SMART CITIES
Smart City development integrates multiple information and communication technology (ICT) and Internet of Things (IoT) solutions to manage a city’s assets, optimize urban flows, improve the delivery of services and provide real time response to challenges.

**SMART GRID**
Intelligent electrical energy dispatching and storage links renewable energy production, such as solar and wind, to urban transportation services.

**REFUELING INFRASTRUCTURE**
Integrated infrastructure systems for hydrogen vehicle fueling and electric vehicle charging links chemical fuels with electricity infrastructure and creates new business models for optimizing fuel production, efficiency, energy storage and grid stability.

**SENSORS, COMMUNICATIONS AND NETWORKING SYSTEMS**
Link people, vehicles, fueling infrastructure and the electric grid to deliver robust safety systems, automated vehicle navigation and optimized energy utilization for urban transportation networks.

**HUMAN FACTORS**
Standardized human interfaces with automated vehicles, connected infrastructure and smart-grid technologies links people with regional and global transportation networks.

**TRANSPORT NETWORK MODELLING AND VISUALIZATION**
Evolution of the energy-transportation nexus will transform how cars and other transport modes interact with the built environment. New predictive tools assess performance, ownership models and impacts of interconnected transportation networks in order to develop resilient and sustainability smart city infrastructure solutions.

**TECHNOLOGY, POLICY AND INNOVATION DEPLOYMENT**
Intelligent Decision Systems visualize, communicate and translate real-time data from the integrated transportation network to capture infrastructure utilization and performance, which informs smart city design, practices, protocols, policies, regulations and alternative infrastructure investment strategies through predictive modeling.
CLEAN, CONNECTED, SAFE TRANSPORTATION SYSTEMS

More than half the world’s population now lives in urban centers. Infrastructure networks are vital for modern economic activity but are also major sources of energy and resource consumption, emissions, and environmental pollution. The combined effects of ageing infrastructure, growing demand from social and economic pressures, and physical interdependency increases risk, vulnerability and failure, driving the need for more efficient, intelligent and interconnected infrastructure to improve the sustainability and resilience of urban environments.

The convergence of renewable energy production, energy storage technologies, smart grid solutions, sensors, wireless networking, predictive modeling and intelligent decision systems will:

- **CLEAN** — Enable the introduction of renewable energy for the delivery of transportation services, and offsetting traditional fossil fuel energy sources.

- **CONNECTED** — Connect people, vehicles and transportation infrastructure to enable new pathways for delivering optimized urban transport and new business models for integrating chemical fuels, energy grids and transportation infrastructure.

- **SAFE** — Deliver new platforms for autonomous transport, connectivity and human interface that reshapes urban transportation, improves safety outcomes and enhances quality of life.
CHALLENGES AND OPPORTUNITIES

Multiple challenges must be addressed to capture the significant opportunities for Canadian leadership in a global market.

There is a momentum to address the reduction of GHG emissions as it will support the growth of clean tech sector, improve access to global markets, and lead the province to a green future. In order to meet these goals, new technology, new highly trained personnel, and new jobs are required.

• New modes and models for decarbonized road, rail and ship transportation and transportation infrastructure must be developed. In particular, new technology pathways that can deliver renewable energy and low-carbon fuels to the transportation sector are required.

• New technologies and platforms for connecting vehicles and transportation infrastructure with people, businesses, information technology and electricity grids must be developed in order to increase efficiency, reduce GHG emissions and improve safety.

• New policy and design innovations for integrating and connecting transportation and transportation infrastructure into the “Smart City” must be created in partnership with municipal and provincial governments, communities, public and industry. Evidence-based decision making tools will inform strategic infrastructure investment strategies. Computational decision-support tools and advanced simulation modelling can help inform investment decisions, decrease financial risk and help plan and manage future infrastructure networks.

Connected technologies and infrastructure are critical to ensure the clean and safe deployment of new transportation solutions and Intelligent Decision Systems will become indispensable as the scale, complexity and cost of connected services and infrastructure increases.
During the 1998 Ice Storm, large segments of rural and urban communities were in the dark and without heat. Traffic and street lights were out. Banking and government services were interrupted. The disruption in one sector - electricity - affected many others. Such inter-dependence will become more critical as transportation services become autonomous and interconnected. The potential for Intelligent Transportation Systems (ITS) to improve road safety, reduce traffic congestion and enhance the efficiency of commercial vehicle operations has long been recognized. Issues associated with scalability, performance and cost have, until now, hampered large-scale deployment of ITS technology.

Connected Vehicles present a diverse IOT ecosystem with diverse application requirements. The ITS Architecture for Canada was developed by Transport Canada as a common framework for planning, defining, and integrating intelligent transportation systems that describes interaction among physical components of the transportation systems including travelers, vehicles, roadside devices, and control centres.

The Resilient and Intelligent Infrastructure Project investigates approaches for integrating IOT-based systems into the ITS Architecture for Canada, using the AURORA Connected Vehicle Technology Testbed at the University of British Columbia, and in collaboration with connected vehicle test bed operators at the University of Alberta, National University of Singapore, Beihang University in Beijing and members of the US DOT Affiliated Test Bed program.

The insights, methods and techniques developed under this project will reshape perceptions concerning configuration and management of IOT networks used in ITS and bring Canada significantly closer to realizing the triple goals of improved road safety, reduced traffic congestion and more efficient commercial vehicle operations.
THE CERC ADVANTAGE

Collaborating with CERC means access to a variety of reliable resources and unique opportunities, including:

EXPERTISE
Research areas on campus include transportation networks, communications, alternative fuels, and urban design, planning and infrastructure design.

STRONG RELATIONSHIPS
Connections to a diverse group of government and industry partners help maximize both the relevance and impact of our efforts. Some of our partners include:
- Transport Canada
- Moove Innovations
- BC Ministry of Transportation and Infrastructure
- BC Transit
- Translink
- Novax Industries
- FP Innovations

CITY SCALE
The UBC campus provides the ideal conditions for the combination of research and execution. Some advantages:
- Own provincial jurisdiction municipal Campus and Community Planning
- Campus-wide Secure wireless network
- A large campus area
- Early adopter profiles
- A wide range of conditions – residential, institutional, mini-town and highway conditions

CERC RESEARCH APPROACH

The Clean Energy Research Centre (CERC) at UBC is developing a city-scale, living laboratory that will emulate critical elements of the “Smart City”, focused on the links between energy, transportation, ICT, and urban design. The program will develop and showcase new technology solutions for delivering renewable energy and low-carbon fuels to the transportation sector, demonstrate new connected-vehicle and infrastructure technologies in real-world applications and develop models for multi-modal infrastructure use that can be foundational for new “Smart City” design and policy initiatives.