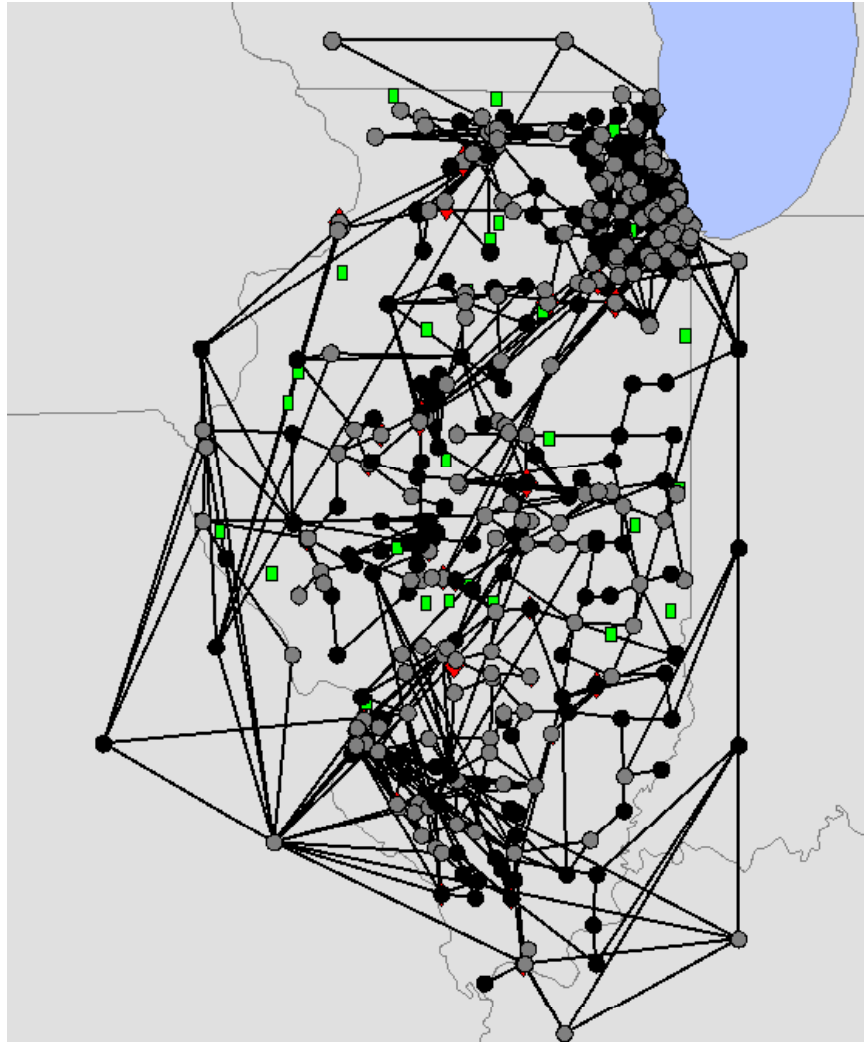# Impacts of PHEV and PHEV+EV Charging on Electric Demand in Illinois in 2030

Prakash Thimmapuram

Computational Scientist

ARGONNE NATIONAL LABORATORY

September 25, 2012

Power System Representation

- 2,500 transmission lines
- 1,900 Buses
- 160 Thermal Units
- 63 Wind Farms
- 40 Solar Farms
- 870 Load Buses

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Power & Energy Society®

System Simulation

- Electricity Market Complex Adaptive System (EMCAS) used to simulate the hourly operations of the power system.

- Simulated one week each in the months January, April, July and October representing the four seasons.

- External loads are included as price elastic loads to facilitate export of nuclear and wind generation during low load periods.

Load Forecast
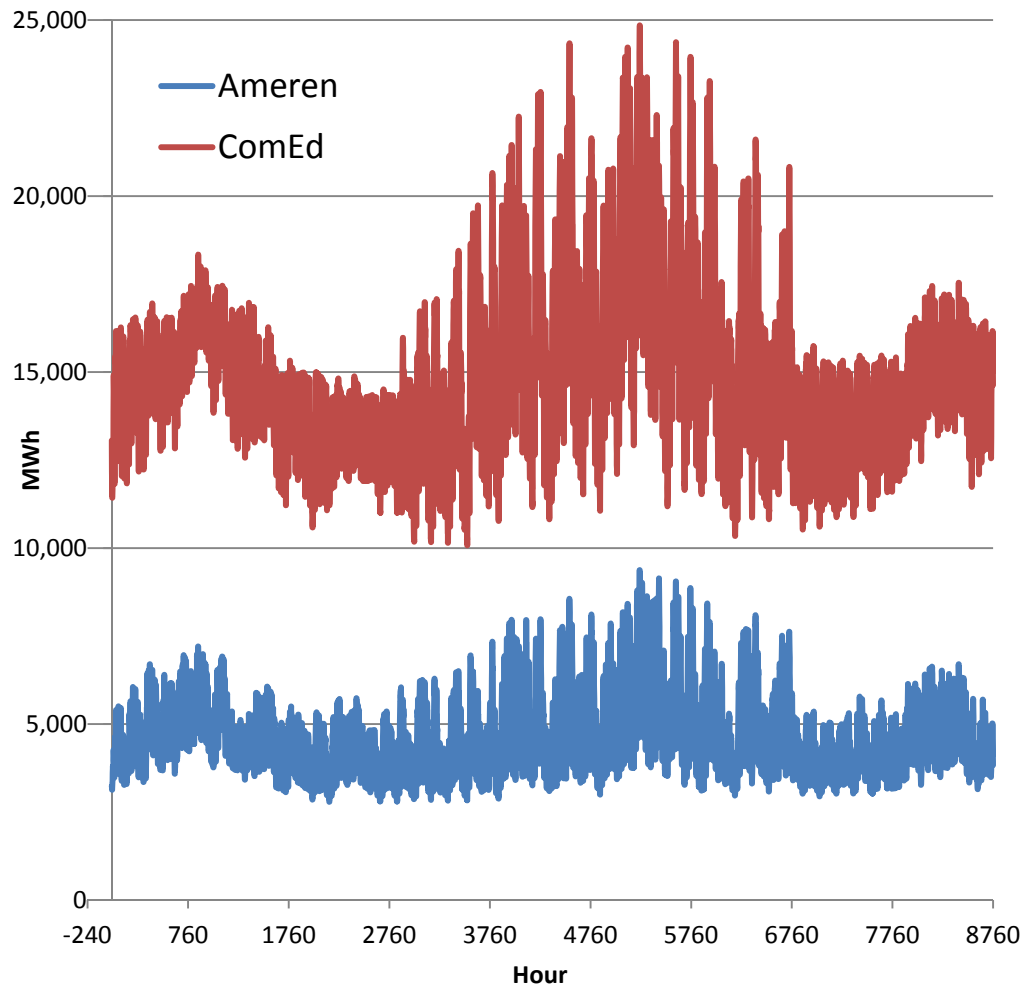
- The non-vehicle electric load is updated based on the long-term projections of annual and peak load projections for ComEd and Ameren areas by PJM Interconnections and the MISO.

- Applied a load shaping algorithm to bus-level hourly loads from 2007 to scale to 2030 by matching area hourly, annual and peak load profiles.

Vehicle Load
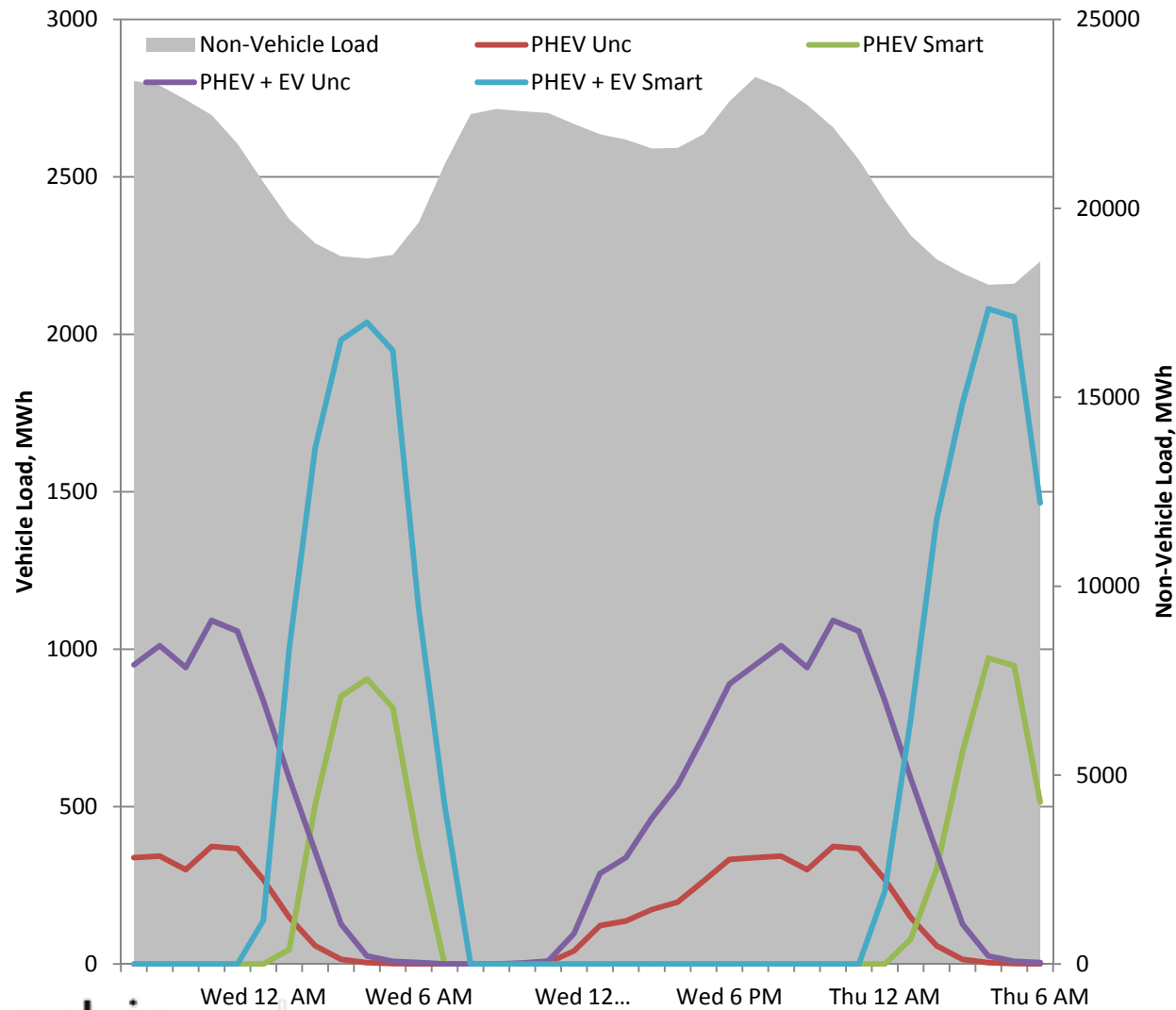
- Penetration in 2030
  - 10% PHEV of light duty vehicles
  - 10% PHEV + 5% of light duty vehicles
- Charging Scenarios
  - Unconstrained
  - Smart

Retirements

- Any coal or fuel oil or nuclear powered unit whose age will be 60 years or more by 2030

- Any natural gas powered unit whose age will be 40 years or more by 2030

- Capacity that will be retired by 2030

    4032 MW of bituminous and 5730 MW of sub-bituminous

    572 MW of fuel oil and 678 MW of natural gas

    No Nuclear units retired

Renewable Energy Portfolio Standards

- 25% of electric sales by 2026 should come from renewable resources of which at least 75% from wind and 6% from solar resources.

- 13,100 MW of Wind-turbines by 2030

- 1,620 MW of Solar capacity by 2030

- Solar and Wind Profiles
  - Based on PV Watts
  - Based on Eastern Wind Integration Study
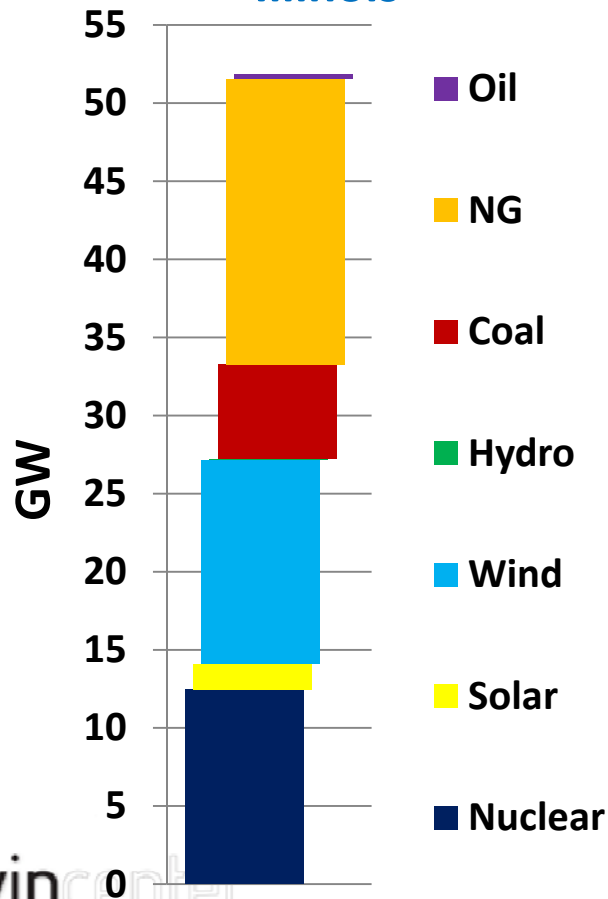
Uprates and Capacity Expansion

- Assumed uprates that have been filed by Exelon and approved by NRC will be in implemented by 2030 (1,115 MW).

- 5,500 MW of thermal capacity is required to maintain a 15% reserve margin.
  - 12 combined cycle plants (400 MW each)
  - 3 gas turbines (230 MW each)
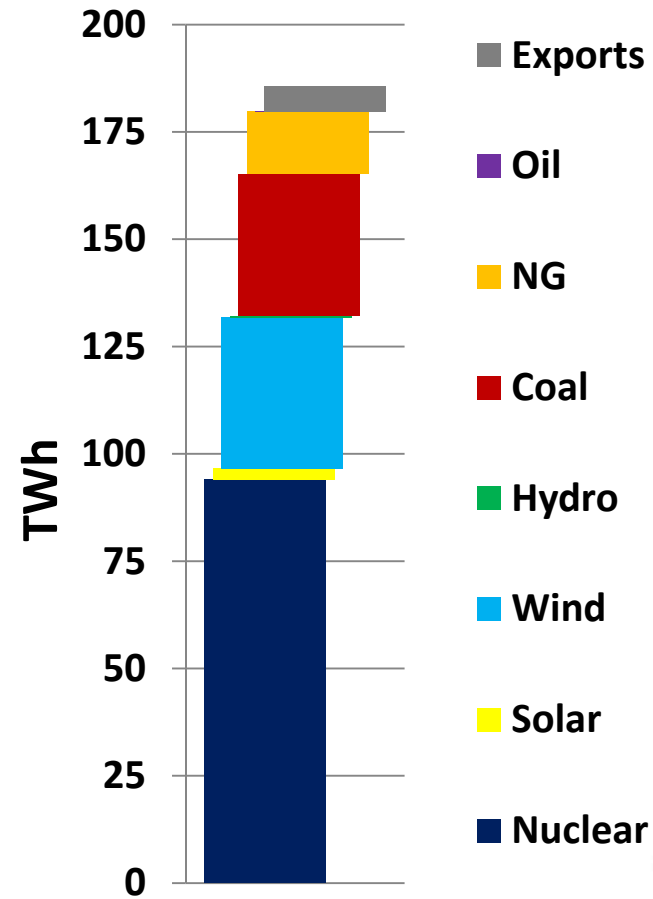
- Minimal changes to transmission lines.

Capacity Mix and Generation
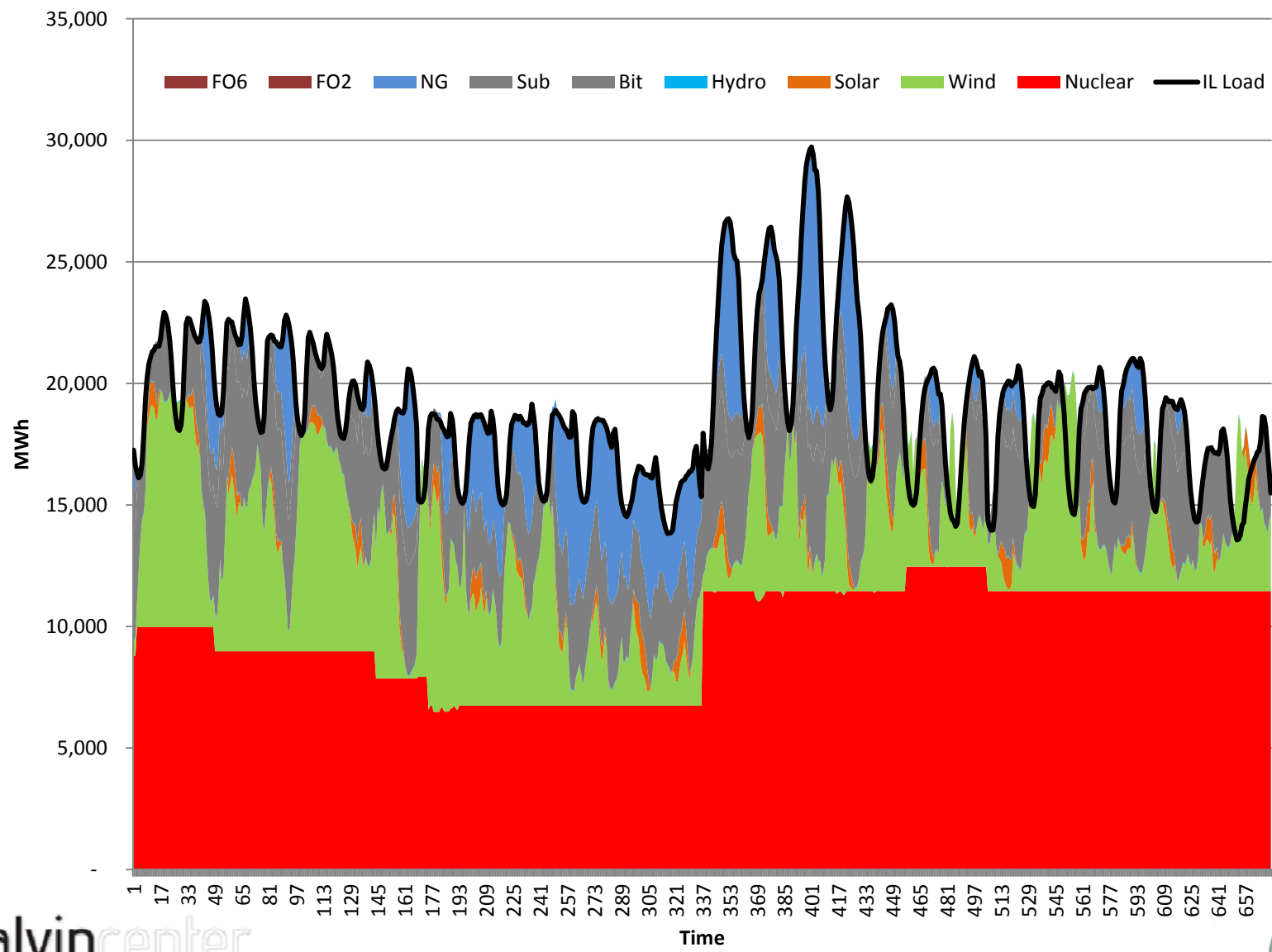

2030 Base Capacity

Illinois

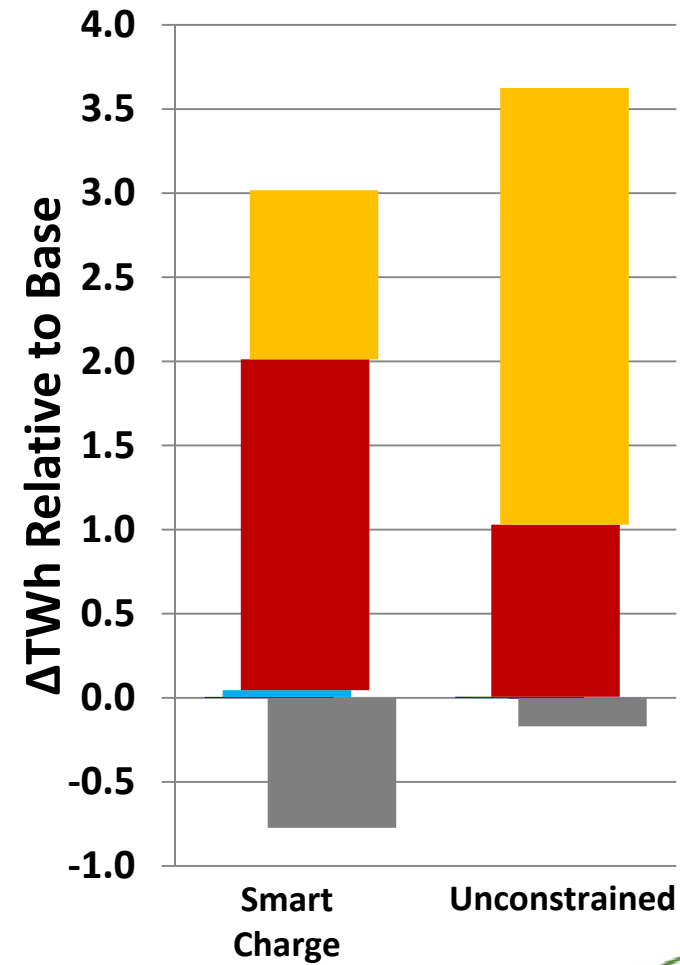GW — Oil, NG, Coal, Hydro, Wind, Solar, Nuclear

2030 Base Generation
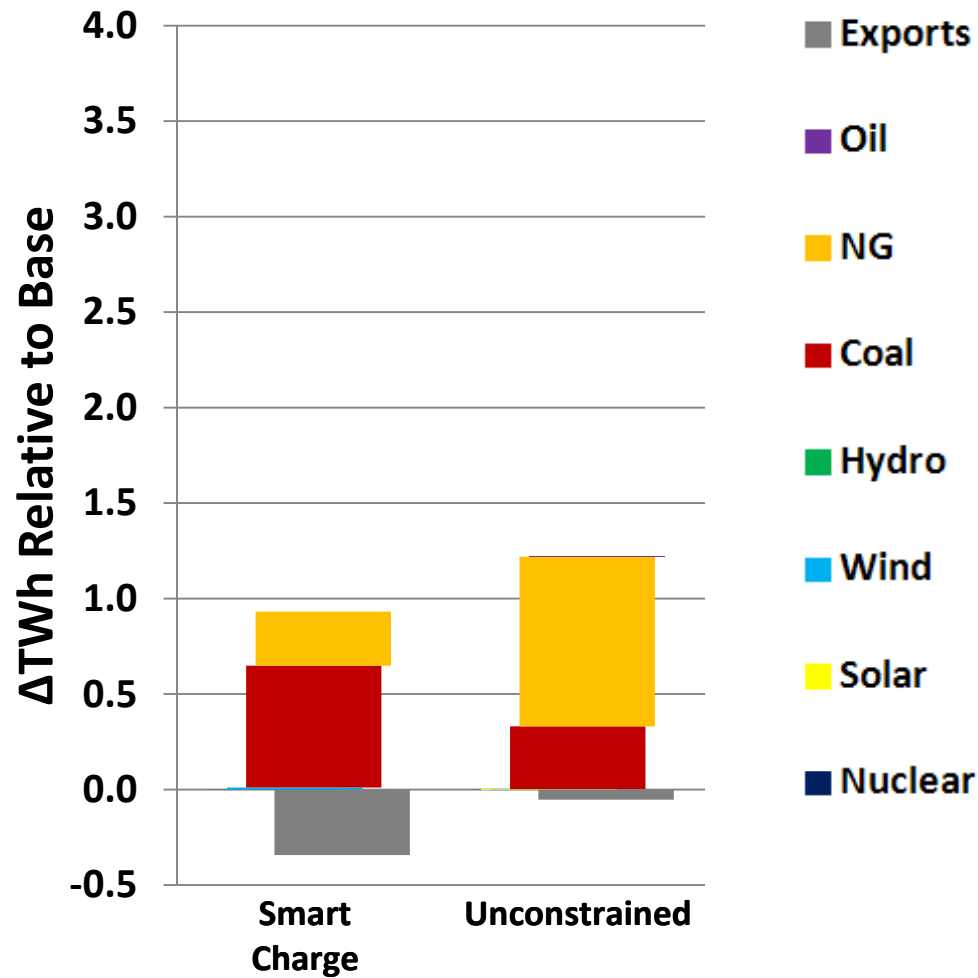
TWh — Exports, Oil, NG, Coal, Hydro, Wind, Solar, Nuclear

Generation by Fuel Type

Generation with Vehicle Loads

2030 Generation with PHEVs

2030 Generation with PHEVs+EVs

Legend:
- Exports (gray)
- Oil (purple)
- NG (orange)
- Coal (red)
- Hydro (green)
- Wind (light blue)
- Solar (yellow)
- Nuclear (dark blue)

Conclusions

- Charging upon arrival adds significant load in the late afternoon hours, which partially overlaps with the system load peak hours.

- Smart charging fills the overnight trough in the daily demand profile.

- The smart charging resulted in more dispatching of coal power plants compared to the arrival time charging (69% vs. 27% share of coal generation in the marginal mix for the smart charging and arrival time charging scenarios, respectively).