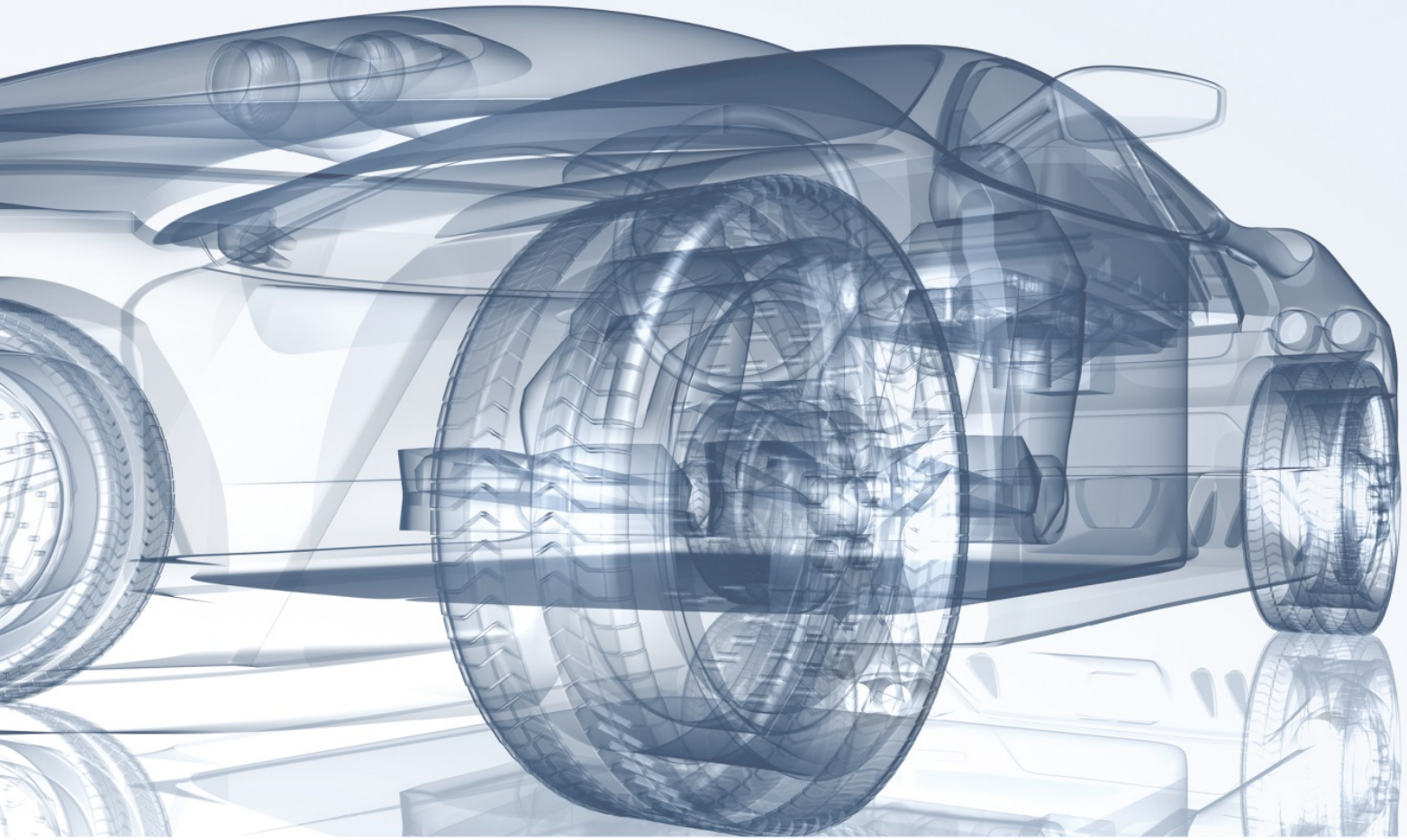
evs30



The 30th International
Electric Vehicle
Symposium & Exhibition

October 9–11, 2017

Messe Stuttgart, Germany

www.evs30.org

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EVS 30 Symposium

Perceived usage potential of fast-charging locations

Stuttgart, 11th October 2017

Dipl.-Psych. Julia Krause

Institute for Automotive Engineering

Background

- 1 million electric vehicles licensed in Germany by 2020
- Current status: about 34,000 BEV and 166,000 HEV
- Biggest challenges for EV decision:
  - Long perceived recharging time
  - Unbalanced distribution of charging infrastructure

How can these challenges be managed?

http://www.stromtankstellen.eu/ladezeit-fuer-elektroautobatterien.html

http://www.zukunftstechnologien.at/mobilitaet/schnellladeinfrastruktur-im-oeffentlichen-raum

Approaching challenges

Long perceived recharging time

- → Shorter recharging time
- → CCS Fast-charging option: 80% SOC within 20-30 minutes

http://www.autobild.de/bilder/eu-einigt-sich-auf-ladestecker-fuer-elektroautos-5042345.html#bild7

Unbalanced distribution of charging infrastructure

- → „Charging whenever and wherever I need to“
- → Optimal distribution of public charging grid (SLAM)
  - → User perspective
  - → Business perspective

SLAM 2016

User perspective
Study 1: EV usage potential of relevant fast-charging use cases

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Aim of study

- **Aim of study**: quantifying the increase of perceived EV (electric vehicle) usage potential depending on
  - Travel purpose
  - Charging scenario

  } Use case

Travel purposes

- MiD 2008: travel purposes have influence on our choice of transportation / mobility behavior
- 5 relevant travel purposes for fast-charging can be identified:
  - Work
  - Business
  - Shopping
  - Private Errands
  - Leisure

User perspective
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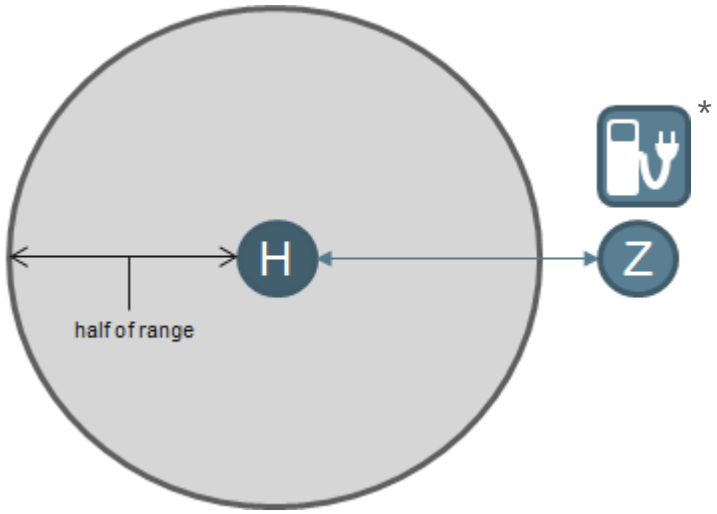
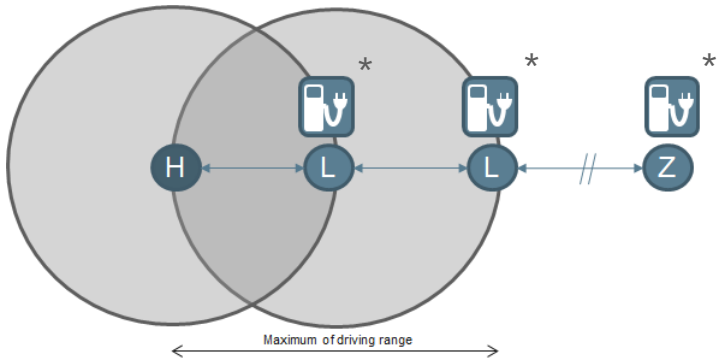
Charging scenarios

Direct short distance
Direct distance from home to destination without interim stops and with exceeding half of the maximum EV driving range



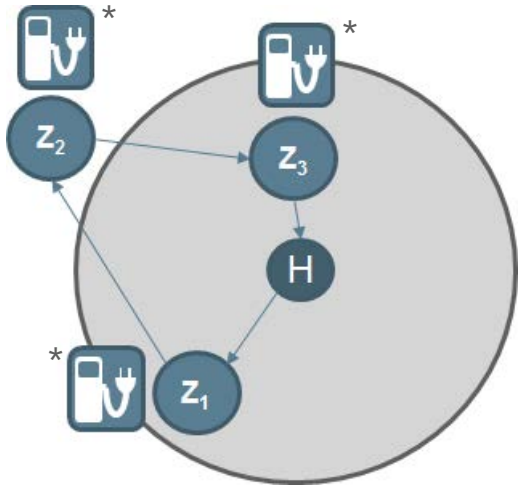
*example of charging location

Direct long distance
Direct distance from home to destination without interim stops and with exceeding the maximum EV driving range



*examples of charging location

Travel chain
Route from home to destination with a number of interim stops and with exceeding the maximum EV driving range until reaching the final destination



*examples of charging location

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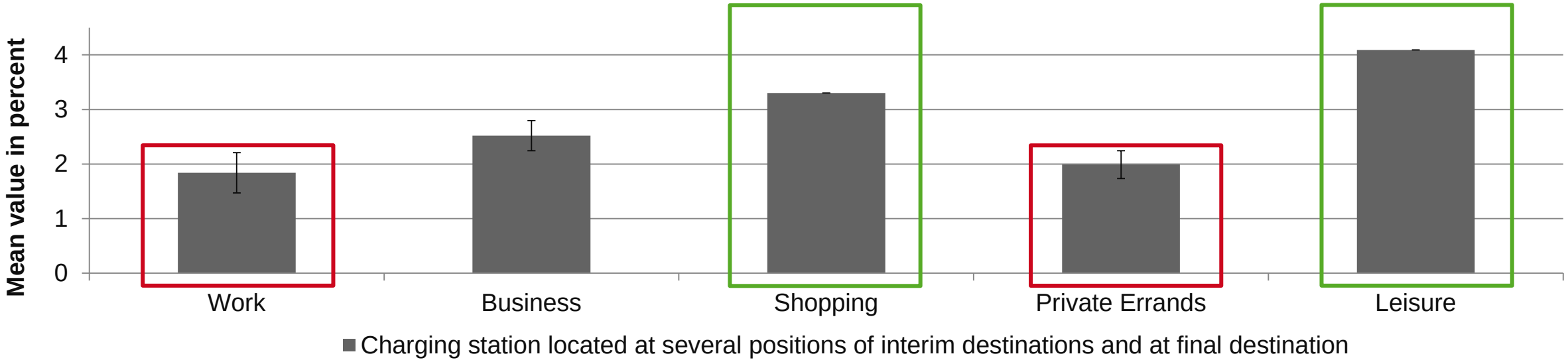
EV usage potential for scenario travel chain

- Use cases with **work purpose or private errands** are indicated with significantly lower EV usage potential (compared to use cases with travel purpose business, shopping or leisure)
- Use cases with **shopping or leisure** purpose show a significantly higher perceived EV usage potential (compared to business cases)



N = 70 EV users (2 females; M_{age} = 48 years, *SD* = 9.40)

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Conclusions

- Optimal located charging stations for trips with shopping or leisure purpose seem to generate a perceived benefit regarding EV usage
- For travel chains, charging locations close to shopping places and leisure spots are recommended

https://www.naturpark-altmuehltal.de/tn_img/4412050_ingolstadt-village_1.jpg

User perspective
Study 2: Further relevant location criteria

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Aim and methodology

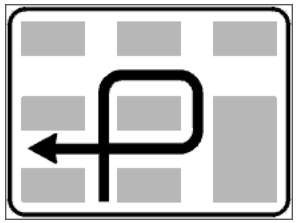
Examination of the influence of relevant location criteria on the acceptance and usage of a fast-charging station:

→ Rating of a location depending on the location criteria

→ Regions: axes, metropolises

- Selected location criteria based on an expert study:

Necessary detour to charging location (in km)



http://sk-8.de/sport/pics/signUmweg.gif

Number of charging options at charging location

Kind of point of interest (POI) at charging location

https://pixabay.com/p-308936/?no_redirect

Walking distance from charging station to POI (in m)

http://www.stupidedia.org/images/thumb/b/b2/Emblem.png/200px-Emblem.png?filetimestamp=20130228114448

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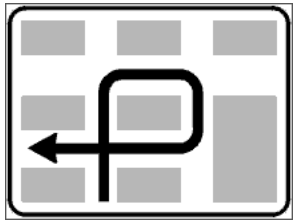
Parameter values of selected criteria



Necessary detour to charging location

Metropolitan region
- 0.5 km
- 2 km
- 5 km

Axes
- 0.5 km
- 2 km
- 5 km

Number of charging options at charging location

- 1
- 2
- 3

- 1
- 2
- 3

Kind of point of interest (POI) at charging location

- Shopping facility
- Sports facility
- Place to eat

- Shopping facility
- Place to eat
- No point of interest

Walking distance from charging station to POI

- 50 m
- 300 m
- 500 m

Excluded due to low relevance for that region

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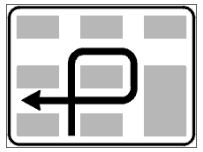
Methodology – Conjoint Modelling / Online questionnaire

- Desirability rating of 20 fictive fast-charging locations for the metropolitan region and of 10 fictive fast-charging locations for axes
- Each location was described by the three / four location criteria with one parameter value each, e.g. for axes:

Necessary detour to charging location	Number of charging options at charging location	Kind of point of interest (POI) at charging location
 2 km	 3	 Place to eat

- Number of possible combinations
  - For axes: n = 27 ⟶ Randomized selection of 10 combinations per participant

User perspective
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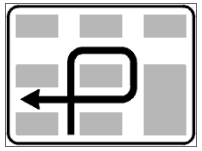
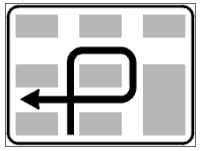
Axes: increase of desirability rating

Necessary detour to charging location: **5 km**



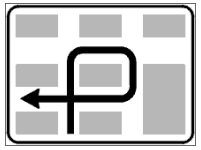
Desirability increases by 4x

Necessary detour to charging location: **2 km**



Desirability increases by 6x

Necessary detour to charging location: **0.5 km**



Number of charging options at charging location: **1**

Desirability increases by 4x

Number of charging options at charging location: **2**

Desirability increases by 2x

Number of charging options at charging location: **3**

n = 66 users of electric vehicles, n = 76 nonusers ($M_{\text{overall age}}$ = 37 years, *SD* = 12.00)

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Axes: increase of desirability rating

Kind of POI at charging location: **No POI**

Desirability increases by 5x

Kind of POI at charging location: **Shopping facility**

Desirability increases by 4x

Kind of POI at charging location: **Place to eat**

n = 66 users of electric vehicles, n = 76 nonusers ($M_{\text{overall age}}$ = 37 years, *SD* = 12.00)

User perspective
Study 2: Further relevant location criteria

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Conclusions

- Current and future EV users seem not willing to putting much effort into the recharge of their vehicle

- **Recommendations for positioning of future fast-charging locations:**
  - Necessary detours should not be longer than 0.5 km or at maximum 2 km
  - Charging locations should have at least 2 charging options
  - An interesting POI (shopping facility or place to eat) should be available within direct walking distance

Investors' point of view

- Charging capacity for fast-chargers is highly performant and therefore expensive
- Two opposing business models
  - Selling energy or rather charging time
  - Using charging station as new service to attract customers

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