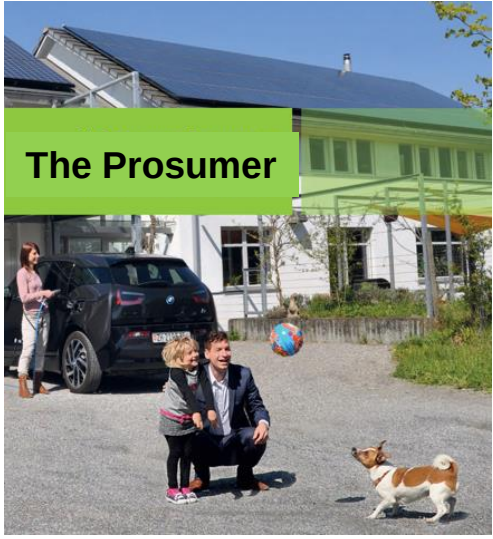
Good Energies Chair for
Management of Renewable Energies

University of St.Gallen



The Flexible Prosumer:
Measuring the Willingness to Co-Create Distributed Ancillary Services

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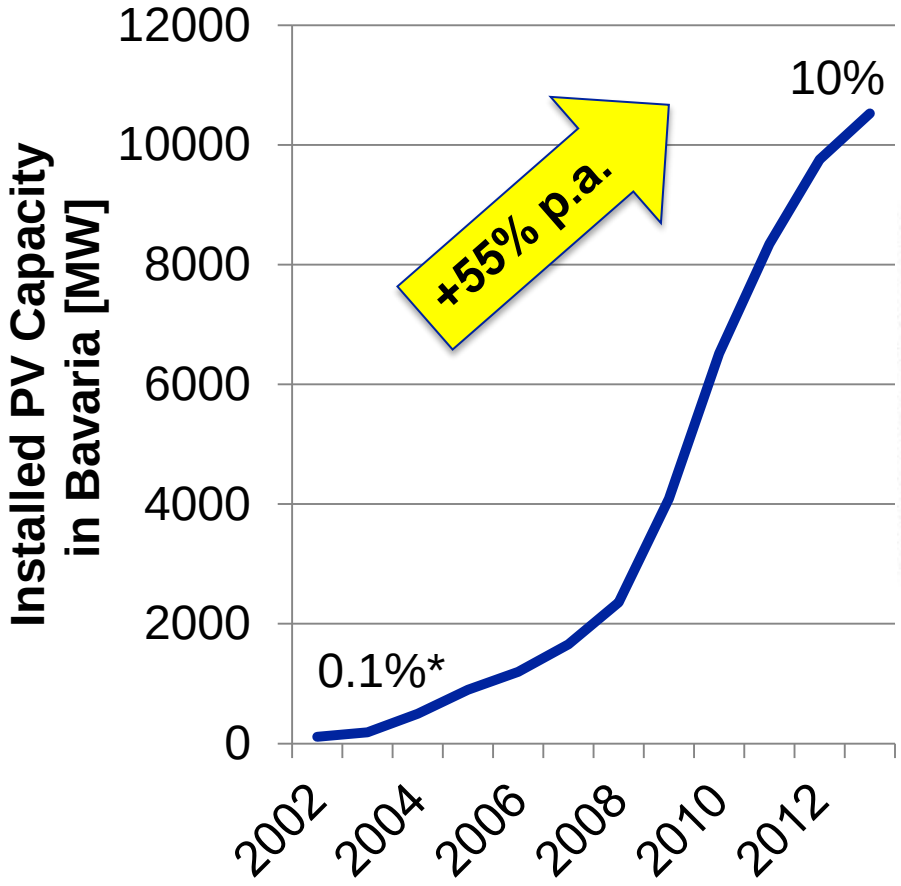
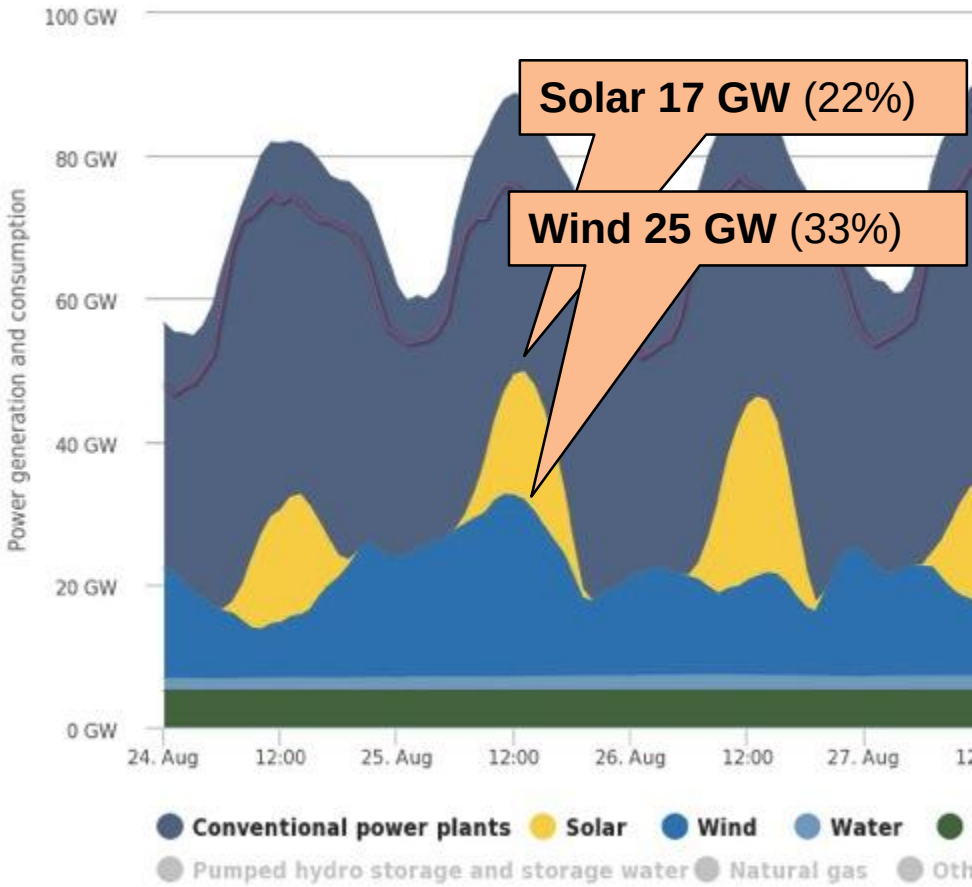
* presenter

Outline

1. **Background and Problem**
2. **Research Questions**
3. **Data and Methods**
4. **Results**
5. **Discussion**

Strong growth in fluctuating renewables leads to search for new forms of flexibility





http://www.energieatlas.bayern.de/thema_sonne/photovoltaik/daten.html

*) Per cent of Bavarian power supply

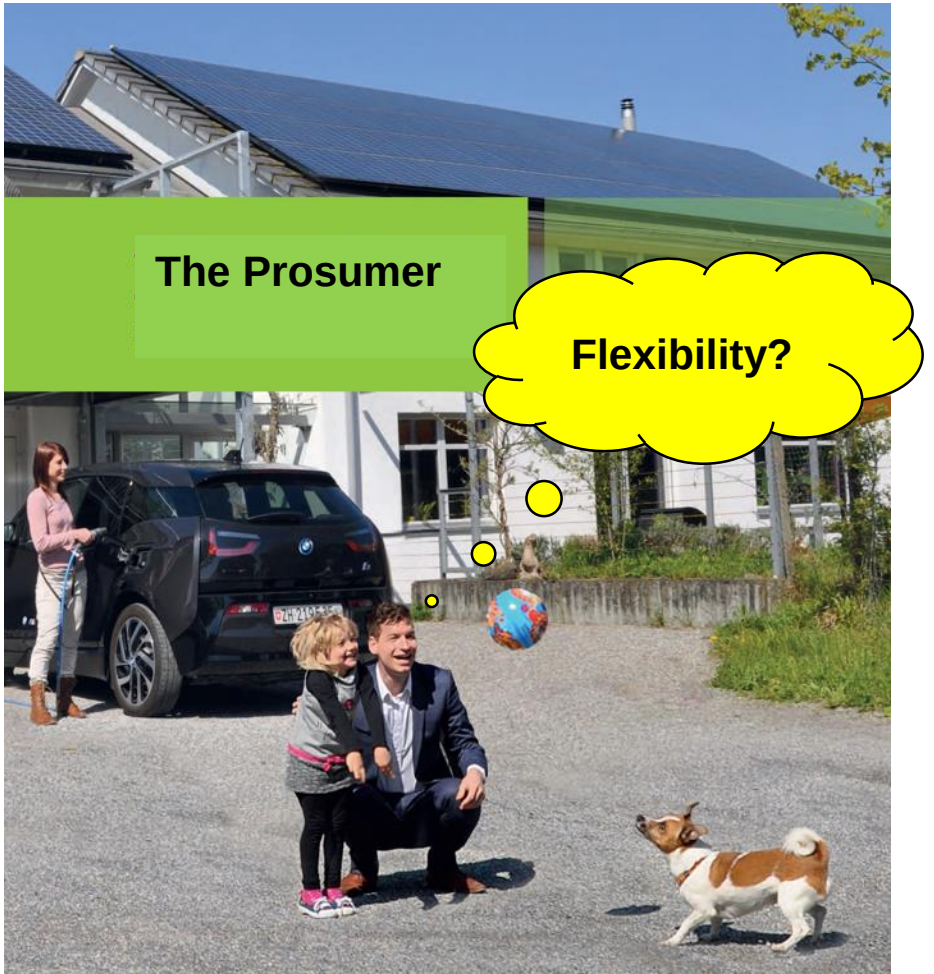
Germany, August 2015: >50% of electricity from PV & wind in certain hours

http://www.agora-energiewende.de/en/topics/-agothem-/Produkt/produkt/76/Agorameter/

Providing Flexibility in the Electricity Market

Old style

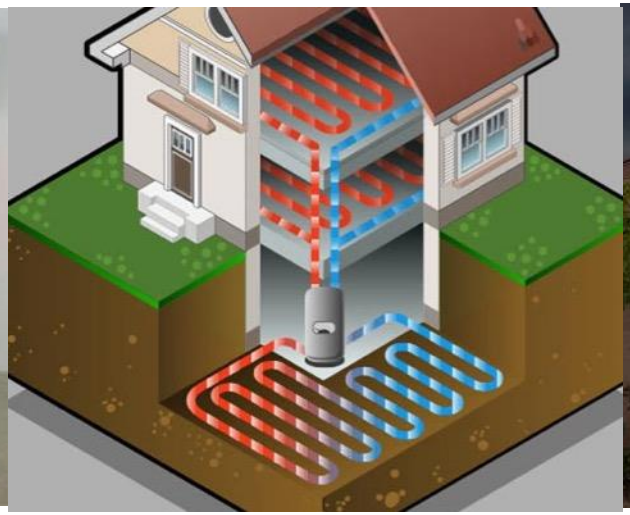
New style



Our Research Approach:
Investigating prosumers' willingness to provide flexibility in three technology areas

1) Electric Vehicles

2) Heat Pumps



3) PV + Battery

SCCER Mobility

In cooperation with the CTI

Energy funding programme
Swiss Competence Centers for Energy Research

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Swiss Confederation

Commission for Technology and Innovation CTI

HeatReserves

nano-tera.ch

EMPOWER

THE FRAMEWORK PROGRAMME FOR RESEARCH AND INNOVATION
HORIZON 2020

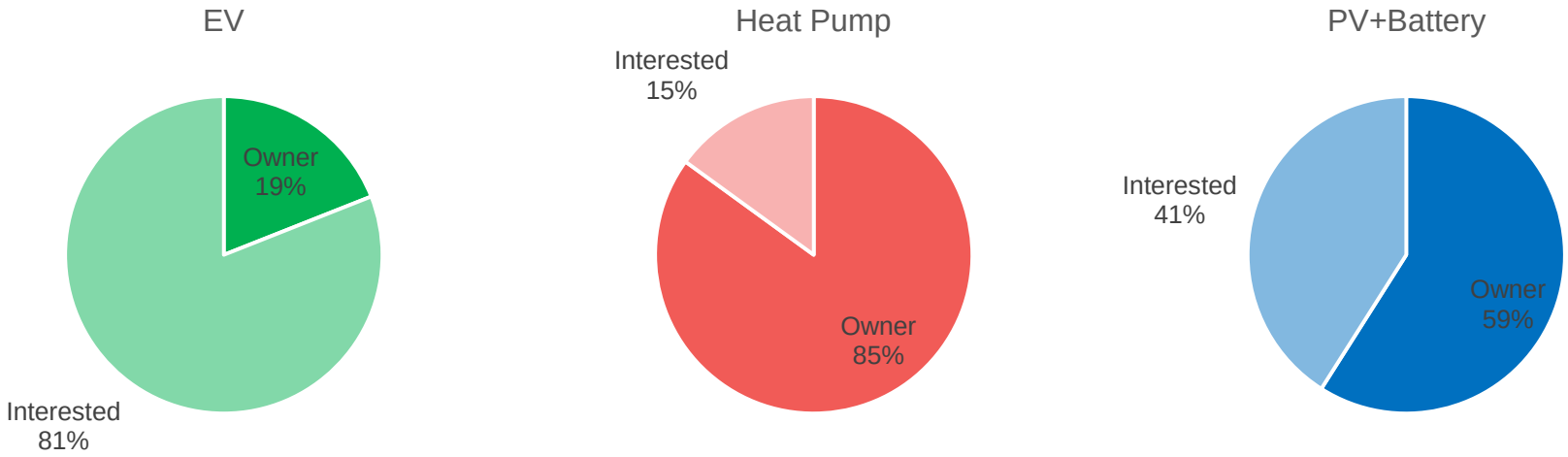
Research Questions

1. To what extent are prosumers willing to co-create flexibility?*
2. Are there differences between the three technology domains?

*) *Would owners of electric cars, heat pumps or PV+battery systems be willing give up some of their autonomy to use electricity whenever they want in exchange for a more favorable electricity contract?*

Data and sample

- N=902 people in Switzerland
- Parallel survey in three technology areas (N= ca. 300 each)
- Target population: People owning electric car/heat pump/PV+battery or interested in purchasing in the next 3 years
- Recruiting via B2C online panel (including nearly 70’000 consumers) of a leading Swiss market research agency
- Data collection January 2017



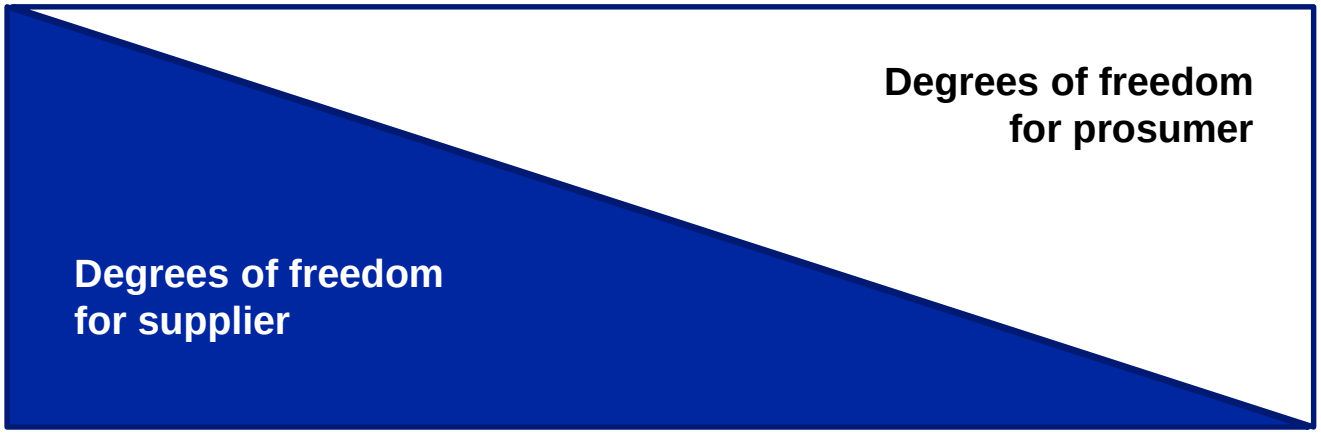
Methodological Approach: Choice-Based Conjoint Analysis

Technology specific attribute levels for "use of flexibility"

Attribute	Levels			
Monthly electricity cost	50 CHF	70 CHF	90 CHF	110 CHF
Use of flexibility	Super Flex	Flex Medium	Flex Light	No Flex
Electricty Mix (for remaining demand)	100% Unknown Origin	100% Nuclear	100% Hydro	100% Solar
Contract duration	4 Years	2 Years	1 Year	Can be cancelled anytime

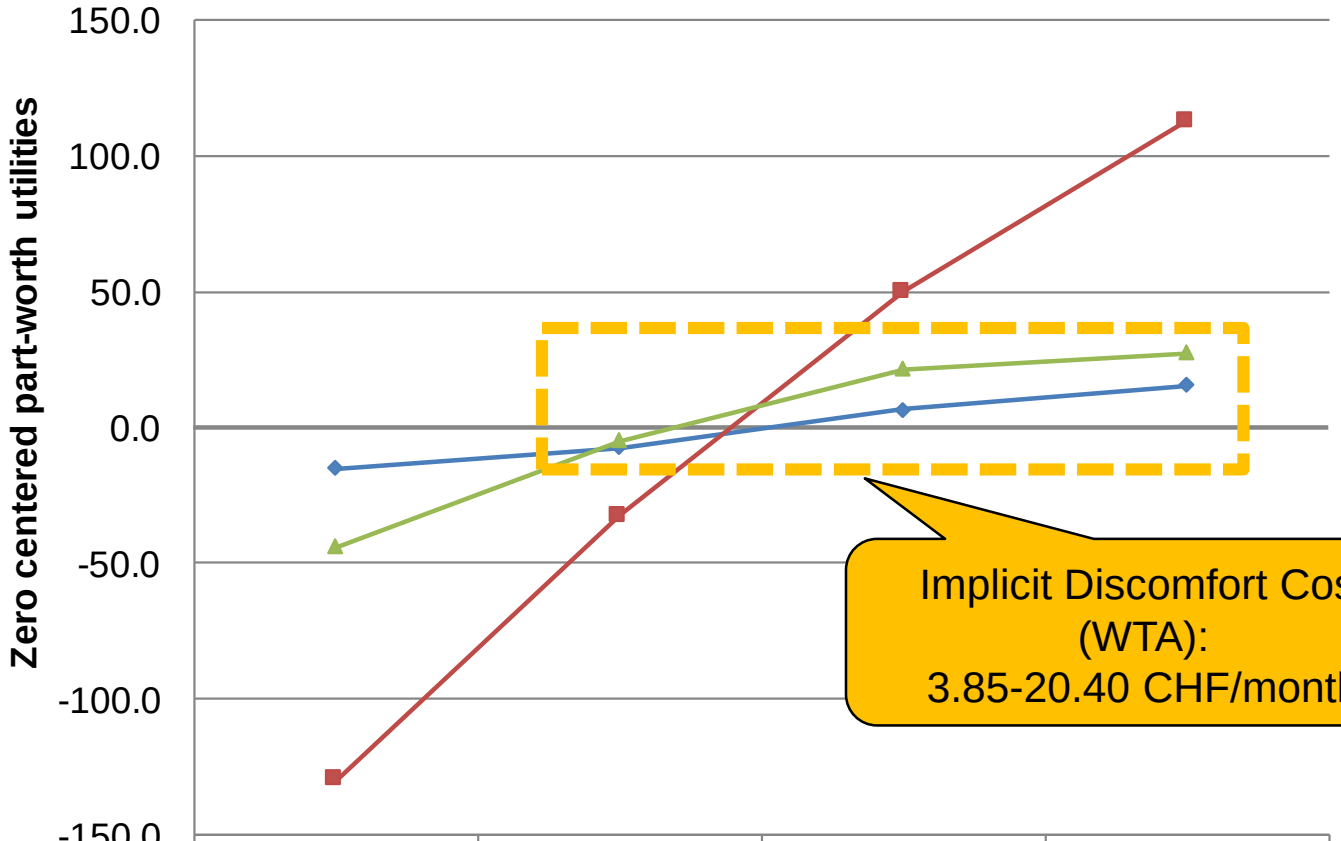
Electric Cars	**Super Flex** Guaranteed charging level 40%; Unlimited amount of discharging cycles per 24 h	**Flex Medium** Guaranteed charging level 60%; max. 3 discharging cycles per 24 h	**Flex Light** Guaranteed charging level 80%; max. 1 discharging cycle per 24 h	**No Flex** No access of utility on battery
Heat Pump	**Super Flex** Guaranteed room temperature 16°; 5 min. hot shower per day	**Flex Medium** Guaranteed room temperature 18°; 10 min. hot shower per day	**Flex Light** Guaranteed room temperature 20°; 15 min. hot shower per day	**No Flex** Guaranteed room temperature 22°; Unlimited hot shower per day
PV+Battery	**Super Flex** 30% PV Self-Consumption; consumption data transmitted and used for forecasting	**Flex Medium** 45% PV Self-Consumption; consumption data transmitted	**Flex Light** 60% PV Self-Consumption; only data on battery charging level transmitted	**No Flex** 75% PV Self-Consumption; no data transmitted

Business models for distributed flexibility need to strike a balance between interests of suppliers and prosumers



Super Flex **Flex Medium** **Flex Light** **No Flex**

Results: Comparison of part-worth utilities for attribute „Use of flexibility“



	SuperFlex	MediumFlex	LightFlex	NoFlex
PV and Battery (N=301)	-14.9	-7.5	6.8	15.6
Heat Pumps (N=301)	-129.7	-32.6	49.8	112.6
Electric Vehicles (N=300)	-44.0	-4.8	21.4	27.5

Conclusions

- To our knowledge, this is the **first study** systematically investigating prosumers' willingness to co-create flexibility across three technology areas (N=902)
- There is some **willingness to co-create flexibility** in exchange for more favorable electricity tariffs
- Some forms of flexibility provision imply a higher **cost of discomfort** than others (e.g. heat vs. EV battery)
- For **utilities** looking to mobilize distributed flexibility resources, electric car drivers and owners of PV+battery systems are lower hanging fruit than heat pump owners.
- For **energy policy**, distributed flexibility can be seen as an alternative (or complement) to centralized flexibility options.

Limitations and further research

- While we have carefully chosen attribute levels to make each of the three choice experiments as close to realistic decisions as possible, there is a trade-off between comparability and specificity of design. Further research can try to replicate our comparison across technology areas with different operationalization of flexibility.
- We have yet to look into explanations for differences in willingness to co-create flexibility (e.g. sociodemographic, psychographic factors).
- Replication in other countries would be interesting. ☺

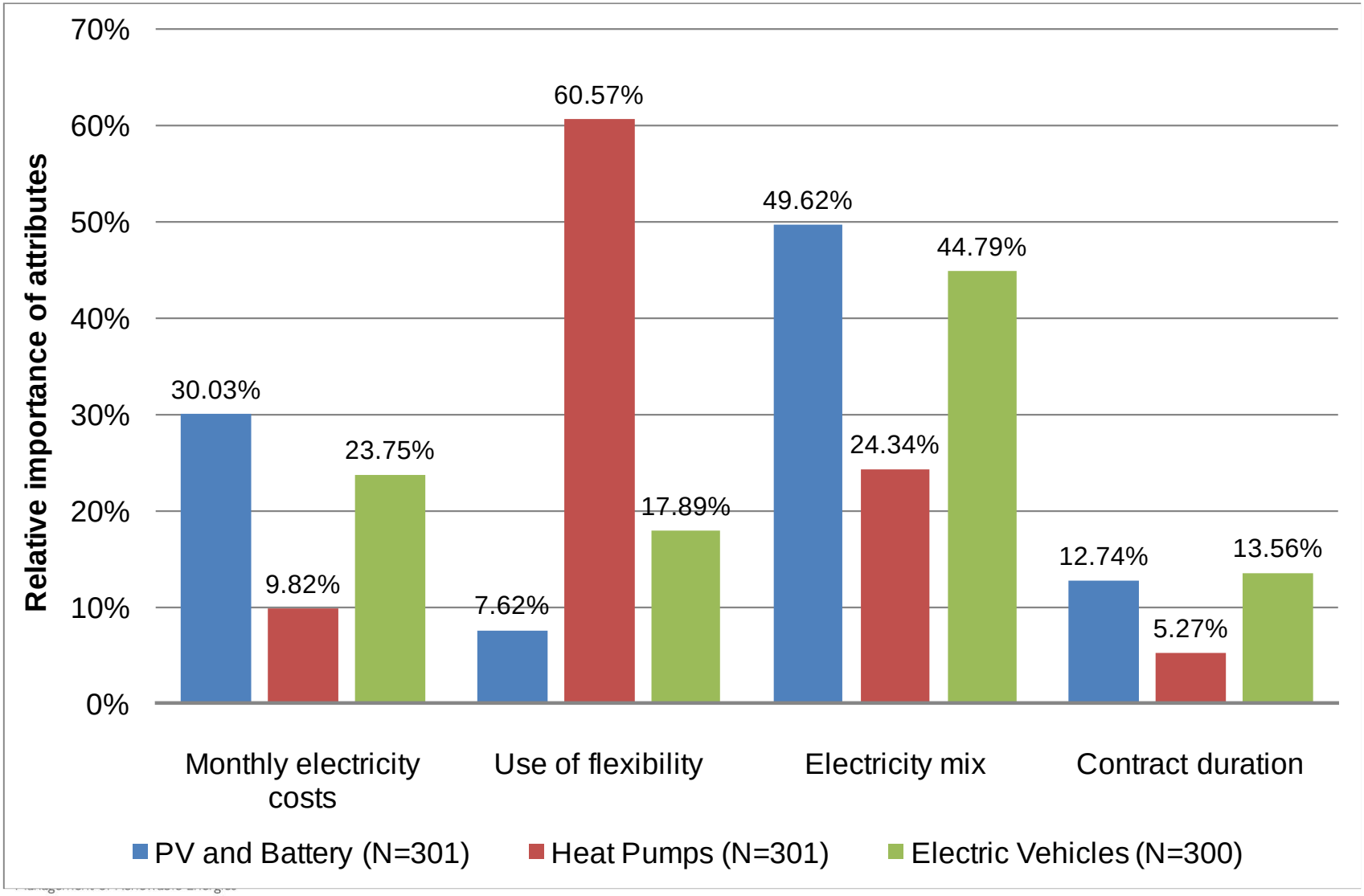
Thank you!

Gianluca Stricker (RollBrettClub Chur) @ Haldenstein, 05.05.2016, Photo: Daniel Ammann

www.iwoe.unisg.ch

Backup Slides

Results (1): Comparison of Importances



Results (2): Part-worth utilities of attribute levels in the three subsamples

		Electric Vehicles (N=300)	PV + Battery (n=301)	Heat Pumps (N=301)
Monthly power costs	110 CHF	-57.8	-72.5	-25.8
	90 CHF	-5.4	-5.0	4.5
	70 CHF	26.0	30.0	7.9
	50 CHF	37.2	47.6	13.5
Use of flexibility	SuperFlex	-44.0	-14.9	-129.7
	FlexMedium	-4.8	-7.5	-32.6
	FlexLight	21.4	6.8	49.8
	NoFlex	27.5	15.6	112.6
Power mix	Unknown origin	-89.1	-97.8	-49.1
	Nuclear	-74.8	-74.6	-42.3
	Hydro	73.8	71.8	43.1
	Solar	90.1	100.6	48.3
Contract duration	4 years	-28.8	-25.9	-12.5
	2 years	-1.4	-1.5	1.2
	1 year	4.8	2.5	2.7
	Cancel anytime	25.4	25.0	8.6