# Towards Large-scale Transportion Electrification

## Opportunities and Challenges

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04/24/2023 @ Texas A&M University

# Background - Electric Vehicle Markets

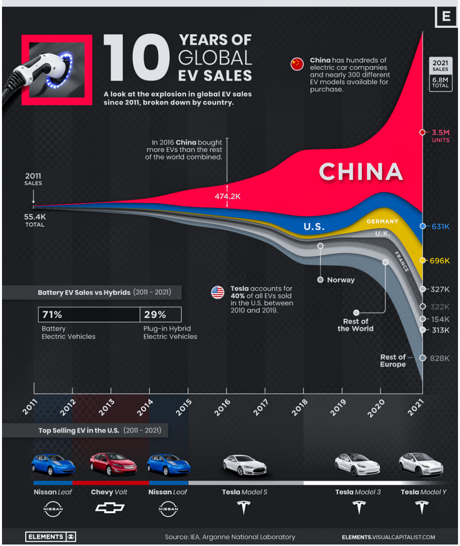


Figure: EV Sales ©Visual Capitalist

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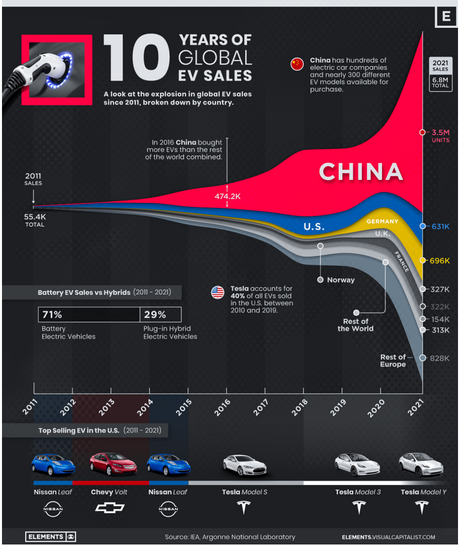


Figure: EV Sales ©Visual Capitalist

Figure: Shanghai Auto Show 2023 ©Pinjia

# Background - Electric Vehicle Adoption Goals

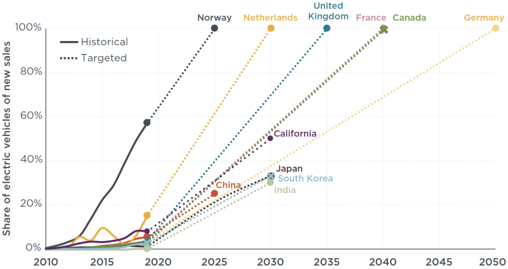


**Figure 5.** Historical and targeted electric shares of new passenger vehicle sales by markets.

Figure: EV Sales Target ©ICCT

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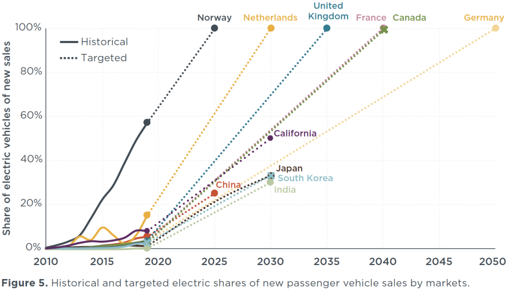


Figure: EV Sales Target ©ICCT

- President Biden's Bipartisan Law will invest $7.5 billion for national network of EV chargers
- 55% of new sales of automobiles worldwide will be electric vehicles (EVs) by 2040 – Bloomberg

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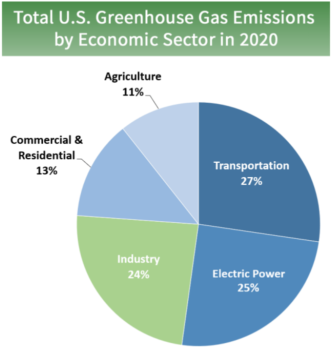



Figure: GHGs by Sector (U.S. EPA, 2022)

# Coupled Transportation and Power Systems

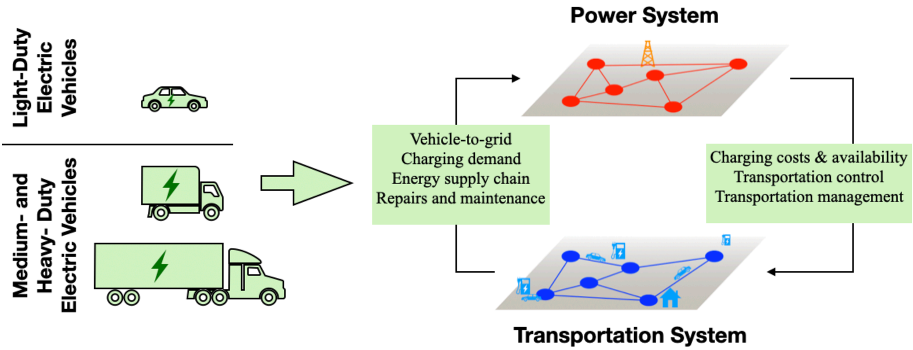
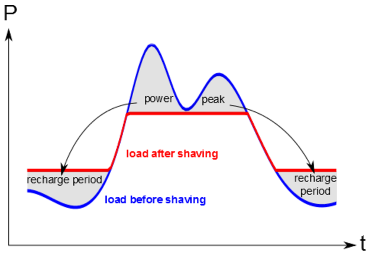


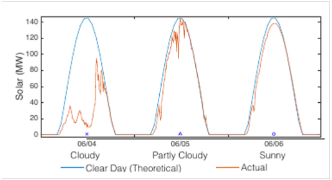

Figure: Coupled Transportation and Power Systems

# Opportunities from Integrated Transportation and Power Systems Perspective

- Infrastructure planning
  - Transportation infrastructure, charging infrastructure, power transmission/distribution/ substations
- Load management
  - Peak shaving
  - Reduce the peak charge
  - Delay new power plants
- Energy storage (technology innovation and costs)
  - Integration of renewable energy
- New business models
  - Frequency/voltage regulation
  - Black start
  - Grid-mobility service
  - Lower vehicle ownership costs




Peak Shaving ©Sandia




Solar Output Fluctuation

# Challenges from a Modeling Perspective

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  - Transportation: investors, multi-modes, TNCs, individuals, operators
  - Power: deregulation in wholesale market, utilities, microgrids, distributed energy resources (DERs)

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  - Privacy and security concerns
  - Individual benefits
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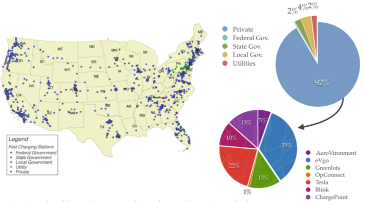
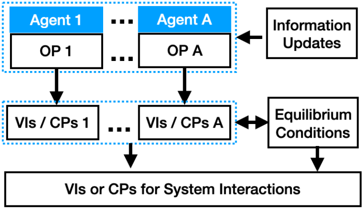
Baghali, et al., 2022 @ IEEE TPS




Data Source: http://www.afdc.energy.gov/locator/stations/, accessed on 02/17/2016



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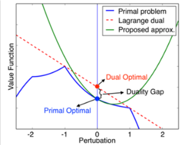


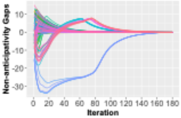


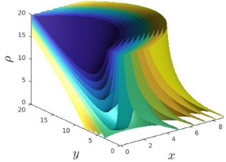

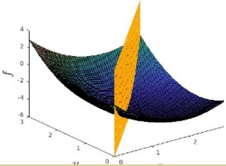

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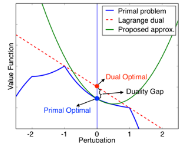


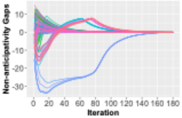


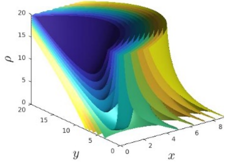


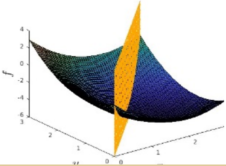

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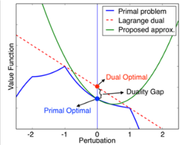


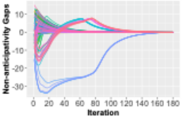


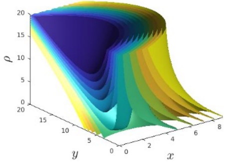

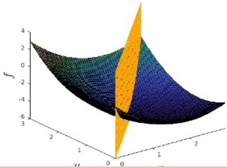

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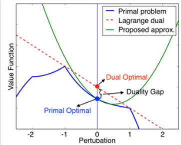


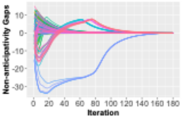


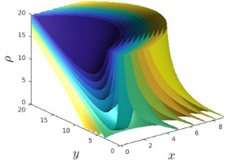

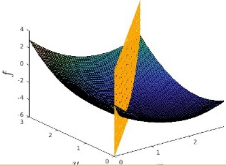

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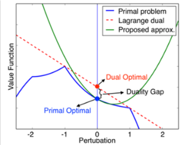


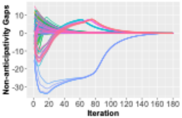


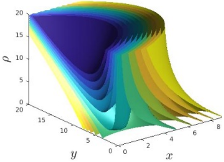

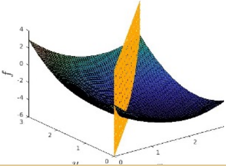

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