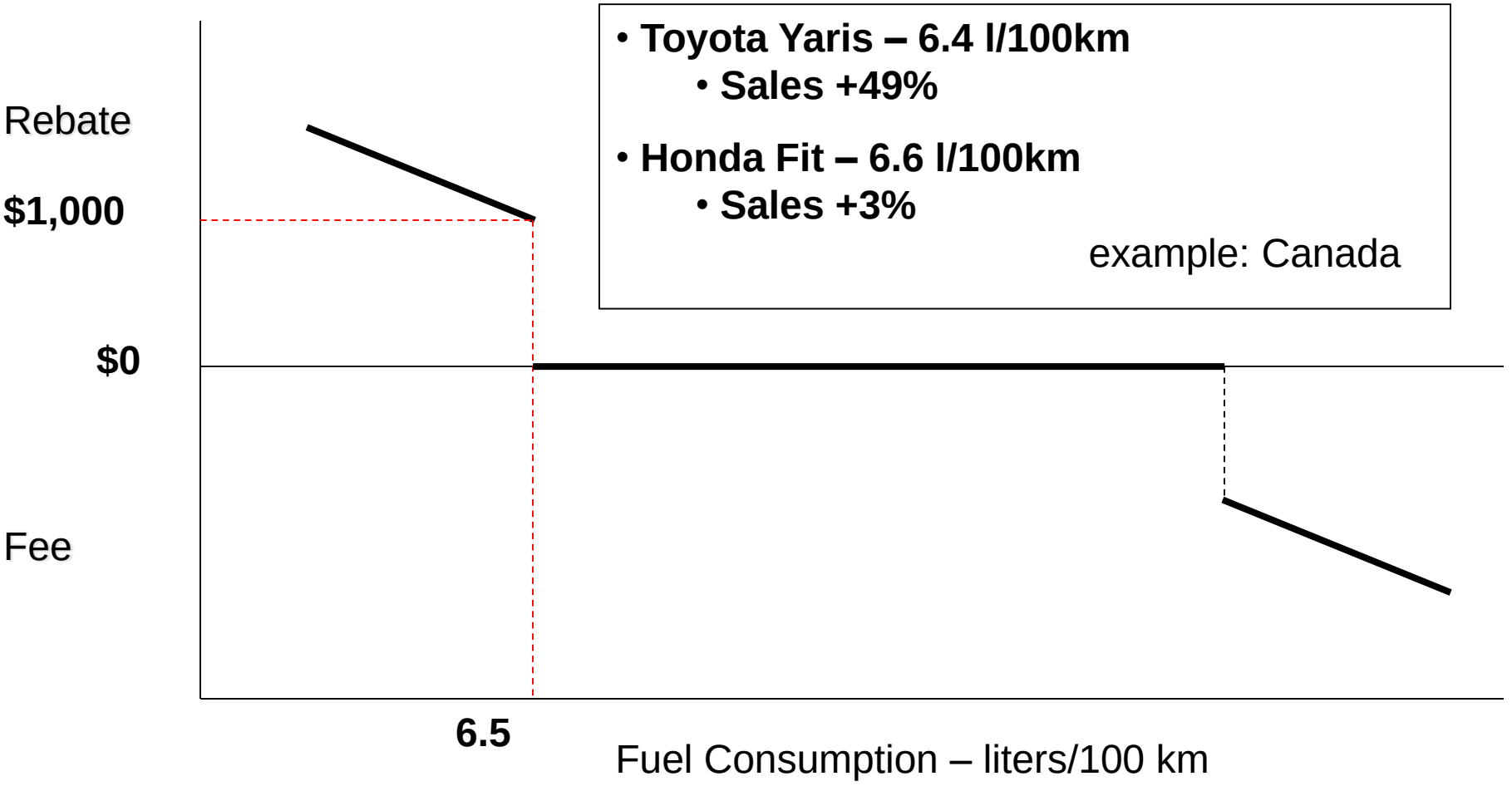
How to design a feebate system?



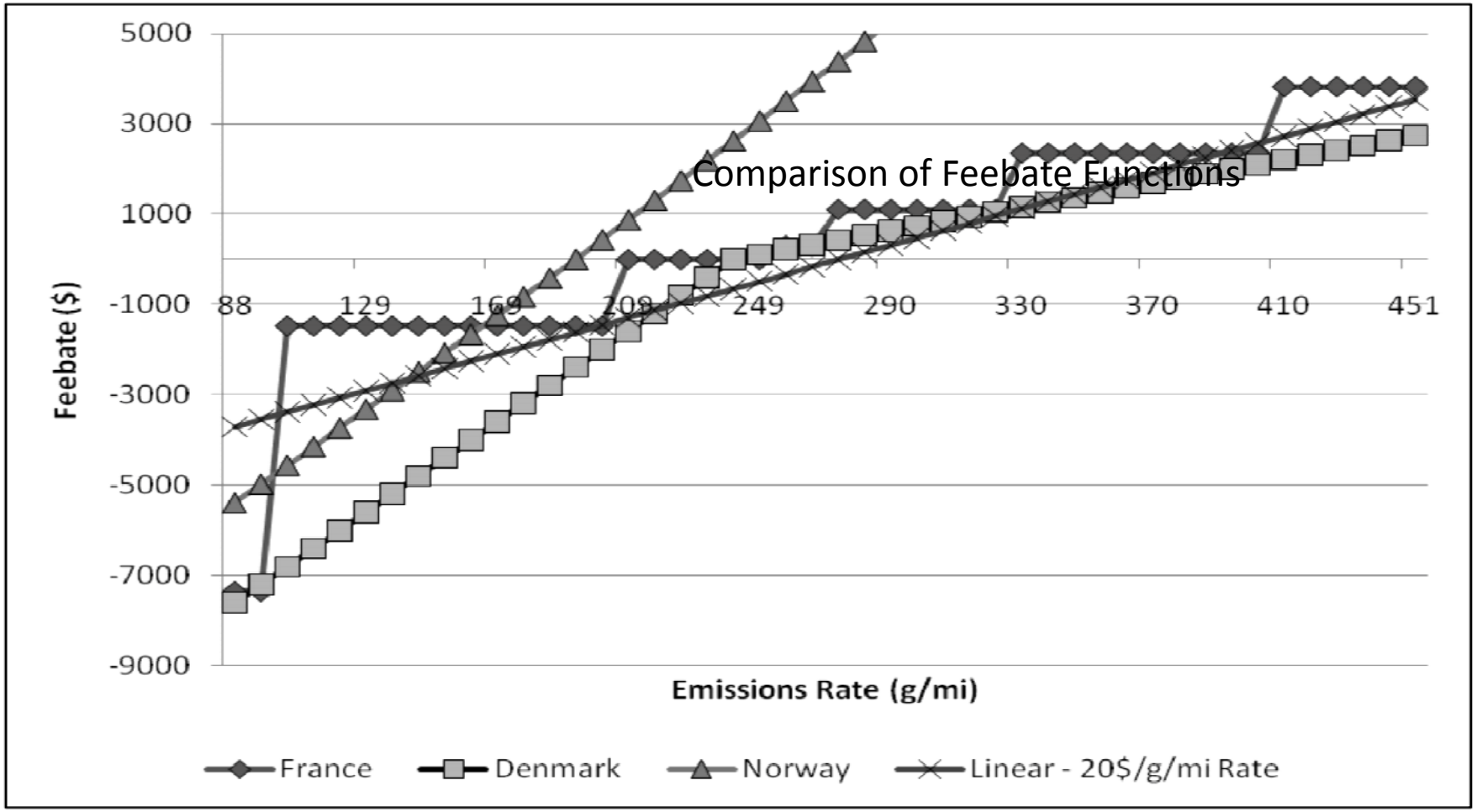
Design Elements For Effective Incentives

- Base fiscal charges directly on vehicle fuel consumption levels, instead of vehicle physical attribute, avoid fixed charges.
  - Mandatory labeling for fuel consumption is an enabler.
- Apply the incentive widely across fleet, instead of limiting to a portion of the fleet.
- Provide continuous incentive on every fuel consumption or fuel consumption level.
- Targeted incentive programs should also be linked to fuel consumption.
  - A targeted incentive program refers to incentive provided to vehicles with special features (such as a certain fuel type, or vehicles equipped with certain technologies).

Important to have a continuous slope, no steps



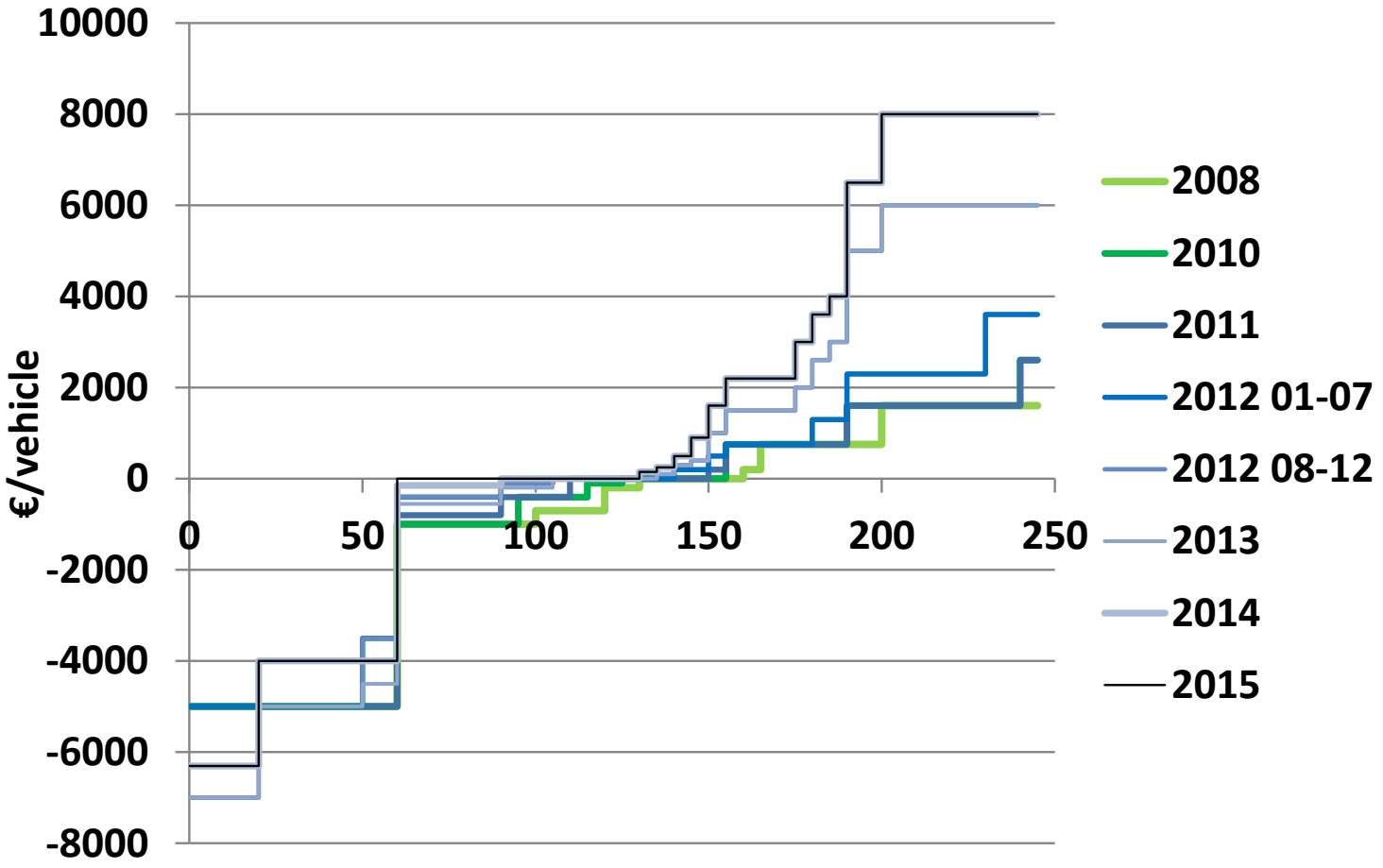
Feebates around Europe – many systems



Source: Bunch and Greene

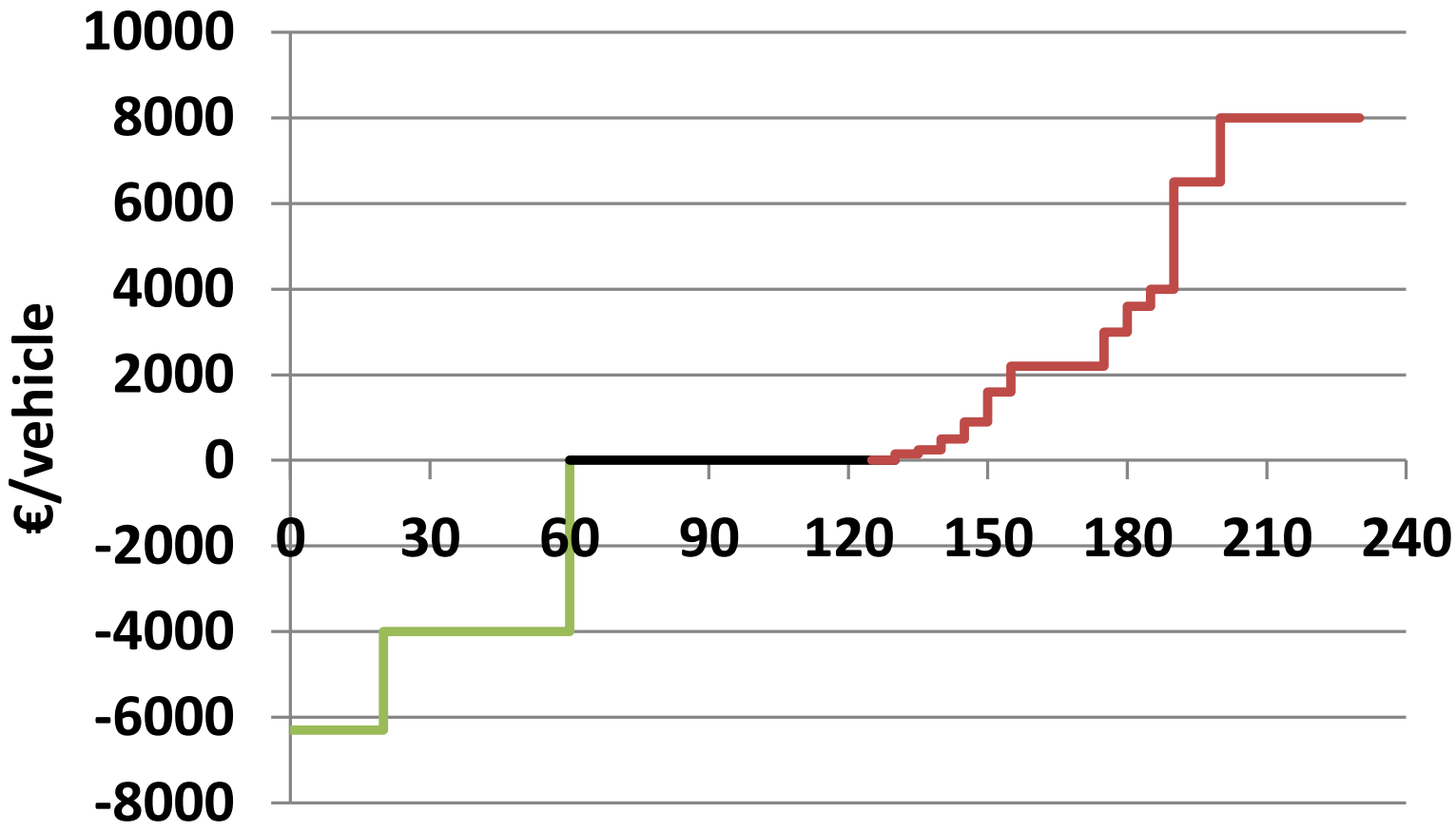
French feebate schedule over time

- The fees have risen and the rebates declined…



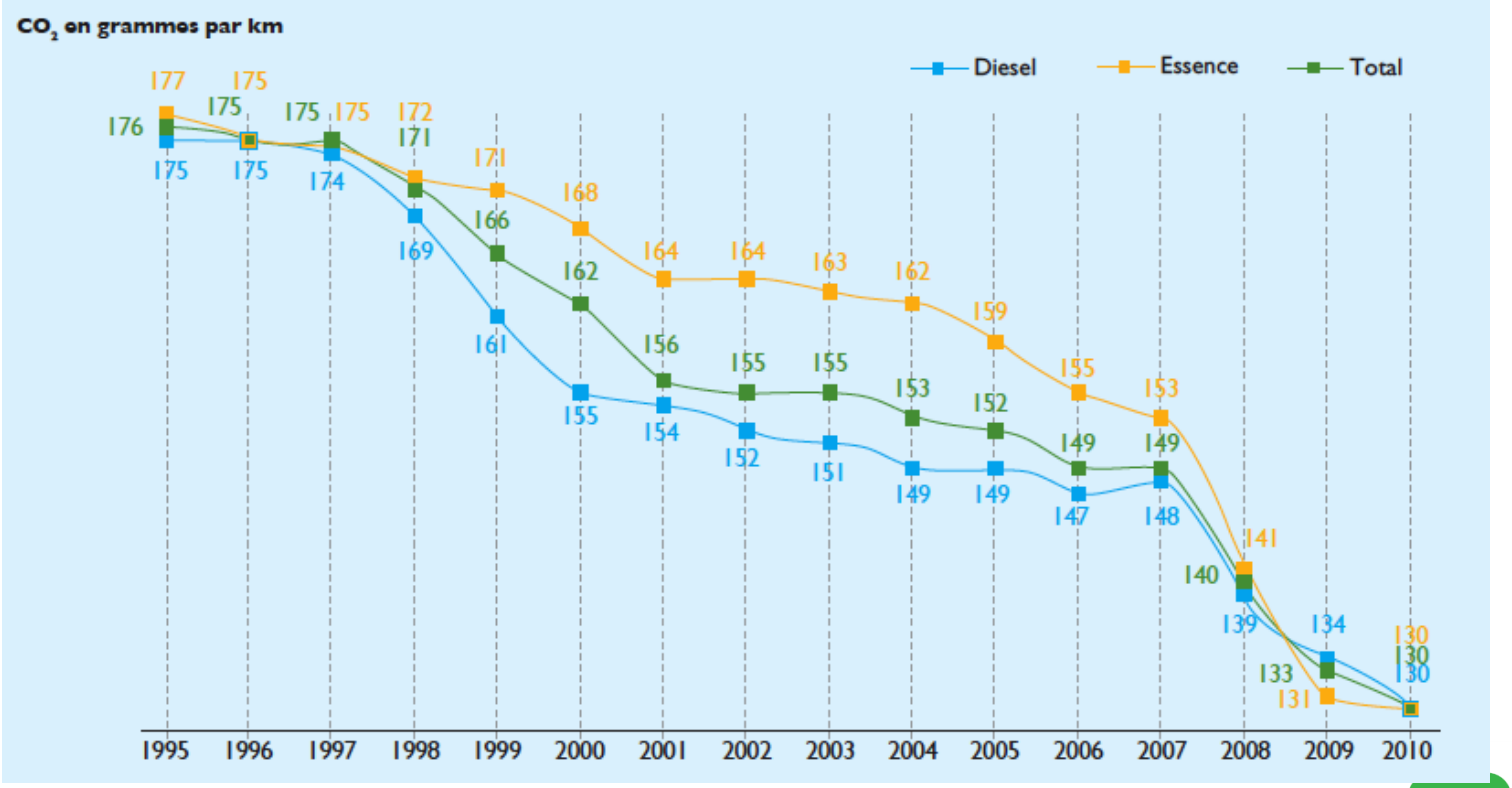
French feebate schedule, 2015

- The only vehicles receiving rebates have 60 g/km or below



French feebate system led to significant drop in CO_2 emissions

- 2001–2007 avg. reduction new vehicle CO_2 = 1 g/km per year
- 2008: emissions drop 9 g/km and 2009 by 7 g/km, Ministry of Transport attributes to introduction of bonus/malus system



Source: Les véhicules particuliers en France (Ademe), March 2010

Standards v. Feebates

Standards	Feebates
"Guarantee" a minimum level of fuel economy	Do not guarantee level
No incentive to go beyond minimum	On-going incentive
Must be regularly updated to maintain pressure	Must be regularly updated to meet revenue targets
No cap on costs	Provide a cap on cost
Could ban some vehicles	Wouldn't ban any vehicles
No clear price signals	Clear price signals to consumers and producers

Source: Bunch and Greene

The FEPIT tool

Purpose of FEPIT

- Simple tool to estimate the impact of selected policy measures on the average fuel economy of newly registered cars in a given year in the future
- Support for decision makers to implement policy schemes to achieve region specific fuel economy targets in the light of the GFEI target
- Light application running in MS EXCEL with limited data requirements and with a simple and user-friendly interface
- Does not replace in-depth policy study: magnitude of the impact of the policy measures rather than exact forecast
- Designed to make the most out of the baseline work

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Data requirement

FE baseline & additional info

- **New registrations by fuel economy segment for at least one past year**
- **Average fuel economy by fuel economy segment of all newly registered cars for at least one past year**
- **Additional Information on:**
  - Vehicle taxation (registration and circulation tax/feebate)
  - Fuel price and fuel taxation
  - Fuel composition of newly registered cars (gasoline/diesel)

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Policy measures in FEPIT

- Fuel economy regulation/standard
- CO_2-Based Vehicle registration tax/feebate scheme
- CO_2-Based Vehicle circulation tax/feebate scheme
- Fuel taxation

Eco-labelling not explicitly considered: it is assumed to be a pre-requisite for the application for all other policies

Fuel economy standard

- Maximum level of average fuel consumption (or CO2 emissions) computed as corporate sales weighted average based on the composition of the new registrations in the regulated zone
- Target set for future time horizon, to be achieved by manufacturers through technical development or changes in the models mix
- Global Fuel Economy Initiative (GFEI) target: 2.8% annual improvement rate from 2005 to 2030, leading to 50% improvement over the 25 years time interval

CO_2-Based Vehicle registration tax/feebate scheme

- Registration tax: a fee paid only once, when the vehicle enters a market for the first time (either as new vehicle or second hand import)
- Setting the level of the registration tax according to the CO2 emission level or the specific fuel consumption of the vehicle (e.g., the higher the emission level the higher the tax)
- "Feebate": allowing the fee to be negative (rebate, e.g. for vehicles having emission and/or fuel consumption levels below certain thresholds and/or for alternative vehicles, HEV, PHEV and EVs)

CO_2-Based Vehicle circulation tax/feebate scheme

- Circulation tax: a fee paid generally on a yearly basis by each registered vehicle irrespective whether the vehicle is actually used or not
- Setting the level of the circulation tax according to the CO2 emission level or the specific fuel consumption of the vehicle (e.g., the higher the emission level the higher the tax)
- "Feebate": allowing the fee to be negative (rebate, e.g. for vehicles having emission and/or fuel consumption levels below certain thresholds and/or for alternative vehicles, HEV, PHEV and EVs)

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Fuel taxation

- Fuel taxes: paid on the quantity of fuel purchased. In general, composed of excise tax and value added taxes (excises can vary according to fuel type)
- Modifying the average level of fuel taxation considering all taxes (modification of the excises or a modification of the value added tax or both)
- The adjustment of the taxation expected to be upwards. Nevertheless, also (limited) reductions of fuel taxation accepted
- FEPIT does not deal with fuel tax differentiation (i.e. between gasoline and diesel)

The methodological approach

Impacts of the policies reported in terms of:

- Average fuel economy of new registrations (lge/100km)
- New registrations composition (share of a given segment in the total amount of newly registered vehicles)

Estimation of the impacts based on:

- policy selection and characterization by users at the projection year
- policy characterization and market environments at the base year (e.g., level of vehicle registration tax or level of fuel duties)
- set of elasticities, linking policy characteristics with changes in the output variable

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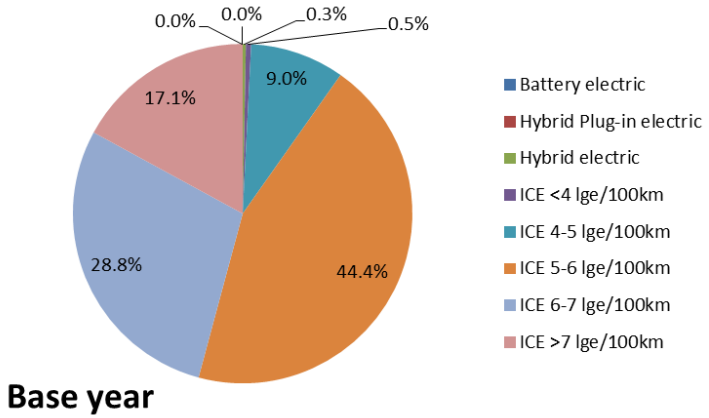
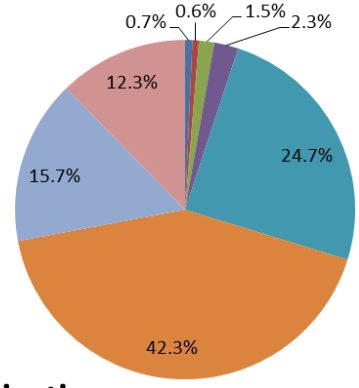
The methodological approach

Theoretical approach

- New vehicles registrations segmented into fuel consumption classes
- Each segment represented by the related average fuel consumption
- Policies affect both
  - the new registration composition, and
  - the average fuel consumption by segment
- Context factors and interaction between policies affect the size of final impacts



Base year



Projection year

Structure of FEPIT

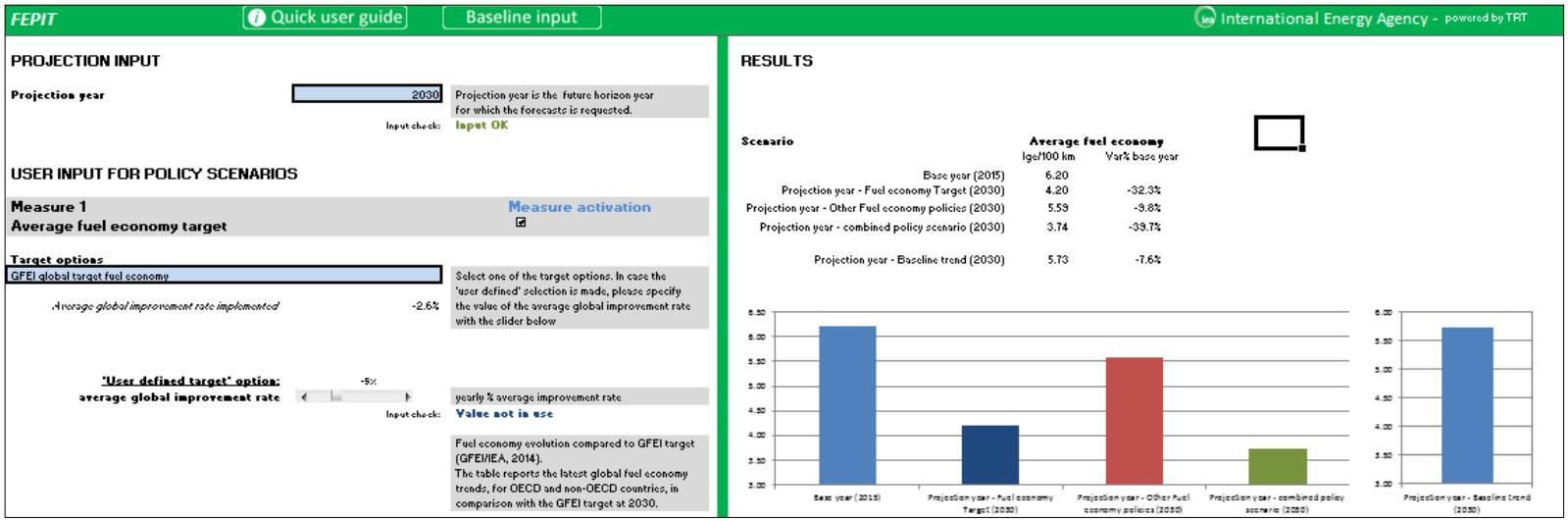
- Excel file including six worksheets:
  - First three worksheets including all relevant information, inputs and outputs for the user
  - Remaining worksheets used for internal calculations only
- User-worksheets
  - With editable cells shaded in light blue for user input
  - Automatic controls to avoid invalid values
  - Error messages in case of wrong / missing inputs
  - When FEPIT is opened for the first time, all input cells are empty and the error messages are displayed

Worksheet	Type
Baseline input	**User**
Projection input and results	**User**
Quick user guide	**User**
Baseline scenario calculations	Calculation only
Policy scenario calculations	Calculation only
Conversion factors - parameters	Calculation only

Structure of FEPIT

Projection input and results worksheet:

- setting the assumptions for the policy scenarios
- and reading the results of the calculations



Structure of FEPIT

Projection input and results worksheet

- Fuel economy target: four alternatives provided with a drop-down menu
  - A. GFEI global target on average fuel economy
    4.2 lge/100 km in the year 2030 (translated in average improvement rate per year depending on the baseline conditions at the base year)
  - B. GFEI average global improvement rate
    required annual improvement rate by -2.8%
  - C. Average between GFEI global target on average fuel economy and global improvement rate average between option A and B
  - D. User defined target annual improvement rate (range of the improvement rate is between 0% and -7%)

Structure of FEPIT

Projection input and results worksheet

- Setting baseline trend on new registrations and average fuel consumption: four alternatives provided with a drop-down menu
  A. Endogenous trend according to past data, using data provided in the base year and in the past year to estimate the past trend, applied up to the projection year
  B. Constant base year values
  C. Exogenous trend: faster development (exogenous trend pre-determined in the tool with fast development)
  D. Exogenous trend: slower development (exogenous trend pre-determined in the tool with slow development)

Structure of FEPIT

Other worksheets:

Quick user guide worksheet: quick indications on the content of the tool

Baseline scenario calculations worksheet: where the baseline trend is estimated in terms of new registration composition and average fuel economy of each segment of newly registered cars

Structure of FEPIT

Other worksheets:

Policy scenario calculations worksheet: where the impacts of the policy measures are estimated in terms of average fuel economy of new registrations and new registration composition

Conversion factors – parameters worksheet: including all relevant conversion factors / parameters used in the tool, accompanied by a short description and the references used for their definition

Hints for using FEPIT

- Criteria for setting the fuel consumption thresholds
  - Analysis of detailed data from national registers, including information on fuel economy
  - current mix reasonably balanced (i.e. all classes have non-zero values and with a reasonable distribution)
  - future mix also represented significantly (e.g., a relative low consumption category can be needed)
  - thresholds useful to discriminate current and future tax level (reproducing the current differentiation in a reasonable fashion even if criteria other than fuel consumption)

Hints for using FEPIT

- Past year data on new registrations and average fuel economy
  - recommended but not strictly required
  - earlier than the base year
  - avoid situations where data affected by extraordinary events (e.g. crises, fuel price spikes, etc.)
  - used to estimate an endogenous baseline trend: if this input is not provided, only constant values or an exogenous baseline trend available

Hints for using FEPIT

- Average fuel economy of new vehicles by segment in lge/100km
  - average across all vehicles in a fuel economy segment irrespective of the fuel type (weighted by the number registrations)
  - conversion of non-gasoline fuel consumption or CO_2 emissions per km in the required unit (l/100 km to lge/100km or g CO_2 /km to lge/100km)

Hints for using FEPIT

- Registration/circulation tax in the base year by segment
  - Usually not designed on the vehicle segments defined by the user in terms of fuel economy (e.g., depending on engine capacity, engine power, vehicle price, etc.)
  - Elaborations required to estimate representative values for each demand segment, base on detailed data on car registrations (average weighted by the number registrations)

Hints for using FEPIT

- Policy registration/circulation tax in the projection year by segment
  - Different values from the base year: if the same, no impacts simulated (policy change not detected by FEPIT)
  - Impacts simulated with reference to policy change from base year to projection year

Hints for using FEPIT

- Average fuel price (at the pump) and taxes
  - average estimated across gasoline and diesel fuels only (other fuels neglected for simplicity)
  - weighted by the shares of each fuel in the market
  - taxes include excises as well as value added tax, etc. on pump price

Thank you

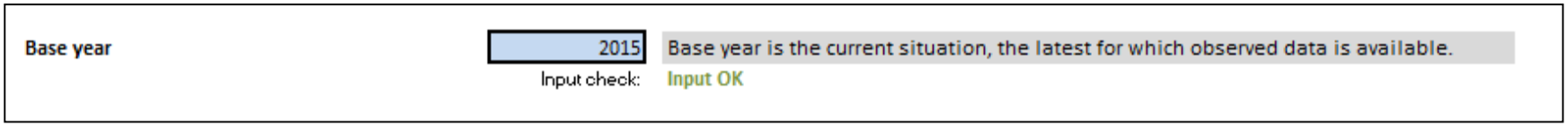
Time for more Q&As

Additional details on FEPIT

Structure of FEPIT

Baseline input worksheet: description of the initial conditions

- Base year



- New cars registrations
  - Fuel consumption thresholds, to define segments
  - Composition of newly registered cars by segment in the base year
  - Composition of newly registered cars by segment in the past year (optional)

Structure of FEPIT

Baseline input worksheet

- New cars registrations

NEW CARS REGISTRATIONS

New registrations classes

Fuel consumption thresholds

	(lge/100km)
ICE <	4.0
ICE 4-	5.0
ICE 5-	6.0
ICE 6-	7.0
ICE >	7.0

These values define the segments used by the tool to represent the registration mix of conventional Internal Combustion Engine cars.
CO2 based vehicle taxation policies are described in the tool by applying taxes differentiated according to these segments.
See the user guide for more details on the choice of the thresholds

Input check: Input OK

New registrations composition

Composition for Base year (2015)

Battery electric	0.0%
Hybrid Plug-in electric	0.0%
Hybrid electric	0.3%
ICE <4 lge/100km	0.5%
ICE 4-5 lge/100km	9.0%
ICE 5-6 lge/100km	44.4%
ICE 6-7 lge/100km	28.8%
ICE >7 lge/100km	17.1%

The composition of new registrations is defined in terms of share of cars registered in each segment (according to the classes defined above).
Hybrid (electric and plug-in) and battery electric cars are kept separeted.
The sum of the shares has to be 100%.

Input check: Input OK

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Structure of FEPIT

Baseline input worksheet – fuel economy

NEW CARS FUEL ECONOMY

Average fuel consumption

Fuel consumption by segment for Base year (2015)	(lge/100km)	The average fuel consumption has to be defined according to the new registrations classes defined above. It is expressed in terms of lge/100 km (litre-gasoline-equivalent per 100 kilometre).
Battery electric	1.50	
Hybrid Plug-in electric	3.00	
Hybrid electric	4.50	
ICE <4 lge/100km	3.86	
ICE 4-5 lge/100km	4.71	
ICE 5-6 lge/100km	5.54	
ICE 6-7 lge/100km	6.47	
ICE >7 lge/100km	8.35	
	Input check:	Input OK

Past year		This is a past year for which data on fuel consumption by car segment is available.
	Input check:	Past year not in use

Fuel consumption by segment for Past year ()	(lge/100km)	Data related to past year is used to estimate the endogenous changing fuel consumption of new registrations according to past trend. If past year data is not available cells should be empty
Battery electric		
Hybrid Plug-in electric		
Hybrid electric		
ICE <4 lge/100km		
ICE 4-5 lge/100km		
ICE 5-6 lge/100km		
ICE 6-7 lge/100km		
ICE >7 lge/100km		
	Input check:	Input OK

Structure of FEPIT

Baseline input worksheet

- Vehicle taxation in the base year
  - Level of registration tax for each car segment, net of any value added tax
  - level of circulation tax for each car segment

VEHICLE TAXATION

Average REGISTRATION tax in the base year

Tax level by segment for Base year (2015)	($)
Battery electric	0.00
Hybrid Plug-in electric	0.00
Hybrid electric	0.00
ICE <4 lge/100km	150.00
ICE 4-5 lge/100km	500.00
ICE 5-6 lge/100km	1000.00
ICE 6-7 lge/100km	2000.00
ICE >7 lge/100km	3000.00
Input check:	Input OK

The REGISTRATION tax is a tax paid only once when the vehicle is purchased and registered. It does NOT include any VAT or similar tax applied to the purchase price

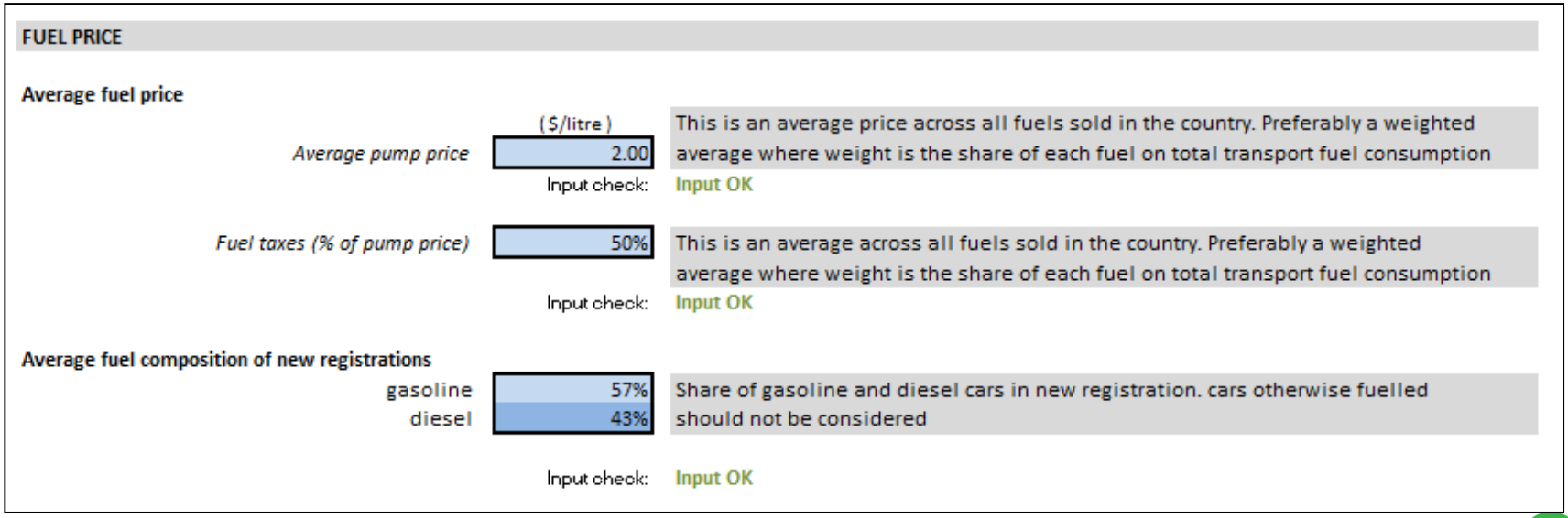
The tax/rebate level has to be defined according to the registration classes defined above.
Taxes should be coded as positive values, rebates should be coded as negative values.
The values of the registration tax should be provided in US Dollars
If registration tax does not exist in the base year all values should be set to zero

GFEI

Structure of FEPIT

Baseline input worksheet

- Fuel price in the base year
  - Average fuel price at the pump (pump price), in $/liter
  - Average share of fuel taxes on pump price
  - Split of newly registered cars between gasoline and diesel



FUEL PRICE			
Average fuel price			
		($/litre)	
	Average pump price	2.00	This is an average price across all fuels sold in the country. Preferably a weighted average where weight is the share of each fuel on total transport fuel consumption
		Input check:	Input OK
	Fuel taxes (% of pump price)	50%	This is an average across all fuels sold in the country. Preferably a weighted average where weight is the share of each fuel on total transport fuel consumption
		Input check:	Input OK
Average fuel composition of new registrations			
	gasoline	57%	Share of gasoline and diesel cars in new registration. cars otherwise fuelled should not be considered
	diesel	43%	
		Input check:	Input OK

Structure of FEPIT

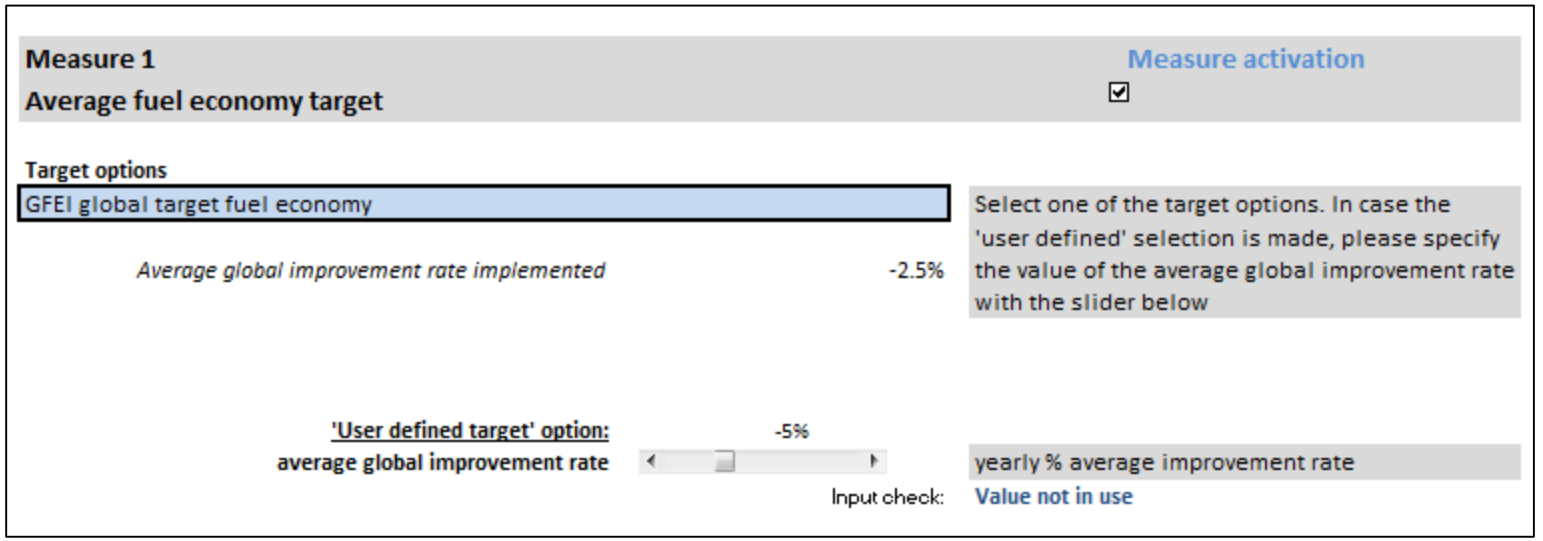
Projection input and results worksheet: setting the policy scenarios and reading the results of the calculations

- Projection year
- Activating and setting policies
  - Fuel economy target
  - CO2-Based Vehicle registration tax/feebate scheme
  - CO2-Based Vehicle circulation tax/feebate scheme
  - Fuel taxation
- Setting baseline trend
- Reading results
  - new registration composition
  - average fuel consumption / CO_2 emission

Structure of FEPIT

Projection input and results worksheet

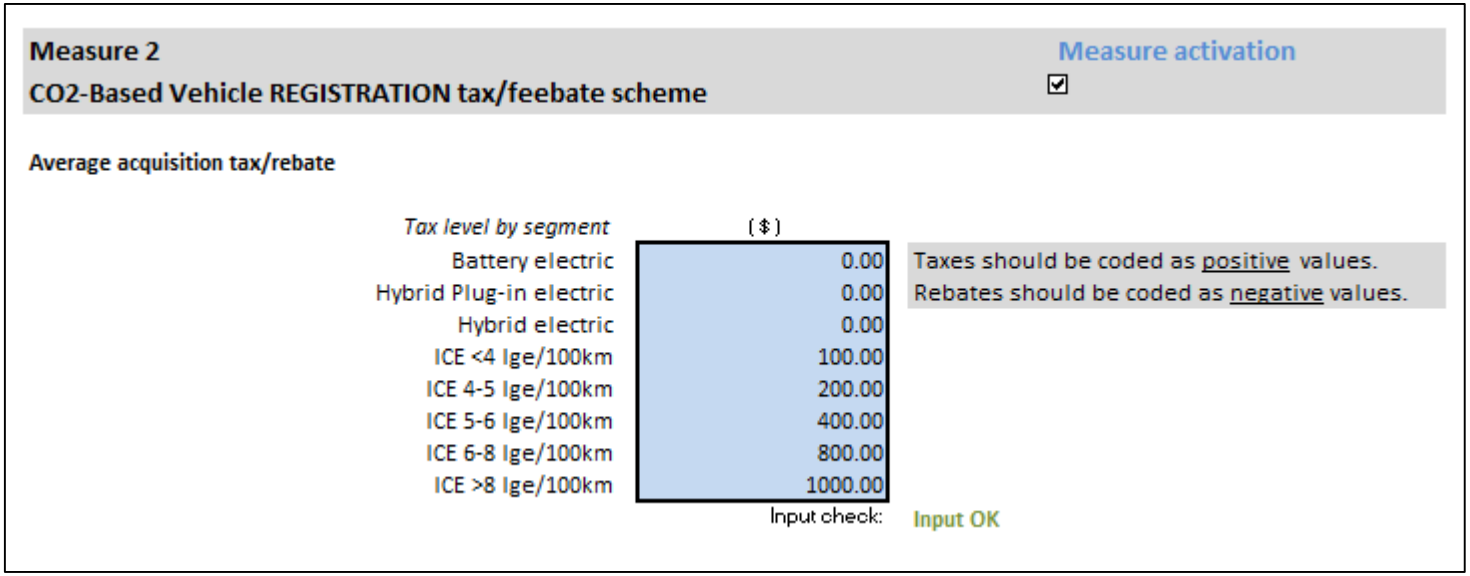
- Fuel economy target



Structure of FEPIT

Projection input and results worksheet

- CO2-Based Vehicle registration tax/feebate scheme: level of registration tax/feebate for each car segment



Measure 2
CO2-Based Vehicle REGISTRATION tax/feebate scheme

Measure activation ☑

Average acquisition tax/rebate

Tax level by segment	($)
Battery electric	0.00
Hybrid Plug-in electric	0.00
Hybrid electric	0.00
ICE <4 lge/100km	100.00
ICE 4-5 lge/100km	200.00
ICE 5-6 lge/100km	400.00
ICE 6-8 lge/100km	800.00
ICE >8 lge/100km	1000.00
Input check:	Input OK

Taxes should be coded as positive values.
Rebates should be coded as negative values.

Structure of FEPIT

Projection input and results worksheet

- CO2-Based Vehicle circulation tax/feebate scheme: level of circulation tax/feebate for each car segment

Measure 3
CO2-Based Vehicle CIRCULATION tax/feebate scheme

Measure activation ☑

Average ownership tax/rebate

Tax level by segment	($/year)
Battery electric	0.00
Hybrid Plug-in electric	0.00
Hybrid electric	0.00
ICE <4 lge/100km	40.00
ICE 4-5 lge/100km	60.00
ICE 5-6 lge/100km	100.00
ICE 6-8 lge/100km	180.00
ICE >8 lge/100km	300.00

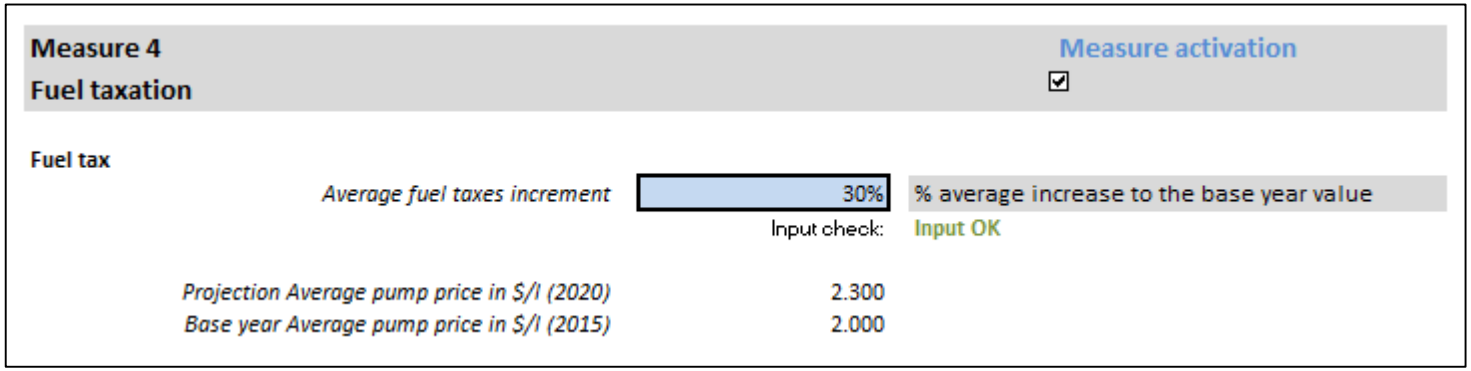
Input check: Input OK

Taxes should be coded as positive values.
Rebates should be coded as negative values.

Structure of FEPIT

Projection input and results worksheet

- Fuel taxation: percentage average increase of the fuel tax

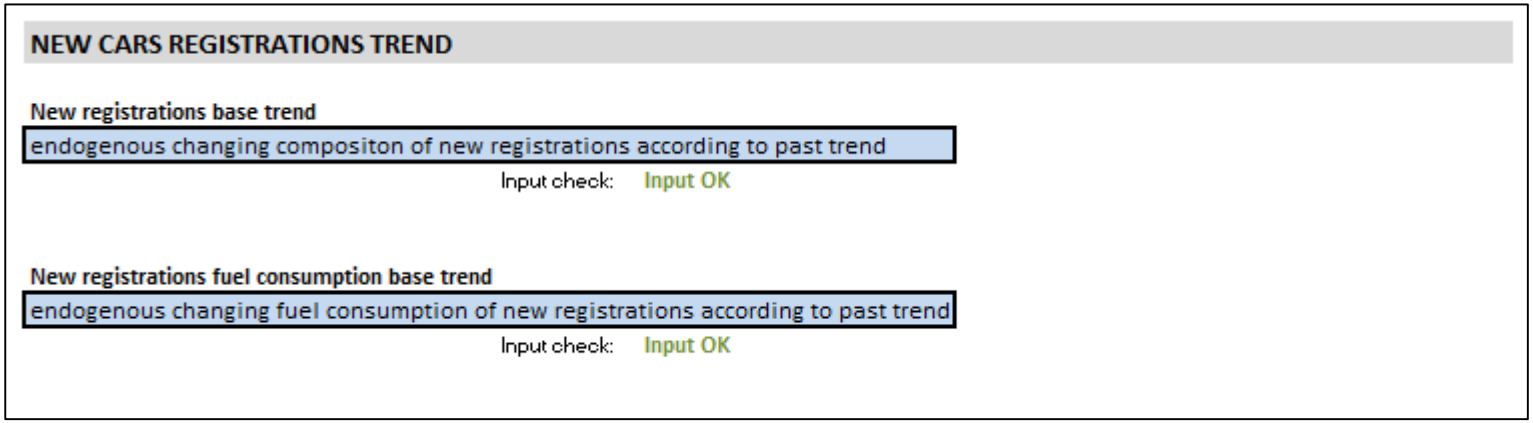


Measure 4 Fuel taxation		Measure activation ☑
Fuel tax		
Average fuel taxes increment	30%	% average increase to the base year value
	Input check:	Input OK
Projection Average pump price in $/l (2020)	2.300	
Base year Average pump price in $/l (2015)	2.000	

Structure of FEPIT

Projection input and results worksheet

- Setting baseline trend on new registrations and average fuel consumption

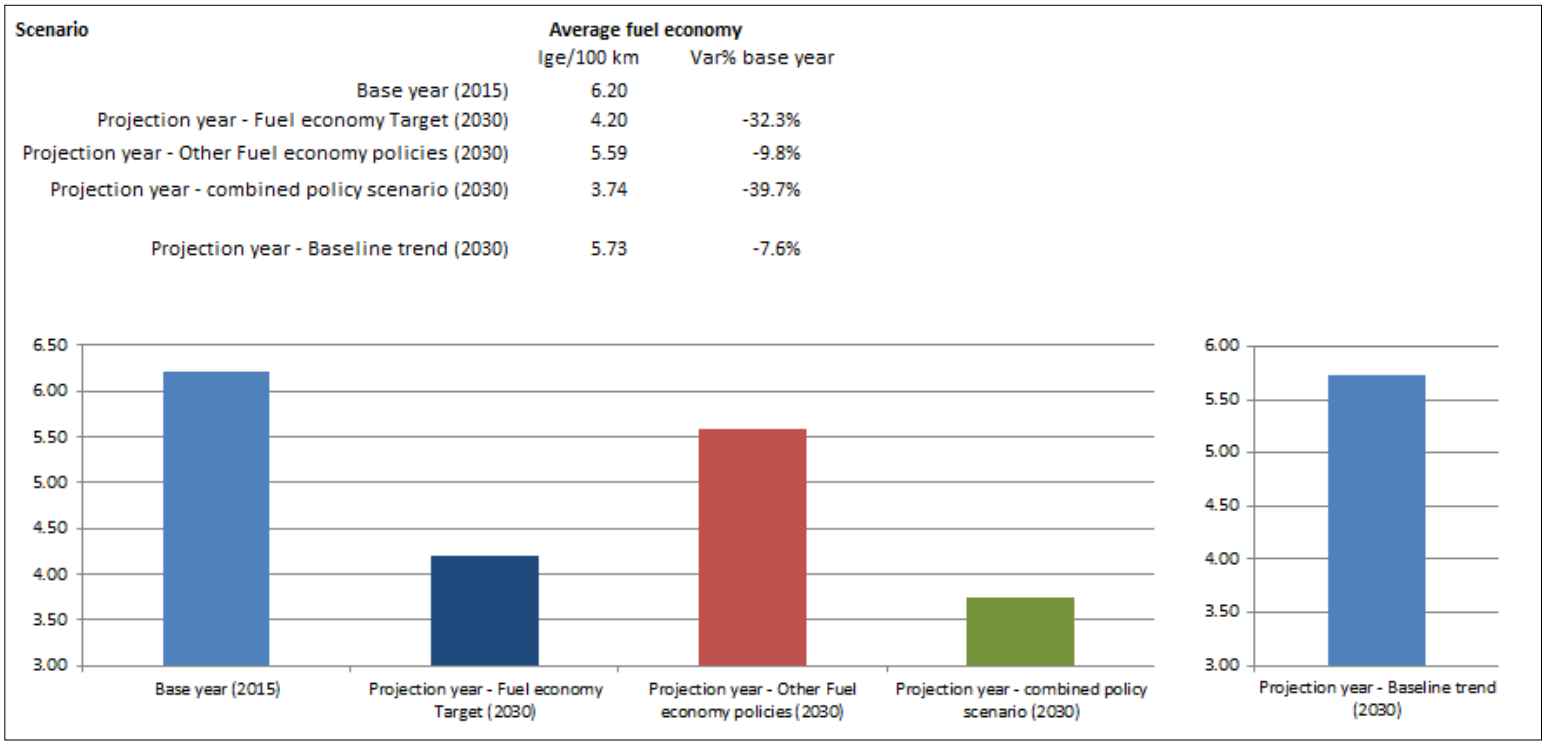


Structure of FEPIT

Projection input and results worksheet

Reading results: average fuel economy

Scenario	Average fuel economy	
	lge/100 km	Var% base year
Base year (2015)	6.20	
Projection year - Fuel economy Target (2030)	4.20	-32.3%
Projection year - Other Fuel economy policies (2030)	5.59	-9.8%
Projection year - combined policy scenario (2030)	3.74	-39.7%
Projection year - Baseline trend (2030)	5.73	-7.6%



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Structure of FEPIT

Projection input and results worksheet

- Reading results: average CO2 emissions per km
  (estimated on the basis of the split of gasoline and diesel registrations provided by the user)

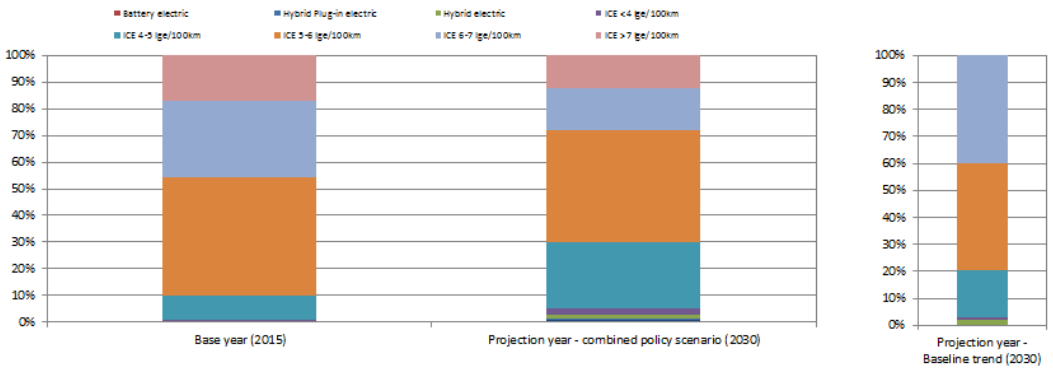
Scenario	Average CO2 emissions per km g CO_2/km
Base year (2015)	154.6
Projection year - Fuel economy Target (2030)	104.7
Projection year - Other Fuel economy policies (2030)	139.4
Projection year - combined policy scenario (2030)	93.3
Projection year - Baseline trend (2030)	142.9

Structure of FEPIT

Projection input and results worksheet

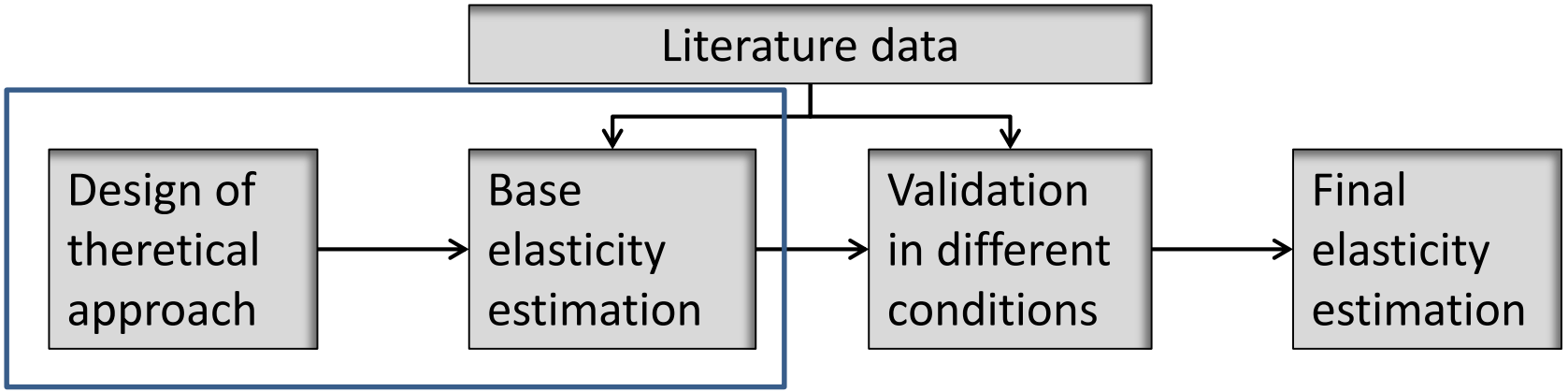
- Reading results: New Registrations composition

Scenario	New Registrations composition (%)							
	Battery electric	Hybrid Plug-in electric	Hybrid electric	ICE <4 lge/100km	ICE 4-5 lge/100km	ICE 5-6 lge/100km	ICE 6-7 lge/100km	ICE >7 lge/100km
Base year (2015)	0.0%	0.0%	0.3%	0.5%	9.0%	44.4%	28.8%	17.1%
Projection year - combined policy scenario (2030)	0.69%	0.61%	1.46%	2.3%	24.7%	42.3%	15.7%	12.3%
Projection year - Baseline trend (2030)	0.0%	0.0%	1.9%	1.3%	17.0%	39.9%	39.9%	0.0%



The methodological approach

- Elasticity parameters estimated on the basis of literature data to provide realistic responses in different conditions



The methodological approach

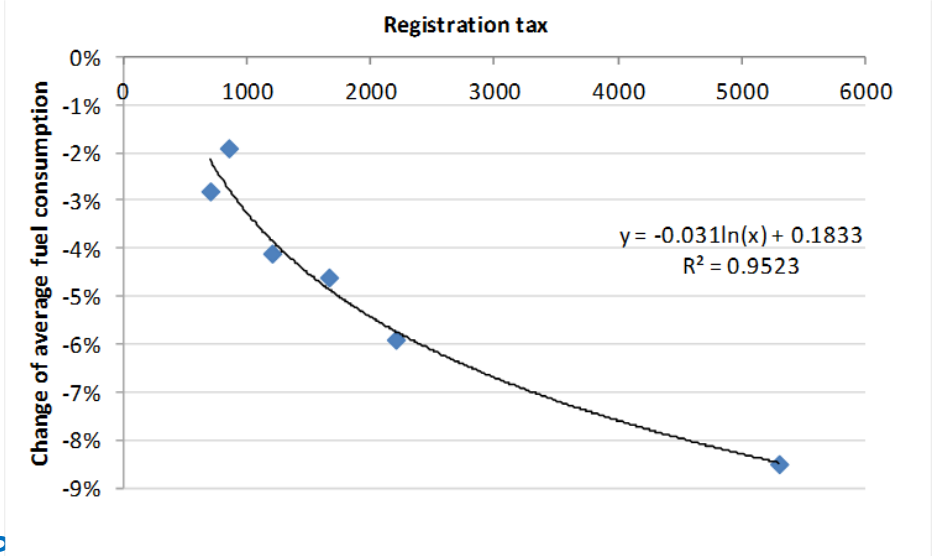
Theoretical approach

- Impact on new registrations composition by segment
  - Direct change of the natural logarithm in car registrations in a given segment in response to a 1000 Euro tax/rebate (registration share of segment s change by x%) *[D'Haultfœuille et al. (2012), Klier and Linn (2012)]*
  - Compensation of direct change by changes in the other segments (for instance, if the most energy intensive class loses 2% of share, this 2% is gained by less energy intensive segments, proportionally to the relative shares they had in the base year)

The methodological approach

Theoretical approach

- Impact on the average fuel consumption by segment
  - Due to changes of the distribution of the registrations within the segments and the deployment of technical improvements *[COWI (2002), Bunch, Gree… et al. (2011)]*
  - Function estimated on COWI (2002) data, generated by registration tax under a fleet neutrality assumption



The methodological approach

Theoretical approach

- Base elasticities drawn from studies based on the experience of vehicle taxation in Europe.
- The effect of vehicle taxation may potentially be quite different in other contexts
- Taking into account context factors influencing the base elasticities: effect of the baseline fuel price
  - Comparing the effect of feebate scheme related to registration tax in US *[Bunch, Greene et al. (2011)]* and France *[Klier and Linn (2012)]*
  - reduction of the elasticity parameters to simulate lower responsiveness in US with respect to the EU reference case (assumed to be related to baseline fuel price differences)

GFEI

The methodological approach

Theoretical approach

- Interaction between measures:
  - Circulation and registration taxes: the effect is larger when combined *[COWI (2002)]*
  - Fuel consumption target and other policies: responsiveness to other measures is reduced assuming that, as vehicle efficiency gradually improves, the incentive to choose a more fuel efficient car also gradually declines
- Electric vehicles segments
  - Comparing the effect of incentives *[Mock, P. and Yang, Z. (2014)]*
  - Smoothing the elasticities
  - Estimating shares at projection year based also on an exogenous increasing trend from 2012 onward

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The methodological approach

Validation in different conditions:

- Simulating various case studies
- Revision of the elasticity parameters