Use of NHTS for Predicting Future Transportation and Electric Energy Demand

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National Energy & Transportation Sustainability, Cost, & Resiliency
NETSCORE21
Research Project

Using NHTS Data for Transportation Decision Making
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Outline

Part I

O&D and mode-share of long-distance nationwide passenger transportation

Part II

Electric energy and power consumption

From plug-in electric vehicles

Part I: O&D and mode-share of long-distance nationwide passenger transportation

1. Introduction
2. NETSCORE^{21}
3. Data & methodology
4. Results
5. Results applied in NETSCORE^{21}
6. Conclusions

Introduction

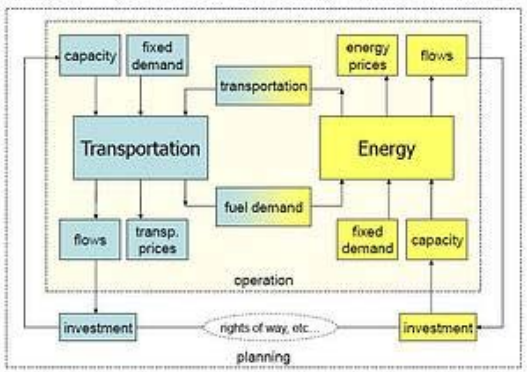
- Passenger transportation in the U.S.:
  - 12% of the energy consumption
  - 17% of the total greenhouse gas (GHG) emissions
  - 60% of the transportation sector's total energy consumption
  - 73% of the transportation sector's total GHG emissions (DOE, 2008; EPA, 2008).

- Passenger transportation demand
  - future energy needs, and
  - transportation infrastructure investment planning.

NETSCORE^{21}*

- NETSCORE^{21}: 21st Century National Energy and Transportation Infrastructures Balancing Sustainability, Costs, and Resiliency

- Interdependency between transportation & energy



- National Passenger Transportation formulation:
  - State-to-state travel
  - Highways (conventional & PHEVs)
  - Air
  - Rail (conventional & hybrid-electric)

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NETSCORE^{21} (cont'd)

Actual Highway Network vs. NETSCORE21 Network

- Arc & node network – Census center for each state
- Each virtual arc is the aggregation of a number of actual links ($C_V = \sum C_A$)

Data & methodology

Research Question: How many people move from state A to state B, and by which mode?

- 2001 NHTS: information on long-, interstate trips (distance > 50 miles)
- Passenger transportation modeling ~ commodity traveling from *point A* to *point B*
- "Long-trip" file (LDTPUB) & "Person" file (PERPUB)

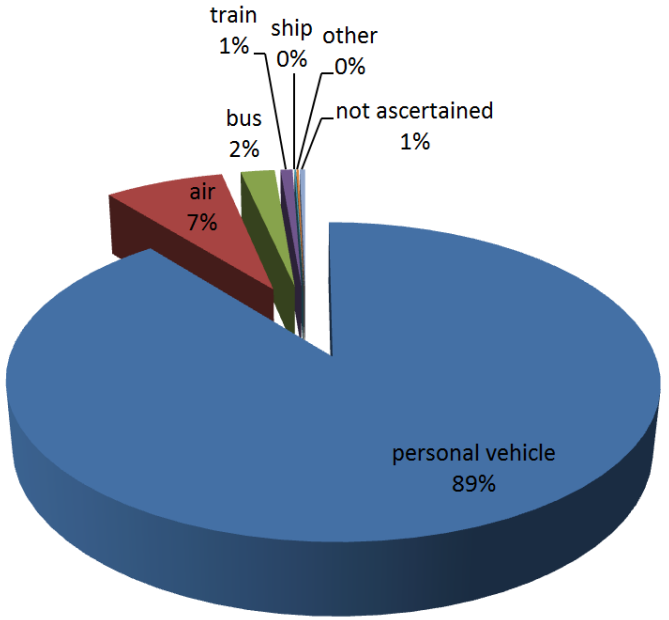
Data & methodology (cont'd)

- "Long-trips" file (LDTPUB) & "Person" file (PERPUB)
  - Matching records according to the "PRCASEID" field
  - Weight used: WTPERFIN (useable HHs person weight for the full sample)

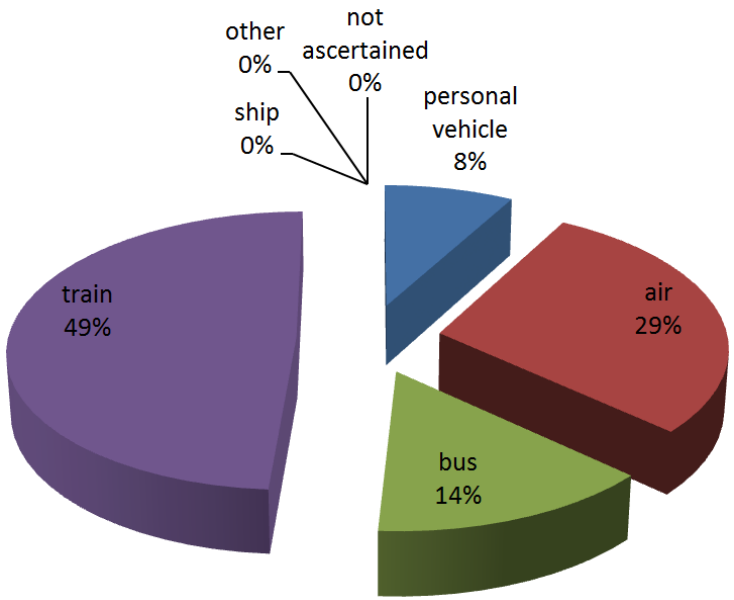
- Weight the data with the "person" file (PERPUB) weights to account for
  - Geographic and demographic variability in the data,
  - Nonresponse
  - Undercoverage
  - Multiple telephones in a HH

Results

- Final data
  - information on long-distance trips
  - categorized by O & D state
  - mode, and
  - trip purpose.



2001 long-trips:
Mode share



- Example: *How many people traveled from New York to District of Columbia in 2001? By which mode?*

Results applied to NETSCORE[21]

- Information on:
  - Passenger volumes moving on each virtual arc
  - Mode- & fleet-share
  - Commute vs. non-commute trip purpose

- Investment & Operation Costs: in terms of volume/capacity ratios
- Sustainability: in terms of VMT per mode
- Resiliency: impact of arc failures on route/mode-choice

Conclusions

- Limitations:
  - 2001 data is the latest NHTS dataset with long-distance trips information
  - Need for more up-to-date information

- Future research:
  - New transport modes (e.g. HSR): change of current mode share

Part II
Electric energy and power consumption from plug-in electric vehicles

D. Wu, D. C. Aliprantis, and K. Gkritza, "Electric energy and power consumption by light-duty plug-in electric vehicles," *IEEE Trans. on Power Syst.*, Vol. 26, No. 2, pp. 738—746, May 2011.

PEVs are here…

Chevy Volt
Starting at $32,780 = $40,280 (MSRP) − $7,500 (tax credit)

Nissan Leaf
Starting at $26,220 = $33,720 (MSRP) − $7,500 (tax credit)

Other manufacturers that plan to launch PEVs between 2011 and 2013: Toyota, Ford, Honda, Tesla, Mitsubishi, Chrysler, BYD, etc.

National Household Travel Survey

2009 NHTS:

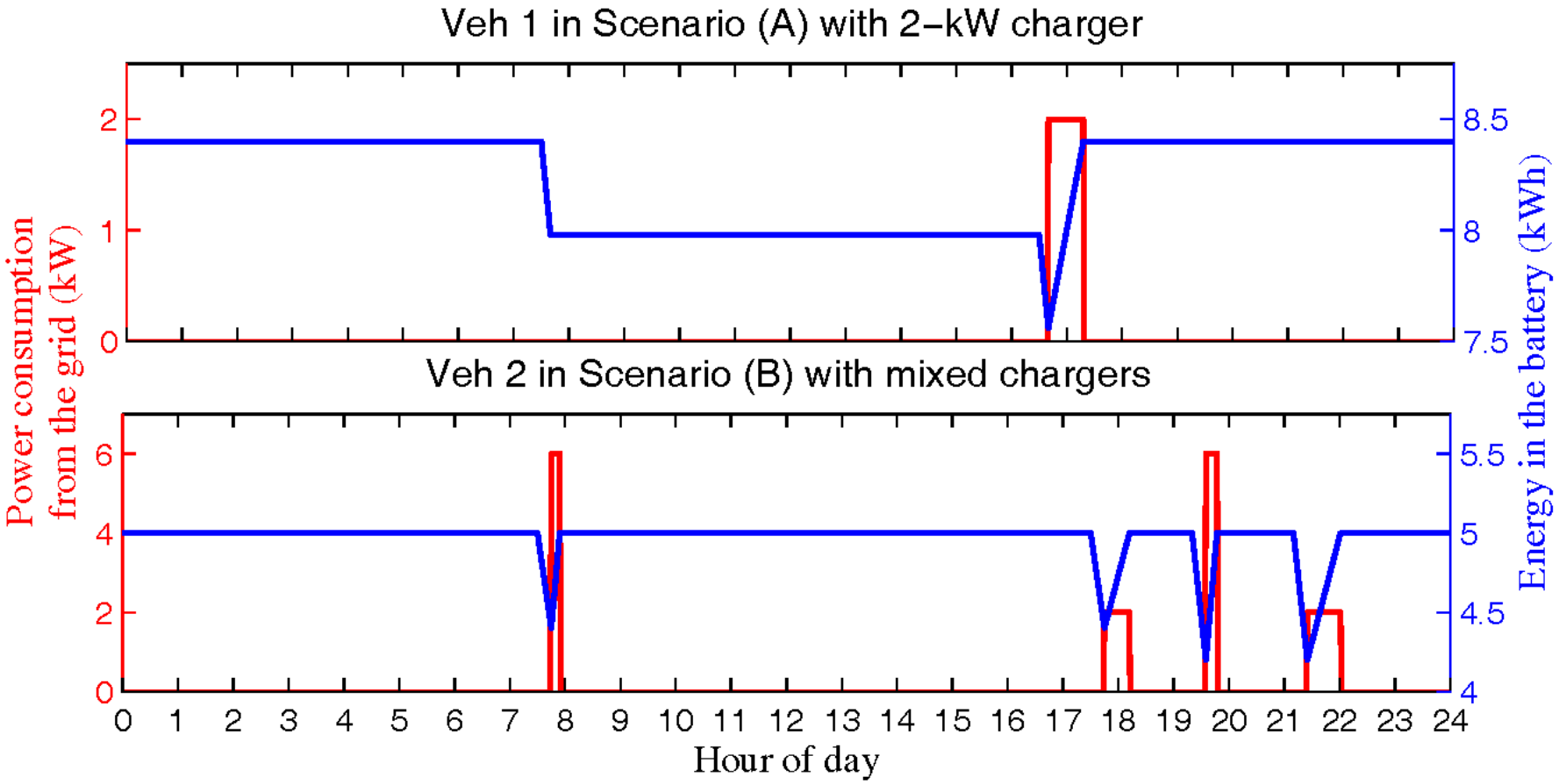
- 150,147 households
- 294,408 Light-Duty Vehicles (LDVs)

Data Example from the 2009 NHTS

Vehicle	Type	Origin/purpose	Start time	Destination/purpose	End time	Trip miles
Veh 1	Car	Home Work	07:30 16:30	Work Home	07:40 16:40	2 2
Veh 2	SUV	Home Work Home Shopping	07:30 17:30 19:20 21:10	Work Home Shopping Home	07:45 17:45 19:35 21:25	3 3 4 4

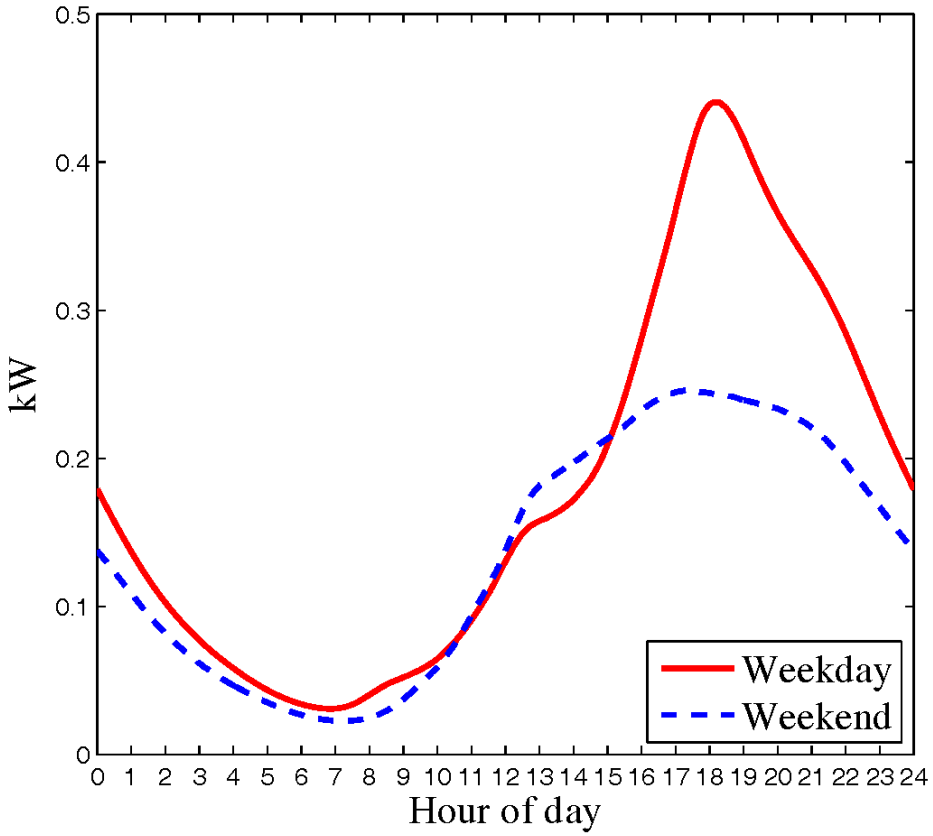
Simulation methodology

Virtually convert vehicles in NHTS into PEVs, and then run Monte-Carlo simulations:

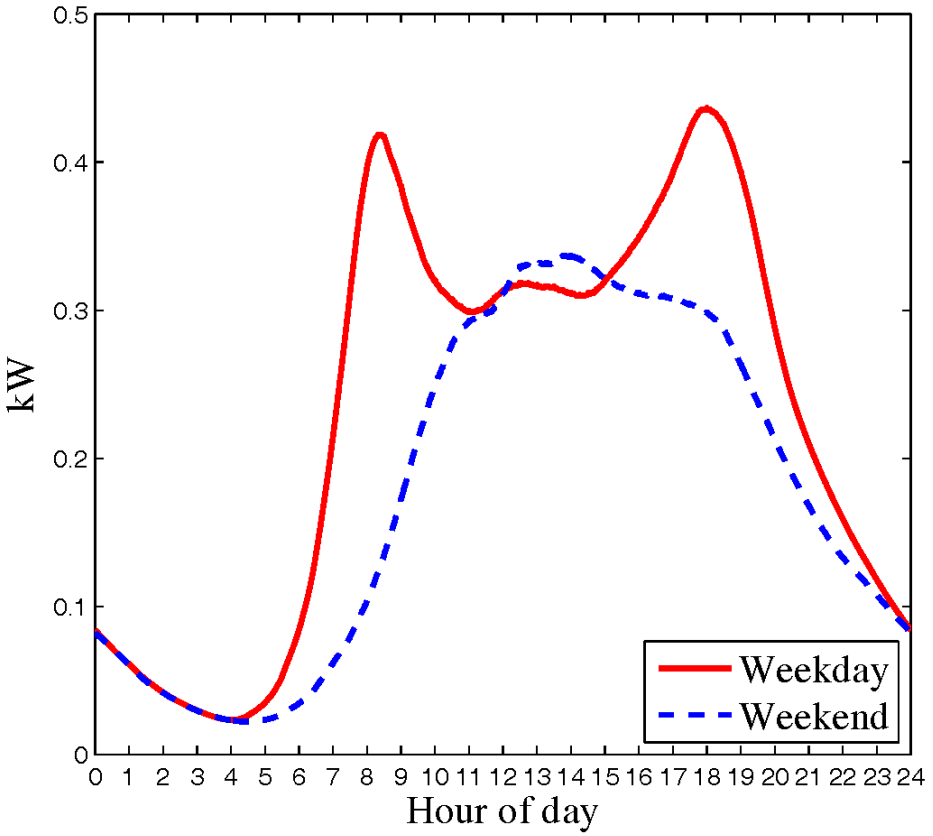


Average power consumption per PEV

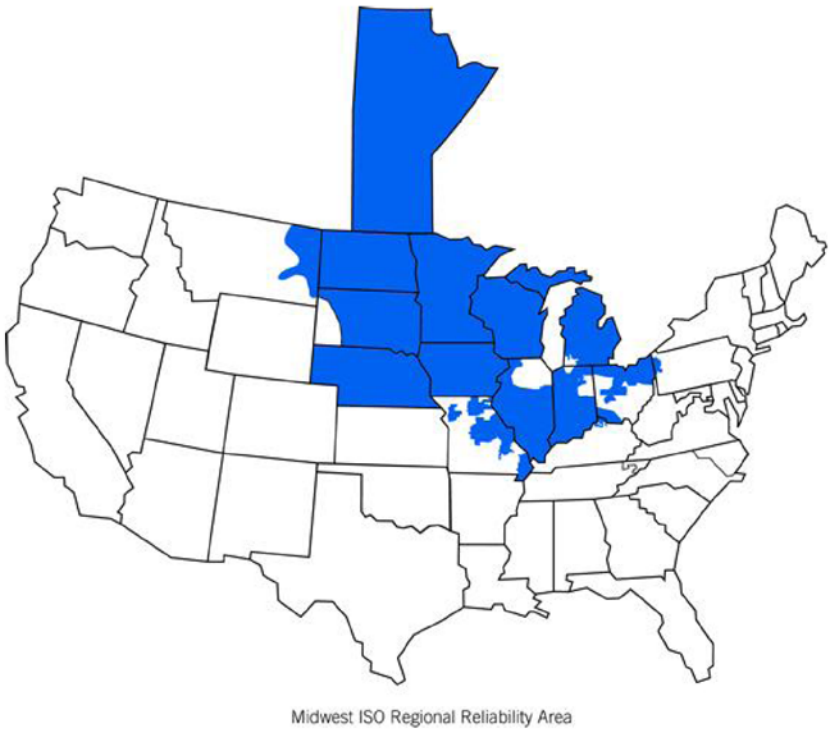
Scenario (A)
Charging only at home

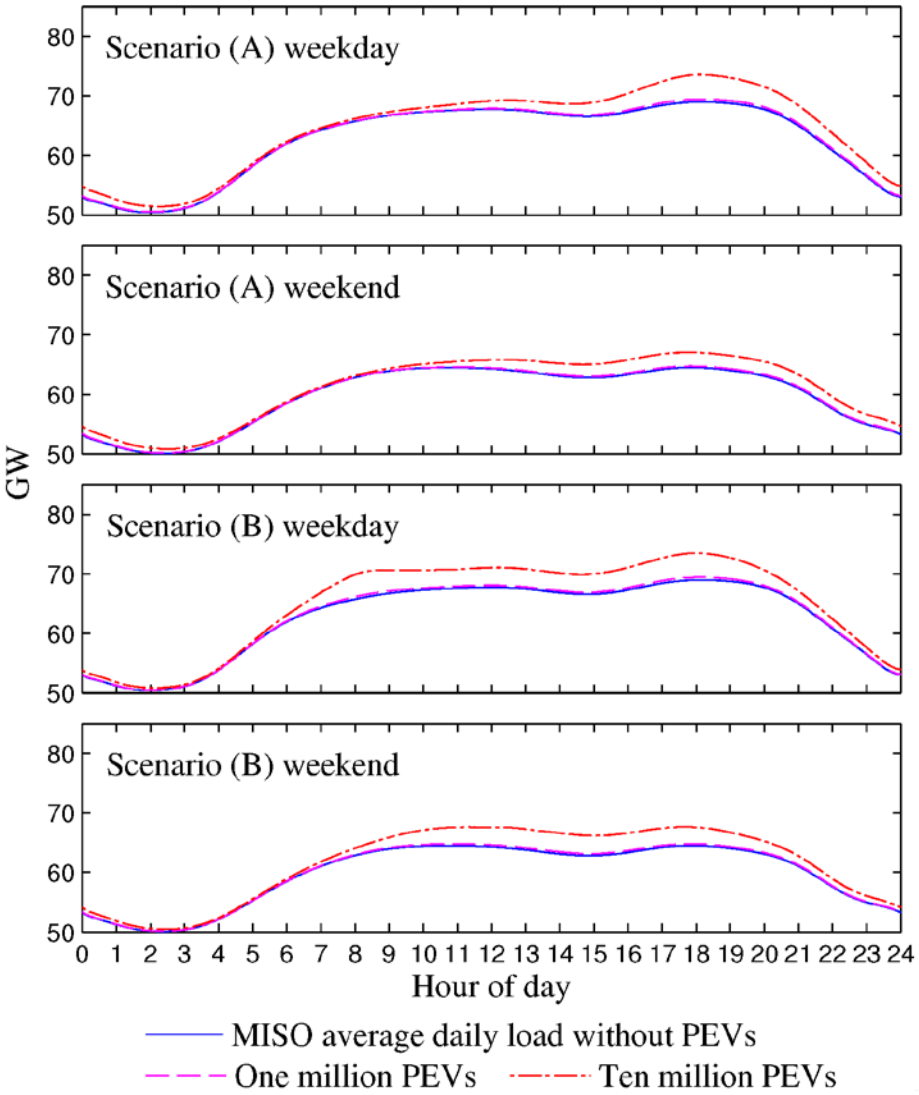


Scenario (B)
Charging anywhere



PEV load superimposed on Midwest ISO load





Questions?

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NETSCORE21:

http://www.ece.iastate.edu/research/research-projects/netscore-21.html