City-based Optimization Model for Energy Technologies (COMET)

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City-based Optimization Model for Energy Technologies

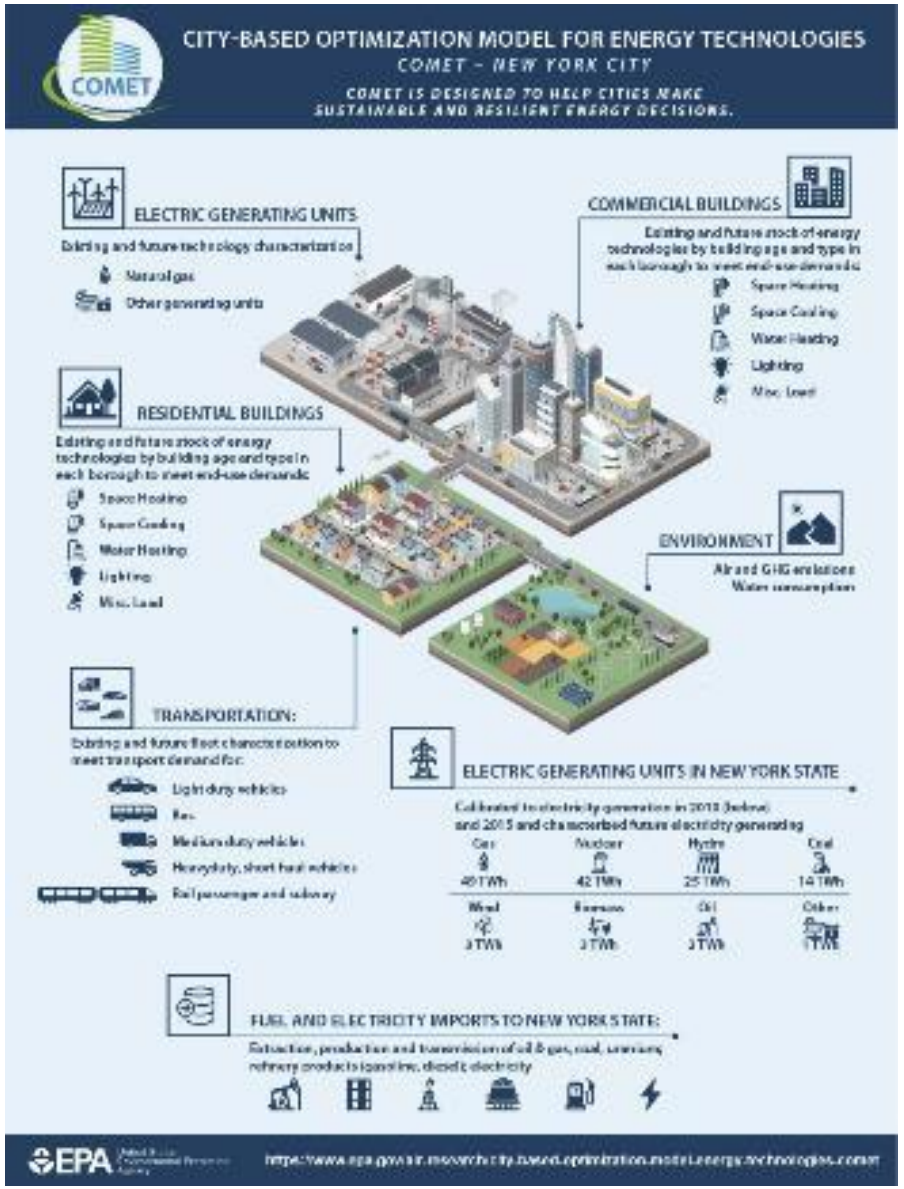
COMET is an analytical peer-reviewed technology evaluation tool for cities and states that can answer

- long-term planning questions (40+years of planning horizon) related to sustainability, resilience, equity, and growth in the energy sector.
- multipollutant and multi-media impacts, unintended consequences of the evolution of energy systems.

COMET can used in various applications such as

- Model a **pre-specified** energy system scenario
  - Technology penetrations are determined *a priori*
  - Reports fuel use, GHG and pollutant emissions, water use
- To **prescribe** a least cost energy system
  - User provides constraints (e.g., emission limits, energy demands)
  - Identifies the least cost strategy while meeting the constraints
- Examine the **sensitivity** of the least cost pathway to the:
  - application of **new policies;** introduction of **new technologies;** changes to **fuel prices** or **fuel availability**
- Examine distinct **scenarios** of the future

The underlying data used to build **COMET** New York City application can be made available for interested parties.

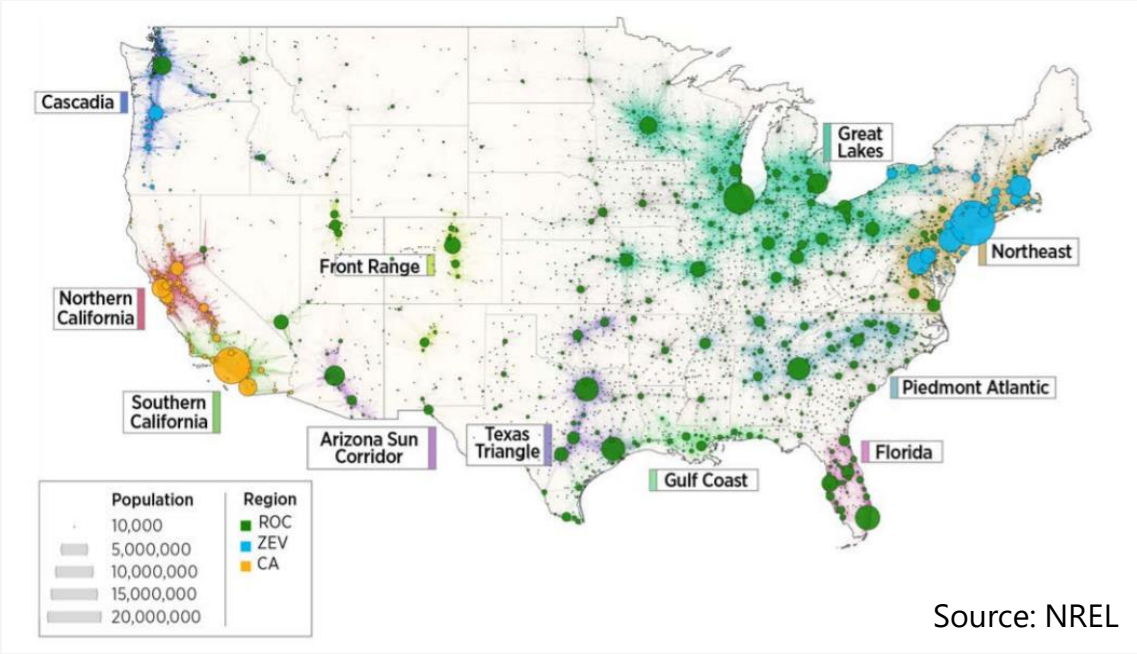


https://www.epa.gov/air-research/city-based-optimization-model-energy-technologies-comet

Why Cities? Regional, State and Local Analysis?

By 2050, almost 70% of the world population is expected to live in urban areas presenting a tremendous challenge for city governments

- To achieve greenhouse gas and air emissions reduction goals cost-effectively
- To meet growing energy, housing, and mobility demand,
- To provide clean air and water to their citizens
- To meet federal and state mandates environmental and energy standards and policies.



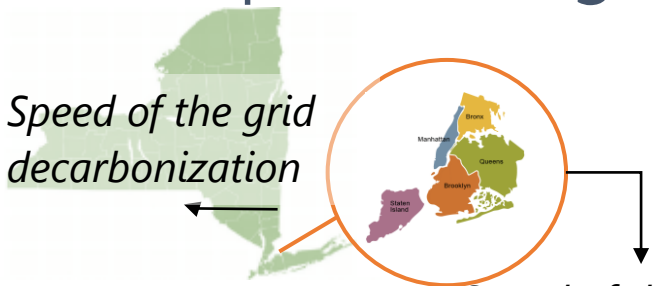
Source: NREL

Issues:

- Attainment of air quality standards
- Impact of climate change on air quality
- Urban heat island impacts and mitigation
- Aging transportation, building infrastructure
- Consequences of energy efficiency retrofits
- Proximity to industrial sources and mitigating climate change - decarbonization

Analysis of NYC's transportation policies targeting 80x50 CO2 reductions

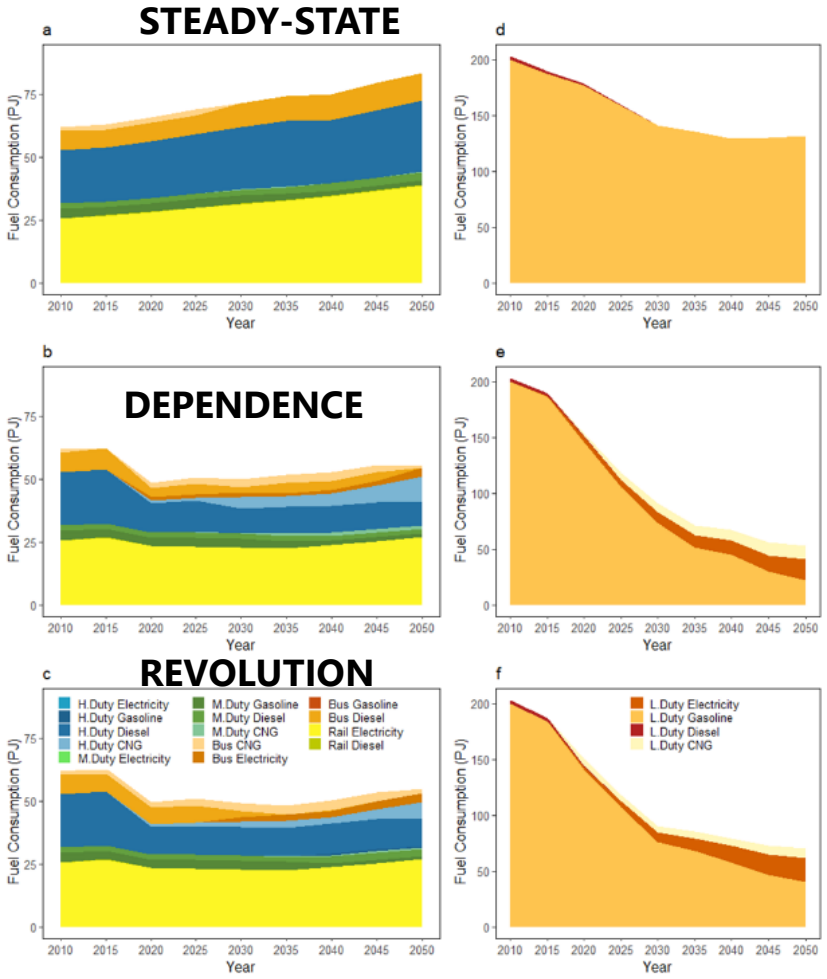
SCENARIOS	Description
STEADY STATE	Business as usual trends
DEPENDENCE	Slower decarb of the grid
REVOLUTION	Fast-paced decarb of the grid



Speed of the grid decarbonization

Speed of the end-use technology decarbonization

Characterized the two most important uncertainties possibly impacting how cities could attain climate goals

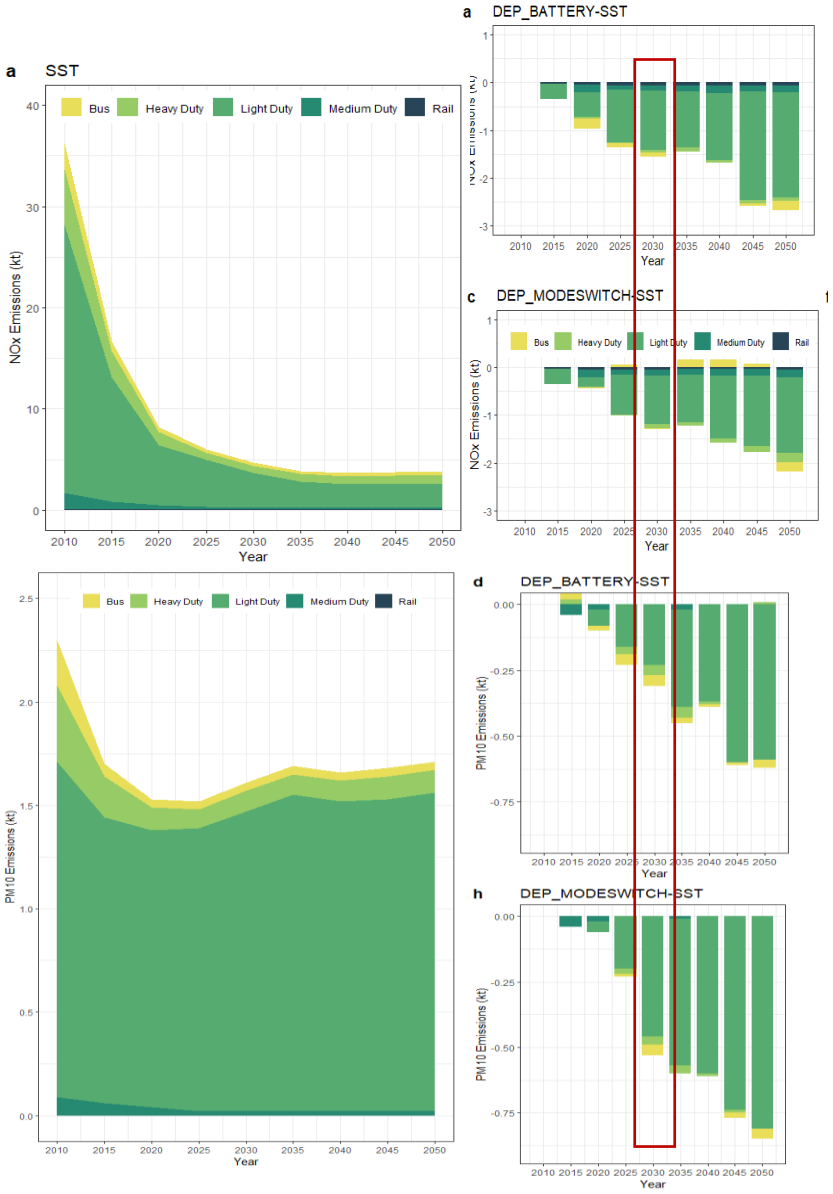


DEPENDENCE converts more heavy-duty short-haul trucks from diesel to CNG while electrifying some portion of the bus fleet earlier

DEPENDENCE results in higher investment in energy efficiency in light-duty fleet rather than boosting the electrification of the fleet

REVOLUTION postponed efficiency improvements in the near term and invested in BEVs more heavily in later years

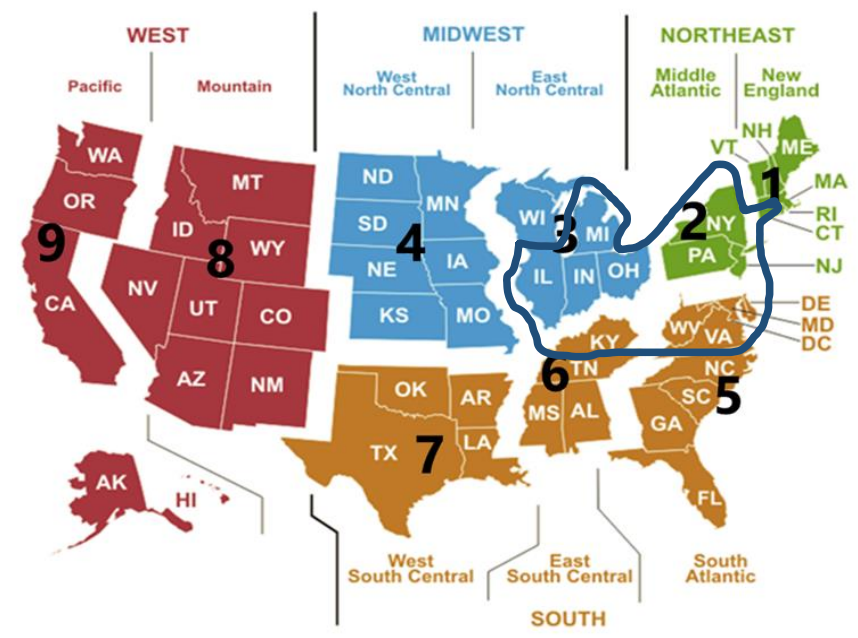
Observed deepest NOx reduction in a scenario with intensified LDV electrification



Isik, M., Dodder, R. & Kaplan, P.O. *Nature Energy* (2021). https://doi.org/10.1038/s41560-020-00740-2

Utility of COMET in issues such as NAAQS Attainment, Decarbonization and EJ Issues

- **Highlights**: The scenario with intense electrification of LDV fleet (i.e., all new LDV purchases to be 100% starting 2030) resulted in more NOx savings than the scenario where the passenger demand is reduced and replaced by public transit, walk and bike modes
- **Highlights:** However, in the decarbonization scenarios, we observed more PM benefits when the LDV demand is reduced and switched to public transit, walk and bike modes.
  - Given the transit modes were moving towards clean fuels and electrification.



Currently:

- Characterize detailed county- and transport mode-level issues (OAR)
- Analyze alternative local and regional pathways to attainment and maintenance of 2015 ozone NAAQS standards within the ozone transport region via electrification and decarbonization scenarios (OAR/OAP)

Potential future applications:

- Applications of COMET to bigger NJ/NY metropolitan area
- Neighborhood level analysis to quantify benefits of building retrofits and mitigate urban heat and characterize impacts of distributed energy resource utilization (CHP) (OAR/OAP)

Thank you

Bibliography

COMET - NYC

Example In-house Activities

- Development of city-level marginal abatement curves for criteria pollutant reductions within ozone transport region (OAQPS and OAP)
- Understanding air emission implications of NYC's GHG reduction goals in transportation and buildings sectors (OAP)
- Exploring extension and use of COMET for neighborhood economic development analysis (R2, CUNY)

Example Peer Reviewed Papers

- Isik, M., Dodder, R. & Kaplan, P.O. (2021) "Transportation emissions scenarios for New York City under different carbon intensities of electricity and electric vehicle adoption rates, " Nature Energy 6, 92–104. https://doi.org/10.1038/s41560-020-00740-2
- Isik, M. & Kaplan, P.O. (2020) "Understanding Technology, Fuel, Market and Policy Drivers for New York State's Power Sector Transformation," Sustainability, vol. 13(1), pages 1-23. https://doi.org/10.3390/su13010265
- Kaplan, P.O. and Isik, M. (2020) "City-based Optimization Model for Energy Technologies: COMET- New York City Documentation" EPA/600/R-19/124
- Kaplan, P.O. and Kaldunski, B. (2016) "An Integrated Approach to Water & Energy Infrastructure Decision Making Using the MARKAL Framework: A Case Study of New York City" in Proceedings of 2016 ACEEE Summer Study on Energy Efficiency in Buildings: From Components to Systems, From Buildings to Communities