FUTURE SMART GRIDS STRUCTURES

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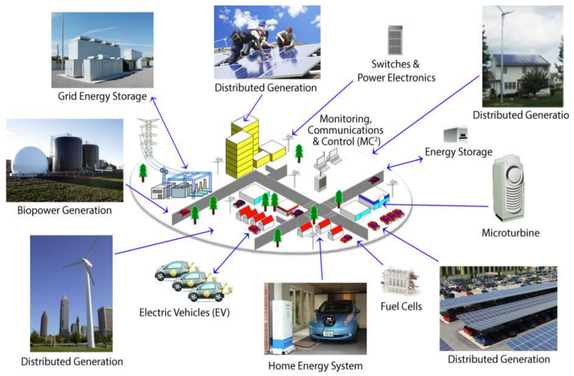
BACKGROUND

- Most renewable energy based power generation, energy storage systems and modern electronic loads are based on DC technologies.
- This necessitates new grid structure such as hybrid AC/DC and DC grids.
- Power electronic converters are key - 30% of produced power is processed by power converters today, which is expected to increase to 80% in the near future.
- New grid technologies are critical for future smart grids with higher efficiency, better power quality and enhanced capability to accommodate more renewable energy and modern loads.

This project focuses on:

- Hybrid AC/DC grids technologies
- Power electronics technologies
- Power and power quality management technologies



Source: www.clean-coalition.org

SHORT-TERM OBJECTIVES

- Develop advanced power electronics interfaces for renewable energy, energy storage and hybrid AC/DC link.
- Develop AC/DC grid technologies and power management strategies.
- Collaborate with other project teams and themes in smart grid and microgrid research.
- Establish the future smart grid technologies lab with hybrid AC/DC grid infrastructure at the 7th floor of ECERF.
- Develop more active collaborations with international partners on smart grid and power electronics research.

PROJECT OVERVIEW

Yunwei (Ryan) Li
Project Lead

Hybrid AC/DC grids, renewable energy grid integration, smart grid power quality management, microgrids

Power electronics design, microgrids, smart inverters

Ali Khajehoddin

Yasser Mohamed

Smart distribution systems control, HVDC control

Greg Kish

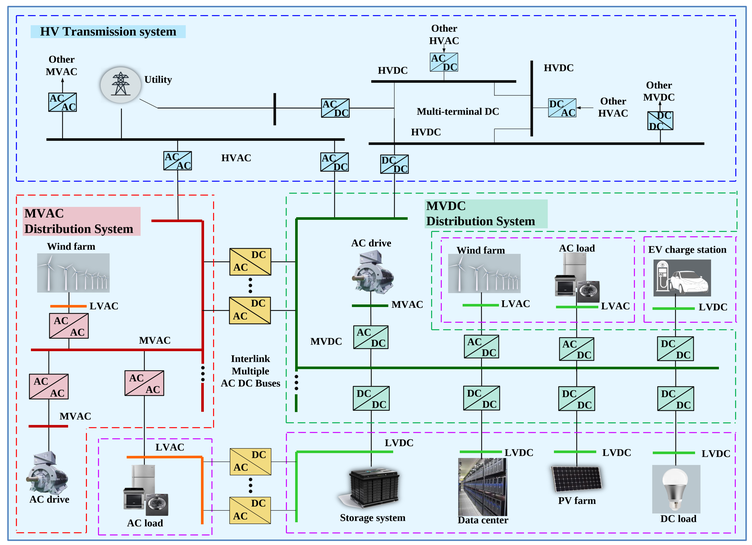
DC grids technologies, DC/DC conversion

John Salmon

Energy efficient power electronics for the utility connection of clean energy systems

Smart grid resilient operation

Hao Liang



Collaboration with Other Teams:

- Collaborate with project team on “Operational Decision Support for Smart Grids”.
- Collaborate with other projects on distributed energy storage.
- Collaboration with Wind Theme on the wind power grid integration and microgrid research.

Long-term Plans:

1) Produce high impact research outcomes through internal and international collaborations and facilitated by the established smart grid lab, and establish the group as an international leader in smart grid and power electronics research.
2) Build strong collaborations with renewable energy and smart grid industry with UAlberta playing a central R&D role.

THEME OVERVIEW

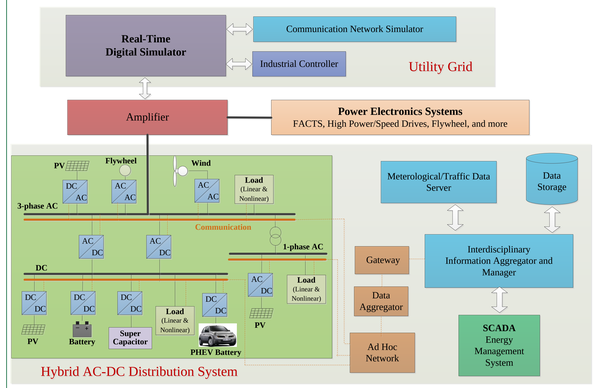
Grids and Storage

New technologies enable us to exploit renewable energy resources, but truly harnessing their energy requires the ability to control and adapt to the complex interaction between multiple sources and users. Smart grid technology will enable systems that can adapt to the variation in supply that is common from renewable sources, while new storage technologies will make it possible to retain energy generated at during peak times to be withheld for later use. Developing hybrid grids that can accommodate both AC and DC power, accommodating distributed generation, and effectively interfacing with legacy grid systems will be essential to our energy future.

EXPECTED OUTCOMES

Anticipated Short-Term Outcomes of This Project:

- New technology/IPs in new power converter topologies and smart converter functions for renewable energy integration; power management and power quality control strategies for AC/DC grids and microgrid operations.
- Establishing a preeminent hybrid AC/DC smart grid lab at Ualberta that enables long-term advanced R&D in this area, with national and international collaborations.
- Working with other projects regarding new policies and market mechanisms for smart converters and ancillary functions.



Schematic of future smart grid technologies lab at the 7th floor of ECERF

EXTERNAL PARTNERS

External partners (existing or under development) include:

- Utility companies
- Power converter manufacturers
- Research institutions

These partners will add additional expertise on power system operation, remote microgrids data, smart grids converters, hybrid AC/DC systems, and provide strong industrial, local and international collaboration.

ATCO GROUP · Rockwell Automation · NAIT · RWTH AACHEN UNIVERSITY · 清華大學 Tsinghua University

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FUTURE ENERGY SYSTEMS

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