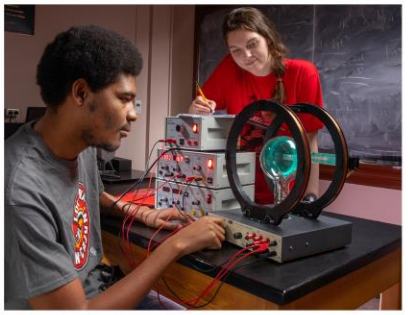
Energy Efficiency and Sustainable Energy at the University of Louisiana at Lafayette

R1
TOP-TIER
RESEARCH
UNIVERSITY







ECONOMIC IMPACT

$2.7 BILLION

Acadiana Economy

$1.7 BILLION

Community Service

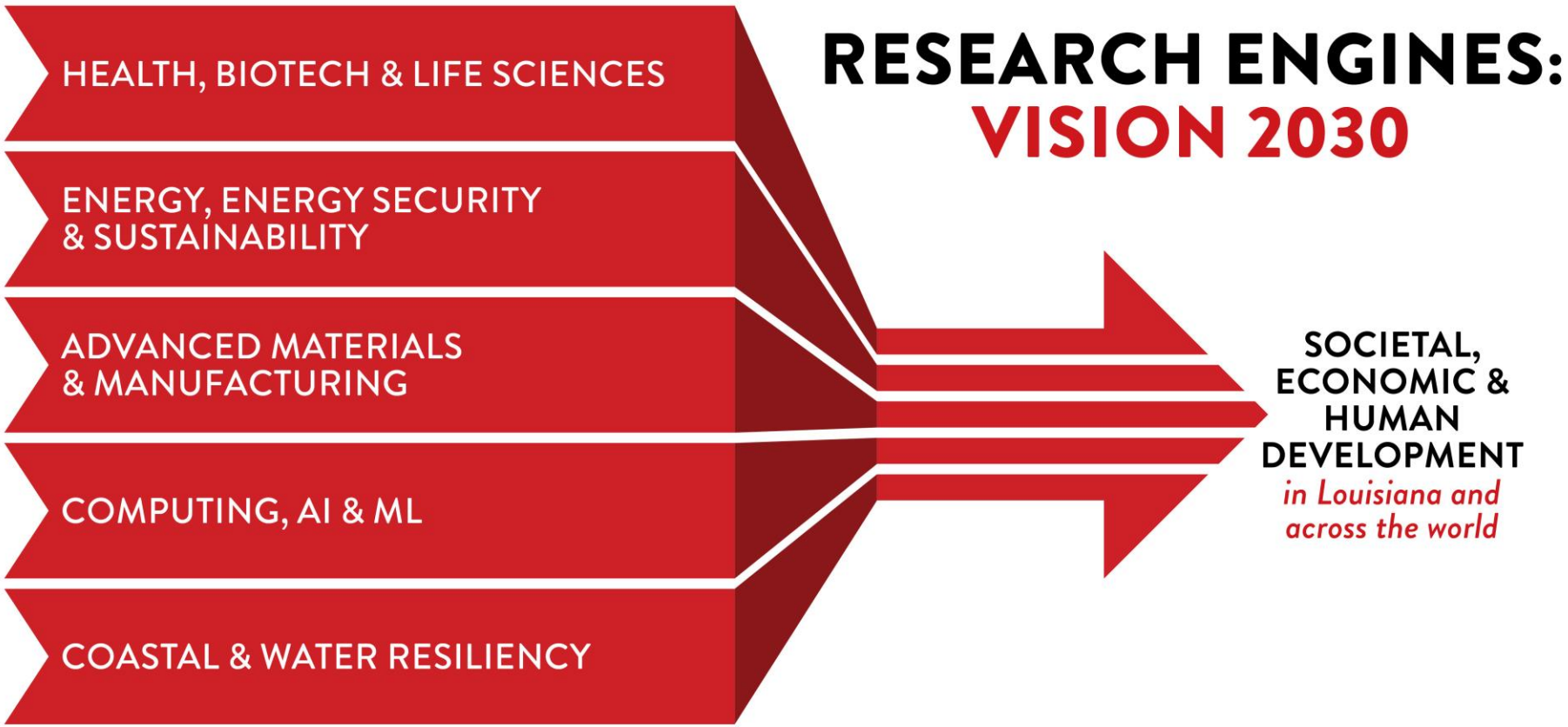
$1.8 MILLION

Operational Spending

$111.1 MILLION

UNIVERSITY of LOUISIANA LAFAYETTE

$1 INVESTED IN THE UNIVERSITY *Yields* **$8 ADDED INCOME AND SOCIETAL SAVINGS**


HEALTH, BIOTECH & LIFE SCIENCES
ENERGY, ENERGY SECURITY & SUSTAINABILITY
ADVANCED MATERIALS & MANUFACTURING
COMPUTING, AI & ML
COASTAL & WATER RESILIENCY
RESEARCH ENGINES:
VISION 2030
SOCIETAL, ECONOMIC & HUMAN DEVELOPMENT
in Louisiana and across the world

RESEARCH *for a Reason*

Economic DEVELOPMENT

Workforce DEVELOPMENT

Human DEVELOPMENT

RESEARCH

for a reason

Multidisciplinary Renewable Energy Research

- Systems Engineering
  - Renewable energy performance modeling
  - Operational field testing of renewable energy systems and components
  - Long-term reliability and degradation studies
  - Microgrids, smart grids, DER's
  - Agrivoltaics
- Big Data and Visualization
  - Solar resource forecasting
  - Power forecasting
  - Virtual reality models for education
- Cybersecurity
  - Cybersecurity of PV, microgrids, and other distributed energy resources (DERs), Electric Vehicles (EV's)
- Water and Sanitation
  - Floating solar power plants for reservoirs
  - Concentrating solar thermal for wastewater treatment, disinfection, desalination
- Emergency Management
  - Use of DERs and microgrids for emergency power
- Building Energy Management
  - Use of solar and other DERs in commercial buildings
- Materials
  - Battery storage
  - Reflective materials for Concentrating Solar Power (CSP)

74 journal articles in last 5 years

37 in last 2 years

Photovoltaic

The 1.1 MW Louisiana Solar Energy Lab is one of the largest outdoor test facilities in the southeast United States

Degradation, soiling, performance modeling, solar resource and power forecasting

Extensive Outdoor Test Facilities

New Building w/ indoor test facilities

Used for research, education workforce development, economic development, and outreach

Research and Training Test Beds

Single-Axis Tracker (FS6)

Dual-Axis Tracker

Bi-Facial Test Stand

Commercial Roof

Residential Roof

Conical Dish Receiver

Antoun Hall

- New 4500 sq ft Building
- Office space
- Classroom
- Indoor Lab Equipment
- SunSim 3c Flash Tester
- Lock-In Thermography
- Light-Soak Chamber

Thanks to a generous donation by George Antoun and Martha Ward Antoun

Cleco Alternative Energy Center

Solar Thermal Applied Research and Testing (START) Lab

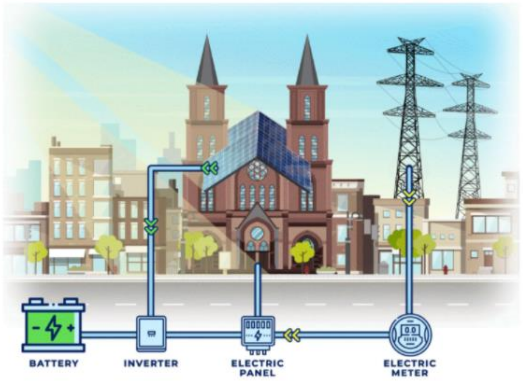
- One of the largest university-owned CSP test facilities in the nation and one of only a few in the southeast

Biomass

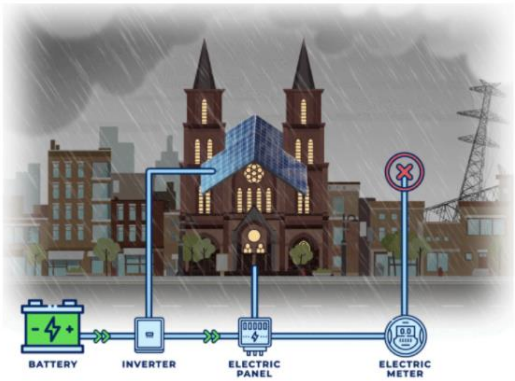
- Gasification
- Torrefaction
- Digestion

Hubs for Energy Resilient Operations (HERO)

- $500M State-wide Proposal to Implement Solar Resiliency Projects
  - Solar + battery microgrids with 12 hours of storage for emergency operations and community support following extreme weather events



In normal times, the **solar array** helps defray electricity costs.



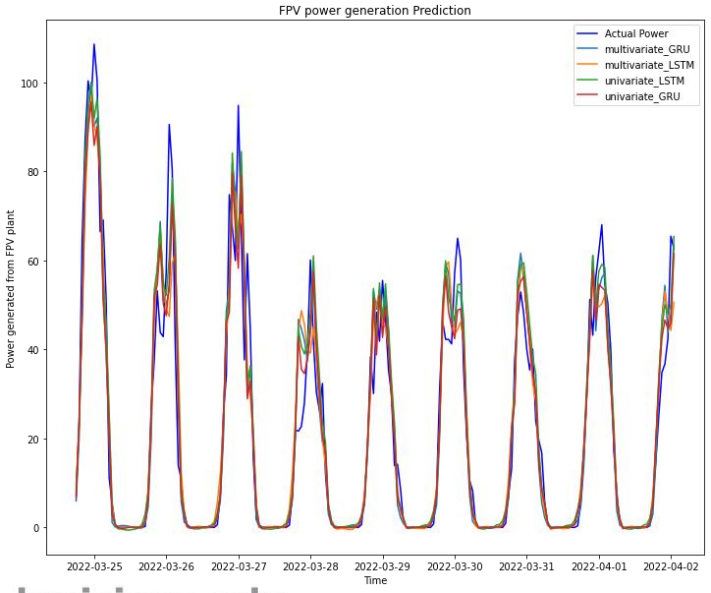
If the grid goes down, **battery storage** restores power so community institutions can respond.

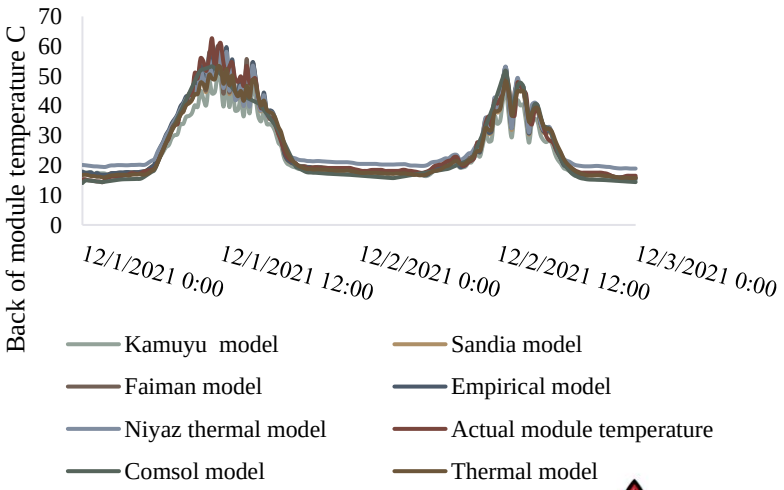
Largest Grant in University History

- UL Lafayette largest subrecipient at $87M
  - UL Lafayette will build eight Community Resilience Hubs, including four for the National Guard, perform workforce development, help with planning of other proposed hubs, and provide emergency management assistance

No.	HERO Member	HUB Type	Distributed Energy Resource Owner & Operator	Community	Construction Cost
1	University of LA	Resilience in Place	Blackham Coliseum	Lafayette	$3,150,000
2	University of LA	Resilience in Place	Crowley - Cleco	Crowley	$1,200,000
3	University of LA	Critical Facility	New Iberia Research Hub/Emergency Center/Airport	New Iberia	$7,000,000
4	University of LA	Resilience in Place	Mobile Solar + WIFI Kiosks		$700,000
5	National Guard	Critical Facility	National Guard Gillis W. Long Center	Carville	$2,680,000
6	National Guard	Critical Facility	National Guard Army Aviation Support Facility	Hammond	$2,600,000
7	National Guard	Critical Facility	National Guard Armed Forces Reserve Center	Baton Rouge	$2,600,000
8	National Guard	Critical Facility	National Guard Chennault Airport	Lake Charles	$2,680,000

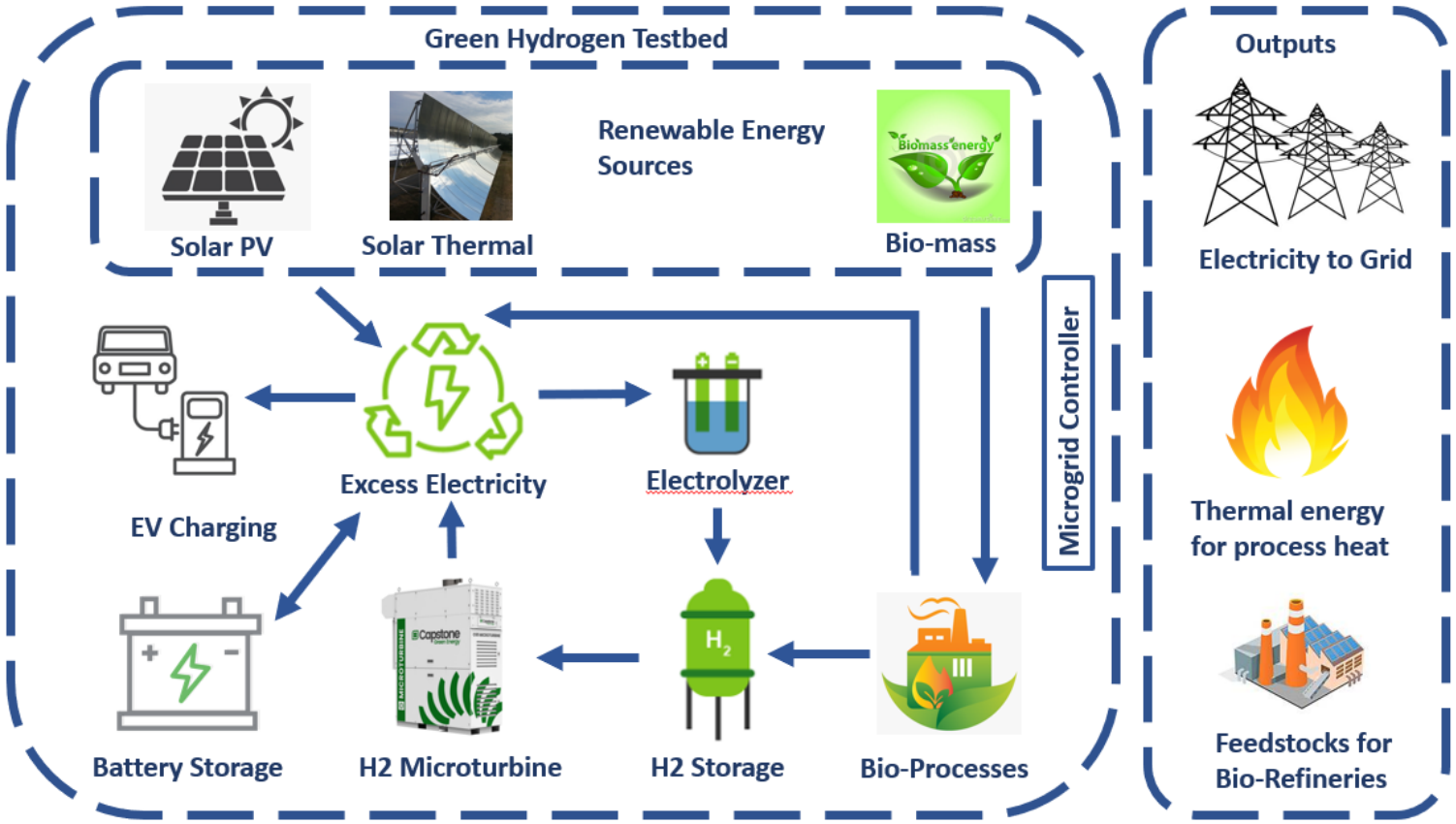
Floating Solar





H2theFUTURE

ENERGY TRANSFORMATION IN SOUTH LOUISIANA



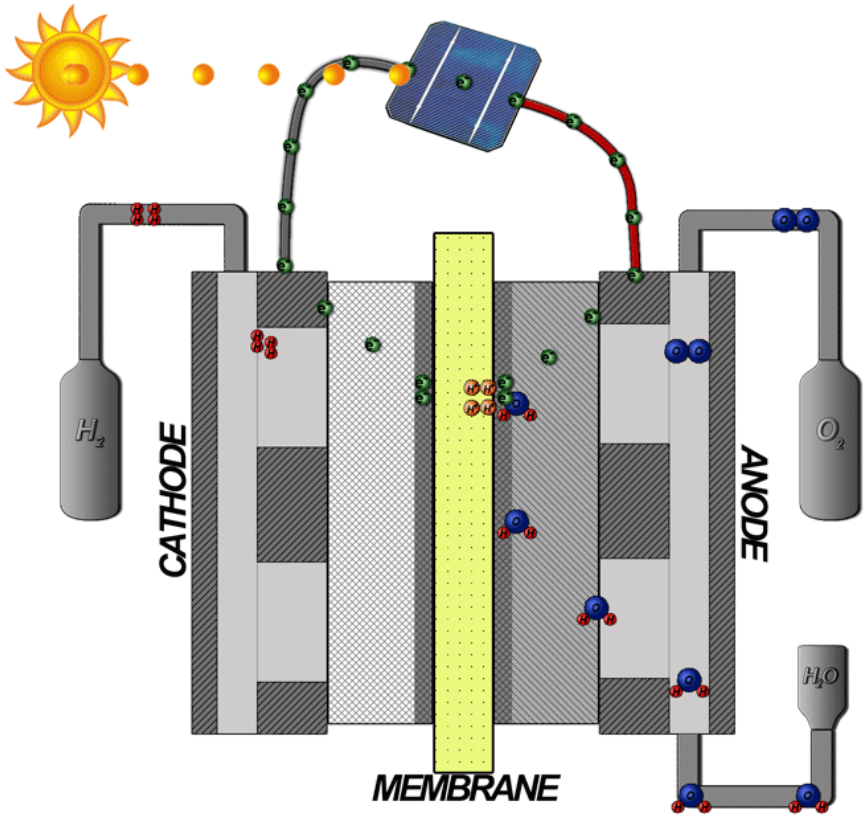
Green Hydrogen Testbed Schematic

Green Hydrogen Testbeds

- Green H2 Production
  - Electrolysis powered by solar energy
  - Bio-mass gasification
  - Bio-digestion
- Storage
- Use
  - H2-blended microturbine
  - Syngas generator

ELECTROLYZER: MAKING HYDROGEN FROM WATER

Example Shown: Polymer electrolyte membrane (PEM) electrolysis with PEM electrolyzer coupled with a solar panel



The cost today of producing and delivering hydrogen from a central electrolysis plant is estimated at $5 to $9 per kg (about 3-4 times that of gasoline).

The cost of onsite production at a local filling station is estimated at $12 per kg (about 6 times that of gasoline).

Replacing one-half of U.S. ground transportation fuels in 2025 (mostly gasoline) with hydrogen from electrolysis would require about as much electricity as is sold in the United States today.

The potential is there, but more R&D is needed to get costs down.

THERMAL BIOMASS-BASED PRODUCTION OF GREEN & GREENER HYDROGEN

UL GASIFIER

Biomass Feed

Thermally Convert into Synthesis Gas within the Gasifier

Syngas Gas: (H2, CO, &CO2)

H2 Separation

W/CCS → GEO CO2, H2

NO CCS → ATMOS CO2, H2

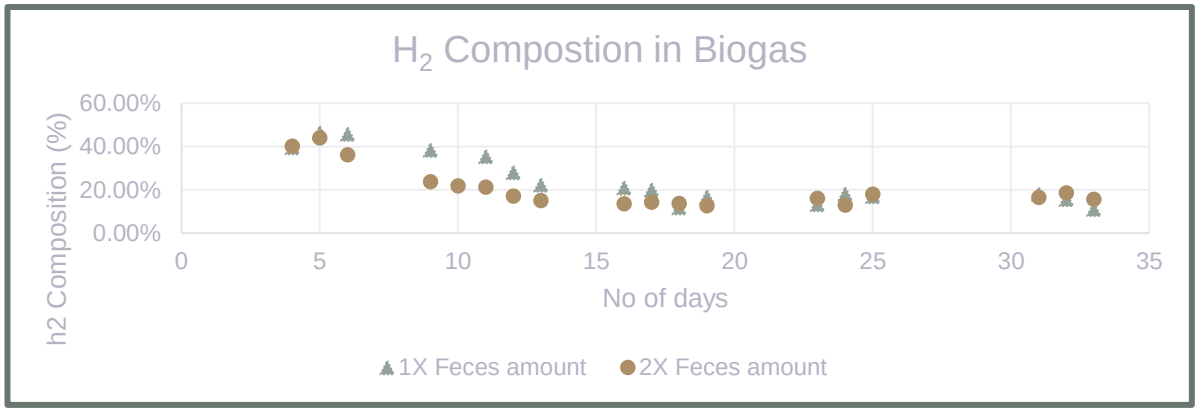
	Air Mode	Oxygen Mode
*Syngas Composition, **Vol. %***	**CO**: 10.4, **CO_2**: 13.8, **H_2**: 19.8, **H_2O**: 17.4, **CH_4**: 0, **N_2**: 38.6	**CO**: 18.7, **CO_2**: 20.1, **H_2**: 34.7, **H_2O**: 24.8, **CH_4**: 0.2, **N_2**: 1.5

UL BIOMASS FED GASIFIER PROCESS

Note: More H2 can be produced via the CO water-gas shift reaction

BIO-DIGESTION – MICROBIAL PRODUCTION FROM WASTE MATERIALS


UL DIGESTER




MUNICIPAL DIGESTER

Microgrid Test Facility

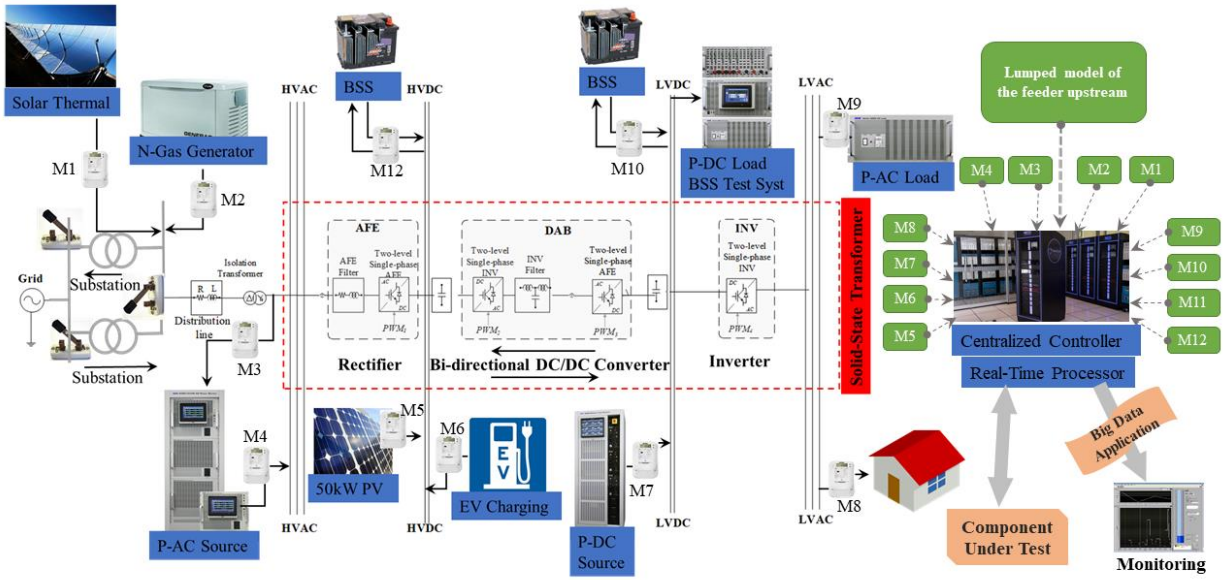
$816K Project

Ties all our renewable energy generation facilities at the Crowley facility into a micro-grid

Test various micro-grid components (solar, storage, EV's, Loads) under realistic conditions

Simulate any type of load profile (commercial, residential, etc.)

Simulate any type of generation profile (wind, solar, traditional)



Cleco Alternative Energy Center

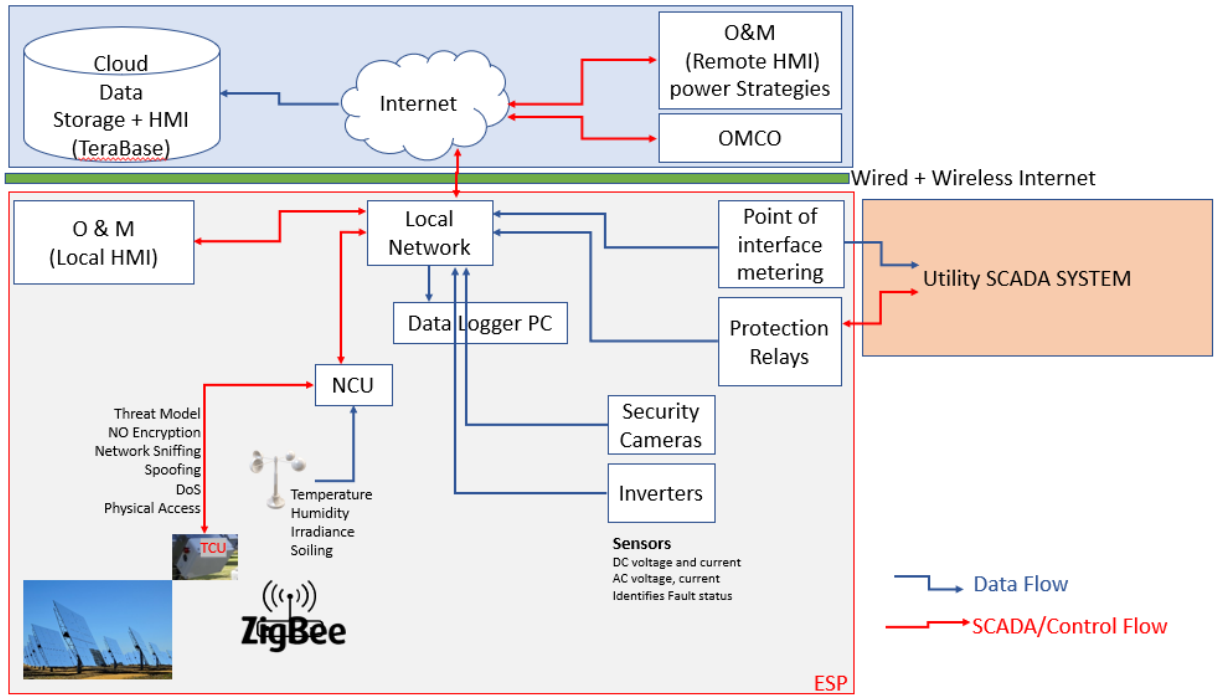
CLECO

UNIVERSITY LOUISIANA Lafayette

UNIVERSITY of LOUISIANA LAFAYETTE

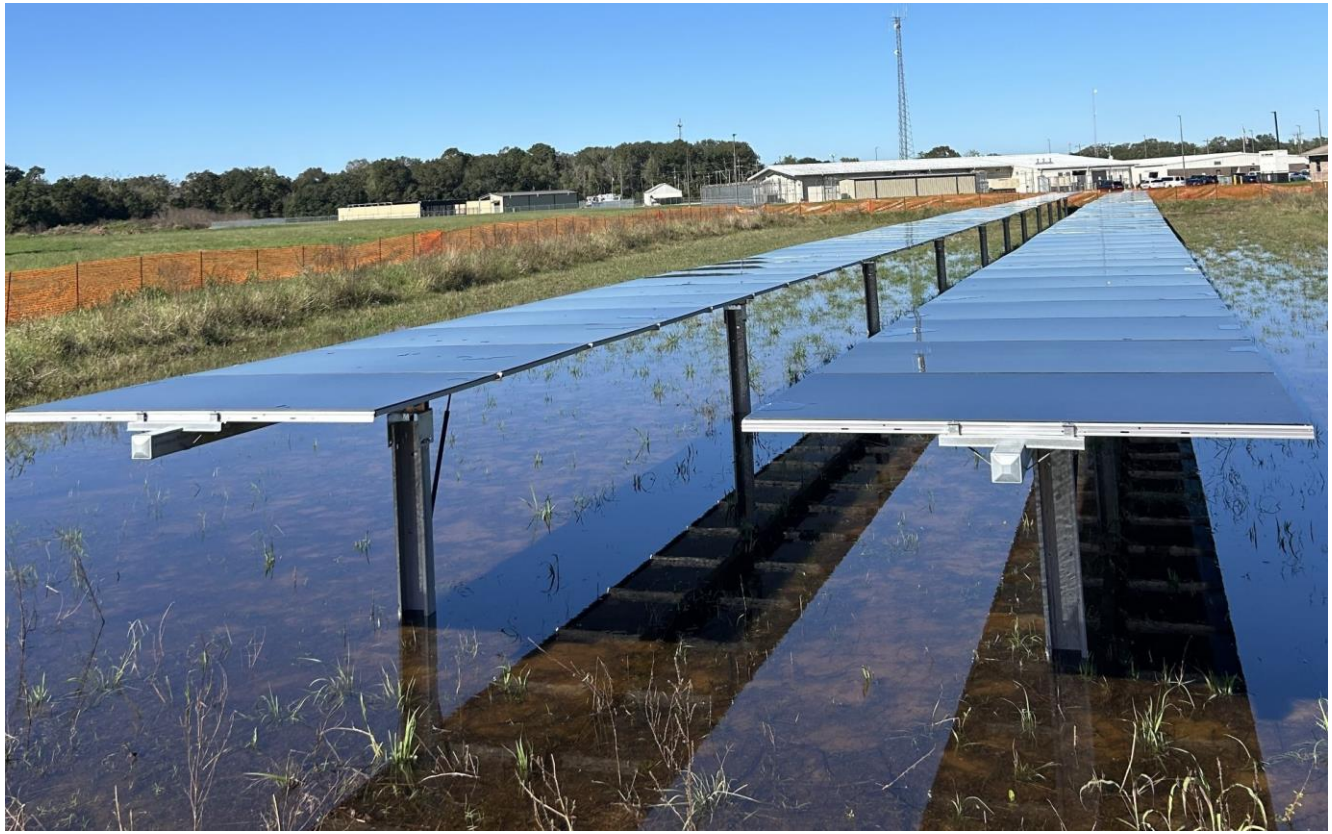
Cybersecurity of Utility-Connected Systems

- EV Charging Stations, SCADA Systems, PV System Components
- Working with National Labs and Industry
- $100K in Recent Funding Applicable to Cleco Alternative Energy Center



Agrivoltaics

- Studying combined use of solar and agriculture in Louisiana
- We will study crawfish farming
- $100K of new funding for Cleco Alternative Energy Center



HVAC&R and Building Energy Research

Peng "Solomon" Yin, Ph.D.

Associate Professor of Mechanical Engineering

Director, Energy Efficiency and Sustainable Energy Center

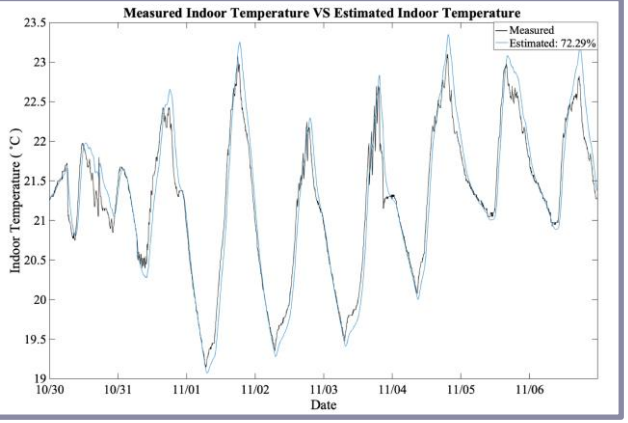
University of Louisiana at Lafayette

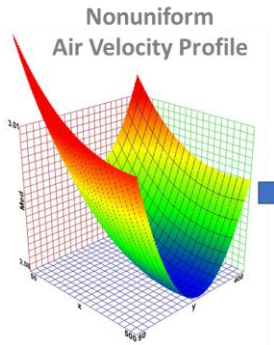
UNIVERSITY OF LOUISIANA Lafayette

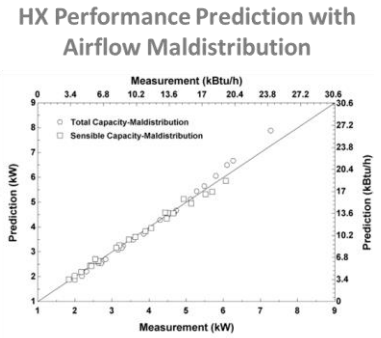
Technical Expertise

Building Energy

- Load flexible HVAC system development and control
- Short-term thermal load forecast using IoT sensors
- Equation-based building energy modeling
- Building energy assessment and analysis







Thermofluids Analysis

- Heat exchanger performance evaluation
- Refrigeration system modeling
- Heat transfer enhancement
- Turbomachinery

Facilities

Psychrometric facility **for testing heat exchangers and heating/cooling systems:**

- **Chamber size: 15’ ×15’ ×15’**
- **Temperature: 30°F to 100°F (-1.1°C to 37.8°C)**
- **Relative humidity: 20% to 90%**
- **Up to 7.5 ton (90 kBtu/h or 26.4 kW)**

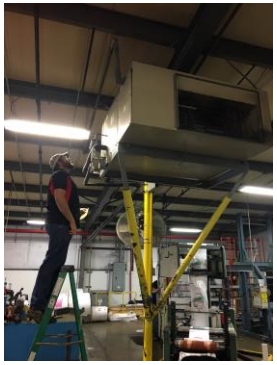
Nozzle chambers **for performance evaluation of air movement devices:**

- **Small chamber: up to 2,000 cfm**
- **Large chamber: up to 5,500 cfm**

Projects

HVAC equipment testing and modeling

- Sponsored by ASHRAE
- Experimental evaluation
- Performance modeling
- Benchmark energy savings



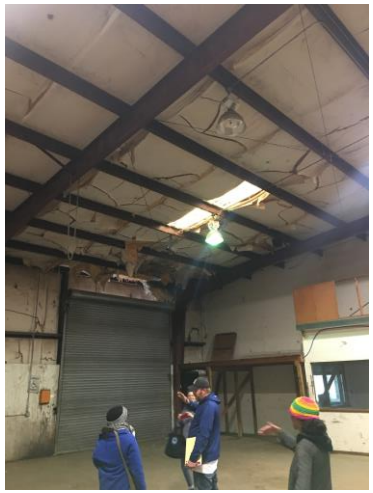
Energy Assessment

- Sponsored by DOE, USDA, and Cleco
- Identify energy savings opportunities
- Quantify potential energy savings
- Assist with project implementation

Energy Assessment Program

USDA REAP

- Agricultural producers and small businesses in rural areas
- Energy efficiency improvement
- Renewable energy implementation



DOE IAC

- Small-to-median manufacturers and commercial buildings
- Energy efficiency improvement
- Waste reduction

SOLAR ENERGY EDUCATION

Train the renewable energy engineers and technologists of the future

Solar Engineering Education

- Renewable Energy Minor
- New solar-related courses (4 courses created in last 2 years)
  - ENGR 400G – Energy Systems and Sustainability
  - ENGR 430 – Introduction to Solar Energy System Design
  - ENGR 431 – Utility-Scale Solar Energy System Design
  - ENGR 432 – Modeling and Simulation of Solar Energy Systems (planned)
  - ENGR 400G - Solar Thermal System Design
  - ENGR 695 – Sustainable Energy System Design
- Internships
  - Establishing industry partners so that students can get design experience to obtain the NABCEP PV Design Specialist Certificate
- MCHE Department has added a solar energy representative to their Industrial Advisory Board as a mechanism for receiving industry input on curriculum
  - David Spieldenner – First Solar/Terrabase

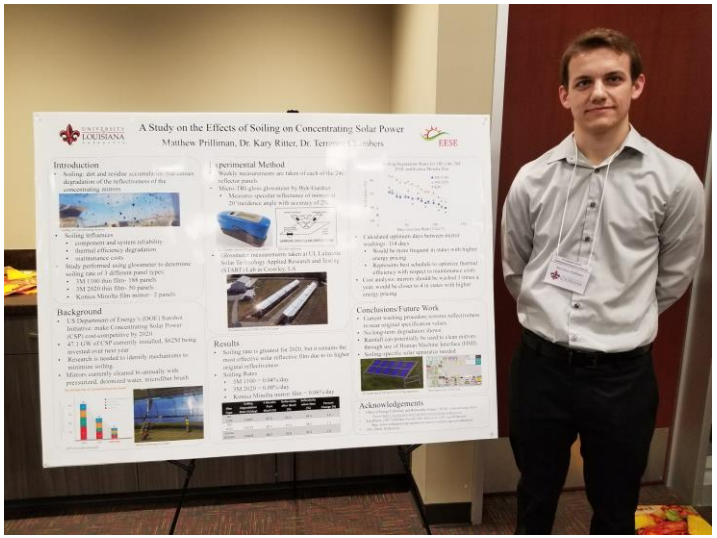
Student Success

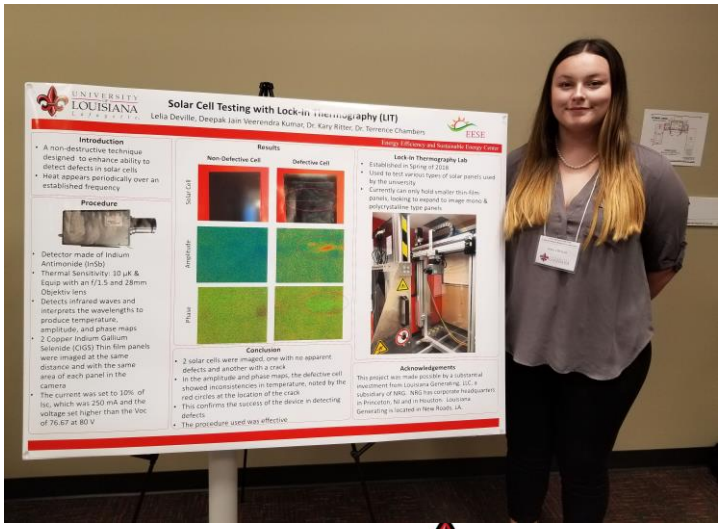
Matthew Prilliman – Sandia, Grad school at ASU, now works at NREL

Tristan Lee – Internship with First Solar

Deepak Jain Verendra Kumar – NREL

Lelia Deville – Sandia National Lab





SOLAR WORKFORCE DEVELOPMENT

Training the solar energy technicians of the future

Solar Energy Technician Program

NABCEP ASSOCIATE™ Photovoltaic

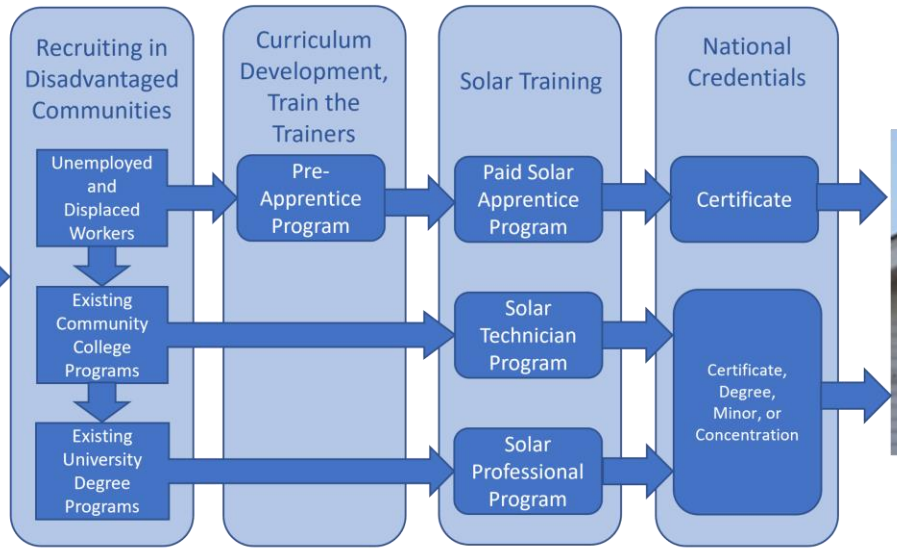
- PV101: Intro to Grid-Direct Photovoltaic Solar Energy System Design and Installation (60 PDH)
- PV202: Intermediate Grid-Direct Photovoltaic Solar Energy System Design and Installation (40 PDH)
- PV203: Intro to Battery-Based Solar Electric Design (40 PDH)
- PV206: Solar Business and Technical Sales (60 PDH)
- PV350: Tools and Techniques for Operations and Maintenance (40 PDH)

Louisiana Solar Corps

Building a Living Wage Economy Around Clean Energy and Community Resilience

Culture Bearers Keep the Spirit of Louisiana Alive

High Poverty Rate
Need for Good Jobs



Permanent Solar Jobs Across Value Chain

Community Resilience
Economic Mobility

$1M DOE Solar Workforce Development Grant
- UNO
- Together Louisiana
- Get Lit Stay Lit
- Louisiana Green Corps

Create a State-Wide Solar Training Program

Training along three pathways
- Pre-apprentice to apprentice
- Two-year
- Four-year

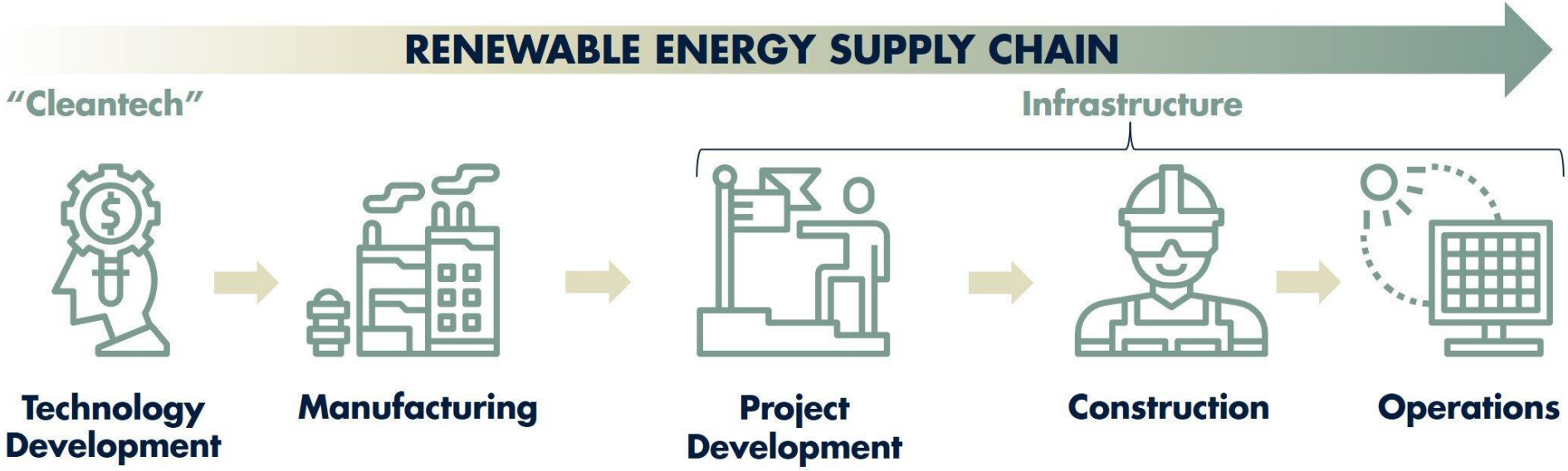
Training across entire solar value chain
- Including manufacturing

Helping other universities and community colleges set up their own solar training programs

ECONOMIC DEVELOPMENT

Helping industry navigate the energy transition, in Louisiana and around the globe.

BUSINESS OPPORTUNITIES ACROSS SOLAR VALUE CHAIN



People are currently employed by the solar industry[1]

263,883

179.0 GW

Amount of solar currently installed in the U.S.

Value of the U.S. solar market in 2023

$51.4 billion

Industry Research Partners

LUS
LAFAYETTE UTILITIES SYSTEM

CLECO
Connecting Louisiana's future.

NORWICH SOLAR

entergy

RAPTOR MAPS

OMCO SOLAR

KIPP & ZONEN
an OTT HydroMet brand

ScorpiusTrackers
Tracking the Sun. From dawn to dusk.

First Solar®

3M

KONICA MINOLTA

POWER STRATEGIES

IN-BETWEEN INTERNATIONAL

terabase

D&D Manufacturing

GreenField Solar

GOSSAMER INNOVATIONS
"THE MOST CREDIBLE NAME IN SOLAR"

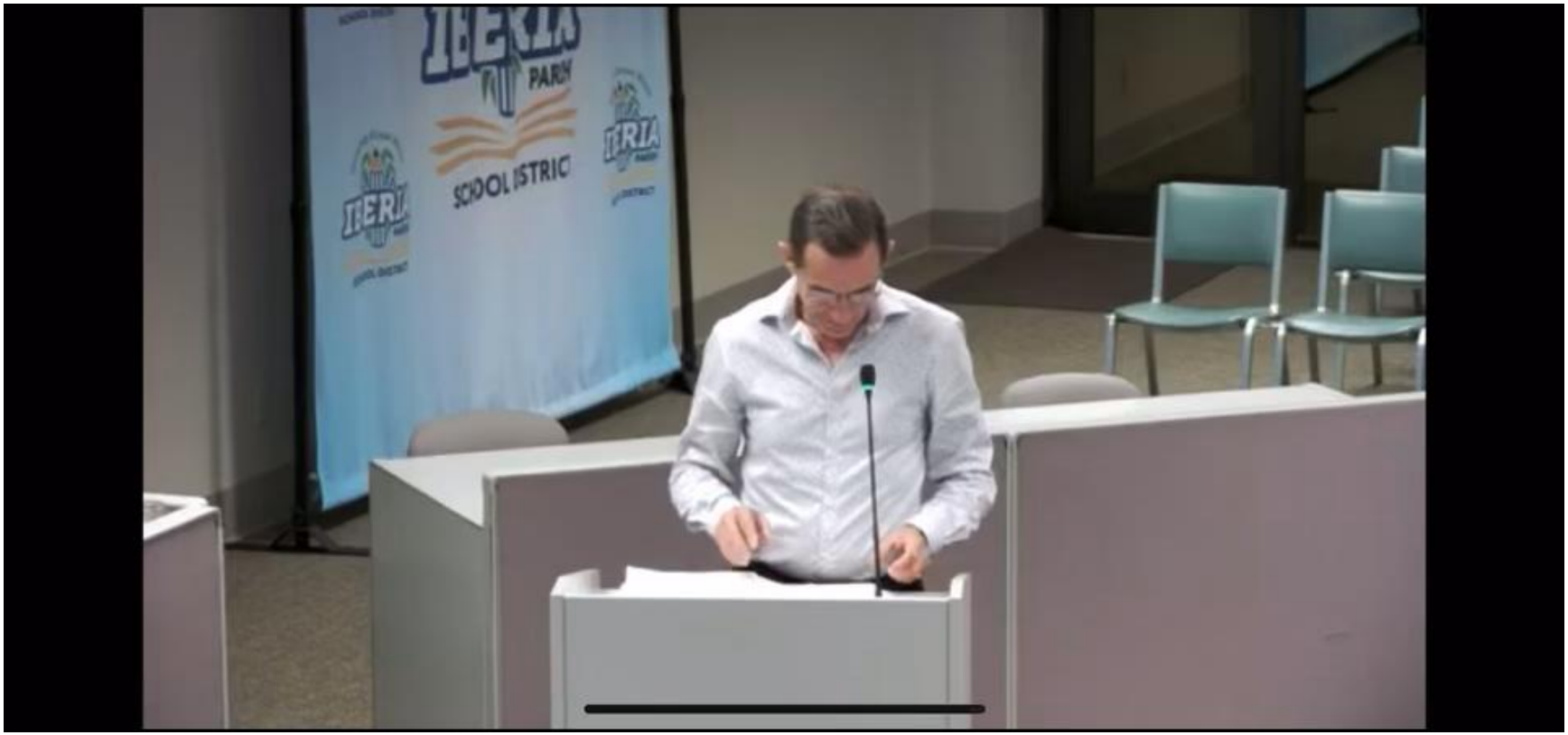
PLANT PREDICT

First Solar Manufacturing Plant

"As we evaluated our options, Louisiana's ability to deliver the talent we need stood out, thanks to its extensive workforce development initiatives and the presence of academic institutions such as the ***University of Louisiana at Lafayette which now features a world-class solar energy lab***." Mark Widmar, Chief Executive Officer, First Solar

- $1.1B investment
  - Largest ever in Iberia Parish
- 700 permanent jobs
- Annual payroll of $40M
- A new 10,000 sq ft manufacturing facility being set up at UL Lafayette

Iberia Parish School Board

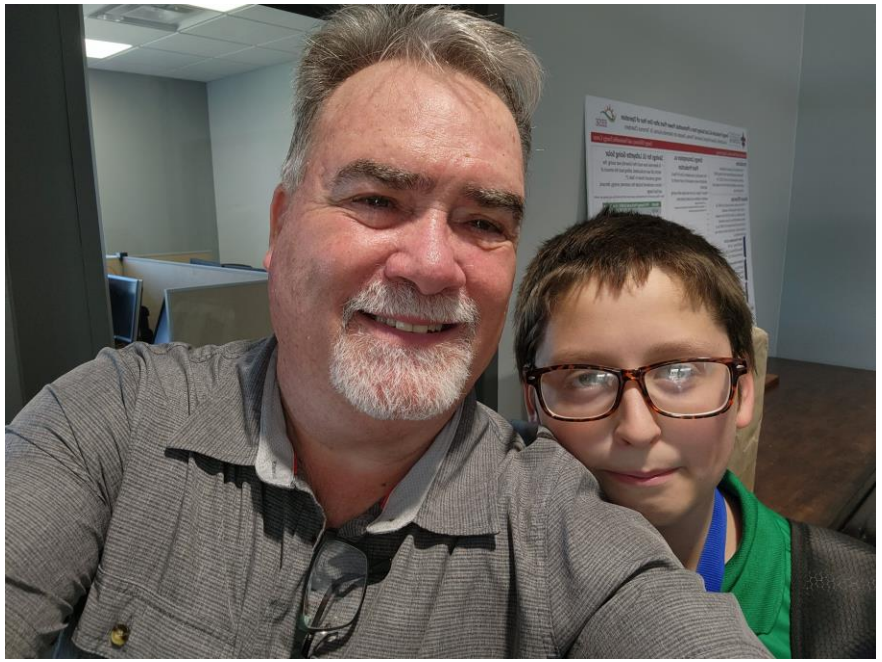


OUTREACH

Inspiring the next generation of renewable energy workers

2 - 3 tours per week for public officials, industry, the general public, and K-12 students

Why do we do all this?



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