Relationship between the mobility in Geneva, carbon emissions and a new tax

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Presentation of the BMST 2024 project

Contents

Motivation

- Climate change has become an issue

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- New tax system concerning mobility

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- New tax system concerning mobility
- What is their relationship?

Use case

- Find out how the mobility in Geneva, CO_2 emissions and taxes are related

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- Find out how the mobility in Geneva, CO_2 emissions and taxes are related
- Parameters chosen by the user allow the description of a large amount of situations
- Implementation of a special batch experiment for a study of the impact of the new tax system
- Basic overview of the simulation: `https://youtu.be/G9k8tXgL7Ak?si=L69N5U2XvbR-6IAQ`

Showcase of the user interface

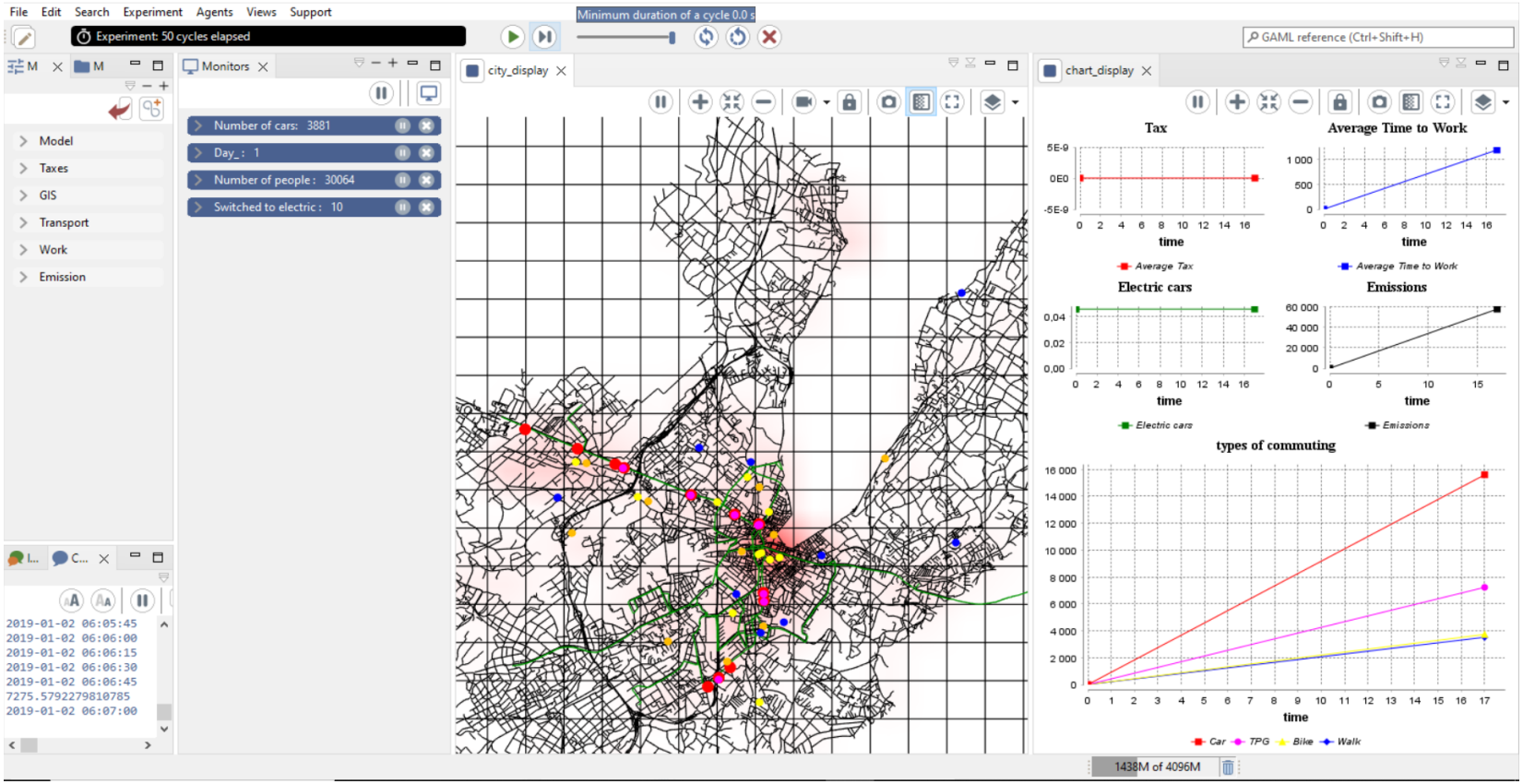

Figure: Showcase of the user interface

DPSIR graph

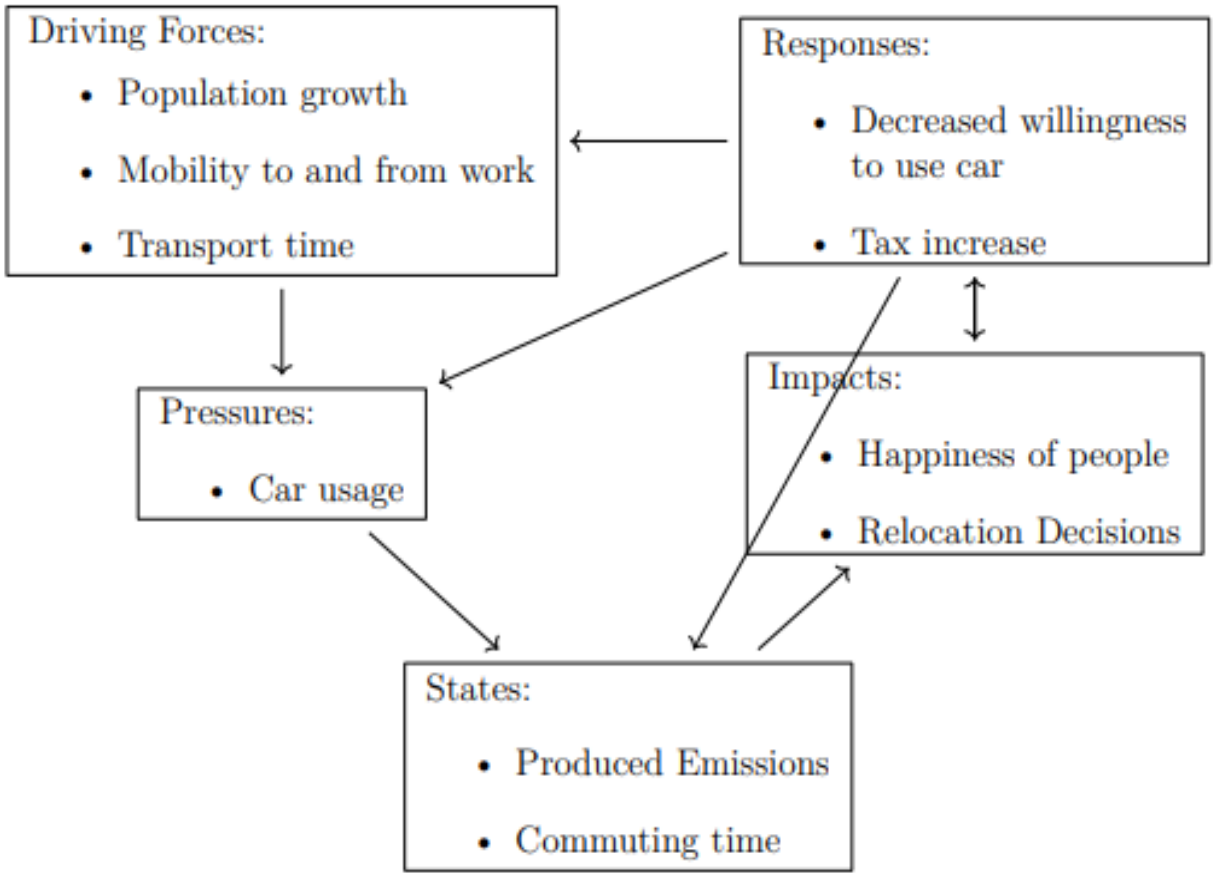

Figure: DPSIR graph

Global

- Attributes - mostly parameters, changeable by the user
- Reflexes: adding people, relocation, tax management

Grid

- Used to display emissions
- The more red the cell is, the more emissions were produced in that cell

Showcase of the grid

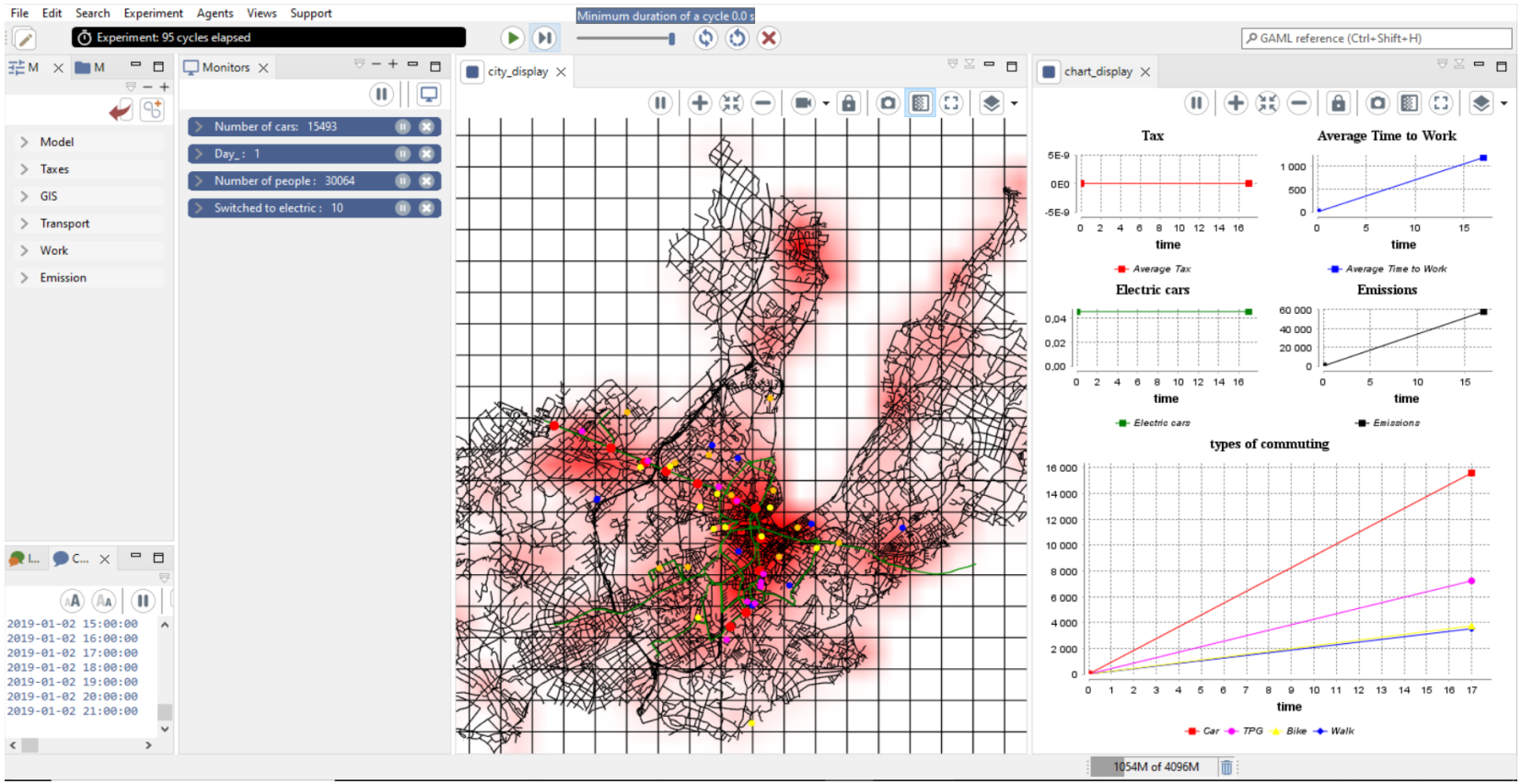

Figure: Showcase of the user interface

Showcase of the grid

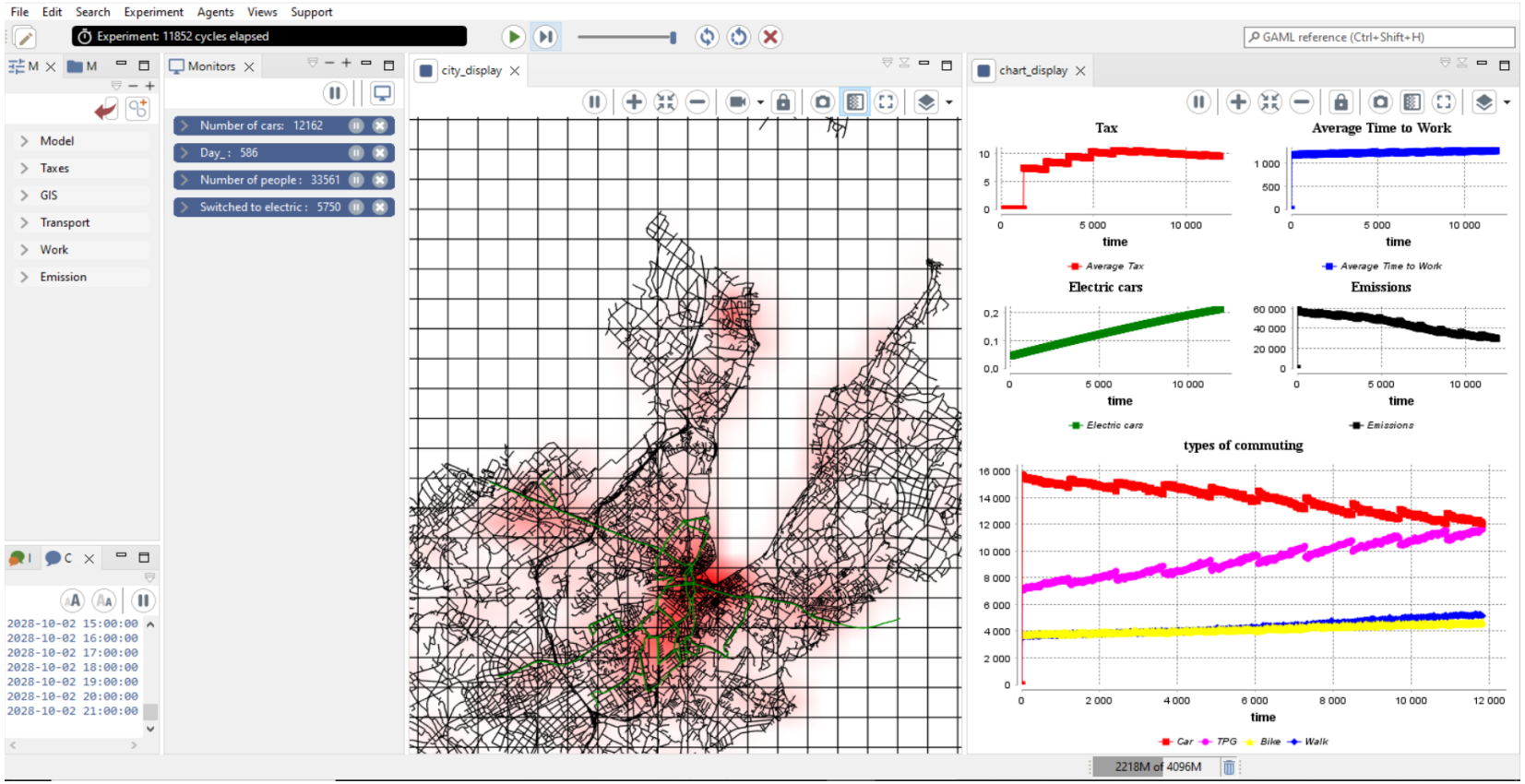

Figure: Showcase of the user interface

Buildings, roads and tracks

- Loaded from shapefiles that come from the SITG website (`https://ge.ch/sitg/`)
- No special function
- Roads and tracks are used to create graphs on which cars and tramways move

Tramways

- Move on tracks from stop to stop, turn around at terminus
- Can pick up people. Implemented in people agent - following location.

People

- Many attributes are just "variables that would take an unreasonable amount of time to calculate over and over again"
- Commute to work
- The choice of transport depends on many factors, eg. proximity to working place, current tax, willingness to use car. Random factor.

People - random factor

Probabilities				
Distance	Walk	Bike	TPG	Car
< 1 *km*	100%	0%	0%	0%
1-2 *km*	72%	15%	0%	13%
2-3 *km*	42%	24%	19%	15%
3-4 *km*	20%	15%	35%	30%
4-5 *km*	19%	16%	35%	30%
5-6 *km*	14%	14%	32%	40%
6-8 *km*	0%	20%	55%	25%
8-10 *km*	0%	10%	60%	30%
10-15 *km*	0%	7%	43%	50%
15-20 *km*	0%	1%	49%	50%
> 20 *km*	0%	1%	49%	50%

Table: Random factor for each transport choice

Disabled tax

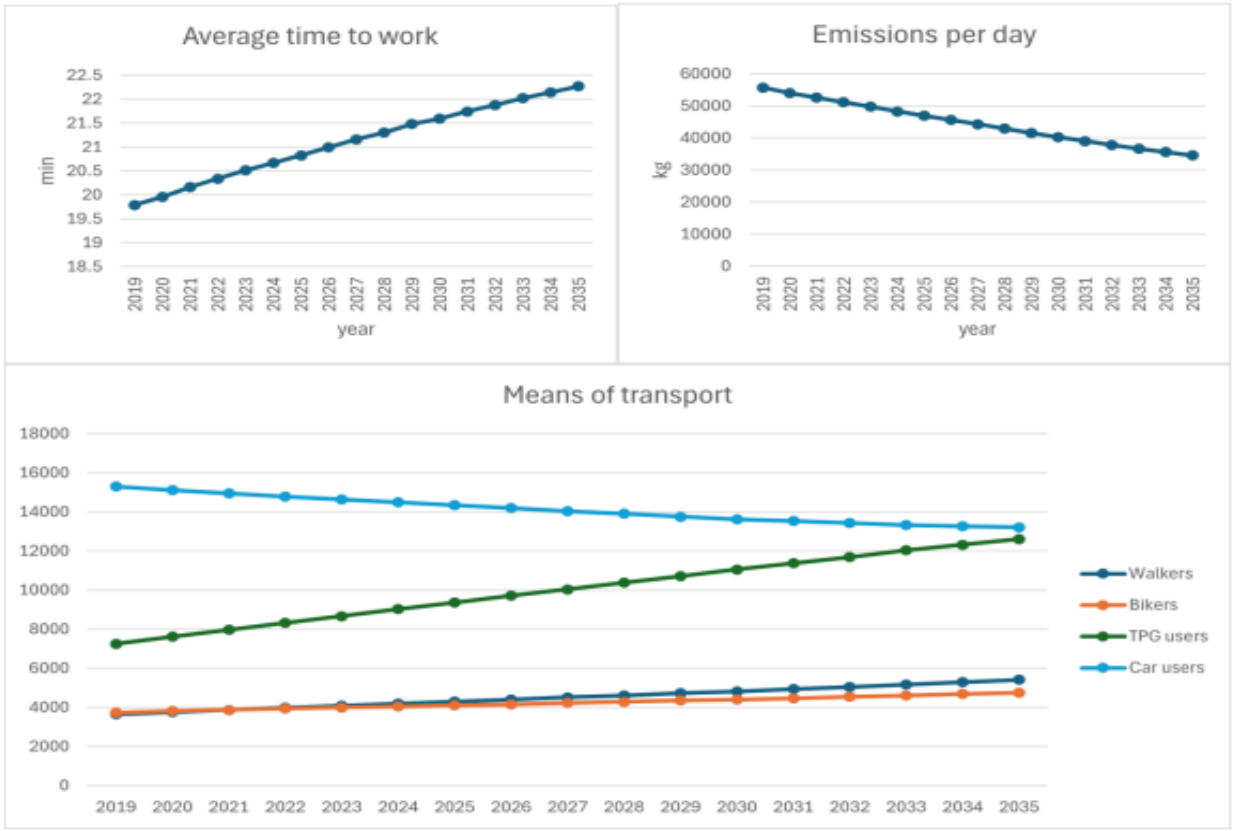

Figure: Disabled tax

Default settings

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Low impact of tax on relocation decisions

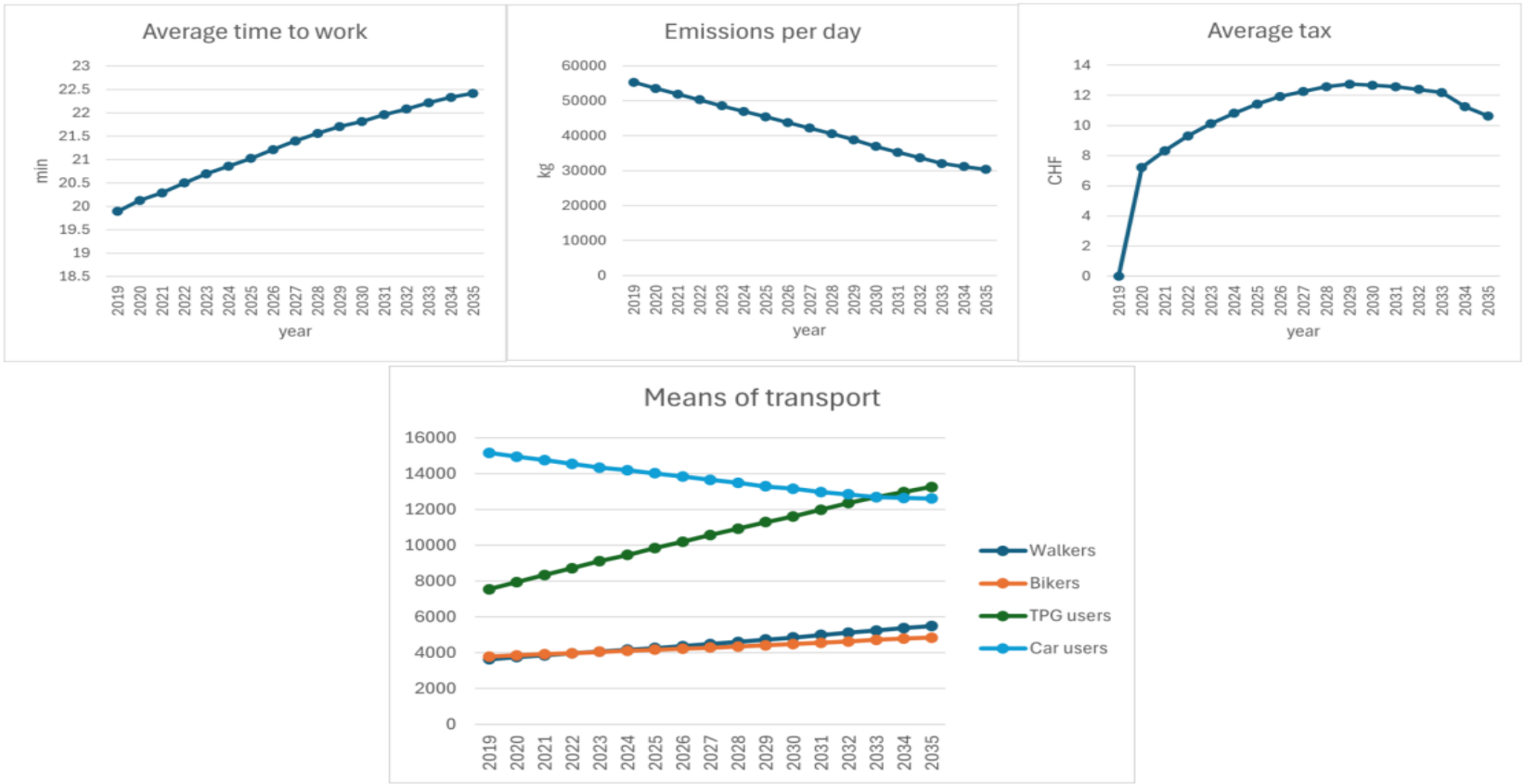

Figure: Low impact of tax on relocation decisions

High impact of tax on relocation decisions

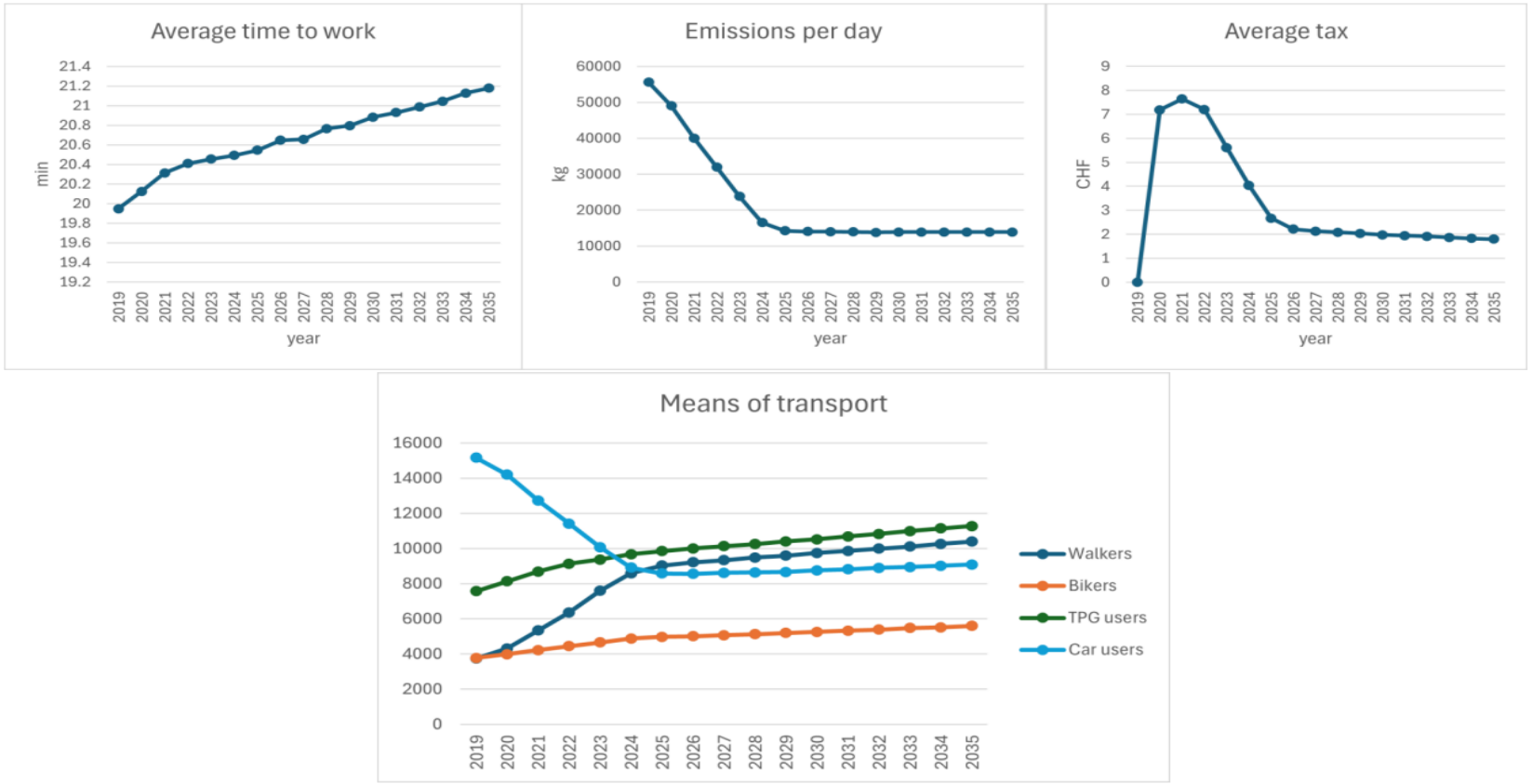

Figure: High impact of tax on relocation decisions

Frequent switches on electric vehicles

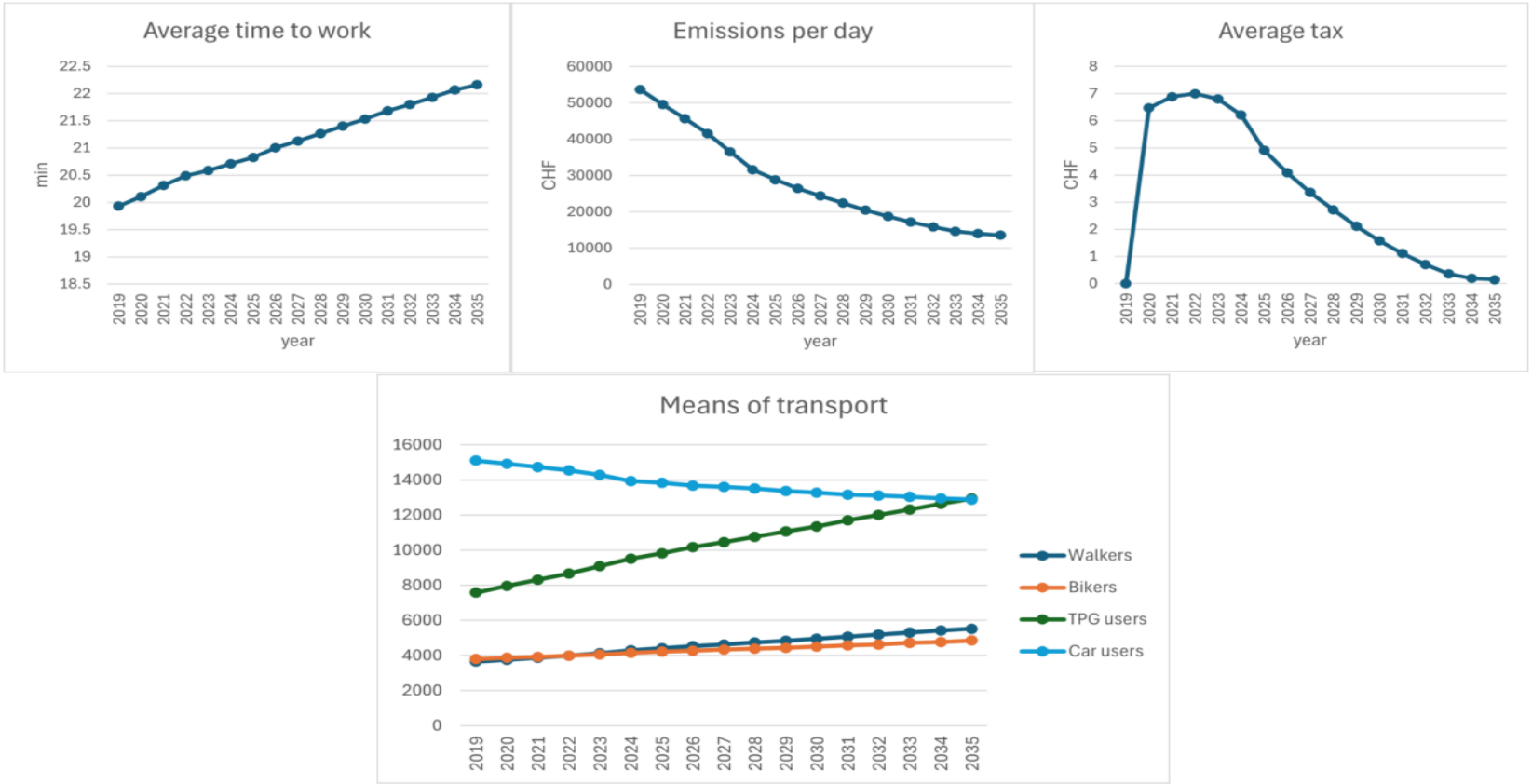

Figure: Frequent switches on electric vehicles

Relationship of emissions in 2035 and tax growth rate

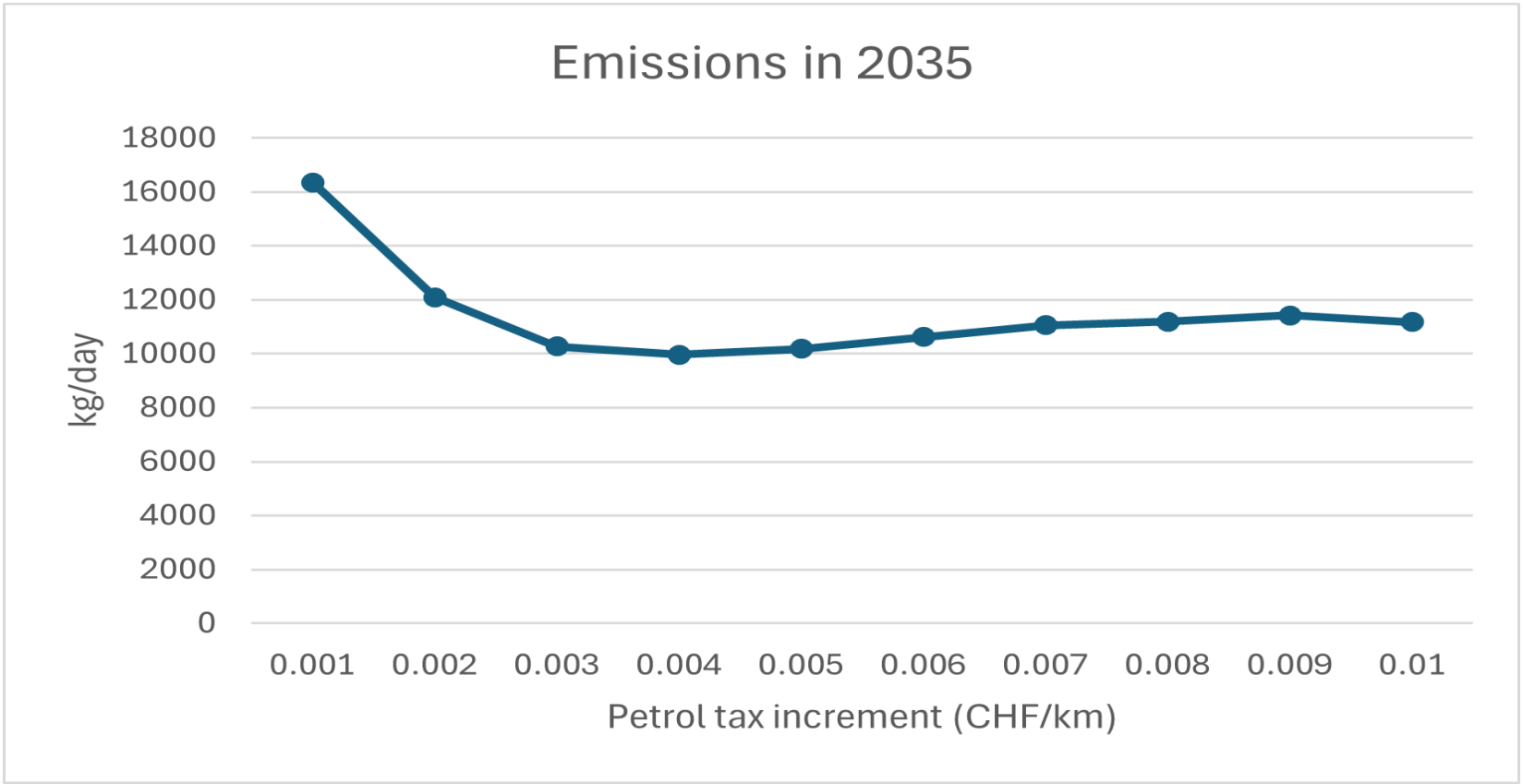

Figure: Relationship of emissions in 2035 and tax growth rate

Discussion

- Increased impact of the tax onto relocation decisions causes people relocate more often, which leads to increased amount of walkers and lower car usage
- Higher frequency of switching to electric cars leads to decreased emissions. Also, after some time, tax decreases to 0.
- Emissions are not monotonously dependent on the tax growth rate.

Contextualisation

- Low average time to work
- High emissions prduction

Electromobility

- High impact on emissions without a dramatic increase in car usage
- Low tax

Electromobility

- High impact on emissions without a dramatic increase in car usage
- Low tax
- Not enough powering stations
- Strong dependence on the electric network
- Low capacity of batteries

Future works

- Change of jobs
- Kids and seniors
- Getting rid of some random decisions
- Implementation of the real tax

Takeaways

- Dependence of emissions on tax and electromobility
- The dependence on tax growth rate is not monotonous
- Comparison of our tax system and the real one