

AUSTRALIAN POWER *and*
ENERGY RESEARCH INSTITUTE



APERI Research

Presentation by:

Professor Kashem Muttaqi

Director, ARC Training Centre in Energy Technologies for Future Grids

Discipline Leader – Electrical Engineering

School of Electrical, Computer and Telecommunications Engineering

University of Wollongong

APERI has six research themes – each theme builds the core strength that can gain a leadership role in the global energy transformation in the power and energy sector:

Theme 1 – Future Grid Energy Technologies (FGET)

Theme 2 – Power and Energy Transformation and Utilisation (PETU)

Theme 3 – Power and Energy Enabling Technologies (PEET)

Theme 4 – Power Grid Planning and Operation (PGPO)

Theme 5 – Future Grids with Electric Vehicles (FGEV)

Theme 6 – IoT and Communication for Energy Technologies (ICET)

APERI has following founding members:

- Prof. Kashem Muttaqi
- Prof. Danny Sutanto
- A/Prof. Raad Raad
- A/Prof. Ashish Agalgaonkar
- Dr. Rabiul Islam

THEME ONE – FGET

Theme One - Future Grid Energy Technologies (FGET)

Theme Leader: Prof. Kashem Muttaqi (email: kashem@uow.edu.au)

- Renewable energy (solar, wind, biomass, wave, fuel-cells)
- Distributed generation
- Energy storage systems (batteries, pump hydro, superconducting, fly-wheels, hydrogen)
- Virtual power plants
- Grid integration of small-scale and large-scale renewable resources
- Hydrogen storage to support power grids
- Renewable energy to power electrolysers
- Black start using renewable power plants

THEME TWO – PETU

Theme Two - Power and Energy Transformation and Utilisation (PETU)

Theme Leader: Prof. Danny Sutanto (email: soetanto@uow.edu.au)

- Smart Grids and micro-grids
- Wide area interconnected clean energy system
- Power grid infrastructure planning
- Supply and demand management
- Load modelling and load control
- Energy savings and energy efficiency
- Building energy management system
- Distributed control in power systems
- Volt/VAr optimisation, control and coordination
- Digital Techniques, data analytics and smart meters

THEME THREE – PEET

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Theme Three - Power and Energy Enabling Technologies (PEET)

Theme Leader: Dr. Rabiul Islam (email: mrislam@uow.edu.au)

- Power electronics and power converters
- Medium voltage multi-level converters
- Smart solid-state transformers and solid-state transfer switches
- Sustainable energy technologies
- Inductive and conductive power charging
- Power converters for electrolysers and fuel-cells
- Intelligent adaptive loads
- Grid-forming Inverters
- Data driven control for smart inverters
- Hybrid inverters and their controls for grid integration
- Component level diagnostic of reliability improvement
- Industrial motors and drives

THEME FOUR – PGPO

Theme Four – Power Grid Planning and Operation (PGPO)

Theme Leader: A/Prof. Ashish Agalgaonkar (email: ashish@uow.edu.au)

- Power system operation and control
- Application of AI and machine learning to power systems
- Advanced optimization techniques application to power systems
- Energy economics and energy policies
- Complex, resilient and intelligent systems
- Electricity markets and regulatory issues
- Power system reliability and flexibility
- Planning for future power systems
- Power system forecasting
- Advanced protection systems
- Climate change adaptability in energy infrastructure
- Network modelling and security
- Power system vulnerability and stability
- Emergency control following catastrophic disturbances

THEME FIVE – FGEV

Theme Five – Future Grids with Electric Vehicles (FGEV)

Theme Leader: Prof. Kashem Muttaqi (email: kashem@uow.edu.au)

- Plug-in Electric vehicles (bicycle, car, bus, train, autonomous vehicles)
- Electric vehicle charging stations
- Impact of electric vehicles to power grids
- Grid infrastructure for hosting electric vehicle fleets
- Hybrid electric vehicles
- Vehicle to grid and vehicle to home
- Hydrogen-powered vehicles
- Utilisation of hydrogen in transportation

THEME SIX – ICET

Theme six – IoT and Communication for Energy Technologies (ICET)

Theme Leader: A/Prof. Raad Raad (email: raad@uow.edu.au)

- Smart sensing for power technologies
- Internet of Things (IoTs) for energy technologies
- Wireless power transfer
- IoT for critical energy infrastructure
- IoT for renewable energy and energy storage
- Smart grid communications
- Data communications for virtual power plants
- Wireless communication for electric vehicles
- Communication networks and data technologies in smart grids
- Optical fibre sensors for power applications
- Cyber security for critical energy infrastructure

For Power and Energy Projects, APERI expects

- students have a background in Power Engineering**
- students have completed the following Subjects (or equivalent):**
 - ECTE324 Power Engineering 1
 - ECTE323 Power Engineering 2
- students will complete at least two Subjects out of the following four Subjects:**
 - ECTE412 Power Electronics and Drives
 - ECTE423 Power System Analysis
 - ECTE426 Power Distribution Systems
 - ECTE429 Smart Power Grids

