Social impacts of decarbonising the Austrian passenger transport system
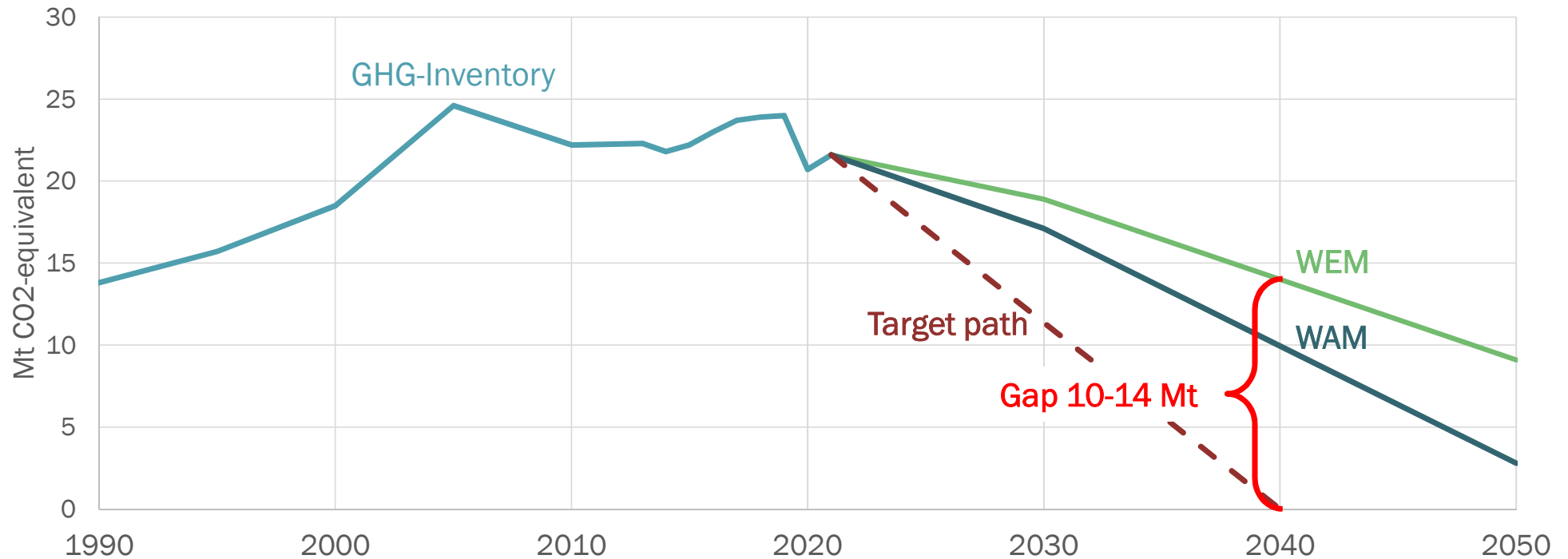
Paul Pfaffenbichler

6th – 8th September 2023
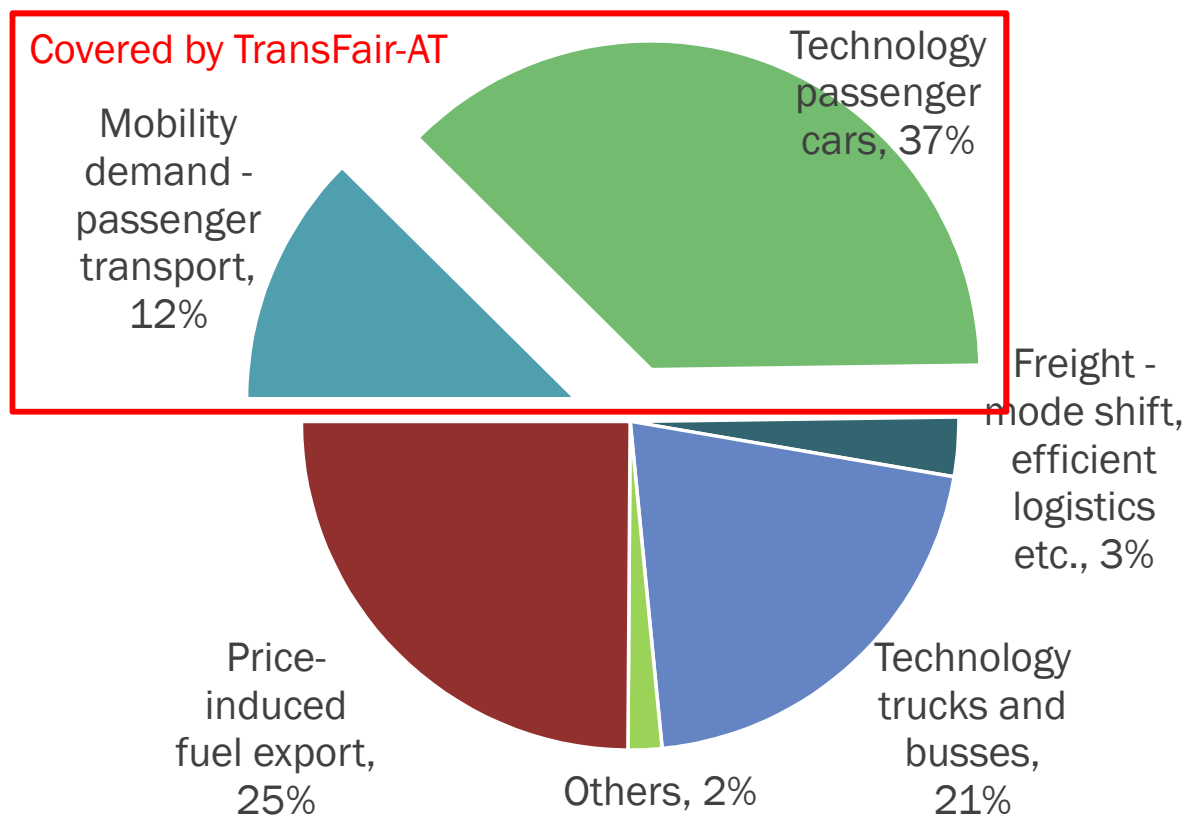
Politecnico di Milano

Scenarios and targets of the official Mobility Master 2030

GHG emissions transport (incl. nat. air transport)

WEM

WAM

Target path

Gap 10-14 Mt

GHG-Inventory

Mt CO2-equivalent

Sources: (Krutzler et al. 2017), (BMK 2021) and (Anderl et al. 2023)
Legend: WEM = With Existing Measures, WAM = With Additional Measures

WIFO BOKU Energy Economics Group ethink ENERGY RESEARCH

Target path towards climate neutrality in transport by 2040

Covered by TransFair-AT

Technology passenger cars, 37%

Mobility demand - passenger transport, 12%

Freight - mode shift, efficient logistics etc., 3%

Technology trucks and busses, 21%

Others, 2%

Price-induced fuel export, 25%

Sources: (BMK 2021)

WIFO   BOKU   Energy Economics Group   ethink

Objectives of the project TransFair-AT

1. to provide comprehensive and innovative **model-based analyses** of the economic incidence and social impacts of a complete decarbonisation of the sectors **residential buildings and passenger transport** in Austria by 2040

2. to **develop targeted compensation mechanisms** to mitigate the burden of these climate policies for particularly vulnerable groups, while ensuring that these compensation mechanisms are consistent with **full decarbonisation**

Sources: https://transfair.wifo.ac.at

Modelling Framework


Sources: https://transfair.wifo.ac.at/wp/wp2.htm
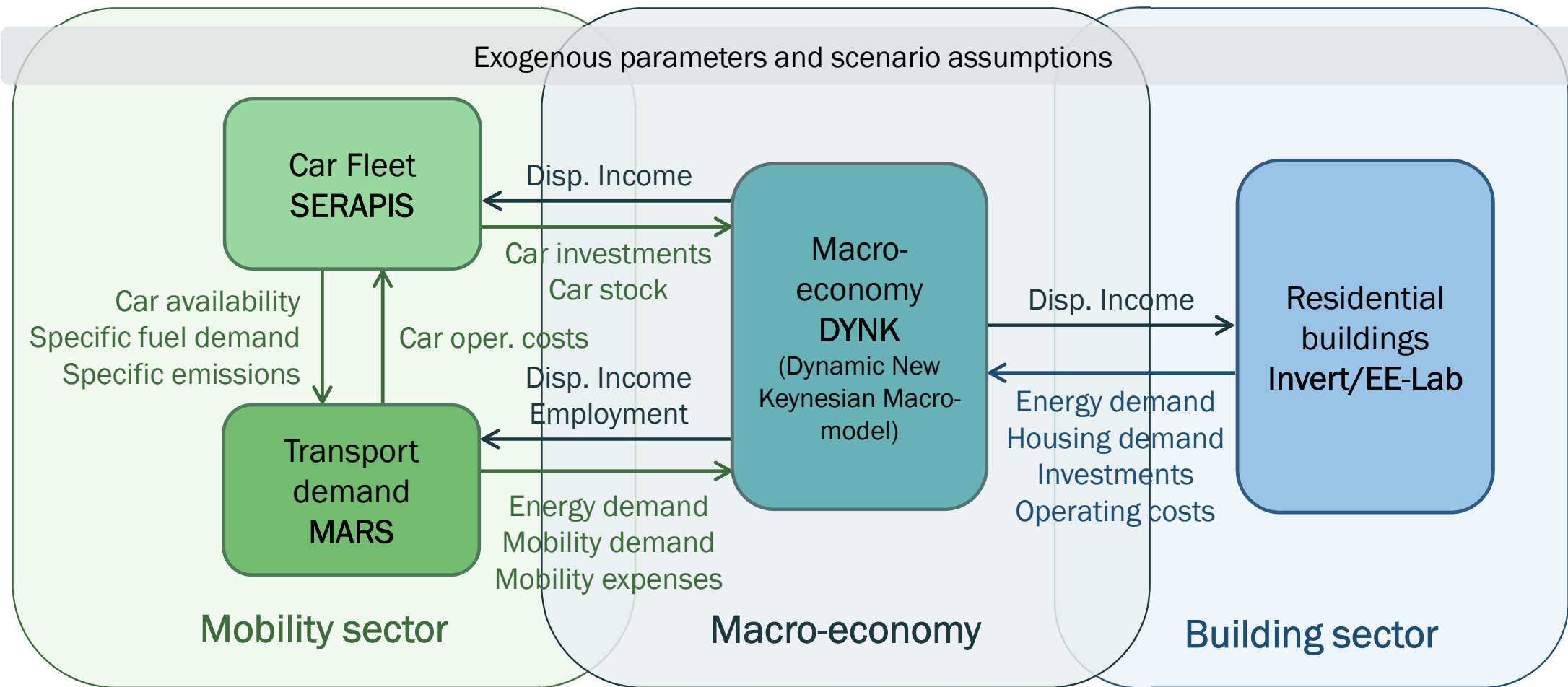
► **SERAPIS**

  ► is a dynamic passenger car fleet and propulsion technology model which

  ► utilises the concept of stocks and flows to and simulate the fleet development and

  ► a multinominal LOGIT model for the choice of propulsion technology.

► **MARS**

  ► is a multi-modal, strategic, dynamic land use and transport interaction model which simulates origin-destination wise transport demand of Austria subdivided into about 120 zones.


Sources: (Pfaffenbichler at al. 2022), (Laa and Pfaffenbichler 2022)
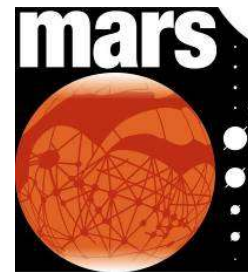
► **SERAPIS**

   ► Review and recalibration of SERAPIS vehicle stock until 2022

   ► EU Green Deal: exclusively Zero Emission Vehicles from 2035 onwards

► **MARS**
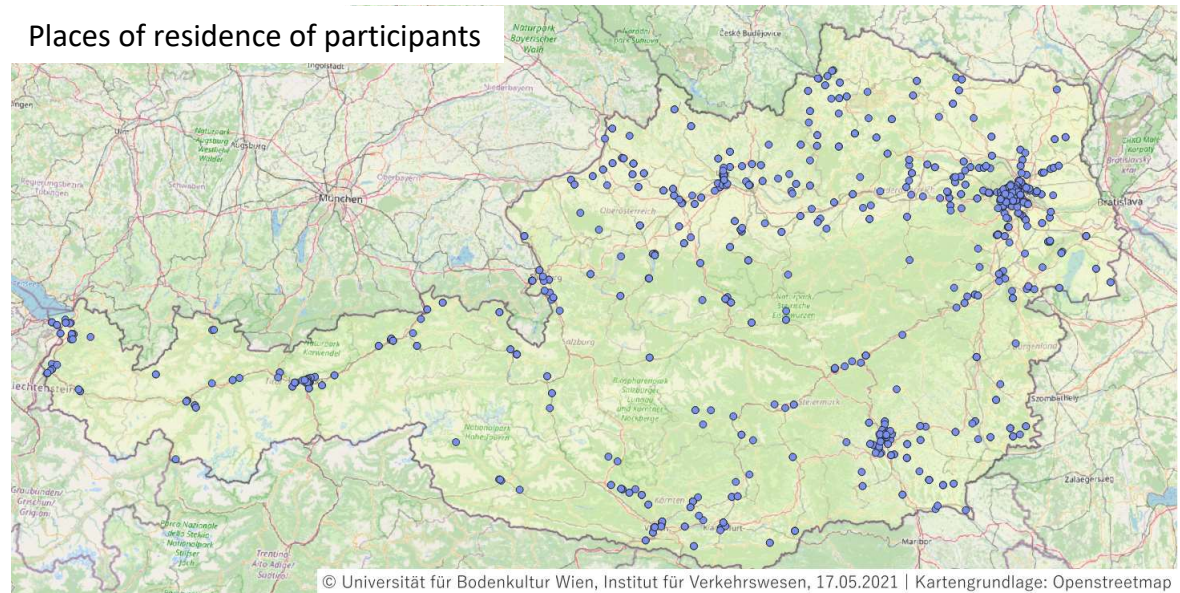
   ► Change of the base year of MARS from 2010 to 2017

   ► Change of traffic zones in MARS model to district boundaries as of 2017

   ► Representation of 2020-2022 pandemic-related effects (lock-down, home office, attitudes toward public transportation and active mobility).

   ► Recalibration MARS with data from Statistics Austria's 2019/20 supplementary consumption survey.
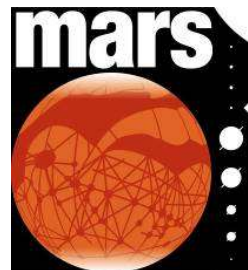
TransFair-AT

► The last nationwide mobility survey was conducted about 10 years ago.

► Data from a mobility and time-use survey conducted by the Institute of Transport Studies (sic!) as part of Statistics Austria's national consumer expenditure survey can be utilized in Transfair-AT.

► **Sample:** 908 representatively selected persons aged 16 years and older residing in Austria

  ► Two roughly equally sized waves September 18, 2019 - March 9, 2020 (before lockdown) and March 16, 2020 - August 8, 2020 (after lockdown).

  ► Respondents documented a whole week in a trip and activity diary.

► In addition these data will be used for a detailed analysis of the effects on vulnerable households.

Places of residence of participants

© Universität für Bodenkultur Wien, Institut für Verkehrswesen, 17.05.2021 | Kartengrundlage: Openstreetmap

Sources: https://ive.boku.ac.at/covid/

WIFO   BOKU   Energy Economics Group   ethink ENERGY RESEARCH

► The modal split for the whole of Austria from the national mobility survey 2013/14 (ÖU) and the supplementary mobility and time use survey of 2019/20 (ZE) corresponds well.

► The results of the simulation with the MARS model are basically within the confidence interval of the sample size of ZE.

► The influence of the lockdown and other Covid-a9 measures (e.g. mandatory use of masks in public transport) is sufficiently reproduced by the simulation.
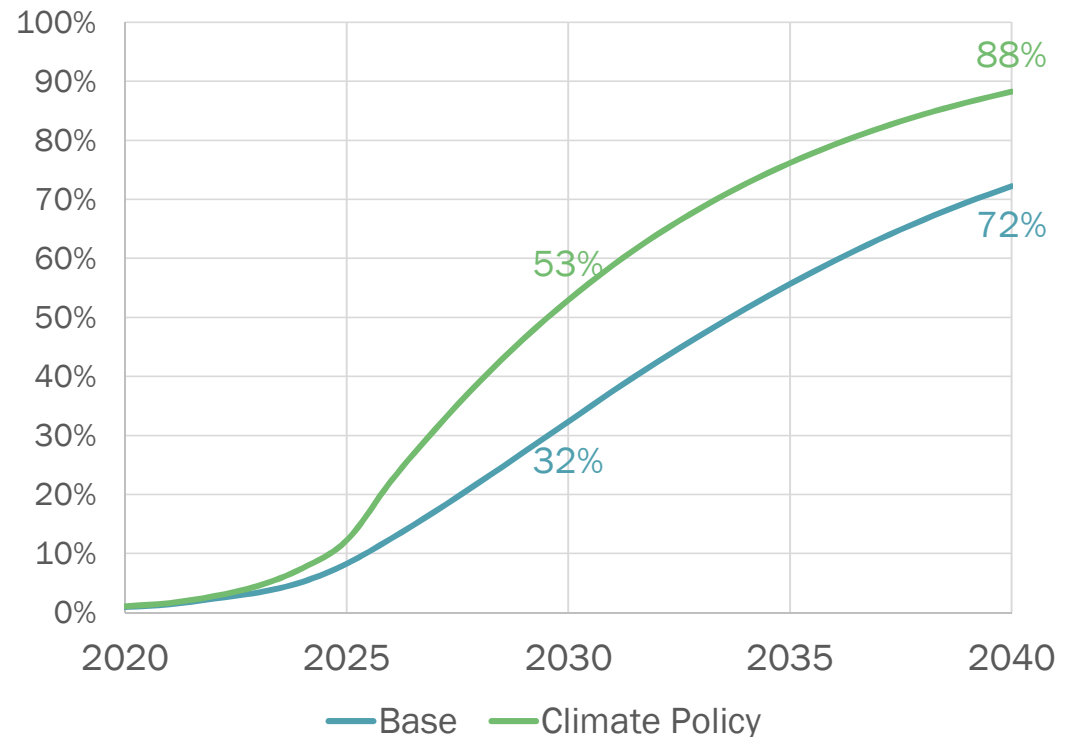

Austria

Sources: (BMVIT 2016), https://ive.boku.ac.at/covid/
Legend: ÖU = National Mobility Survey 2013/14, ZE = Mobility and Time Use Survey 2019/20

WIFO   BOKU   Energy Economics Group   ethink ENERGY RESEARCH

▶ **Climate Policy:**

 ▶ Car ownership, BEV fleet, fuel costs, fuel tax, carbon price, efficiency, parking charges ST, car occupancy rate
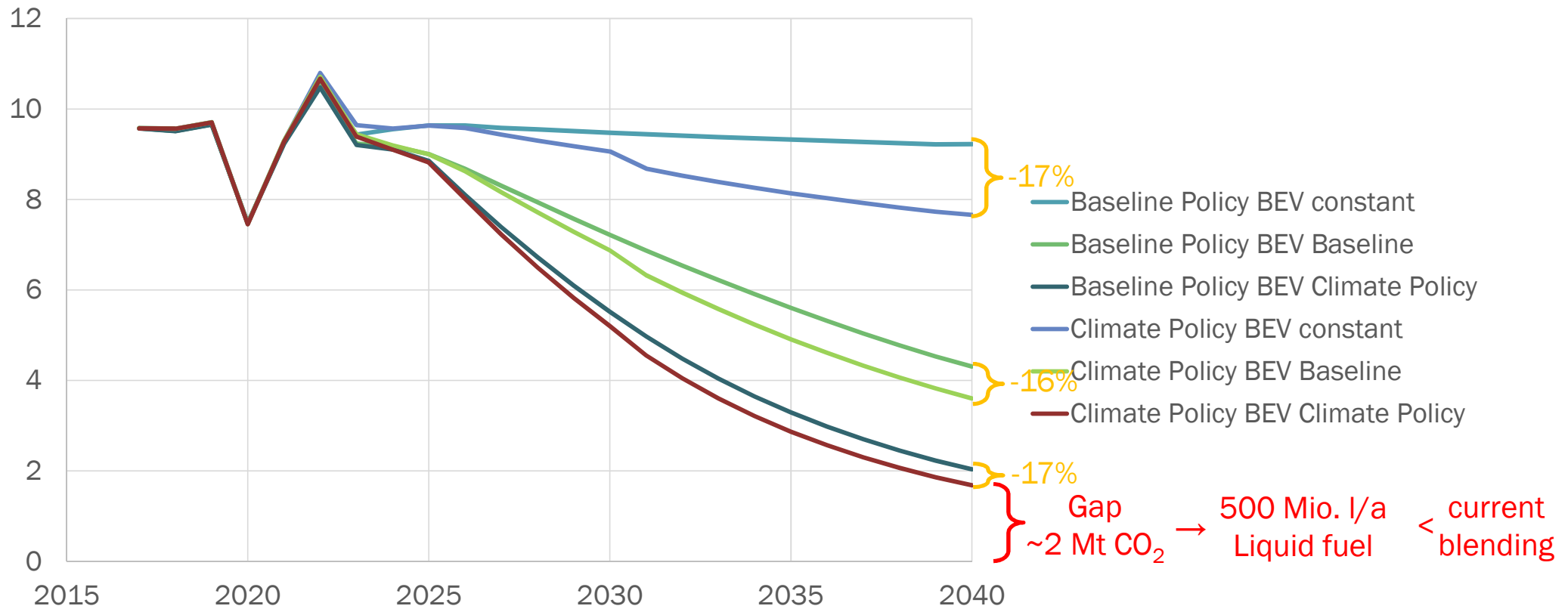
▶ **Combinations**

 ▶ Baseline Policy – BEV fleet: Constant 2022

 ▶ Baseline Policy – BEV fleet: Baseline

 ▶ Baseline Policy – BEV fleet: Climate Policy

 ▶ Climate Policy – BEV fleet: Constant 2022

 ▶ Climate Policy – BEV fleet: Baseline

 ▶ Climate Policy – BEV fleet: Climate Policy

Share of BEVs in the car fleet

Sources: Own simulations
Legend: BEV = Battery Electric Vehicles, ST = short term

WIFO   BOKU   Energy Economics Group   ethink ENERGY RESEARCH

GHG emissions passenger transport (Mt/a)

-17% Baseline Policy BEV constant
Baseline Policy BEV Baseline
Baseline Policy BEV Climate Policy
Climate Policy BEV constant
-16% Climate Policy BEV Baseline
Climate Policy BEV Climate Policy
-17%

Gap → 500 Mio. l/a < current
~2 Mt CO_2 Liquid fuel blending

Sources: Own simulations and calculations, (Aichmayer et al. 2021)
Legend: BEV = Battery Electric Vehicles

WIFO   BOKU   Energy Economics Group   think ENERGY RESEARCH

Gini coefficient mobility expenditures (excl. car purchase costs)

Legend:
- Baseline Policy BEV constant
- Baseline Policy BEV Baseline
- Baseline Policy BEV Climate Policy
- Climate Policy BEV constant
- Climate Policy BEV Baseline
- Climate Policy BEV Climate Policy

Sources: Own simulations and calculations
Legend: BEV = Battery Electric Vehicles

WIFO ■   BOKU   Energy Economics Group   ethink ENERGY RESEARCH
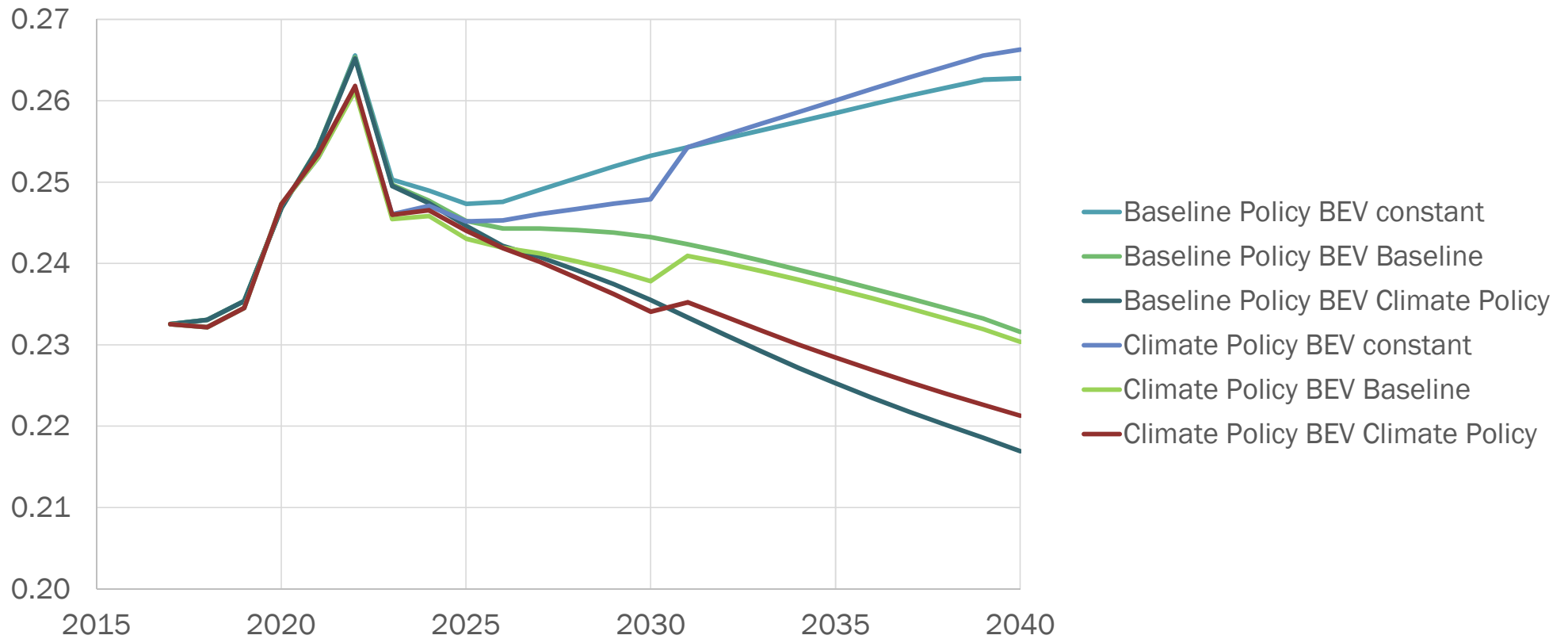
► Model linkage

  ► A Github repository and model specific scripts have been set up to facilitate the iterative data exchange between the models from the three domains.

  ► After finalising the definition of the base and climate policy scenarios joint model runs will be carried out.

    ► Convergence and sensitivity tests

    ► Simulation of climate and mitigation policies

► In depth analysis

  ► The level of detail concerning household types in the mobility models is low.

  ► Households are uniform within the travel analysis zones of the models.

  ► As a solution we will enrich the high level results from the travel demand simulations with detailed information from the supplementary mobility and time use survey of the national consumer expenditure survey.

WIFO ■   BOKU   Energy Economics Group   ethink ENERGY RESEARCH

► Definition:

   ► Mobility and energy poor households are households in the lowest income quartile[1] whose expenditures on mobility (excluding vehicle purchases) resp. energy are in the top quartile (aspect affordability).

   ► Mobility poor households have/are:

      ► smaller with less children

      ► lower educational levels and employment rates

      ► longer distances to cover

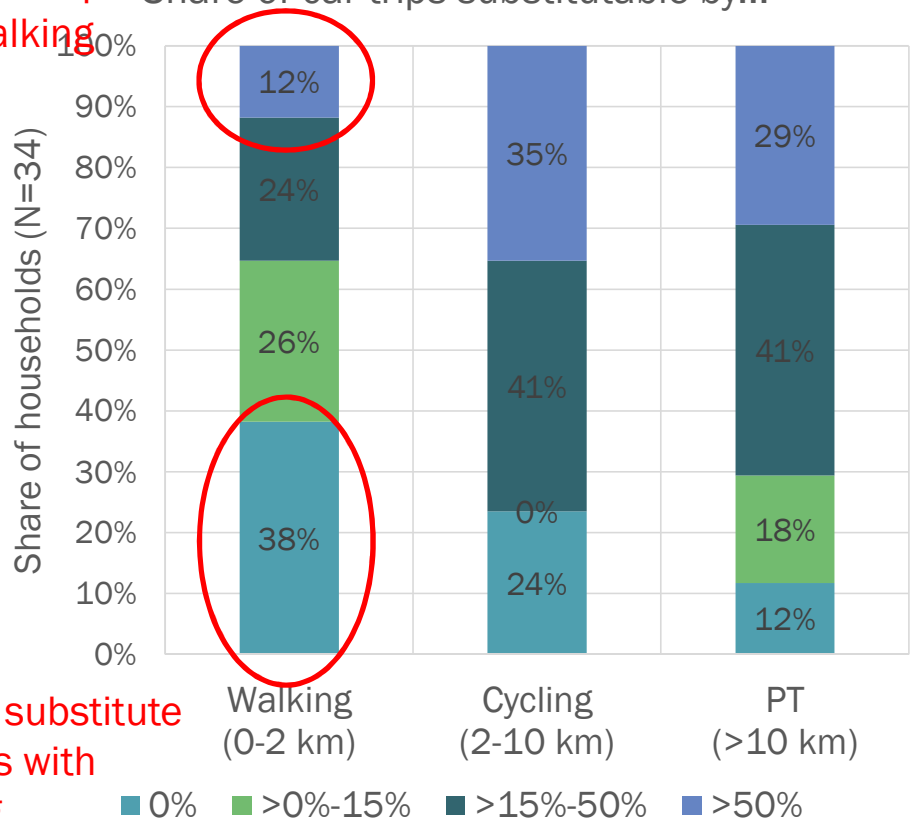   ► lower shares of walking, cycling and public transport

      ► higher share of car use

      ► etc.

1) < 2092,75 € (Statistik Austria)

Share of households by category (N = 532)

WIFO BOKU Energy Economics Group ethink ENERGY RESEARCH

Can substitute >1/2 car trips with walking

Share of car trips substitutable by...

Cannot substitute car trips with walking

Share of households (N=34)

Walking (0-2 km)	Cycling (2-10 km)	PT (>10 km)
12%	35%	29%
24%		41%
26%	41%	18%
38%	0%	12%
	24%	

Legend: ■ 0% ■ >0%-15% ■ >15%-50% ■ >50%

Example: rural single person household	
Trips per week	19
Share car	100%
Total distance	318 km

Distance	Share	Coping strategy
0-2 km	11%	Walking
>2-10 km	32%	Cycling
>10 km	58%	PT

No viable option:
$t_{PT} = 2.3 - 5.5 \times t_{car}$

WIFO   BOKU   Energy Economics Group   Ethink

► An iterative modelling framework covering macro-economy and the mobility and housing sector is used to analyse effects of decarbonisation policies.

► Our simulations show that it is hardly possible to achieve the zero emissions target in 2040 in the mobility sector.

  ► The largest part of the emission reduction results from the electrification of passenger car transport.

  ► The SERAPIS model shows that a complete fleet renewal is not possible until 2040.

► The simulations also show that decarbonization policies affect equity.

► The decarbonisation policy slightly decreases the spatial inequality concerning the share of mobility expenditure (excluding car purchase costs) of household income while the median in 2040 decreases from 13.2% to 11.0%.

► The rather highly aggregated simulation results will be enriched by a "what-if" analysis using detailed data from the complimentary mobility and time use survey of the national consumer expenditure survey.

Thank you for your attention!

Webpage: https://transfair.wifo.ac.at/index.htm

Twitter: @TransFair_AT

Email: paul.pfaffenbichler@boku.ac.at

DOI: 10.5281/zenodo.8339131

This project is funded by the Klima- und Energiefonds and carried out within the Austrian Climate Research Program (ACRP)

powered by klima+ energie fonds

References

▶ Krutzler, T., Zechmeister, A., Stranner, G., Wiesenberger, H., Gallauner, T., Gössl, M., … Winter, R. (2017). Energie- und Treibhausgas-Szenarien im Hinblick auf 2030 und 2050. Retrieved from http://www.umweltbundesamt.at/fileadmin/site/publikationen/REP0628.pdf

▶ BMK. (2021). Mobilitätsmasterplan 2030 für Österreich. Retrieved from https://www.bmk.gv.at/dam/jcr:6318aa6f-f02b-4eb0-9eb9-1ffabf369432/BMK_Mobilitaetsmasterplan2030_DE_UA.pdf

▶ Anderl, M., Bartel, A., Bürger, J., Gössl, M., Haydn, M., Heinfellner, H., Heller, C., Heuber, A., Köther, T., Krutzler, T., Kuschel, V., Makoschitz, L., Mayer, M., Mayer, S., Moldaschl, E., Pazdernik, K., Perl, D., Poupa, S., Purzner, M., … Zechmeister, A. (2023). Klimaschutzbericht 2023. Umweltbundesamt GmbH. https://www.umweltbundesamt.at/fileadmin/site/publikationen/rep0871.pdf

▶ Pfaffenbichler, P., Emberger, G., Figenbaum, E., & Fearnley, N. (2022). Simulating the effects of tax exemptions for plug-in electric vehicles in Norway. ETC Conference Papers 2022. https://aetransport.org/private/downloads/PNM6LkbzQ6pK3Vkwi-hMcLB0ClQ/ETC_2022_Paper_Elan_v3.pdf

▶ Laa, B., & Pfaffenbichler, P. (2022). Modelling the Effect of a Nationwide Mobility Service Guarantee on Travel Behaviour Using the Strategic Model MARS. European Transport Conference 2022. https://aetransport.org/private/downloads/5Y5pT2mB01usB-oUHs7iGb5SqU4/2022_09_02_ETC_Laa_Pfaffenbichler_Modelling MSG.pdf

▶ BMVIT. (2016). Ergebnisbericht zur österreichweiten Mobilitätserhebung „Österreich unterwegs 2013/2014". https://www.bmk.gv.at/dam/jcr:fbe20298-a4cf-46d9-bbee-01ad771a7fda/oeu_2013-2014_Ergebnisbericht.pdf

▶ Aichmayer, S., Mitterhuemer, R., & Winter, R. (2021). Biokraftstoffe im Verkehrssektor 2021. file:///C:/Users/ppfaffenbichler/Downloads/Biokraftstoffbericht_2021.pdf

▶ Pfaffenbichler, P., Gühnemann, A., Gold, O., & Hartwig, L. (2023). TransFair-AT Research Brief #2: Exploring the characteristics of mobility and energy poor households in Austria. https://doi.org/10.5281/ZENODO.8273233