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An Agent Based Micro-Simulation of PHEVs

Rashid A. Waraich

IVT
ETH
Zurich

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Institut für Verkehrsplanung und Transportsysteme
Institute for Transport Planning and Systems

ETH
Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

Two part of Presentation

- Overview of MATSim – An agent-based traffic simulation tool
- Current work: A framework to investigate PHEVs (based on MATSim).

Some requirements of PHEV research community

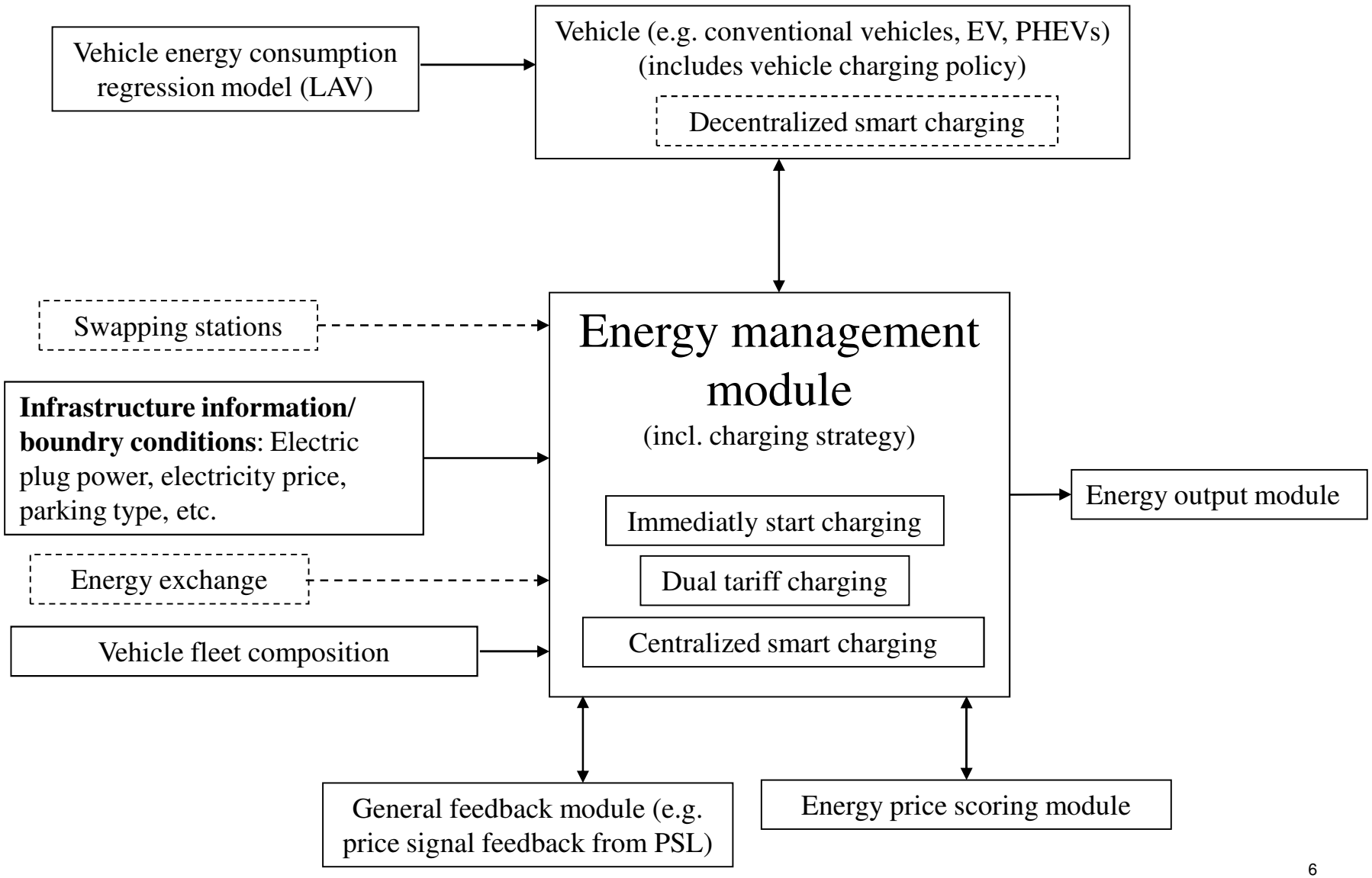
- Electricity demand changing in terms of location and time of day
  - charging power/speed can vary between locations
  - Influence/bottlenecks in lower voltage grid?
- Need to distinguish electric vehicles and PHEV
  - PHEVs more flexible due to gasoline tank
- Vehicles with batteries could potentially supply the grid (V2G, V2H)
  - What is the role of battery size in terms of V2G and emissions
- Ability to incorporate individual agent's preferences
  - E.g. parking price, distance, income, location
- Government policy (e.g. Parking advantage for electric vehicles, street tolls)
- Fleet modelling: Emissions analysis (e.g. green house gase emissions after change of a policy)

Some requirements of PHEV research community (cont'd)

- Charging Schemes
  - Decision by agents (manually)
  - Decisions by electric grid (e.g. smart grid)
  - Decisions by on board computer of cars (automatically)
    - E.g. based on current state of charge, distance to next destination(s), charging price (changing over the day), parking duration, max unchargable state
- Energy Exchange (buying and selling electricity)
- Analyzing black outs (focusing on detailed analysis instead of on rough numbers)
- ...

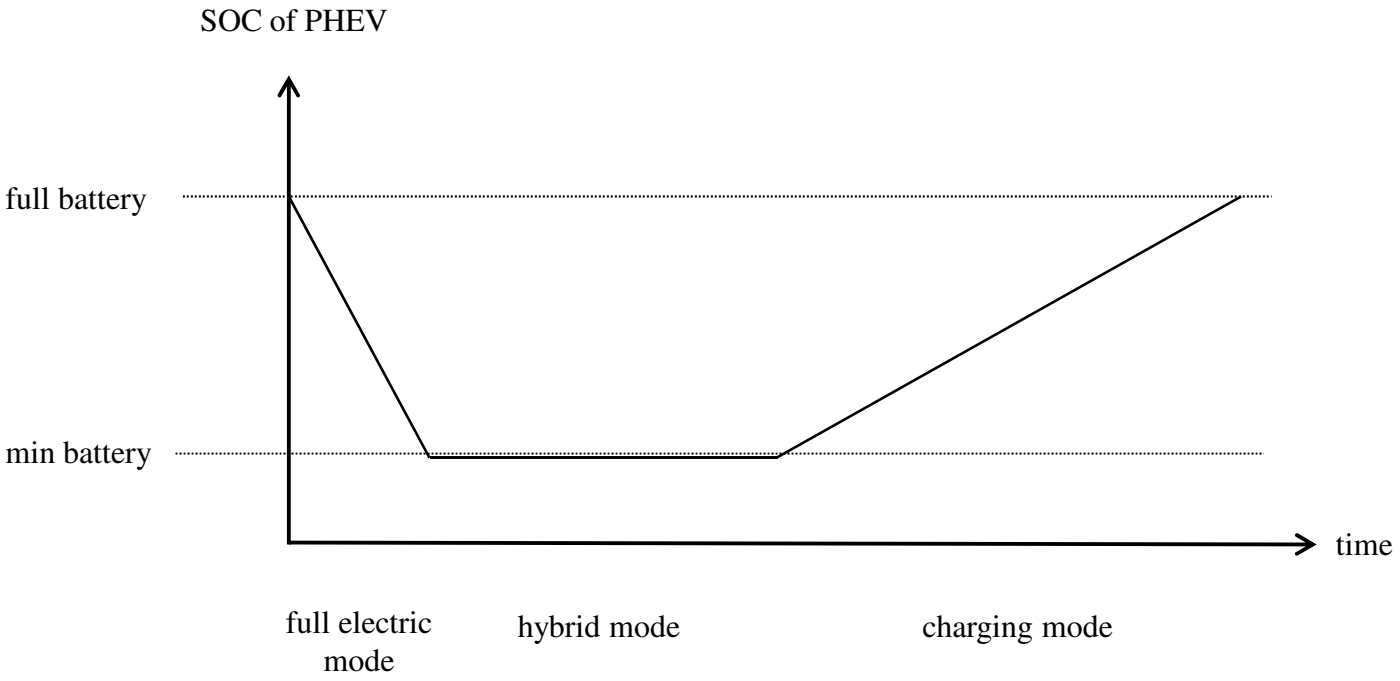
=> **The proposed PHEV framework helps answering such questions.** Many of these features have already been implemented.

PHEV Framework Overview (Core Modules)



PHEV Framework Overview (Vehicle Types)

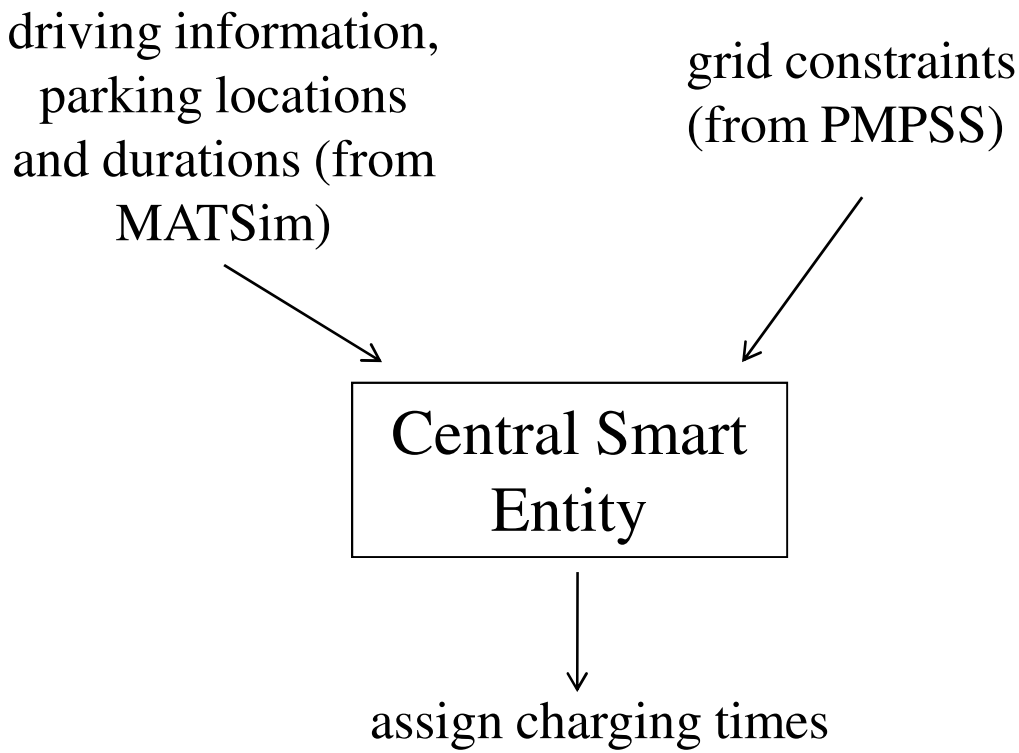
- Conventional Vehicles: Just how much they drive and along which streets => spacial map of emissions
- EV and PHEVs: Keeping track of driving and charging of battery
- Vehicle energy consumption: Regression model for different types of vehicles in Switzerland (LAV)



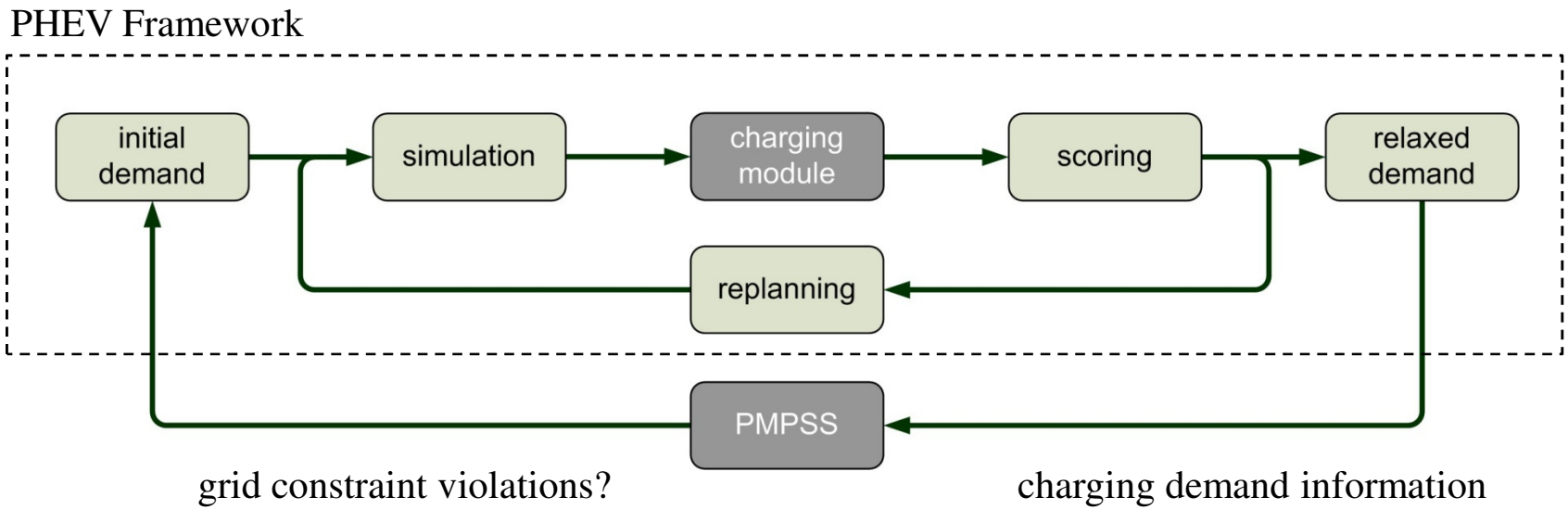
Charging Strategies

- Completed work on individual charging patterns:
  - Charge immediatly upon arrival at location
  - Charge if high price during the day and low price during the night
  - Simulate a possible smart grid (centralized version)
- Scenario dependent
  - e.g. only home charging
  - e.g. home and work charging
  - different types of plugs/changing speed

Centralized Smart Charging (Smart Grid)



Plugging-in Feedback Module into PHEV Framework



Joint Experiments (IVT – PSL)

- Test experiments conducted in October 2009
  - Matthias Galus will present later
- At the moment we are working on setting up a scenario for the city of Zürich (November 2010)
  - 10’s of GB of RAM required

Work in Progress and Future Work

- Decentralized smart grid
- Energy exchange
- Swapping stations
- Integration of general energy source/storage concept (e.g. solar panels)

Questions?