EV Charging and Grid Integration Tool

Launch event, 28 March 2023

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International
Energy Agency

Outline

- Background
- Presentation of the tool features
- Live demo
- Q&A

GEF Global Programme to Support Countries with the Shift to Electric Mobility

Thematic Working Groups

- Knowledge materials and tools
- Network for advocacy, technology and policy advice

UN environment programme: **2 & 3 wheelers**; **Heavy-Duty Vehicles**

IEA: **Light-Duty Vehicles**; **Charging, grid integration, RE power supply, batteries**

Regional Platforms

- Capacity building
- Establish communities of practice
- Replication and upscaling

ADB: Asia & Pacific

European Bank for Reconstruction and Development: Europe, Middle East, West Asia

Centro Movilidad Sostenible: Latin America & Caribbean

UN environment programme: Africa

Country Projects

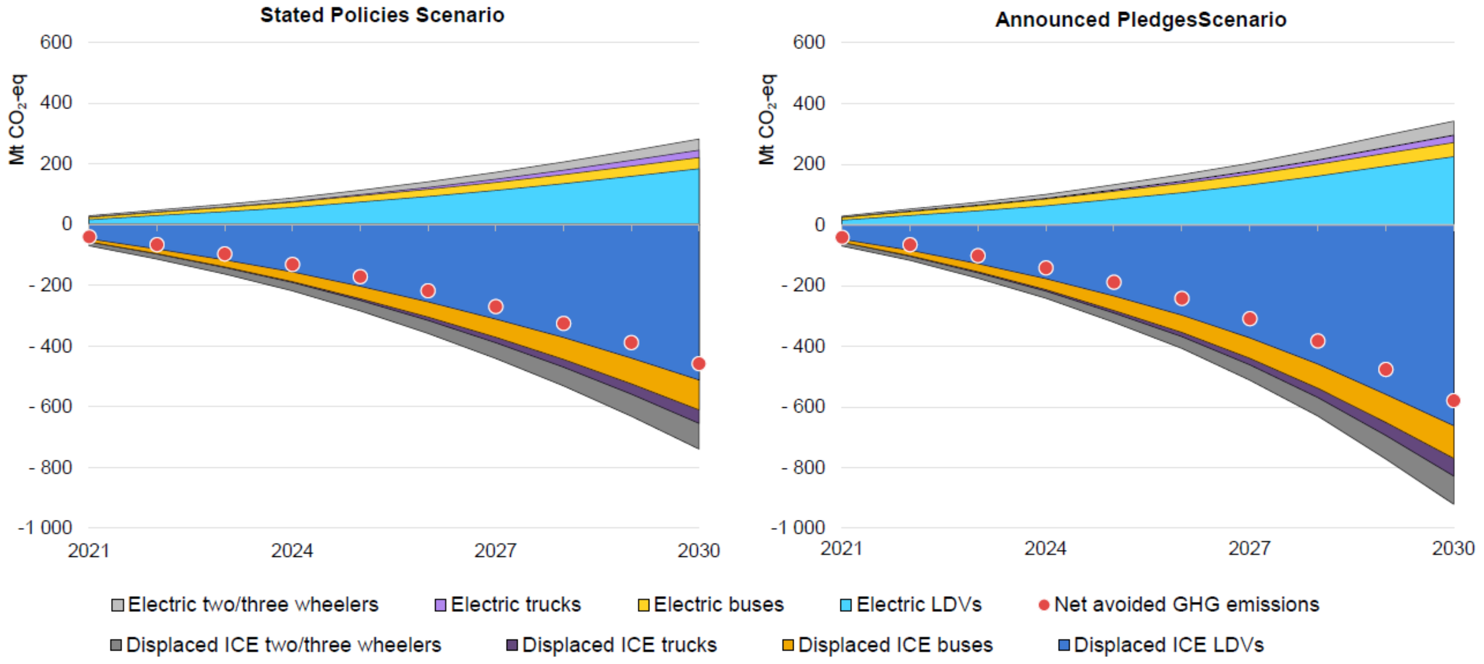
- Onsite demonstration

30+ country projects

https://www.thegef.org/project/global-programme-support-countries-shift-electric-mobility

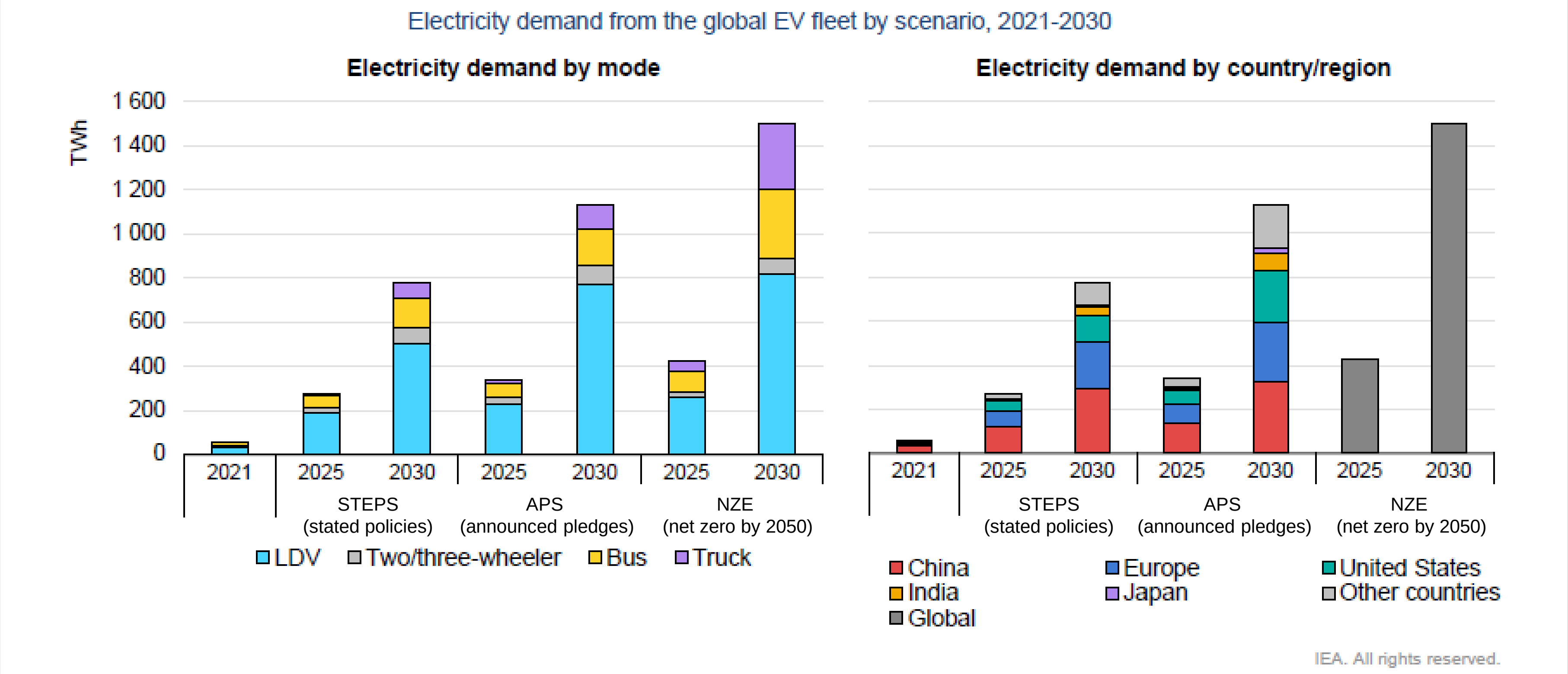
Emissions from Electric Vehicles (EV) charging

Well-to-wheel GHG emissions from the global EV fleet, 2021-2030



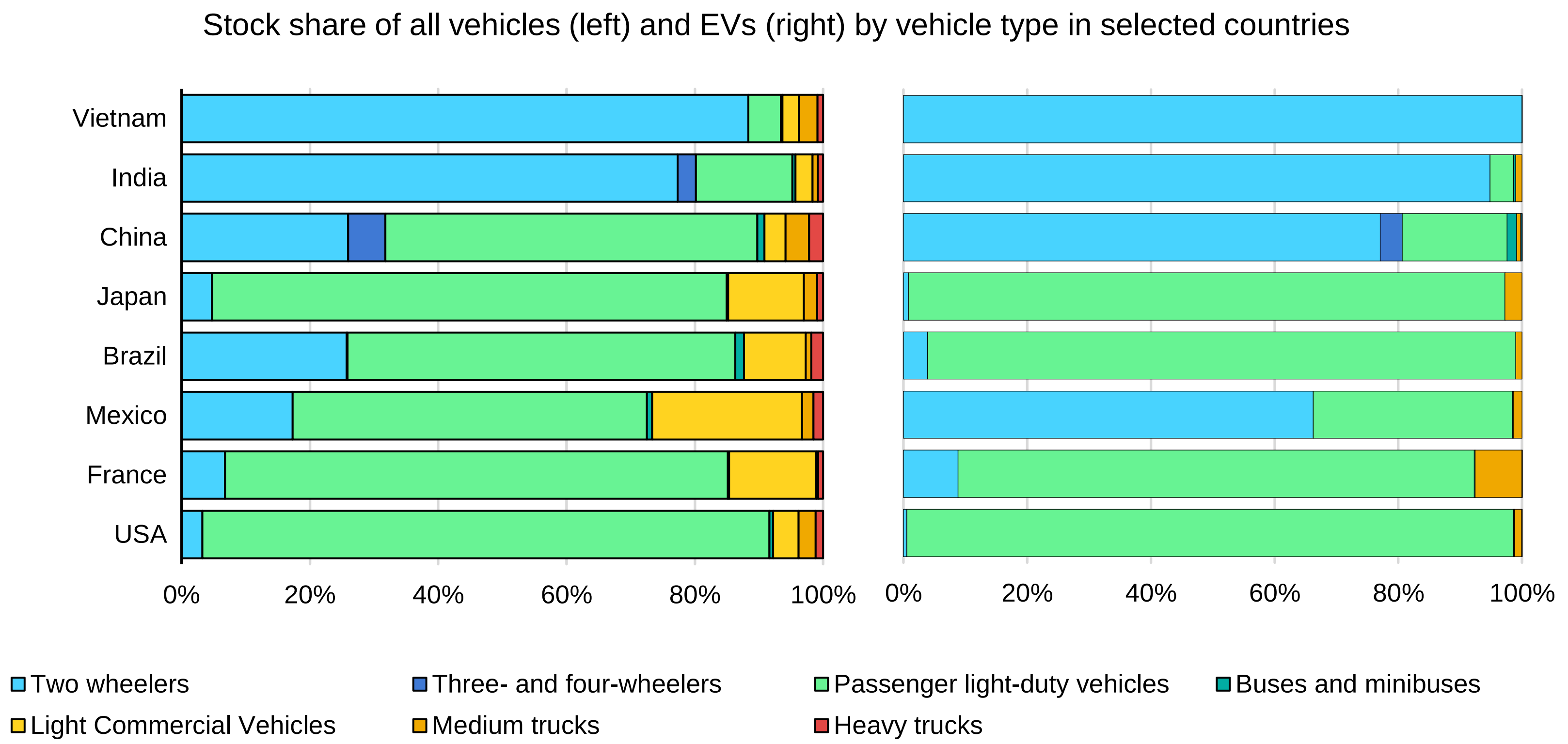
As the power sector decarbonises, net reduction of GHG emissions from shift to EV accelerates.

Electricity demand from Global EV fleets



Meeting climate pledges will require electricity demand for EV to grow 20 times by 2030 compared to 2021.

A wide range of road transport electrification priorities



Assessing grid impacts is a necessary step for planning the uptake of EV.

EV Charging and grid integration tool

Motivation #1

Assessing the impact of EV charging on the power system

Module 1

Simulation of EV charging behaviour

Output: weekly EV charging demand profile

Motivation #2

Assessing effect of measures for mitigating EV charging impacts

Module 2

Simulation of EV charging behaviour with managed charging

Output: weekly EV charging demand profile with managed charging

Motivation #3

Estimating the CO_2 emissions related to EV charging

Module 3 (*API*)

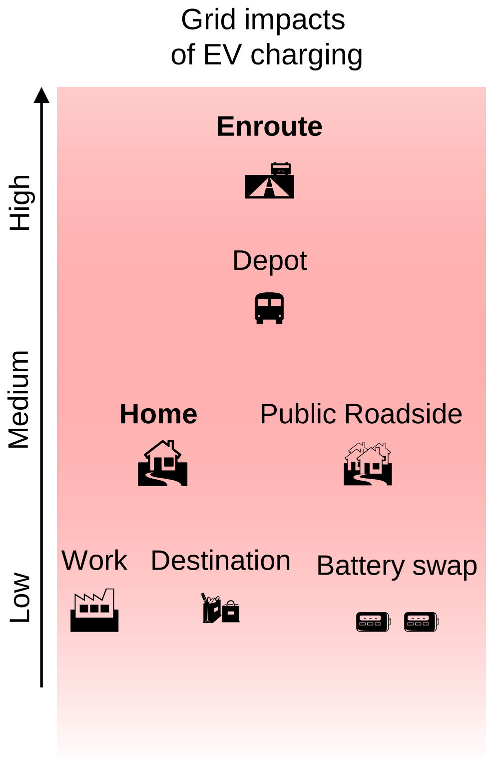
Simplified representation of the electricity mix

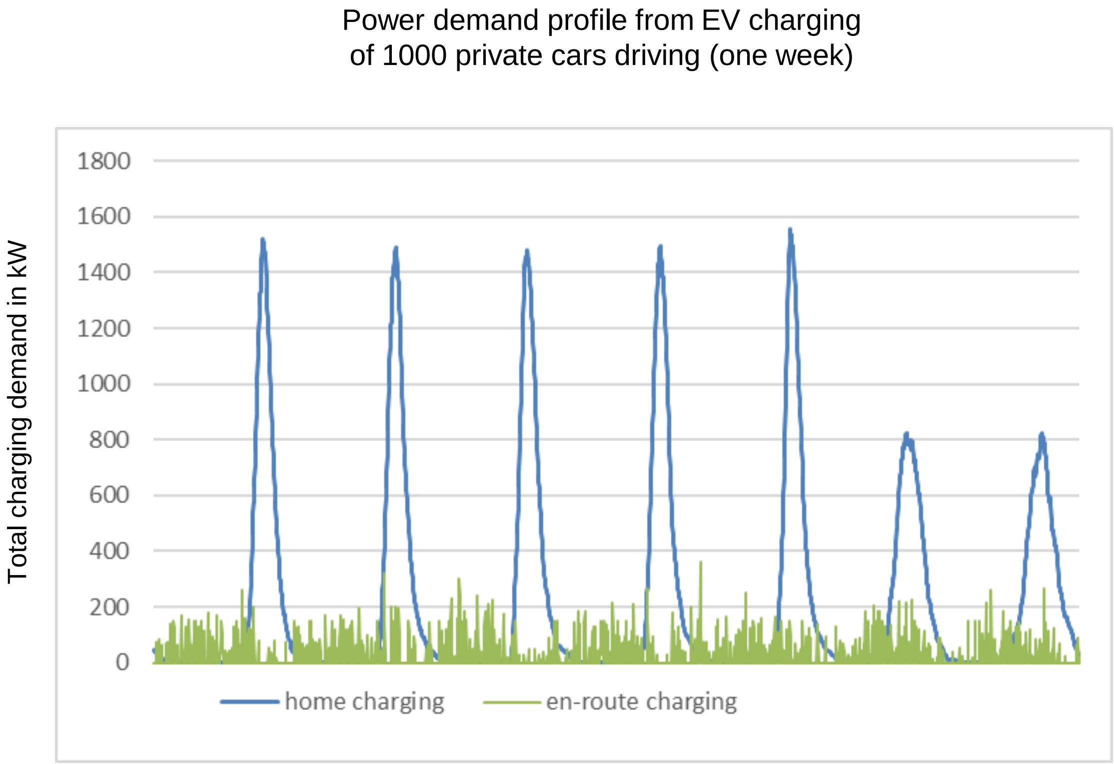
Output: calculation of yearly CO_2 emissions

Motivation #1 (Module 1)

Assessing the impact of EV charging on the power system

Many factors influence the profile of electricity demand by EV

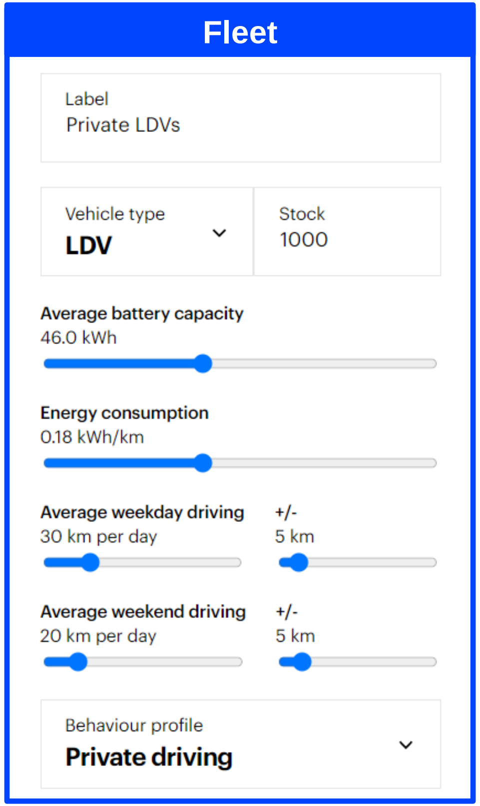




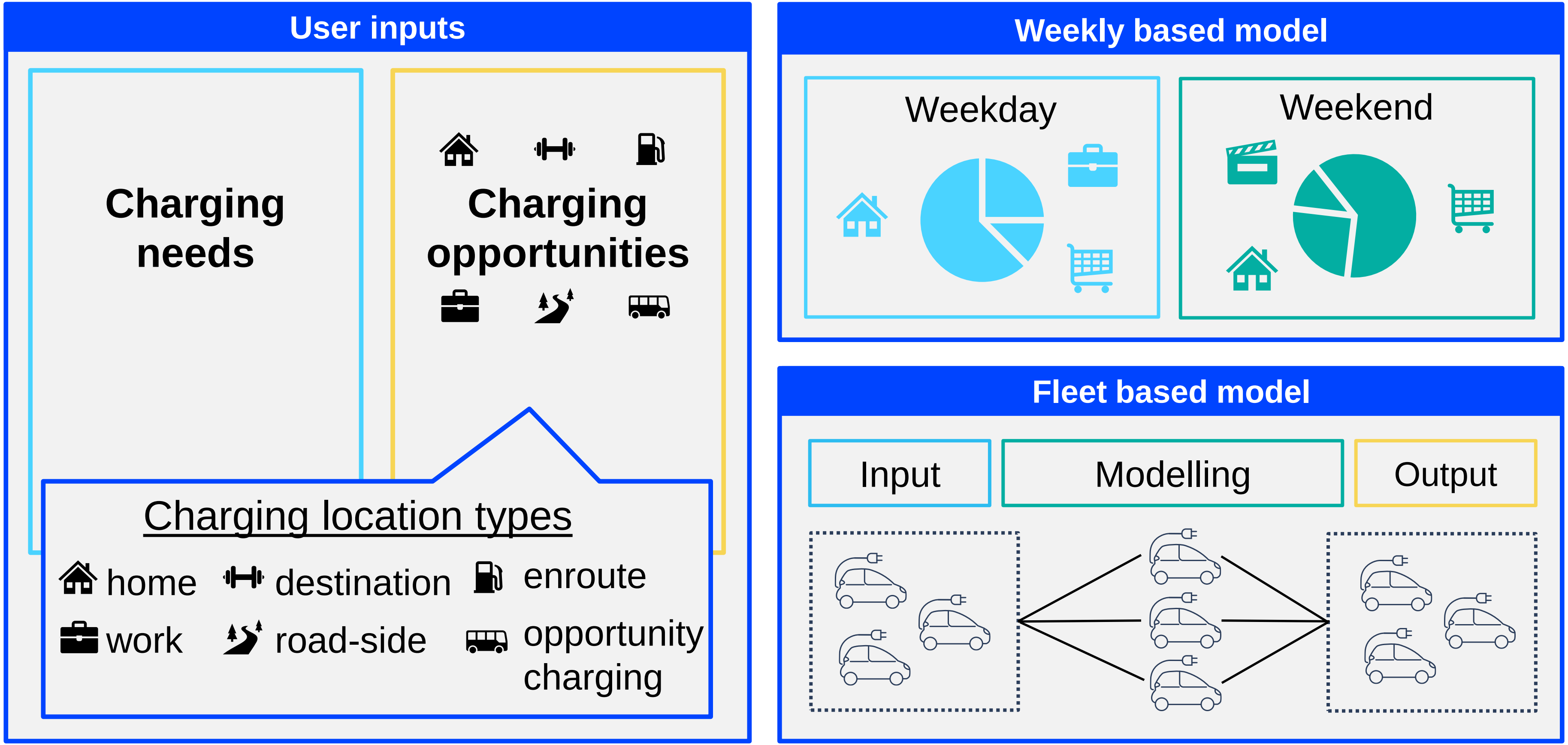
Grid impacts of charging solutions vary based on EV fleet and electricity system characteristics.

Example : 1 000 private cars – fleet size and driving pattern

How can tool users enter a fleet?



Modelling charging behaviour to calculate power demand profile



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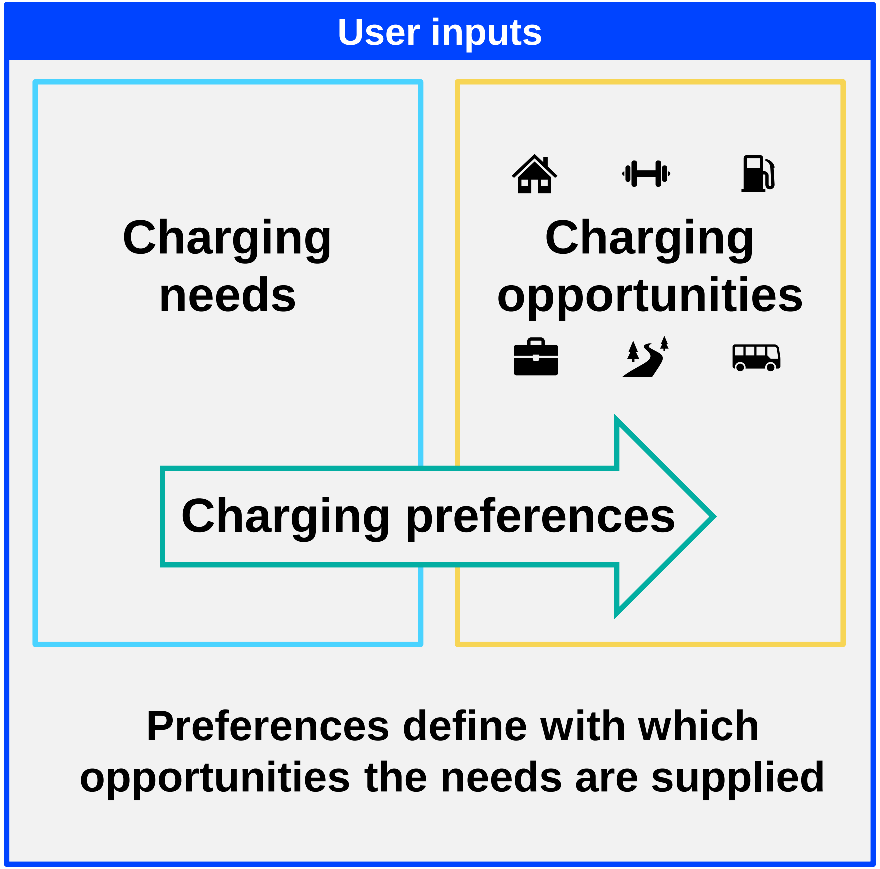
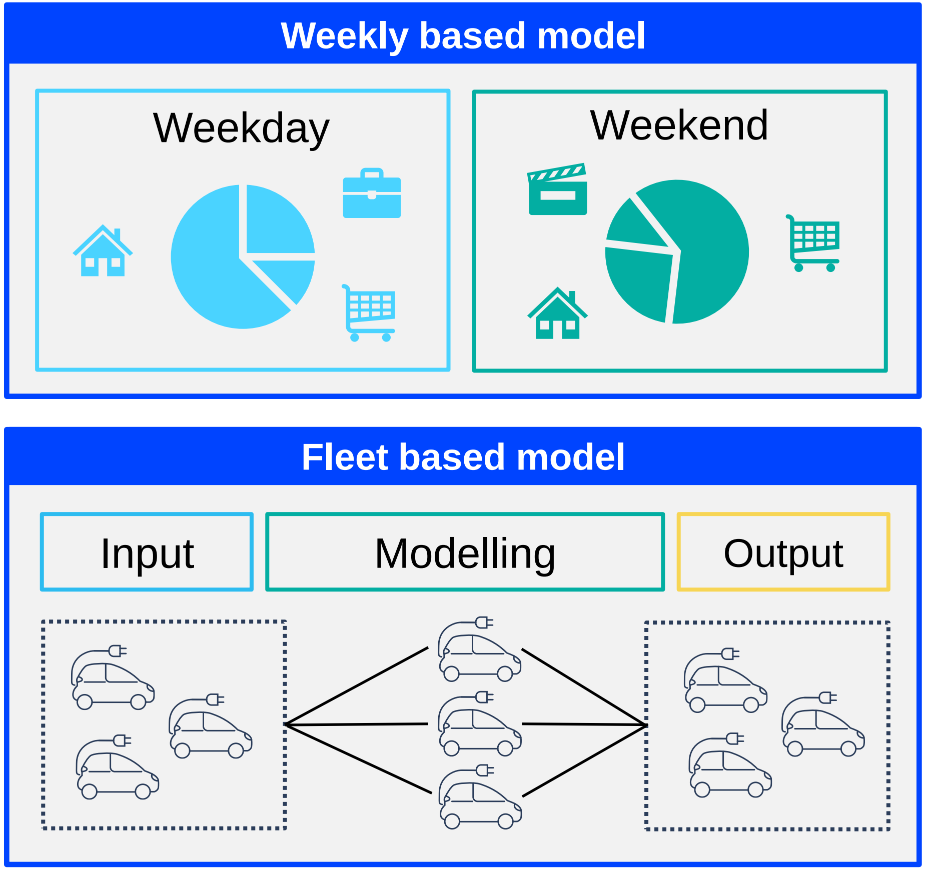
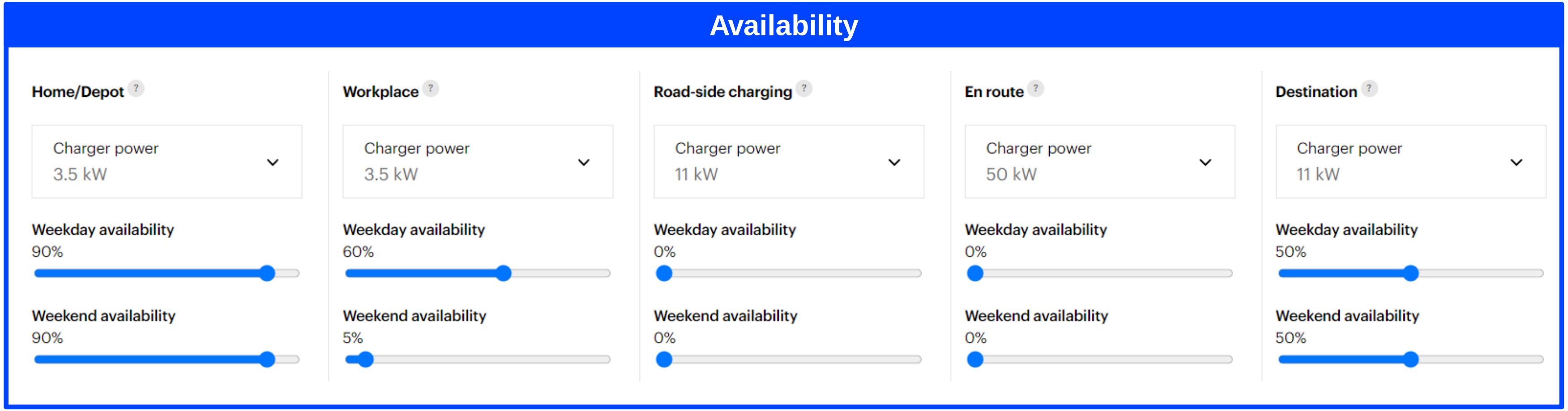




Example : 1 000 private cars – charging behaviour

How can tool users define the charging preference and opportunities?



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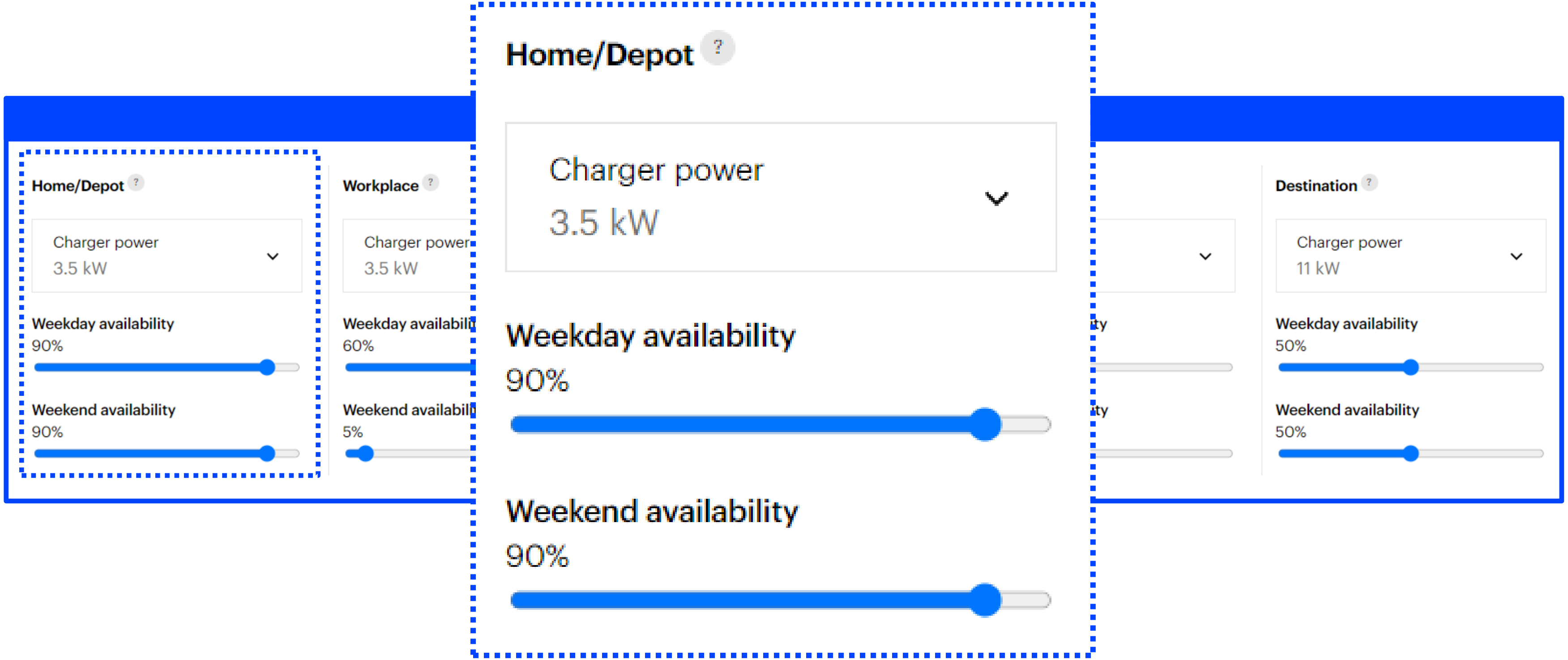
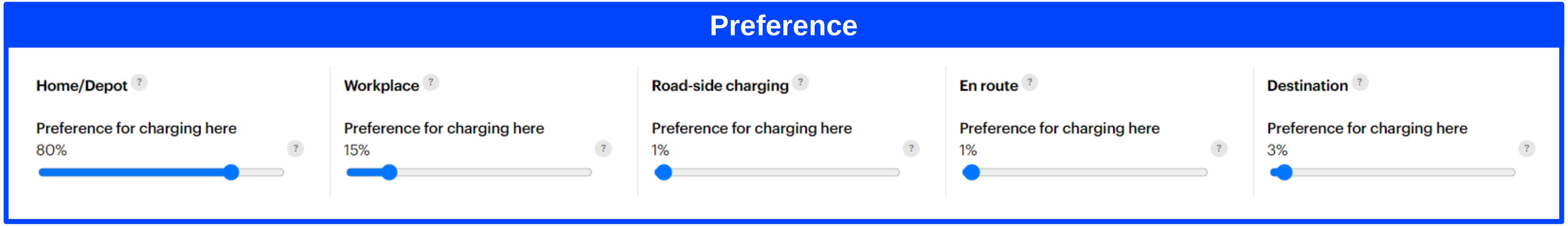


Example : 1 000 private cars – charging behaviour

How can tool users define the charging preference and opportunities?



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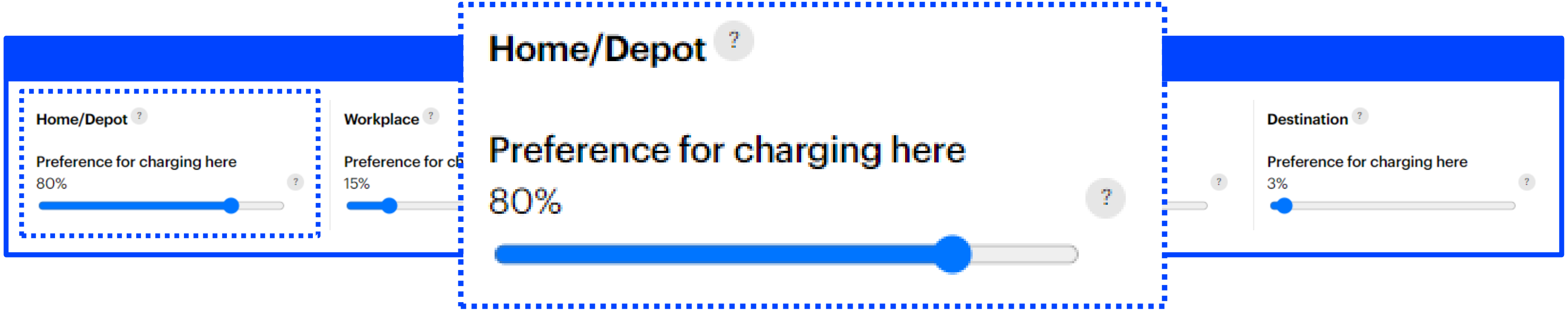


Example : 1 000 private cars – charging behaviour

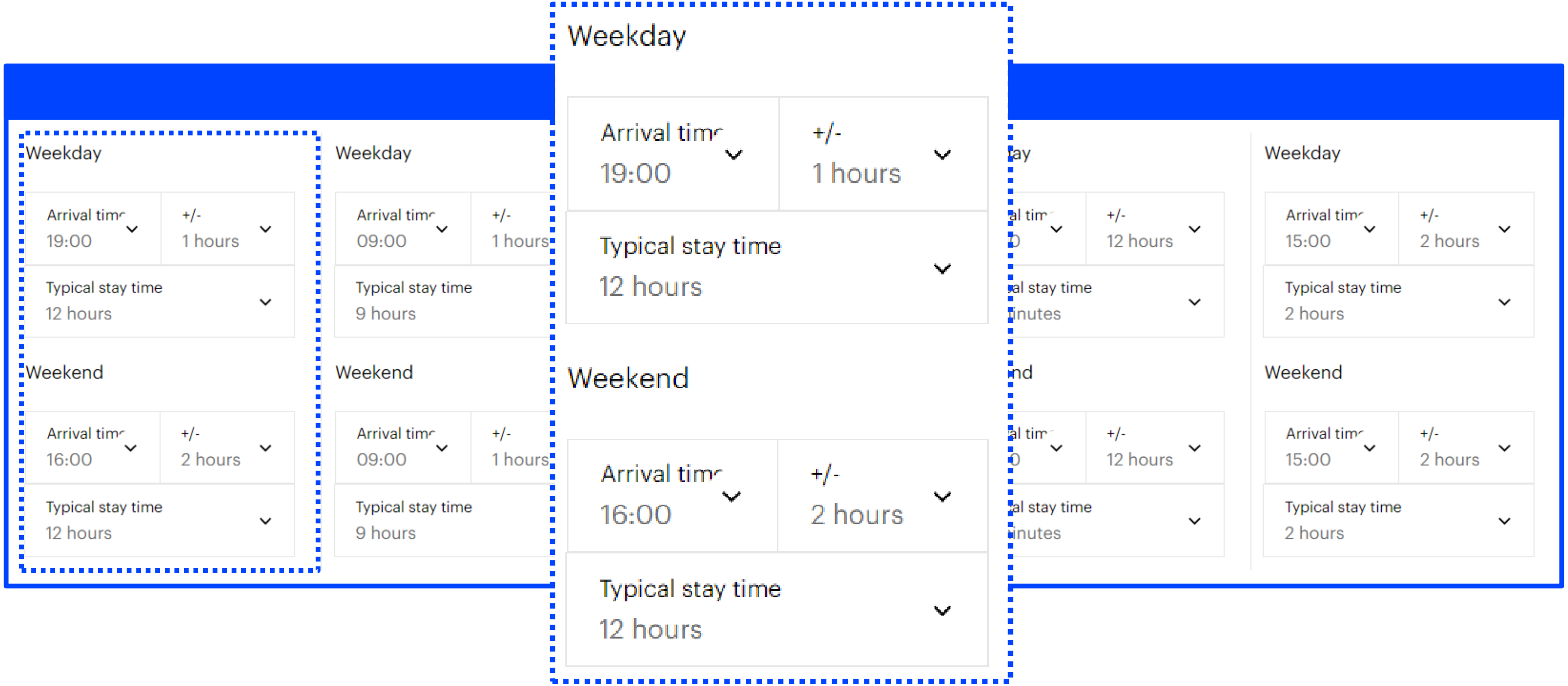
How can tool users define the charging preference and opportunities?

Typical charging times

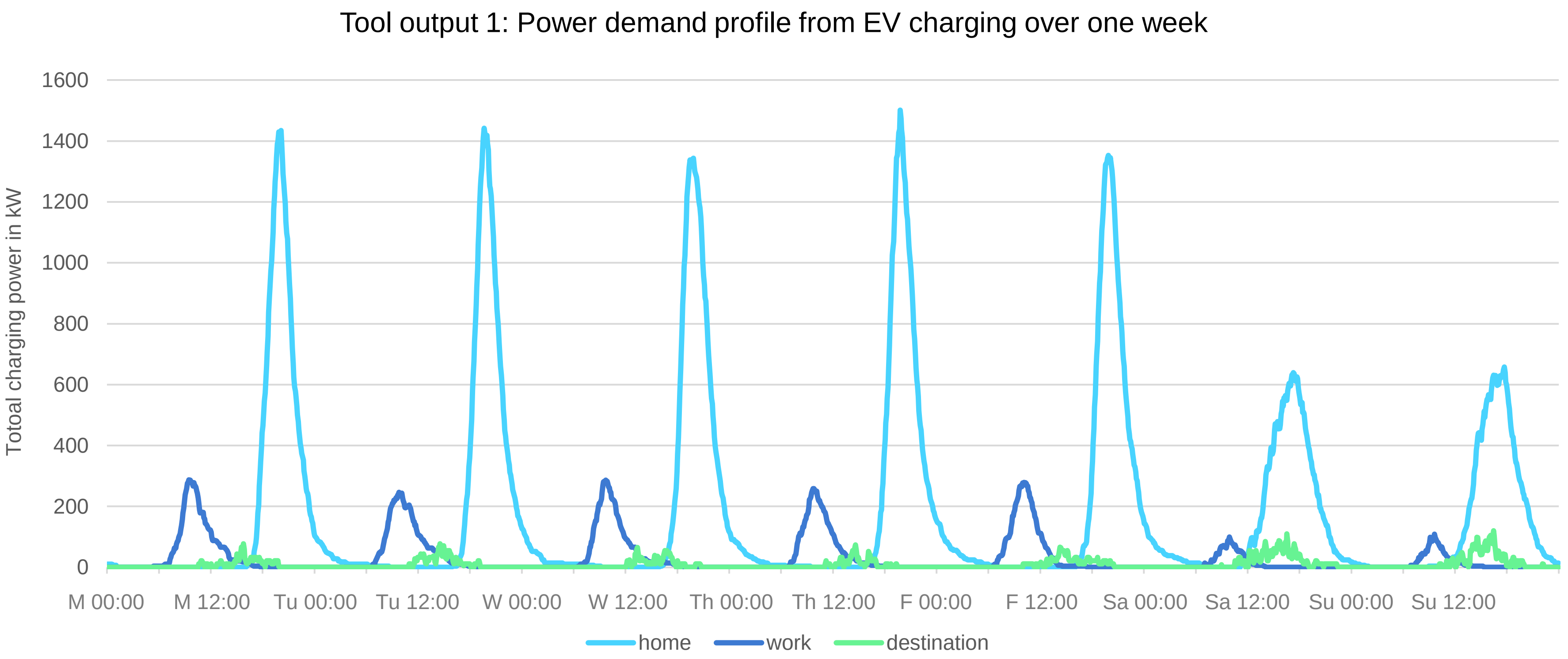
Weekday					
Arrival time	19:00	09:00	12:00	12:00	15:00
+/-	1 hours	1 hours	12 hours	12 hours	2 hours
Typical stay time	12 hours	9 hours	3 hours	15 minutes	2 hours
Weekend					
Arrival time	16:00	09:00	12:00	12:00	15:00
+/-	2 hours	1 hours	12 hours	12 hours	2 hours
Typical stay time	12 hours	9 hours	4 hours	15 minutes	2 hours

Example : 1 000 private cars – charging behaviour

How can tool users define the charging preference and opportunities?



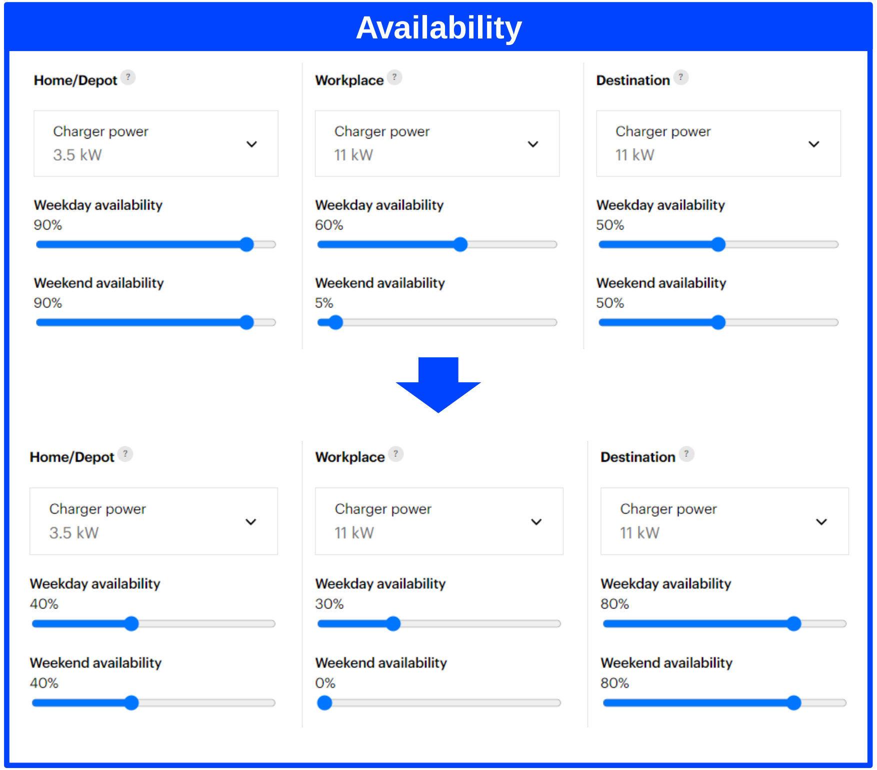
Example : 1 000 private cars



If unmanaged, most charging takes place in the early evening, when the non-EV electricity demand peaks. This can overload grids and require expensive thermal units to cover the additional demand.

Example : 1 000 private cars – lower access to home charging

What does happen, if the charging availability change?



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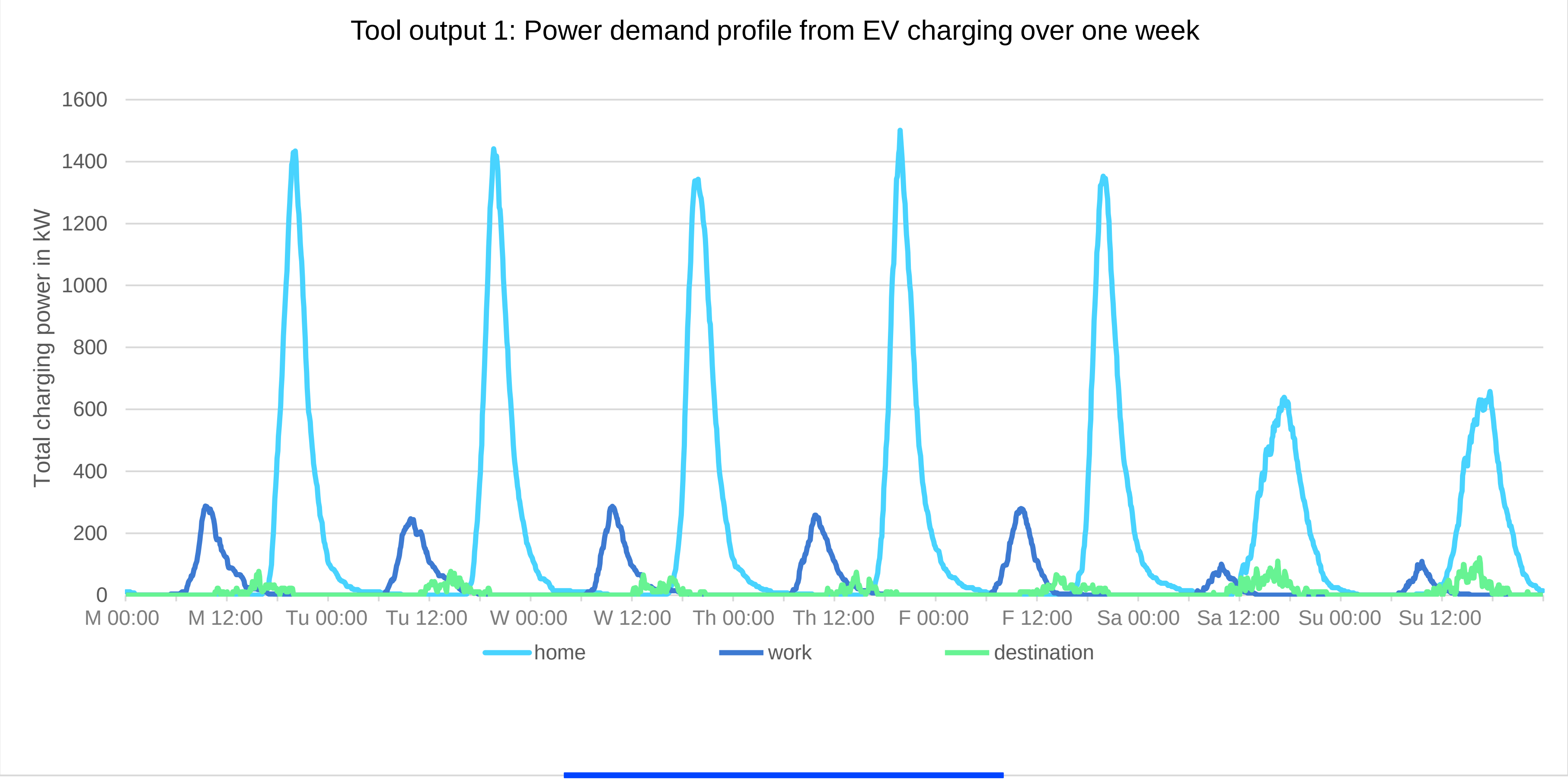

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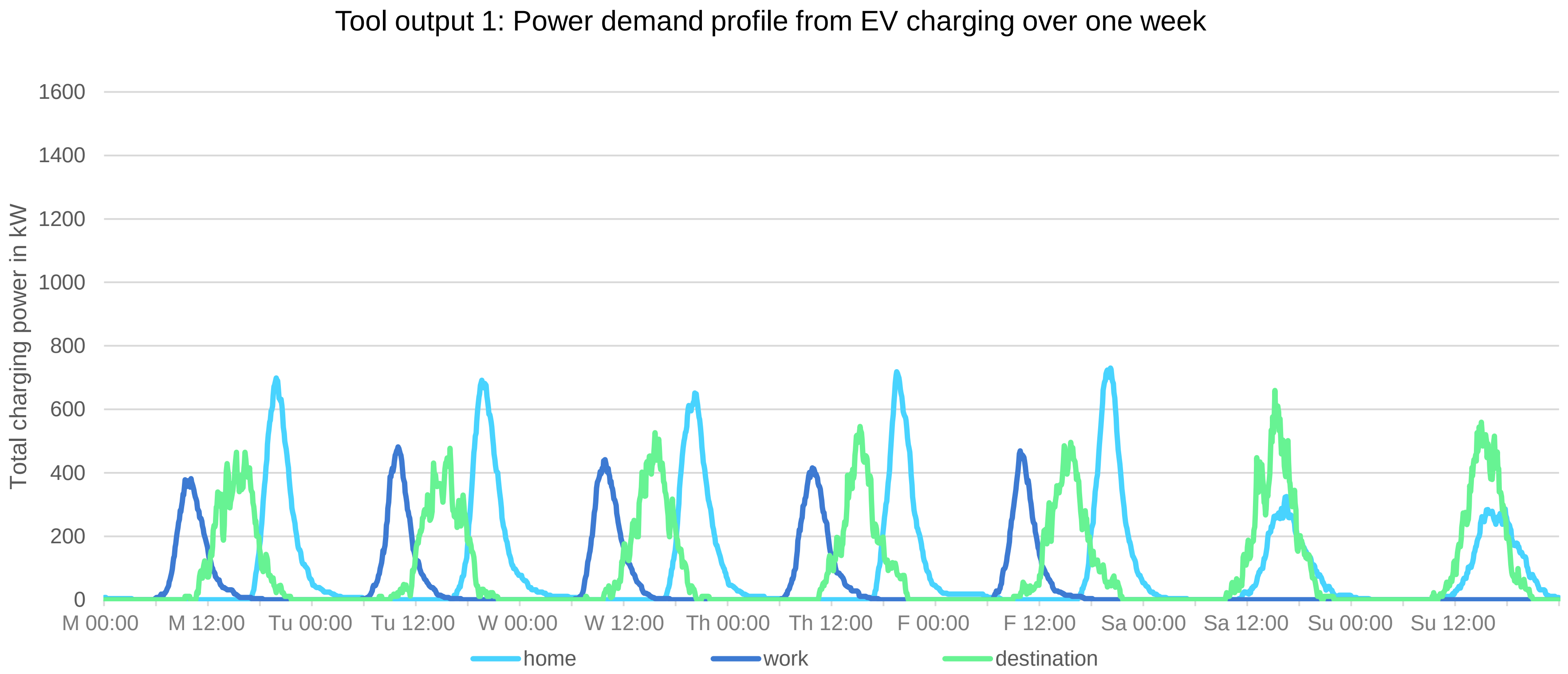
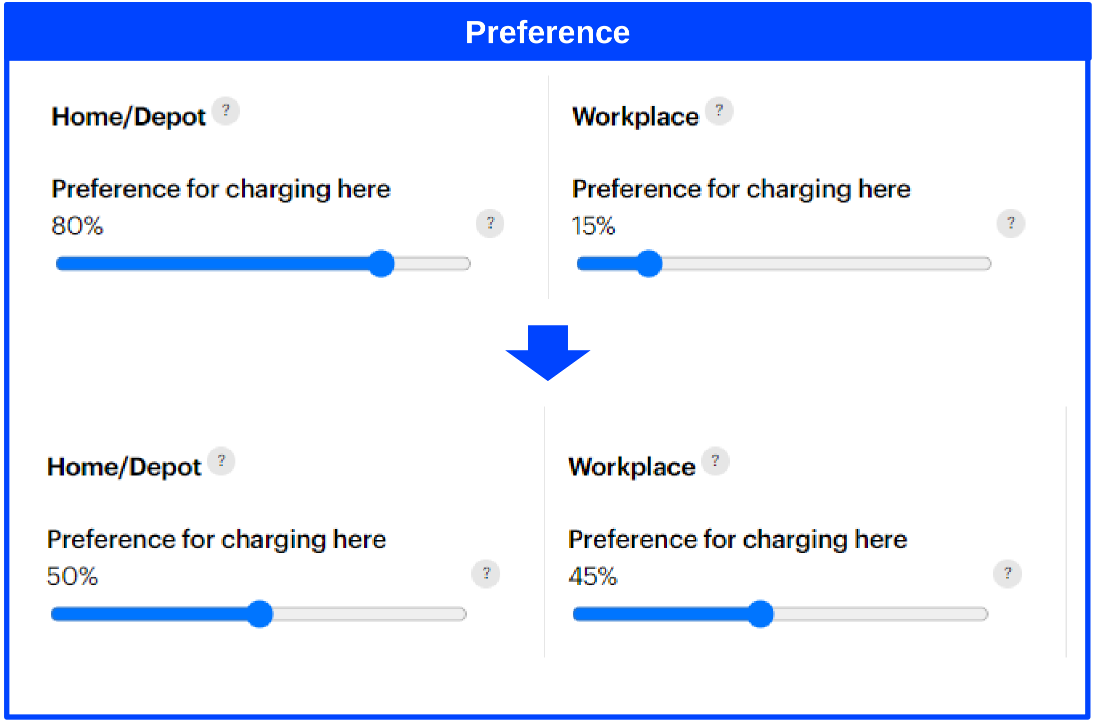


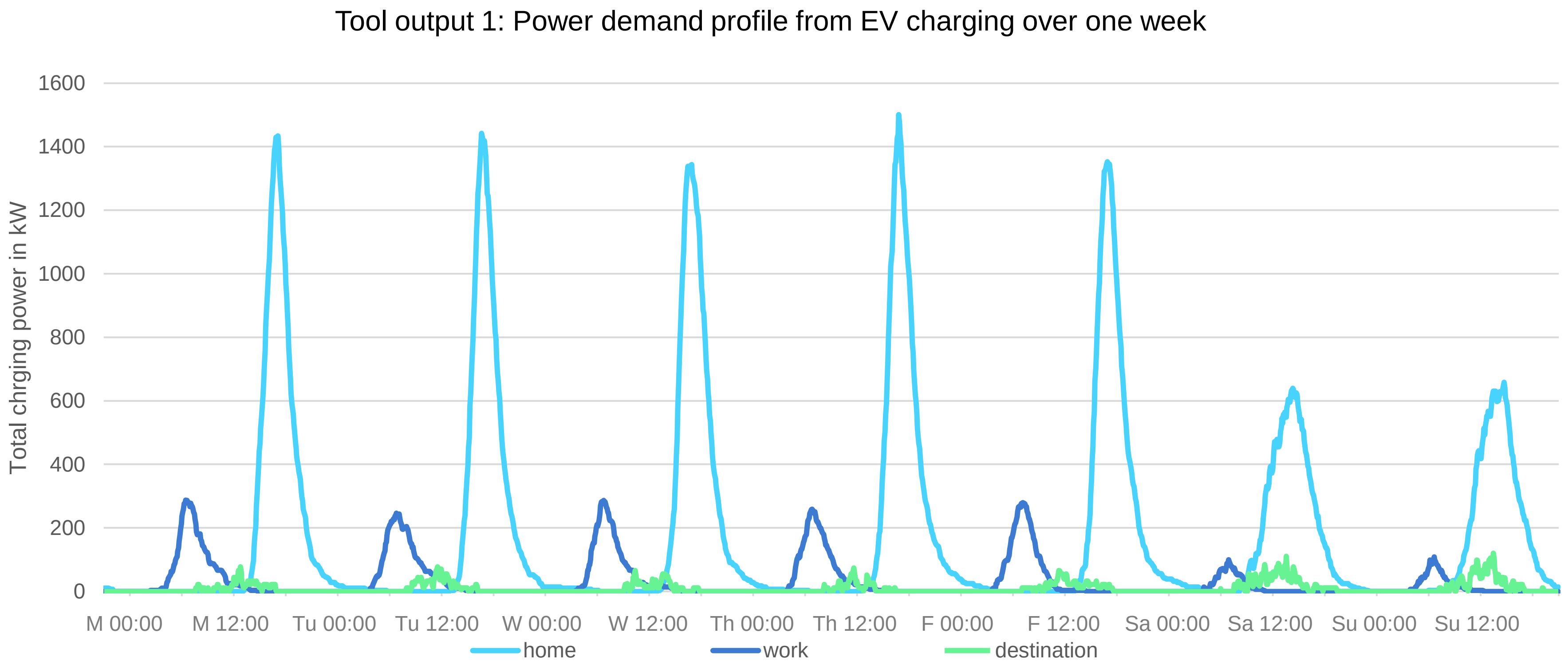
High reliance on public charging network could create sharp surges in demand.

Example : 1 000 private cars – increased access to workplace charging

What does happen, if the charging preferences change?

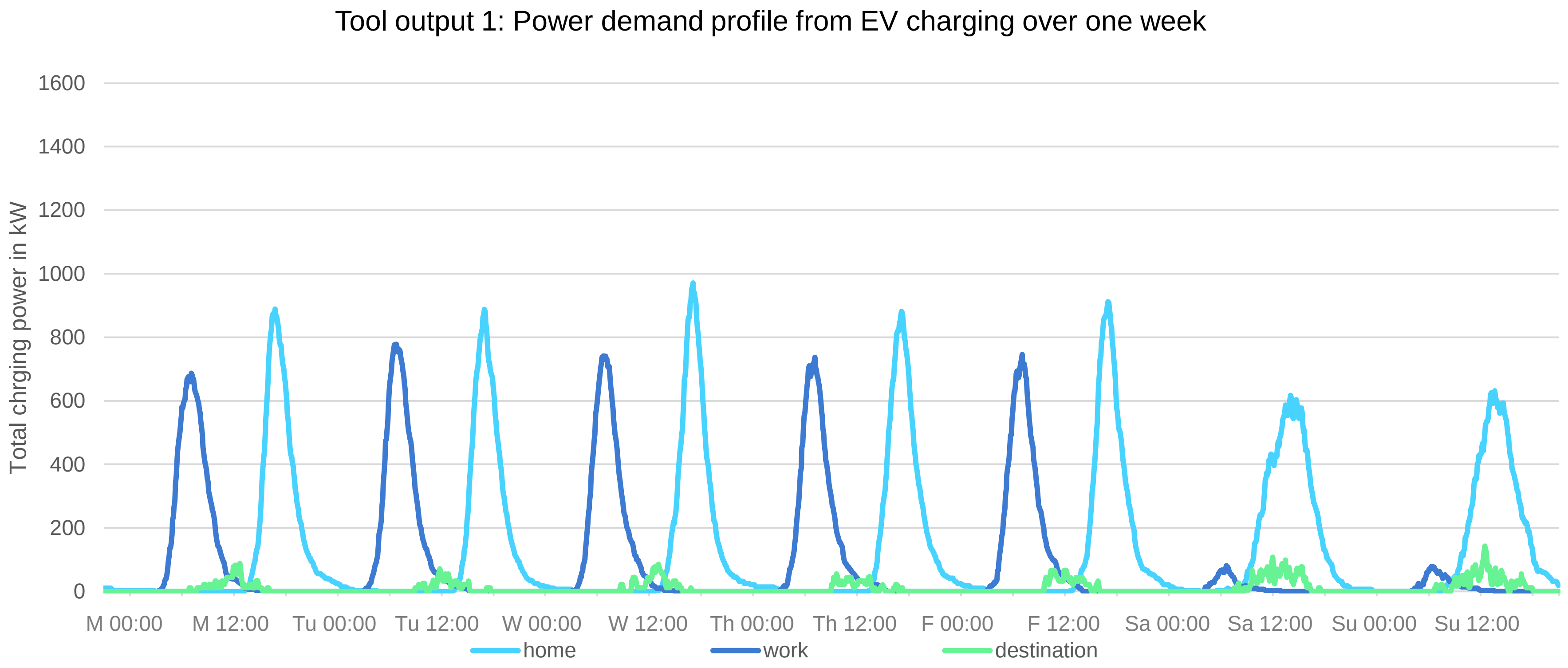


Example : 1 000 private cars – increased access to workplace charging



Daytime charging reduces amplitude of evening peak and makes better use of solar energy.

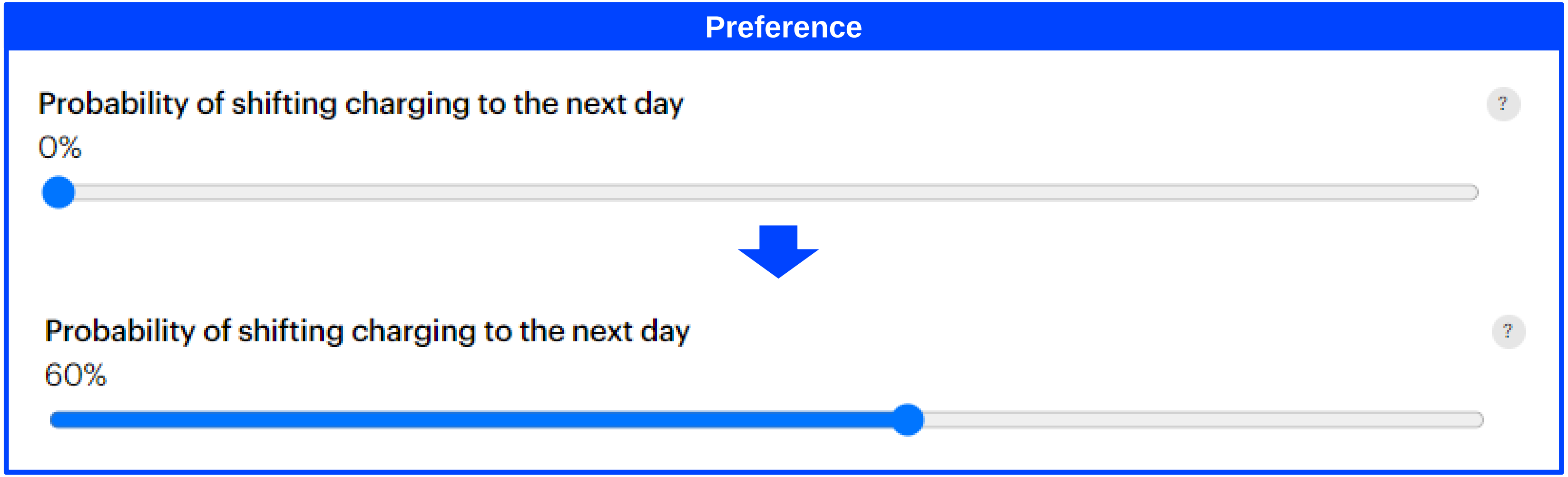
Example : 1 000 private cars – increased access to workplace charging



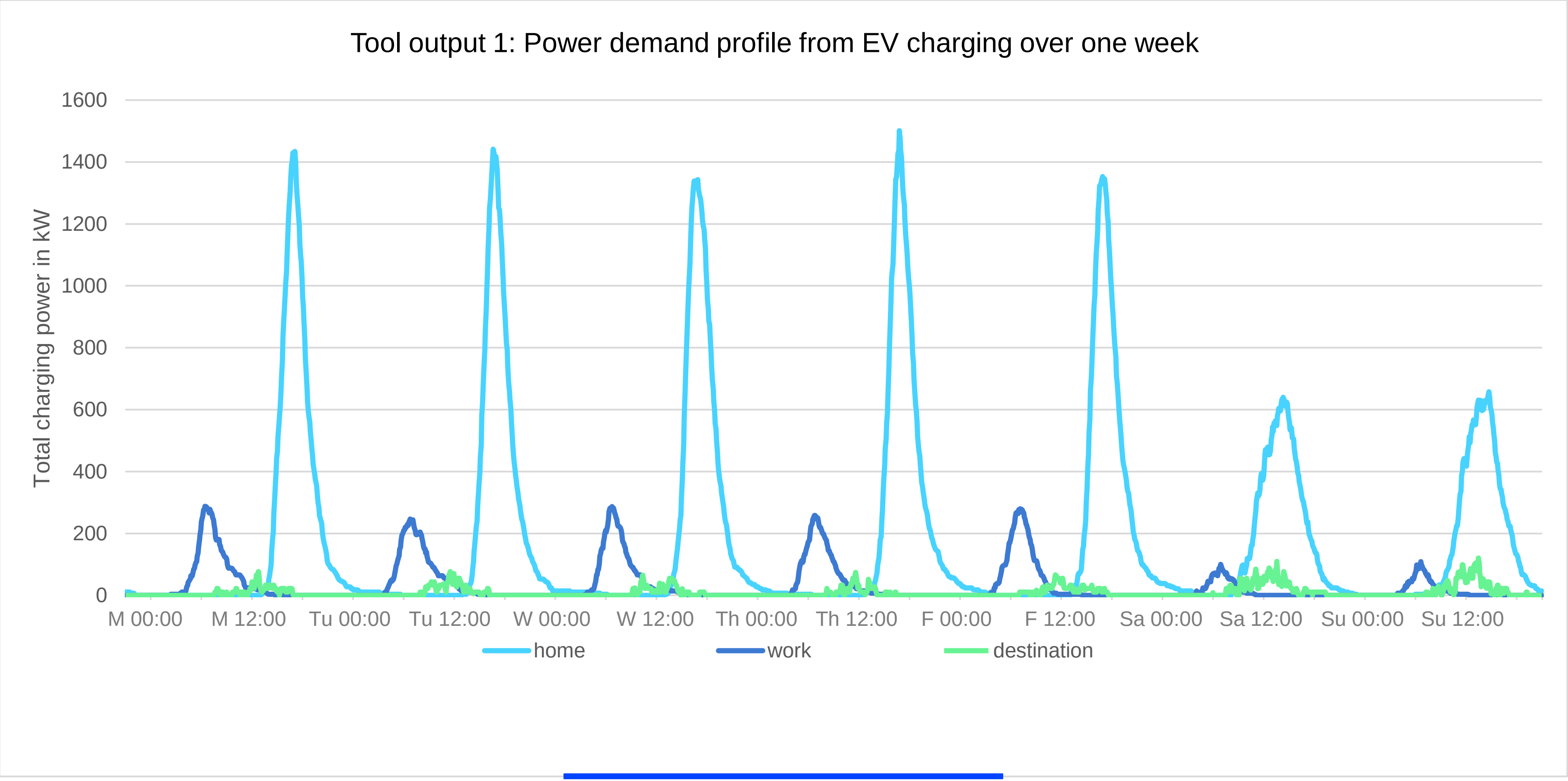
Daytime charging reduces amplitude of evening peak and makes better use of solar energy.

Ex: 1 000 private cars – drivers less proactive in connecting to grid

What does happen, if 600 (60%) EV-drivers wait for charging until state of charge of battery = 50%?



Ex: 1 000 private cars – drivers less proactive in connecting to charger



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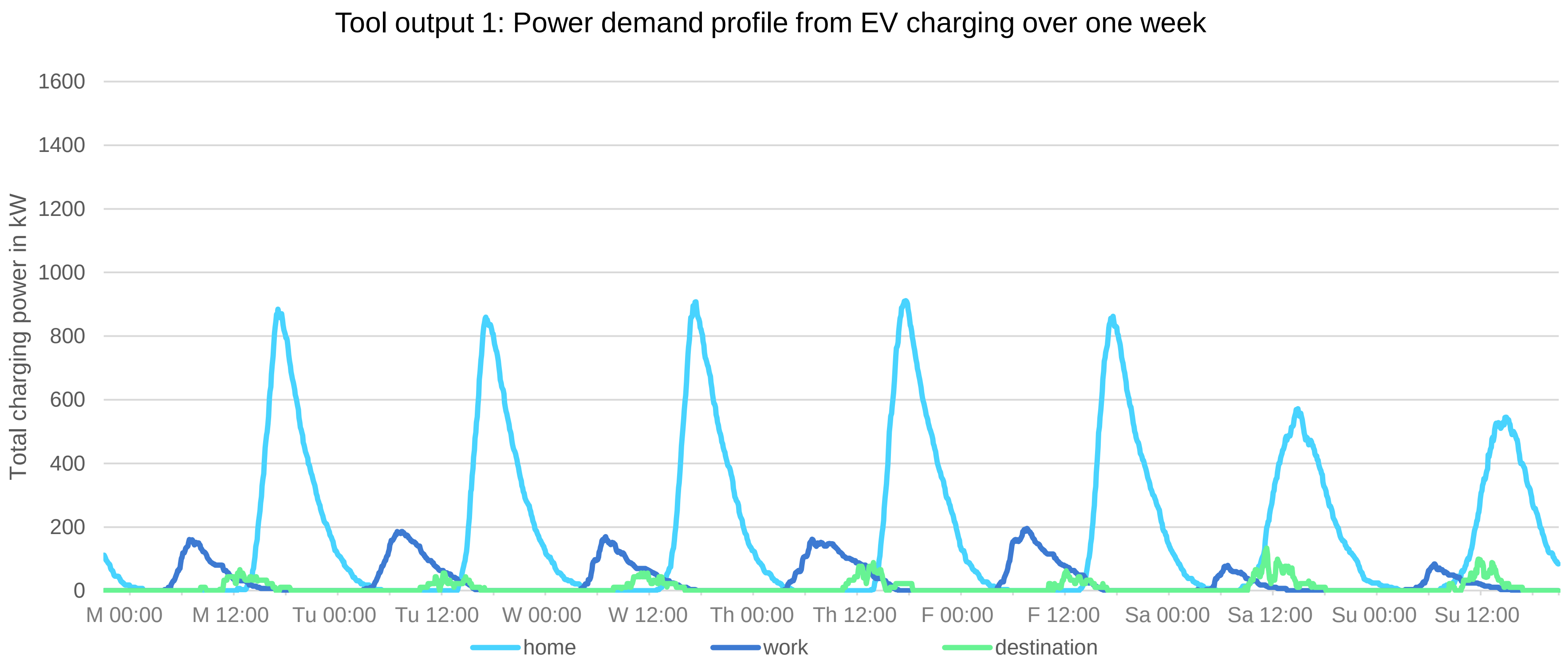
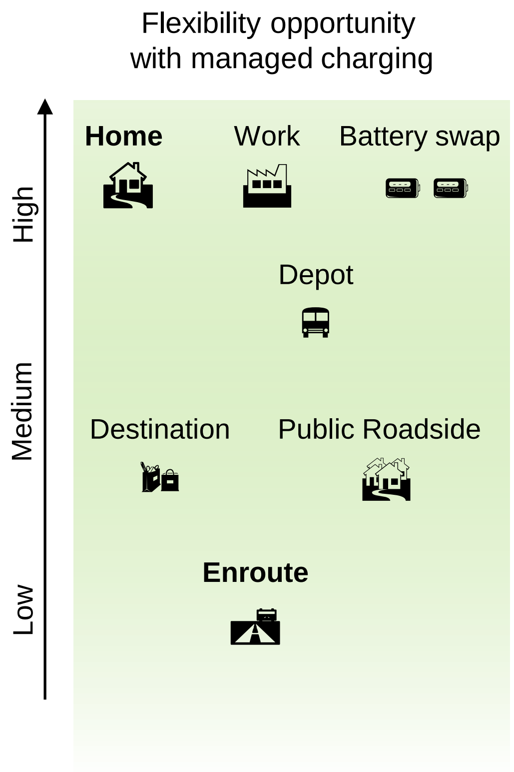


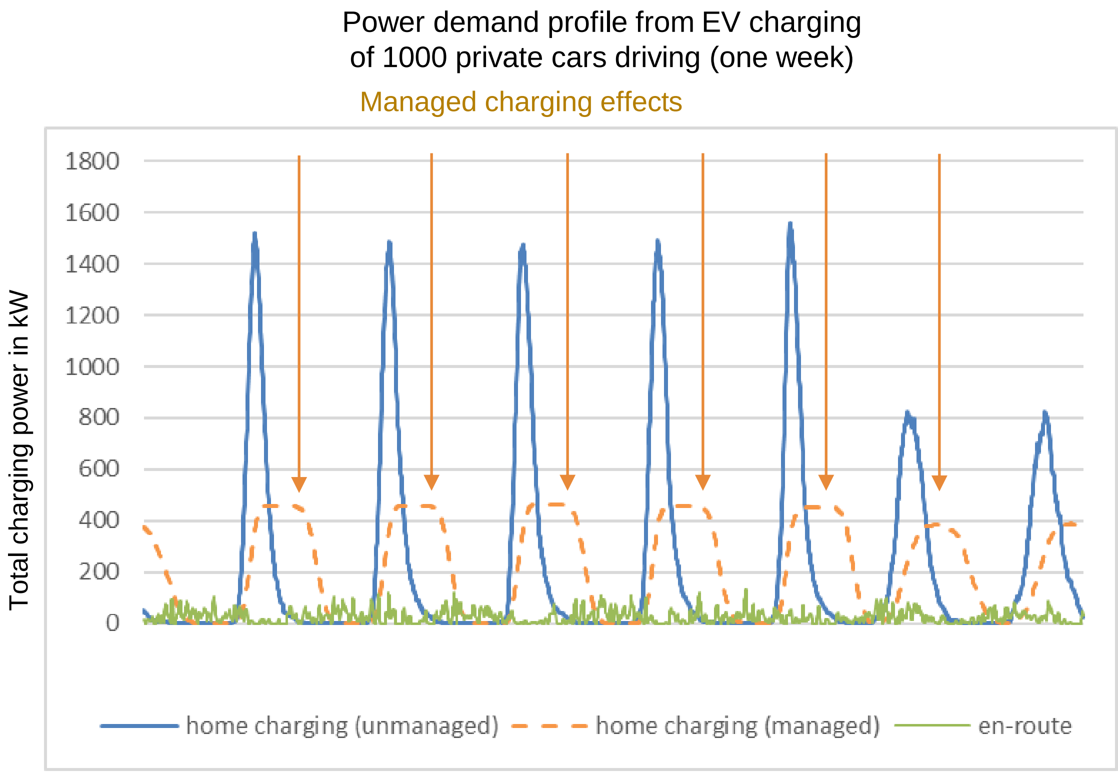
Charging events are less intense but longer if drivers tend to charge only when the battery state of charge is low.

Motivation #2 (Module 2)

Assessing effect of measures for mitigating EV charging impacts

Opportunities of road transport electrification





Managed charging unlocks demand flexibility, reduces peak demand and grid congestions, and accelerates electricity decarbonisation.

Applying managed charging measures

Is managed charging possible?

Checking flexibility

Energy required to charge EV

Flexibility

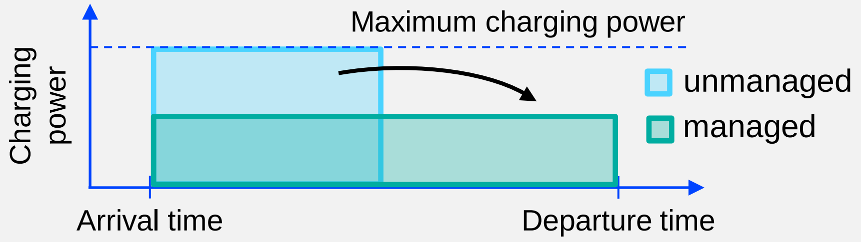
Energy available for charging (during connection time)

Participation rate

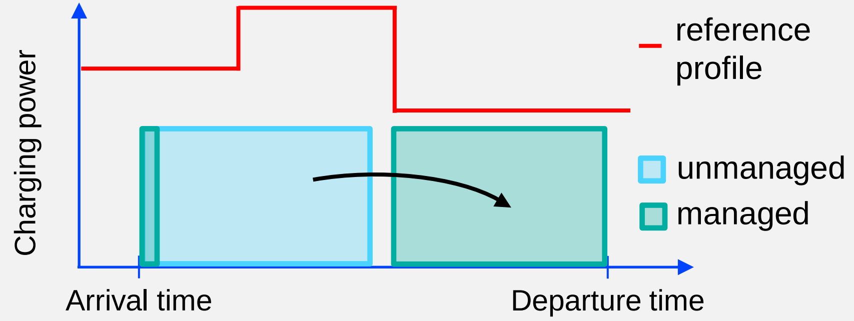
Is the infrastructure adapted? AND
Is the driver willing to participate?

Apply a managed charging measure

Balanced charging



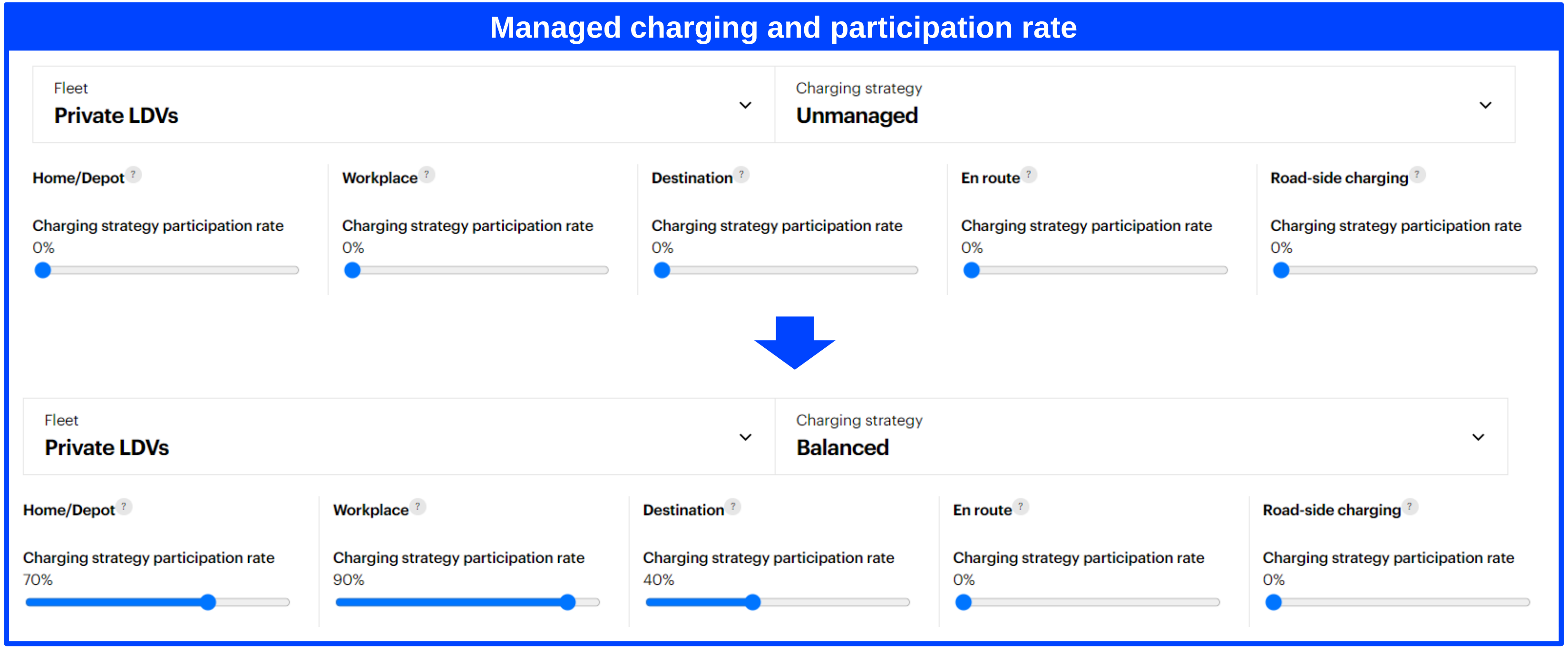
Time-of-Use (ToU) tariffs and smart charging (API)



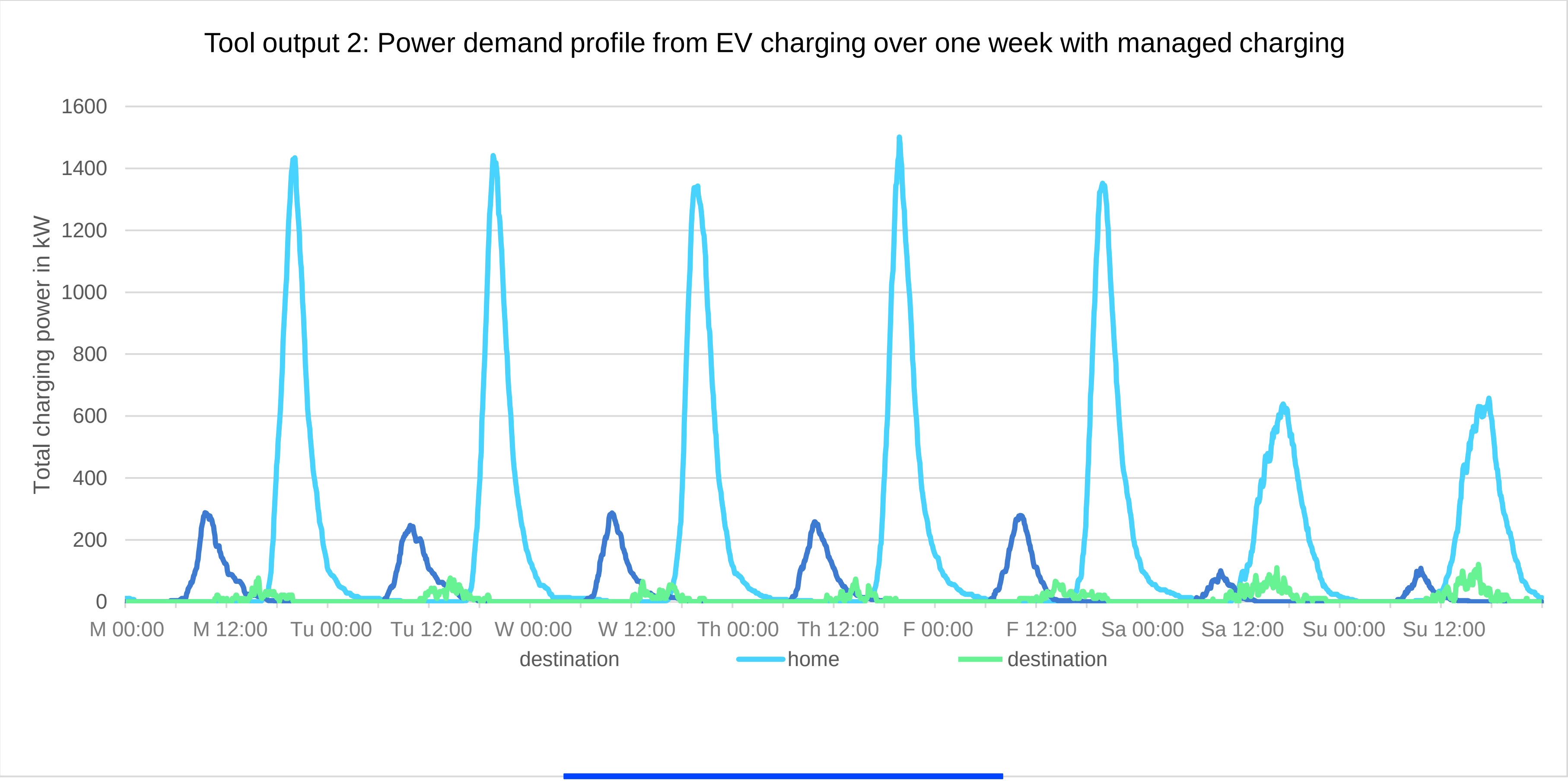
- Shift of energy depending on the **hourly tariff schedule reference electricity demand curve**

Ex: 1 000 private cars – applying balanced charging

How can a managed charging strategy be applied?

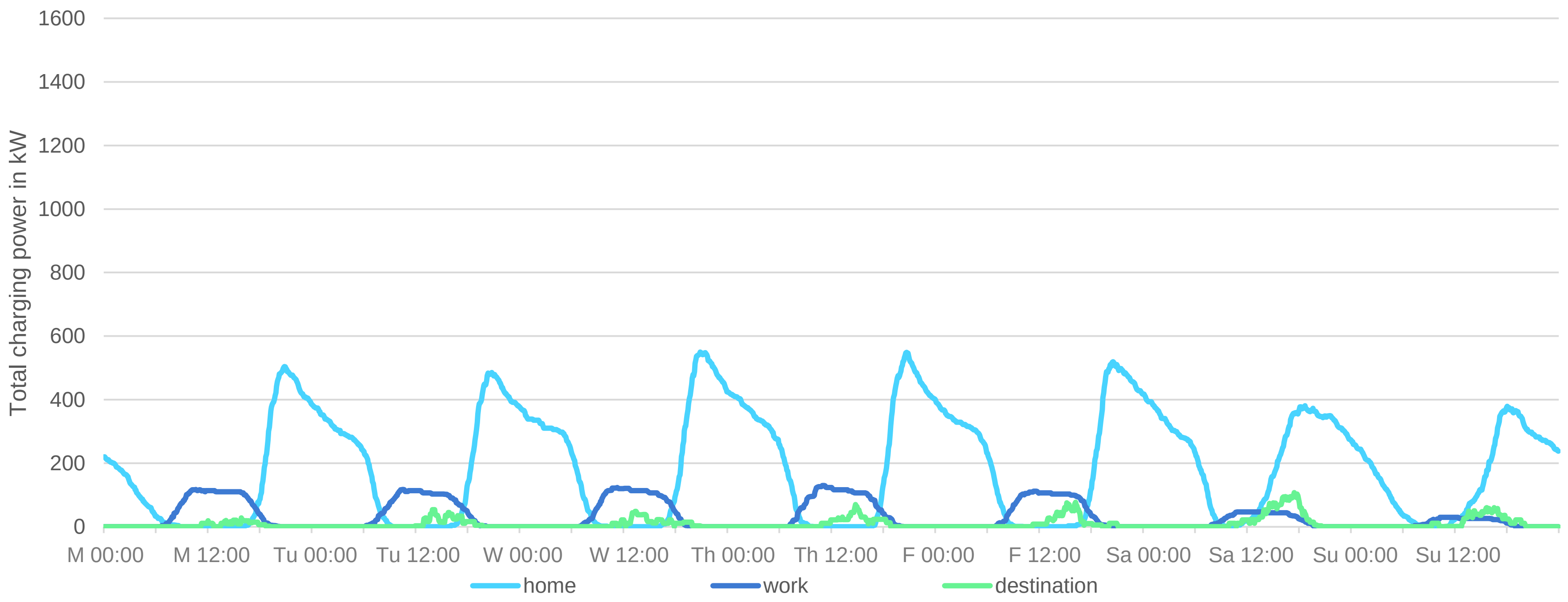


Ex: 1 000 private cars – applying balanced charging



Ex: 1 000 private cars – applying balanced charging

Tool output 2: Power demand profile from EV charging over one week with managed charging



Balanced charging has a significant smoothing effect on demand.
Peak power is reduced, leading to lower impact on electricity supply capacity.

Key messages

Key messages

- Electrification of road transport is ongoing and will accelerate as it contributes to decarbonisation and helps reducing dependency to fossil fuels
- Electrification will contribute to the increase in electricity demand but is an opportunity for the electricity system as the new electricity end-uses have some embedded flexibility
- The power sector can accommodate a wide range of charging solutions but encouraging managed charging can bring gains in avoided generation costs and emissions, and support faster growth of renewables
- Flexibility of new electricity-end uses needs to be incentivised from early stages
- Expansion of grids and charging infrastructure supports the update of EVs, but this requires breaking silos between sectors

International Energy Agency

Thank you for your attention.

Thank you to all contributors:

- Tool specifications: **Luis Lopez, Jacques Warichet**
- Algorithm developers: **Luis Lopez, Juha Koÿkka, Woan Ho Park, Andreas Bong**
- Digital support (web tool and API): **Barbara Moure, Jon Custer**
- Guidance and review: **Per-Anders Widell, Julia Guyon, Javier Jorquera, Shane McDonnagh, Elizabeth Connelly, Brendan Reidenbach, Alejandro Hernandez, Pablo Hevia-Koch**

Live Demonstration

Interactive web tool:

EV Charging and Grid Integration tool

http://www.iea.org/data-and-statistics/data-tools/ev-charging-and-grid-integration-tool

Report (December 2022)

Grid Integration of Electric Vehicles: A Manual for Policy Makers

https://www.iea.org/reports/grid-integration-of-electric-vehicles