Renewable Energy Programs
at Florida Gulf Coast University

Joseph H. Simmons, Backe Chair
Director of the FGCU Renewable Energy Institute
Florida Gulf Coast University
Fort Myers, Florida
jsimmons@fgcu.edu
Retired Founding Director
Arizona Research Institute for Solar Energy, AzRISE
University of Arizona
Single-axis tracking, polysilicon modules from Mitsubishi 15 acres, 2 MW with 4 inverters. The field provides 60% electrical power to 3 campus buildings.

We study power and energy performance under SW FL skies –
- Annual Energy Production = 2,600 kWh AC per kW DC name-plate rating.
- Modeling single-axis-tracking flat plate PV
DOE Multi-Model, Machine-Learning Solar Forecasting - Overview

Integration:
- Website setup
- Forecast report generation using IBM Cognos linked to database
- Modeling PV installations (FGCU)
- PV Power Validation
- GMP Test Site Survey and Forecast
- TEP Site visit survey and preparation for historical data and real-time data transfer (UA)
- Developing regional forecast strategies

Model blending based on simplistic weather categorization.
- Weather categorization strategies
- Forecast based on persistence and climatology (ANL)

Compact sky camera capable of direct sun imaging
- Climatology model

NOAA Surfrad/ISIS
- DOE ARM
- 1st Solar Plant (Smyrna, TN)

Introducing IBM MMT Tech for solar plant modeling
- Irradiance-Power modeling with forecasted irradiance / temperature (UA/FGCU)
- First PV Power forecast online

Illustration of info blending
- Site dependent blending
- Use of blending for forecast

Three Model Blending
- Substantial (>20%) improvement

Establish initial RT model
- RT model improvement
- Spectral dependent calculation

VM Setup
- DB (Informix) setup
- Daily RAP/HRRR input
- Daily NAM input
- Physical Infrastructure
- Automated data processing and feeding to database.

NASA MODIS
Existing AzRISE Solar Fields - TEP Solar Test Yard: flat plate and CPV technologies
Florida Gulf Coast University Renewable Energy Institute

FGCU Solar Energy Park

Outdoor test facility:
- Outreach – Education and hands-on training – Visitors Park – Demonstration and testing of new devices
- Shared instrumentation and weather station
- Solar-electric vehicle shuttle bus to campus
Energy Storage

Measurements of power produced from a hybrid PV-battery system under various conditions of load and weather intermittencies show that the zinc-bromide flow battery can support the PV output to make solar electricity dispatchable and time shifted. The operational ranges indicate a need to improve design and operational conditions. But the performance of the battery clearly supports its promise as a major component of future solar PV systems that require some measure of dispatchability.
- Thermodynamic analysis of efficiency with and without compression inter-cooling
- Build and test compressor operation with heat exchange system
- Build and test expansion turbine
- Evaluate reduction in NG consumption due to thermal management
Solar Economics!!! Is Solar too expensive for the Sunshine State?

- The cost of a PV system today: (very approximate figures)
  - $0.85/watt for the modules
  - $0.25/watt for the inverter
  - $0.10/watt for other electrical components
  - $1.50/watt for installation
  - TOTAL = $2.70/watt installed (2012) Today - $2.00/watt (NO REBATES)
  - A good installer will produce 2,000kWh/kW (AZ) and 1,500kWh/kW (FL) annually. This translates to $1.35/kWh (AZ), $1.80/kWh (FL)
  - If amortized over 20 years, then the cost per year is well below the retail price of electricity ($0.12/kWh – grid price)
    - Solar AZ - $0.07/kWh and Solar FL - $0.09/kWh

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Energy Information Agency 2011 except for Solar PV
Ongoing Projects

- FGCU 2MW Solar Field – Performance under SW Florida skies
- Solar power forecasting (DOE/IBM)
  - Modeling Single-Axis-Tracking flat-plate PV systems
- Energy Storage
  - Testing novel storage devices (flow batteries and supercapacitors)
  - Development of small-scale Compressed Air Energy Storage
- Solar economics – Critical to Florida
- Solar multistage desalination and water treatment (NFWF)
- Sandia multijunction solar cells
- Construction of I-Hub Research Park and FGCU Solar Park
- Collaboration with Algenol on algae-based ethanol production
- Development of Renewable Energy Engineering degree
- Outreach and regional economic development