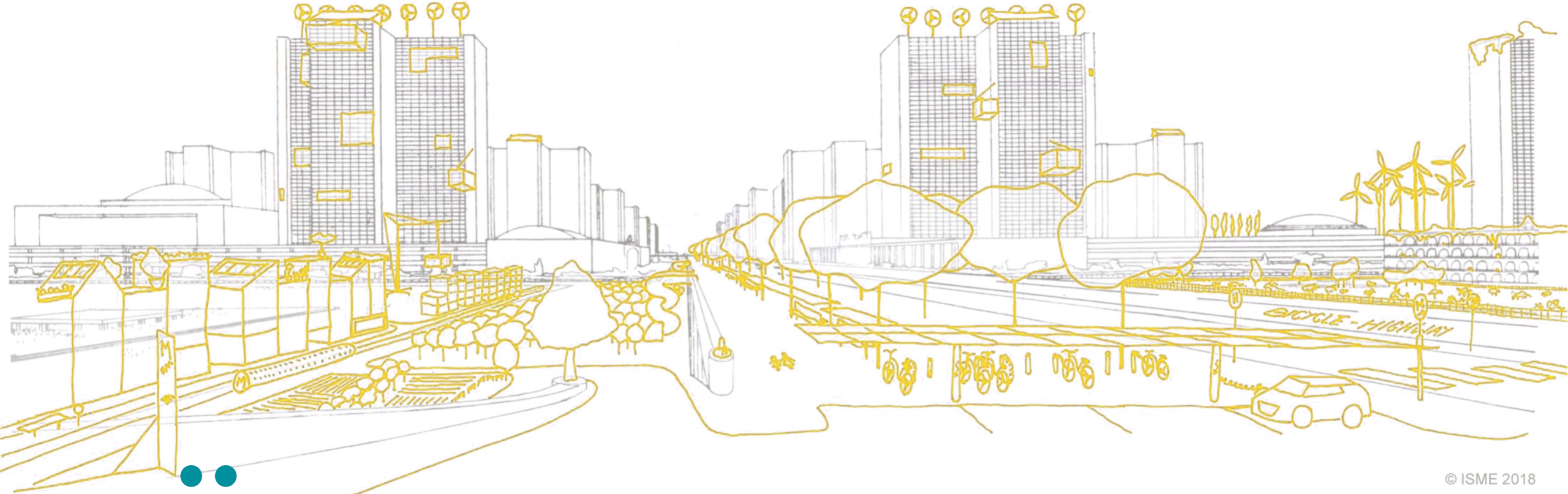


EVS35
OSL2022

THE IMPACT OF CHARGING INFRASTRUCTURE ON LOCAL EMISSIONS OF NITROGEN OXIDES

Session E2, EVS35 Oslo, 14.06.2022

Karsten Hager, M.Sc., Alexandra Graf, M.Sc.
Institut Stadt | Mobilität | Energie (ISME) GmbH

Gefördert durch:
Bundesministerium für Wirtschaft und Klimaschutz
aufgrund eines Beschlusses des Deutschen Bundestages

ISME Institut Stadt | Mobilität | Energie

INSTITUT STADT | MOBILITÄT | ENERGIE (ISME)

- Numerous projects to develop and implement **concepts for electric mobility in german municipalities:**
  e.g. Stuttgart, Kempten, Eschborn, Schwäbisch Gmünd, Göppingen, Offenburg/Kehl/Lahr, Schwerin, Ilm-Kreis, Gärtringen, Flein, Lörrach etc.

- **Focal points**: (electric) mobility concepts, cycle track concepts, city-logistic concepts, voluntary public transport, operational mobility management, neighbourhood concepts

- **Application-oriented research**:
  LINOxBW (2018-2023, BMWi/BMWK) / SNAcKS – Schweriner Lieferverkehr der Zukunft (2021-2022, BMUV)

- Strategic **accompanying research (BMVI/BMDV)**:
  - 2021 - 2023 Themenfeld „Rahmenbedingungen & Markt“
  - 2016 - 2019 Themenfeld „Vernetzte Mobilität“
  - 2014 - 2015 Themenfeld „Flottenmanagement“
  - 2011 - 2013 Themenfeld „Stadt- und Verkehrsplanung“
  - 2018 Studie Digitalisierung & Mobilität für das Land BW

- **Participative approach**: surveys, workshops, outreach participation…

Gefördert durch: Bundesministerium für Wirtschaft und Klimaschutz aufgrund eines Beschlusses des Deutschen Bundestages

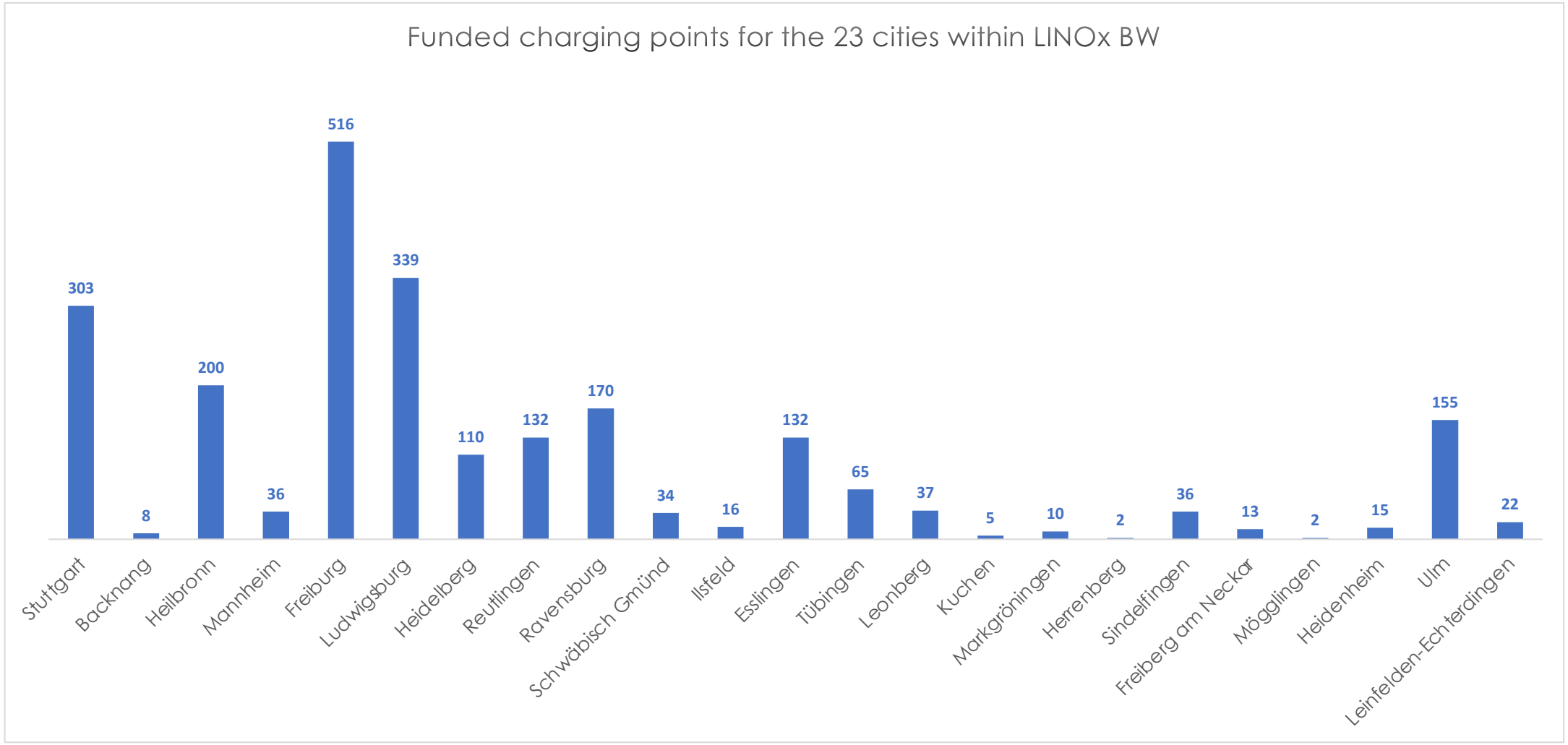
SHORT FACTS ABOUT THE PROJECT LINOX BW

- German corporate research and funding program, funded by German Ministry for Economic Affairs and Climate Action (BMWK)
- Project duration: 01.09.2018 bis 30.09.2022 → project lengthining until **31.12.2023** and funding amount increase approved (~3 million €)
- Funding amount: over 14 million € (for charging infrastructure, project management and research)
- Project research goal: Derivation of the reduction of local nitrogen oxide values
- 178 recipients (real-life-setting projects) from 23 cities in Baden-Württemberg, accounting for 2.358 funded charging points

DLR Projektträger

Gefördert durch:
Bundesministerium für Wirtschaft und Klimaschutz
aufgrund eines Beschlusses des Deutschen Bundestages

FUNDED CHARGING POINTS (AC+DC) FOR THE 23 CITIES WITHIN LINOX BW



Gefördert durch: Bundesministerium für Wirtschaft und Klimaschutz aufgrund eines Beschlusses des Deutschen Bundestages

ISME Institut Stadt | Mobilität | Energie

Research Design (1)

- Categorization of the funding recipients in **seven different use cases**: 1) residential quarter, 2) semi-public space, 3) parking lots and park & ride, 4) private on-site parking, 5) nursing services, 6) tourism and 7) pedelecs
- Mixed methods approach consisting of quantitative and qualitative surveys
    - **t_0 survey** at the start of their respective project for all recipients about their status quo containing questions, among others, relating to their **vehicle fleets, existing charging infrastructure, parking lot size and enterprise size**. (mandatory survey)
    - Additionally, hand-picked recipients planning exceptionally large or special charging infrastructure projects were chosen for a **one-hour telephone interview** and are referred to as *lead-partners* (21 interviews)
    - the schedule for **the t_1 survey** was postponed due to project lengthening (mandatory survey)
- To collect information for this paper, all *lead-partners* were chosen to complete a short survey containing data of the current charged electricity of the funded charging infrastructure (bundled with the respective commissioning date of the charging infrastructure) and information about their respective vehicle fleets. *This survey was not mandatory*. However, **nine recipients** responded and delivered extensive data.

Gefördert durch: Bundesministerium für Wirtschaft und Klimaschutz aufgrund eines Beschlusses des Deutschen Bundestages

Research Design (2)

1) NO_x-emissions of lead-partners vehicle fleet

Fleet of vehicle data – mileage and car classifications

↓

HBEFA-emission factors for different car emission concepts

↓

mileage (for each car classification; km) * HBEFA-emission factor (g/km) = NO_x-reduction (g)

2) Current NO_x-reduction based on lead-partners data

Delivered electricity of funded charging infrastructure

↓

Average HBEFA-emission factors for german fleet composition

↓

mileage (average consumption 18,4 kWh/100km) * average HBEFA-emission factor (g/km) = NO_x-reduction (g)

Gefördert durch: Bundesministerium für Wirtschaft und Klimaschutz aufgrund eines Beschlusses des Deutschen Bundestages

Results: Collected Data from lead partners

Applicant-number	Funded Charging points	Charged Electricity (kWh)	Days of data acquisition of charged electricity	Vehicle fleet data	Mileage (sum in km)	Accessibility	Miscellaneous
01	62	86.866	761	28 cars (20 diesel, 8 petrol)	888.467	Private	Official vehicle fleet of a municipality
02	4	4.221	799	1 car (petrol)	10.000	Private	Tourist attraction
03	10	37.431	365	40 cars (39 petrol, 1 electric)	221.000	Semi-public	Nursing service
04	4	7.195	309	17 cars (17 petrol)	127.500	Private	Nursing service
05	83	21.630	100	83 cars (unknown)	1.137.100	Private	Home-owners' association
06	8	33.682	1075	2 cars (2 petrol)	40.000	Semi-public	Electric carsharing
07	24	8.370	365	36 cars (18 petrol, 18 diesel)	1.060.000	Semi-public	Car dealership
08	50	156.258	567	20 cars (20 electric)	253.000	Semi-public	Electric carsharing
09	18	38.051	1106	50 cars (16 petrol, 11 diesel, 15 PHEV, 8 electric)	847.000	Semi-public	11 different spatial locations

Gefördert durch: Bundesministerium für Wirtschaft und Klimaschutz aufgrund eines Beschlusses des Deutschen Bundestages

RESULTS: LIMITATIONS

- **Vehicle fleet data is based on the t_0 survey** ranging from 2018 to 2021.
- The possibility of **lead-recipients adding electric cars** (BEV or PHEV) to their respective vehicle fleets **since conducting the t_0 survey is given.**
- **Charged electricity data** is ranging from the beginning (the first day of implementing the charging infrastructure) to the time span of one year.
- **Accessibility of the funded charging infrastructure** is also derived **from t_0 survey data** and might change over time in real-life settings.
- Charging infrastructure from lead-recipients with **semi-public accessibility** might include the **charging of other electric cars** where the amount of charged electricity and vehicle fleet data **are unknown**.
- The task of **standardizing the gathered data** from real-life-conditions from all recipients is and remains difficult – particularly for the forthcoming t_1 survey.

Gefördert durch: Bundesministerium für Wirtschaft und Klimaschutz aufgrund eines Beschlusses des Deutschen Bundestages

RESULTS: NOX-EMISSIONS REDUCTION BASED ON HAND-PICKED RECIPENTS DATA

Applicant-number	1) NO_x-emissions of lead-recipients vehicle fleet (kg)	2) Current NO_x-reduction based on lead-recipients' data (kg)
01	1.008,94	151
02	2,00	2,09
03	19,66	18,57
04	11,63	3,57
05	766,26	37,6
06	10,75	16,71
07	371,01	14,55
08	0	271,62
09	292,61	66,14
Sum	2.482,88	581,85

Gefördert durch: Bundesministerium für Wirtschaft und Klimaschutz aufgrund eines Beschlusses des Deutschen Bundestages

Discussion (1)

- **Standardizing the gathered data** from all recipients following the t_1 survey is important.
  - Unfamiliarity with research projects
  - Unavailability of certain data
  - The possibility for each applicant to be able to derive electricity data of their funded charging infrastructure **could not be made mandatory due to funding guidelines**
  - Calculating side effects like the allowance for semi-public or employee charging

- **Final calculations for the emission reduction potential need data from the t_1 survey**, in particular from the respective vehicle fleets. The substitution of ICV to BEV or PHEV differs from applicant to applicant and is also based on other **effects like depreciation periods** of currently utilized cars (research design 1)

Gefördert durch: Bundesministerium für Wirtschaft und Klimaschutz aufgrund eines Beschlusses des Deutschen Bundestages

Discussion (2)

- **In 2020, the German emissions of NO_x** reached the total of 978.000 tons, with **390.300 tons** belonging to the traffic sector. The current gathered LINOx BW data adds up **to 581,85 kg** and is partly collected from **several different years**.
    - Overall, the presented results utilized data from **263 charging points** (the whole project funds **2.358 charging points**, **~11%**).

- The **original task** to quantify the reduction for nitrogen oxide measurement sites to prevent cities from adopting legal measures for their municipality **is not possible** for various reasons.
    - Selective measurement sites on certain streets are utilized for statements for whole municipalities
    - the specific driving patterns and / or relations from electric cars are unknown.
    - Added up results for the whole research project in comparison to overall German values seem to be a better way to quantify the success of the project.

Gefördert durch: Bundesministerium für Wirtschaft und Klimaschutz aufgrund eines Beschlusses des Deutschen Bundestages

THANK YOU FOR YOUR ATTENTION

Karsten Hager, M.Sc.
Managing director
karsten.hager@i-sme.de
0711 / 65 69 90-15

Alexandra Graf, M.Sc.
Research associate
alexandra.graf@i-sme.de
0711 / 65 69 90-21

ISME - Institut Stadt | Mobilität | Energie
Rotenwaldstraße 18
70197 Stuttgart

Gefördert durch:
Bundesministerium für Wirtschaft und Klimaschutz
aufgrund eines Beschlusses des Deutschen Bundestages

ISME Institut Stadt | Mobilität | Energie