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Monitoring transformative change within a living lab:

a participatory survey design for base-lining key data

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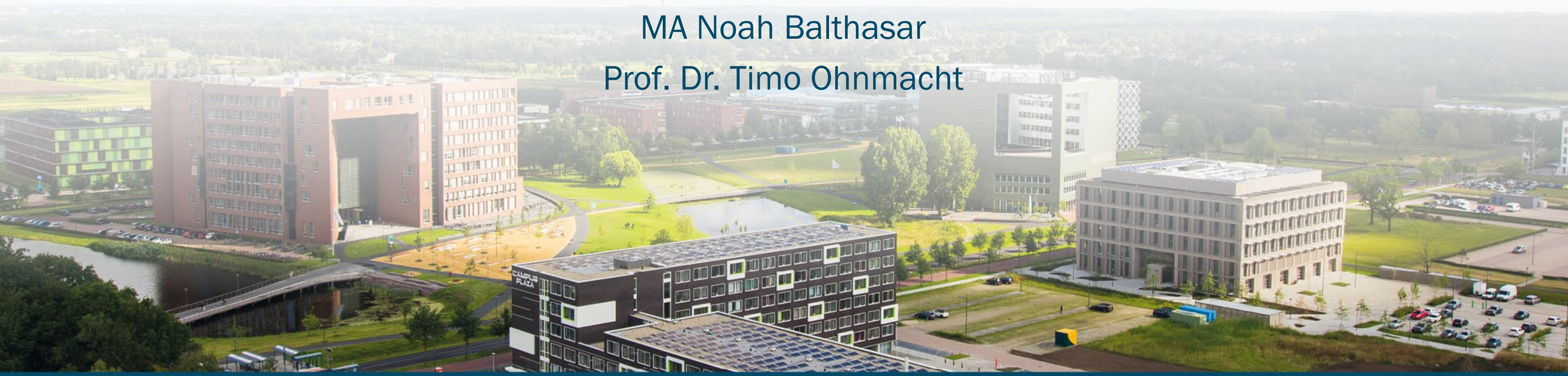

HSLU Lucerne University of Applied Sciences and Arts

Monitoring transformative change within a living lab:
a participatory survey design for base-lining key data

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Overview

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Our living lab «*Suurstoffi*»

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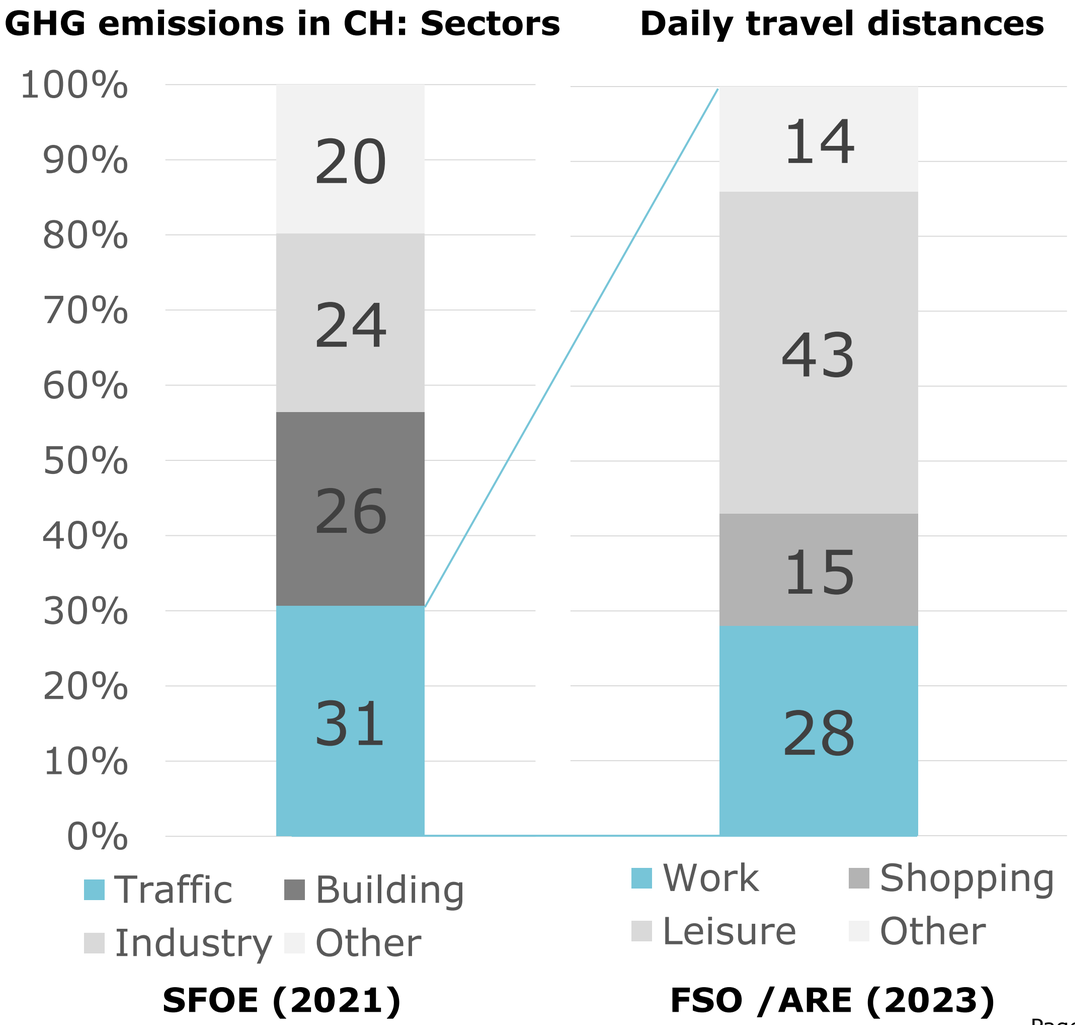
Summary & outlook

Green house gas (GHG) emission in Switzerland and daily travel distances (2021)

- So far, **GHG reduction** has been achieved **mostly** in the **building** and **industry sector**.
- **One third** of GHG emission is caused **in the traffic sector**.
- **But: No** reduction in emissions since **1990 in the traffic sector** (FOEN 2022; SFOE 2020; 2021, p.5; FSO 2022b, 2022a).
- Traffic caused in 2021 **13.9 mio. tons** of **CO_2**
- **Trip purpose work = 28 %,** equals **3.9 mio. tons of CO_2**
- 5 mio. employees in Switzerland. On average: **761 kg of CO_2 per year.**

How high is this figure in our LL?
Can it be influenced?



Literature Review

Telework is considered as a (transport) **policy** to **reduce** work related **travel CO_2 emissions**
(Cass & Faulconbridge 2016; Santos & Azhari 2022)

For Switzerland:

- Ohnmacht et al. (2020) show effects for using **co-working spaces** and
- Wöhner (2022) & Ravalet and Rérat (2019) for **home-office use**

on **reducing distance travelled** on the day of the telework activity.

In general: CO_2 emissions for work commutes are influenced by

- **commuting distance** (i.a. Heinen & Mattioli 2019)
- **mode of transport** (i.a. Pérez-Neira et al. 2020; Sobrino & Arce 2021)
- various **sociodemographic indicators** (gender, income, age, household)
  (i.a. Brand et al. 2021; Cao & Yang 2017; Cirilli & Veneri 2014, Wang & Zeng 2019)

Research gap: Rebound effects (e.g., more leisure trips on teleworking days) and spillover effects (increase in individual living space due to separate rooms for home office)

Transformative change within a Living Lab (LL)

<u>Our understanding</u>: In energy studies, a living lab introduces a (temporary) **transformative change within a real-life setting**.

To "**encourage people's engagement in new ways of doing**" within the discourse of climate change through a participatory setting (co-creation of interventions) (see Sahakian et al. 2021, p.3).

<u>Shortcomings of participatory practices within LLs</u>:

- **Valid population data on consumption patterns** and mobility behavior **is often scarce** especially when the living lab is set up initially.
- **Quantitative monitoring** of **energy savings** and the GHG **mitigation** reduction introduced by interventions is central to a living lab approach (e.g. for the government or policy makers that finance research).
- **Key data** is the backbone **of evaluation studies.**

But how to achieve this key data?

Study aim and research questions

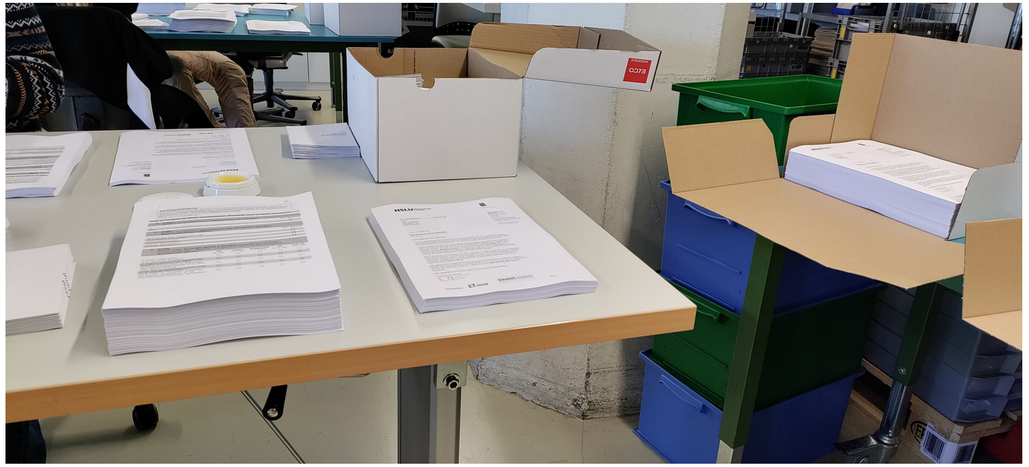
Aim 1: Carrying out a (cross-sectional) base-line-survey, ex-ante-intervention, quant. questionnaire

Aim 2: Including key data to describe the residents of the living lab (socio-demographics, work life characteristic, CO_2-figures for work commutes)

Aim 3: Survey design and methodology is understood as a process of collaboration within the living lab

RQ1: How can the GHG mitigation potential of the intervention "telework" be analyzed in a living lab?

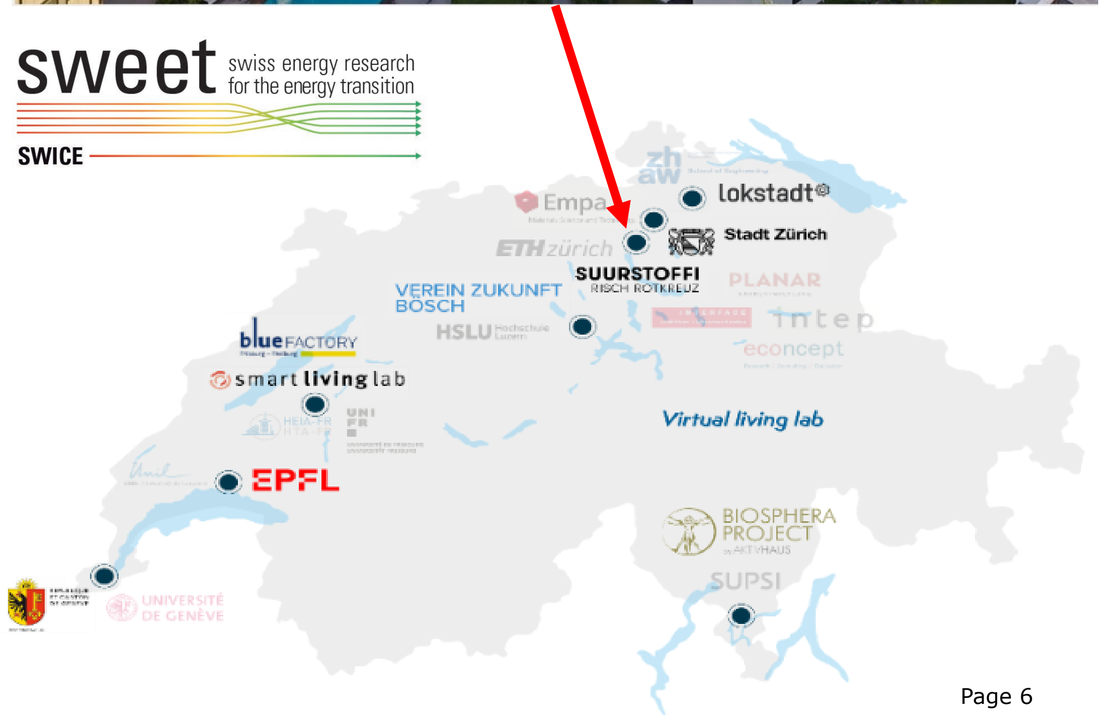
RQ2: What are the correlates between individual / work characteristics and CO_2 emission for work commutes?



Our living lab «Suurstoffi»

The modern “Suurstoffi” Site in the municipality of Risch-Rotkreuz serves as a **living lab.**

- 1500 inhabitants
- 2500 workplaces
- 2600 students



Methodology: Study design

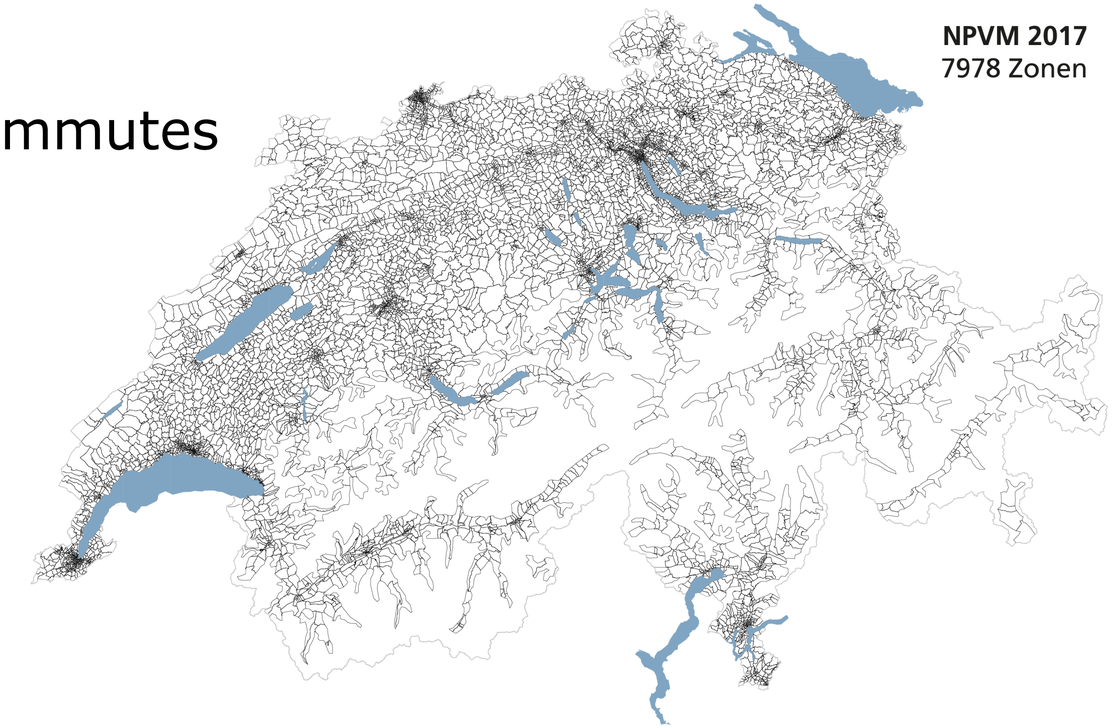
Participative approach

Researchers, public bodies, a real-estate company, industry partners and transport companies have served as a sounding board for the methodological design and content of our study.

Addresses were provided by the **municipality** of Risch-Rotkreuz.

- **Quantitative cross-sectional study** with standardized questionnaire
- **Representative survey** of residents with an age of 18 years and older (N = **922 persons**)
- **Personal letter** with paper-pencil-survey and prepaid reply envelope, in parallel **online survey** in German or English
- **Incentive** in form of a **voucher worth 10 Swiss francs** per person from a local bakery after response
- **Reminder** wave with response control & **field support** with hotline and email support
- **Response rate after** date cleaning: **n = 296 : 32%**

Methodology: Generating CO_2 figures for work commutes



- Study participants report **work-days of the week**, **postal code of workplace locations**, **mode of transport (MoT)** for commute
- **Matching of living location** and **workplace location via postal codes** with traffic zones of the Swiss federal transport model
- **Imputation** of **commuting distance** to the survey
- Combining the distances per MoT and commute with **CO_2 equivalent factors based on mobitool factors (Swiss standard)**

MoT	CO_2 factors [grams Co_2-equivalents]
Passenger car, diesel, gasoline (fleet average)	186.4
Passenger car, battery electric (fleet average)	89.8
Train, regional transport, s-rail	8.2
By bike	5.6
On foot	0

Descriptives: general

Attribute	**% or Average**	**Attribute**	**% or Average**	*Sig.*
Gender	50 % female	MoT for work commute		
Age	41 years	*Car*	46 %	
Household (HH) size	2.4 persons	*Public transport (PT)*	35 %	
HH income	10 140 Swiss Francs	*Bike*	5 %	
		Walk	13 %	
Car use	23 % car free HH			
PT tickets	86 % of HH	Commuting distance (per day & one way)		*
		All	27 km	
Employment rate	84 %	*Teleworkers*	31 km	
Telework rate	60 %	*No teleworkers*	21 km	
Telework days/week	1.6			

Two sample t-test n=242

* = The difference is significant at the 0.05 level ($p < .05$, 2-sided).

Descriptives: CO_2 emission for work commute in a year

Attribute	**Average**	*Sig.*	**Attribute**	**Average**	*Sig.*
Work commute			Gender		
Switzerland	761 kg		*Female*	622 kg	
Our Living lab	**742 kg**		*Male*	819 kg	
MoT for work commute		**	Survey language		**
Car	1538 kg		*German*	805 kg	
Public transport (PT)	77 kg		*English (proxy for "expats")*	326 kg	
Bike	28 kg				
Walk	0 kg		Teleworking		*
			Yes	597 kg	
	Correlation		*No*	964 kg	
Income	.125	.			

Two sample t-test / ANOVA n=235

** = The difference is significant at the 0.01 level ($p < .01$, 2-sided).
* = The difference is significant at the 0.05 level ($p < .05$, 2-sided).
. = The correlation is significant at the 0.10 level ($p < .10$, 2-sided).

PMA & «Orientations» towards the car and public transport (PT)

Constructs	**Average**	*Sig.*	**Constructs**	**Correlation** *Sig.*
Phase Model of Action (PMA) (based on Bamberg 2013)		**	Orientations (5-point Likert scale)	
Phase 1: no car use reduction planed	1005 kg	.	*Travelling by other MoT than car is good/pleasant*	-.222 *
Phase 2: reduction considered, but impossible	1549 kg	**	*Travelling by other MoT than car is easy/practicable*	-.377 *
Phase 3: reduction planed, first attempts	681 kg	.	*PT is too inflexible for me*	.193 **
Phase 4: is reducing, wants more	463 kg		*I like to travel by PT because I can focus on other things during the journey*	-.182 **
Phase 5: no car is used at all	61 kg	**		

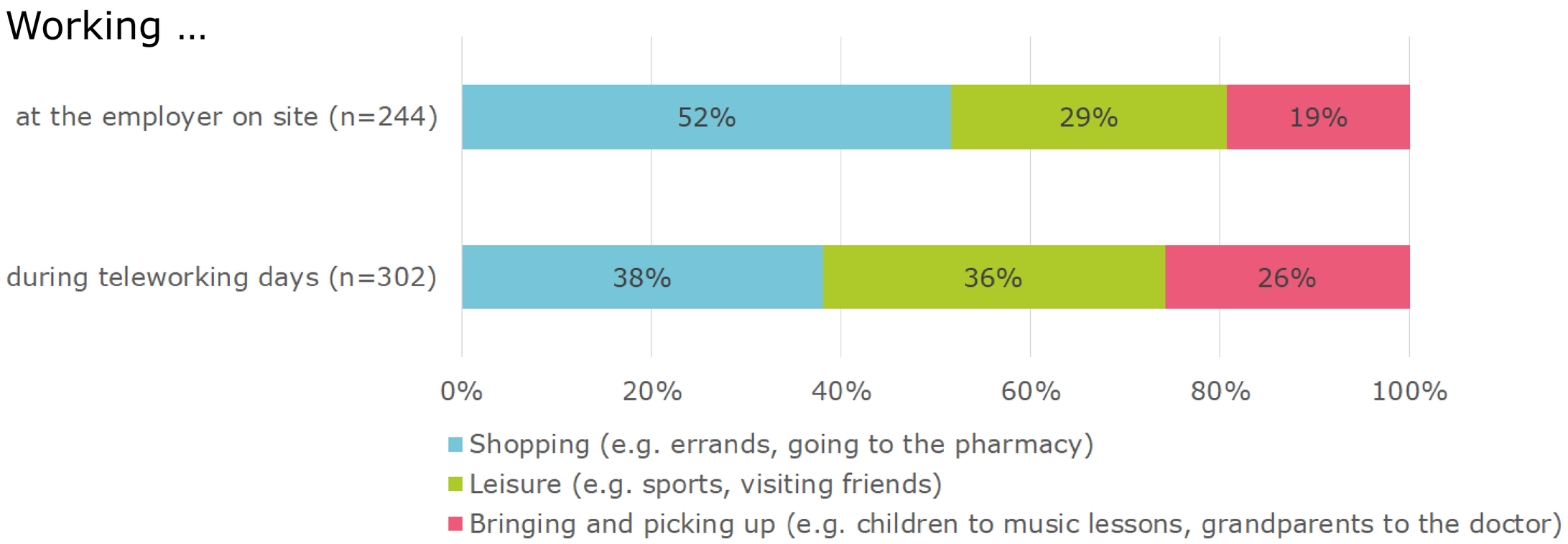
Two sample t-test / ANOVA n=235

** = The difference/correlation is significant at the 0.01 level ($p < .01$, 2-sided).

* = The difference/correlation is significant at the 0.05 level ($p < .05$, 2-sided).

. = The correlation is significant at the 0.10 level ($p < .10$, 2-sided).

Travel activities : some hints on rebound effects



Working during telework days: **Higher shares for "leisure"** and **"bringing and picking up"**.

Summary & outlook

- **Key data** was produced with a survey that was supported and feedbacked by members of the LL on the meso-level (public bodies, companies, transportation companies).
- A **T_0-measurement** was produced: The people in the LL consume **742 kg CO_2 a year for commutes.**
- **This key data is correlated with**
  - teleworking
  - orientations towards the car and public transport
  - expats vs. Swiss people
  - income

Outlook on further RQs:

How does this figure change when we introduce **interventions** in the LL (e.g., new co-working spaces as shared space in LL)?

Rebound effects regarding **leisure time** need to be considered in detail. **But**: First indication that the share of **leisure trips increase** on the teleworking days.

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Thank you for your attention!

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