AUSTRIAN INSTITUTE OF TECHNOLOGY
TOMORROW TODAY

RAPID MODELLING OF PARK & DRIVE SCHEMES USING AGENT-BASED TRIP CHAIN DATA

15th ECTRI TG TMM Webinar

05.02.2026

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MOTIVATION

- Transport sector decarbonisation requires behavioural change
- Private car use dominates; car occupancy remains low (≈1.14 persons/car in Austria)
- Ridesharing can reduce congestion, emissions, and improve accessibility
- Park & Drive (P+D) stations support informal ridesharing
- Rapid growth of P+D stations, but planning often lacks systematic grounding
- Existing tools rely on aggregated data and simplified assumptions
- Full agent-based simulations are data- and computation-intensive
- Need for a fast, transferable, and behaviourally informed planning tool

MOTIVATION

Research Objective

- Develop a fast, low-cost tool to assess P+D potential at specific locations
- Estimate realistic ranges of ridesharing potential
- Support early-stage strategic planning and decision-making

Tool

- Python-based, open-source implementation
- Uses representative daily trip chains from traffic models
- Faster* and cheaper than full-scale traffic simulations

Available on:
https://github.com/ait-energy/park-drive-potential

*11 locations analysed in 40 minutes on a 2020 high-end laptop (Core i7 10610U, 32 GB RAM).

INPUT DATA REQUIREMENTS

- Car road network
- Trip chains with:
  - Detailed car routes
  - Departure and arrival times
  - Optional: Socio-demographic data (e.g. age, employment status for behavioural models)
  - Optional: trip purpose information

SCENARIO DEFINITION PARAMETERS

- $PD_{LOCATION}$ location of P&D station (geo-coordinates)
  $PD_{CATCHMENT}$ catchment area as straight-line distance (5 km)
- PD_{SHARED} minimum length of shared route segment (20 km)
- $PD_{DEPARTURE}$ time slot size for departure times (15 minutes)
- PD_{CELL} geographic proximity of destinations (H3 cell* resolution: 7; ~5 km² hexagons)

*https://h3geo.org

KEY OUTPUTS

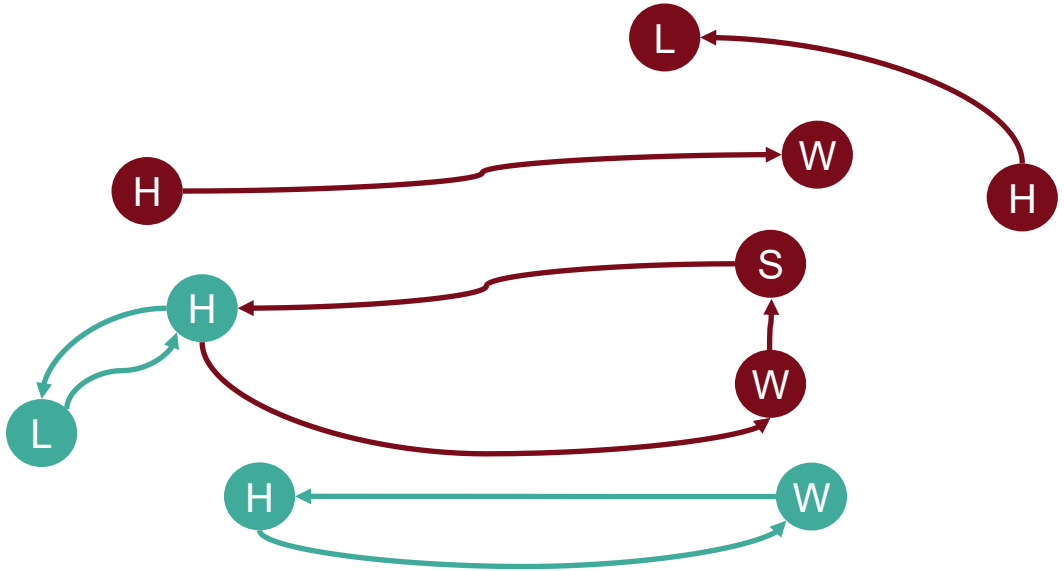
- Potential per station and willingness model
- Number of ridesharing matches per station
- Saved vehicle kilometres
- Required parking capacity over time
- Spatial and temporal characteristics of matches
- Flow bundles per P+D station

CARPOOLING CONCEPT AT PREDEFINED P&D STATIONS

- Informal system
- No booking or matching system
- Assumption: passengers ride with the same driver for the entire trip chain
- Restriction to trip chains that:
  - Start and end at home
  - Consist of two trips

1. PREPARATION & FILTERING OF TRIP CHAINS

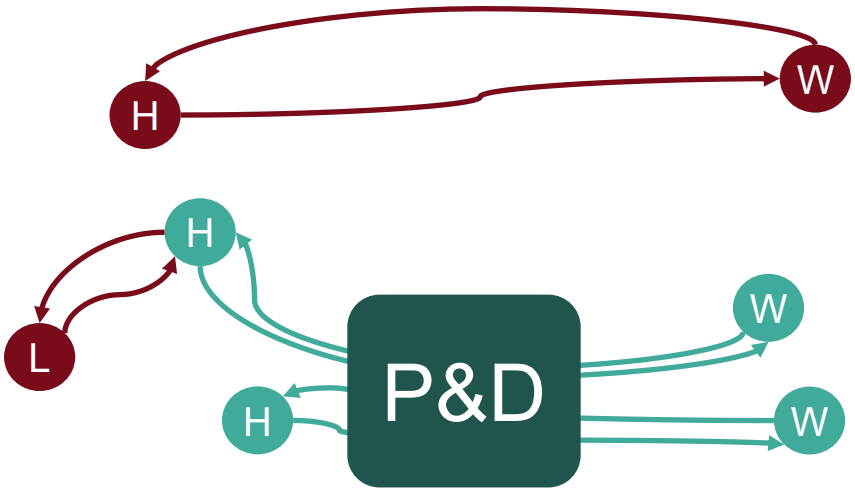
- **Splitting daily plans of all agents at home activities**
- **Trip chain filter**
  - Car as mode of transport for all trips
  - Home as start and end activity
  - Exactly one intermediate stop (i.e. two trips)



Red routes do not meet the filter criteria

2. P&D FILTERING

- All trips in the chain must pass the P&D station within a maximum distance



Red routes do not meet the filter criteria

3. BEHAVIOURAL MODELS

- Account for willingness to use ridesharing
- Based on two surveys:
  - pro:NEWmotion* – everyday mobility services
  - DOMINO** – ridesharing for commuting
- Significant variation by age and employment status
- Provides lower and upper bounds of realistic potential

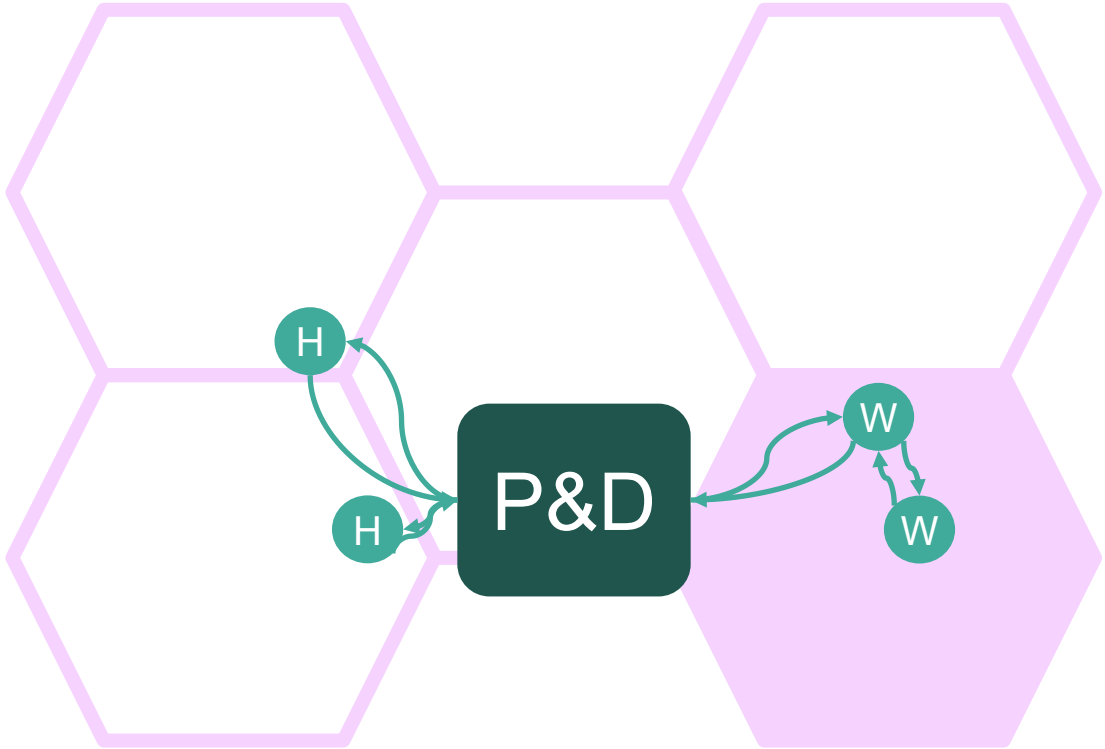
Average willingness to use P+D by behaviourally homogeneous group according to pro:NEWmotion and DOMINO surveys

Demographic group	pro:NEWmotion	DOMINO
Employed, part-time, 18–34 years old	28%	48%
Employed, part-time, 35–49 years old	20%	34%
Working, part-time, 50+ years old	13%	42%
Employed, full-time, 18–34 years old	22%	46%
Employed, full-time, 35–49 years old	17%	43%
Employed, full-time, 50+ years old	17%	39%
In education, 18+ years old	12%	53%
Not employed, 18–49 years old	12%	53%
Not employed, aged 50–64	15%	53%
Not employed, 65+ years old	19%	53%

* https://projekte.ffg.at/projekt/4443999
** https://projekte.ffg.at/projekt/3300226

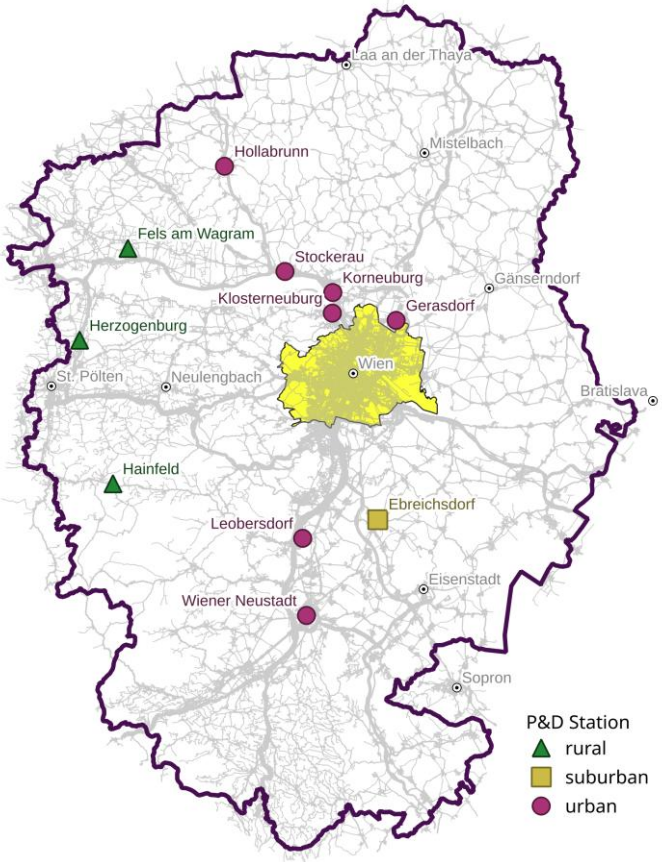
4. P&D COMPATIBILITY: ASSIGNMENT OF DRIVER TO PASSENGER

- Ride-along possible if the following are compatible:
  - Departure time (outbound, at P&D)
  - Destination area
  - Return departure time
  - Willingness to use ridesharing



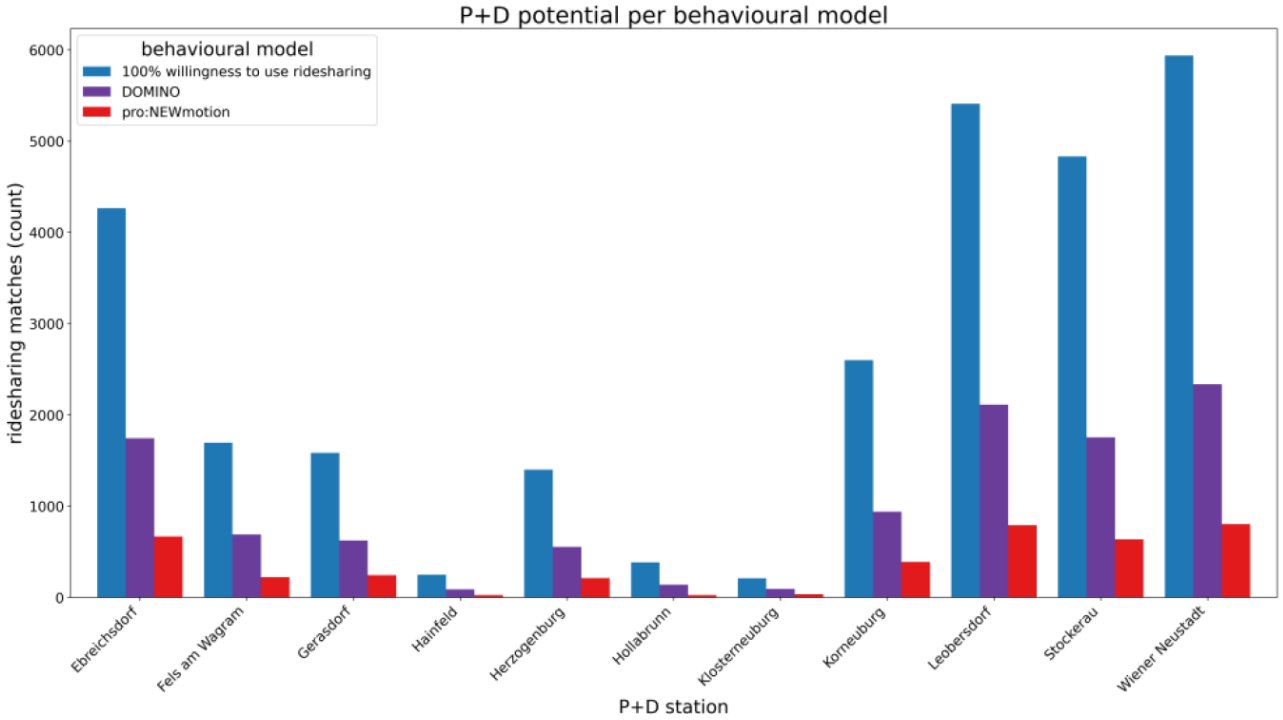
CASE STUDY: VIENNA REGION

- MATSim weekday traffic model*
- 332,000 agents (12.5% of population)
- Over 1 million trips, 40% by car
- 11 candidate P+D locations analysed



* https://github.com/ait-energy/matsim-model-vienna

RESULTS: STATIONS COMPARED NUMBER OF CARPOOLS



RESULTS: STATIONS COMPARED: QUANTIFIED IMPACTS

- Stations, with the greatest relative potential show:
  - Up to ~6.6% of trips suitable for ridesharing at best locations
  - Vehicle-kilometre savings up to ~2%

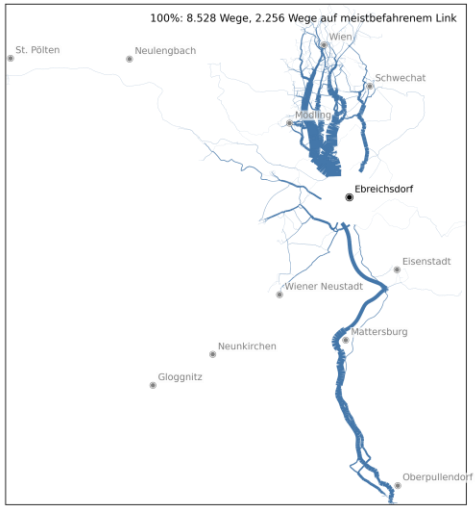
P+D station	behavioural model	matched trips		car kilometres saved	
		absolute	relative	absolute	relative
Ebreichsdorf (suburban)	DOMINO	3,488	6.63%	48,348	1.98%
	pro:NEWmotion	1,336	2.54%	16,562	0.68%
Fels am Wagram (rural)	DOMINO	1,376	4.92%	29,584	2.06%
	pro:NEWmotion	444	1.59%	8,753	0.61%
Stockerau (urban)	DOMINO	3,508	4.35%	45,684	1.61%
	pro:NEWmotion	1,272	1.58%	17,421	0.61%

DETAILED RESULTS: EBREICHSDORF

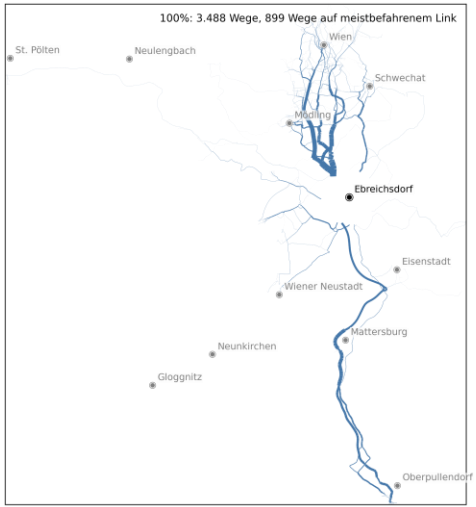
- High share of work (~ 60%) and leisure (~ 40%) trips
- Pronounced morning peak in departures
- Most users originate south of Vienna
- Destinations mainly in Vienna and Mödling

DETAILED RESULTS: EBREICHSDORF FLOW BUNDLES

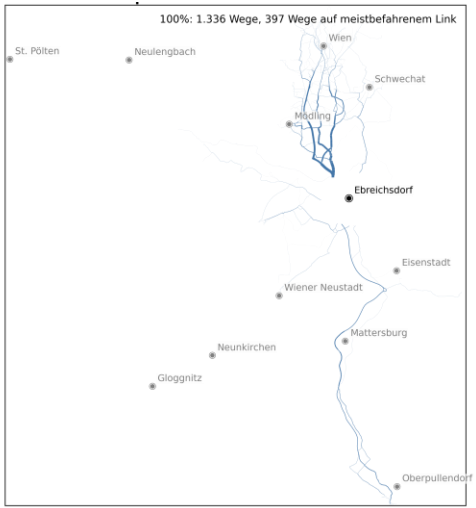
All trips by car



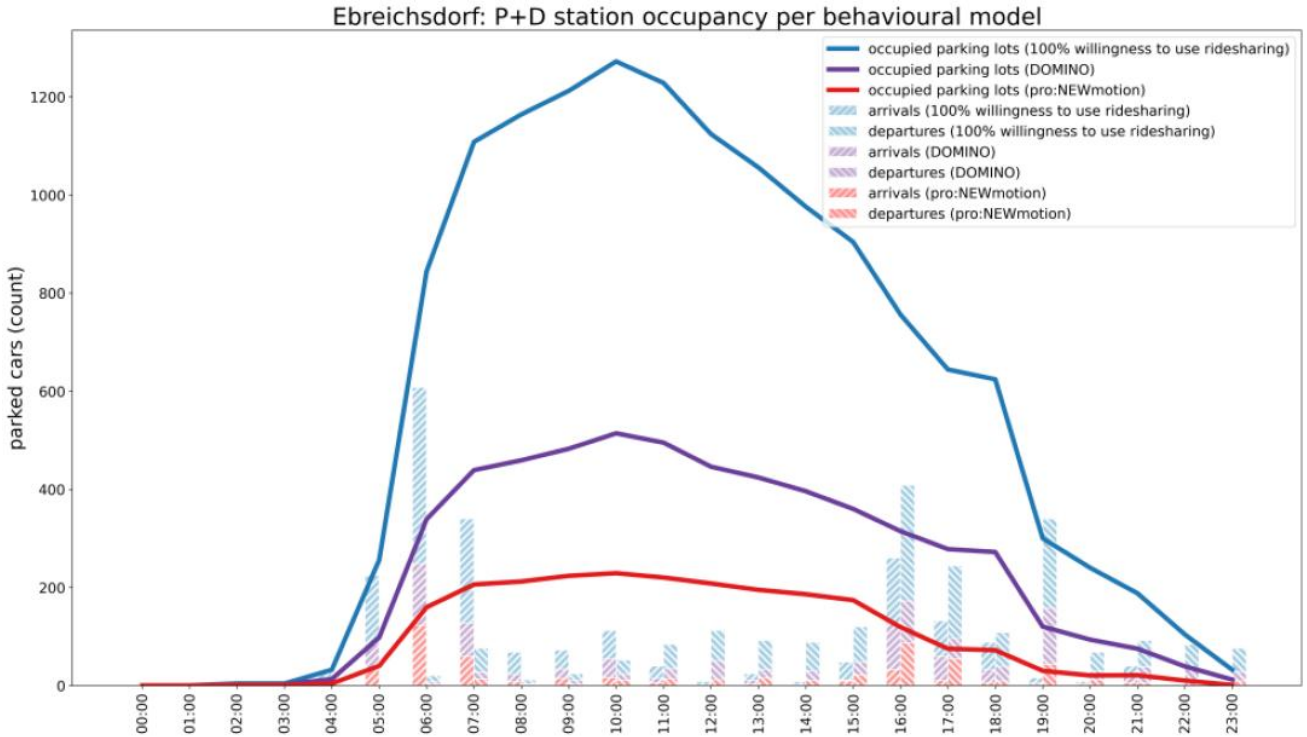
P+D potential DOMINO



P+D potential pro:NEWmotion



DETAILED RESULTS: EBREICHSDORF OCCUPANCY OF P&D STATION



LIMITATIONS

- Restricted to simple home – x – home trip chains
- Requires same destination cell for matching
- Purely demand-oriented; no parking capacity constraints
- Population upscaling may distort matching

CONCLUSIONS & OUTLOOK

- Tool enables fast, spatially detailed P+D potential assessment
- Provides realistic bandwidth of impacts
- Useful for early-stage planning of mobility hubs
- Complements, but does not replace, detailed simulations
- Validation with empirical data from existing P+D stations
- Extension to more complex trip chains
- Integration with push and pull policy measures
- Support broader sustainable mobility strategies

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THANK YOU!

Benjamin Kokoll, 05.02.2026

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https://projekte.ffg.at/projekt/4906625