



A financial impact analysis of market conditions and policy measures on total costs of vehicle ownership

Elisabeth Windisch

► To cite this version:

Elisabeth Windisch. A financial impact analysis of market conditions and policy measures on total costs of vehicle ownership. Annual Summit of the International Transport Forum, Leipzig, Germany. 2011. hal-00676021

HAL Id: hal-00676021

<https://enpc.hal.science/hal-00676021>

Submitted on 2 Mar 2012

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Context

- National governments are on the verge of launching public policies that aim at promoting the introduction of EVs and the development of necessary infrastructure.
- The financial impact on the single user of such policies and of EV ownership in general has not been studied sufficiently.
- Existing financial studies frequently take a very *generalized* and *aggregate* perspective; underlying assumptions are often not revealed.
- Results of such studies are difficult to interpret and only meaningful if applied to the regarded region.
- Generalizations render subsequent demand analyses extremely approximate.

Study	Area	Results - EV/CV Comparison
<i>Funk and Rabi (1999)</i>	France	EVs 30-40% more expensive than CVs
<i>Carlsson and Johansson-Stenman (2002)</i>	Sweden	Cost break-even at \$3840 subsidy for EVs
<i>Figliozzi et al. (2010)</i>	US	EVs are not profitable in vehicle fleets in a 14 year time frame (base case scenario)
<i>Delucchi, Lipman (2001)</i>	US	Cost break-even at 0,59 \$/l fuel retail price
<i>BCG (2009)</i>	Germany	Cost break-even at 280 \$/barrel oil price in 2020 (or at 120 \$/barrel if battery costs 500 \$/kWh)
<i>Deutsche Bank (2009)</i>	US	Cost break-even at 1,05\$/l (or 4\$/gallon) fuel retail price
<i>EDF (2009)</i>	France	2012: EV 16c/km more costly than CV, 2020: EV 6c/km more costly than CV

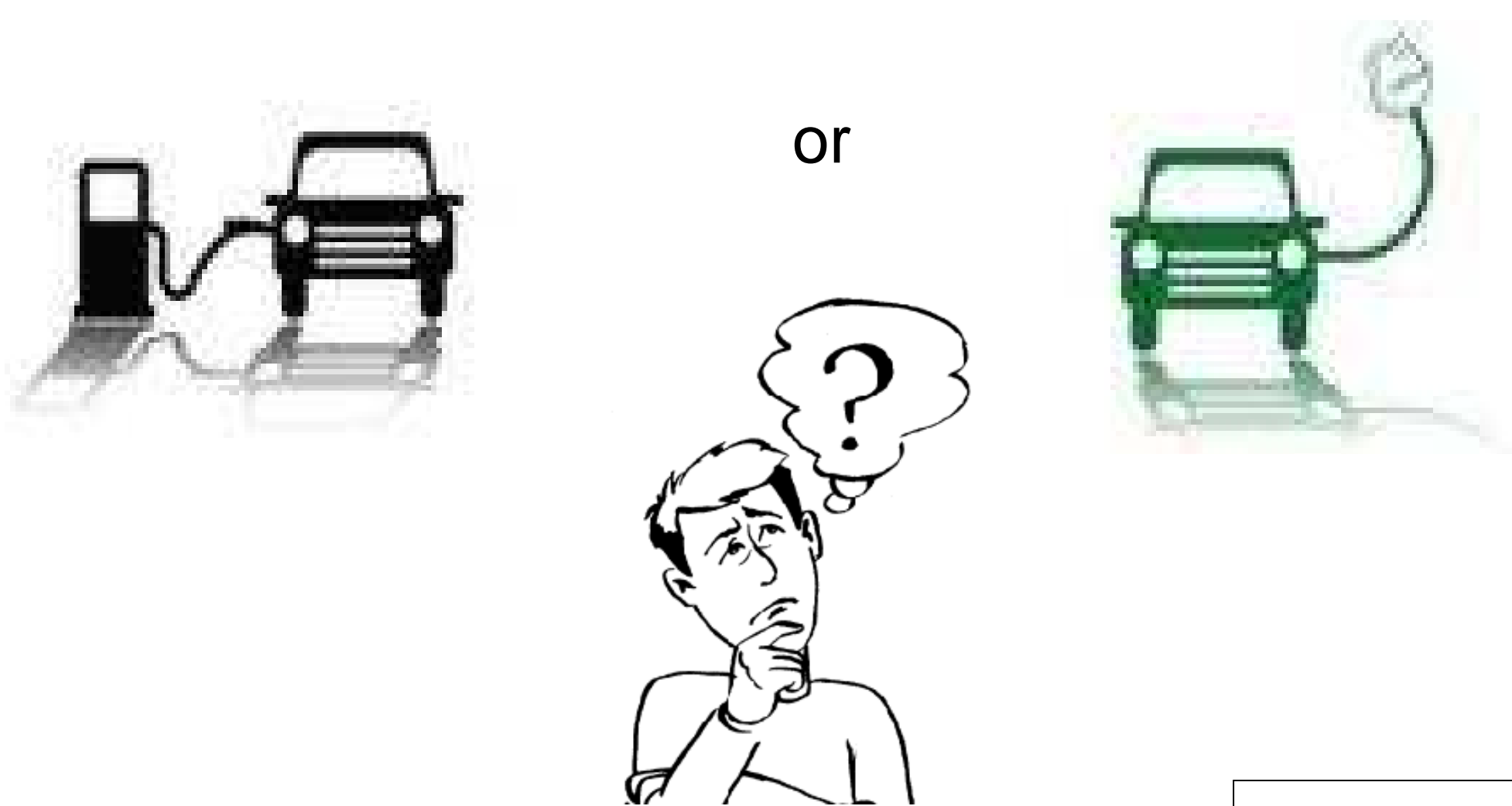
Table 1 (CV – conventional vehicle)

Objective

The objective is to carry out a disaggregate financial cost-benefit analysis for the Paris region comparing EVs with CVs that

- allows testing the influence of **varying vehicle user/usage characteristics**, **changing market developments** and **diverse policy settings**
- has the potential to serve as profound basis for future EV demand analyses

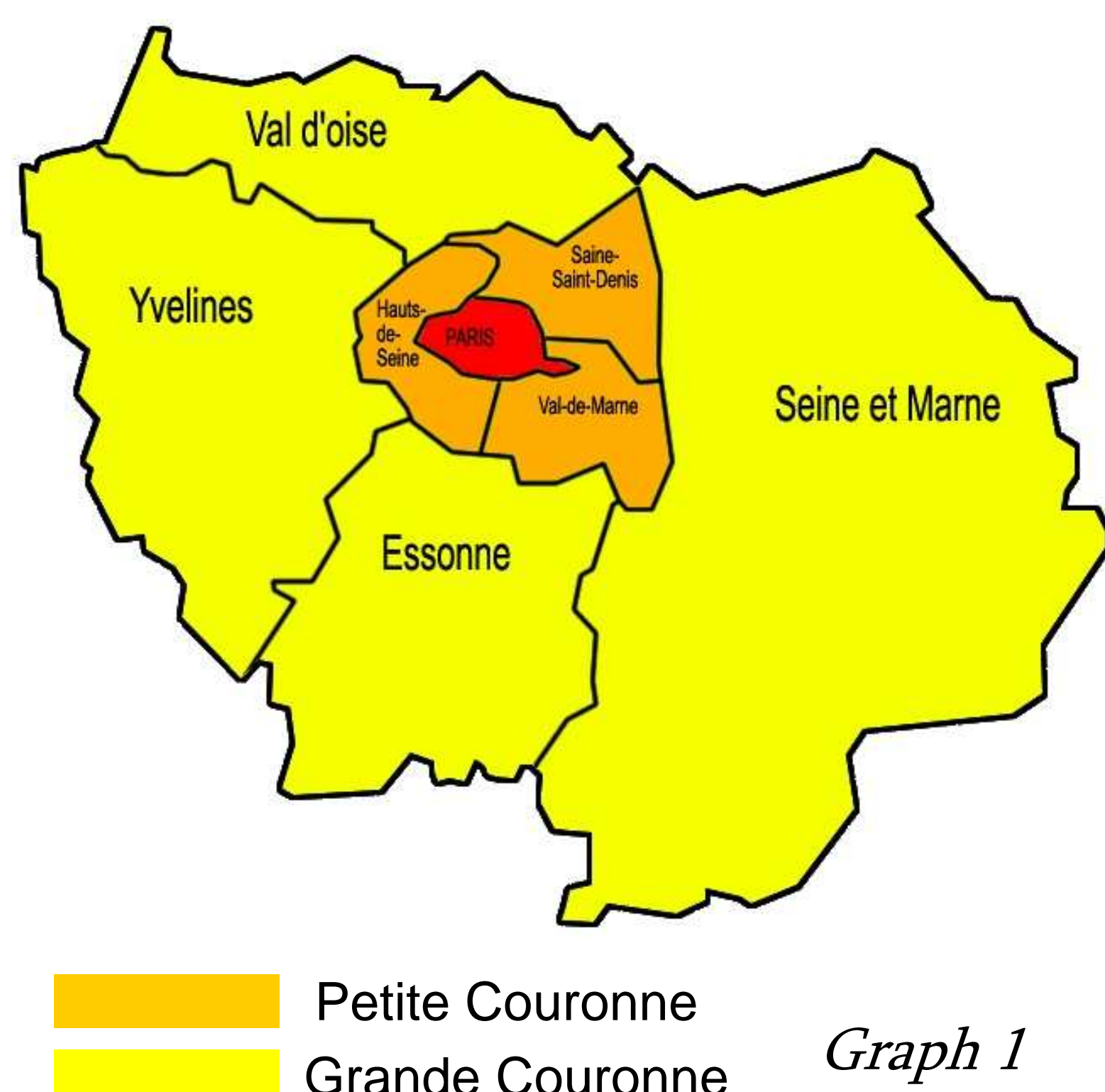
Methodology



The perspective from a single vehicle user (or potential vehicle buyer) is studied by taking:

- ✓ a **holistic TCO approach** that accounts for all direct (e.g. maintenance costs) and indirect (e.g. parking costs) cost components
- ✓ a **'dynamic' approach** that allows for a changing market environment over time (e.g. concerning fuel prices)
- ✓ a **territorial approach**, which refers to a well defined region and allows an adequate level of detail of regional parameters (e.g. parking costs)
- ✓ **latest data** of most recent EV/CV models into consideration

Characteristics of the Ile-de-France region (IDF)



IDF is divided into the 3 residential zones (1) Paris, (2) Petite Couronne and (3) Grande Couronne for the definition of area (and user) specific parameters

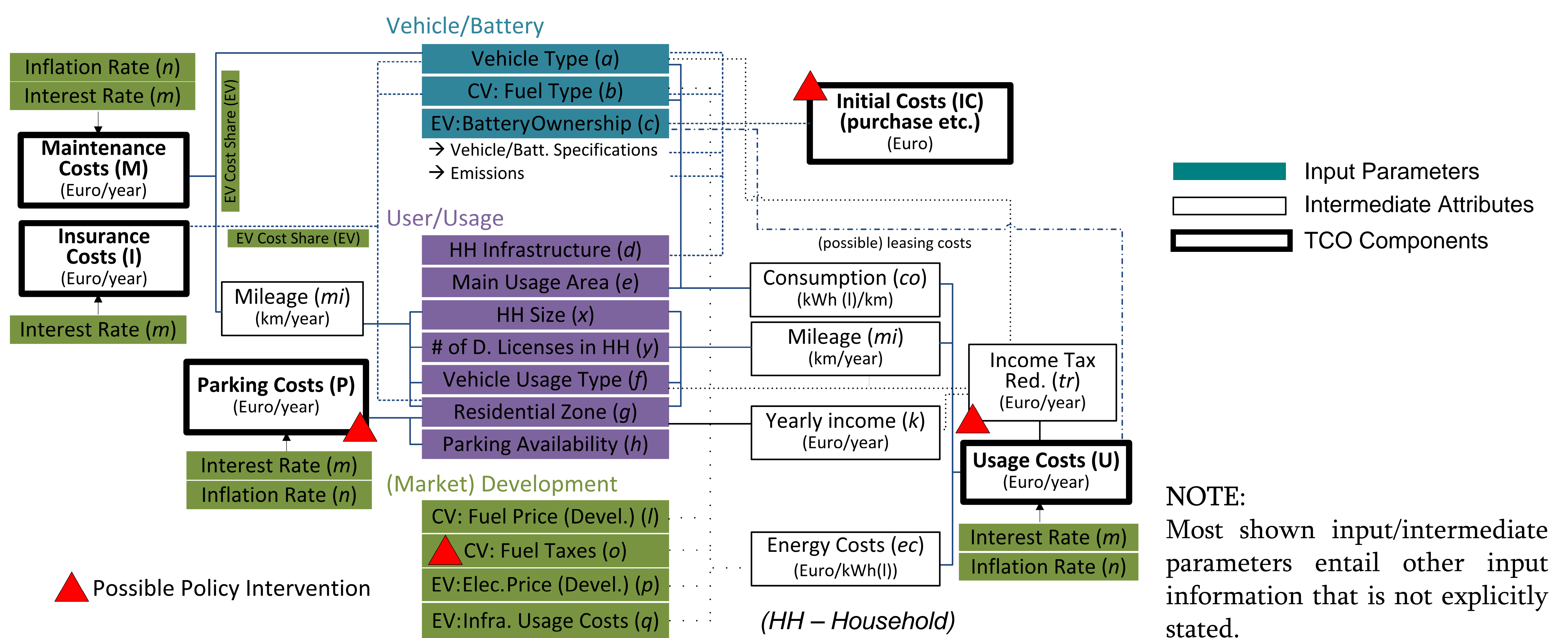
	Vehicle/Battery Characteristics				
	Compact			Sedane	
	CV Petrol	CV Diesel	EV	CV Diesel	EV
Reference Vehicle	Renault CLIO	Renault CLIO	Renault ZOE	Renault Fluence	Fluence Z.E.
Purchase Price (EUR)	16 650	17 450	21 000	22 850	26 300
CO2 emission (g/km)	129	115	0	120	0
Power (kW)	74	50	60	81	70
Petrol usage (l/100km)	7,6	5,3	-	6,0	-
Electricity usage (kWh/100km)	-	-	10,13	-	12,38
Battery Purchase Price kWh Battery	-	-	7 200	-	8 800
EUR/kWh Battery (assumption)	-	-	18	-	22
Battery Lease Price (€/month)	-	-	400	-	400
	-	-	69	-	79

Table 2

The Uptake of Electric Vehicles (EVs) in the Paris region

A financial analysis of territorial impacts, market conditions and policy measures on total costs of vehicle ownership (TCO)

TCO Model Setup



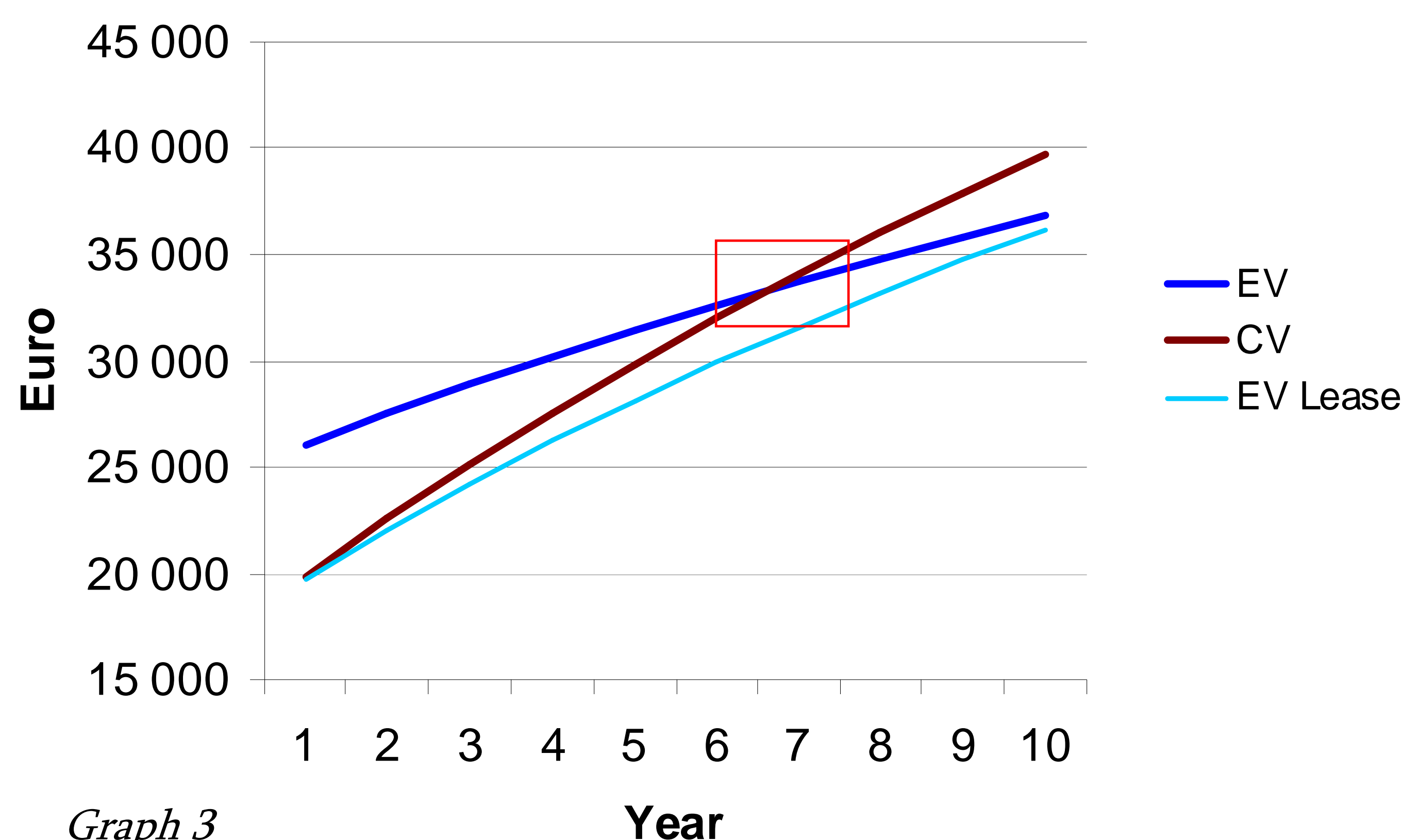
Graph 2

Results for the Reference Scenario

TCO AFTER 10 YEARS

Vehicle Type	TCO (Euro)			TCO/km (Euro/km)		
	EV	CV	EV - Lease	EV	CV	EV - Lease
Initial Costs	24 553	16 980	17 353	0,205	0,141	0,145
Vehicle Usage Costs	1 589	9 790	7 542	0,013	0,082	0,063
Fuel/El. Costs	1 130	9 790	1 130	0,009	0,082	0,009
Infrastructure Usage	459	0	459	0,004	0,000	0,004
Battery Leasing Costs	0	0	5 952	0,000	0,000	0,050
New Battery Costs	0	0	0	0,000	0,000	0,000
Tax Reduction	0	0	0	0,000	0,000	0,000
Maintenance Costs	1 274	2 548	1 274	0,011	0,021	0,011
Insurance Costs	3 082	3 853	3 082	0,026	0,032	0,026
Parking Costs	6 321	6 321	6 321	0,053	0,053	0,053
Interest Gains	-	203	606	-	0,002	0,005
Total	36 819	39 491	35 572	0,307	0,329	0,296

TCO DEVELOPMENT OVER TIME



Graph 3

SCENARIO SETTINGS

		Annual driving distance (km)	12 000
Vehicle/Battery Specifications			
Vehicle type	compact	Fuel type	Benzine
Battery ownership	purchase		
User Specifications		Usage Specifications	
Residential zone	Paris	Vehicle usage (in years)	10
# of vehicles in HH	1	Main usage area	urban (city)
# of driving licences in HH	1	Vehicle usage type	private use
Home installation costs	yes		
Private parking availability	yes		
Market Development			
Oil price development	medium	EV Maintenance cost share	50
Market interest rate (%)	0,065	EV Insurance cost reduction	20
Yearly inflation rate (%)	0,017		
Policy Intervention			
EV purchase subvention (€)	5000	Public Parking Policy	no policy
Increase of TIC by (%)	0	Registration tax exemption	yes

BREAK EVEN ANALYSES

MILEAGE Break Even	
B/E Mileage (per year)	7 802
B/E TCO (Euro)	35 818

FUEL PRICE Break Even	
B/E Price 2020 (before tax)	0,76
B/E TCO (Euro)	36 819

Payback Time (years)	7
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Break Even Analyses explore under which conditions the EV pays off in year 10 (all other settings being unchanged)

The Payback Time shows after which ownership period the EV becomes profitable (all other settings being unchanged).



Elisabeth WINDISCH
LVMT, Ecole des Ponts ParisTech, Université Paris-Est, France
elisabeth.windisch@enpc.fr

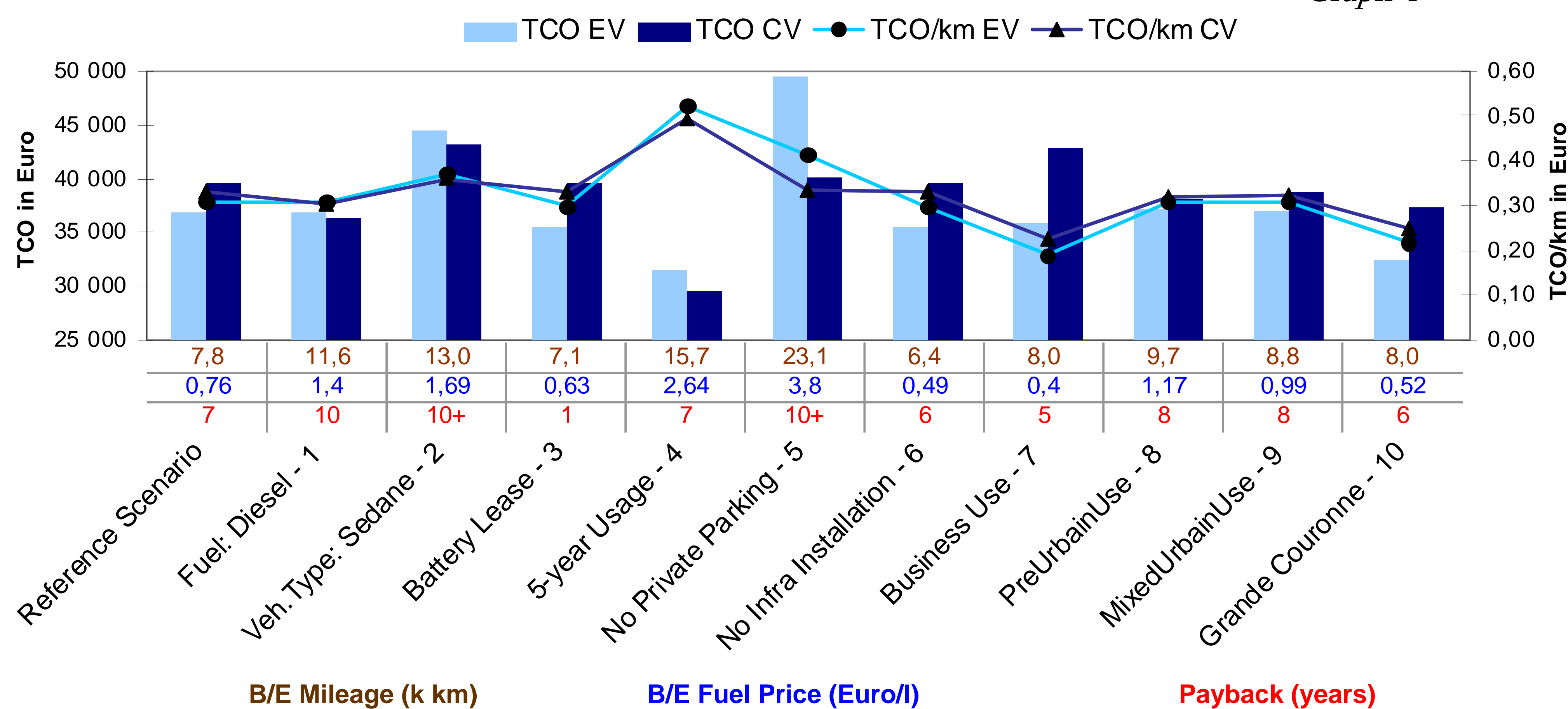
Scenario Analysis

The Reference Scenario, serving as basis for all following scenarios, is NOT an average scenario. Chosen settings even-out the TCO of the EV and the CV. This way a distorted picture of all subsequent scenarios is avoided.

The created scenarios differ from the reference scenario only by the change of one single parameter setting (as indicated by the scenario name).

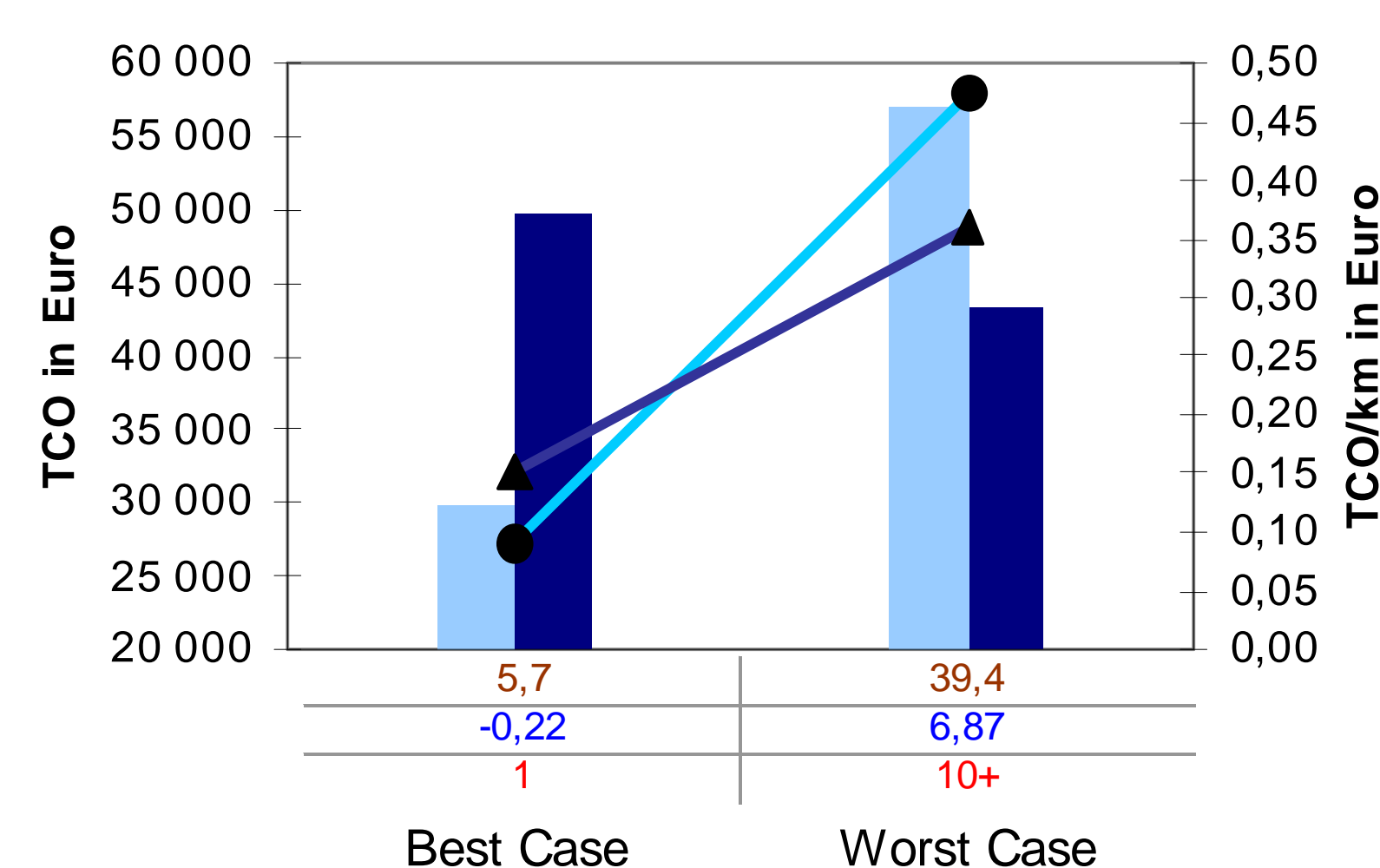
VEHICLE / USER / USAGE SCENARIOS – RESULTING TCO

Graph 4



Private parking facilities (scen. 5) are essential for the profitability of an EV. Battery leasing makes EVs profitable from year 1 onwards (scen. 3). Elevated yearly mileage makes the EV profitable at an earlier stage (scen. 7, 10).

Overall Best and Worst Case scenarios show the possible magnitude of the impact of vehicle / user / usage characteristics on TCO.

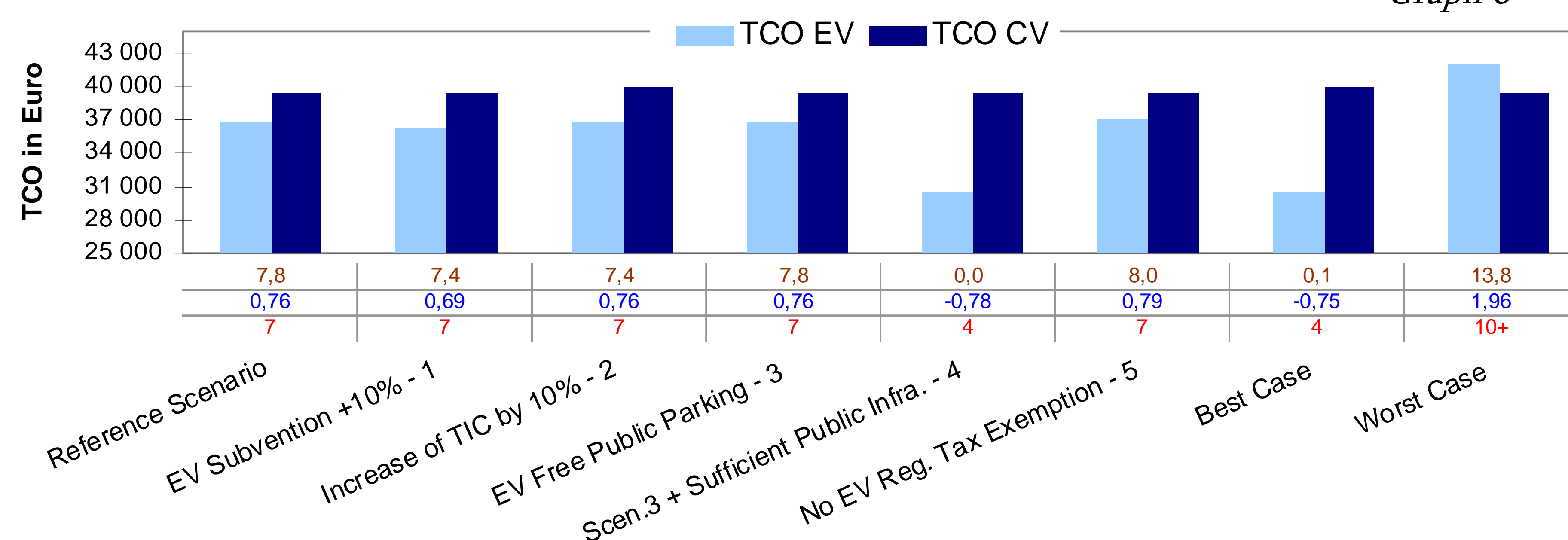


Graph 5

TCO (Euro)	Best Case			Worst Case		
	EV	CV	EV - Lease	EV	CV	EV - Lease
Initial Costs	16 003	16 980	16 003	31 453	23 126	22 653
Vehicle Usage Costs	6 114	20 981	6 114	1 994	6 221	8 809
Fuel/El. Costs	3 108	26 922	3 108	1 535	6 221	1 535
Infrastructure Usage	1 263	0	1 263	459	0	459
Battery Leasing Costs	5 952	0	5 952	0	0	6 815
New Battery Costs	0	0	0	0	0	0
Tax Reduction	-4 209	-5 941	-4 209	0	0	0
Maintenance Costs	3 504	7 008	3 504	1 529	3 058	1 529
Insurance Costs	2 473	3 091	2 473	3 623	4 529	3 623
Parking Costs	1 726	1 726	1 726	18 501	6 321	18 501
Interest Gains	-	-2 301	0	-	2 123	793
Total	29 820	49 786	29 820	57 100	43 254	55 115

POLICY SCENARIOS – RESULTING TCO

Graph 6



Especially policy levers concerning public parking facilities (even more so if equipped with charging infrastructure – scen. 4) show to have significant impact in the IDF region.

Conclusions

- ‘Alternative’ business models, such as the lease of the battery, are essential for a short payback time and the overall profitability of an EV. (Graph 3)
- Characteristics of the vehicle user and the vehicle usage have significant impact on TCO. (Graph 4 +5)
- Policy measures can have considerable impact on TCO – especially if focused on public parking facilities.
- Realistic scenario settings show that the purchase and the ownership of an EV can be financially profitable in the IDF region.
- In order to serve as profound basis for demand analyses, TCO studies should be carried out on disaggregate level taking the heterogeneity of potential vehicle buyers and geographic regions into account.