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Assessing impacts of fuel economy measures FEPIT

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Contents

- Introduction
- Purpose of FEPIT
- Setting of the baseline
- FEPIT: included policy measures
- The use of FEPIT
- FEPIT validation
- Discussion

GFEI target – Maximising the benefits of improved fuel economy

- Reduce new passenger light-duty vehicle fuel consumption (Lge/100km) by 50% until 2030 globally

- Reduce passenger light-duty vehicle stock fuel consumption (Lge/100km) by 50% until 2050 globally

Technical steps to introduce FE policies

- Baseline – What is the average fuel economy of new passenger vehicles sold today in your country?
- Target – Where will fuel economy need to be in the future?
- Identification of policies – Which measures are appropriate to reach the target?
- Quantification of policy measures – regulatory, monetary and soft measures

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

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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Baseline setting

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FE baseline setting: How to get from the vehicle registration database…

Country	Year	Vehicle Type	Model	Engine ccm	Engine kW	Fuel type	Transmission type	Emission standard	Vehicles registered	Final FE data, lge/100km
xxx	2013	Pass.	VW Polo	1199	55	Diesel	Manual	EURO5	614	4.1
xxx	2013	Pass.	VW Polo	1199	55	Diesel	Manual	EURO5	512	3.7
xxx	2013	Pass.	Renault Clio	1461	55	Diesel	Manual	EURO5	1474	3.9
xxx	2013	Pass.	Renault Clio	1461	55	Diesel	Manual	EURO5	1448	4.1
xxx	2013	Pass.	Renault Clio	1461	55	Diesel	Manual	EURO5	1140	4.3
xxx	2013	Pass.	Suzuki Grand Vitara	1870	95	Diesel	Manual	EURO5	217	7.5
xxx	2013	Pass.	Jaguar XF	2179	147	Diesel	Automatic	EURO5	20	5.8
xxx	2013	Pass.	Audi A7	2967	180	Diesel	Automatic	EURO5	37	6.5
xxx	2013	Pass.	Audi A7	2967	180	Diesel	Automatic	EURO6	29	6.4
xxx	2013	Pass.	BMW 535	2993	230	Diesel	Automatic	EURO6	2	6.0
xxx	2013	Pass.	BMW 535	2993	230	Diesel	Automatic	EURO5	1	6.2
xxx	2013	Pass.	Jeep Grand Cherokee	2987	184	Diesel	Automatic	EURO5	97	8.1
xxx	2013	Pass.	BMW X6	2993	180	Diesel	Automatic	EURO5	61	8.0
xxx	2013	Pass.	Citroen C5	1560	84	Diesel	Manual	EURO5	286	5.2
xxx	2013	Pass.	Citroen C5	1560	84	Diesel	Automatic	EURO5	247	4.8

…to the FEPIT input?

FEPIT

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**

Sales weighted average FE

SUM =SUMPRODUCT(J2:J16,K2:K16)/SUM(J2:J16)

SUMPRODUCT(**array1**, [array2], [array3], [array4], ...)

	A	B	C	D	E	F	G	H	I	J	K
1	Country	Year	Vehicle Type	Model	Engine ccm	Engine kW	Fuel type	Transmission type	Emission standard	Vehicles registered	Final FE data, lge/100km
2	xxx	2013	Pass.	VW Polo	1199	55	Diesel	Manual	EURO5	614	4.1
3	xxx	2013	Pass.	VW Polo	1199	55	Diesel	Manual	EURO5	512	3.7
4	xxx	2013	Pass.	Renault Clio	1461	55	Diesel	Manual	EURO5	1474	3.9
5	xxx	2013	Pass.	Renault Clio	1461	55	Diesel	Manual	EURO5	1448	4.1
6	xxx	2013	Pass.	Renault Clio	1461	55	Diesel	Manual	EURO5	1140	4.3
7	xxx	2013	Pass.	Suzuki Grand Vitara	1870	95	Diesel	Manual	EURO5	217	7.5
8	xxx	2013	Pass.	Jaguar XF	2993	180	Diesel	Automatic	EURO5	20	5.8
9	xxx	2013	Pass.	Audi A6	2967	180	Diesel	Automatic	EURO5	37	6.5
10	xxx	2013	Pass.	Audi A6	2967	180	Diesel	Automatic	EURO6	29	6.4
11	xxx	2013	Pass.	BMW 535	2993	220	Diesel	Automatic	EURO6	2	6.0
12	xxx	2013	Pass.	BMW 535	2993	230	Diesel	Automatic	EURO5	1	6.2
13	xxx	2013	Pass.	Jeep Grand Cherokee	2987	184	Diesel	Automatic	EURO5	97	8.1
14	xxx	2013	Pass.	BMW X6	2993	180	Diesel	Automatic	EURO5	61	8.0
15	xxx	2013	Pass.	Citroen C5	1560	84	Diesel	Manual	EURO5	286	5.2
16	xxx	2013	Pass.	Citroen C5	1560	84	Diesel	Automatic	EURO5	247	4.8
17											
18	Total average									6185	4.4
19											
20	<4									1986	3.8
21	4 to 5									3449	4.2
22	5 to 6									306	5.2
23	6 to 7									69	6.4
24	>7									375	7.7

$$FE = \frac{\sum_i^n Sales_i \times FE_i}{\sum_i^n Sales_i}$$

Baseline – minimum data requirement

Number of sales in at least one past year by:

- Vehicle make and model
- Year of first registration
- Model production year (important for used imports)
- Engine displacement (liters or cubic centimeters)
- Engine power (kW or HP)
- Fuel type
- Rated fuel economy (alternatively CO2 emission) and test cycle basis (NEDC, FTP, JC08)

Baseline data – “nice to have”

Number of sales in at least one past year by:

- Transmission type (automatic, number of gears)
- Vehicle footprint (wheelbase x track width)
- Vehicle weight (mass in running order)
- Axle configuration (4x2, 4x4)
- Vehicle price

Baseline setting challenges

- **Level of detail available**
  - Accuracy depends on level of detail of registration database – ideally: Manufacturer, model, engine displacement, engine power, fuel, transmission
- **Used imports vs. new sales**
- **Availability of alternative sources to fill gaps, example: FE data by model**
  - FE data – EEA, EPA, Chinese government website…

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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 average fuel consumption (or CO2 emissions) computed as weighted average of new registrations
- Regulatory limit set for a specific time horizon
- Can be achieved by manufacturers through technical development or changes in the models mix
- FEPIT allows setting targets according to
  - Global Fuel Economy Initiative (GFEI) target: 4.2 lge/100 km for new vehicle tested fuel economy in the year 2030
  - Region-specific considerations

CO_2-Based vehicle registration tax/feebate

- 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)
- "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)
- FEPIT allows 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)

CO_2-Based vehicle circulation tax/feebate

- Circulation tax: a fee paid generally on a yearly basis by each registered vehicle irrespective whether the vehicle is actually used or not
- Unlikely to be a feebate
- FEPIT allows 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)

Fuel taxation

- Fuel taxes: duties paid on the quantity of fuel purchased. In general, excises and value added taxes (excises can vary according to fuel type)
- FEPIT allows 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 is expected to be upwards. Nevertheless, also (limited) reductions of fuel taxation are accepted
- FEPIT does not deal with fuel tax differentiation (i.e. between gasoline and diesel)

Methodological approach

Results of the policies reported in terms of:

- Changes in average fuel economy of new registrations (lge/100km)
- Changes in new registrations composition

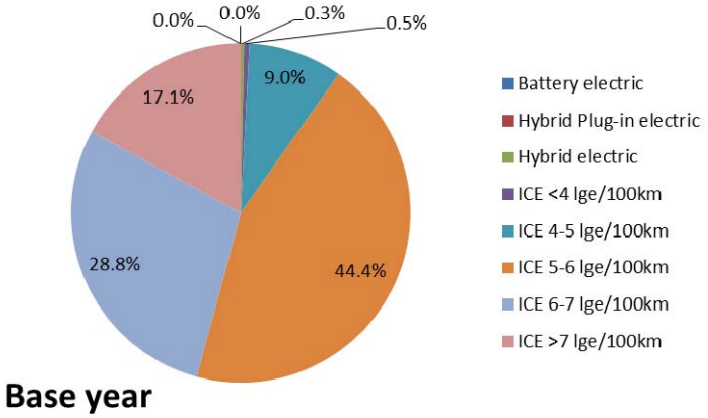
Estimation of the impacts based on:

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

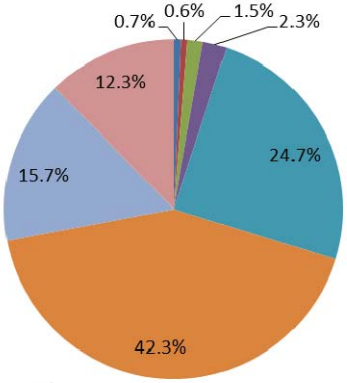
Methodological approach

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

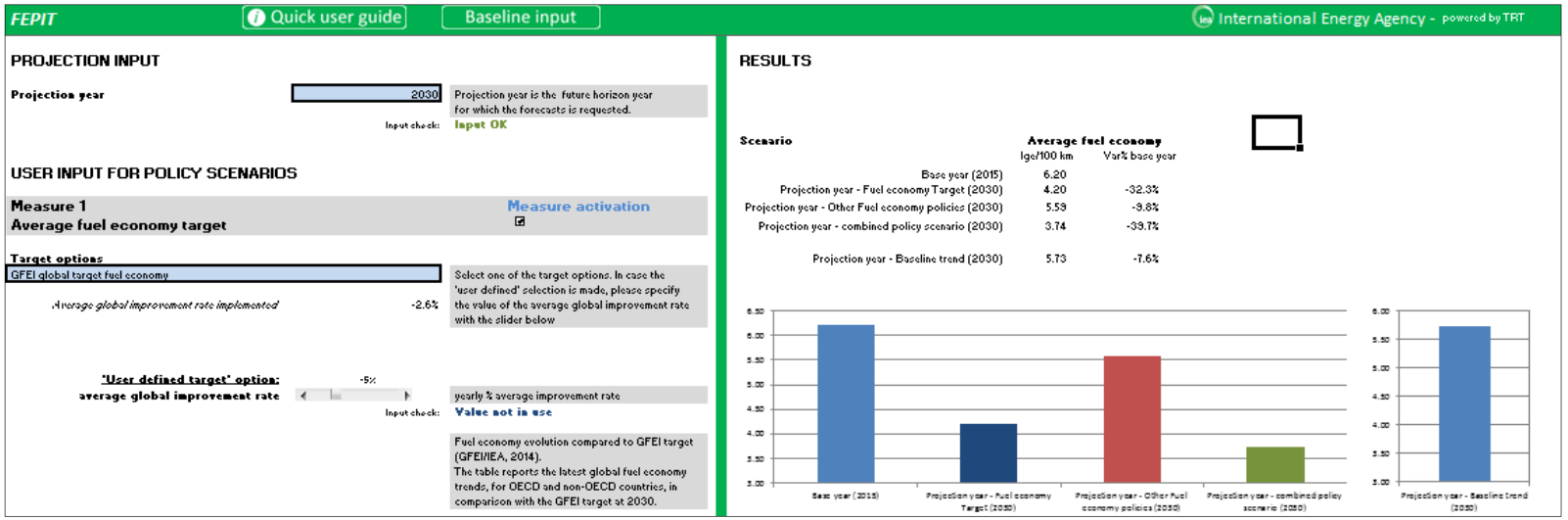
Use of FEPIT

1.) Baseline input

- Filling the baseline input fields

2.) Projection input and results worksheet:

- Setting the assumptions for the policy scenarios
- Reading the results of the calculations



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FEPIT - Projection input and results sheet

- **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 -3.1%
  - **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%)**

FEPIT - Projection input and results sheet (2)

- 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: fast (exogenous trend pre-determined in the tool with fast development)
  - D. Exogenous trend: slow development (exogenous trend pre-determined in the tool with slow development)

FEPIT – Additional sheets

Quick user guide: indications on the content of the tool

Baseline scenario calculations: calculation of baseline trend for new registration composition and average fuel economy of each segment

Policy scenario calculations: calculation of combined policy impact on new registration composition and average fuel economy of each segment

Conversion factors and parameters: 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 (1)

- Criteria for setting the fuel consumption thresholds
  - Requires analysis of detailed data from national registers, including information on fuel economy
  - Current mix needs to be reasonably balanced (i.e. all classes have non-zero values and a reasonable distribution)
  - Future mix needs to be represented significantly (e.g., a relatively 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 are used)

Hints for using FEPIT (2)

- 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 (3)

- 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 (4)

- **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 (5)

- **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 (6)

- 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

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FEPIT validation

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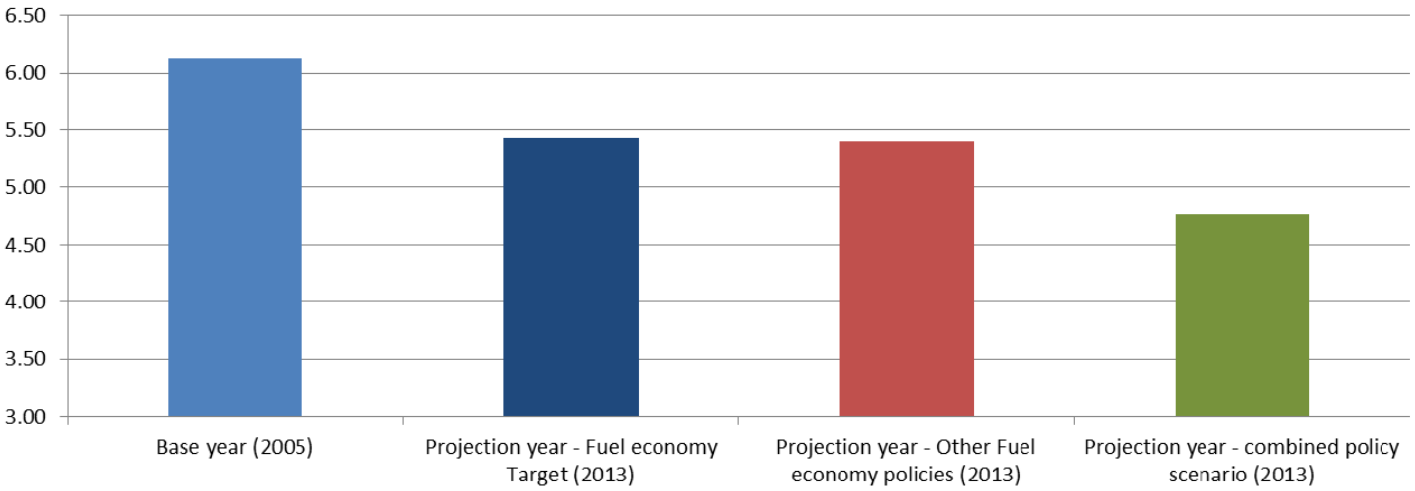
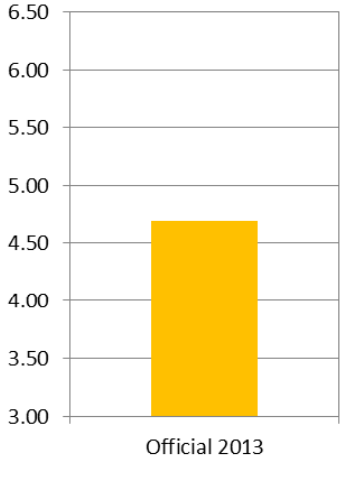
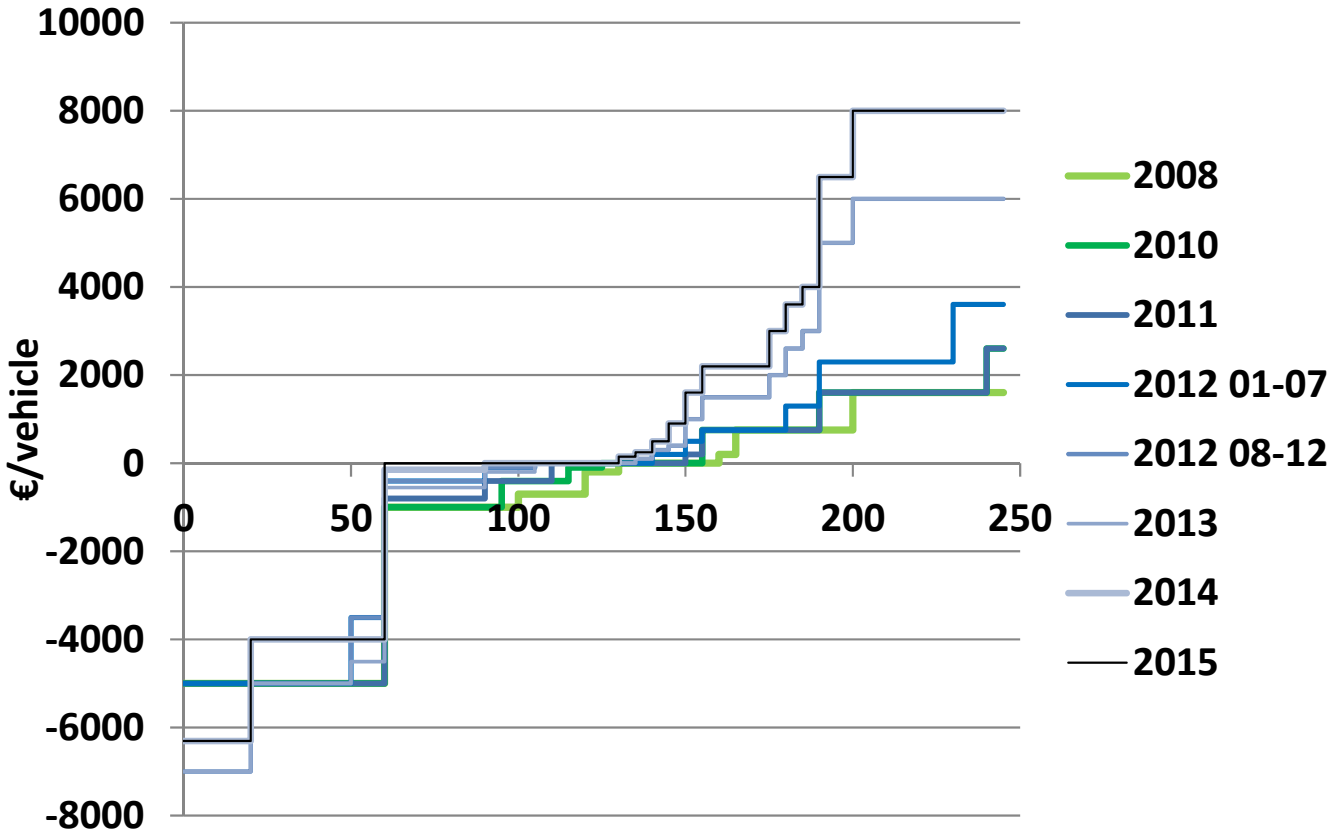
France: back casting exercise 2005 to 2013

- GFEI data for 2005 as baseline
- Projection year: 2013
- Comparison of results: 2% deviation projection vs. 2013 data





France – simplifying "feebate" input



- The fees have risen and the rebates declined over time
- Average values per emission interval need to be estimated for FEPIT input

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Thanks!

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FEPIT – User guide

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Structure of FEPIT

Baseline input worksheet: description of the initial conditions

- Base year

Base year	2015	Base year is the current situation, the latest for which observed data is available.
	Input check:	Input OK

- 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

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)	
Battery electric	1.50	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).
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)	
Battery electric		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
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

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

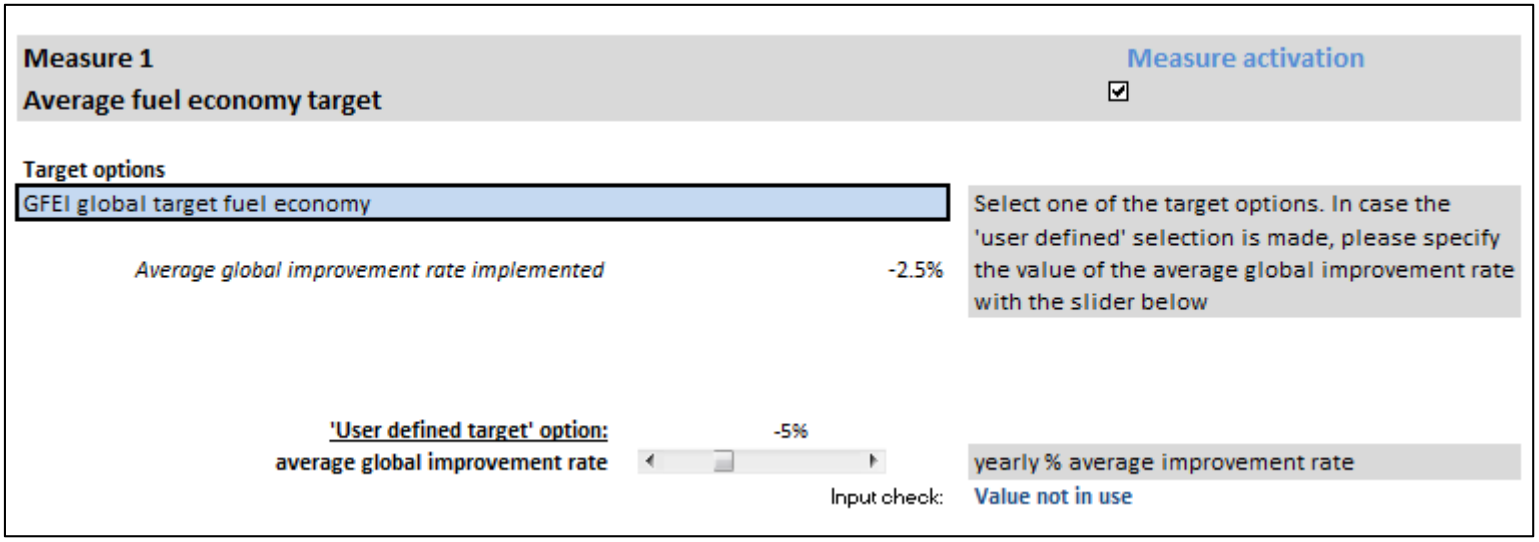
Projection input and results worksheet: setting the policy scenarios and reading the results of the calculations

- 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



Measure 1 Average fuel economy target		Measure activation ☑
Target options		
GFEI global target fuel economy		Select one of the target options. In case the 'user defined' selection is made, please specify the value of the average global improvement rate with the slider below
Average global improvement rate implemented	-2.5%	
'User defined target' option: average global improvement rate	-5%	yearly % average improvement rate
	Input check:	Value not in use

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			Measure activation
Fuel taxation			☑
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

NEW CARS REGISTRATIONS TREND

New registrations base trend

endogenous changing compositon of new registrations according to past trend

Input check: Input OK

New registrations fuel consumption base trend

endogenous changing fuel consumption of new registrations according to past trend

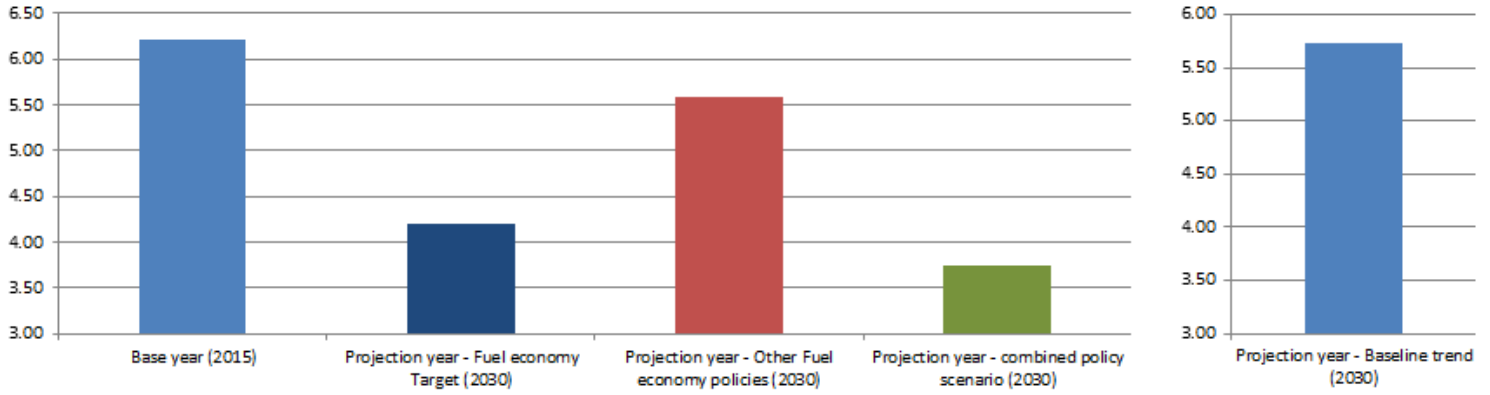
Input check: Input OK

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%



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)

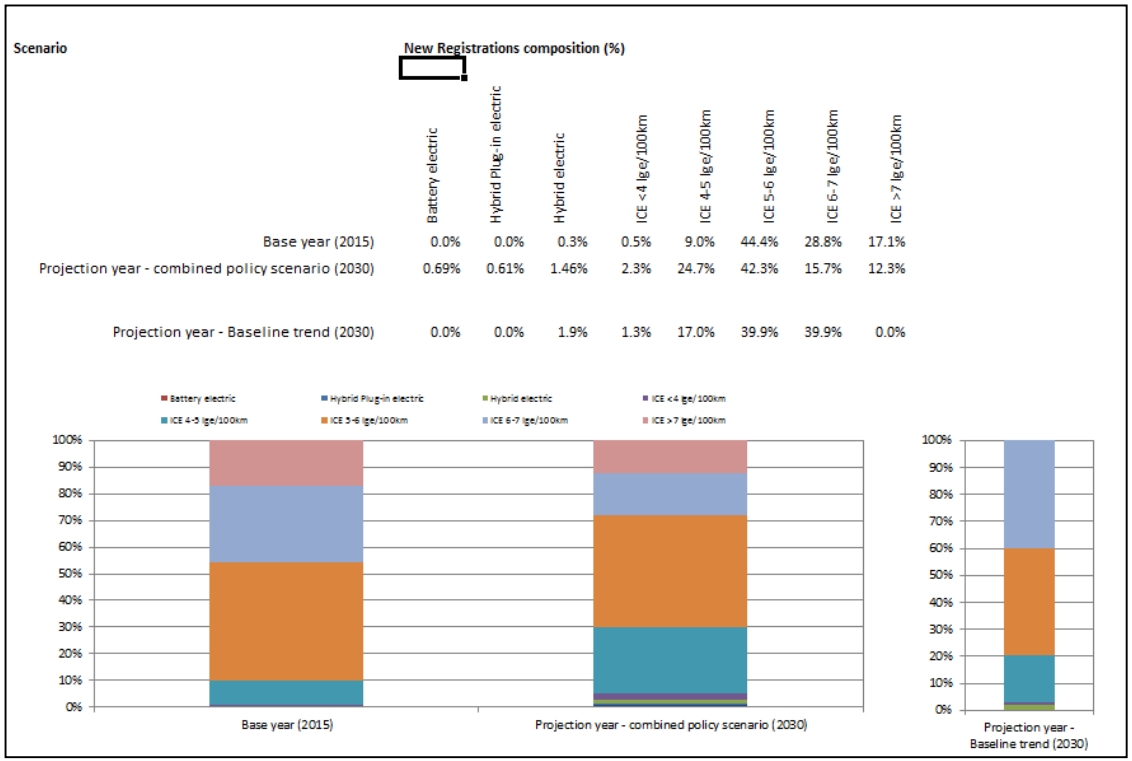
Scenario	Average CO2 emissions per km g CO_2/km
Base year (2015)	154.6
Projection year - Fuel economy Target (2030)	104.7
Projection year - Other Fuel economy policies (2030)	139.4
Projection year - combined policy scenario (2030)	93.3
Projection year - Baseline trend (2030)	142.9

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%



FEPIT – Methodology

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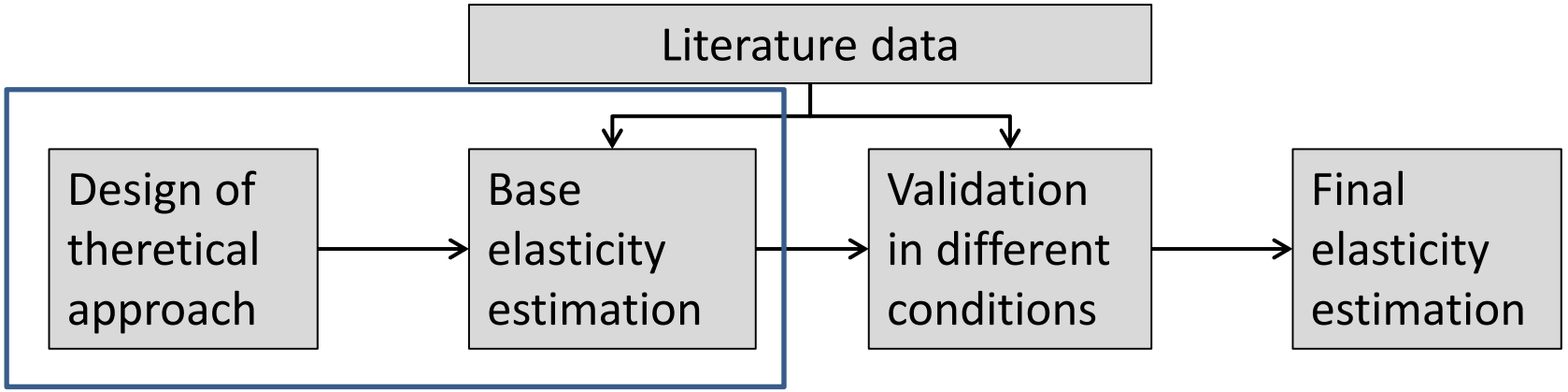
Methodological approach

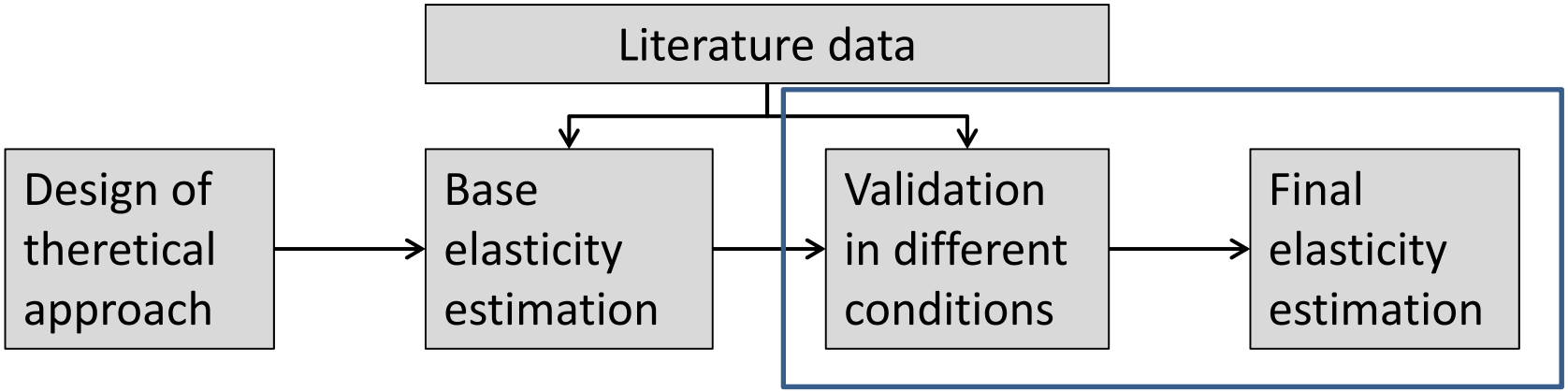
- **Elasticity parameters estimated on the basis of literature data to provide realistic responses in different conditions**



Methodological approach

Validation in different conditions:

- Simulating various case studies
- Revision of the elasticity parameters



Methodological approach

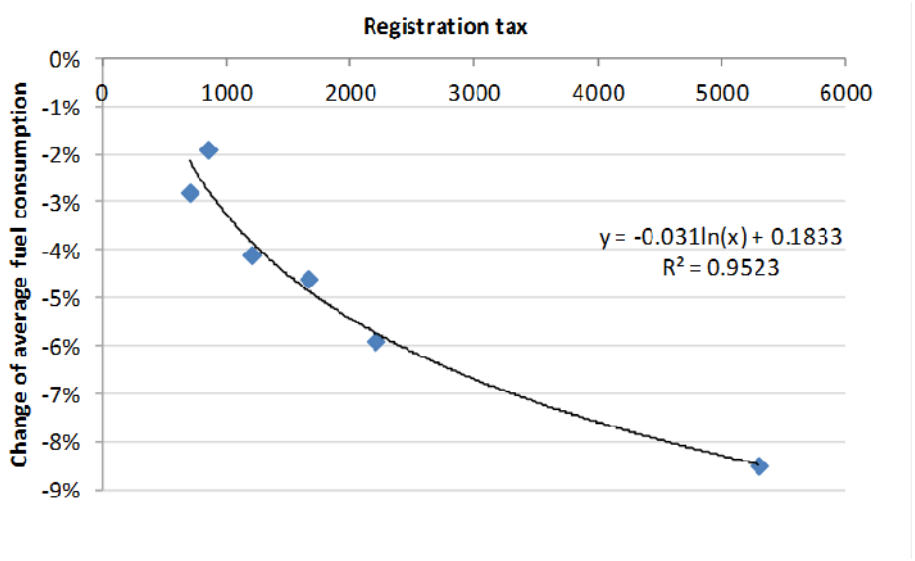
Theoretical approach

- 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)

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, Greene et al. (2011)]*



  - Function estimated on COWI (2002) data, generated by registration tax under a fleet neutrality assumption

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)

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**