

RESEARCH SEMINAR ABSTRACT

Smart Microgrids for Healthy and Sustainable Communities and Environments

Energy is fundamental to life, as is the conversion of energy into useful forms, particularly for electricity generation in order to supply demanded loads and provide food, water and energy security. Three billion people, or 20% of the planet, do not have access to electricity, of those in remote communities that number grows to 90% - How can this energy poverty be alleviated? Communities and individuals need sustainable energy conversion practices that will meet basic needs, empower local livelihood and stimulate economic growth. In fact, the present day environmental situation demands that economical and feasible sustainable renewable energies be harnessed. Unfortunately, the ability to convert energy from renewable resources into useful and tradable forms often is beyond the control of ordinary people, leaving them in a position to pay high electricity bills or be dependent on others for their power and essentially their basic needs. Furthermore, the lack of legislation to allow ordinary people to take part in renewable energy generation is detrimental to their communities and livelihoods.

Climate change and its accompanying issues affect every community, the scope of which is daunting. As communities become aware of the opportunities to generate renewable energy in their vicinities, with a desire to create a legacy for future generations, they recognize the additional benefits of implementing such projects in their communities, beyond the “cradle- to- grave”. Introducing a renewable energy power project in a region can rebalance a community’s economic structure and social integrity through energy independence and economic development (Gipe, 2007). The means to harness resources available to communities at their geographic location has many benefits, such as offsetting the cost and volatility of fossil fuel imports while stimulating the local economy through job creation. This, in turn, offsets the costs of the renewable energy technology to be purchased, installed and maintained. The overall result helps to educate local communities in sustainable energy practices and state of the art technology while reducing GHGs and empowering the local community.

Distributed generation along with smart grid applications are poised to make important contributions to the clean-tech sector, innovating cities and remote communities. However, the dependence on one source for energy supply does not prove reliable enough when the renewable resource, such as wind or solar, is variable, causing a dependence on external fuel supply and a vulnerability to foreign control. Smart Microgrids are a means to solve these problems with 100% renewable energy, net-zero, autonomous power for communities. Developing an integrated energy strategy through intelligent computational infrastructures can help communities make informed decisions about their energy investments and optimize the generation and distribution of distributed resources. Fundamentally, the diversification that the microgrid inherently provides, creates a more secure energy supply. This research has established that the behaviour of complementary resources with the use of storage technology can work together to provide a more robust energy system, both in its reliability and affordability. Coupled with the community-energy model, this work enables communities to plan their energy strategy with the appropriate business and technology capabilities within the circular economy. Moving forward, this research expands to developing smart microgrids for the Arctic environment and evolving existing research in icing mitigation of wind turbines to include arctic microgrids, bridging energy system research with human activity and wellness for the development of healthy and sustainable communities.

DR. ANDREA KRAJ, P.ENG – BIO



Dr. Andrea Kraj is a leader in developing virtual power plants using microgrid renewable energy and storage systems. She is a Professional Engineer with over 20 years of experience.

Dr. Kraj is a computational engineer with expertise developing algorithms to predict and optimize renewable energy systems for enhanced energy security in remote community and smart cities applications.

Her research areas include: 1) Developing analytical methods to predict, investigate and optimize energy generation and storage for sustainable communities 2) Remote and rural power infrastructure in contrasting environments 3) Smart microgrids and healthy communities and environments.

Dr. Kraj completed her undergraduate degree in Mechanical Engineering with Aerospace specialization, her MSc in Mechanical Engineering on icing mitigation of wind turbines in cold climates and her PhD in Mechanical Engineering in Intelligent Computational Infrastructures for Optimized Autonomous Distributed Energy Generation in Remote Communities, at the University of Manitoba. She is a Fulbright Scholar in the Fulbright Arctic Initiative III working on energy security and remote electrification in the circumpolar north.

Dr. Kraj set precedent in Manitoba with her work in utility scale community owned wind farm development, helping rural farming communities characterize their resources, establish community cooperative businesses models for their energy projects and create feasible 150-300 MW wind energy projects. Her foundational work in energy policy for community power projects enabled communities to retain ownership through project development and lead other communities to do the same. Her vision in community energy policy and microgrid technology is leading Northern Remote Communities to employ the community power model for empowering themselves with the appropriate energy technology at their location using smart microgrids.

Dr. Kraj additionally advises on design innovation in business and founded CORE Renewable Energy Inc., a company dedicated to empowering community orientated renewable energy worldwide through accurate, intelligent and affordable power modelling and operations. She is an accomplished author and speaker ([TEDx](#)).