Holistic and Energy-Efficient Rural County Mobility Platform (RAMP)

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June 23, 2021

Project ID:ti113

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Carnegie Mellon University
Civil & Environmental Engineering

Overview

Overall goal:

- Develop, demonstrate and refine affordable, accessible, sustainable, and replicable mobility services in Greene County, PA

Timeline:

- Start: Jan 1, 2021 (COVID-19 delay)
- End: Dec 31, 2023
- 5% complete (COVID-19 delay)

Budget:

- Total: $2,037,781
- DOE share: $999,996
- Cost share: $1,037,785
- Budget Period 1: $701,815
- Expended as of May 2021: $164,316

Partners:

- **Lead**: Carnegie Mellon University (CMU)
- National Renewable Energy Laboratory (NREL)
- 412 Food Rescue
- Waynesburg University (WU)
- Pittsburgh Region Clean Cities (PRCC)
- Greene County Transportation Program (GCTP)

Barriers addressed:

- Mobility services to rural areas are insufficient, inefficient, unaffordable and inaccessible, with highly limited resources
- Lack of public transit or broadband services in Greene County. Most rural trips are made by solo-driving with private vehicles of low fuel economy
- GCTP provides ~40k trips a year, and 26% were associated with seniors. An average trip costs over 60 min and $26.
- Food, healthcare, work and community services are inaccessible.

Project Objectives

Objectives

- Understand the mobility need of rural population: when, where, how, and current issues related to four types of trips: work, food, health care and community-based services
- Develop a replicable Rural County Mobility Platform (RAMP) consisting of both an online platform and phone-based system: hybrid of a volunteer-based ridesharing system and a fixed/flex-route shuttle service. Understand the life cycle cost, energy consumption and benefit (alternative fuel solutions)
- Develop the algorithms and prototype system for the hybrid system, and pilot the program for three months in Greene County. (BP 3)

VTO TI goals

- Economic growth: the ability to support rural population and business
- Affordability for business and consumers: the ability to travel among rural, suburban and urban inexpensively
- Reliability/resiliency: accessibility, day-to-day travel reliability, system resiliency to infrastructure/energy disruptions

Impacts

- Establish a replicable and flexible RAMP system for U.S. regions
- High-resolution data, survey and network models that design RAMP in strategic, tactical and operational levels.
- Models to a better understanding of cost and benefits of RAMP for policies and operations
- Provide reliable and affordable mobility services to disadvantage or vulnerable population/business

Project Approach 1

- Budget Period 1:**Data collection and RAMP setup**
  - Task 1.1 - Collect data from local residents using surveys
  - Task 1.2 - Collect and process data from the current Transportation Program offered by Greene County
  - Task 1.3 - Collect data from current Shuttle Service offered by WU
  - Task 1.4 - Establish a volunteer program
  - Task 1.5 - Create a check-in system for volunteers
  - Task 1.6 - Mapping of Greene County and analytics of main points of interest
  - Task 1.7 - Data collection for network modeling
  - Task 1.8 - Creating a dynamic network simulation model
  - Task 1.9 - Validating time-dependent trips using the network simulation model
  - Task 1.10 - Develop a tool to simulate shuttle service in the regional network
  - **Models, algorithms and regional case studies will be all open sourced and shared online**

Project Approach 2

- Overall contributions
  - High-resolution data, survey and network models to model RAMP
  - Flex-route service + Volunteer mobility services
  - Leverage Waynesburg University's central role: shuttle services, volunteer program and travel demand
  - Design RAMP in strategic, tactical and operational levels
  - Design RAMP resilient to demand/supply disruption
  - Life cycle cost analysis of natural gas-powered shuttles
  - Pilot RAMP

Milestones

Budget Period 1:

Milestone	Type	Description
Database Designed and Implemented (5% completed)	Technical	Generalized database that consistently encapsulates all types of system-level data relevant to network mobility and energy efficiency designed and implemented. System-level data processed and stored.
Simulation Model Developed (33% completed)	Technical	Dynamic network simulation model that encapsulates propagations of vehicular trips in the roadway network and their associated energy use in high spatio-temporal resolutions developed and implemented.
Simulation Model Validated	Technical	Model using trip travel times from previous operations data is validated to ensure the model and survey data are consistent.
Tool Developed	Go/No-Go	Analytical tool developed to simulate shuttle operations in Greene County given arbitrary ride requests and estimate system operation costs and service quality.

Project Accomplishments: Designed surveys

- General public – Greene County residents
- Waynesburg Univ affiliates – faculty, staff, students
- Trip characteristics, barriers and socio-demographic
- IRB approved
- Conducted two focus groups and tested the surveys
- To be conducted in fall 2021, targeting 1,000+ responses

Project progress: establish a volunteer program

- Volunteer Recruitment & Retainment
  - Volunteer Recruitment Strategy
  - Volunteer Encouragement Strategy
  - Volunteer Retainment and Engagement
  - Volunteer Recruitment Hotspots
- Operational Guidelines
  - Liability
  - Insurance, volunteer vetting and training
  - Ride Scheduling
  - Key Performance Indicators
- Marketing analysis, interviews, focus groups

Project progress: data collection and analytics

- Greene County Transportation Program
- Waynesburg Univ shuttles
- Greene County GIS of roads and POIs
- Volunteer recruitment strategies

Project progress: simulation models

- Regional GIS model
- GCTP shuttle vehicles provide door-to-door services
- Background traffic (INRIX speed data)
- Emission and energy consumption models (MOVES lite)

Collaboration and Coordination

- Biweekly meetings
- BOX fileshare
- Monthly meetings with stakeholders
- Quarterly progress reports
- Other relevant projects leveraging the data/models developed through this DOE project

Sponsor: DOE VTO

Lead: Carnegie Mellon University (CMU)
- National Renewable Energy Laboratory (NREL)

CMU (one postdoctoral researcher and one phd student):
Sean Qian: lead PI, surveys, network modeling, mobility service, data analytics, machine learning, vehicle routing, demand matching
Costa Samaras: energy policies, mobility accessibility
Karen Lightman: outreach, communication, project management
NREL: Josh Sperling, Andy Duvall and Stan Young: MEP implementation, outreach, replicability study
412 Food Rescue: volunteer program
Waynesburg University (WU): surveys, data analytics, mobility program

Partners:
- Southwestern Pennsylvania Commission (SPC)
- Pittsburgh Region Clean Cities (PRCC)
- Greene County

Overall Impact

- Achievement to date
  - Outreach to local residents and WU
  - Outreach to all southwestern PA counties
- Upcoming
  - Design RAMP in strategic, tactical and operational levels for Greene
  - Models to a better understanding of cost and benefits of RAMP for policies and operations under various demand scenarios
  - Quantify potential benefits and savings to disadvantage or vulnerable population/business

Summary

- **Objectives**: develop and demonstrate affordable, accessible, sustainable, and replicable mobility service in rural Greene County, PA supported by dataset collection, analysis, sharing, and public dissemination of results.

- **Innovation claims**:
  - Use surveys, system-level traffic data, ridership data from existing services
  - A hybrid service of shuttles and volunteer services
  - Leveraging existing services and WU's central role
  - Address rural needs: essential trips
  - Cost and benefits of RAMP for policies and operations under various demand scenarios
- Develop and pilot RAMP
  - Models, simulations, strategic design, operational design, pilot tests

Thank you!

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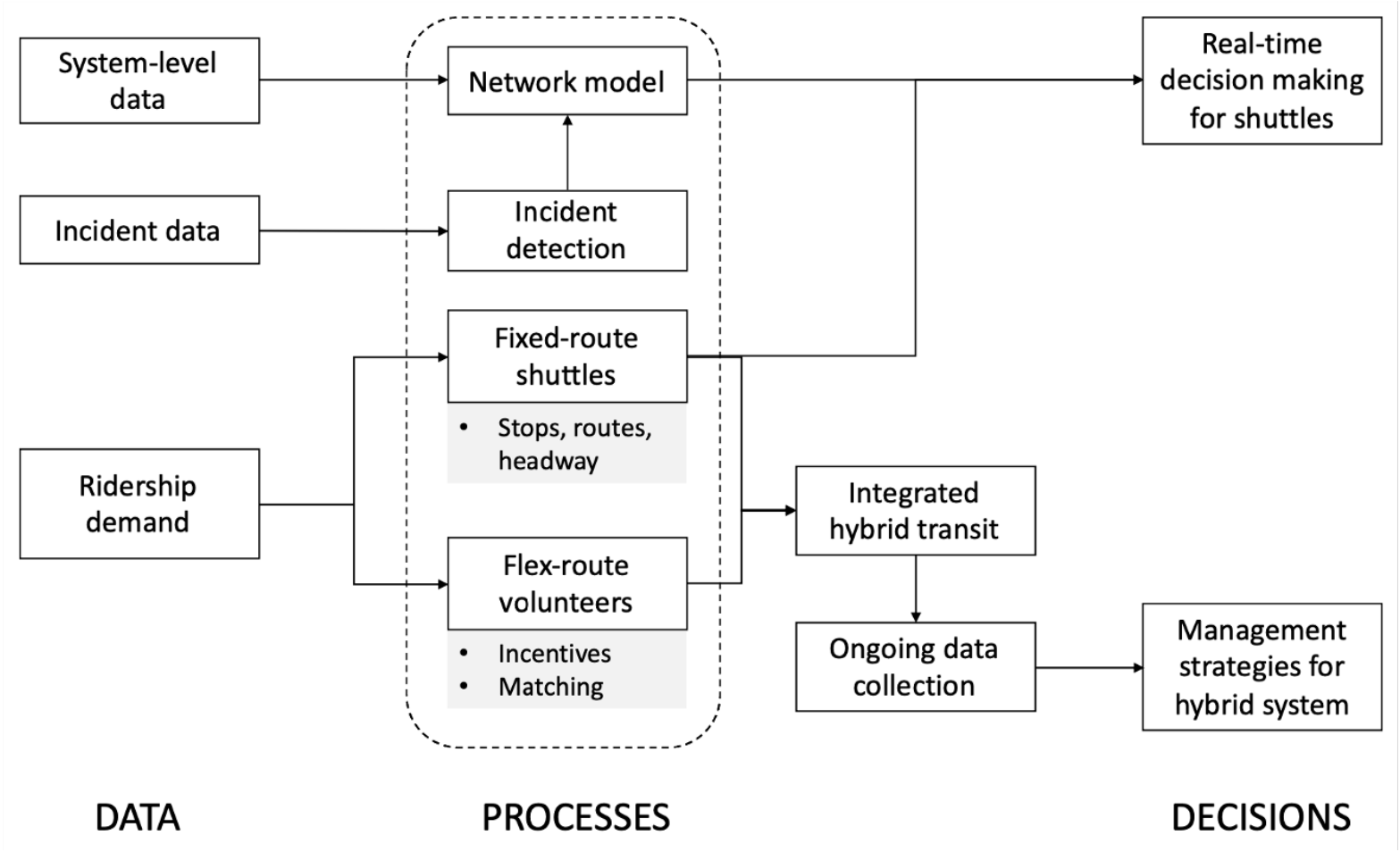
TECHNICAL BACK-UP SLIDES

Conceptual work flow for RAMP



Conceptual work flow for RAMP