Collaborative Approaches to Foster Energy-Efficient Logistics (EEL) in the Albany-New York City Corridor

Project ID: ti086

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Overview

Timeline

- Start: October 1st, 2017
- End: December 31st, 2020
- 40% complete

Barriers addressed

- Lack of tradition of cooperation among private, public and research efforts which limits innovation and prevents from addressing energy efficient goals
- Lack of comprehensive analytical models that can predict how changes in supply chain's behavior could impact energy consumption

Budget

- Total project funding: $4,000,343
  - DOE share: $1,999,999
  - Cost share: $2,000,344
- Total project expended: $1,801,253
  - DOE share: $604,055
  - Cost share: $1,197,198

Partners

- Leader: Rensselaer Polytechnic Institute (RPI)
- Partners:
  - Argonne National Lab (ANL)
  - George Mason University (GMU)

Project Objectives

General objectives

- To foster adoption of Energy Efficiency Logistics (EEL) initiatives
- To gain insight into best ways to induce shippers, carriers, and receivers to adopt energy efficient Technologies and Operations (Tech/Ops), and change demand patterns to reduce energy use
- To provide public sector decision-makers with the procedures and analytical tools they need to determine the best ways to reduce freight energy use in their jurisdictions

Objectives in Year 2

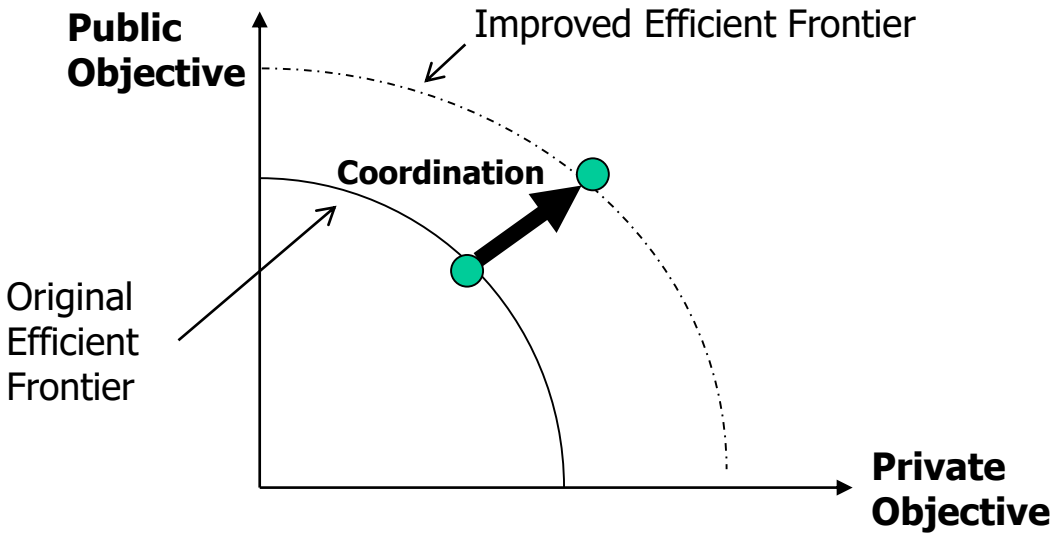
Progress in characterization of baseline conditions

Start to assess impacts of policy measures on adoption EEL initiatives

Continue to work in the development of algorithms and modeling tools

Project Objectives

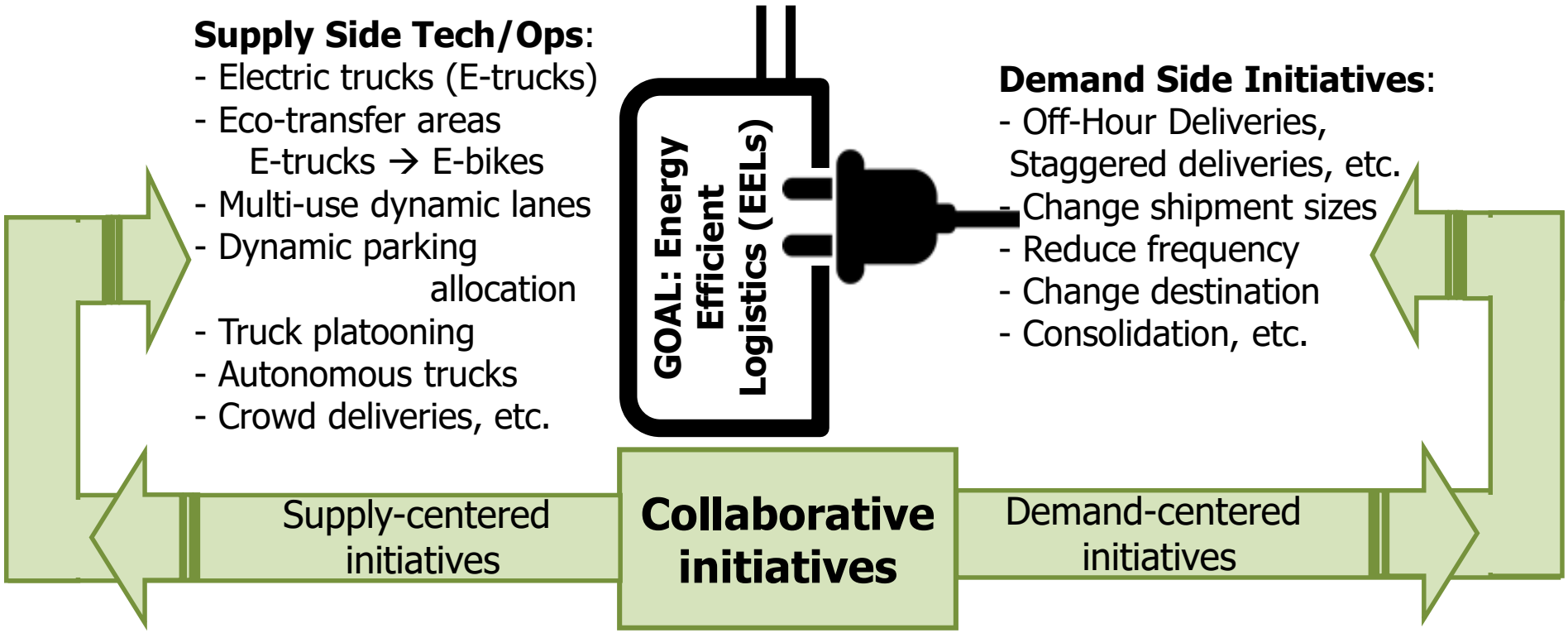
- Changes in behavior induce economic efficiency by tackling the coordination challenges that impede the system to achieve higher states of performance



- This supports the following VT Office Technology Integration goals:
  - **Economic Growth** by providing business opportunities related to the adoption of EEL initiatives
  - **Affordability for Business and Consumers** by means of reducing the costs of logistical operations through EEL initiatives

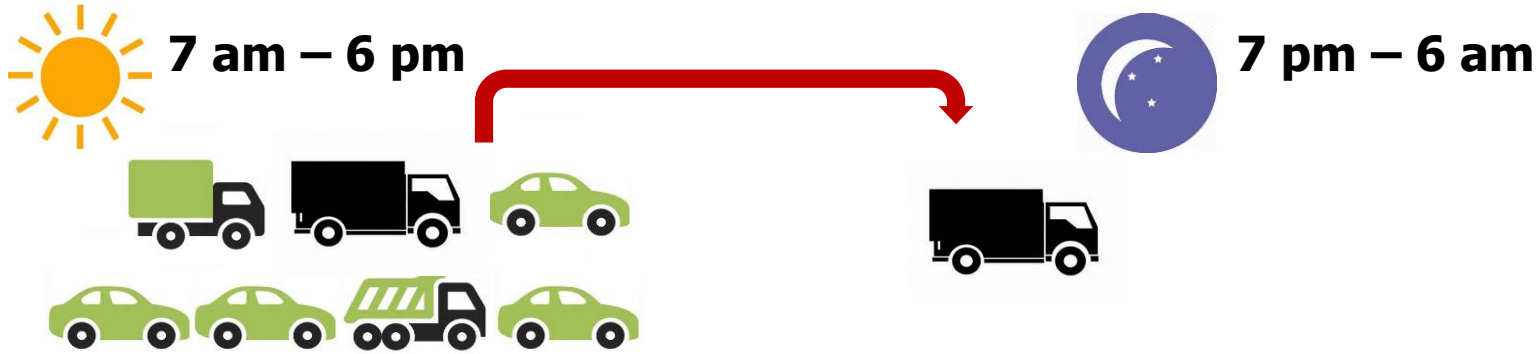
Project Approach: Overall Concept

- Identify **combination of strategies**, both supply and demand side, that complement and reinforce each other; and use them in combination to foster adoption of EELs



Project Approach: Example

- Off-hour deliveries (OHD) and electric vehicles



OHD allows carriers to use vehicles in double duty (day and night) making them more financially viable

OHD fosters use of electric vehicles

Electric vehicles facilitate implementation of OHD

Electric vehicles reduce energy consumption and minimize externalities (noise, pollution)

Project Approach: Tools Integration

- The **Behavioral Micro-Simulation (BMS)**: A state-of-the-art **freight demand simulator** developed at RPI and finalist of the prestigious Franz Edelman Award at INFORMS

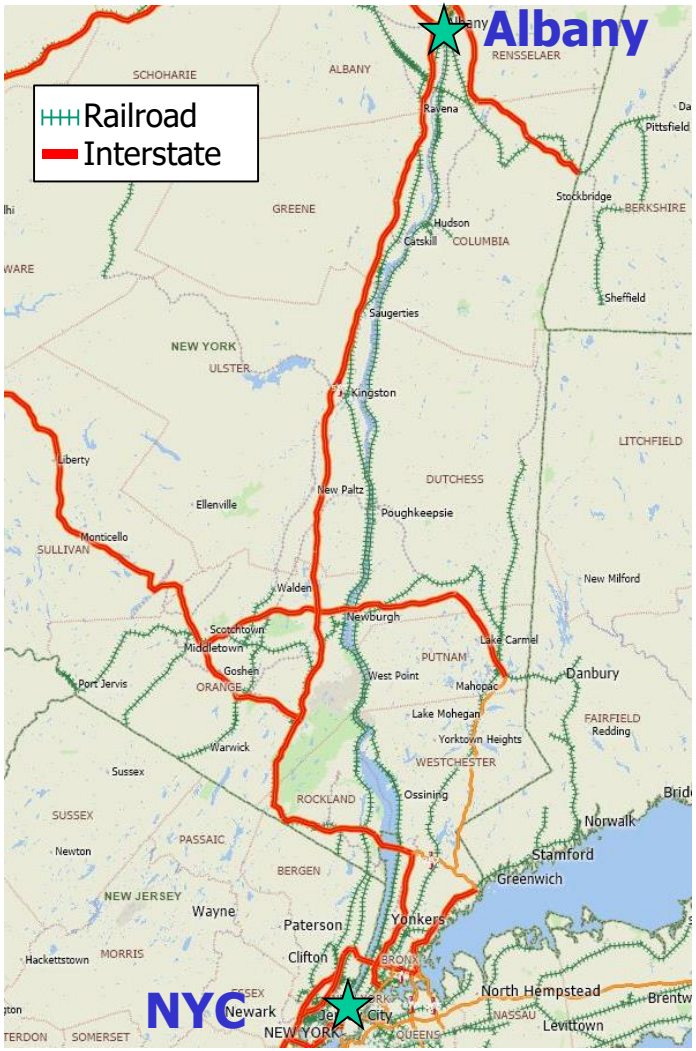
- **POLARIS** (developed by ANL): Agent-based **simulator** for modeling **large-scale transportation systems**, currently licensed to more than 175 organizations worldwide

- **SVTrip** (developed by ANL): A simulator that uses individual vehicle **speeds** and generates realistic **driving cycles**

- **AUTONOMIE** (developed by ANL): A system-integrated tool that estimates **energy consumption** and **emissions**, and performs economic analysis using vehicle characteristics and **driving cycles**

Project Approach: Tests on Living Lab

- **Living Lab: Albany-NYC corridor**
- The Albany-NYC corridor is a **unique corridor** with water transport, rail (passengers and freight), highways, toll facilities, anchored by the Port Authority of NY and NJ's complex and the Port of Albany
- The corridor will be used to assess baseline conditions, measure energy consumption, test energy efficient initiatives, and address challenges to be overcome to foster implementation in other corridors and urban areas

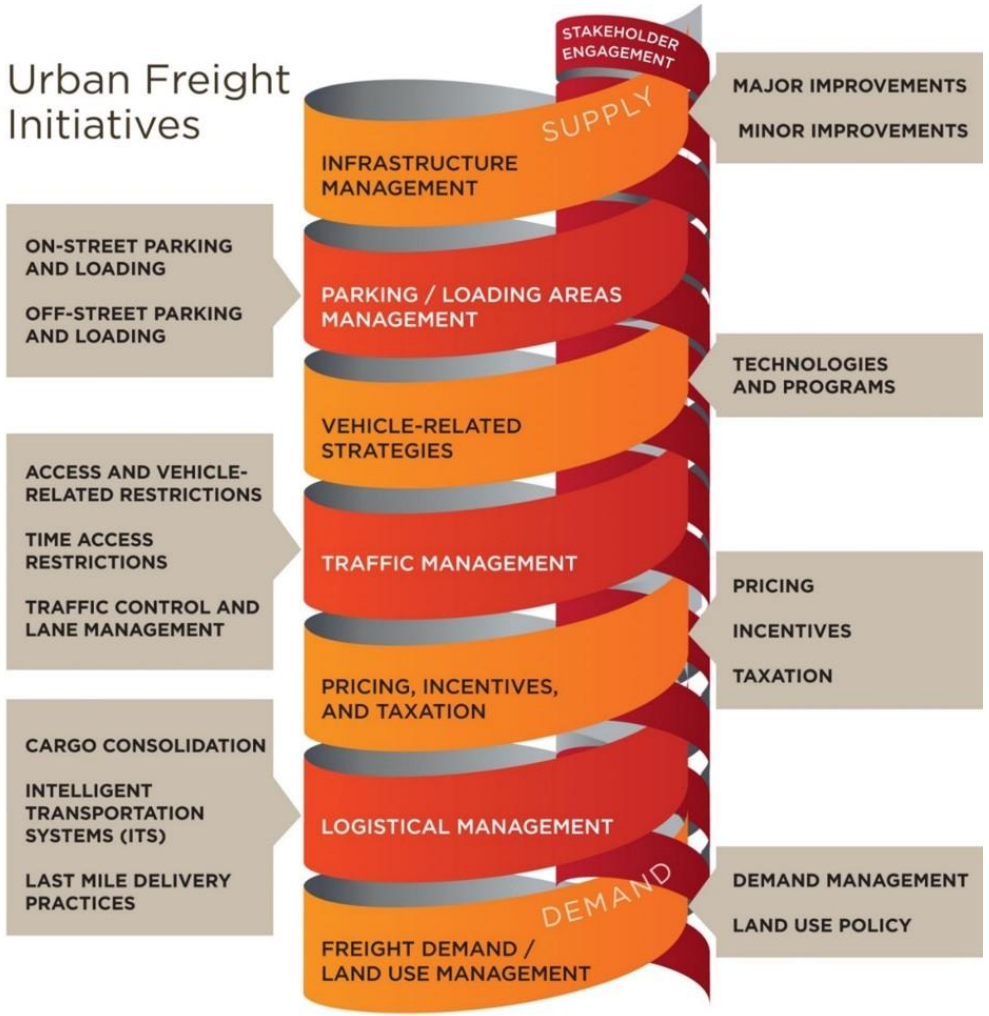


Milestones

Milestone	Type	Description
Budget Period 1		
Q1: List of EEL initiatives	SMART technical	A catalog of all potential initiatives
Q2: Summary of stakeholder input	SMART technical	Technical memorandum (TM) summarizing input
Q3: Draft conceptual design	SMART technical	TM documenting conceptual design
Q4: Draft tools	SMART technical	Draft prototypes for BMS, SVTrip, and transport-energy model
Go/No Go Decision	SMART technical	The project will be evaluated on the performance of tools and feasibility of initiatives based on stakeholder inputs
Budget Period 2		
Q1: Progress of Tasks	Progress measure	Tasks 2.1 to 2.4 should be started and 25% progress.
Q2: Completion of survey	SMART technical	TM summarizing the survey design and data analysis
Q3: Assessment results	SMART technical	TM summarizing assessments of measures and initiative
Q4: Finalized models and pilot test design	SMART technical	Final version of tools and models. Technical memorandum documenting selected initiatives and data collection plan
Go/No Go Decision	SMART technical	The project will be evaluated on assessment results of the initiative effectiveness and the completion of final tools.
Budget Period 3		
Q1: Progress of pilot test and Policy Guidebook	Progress measure	Pilot tests should be started and about 40% completed. Draft Policy Guidebook should be 50% completed
Q2: Progress of pilot test and Policy Guidebook	Progress measure	Pilot tests should be 100% completed. Draft Policy Guidebook should be 75% completed
Q3: Data collection	SMART technical	TM summarizing the pilot tests and the data collected
Q4: Final deliverables	SMART technical	Final Policy Guidebook and final report.

Accomplishments: Catalog of Urban Freight Initiatives

- A comprehensive revision of **demand/ supply initiatives** that can reduce energy use
- Development of a **typology** to qualitatively **evaluate the benefits and costs** of the initiatives
- Establishment of an **advisory group** to gather feedback on feasibility and potential of corridor and urban initiatives
- Identification of potencial sources of **energy efficiency**



52 different initiatives were characterized

Progress: Behavioral Micro-Simulation (BMS)

- The **BMS** developed at RPI that uses as an input: policies, network, behavior models

Define range of incentives to be studied

Synthetic generation of delivery tours

Apply the receiver behavioral model

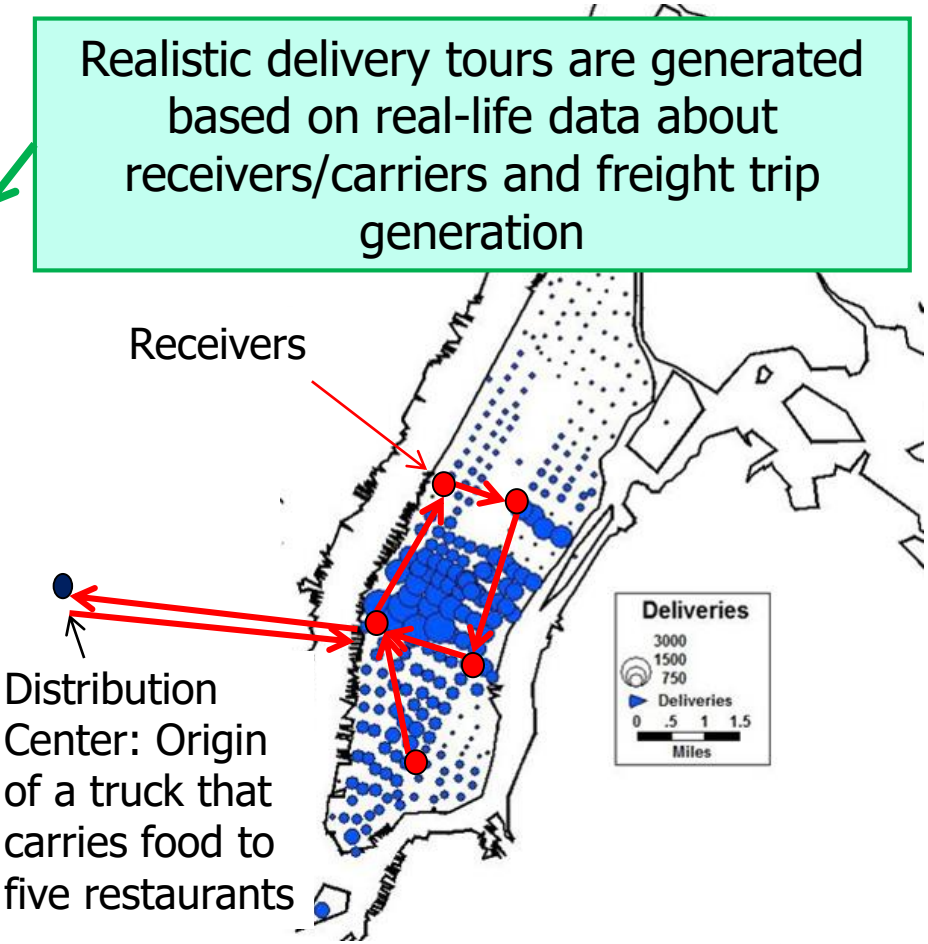
Carrier behavioral simulation: Compute costs for base case and OHD

Repeat for another delivery tour

Change incentives to improve

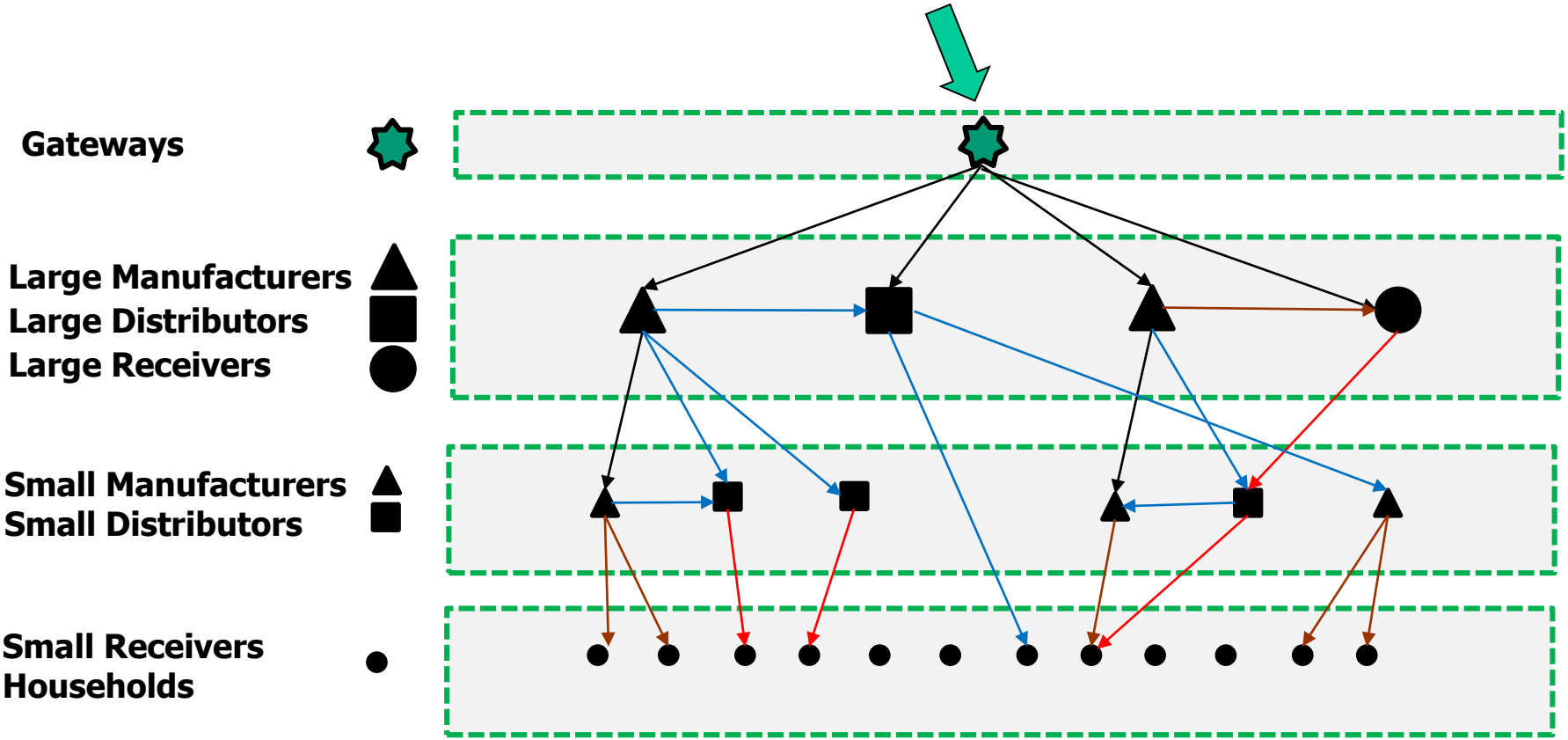
Stop if "optimal"

Realistic delivery tours are generated based on real-life data about receivers/carriers and freight trip generation



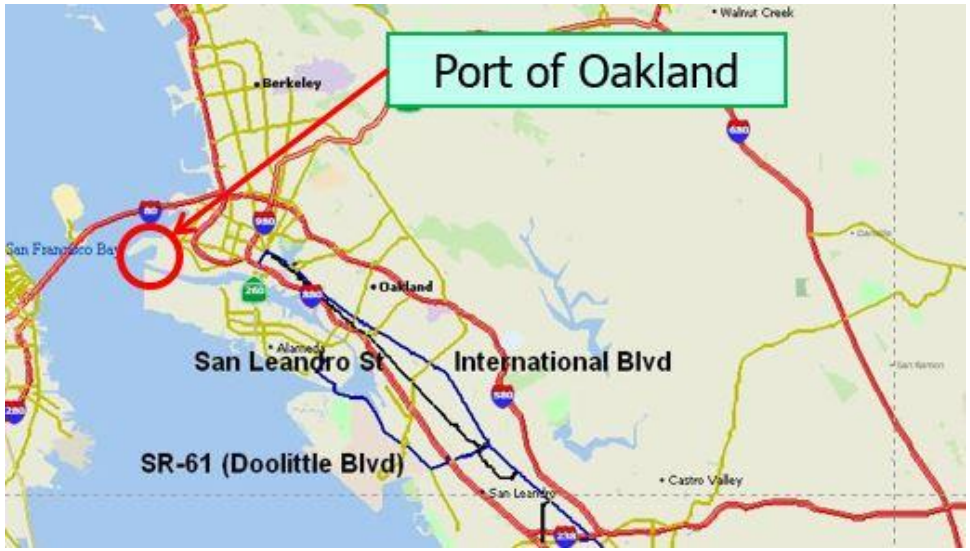
Progress: Behavioral Micro-Simulation (BMS-EEL)

- The BMS-EEL considers the various stages of the supply chains at the level of detail required to analyze effectiveness of EEL initiatives
- The BMS considers the input/output flows between industry sectors

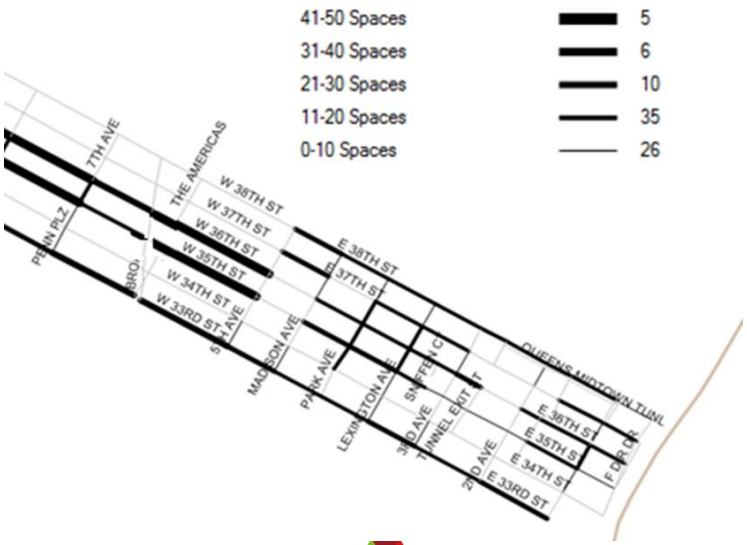


Progress: Other Micro-Simulation Models

- **Port simulation**: the team is adapting a micro-simulation model to study the effects of port extended hours (staggered hours) on fuel consumption on the surrounding transportation networks, using the Port of Oakland as a case study



- **Parking simulation**: the objective of this simulation is to model small scale traffic dynamics

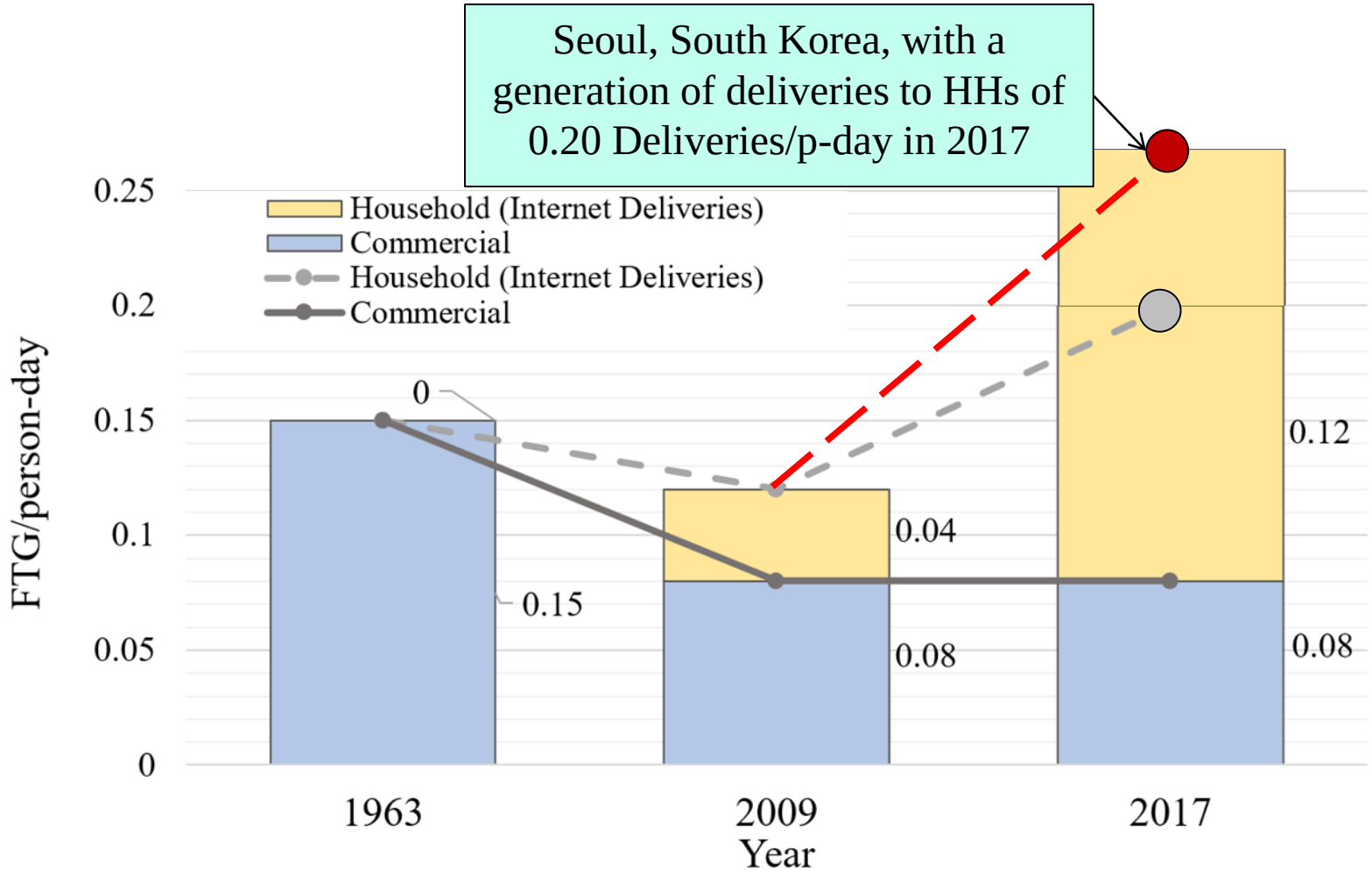


Progress: Behavioral Modeling

- **Objective**: To gain insight into the most promising supply chain behavior changes, in terms of potential for energy use reductions, and the best ways to foster them in real-life settings
- **In-Depth Interviews**: The team is arranging IDIs with large traffic generators in NYC to:
  - Gain insight into their operations and logistic activities
  - Identify challenges and opportunities for consolidation, and staggered deliveries
- **CATI Surveys for Receivers and Carriers**:
  - **Receivers**: To assess willingness to change behavior and their responses to various policies to foster:
    - Cargo consolidation, Staggered deliveries, etc.
  - **Carriers**: To assess willingness to change behavior and their responses to various policies to foster:
    - Mode changes → To water modes (NYCDOT/PANYNJ), Truck-freight-bike combinations, etc.

Progress: Household Internet Survey

- This survey will characterize citizen's shopping habits and gain insight into the effects of demand management policies
  - Status: Undergoing final review, almost ready to go



Collaboration and Coordination Among Project Team

- The **RPI** team, as a globally influential freight research group, leverages its experience in **behavior and freight modeling** and working relations with public and private sectors to design effective energy efficiency strategies

- **ANL** has extensive experience in vehicle energy management including dynamic programming, rule based control (from vehicle dynamometer test data), instantaneous optimization as well as predictive control

- **GMU** team brings its expertise in applying **machine learning** and **statistical modeling** techniques to data collected from vehicles to calibrate the models

Collaboration and Coordination Among Project Team

- The **RPI team**, due to its long track record of collaboration with the public and private sectors, has been able to set up an **advisory group** consisting of members of the following organizations:

- Capital District Transportation Committee
- The Port Authority of New York and New Jersey
- The New York State Marine Highway Transportation Co.
- New York State Canal Corporation
- The Port of Albany
- The New York Energy Research and Development Authority
- The New York Metropolitan Transportation Council
- The New York State Department of Transportation
- Trucking Association of New York
- The New York State Thruway Authority
- Golub Corporation-Price Chopper
- Walmart
- GE Global Research

Overall Impact

- **Achievements during the last year**:
  - Produced a catalog of urban freight initiatives that aim to foster energy efficiency in logistics context
  - Secured the participation of prominent members of the private sector such as UPS, Anheuser Busch or Price Chopper for data to be collected
  - Significant progress in the development of algorithms and modeling tools

- **Upcoming**:
  - Active involvement of stakeholders in the GPS data collection plan
  - Justification of which initiatives should be pilot-tested based on simulation results from cutting edge simulators
  - Pilot-testing of the most beneficial initiatives

"Any proposed future work is subject to change based on funding levels"

Summary

Goal

- Foster collaboration with private/public/academia to achieve more energy efficient freight logistics

Approach

- Identify initiatives that create synergies between Tech/Ops and freight demand management
- Integrate the state-of-the-art freight and energy assessment models to test combination of energy efficient initiatives and pilot test them in the Albany-NYC corridor

Collaborators

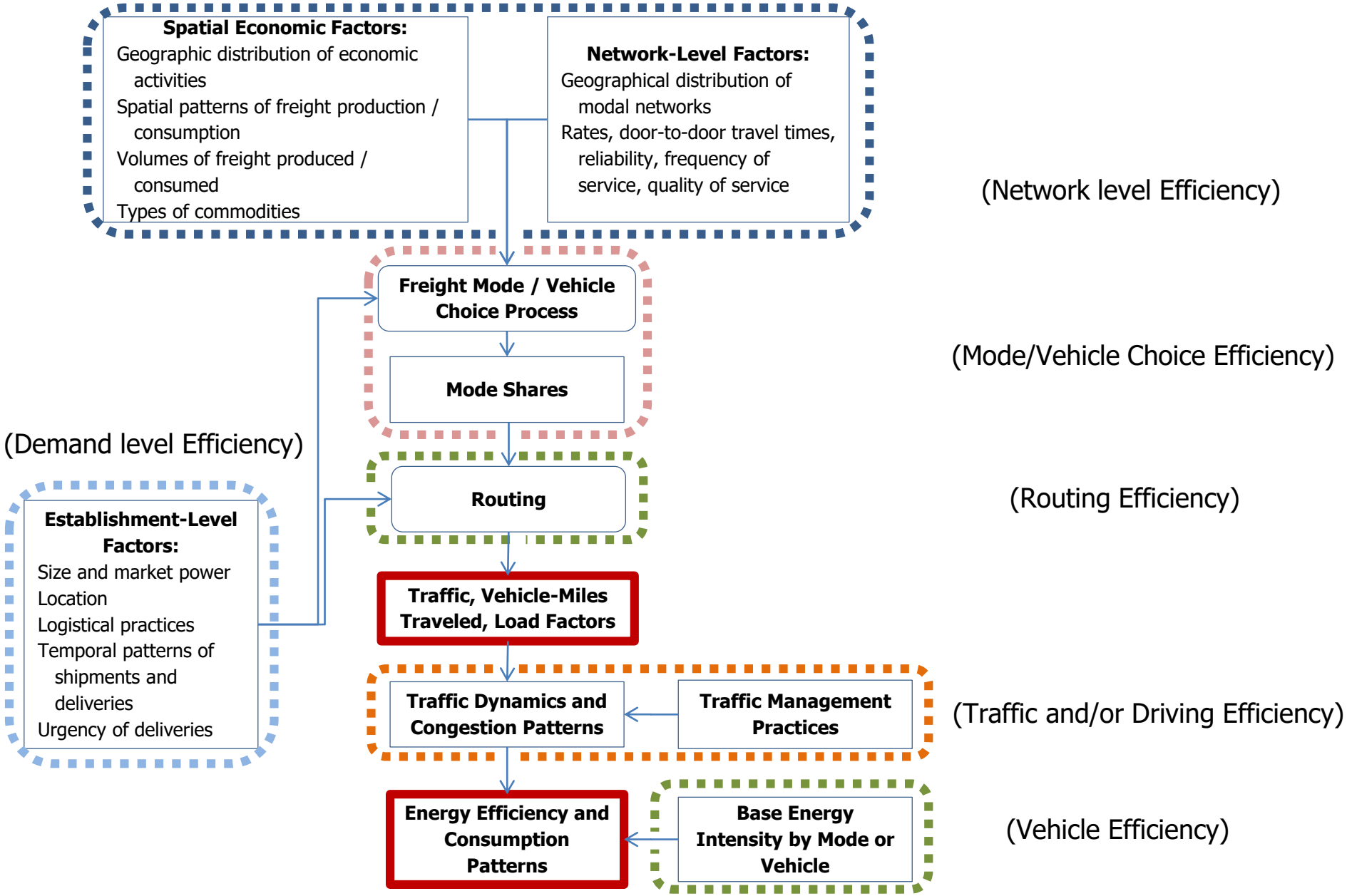
- Partners: RPI (lead), Argonne National Lab, George Mason University
- Advisory Group comprised of public and private sectors members

Achievements

- Produced a catalog of urban freight initiatives that aim to foster energy efficiency in logistics context
- Significant progress in the development of algorithms and modeling tools
- Secured the participation of prominent members of the private sector such as UPS, Anheuser Busch or Price Chopper

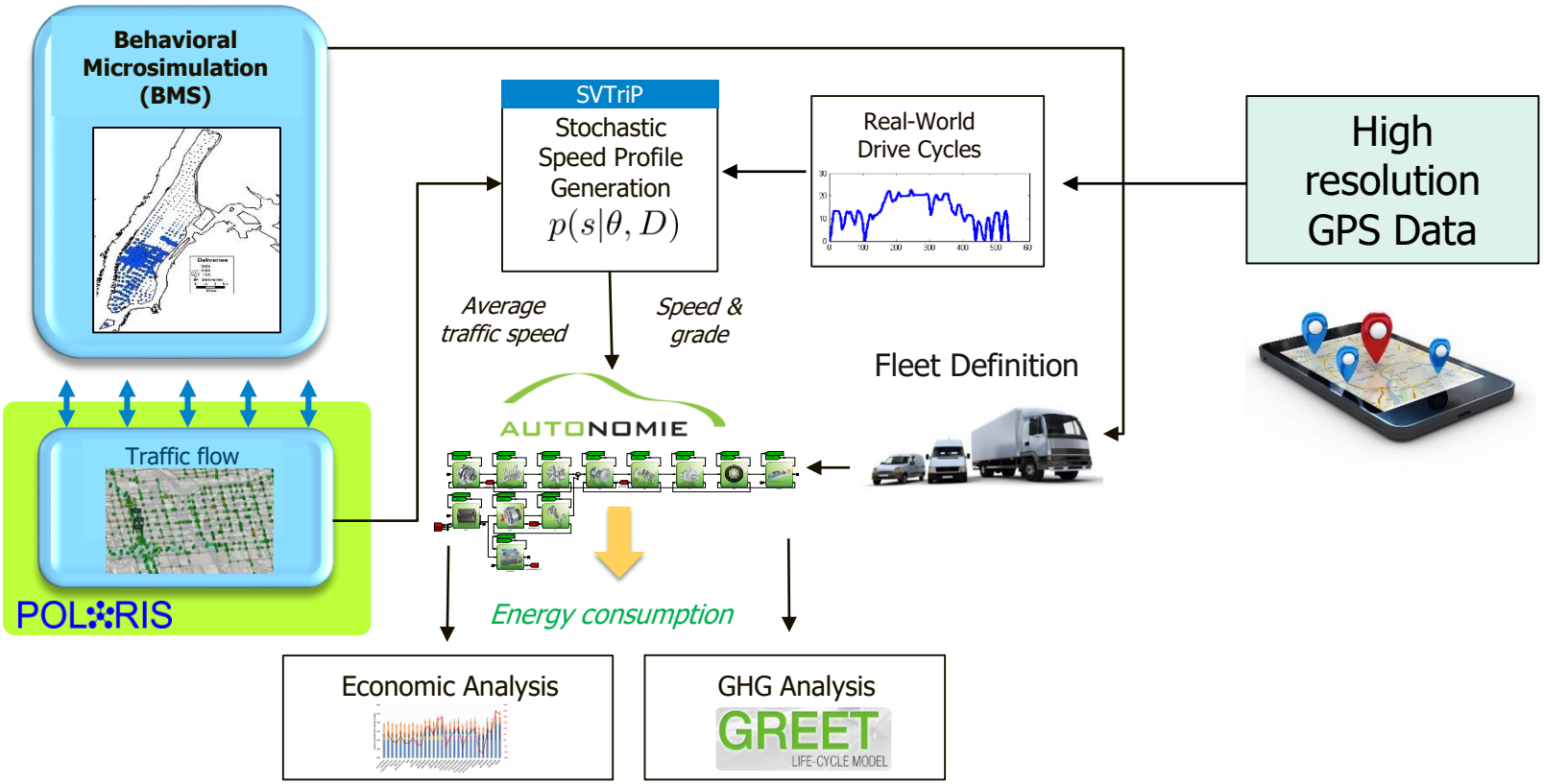
Technical Back-Up Slides

Catalog: Sources of Energy Efficiency



Development of Draft of Tools

- Currently drafting the integration of tools and gathering **high resolution GPS** data for model **calibration**



Tools Integration

- A realistic and comprehensive freight mobility and energy analysis requires proper modeling of the complex interaction of freight activity, routing, energy saving decisions, and traffic:
  - **Demand** decisions of shippers and receivers
  - **Routing** decisions made by the carriers
  - Traffic **performance** characteristics, e.g., accelerations/decelerations
  - **Energy** analysis of freight vehicles