

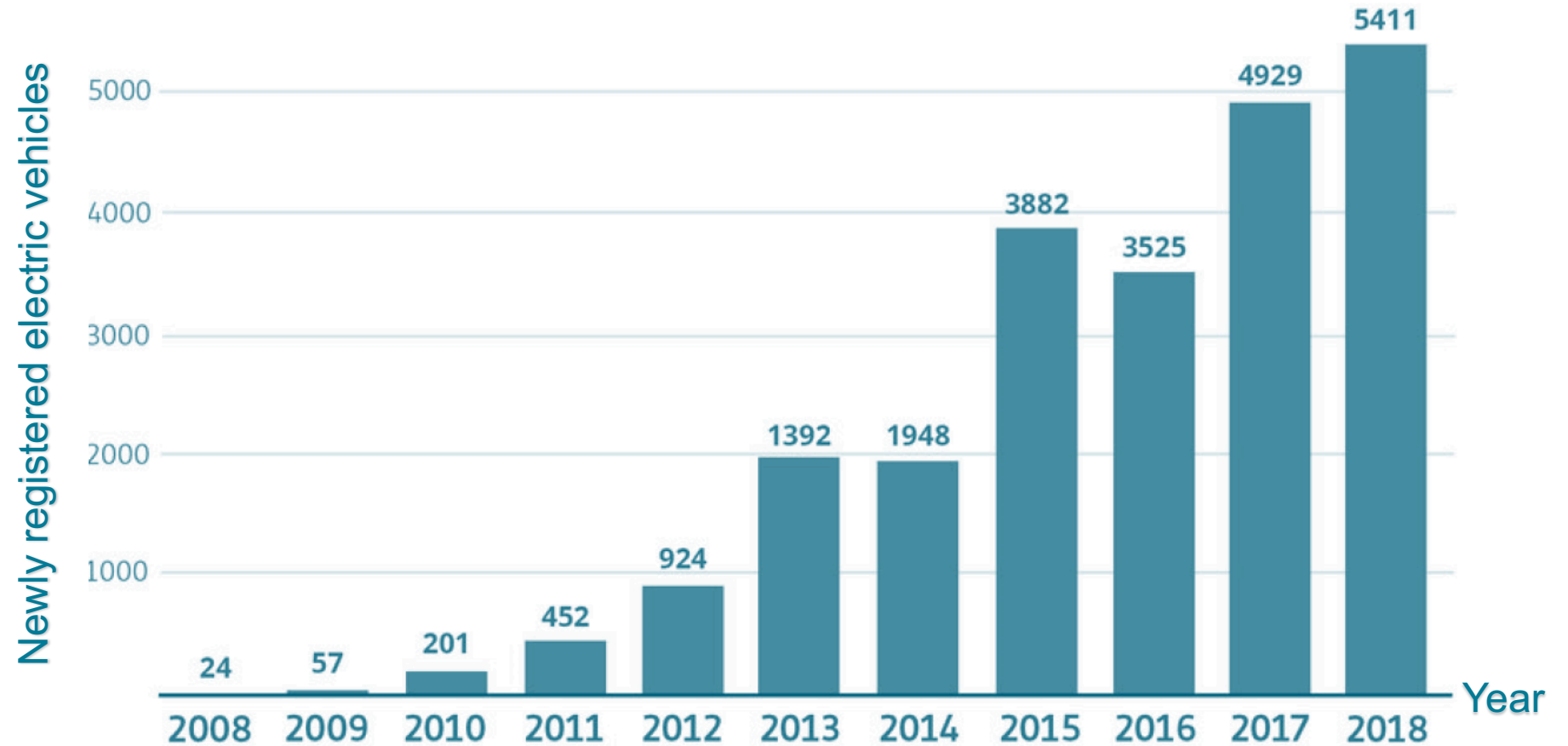


Promoting energy efficiency in car transportation through user experience or information?

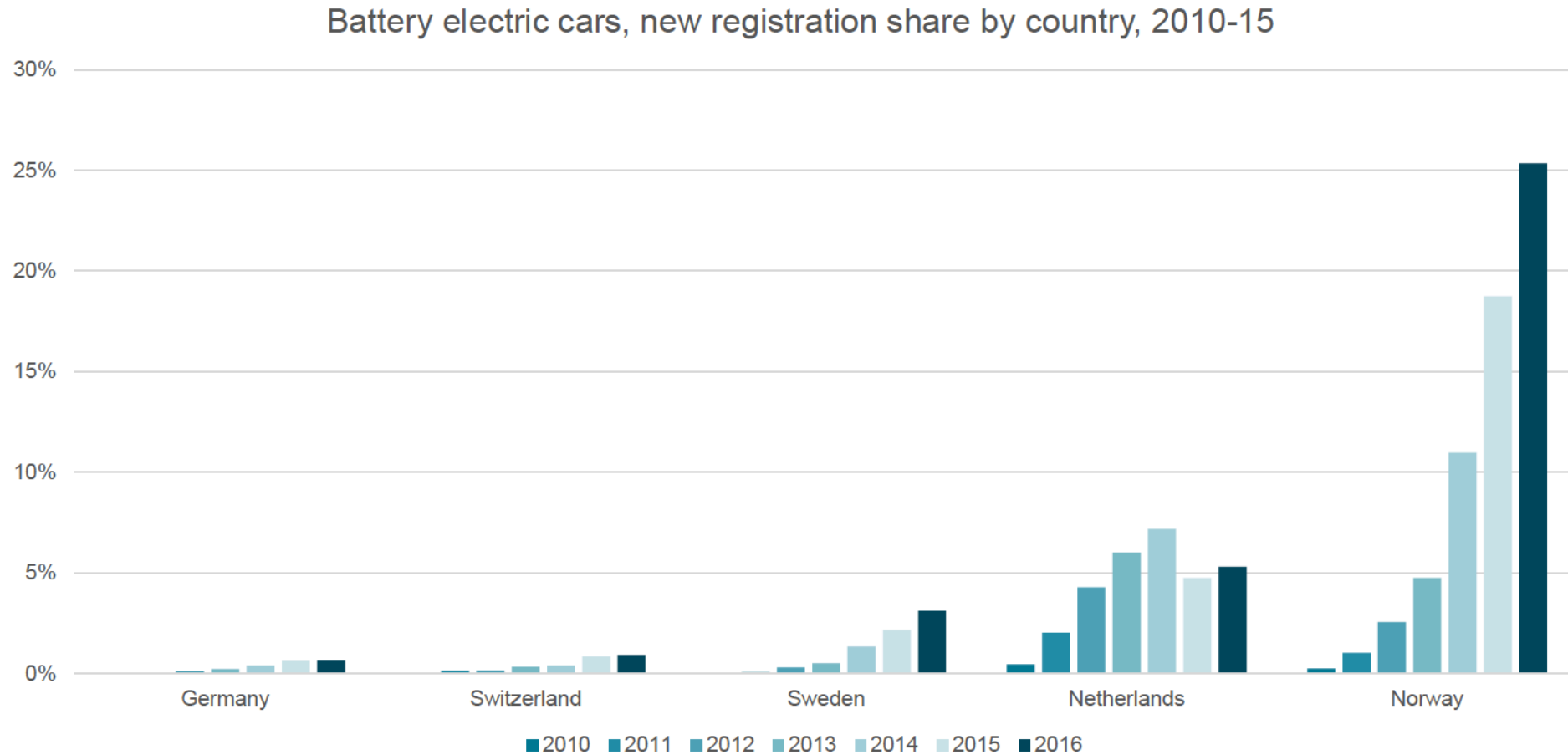
Gracia Brückmann

Prepared for 4th AIEE Energy Symposium, Rome

The number of EVs on Swiss roads is rising...



... in international comparison ...



... Switzerland is not yet performing well!

Drastic increase in EVs could reduce transport emissions and needed for 0 net - emissions in Switzerland!



Starting point

- Consumers' prejudices against EVs
 - Higher purchase price
 - Range anxiety
 - Charging possibilities (duration, time and space availability)
 - Safety + environmental concerns
 - Limited model/4x4 availability
- Weak incentives from the public sector in Switzerland
 - Purchase premia (only in very few areas)
 - Tax relief (only - 4% automobile tax)
 - Charging stations (in progress)
 - Parking (tbd)


Motivation for this study

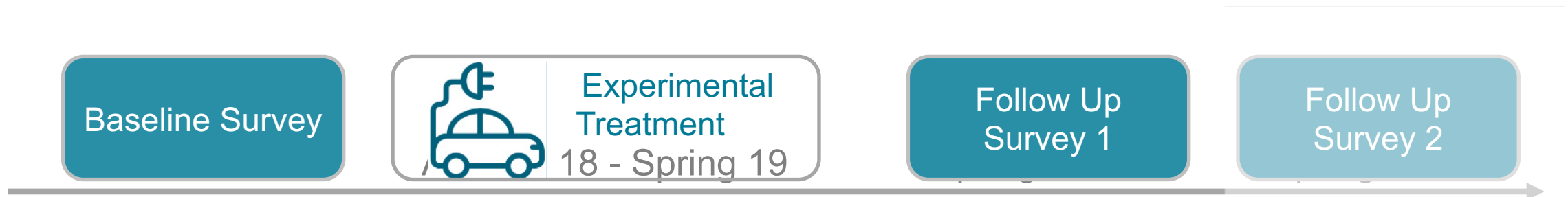
- Consumers' prejudices against electric cars
 - → Might be changed through information
 - Currently consumers are still lacking knowledge on EVs (Long et al. 2019)
 - In China, significant pos. relationship between knowledge about EVs and perceived usefulness of EVs, leading to higher intentions to adopt EVs (Wang et al. 2018)
- Weak incentives from the public sector in Switzerland
 - testing specific incentives in this study
 - How information could be a policy option to promote EVs
 - How test-drives could be a policy option to promote EVs

Research question

- What are the effects of
 1. **test driving** a battery electric vehicle
 2. **information on energy-efficient cars**on car holders'
 - a. perceptions of EV attributes
 - b. intention to switch car
 - c. preferences regarding policies to promote energy-efficient cars

Could lack of information and experience explain low EV market shares?

- Self-selection into car ownership (EV or conventional car), self-selection into information gathering about EVs
 - Overcoming these threats to causal inference through randomisation 
- RCT (randomised control trial) field experiment



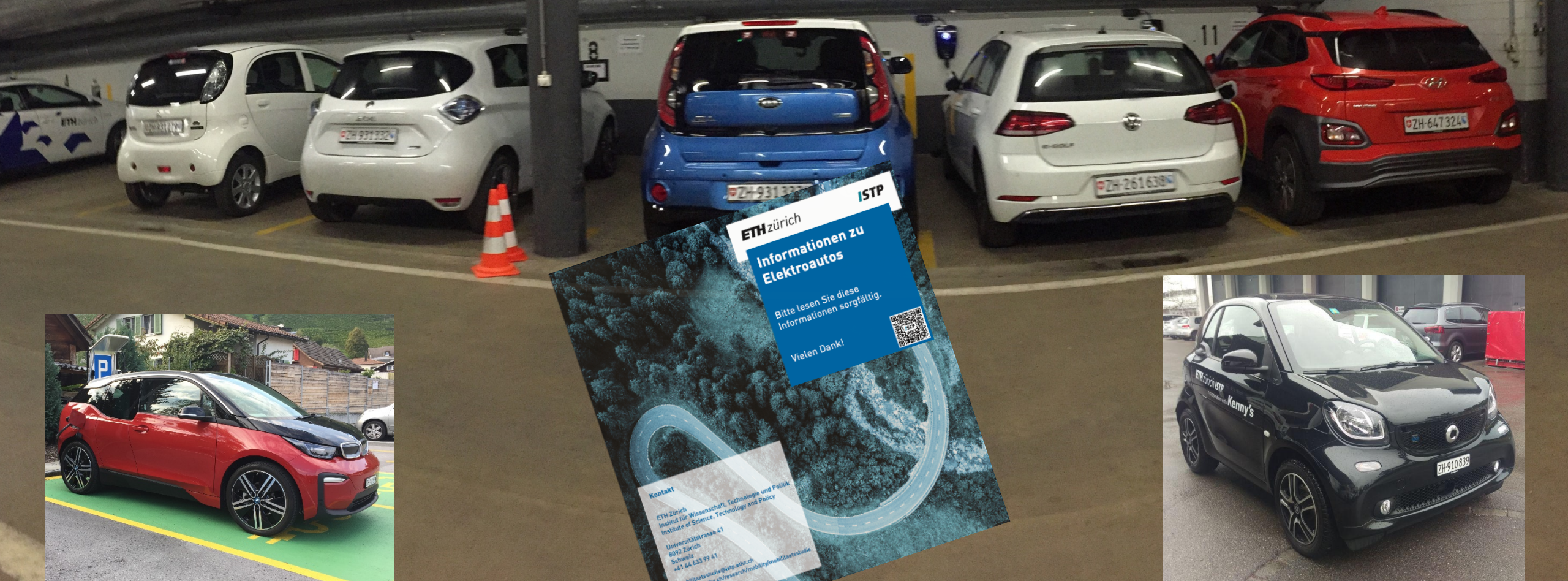
Sampling and set-up



- Random sample of Swiss car holders (cantons AG, SZ, ZG, ZH) with no BEV registered invited to baseline survey (response rate 21%)
- 4,148 survey participants randomly assigned to one of three experimental treatment groups:
 1. information on BEVs
 2. the same information on BEVs, plus test-driving of such a car;
 3. a control group with neither (1) nor (2).
- Follow-up survey \cong three weeks after the test-drive treatments / spring 2019



Test Drives & Information Treatment

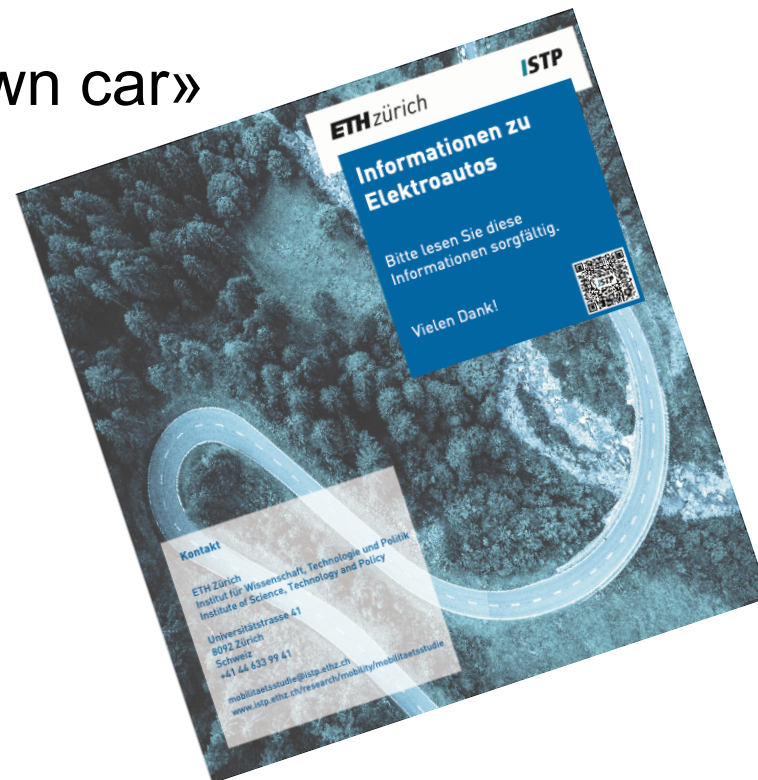


Test Drives & Information Treatment

- Information sheet (printed)
- 48h test drive (with short technical introduction and opportunity to ask questions about the car)
- «Use as if it were your own car»



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Information Treatment

- Energy efficiency
- Environmental impacts
- Range
- Charging duration and locations
- Costs
- Comparison EV and conventional car

- Delivered according to mode
 - On screen for online survey
 - In print for PAPI version

Informationen zu Elektroautos

Energieeffizienz

Elektromotoren haben einen Wirkungsgrad von rund 90%, Benzin- und Dieselmotoren einen Wirkungsgrad von rund 30%. Das heisst, dass bei Elektroautos 90% der eingesetzten Energie (Strom) zur Fortbewegung verwendet werden kann. Bei Benzin- oder Dieselaautos brauchen somit viel weniger Energie pro Kilometer als Benzin- oder Dieselaautos.



Umweltauswirkungen

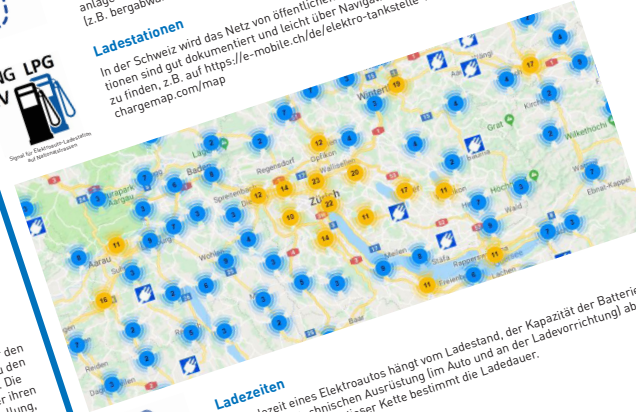
CO₂-Emissionen sind hauptverantwortlich für den Klimawandel. Der Verkehr trägt rund 30% zu den Klimawandel. Die Emissionen der Schweiz bei der gesamten CO₂-Emissionen von Elektroautos sind über ihren gesamten Lebenszyklus gerechnet (Herstellung, Betrieb, Entsorgung) um mindestens 60% geringer als die CO₂-Emissionen eines vergleichbaren Benzin- oder Dieselaautos aus erneuerbaren Energiequellen stammt, was in der Schweiz gut möglich ist. Zudem verursachen Elektroautos keine Abgase und belasten die Luftqualität nicht. Auch verursachen sie deutlich weniger Lärm als Benzin- und Dieselaautos.

Reichweite von Elektroautos

Die Reichweite von Elektroautos ist abhängig von der Kapazität der Batterie, Kompaktere, günstigere Elektroautos haben kleinere Batterien und Reichweiten von 200 km im realen Fahrbetrieb. Grössere und teurere Elektroautos haben Reichweiten von bis zu 500 km im realen Fahrbetrieb. Der Fahrstil beeinflusst die Reichweite des Elektroautos. Durch langsames Fahren und den massvollen Einsatz von Heizung und Klimaanlage kann viel Energie gespart werden. Darüberhinaus kann beim Bremsen und (z.B. bergabwärts) Rollen Energie rückgewonnen werden.

Ladestationen

In der Schweiz wird das Netz von öffentlichen Ladestationen immer dichter. Ladestationen sind gut dokumentiert und leicht über Navigationsgeräte, Apps und Websites zu finden, z.B. auf <https://e-mobile.ch/de/elektro-tankstelle-finden> oder auf <https://chargemap.com/map>



Ladezeiten

Die Ladezeit eines Elektroautos hängt vom Ladestand, der Kapazität der Batterie (in kWh) und der technischen Ausrüstung im Auto und an der Ladevorrichtung ab. Der schwächste Faktor in dieser Kette bestimmt die Ladedauer.



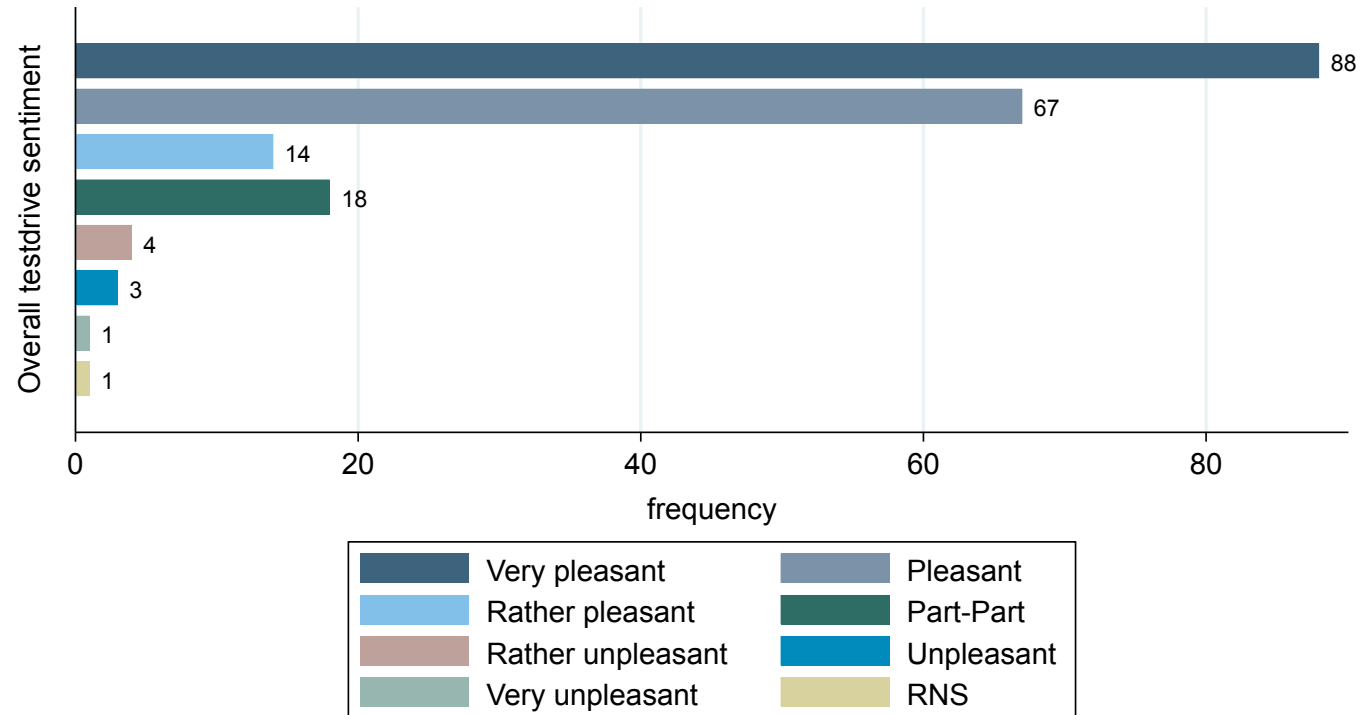
Threads to (perfect) randomization



- Attrition (n = 535 of 4,149 did not want to take part in a 2nd survey)
- Unwillingness to take part in a test-drive (n = 337 of 1,132) stated in baseline
- Abstentions from test-drive when offered (405 of 852)
- Limited amount of test-drives that could be offered (235 no test-drives offered)

→ Estimating treatment effects on the treated (TOT) using treatment-status from baseline as an instrumental variable (IV)

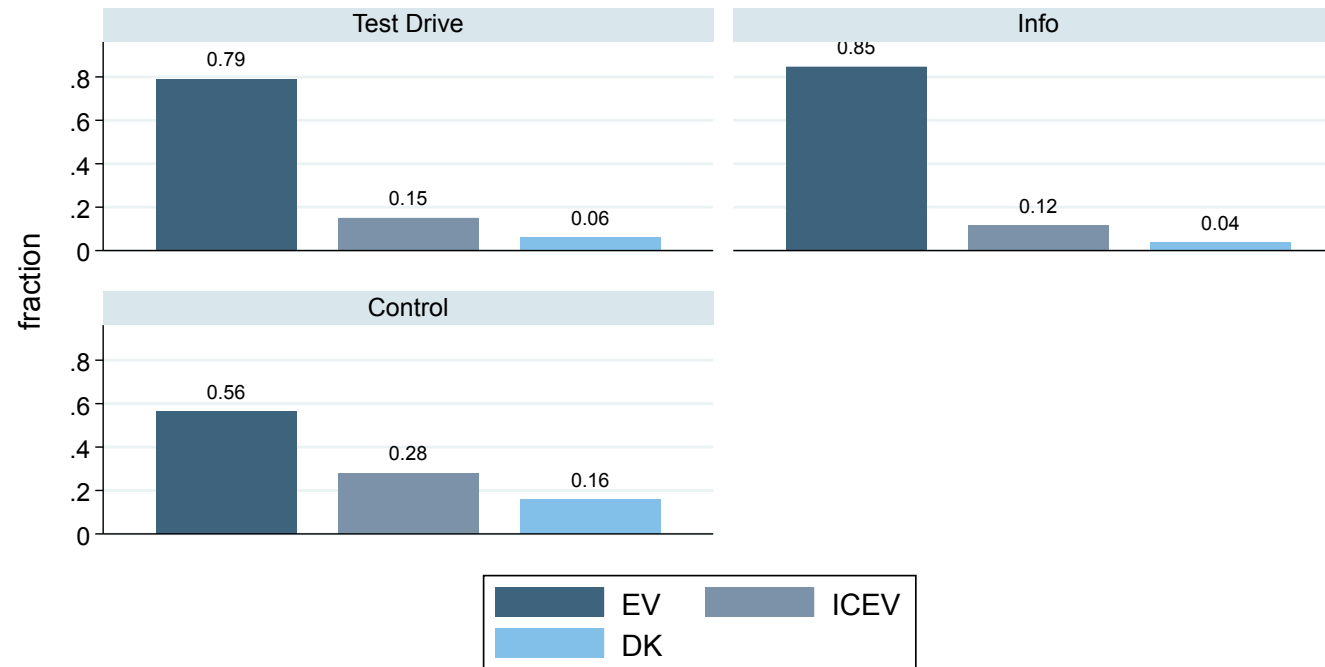
Perception of test drives



Testdrivers only,
N = 196

Overall test drives were
rated «(very) pleasant».

Altering knowledge about energy efficiency of different cars?



By received treatment,
N = 2450

Higher Energy Efficiency?

Altering knowledge about energy efficiency of different cars?

	(1)	(2)	(3)
	1st stage: Test&Info	1st stage: Info	Second stage
Test&Info	0.27*** (21.67)	0.27*** (21.67)	
Info	7.94e-16 (.01)	1.0*** (84.10)	
Control	1 (.)	1 (.)	
Test&Info (realised)			0.764* (-2.52)
Info (realised)			0.672*** (-13.10)
Control (realised)			1 (.)
N	2450	2450	2450

Both treatments significantly* increase the knowledge about higher energy-efficiency of EVs.
*using IV

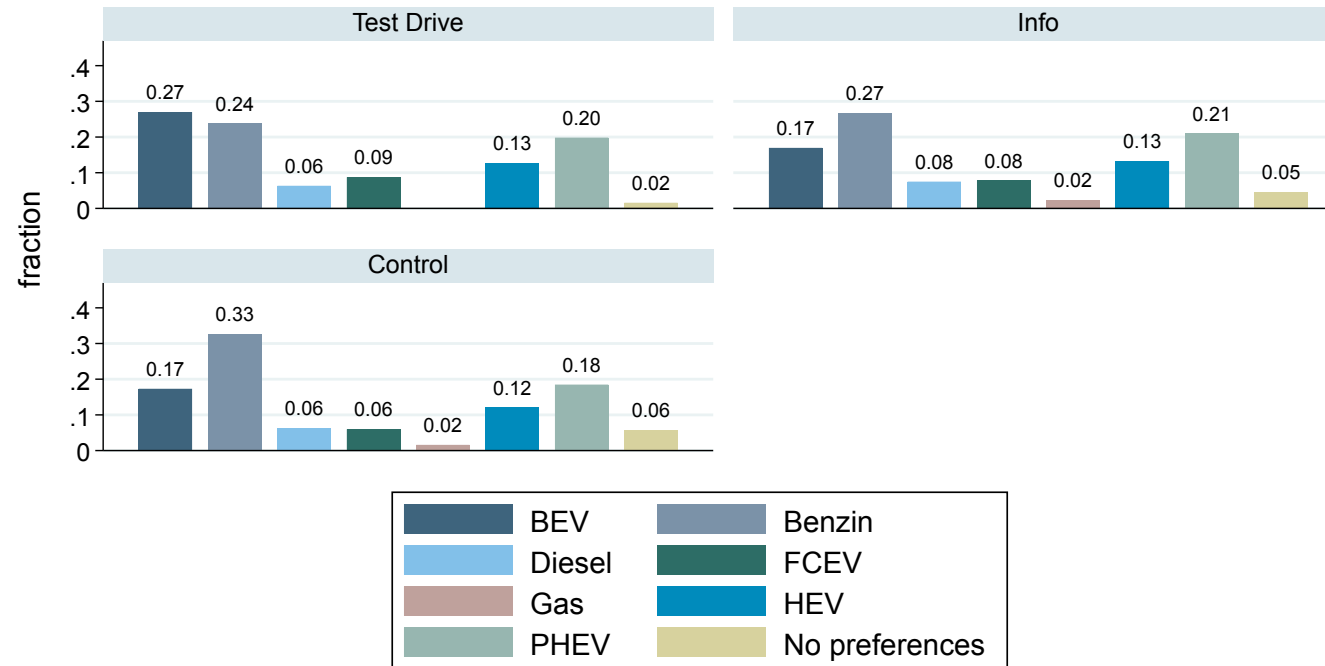
Exponentiated coefficients; t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Altering believes about electric cars?

- Both treatments increase perceived better environmental friendliness of EVs significantly
- Both treatments increase perceived lower running costs of EVs (only information significant)
- Both treatments increase perceived technological matureness of EVs and reduced road noise (not significant)

Planned next car purchase



By received treatment,
 N = 1479

Stated Choice for Next Car

Intended next car purchase a BEV?

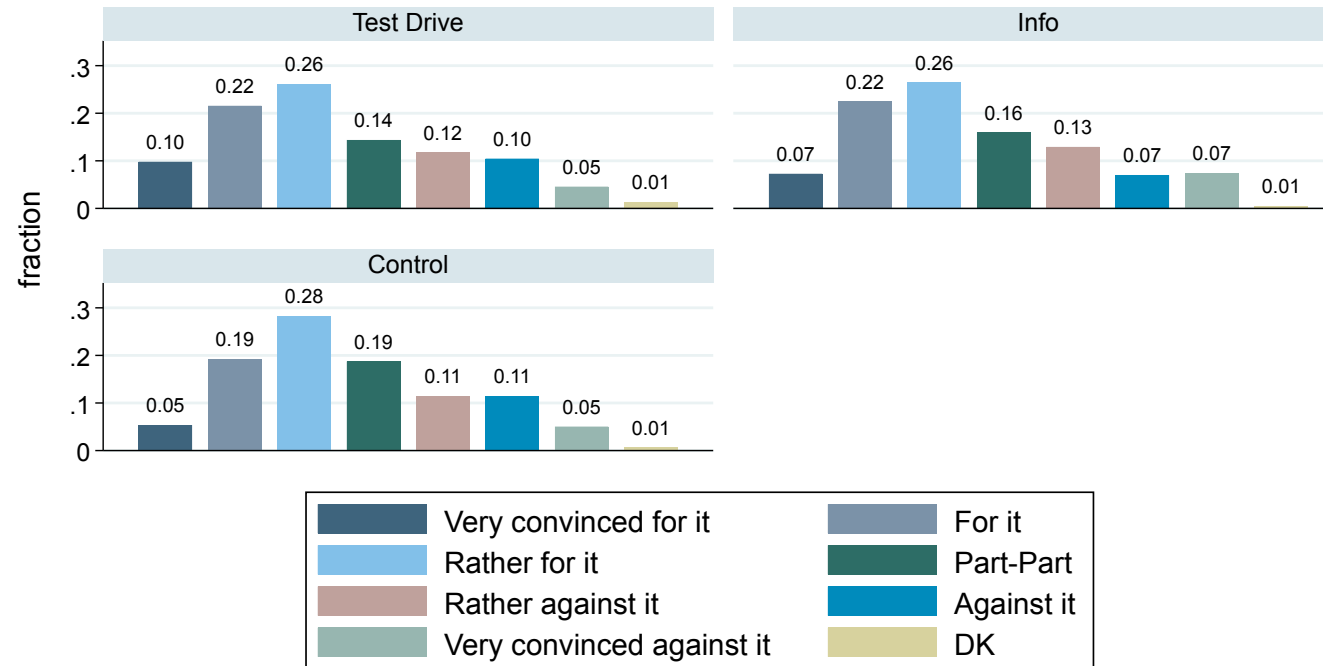
	(1)	(2)	(3)
	1st stage: Test&Info	1st stage: Info	Second stage
Test&Info	0.28*** (0.13)	0.25*** (0.01)	
Info	4.49e-15 (0.01)	1.0*** (0.01)	
Control	1 (.)	1 (.)	
Test&Info (realised)			1.053 (1.00)
Info (realised)			1.010 (0.63)
Control (realised)			1 (.)
N	2425	2425	2425

Both treatments do not significantly alter the likelihood that the next car is a BEV. This includes people not wanting any car.

Exponentiated coefficients; t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

General EV policy sentiment



By received treatment,
N = 1863

General EV Policy Attitudes

General EV policy sentiment

	(1)	(2)	(3)
	1st stage: Test&Info	1st stage: Info	Second stage
Test&Info	0.26*** (18.60)	0.27*** (0.01)	
Info	-2.53e-15 (0.01)	1.0*** (72.18)	
Control	1 (.)	1 (.)	
Test&Info (realised)			.11 (0.35)
Info (realised)			-.05 (-0.51)
Control (realised)			1 (.)
N	1,863	1,863	1,863

Both treatments do not alter the policy preferences.

Exponentiated coefficients; t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Main conclusions

- Both treatments can increase the knowledge about EVs
- And have the potential to close the gap between perceived and actual EV attributes
- These interventions do not alter car purchase intentions or policy beliefs
- Many already want electric cars and EV policies
- 2nd Follow-Up survey already planned

Thank you for your attention!

„The principle of science, the definition almost, is the following: The test of all knowledge is experiment. Experiment is the sole judge of scientific `truth`.”

(R.P. Feynman, 1964)

