CAREER: Cyber Physical Solution for High Penetration Renewables in Smart Grid

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CAREER: Cyber Physical Solution for High Penetration Renewables in Smart Grid

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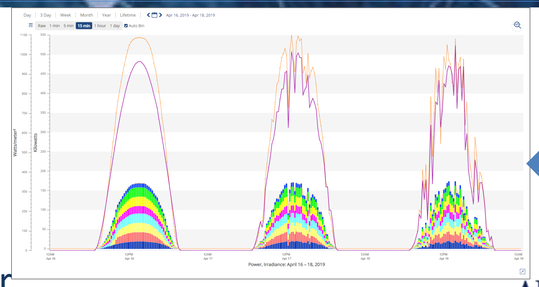
Dr. Arif Sarwat, Florida International University

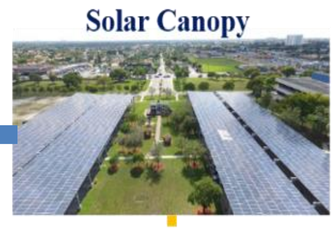
Challenge

- Addressing intermittencies in PV generation
- Renewable energy forecasting
- Increased penetration levels of solar PV in the distribution smart grid
- Moderate-to-severe ramps of PV

Solutions

- Mixed Integer Programming power flow on Massively Parallel Processing architecture
- PV power generation modeling and forecasting
- Control intermittencies using BESS and Supercapacitor systems
- Validation of proposed systems by large-scale demonstrations on real data





Artificial Intelligence based Renewable Microgrid

Proactive ANalytics and Data-Oriented Research on Availability & Security-PANDORAS facility

Grid ENergy Intelligence Exploration-GENIE facility

EPS Group with FPL Team at AIR Microgrid site

- **2** Patents, **5** Book chapters, **17** Journals, **30** Conference papers
- PEACE controller: incorporates a novel power-sharing, PV generation forecasting, and battery SoC forecasting algorithms for real-time monitoring and control of active and reactive power dispatch depending on the prevailing circumstances

Scientific Impact

- Allow increased penetration of renewables
- Cyber security, Solid state transformers, Deep learning, IOT

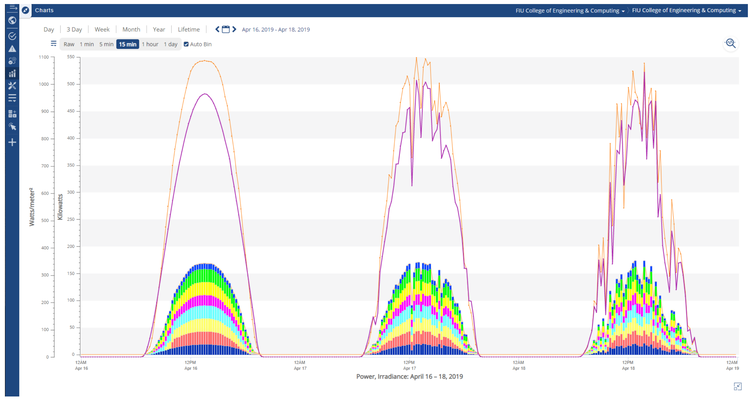
Broader Impact

- Resilient power system for man-made and natural disaster
- "Grid-tied living lab"
- Working with the biggest renewable company in the world - NextEra/Florida Power And Light (FPL)
- Visits of K12 students to FPL new hires

Achievements

- Roadmap for future renewable power plants
- Modern renewable microgrid with Grid Forming Inverter
- **7** PhD students graduated and are working at leading places, national labs
- Minority students and women are working on the project

Artificial Intelligence based Renewable Microgrid and Hybrid Photovoltaic Power Plant



- 3 MW/ 9MWHr battery system with grid forming inverters
- 1.4 MW solar canopy
- 750kVA dynamic load bank
- Black start with Human-Machine Interface and machine learning programming
- Real time simulation connected to AIR

Artificial **I**ntelligence based **R**enewable Microgrid

Proactive **AN**alytics and **D**ata-**O**riented **R**esearch on **A**vailability & **S**ecurity-PANDORAS facility

Grid **EN**ergy **I**ntelligence **E**xploration-GENIE facility

Solar Canopy

AIR Microgrid

PANDORAS

GENIE

Battery Bank

Inverter

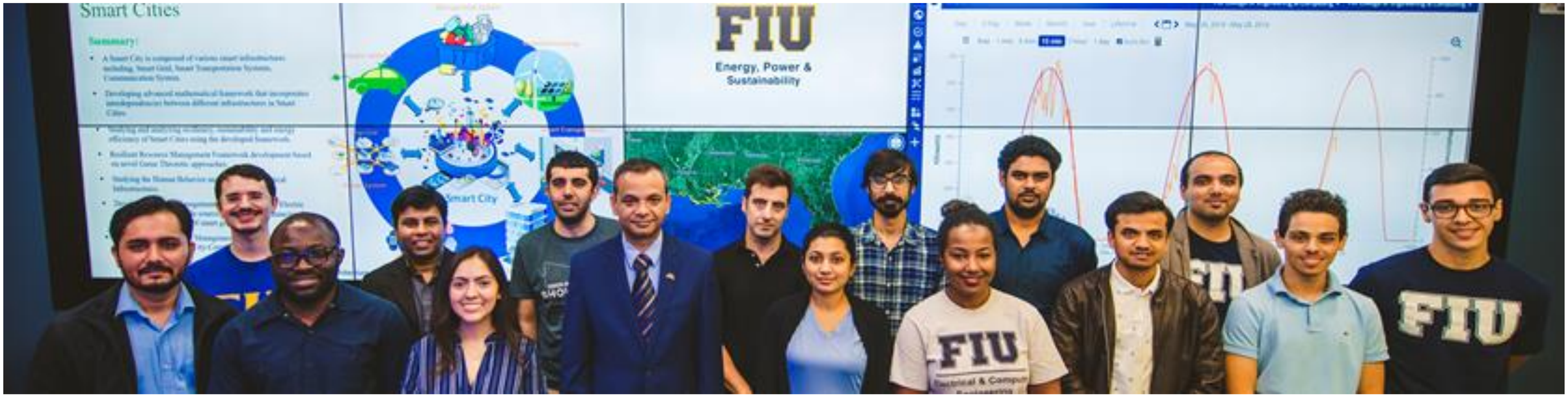
Switchgear Room

Communication

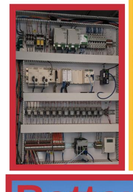
SCADA Interface

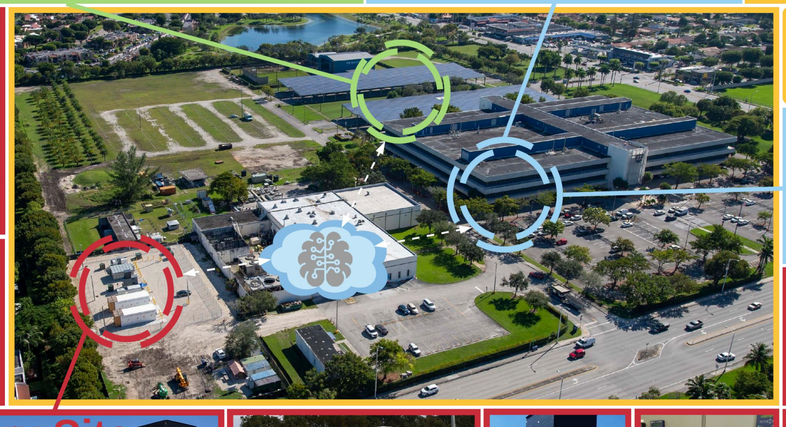
Load Bank

EPS Group with FPL Team at AIR Microgrid site



Strength in Diversity- **Energy, Power & Sustainability Group** https://eps.fiu.edu





AIR MicroGrid
FIU Engineering Campus
Miami, Florida