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

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

Table 1 (CV – conventional vehicle)

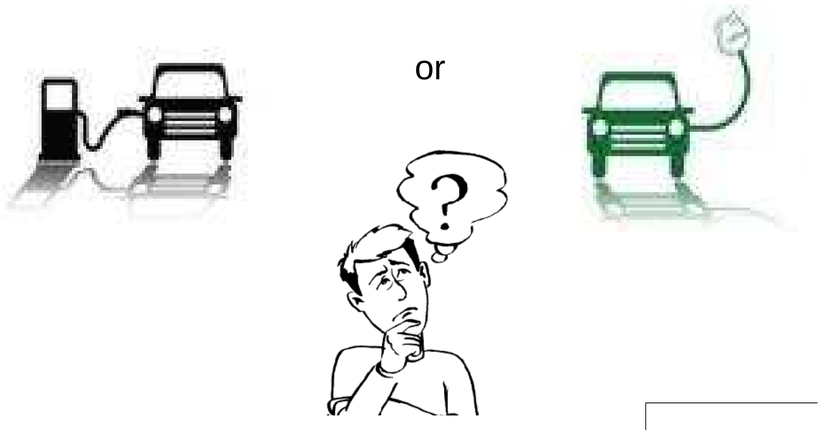
Objective

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

(1) allows testing the influence of varying vehicle user/usage characteristics, changing market developments and diverse policy settings

(2) has the potential to serve as profound basis for future EV demand analyses

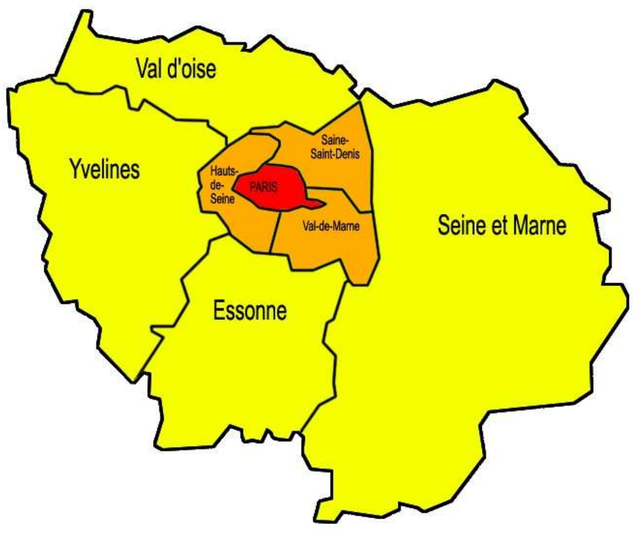
Methodology



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)



Graph 1

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

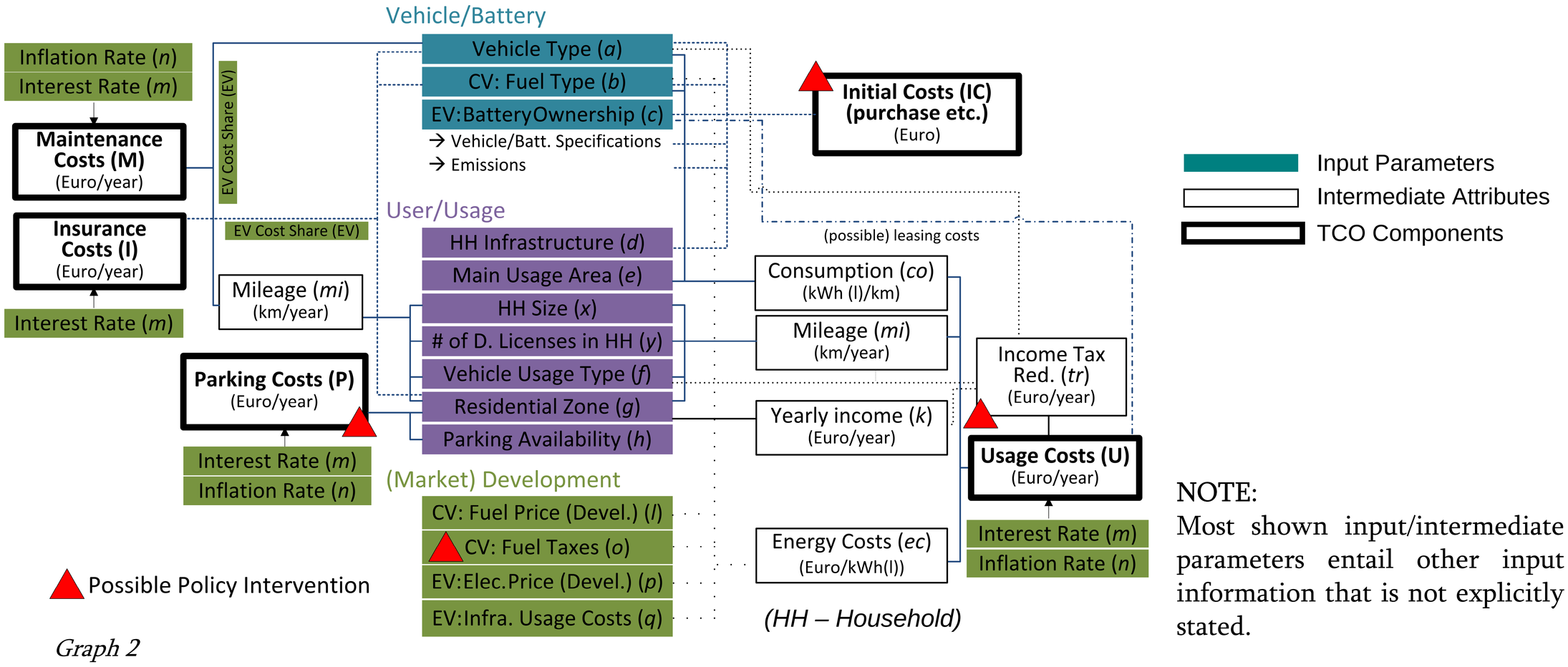
Vehicle/Battery Characteristics					
	Compact			***Sedane***	
	CV Petrol	**CV Diesel**	**EV**	**CV Diesel**	**EV**
Reference Vehicle	*Renault CLIO*	*Renault CLIO*	*Renault ZOE*	*Renault Fluence*	*Fluence Z.E.*
Purchase Price (EUR)	16 650	17 450	21 000	22 850	26 300
CO2 emission (g/km)	129	115	0	120	0
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	-	-	7 200	-	8 800
kwH Battery	-	-	18	-	22
EUR/kWh Battery (assumption)	-	-	400	-	400
Battery Lease Price (€/month)	-	-	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

NOTE:
Most shown input/intermediate parameters entail other input information that is not explicitly stated.

Results for the Reference Scenario

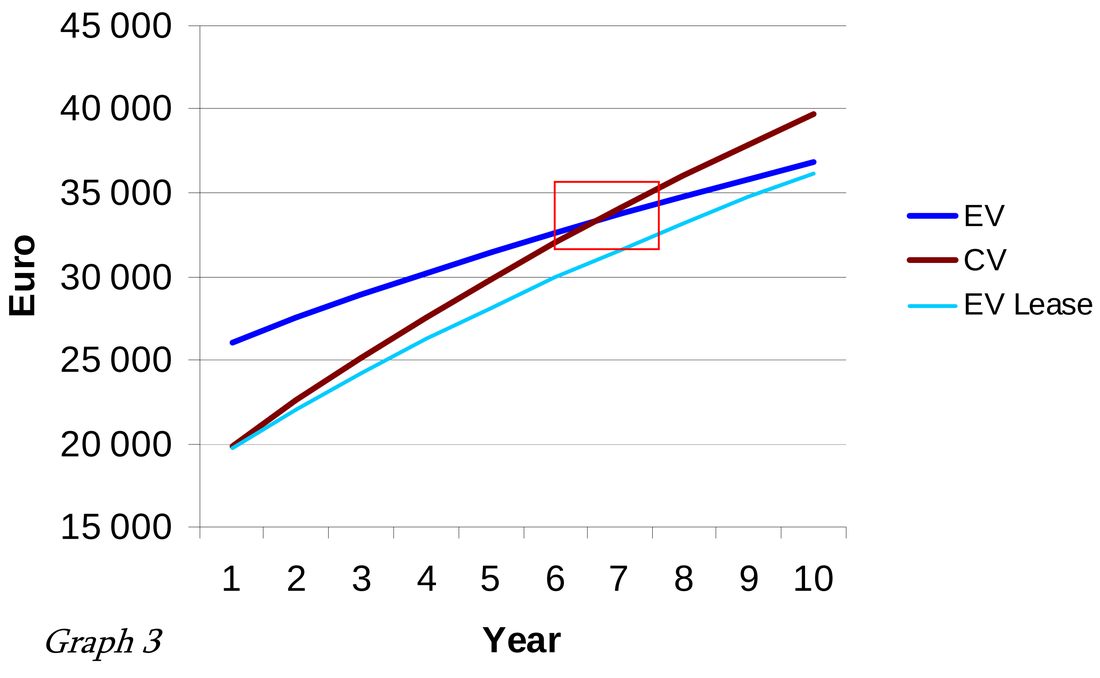
TCO AFTER 10 YEARS

	TCO (Euro)			TCO/km (Euro/km)		
Vehicle Type	*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**

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**		
# of vehicles in HH	**1**	Vehicle usage (in years)	**10**
# of driving licences in HH	**1**	Main usage area	**urban (city)**
Home installation costs	**yes**	Vehicle usage type	**private use**
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**

TCO DEVELOPMENT OVER TIME



Graph 3

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**

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).

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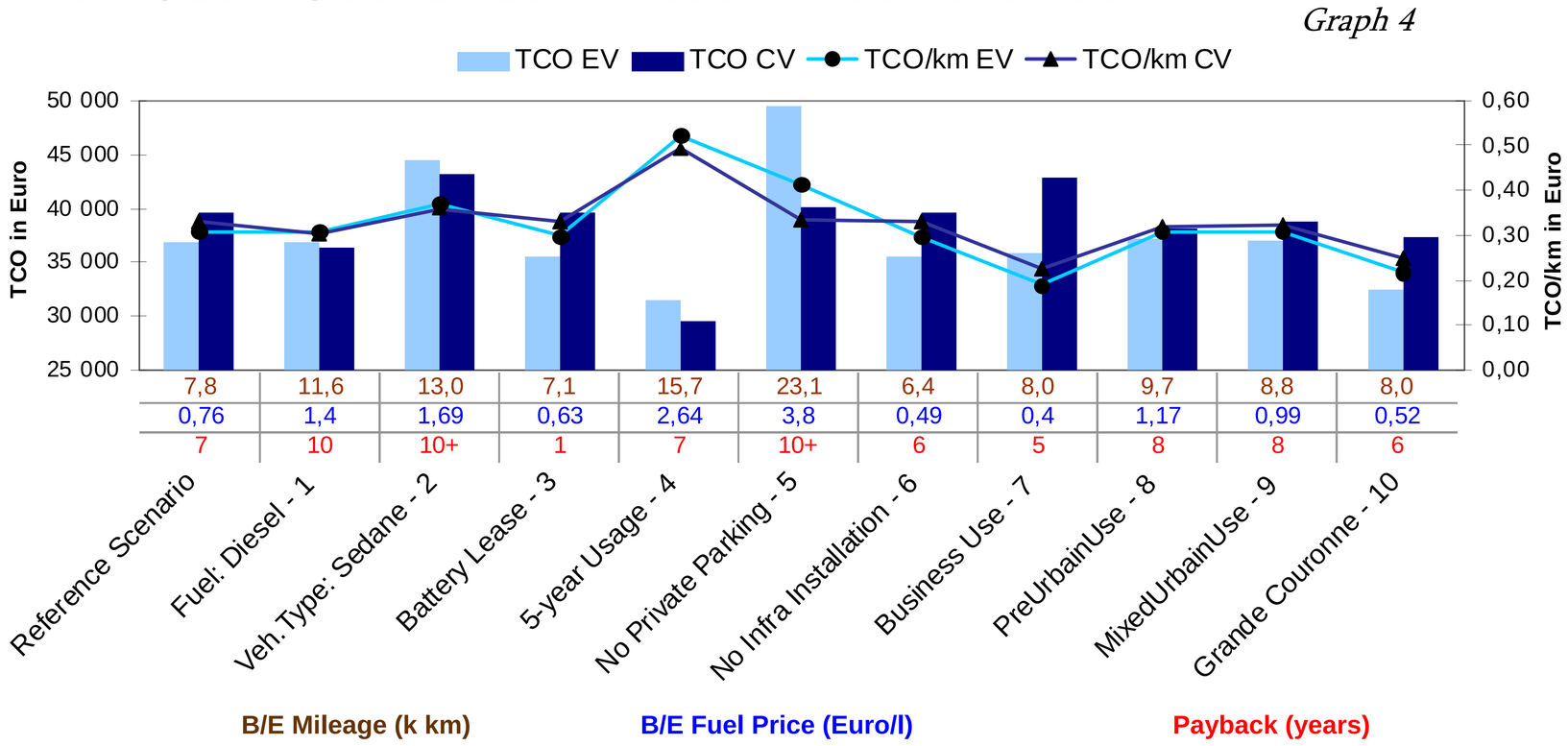
Scenario Analysis

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).

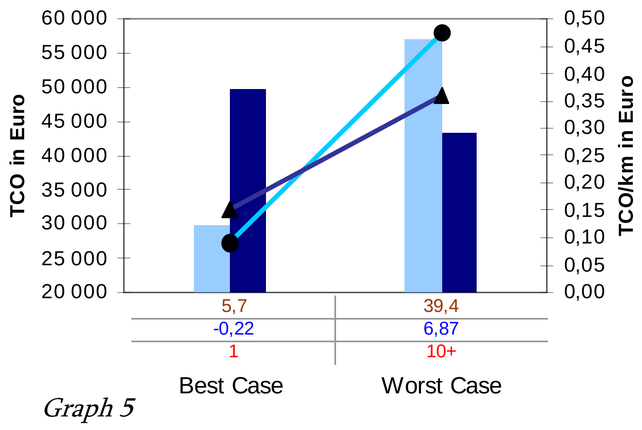
VEHICLE / USER / USAGE SCENARIOS – RESULTING TCO

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.

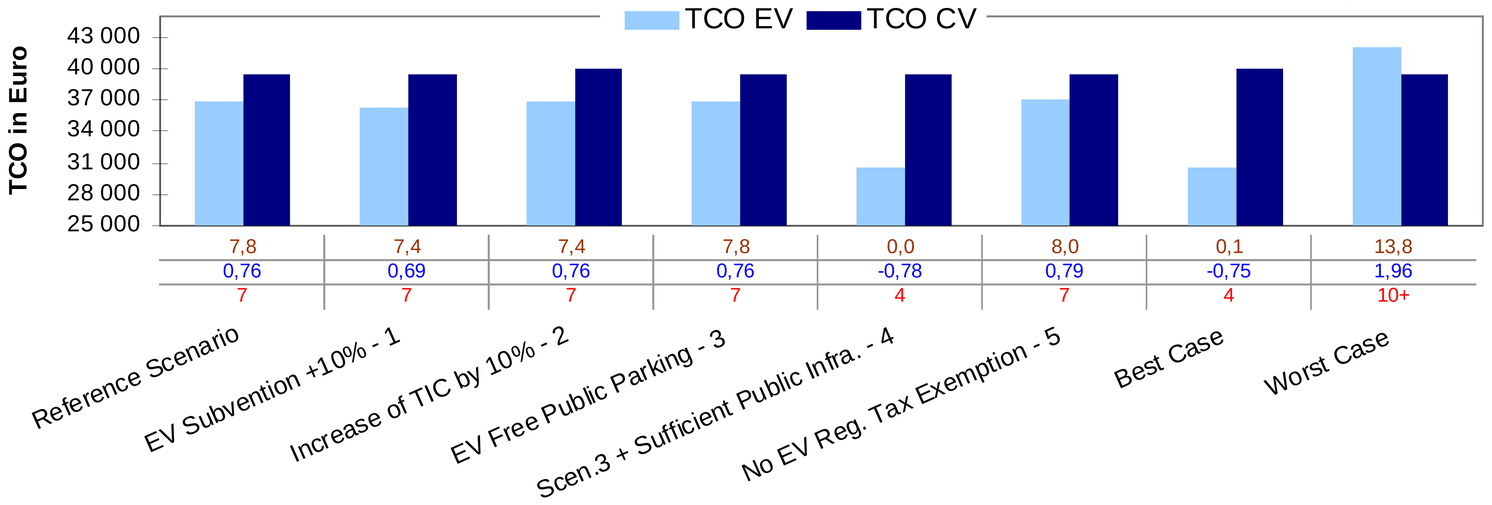


Graph 5

TCO (Euro)	Best Case			Worst Case		
Vehicle Type	*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.