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SOUTH ASIA SUBREGIONAL WORKSHOP

INCLUSIVE CLEAN ENERGY TRANSITIONS IN BANGLADESH, MALDIVES AND SRI LANKA

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AI-Powered Microgrids to Improve System Reliability and Consumer Supply

AI Micro grid Pilot Project in Sri Lanka

LECO
Lanka Electricity Company (Pvt) Ltd

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Context

- Sri Lanka has pledged to achieve net-zero carbon emissions by the year 2050.
- The country is also committed to meeting 70% of its electricity demand through renewable energy sources by 2030.
- According to the Long-Term Generation Expansion Plan (2023–2042), Sri Lanka aims to add approximately 160 MW of rooftop solar PV capacity annually.
- However, the further deployment of rooftop solar systems in urban and semi-urban areas has been constrained due to high levels of daytime generation leading to voltage regulation issues.
- Currently, Sri Lanka has around 1,600 MW of installed rooftop solar PV capacity, which accounts for nearly 25% of the country's total installed electricity generation capacity.

Objective

- Deploy a pilot project using AI-based frameworks to manage rooftop solar PV in low-voltage networks.
- Mitigate voltage fluctuations arising from high rooftop solar PV penetration and enhance hosting capacity
- Encourage community participation in the energy transition by involving local residents in the planning, operation, and benefit-sharing of the microgrid.
- Enhance the concept of energy prosumers, not just to generate, but also to actively engage with network management through flexible generation and consumption.
- Strengthen local energy resilience, particularly during grid outages through the microgrid.
- Support the development of local energy markets, including reliability markets.
- Encourage community participation in reducing overall carbon emissions by maximizing the use of clean, renewable energy sources at the community level.
- Create a replicable model that can be scaled and customized for other urban, semi-urban communities.

AI-Powered Microgrids and Network Management

Key Outputs:

Output 1 – AI Framework for Microgrids

Develop a smart system architecture for real-time monitoring of microgrids
Collect data for demand forecasting & predictive analytics
Optimize generation dispatch and demand response via AI
Ensure interoperability among BESS, lifeline systems, and DRE units

Output 2 – AI-Based Network Management

Deploy AI-powered energy management platform
Enable communication with inverters & smart meters for improved reliability
Utilize 400 kWh BESS for grid support and backup during outages

AI-Powered Microgrids and Network Management

Output 3 – Pilot Lifeline Power Market

Supply 10% of emergency power needs for 2–3 hours during outages
Minimize and mitigate social impacts of outages
Improve grid reliability and promote private sector involvement
Identify consumer-driven willingness to pay via automated market

Output 4 – Gender-Sensitive Capacity Building

Train utility staff and solar providers (20% women) in DRE & AI integration
Promote awareness on energy efficiency among women & households

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Collaborative Technical partners

No.	Deliverables	Responsibility (Technical Specification, Design, & Cost Estimation)
1	Battery energy storage system (BESS - 400kWh) including the battery inverter	University of Peradeniya
2	Automatic tap changer with communication and remote operations facility and LV remotely operated disconnection switch	University of Peradeniya
3	Smart meters for customers in transformer island/microgrid area	University of Ruhuna
4	Development of AI based energy management system (backend)	University of Jaffna
5	Development of customer portal as a power market (backend) and mobile and web application to connect customer portal (frontend)	University of Jaffna
6	Microgrid architecture and communication system development, and test the system at the LECO-UOM Smart Grid Lab and Digital Grid Research Lab	University of Moratuwa
7	Project site data collection, surveying customer preferences/requirements on power market and defining energy market constraints inside the microgrid	University of Moratuwa

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Survey findings

Transformer ID	AZ1088
Location	Delkanda fair
Transformer capacity	100 kVA
Customer count	Domestic: 113 Domestic solar: Net Accounting: 7; Net Metering: 0; Net Plus: 0 General purpose: GP1-1: 28; GP1-2: 8 General purpose with solar: Net Accounting: 0; Net Metering: 1 Industrial: 1 Religious: 1 Total: 158
Installed inverter capacity	75.4 kW
Solar penetration	75%

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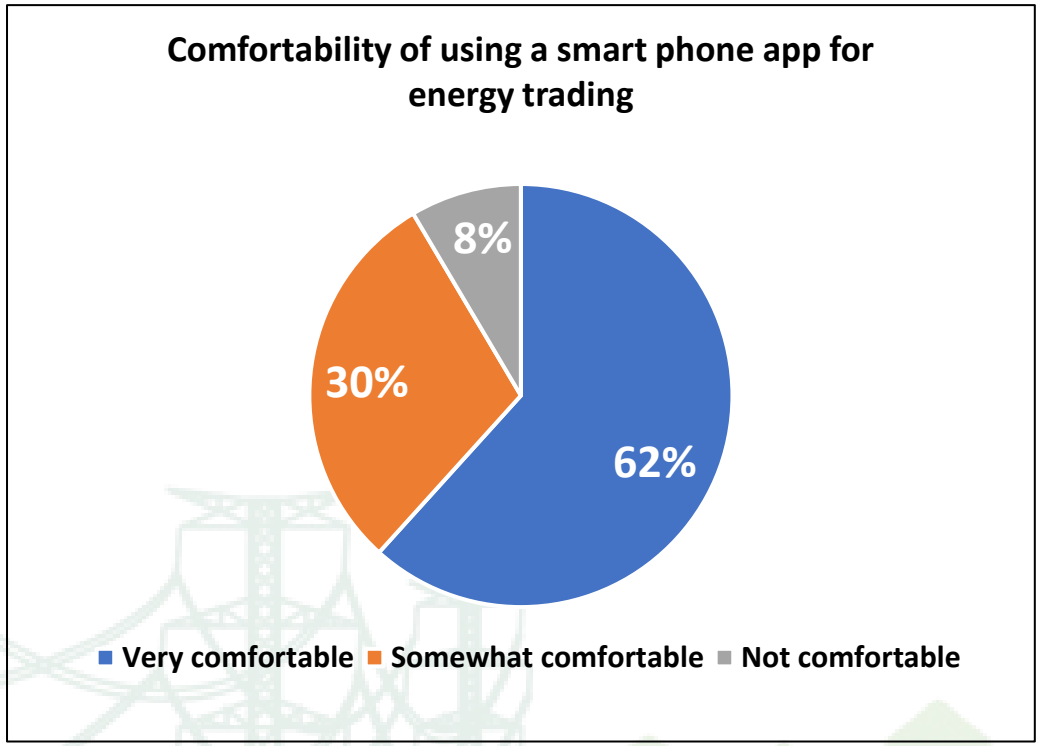
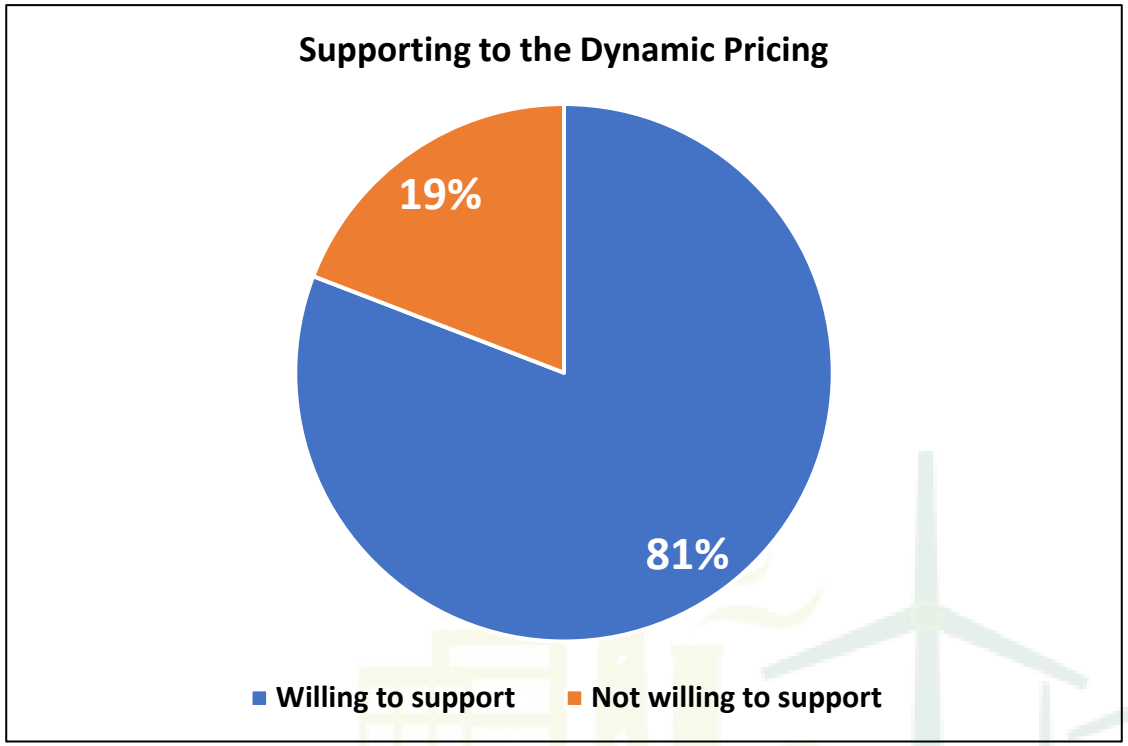
Survey findings





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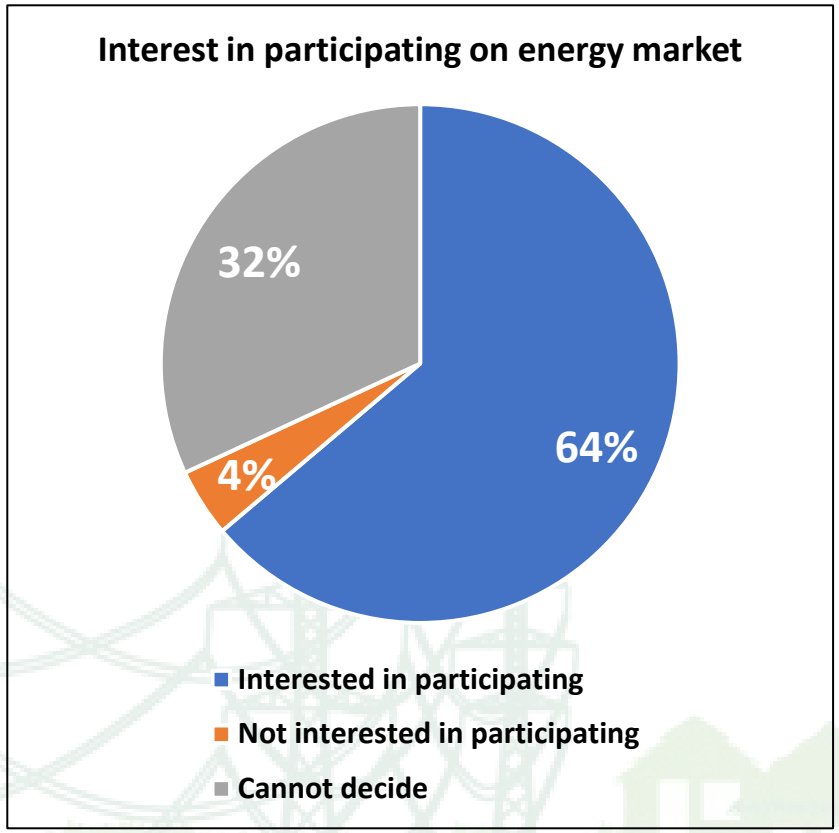

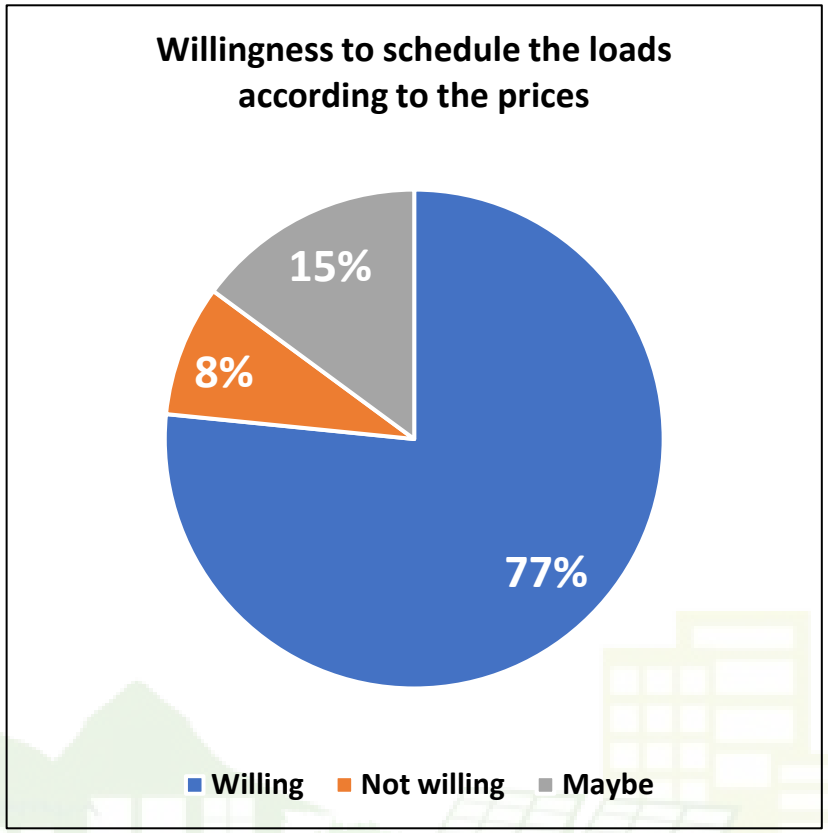

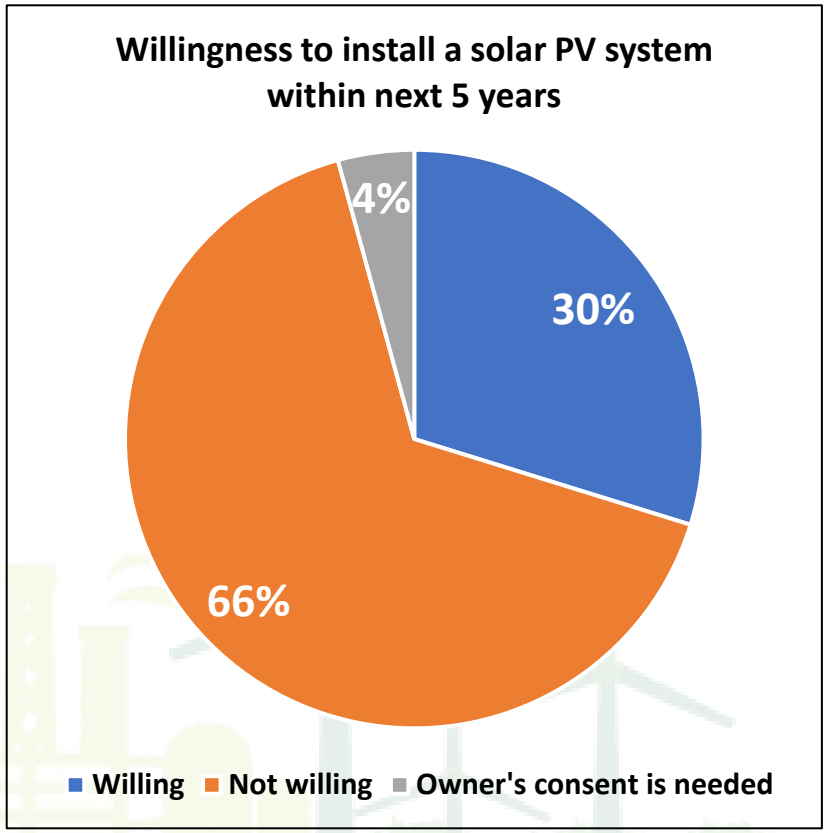

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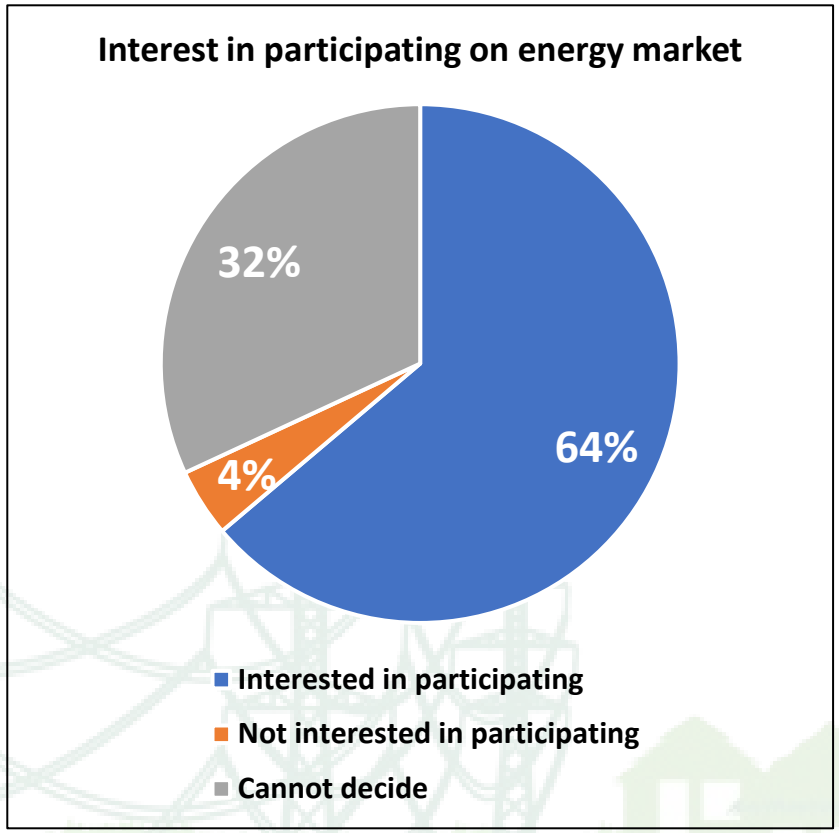

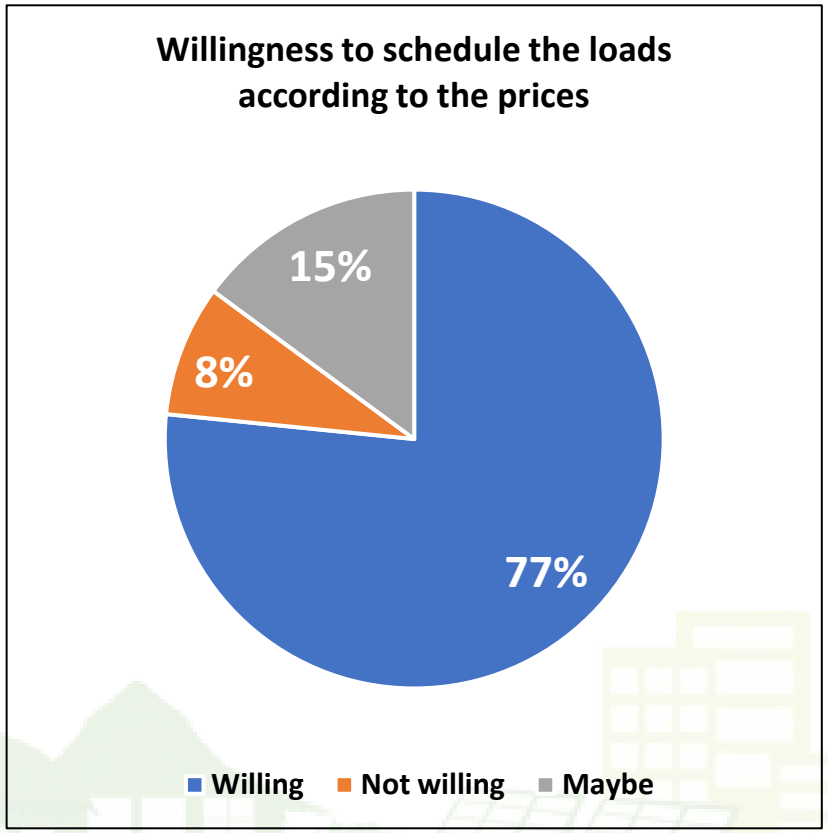

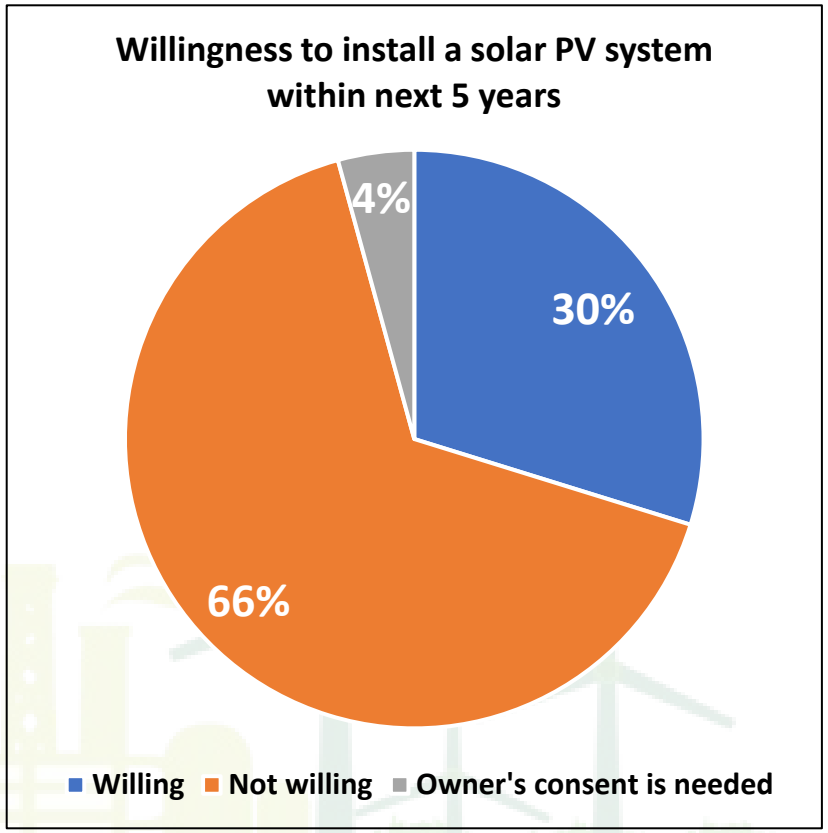

Survey findings

Promoting Gender Equality in the Microgrid Energy Market

Gender Empowerment Strategy

- **Area selection** prioritized **women-led economic activity zones**
  - Local markets, beauty salons, micro-garment industries
  - Ensures **power resilience** for women's daily income activities
  - Reduces reliance on costly generators

Digital Inclusion

- Smartphone training and simplified apps
- Door-to-door campaigns led by trained **female staff**
- Use of local languages, voice guidance, and helplines

Survey findings

Pathways Forward – Awareness, Participation & Solar Adoption

Community Engagement

- **Mass and door-to-door consultative meetings**
  - Conducted by women to improve trust and inclusivity
  - Build awareness on energy market benefits and safety

Enhancing Solar Adoption

- **Roof renting model** to overcome capex and space barriers
- Utility to act as mediator to **guarantee fair deals** with solar providers
- Clear demonstration of long-term savings & reliability

Trust & Participation

- Build consumer confidence via **local champions** and success stories
- Pilot programs with incentives and transparent billing
- Regular updates to reinforce value and reliability

Intended function of the AI powered EMS

- The AI-powered EMS intelligently balances supply and demand to meet customer outage needs at the **most economical tariff**.
- **Customizable power plans** based on:
  - Battery Energy Storage System (BESS) availability
  - Weather forecasts (solar irradiance/cloud cover)
  - Consumer load patterns
- **Smart meters** collect real-time:
  - Daily consumption data
  - Distributed Renewable Energy (DRE) generation (e.g., rooftop solar)
- This enables **accurate forecasting** of:
  - Demand peaks and troughs
  - Dynamic tariff structures within **islanded or microgrid markets**
- Overall goal: **Minimize cost** while ensuring **supply reliability** and **load sustainability**.

Way forward

- Performance analysis of the generation mix using Homer (UOM)
- Dynamic stability analysis under disturbances using PSCAD (UOP)
- Development of the control algorithm for the programmable controller (UOM in collaboration with others)
- Development of the full technical specification and BOQ (Collaborative)