1. Describe the problem to be addressed:

Recently Utah received a $4 million grant to increase Electric Vehicle [EV] charging infrastructure in the state. Overall $ 2.4 billion have been allocated for the ‘EV project’ in US to further the electric vehicle drive. But there is significant lack of electric vehicles on street to take advantage of this huge infrastructure. That is because there is a total of 330,000 electric vehicle stock in US, 2015 [Global EV Outlook, 2015], which represent 1.3% of total passenger cars in 2015 and only 0.67% of market share.

Additionally there is the issue of vehicular induced urban air pollution. Salt Lake City with its unique topography faces trouble of cold air trapping the pollutants and exacerbating the issue, viz. temperature inversion and aggravated pollution. The Department of Air Quality, estimated the Utah emission inventory that suggests 57% of air pollution in Utah is from cars.

In this scenario, alternative fueled vehicles like electric vehicle can be the panacea and go long way towards urban air pollution amelioration. But there are various issues influencing EV adoption in any city; range anxiety, consumer education and confidence building, government initiatives of research and development, provision of incentives and standardized charging. National and local policies thus focus on one or more of these but so far, the focus has been piecemeal. It is relevant to look into which of these makes the urban system more robust and hence more able to implement electric vehicles in response to urban air pollution. Consequently, to be able to function to its full potential of improving urban air pollution, it is critical to delve into a nuanced analysis of all these factors leading to mainstreaming of EV.

2. Explain why this research is important:

Vehicular emission is one of the major pollution source in urban areas. Thus, implementation of electric vehicles as a viable green transportation can increase urban resiliency towards bad air quality. Mainstreaming EV will be vital for decoupling GHG [green house gas] emissions from economic growth, insuring better air quality and improved health.

Various studies worldwide have used System Dynamic Modelling to simulate scenarios for EV diffusion. This kind of modelling is important for policy analysis and complex systems where the whole system is required to be modelled rather than part of it while assessing its behavior to changes. A recent study Sylvia, 2016 used agent based modelling to predict consumer behavior towards EV adoption. But this project will try to take into consideration the whole gamut all key sectors of EV environment viz. consumers, suppliers, government and environment to create a multi-loop, multi-scale, non-linear feedback system.

It is important to develop a framework that holistically address all the stakeholders, and the demand and supply side of EV production. Building a dynamic system model of how the different players in an EV environment works will give insight into the process that impact EV adoption and result in faster acceptance of EV. It will help to identify the most important nodes and fluxes that is either hindering or facilitating the process. This will assist to comprehend consumer behavior, their reservations towards EV adoption, or insight into the supplier side
of infrastructure provision. Once the role of all the stakeholders are identified, it will be easy to localize the result and develop measures that will warrant a better EV adoption for Salt Lake City.


3. List the research objective(s):
   - Enhanced understanding into slow growth of EV adoption.
     1. Dynamic interplay of each sector viz. consumer, supplier, government etc.
     2. Identify which of these sectors are most relevant for Salt Lake City
     3. Assess political, economic, and geographic stimulus on these sectors
   - Understand barrier in successful policy implementation and establish a holistic EV adoption framework.

4. List the major tasks:
   - Compile relevant information from literature search, policy review and review of local and global best practices.
   - Primary data search through interaction with industry partners, current and potential EV users, state policy makers, and EV infrastructure providers in Salt Lake City.
   - Conceptualize, document, simulate, analyze and optimize models of system dynamic using causal loop diagram.
   - Building and parameterizing of each indicator into the overall model.
   - Testing a model for successful EV adoption through dynamic system modelling in STELLA.
   - Final framework development that will help the state agencies and industry partners to mainstream EV.
   - Draw conclusion from the analysis and write up methodology and results in a report for UDOT and peer-reviewed article.

5. List the expected results:
   - A model to identify the different degrees of impact of various stakeholders and isolate the most important local influences for success for EV or generalized framework.
   - Identification of local barriers towards EV adoption
   - Suggested local pathways around barriers or a roadmap for EV adoption.
   - A holistic framework that can be adopted to mainstream EV

6. Describe how the research results will be implemented:

   The result of this study will be useful to state agencies and industry partners for electric vehicles. With the enormous population increase the need for the city to function properly demands better mobility. However, with increased mobility there is always the risk of heightened air pollution, so electric vehicles
give a way to bypass that. Hence, this project is timely trying to fathom the reasons for slow growth of electric vehicles. This project will help identify the barriers and help target resources towards effective action and polices. This will also facilitate collaboration between sectors. The adoption of alternative fueled vehicle will also help in addressing the state commitment towards cleaner energy source. The framework developed in this project will aid in implementing better electric vehicle policies. The meta-analysis of the policies and modelling will increase the knowledge base regarding various stakeholders’ role in the whole process. Thus will help state agencies take an informed decision regarding where to focus be it provision of better infrastructure or supplier incentives or consumer education through outreach programs.

7. Requested from UDOT: $27000 Other/Matching Funds: $7270 Total Cost: $34270
(or UTA for Public Transportation)

8. Outline the proposed schedule, including start and major event dates:
   Project Start Date: August 1, 2017
   Data Collection: August-October, 2017
   Model Building: November 2017-February, 2018
   Data Analysis: March-May 2018
   Report Writing and Journal Manuscript: May-July, 2018
   Project End Date: 31st July, 2018