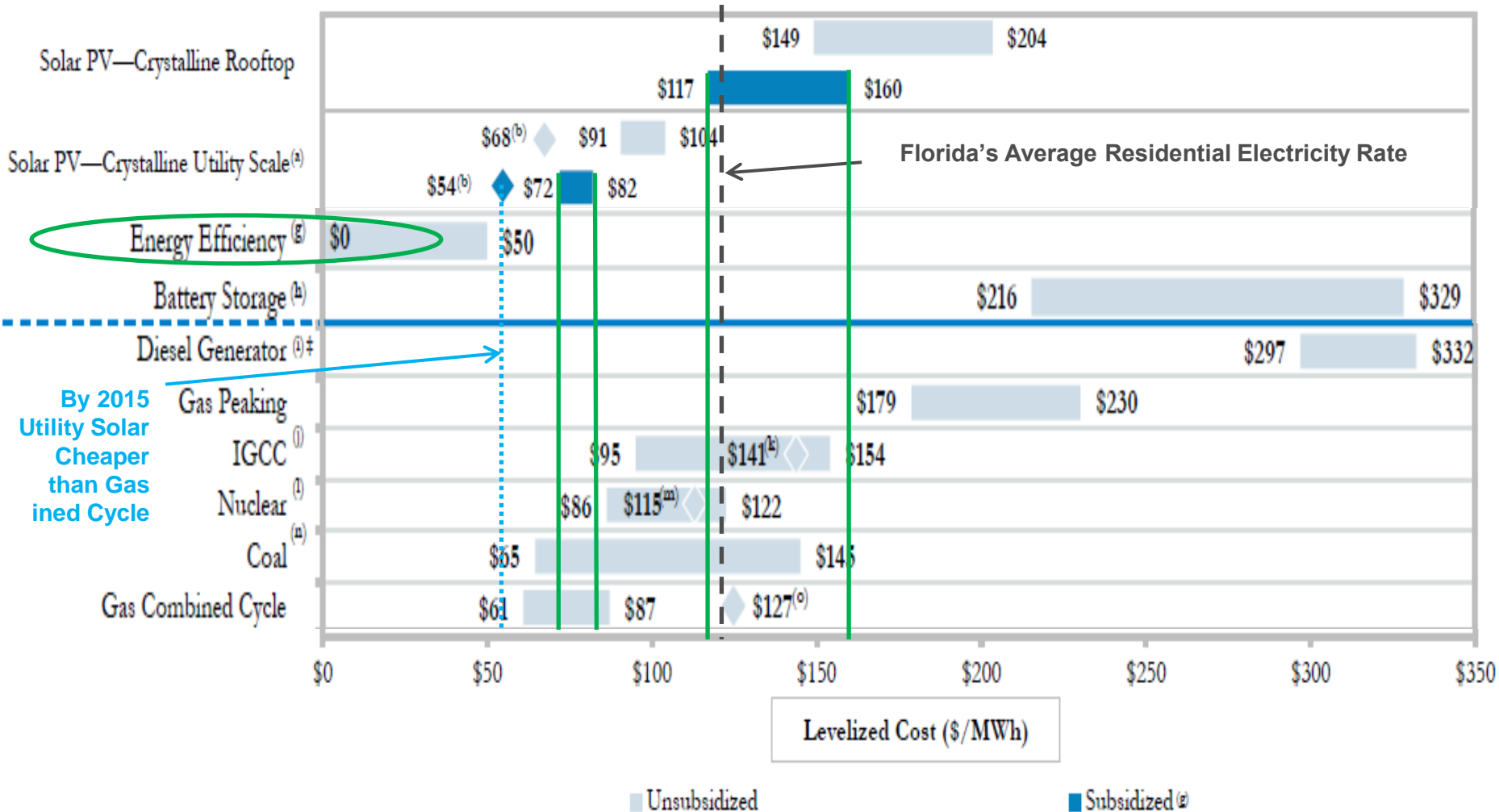


2013 US Solar Data*

- If 2013 was about raising the issue of the future of electricity and utilities, 2014 will be about defining solutions.
- Key Figures
 - **4,751 MW** of solar PV installed in 2013, **up 41%** over 2012
 - **13 GW** in place today (12.1 GW PV & 918 MW CSP)
 - 140,000 individual solar installations in 2013 = **1:1 solar jobs**
 - More solar in the last 18 months than in the 30 years prior
 - Market value of all 2013 PV installations = **\$13.7 billion**
 - Solar = **29%** of all new generation capacity in 2013, 2nd only to natural gas & **100%** of new capacity **in 7 states including IL & MO!**
 - PV system prices **fell 15%** in 2013
 - **26% PV growth** forecast for 2014, most rapidly in **residential**

*www.seia.org

Utility Solar Cheaper than GCC in 2015



Solar Energy Research Focus Areas

- Design, Construction and Operation of Concentrated Solar Power Plant - **Operational**
- Low Cost CIGS and other Thin Film PV Processes
- In-line/Off-line Metrology
- cSi New Feedstock/Wafering Methodologies
- Non-Contact Energy Delivery for PV System
- PV Panel-mounted Micro-inverter
- Integrated PV/Storage and PV/Storage/Lighting Systems and PV EV charging (PV4EV)
- Florida is only state with more than 100, 10-kW photovoltaic systems with battery back-up on emergency shelter schools.

Solar Thermal Power Plant at USF

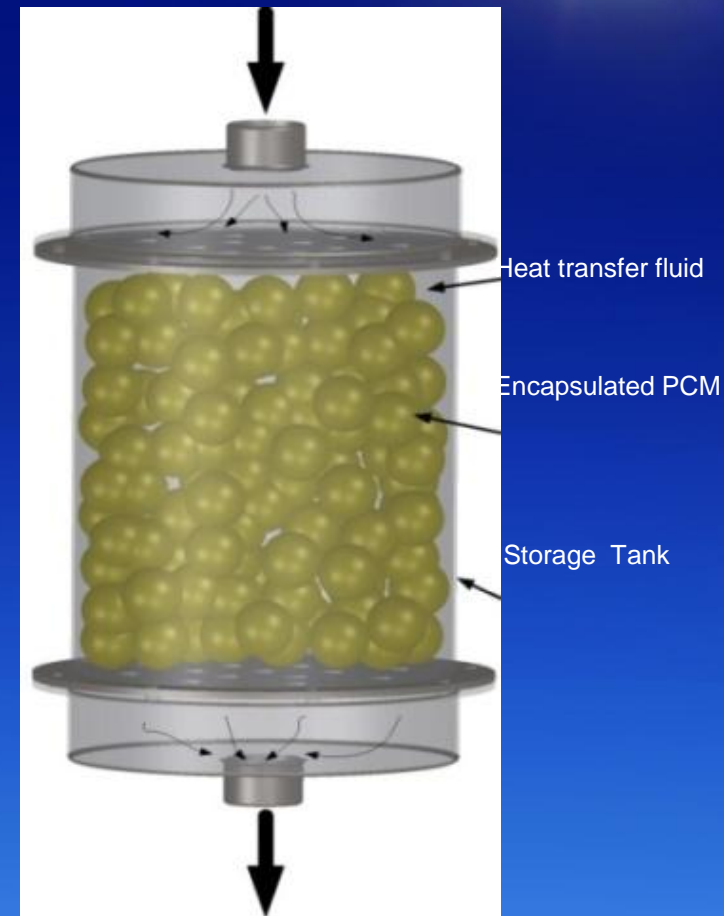


- Serve as a platform to demonstrate technologies developed in the lab
- Facilitate technology transfer to industries
- Serve as a teaching and training facility for students
- Public education



Thermal Energy Storage (USF)

- Developed low cost, industrially scalable capsules of PCMs
- Reduce system costs from $\$80/\text{kWh}_{\text{th}}$ at present to $< \$15/\text{kWh}_{\text{th}}$.
- Utility Scale



Developed with \$7.1 M funding from USDOE, ARPAe, eON, SunBorne Energy, FESC

Innovative Latent Thermal Energy Storage System for Concentrating Solar Power Plants

Technology ready for pilot scale demonstration



Polymer Coated Capsules to 300°C



Metalized Capsules to 450°C



Ceramic Coated Capsules to 1000°C



Flexible Polymer Solar Modules by roll-to-roll Printing



14"x14" polymer solar modules have been printed. 12 cells are connected.

UF's Franky So collaborating with Frederik Krebs, RISO, Denmark

USF Thin Film PV Research

D. L. Morel and C. S. Ferekides

Photovoltaic Solar Cells

- Organic solar cells
- Amorphous Si solar cells
- CIGS and other I-III-VI₂ solar cells
- II-VI solar cells(world record efficiency for CdTe)
- Tandem solar cells
- Solar cell modeling and simulation

Other Devices

- TFT, memory devices, x and Y-ray detectors, LED

Experience/Funding

- Over 60 years combined experience in solar cell R&D
- Over \$10 MM funding from NREL/DOE/NASA/NSF

U.S. Photovoltaic Manufacturing Consortium (PVMC)

- DOE decided it needed a similar SEMATECH model for the PV Industry
- Led by SEMATECH in partnership with CNSE (College of Nanoscale Science and Engineering) and UCF (University of Central Florida)
- Overall investment of ~\$300M over 5 years from DOE and matching funds



Initial PVMC cSi Program Areas

\$14.3M of DOE and industry/partner matching funding

In-line/Off-line Metrology

Primary Goals

- Identify critical industry needs in metrology and rank
- Develop projects to demonstrate new cSi metrology technologies
- Transition new metrology technologies into pilot and manufacturing lines

New Feedstock/Wafering Methodologies

Primary Goals

- Identify necessary feedstock/wafering targets for \$/W
- Establish cSi feedstock/wafering programs to accelerate transition of new technologies into mainstream manufacturing
- Provide and foster process, test, and demonstration activities to validate new technologies and identify technical barriers



Energy Researchers & Engineers **FUEL LOCAL ECONOMY**

Research from the Florida Solar Energy Center (FSEC) and the College of Engineering and Computer Science (CECS) is helping the nation's transportation planners prepare the nation's highways for an influx in plug-in electric vehicles. The \$9 million grant funds the Electric Vehicle Transportation Center, located at the FSEC in Cocoa. The center will also focus on developing smart grid applications so that users of electric vehicles will have adequate power supplies.

DOT's EVTC (UCF)

Other successful collaborations between the CECS and FSEC include revamping the nation's energy grid in preparation for alternative energy sources and training the future workforce to develop and operate needed technologies. With a \$3.2 million grant from the U.S. Department of Energy, UCF is leading a team from throughout the southeast to develop research and training programs to prepare for a more energy-efficient future.

(UCF, UF, FSU)

DOE's FEEDER



UCF's FSEC Programs in Energy



FEEDER Foundations for Engineering Education
for Distributed Energy Resources

>100, 10-kW PV systems with battery back-up on emergency shelter schools



ENERGYWHIZ

Connecting Schools, Teachers and Students with Solar Energy.

See Solar In Action

Map View ▶ Select a Florida School ▶

- All
- Progress Energy
- FPL
- Alachua
- Broward

- Abess Park Elementary School
- Alta Vista Elementary
- Apollo Elementary
- Arlington Middle School
- Boynton Beach Community High School
- Brevard Community College

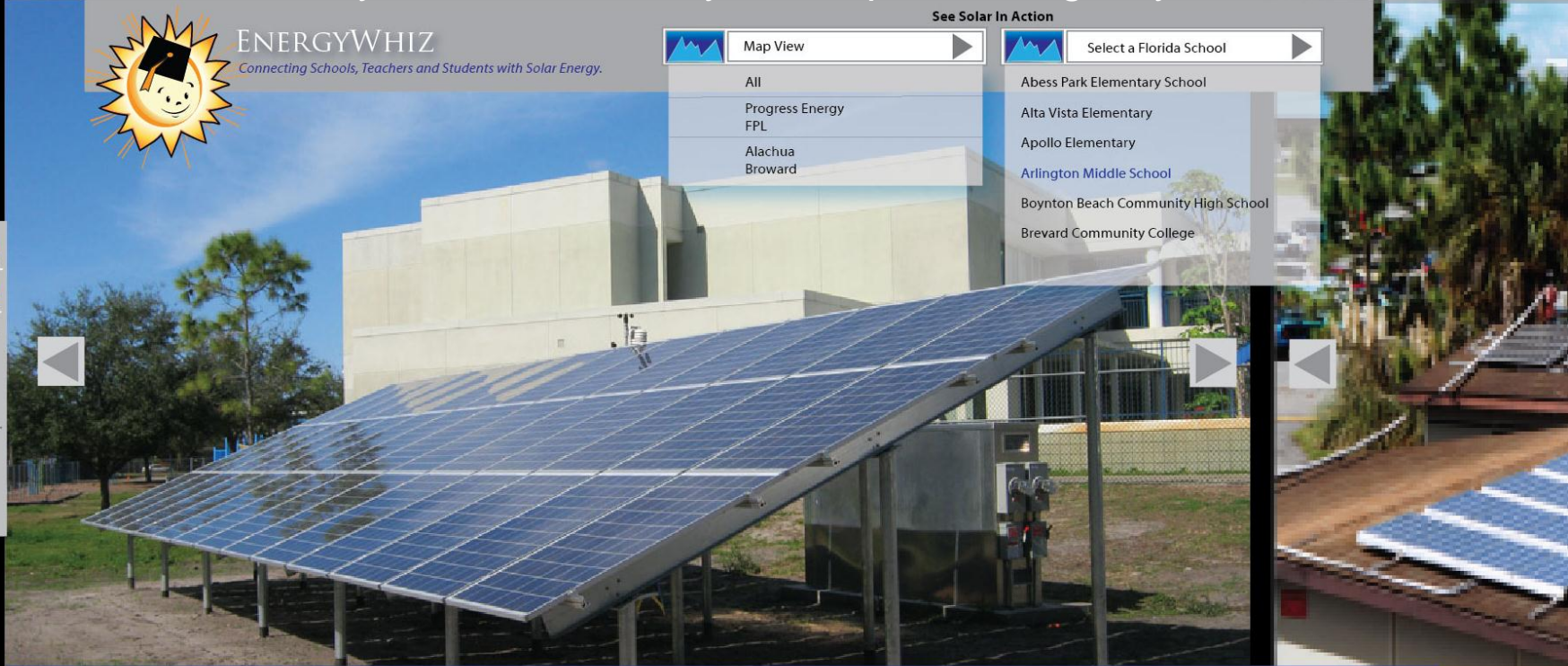
Date: From - To ▼

Jan -17-2013 📅

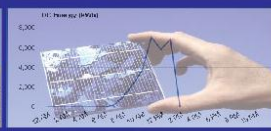
Jan -17-2013 📅

Hourly/Daily/Monthly ▼

Download Data ▼



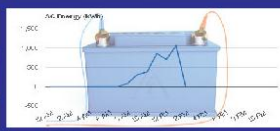
Irradiance



DC Energy Data



AC Energy Data



Battery voltage

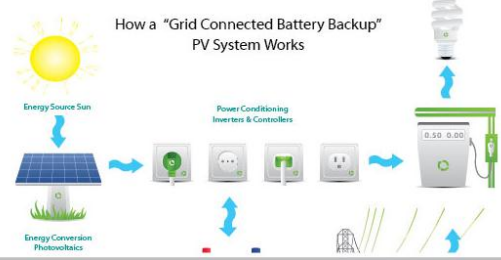


Photos

Site Name: Fairmount Park Elementary

City: St. Petersburg, FL
 County: Pinellas
 Latitude: 27.7653
 Longitude: -82.6889
 Comissioned: 2012-02-01
 System Size: 10.08 kW
 Array Area: 50 sq. ft.
 Utility: Progress Energy

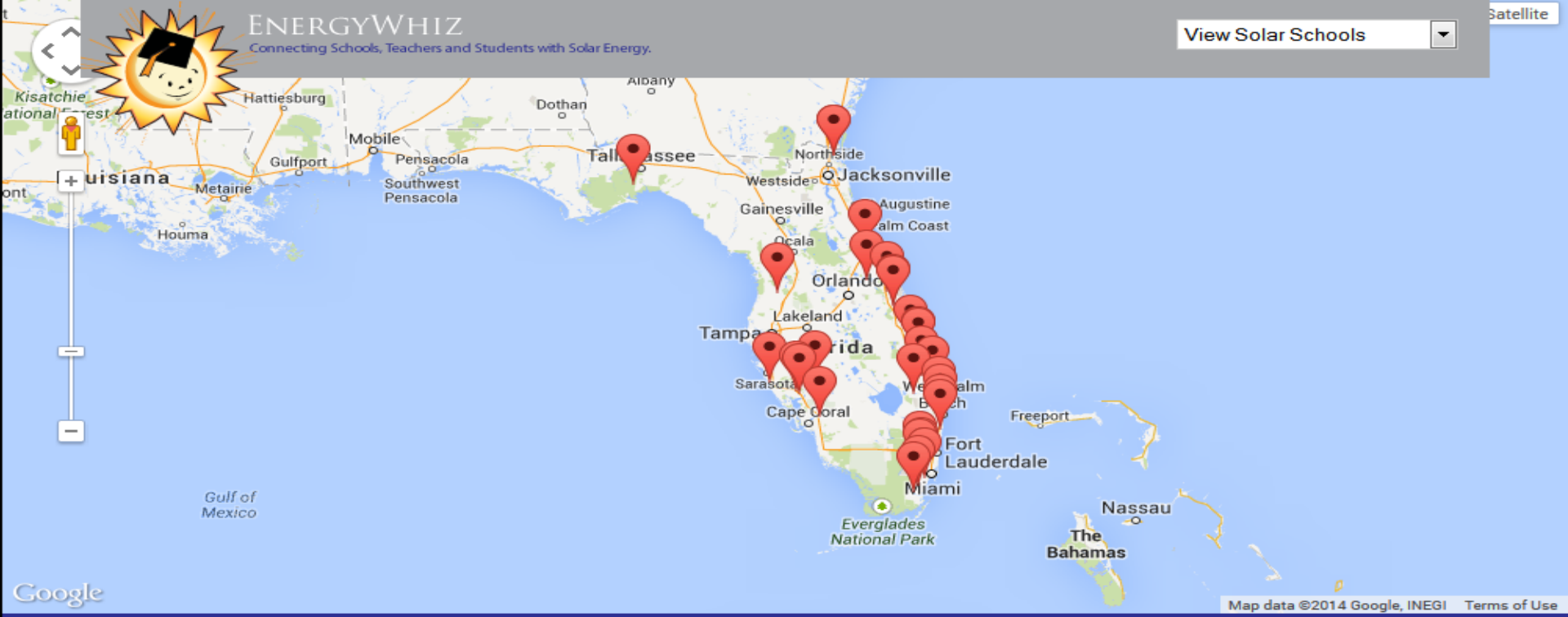
How a "Grid Connected Battery Backup" PV System Works



Daily Program Performance Stats

AC Energy Generated	70 kWh
Dollars Saved	\$36.89
Carbon Saved	990 tons

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 Developed and Maintained by the Florida Solar Energy Center, a research institute of the University of Central Florida.
 EnergyWhiz Schools energy data is part of the SunSmart Schools E-Shelter Program, which is supported by the U.S. Department of Energy and the Florida Department of Agriculture and Consumer Services under the American Recovery and Reinvestment Act, 2010-2012.



Google

Map data ©2014 Google, INEGI Terms of Use

Home > Data > EnergyWhiz Sites

EnergyWhiz Schools:

Site Name	City	County	Utility	System Size
Apollo Elementary	Titusville	Brevard	FPL	10.08 (kW)
Atlantic Community High School	Delray Beach	Palm Beach	FPL	10.08 (kW)
Atwater Elementary School	North Port	Sarasota	FPL	10.08 (kW)
Bayshore Elementary School	Port St. Lucie	St. Lucie	FPL	10.08 (kW)
Bayside High School	Palm Bay	Brevard	FPL	10.29 (kW)
Boynton Beach Community High School	Boynton Beach	Palm Beach	FPL	10.08 (kW)
Brevard Community College	Cocoa	Brevard	FPL	10.08 (kW)
Champion Elementary	Daytona Beach	Volusia	FPL	10.08 (kW)
Crawfordville Elementary School	Crawfordville	Wakulla	FPL	10.08 (kW)
DeSoto Middle School	Arcadia	DeSoto	FPL	10.08 (kW)
Endeavour Elementary Magnet School	Cocoa	Brevard	FPL	10.08 (kW)
Everglades High School	Miramar	Broward	FPL	10.08 (kW)
Geneva Elementary	Geneva	Seminole	FPL	10.08 (kW)
Hernando High School	Brooksville	Hernando	FPL	10.08 (kW)
Hialeah Gardens Senior High School	Hialeah Gardens	Miami-Dade	FPL	10.08 (kW)
Kingsway Elementary	Port Charlotte	Charlotte	FPL	10.08 (kW)
Oak Hammock Middle School	Fort Myers	Lee	FPL	10.08 (kW)



FPL®

FPL, one of the largest rate-regulated electric utilities in the country, is a subsidiary of NextEra Energy, Inc. and serves approximately 4.6 million customer accounts in Florida. FPL has partnered with the SunSmart Schools Program and 29 schools all over Florida from October 2011 through October 2012.



EXTRA SLIDES

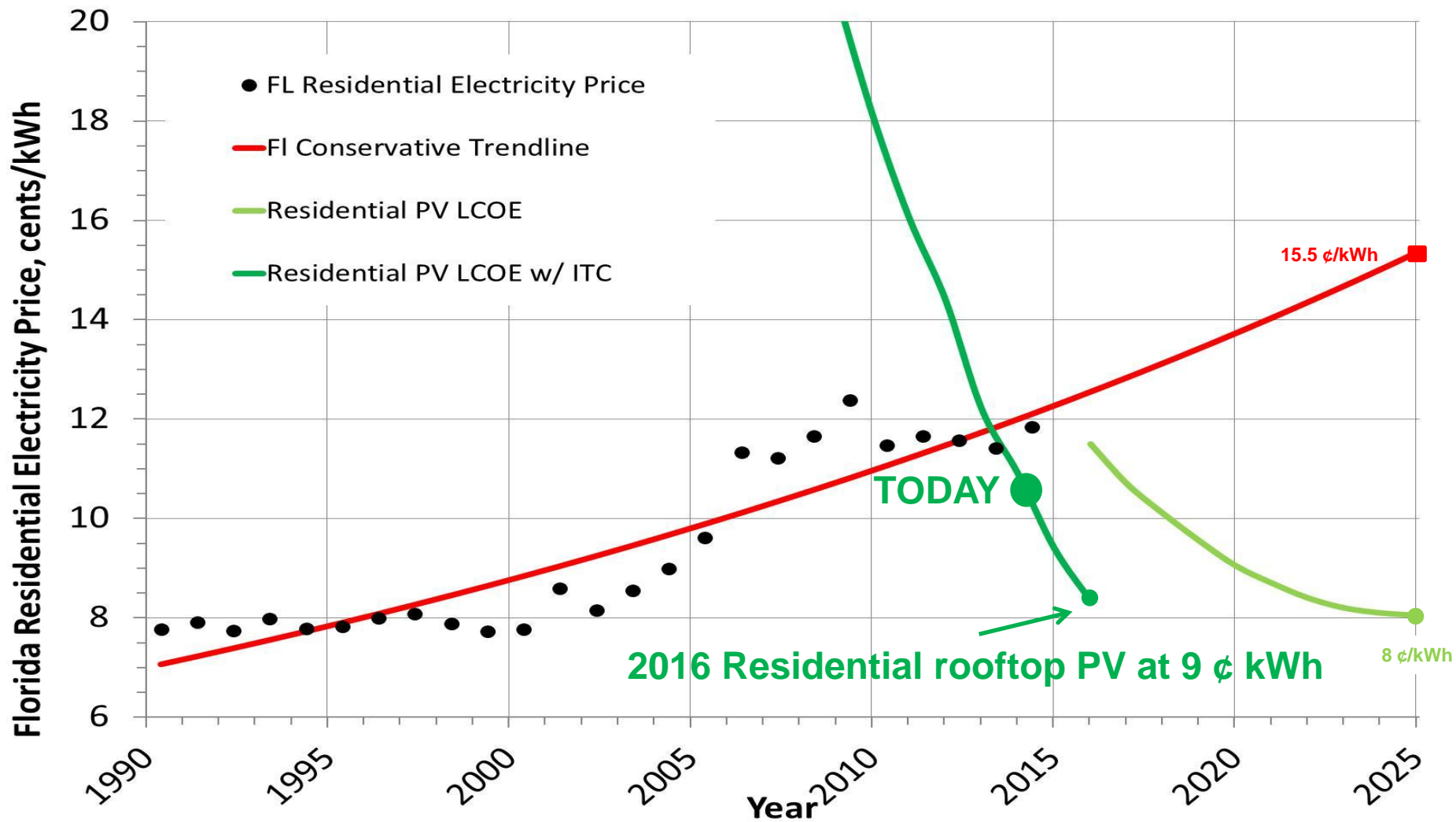
We are like tenant farmers chopping down the fence around our house for fuel when we should be using Nature's inexhaustible sources of energy.....



..... I'd put my money on the sun and solar energy.
What a source of power! I hope we don't have to wait until oil and coal run out
before we tackle that.

Thomas Edison (1931)⁵

PV Grid Parity?



Florida Least Cost Potential 16,350 MW residential PV in 2016

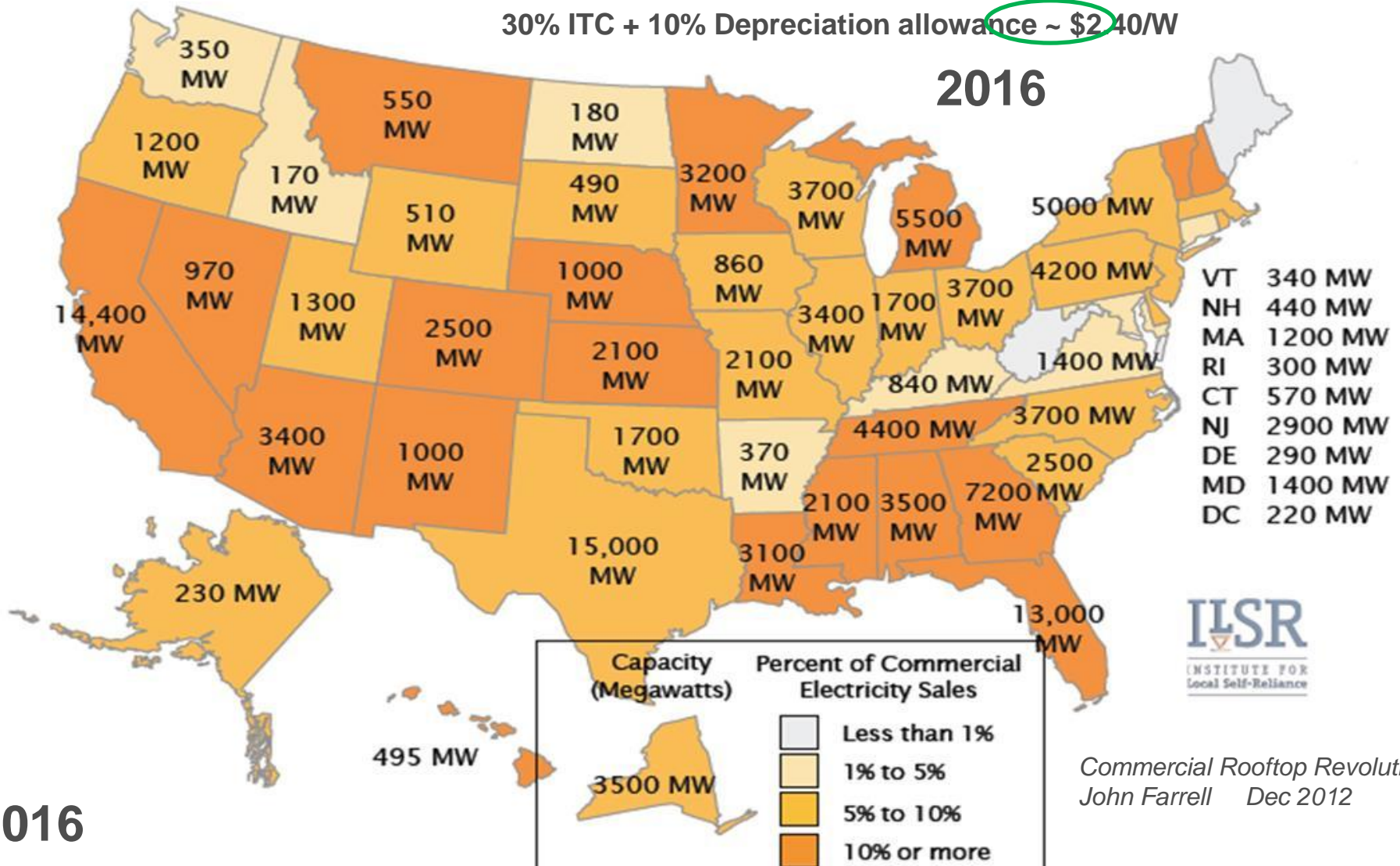
5 kW/resident leads to 3.3M residences, 1.5 voters/resident ~ 4.9 Million voters

<http://www.ilsr.org/wp-content/uploads/2012/12/commercial-solar-grid-parity-report-ILSR-2012.pdf>

Energy Potential from Federally Subsidized \$3/W Commercial Solar (Capacity and % of Sales)

30% ITC + 10% Depreciation allowance ~ \$2.40/W

2016



2016

Commercial Rooftop Revolution
John Farrell Dec 2012



Florida Least Cost Potential 16,350 MW residential & 13,430 MW commercial PV (14% FL's electricity)

5 kW/resident leads to 3.3M residences, 1.5 voters/resident ~ 4.9 Million voters

<http://www.ilsr.org/wp-content/uploads/2012/12/commercial-solar-grid-parity-report-ILSR-2012.pdf>

<http://www.ilsr.org/projects/solarparitymap/>

2013 New US Generation, MWs

0 1000 2000 3000 4000 5000 6000 7000 8000 9000

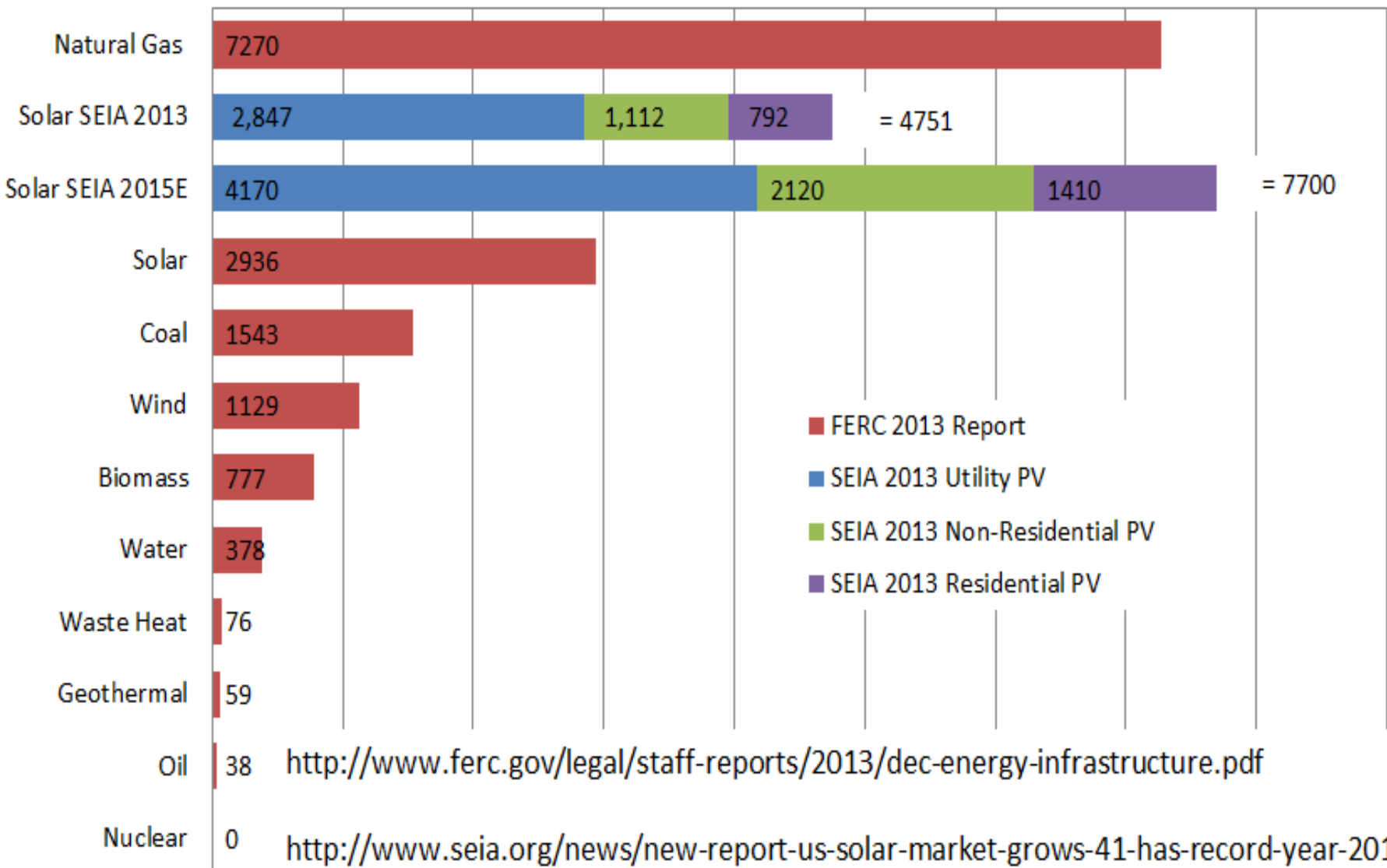
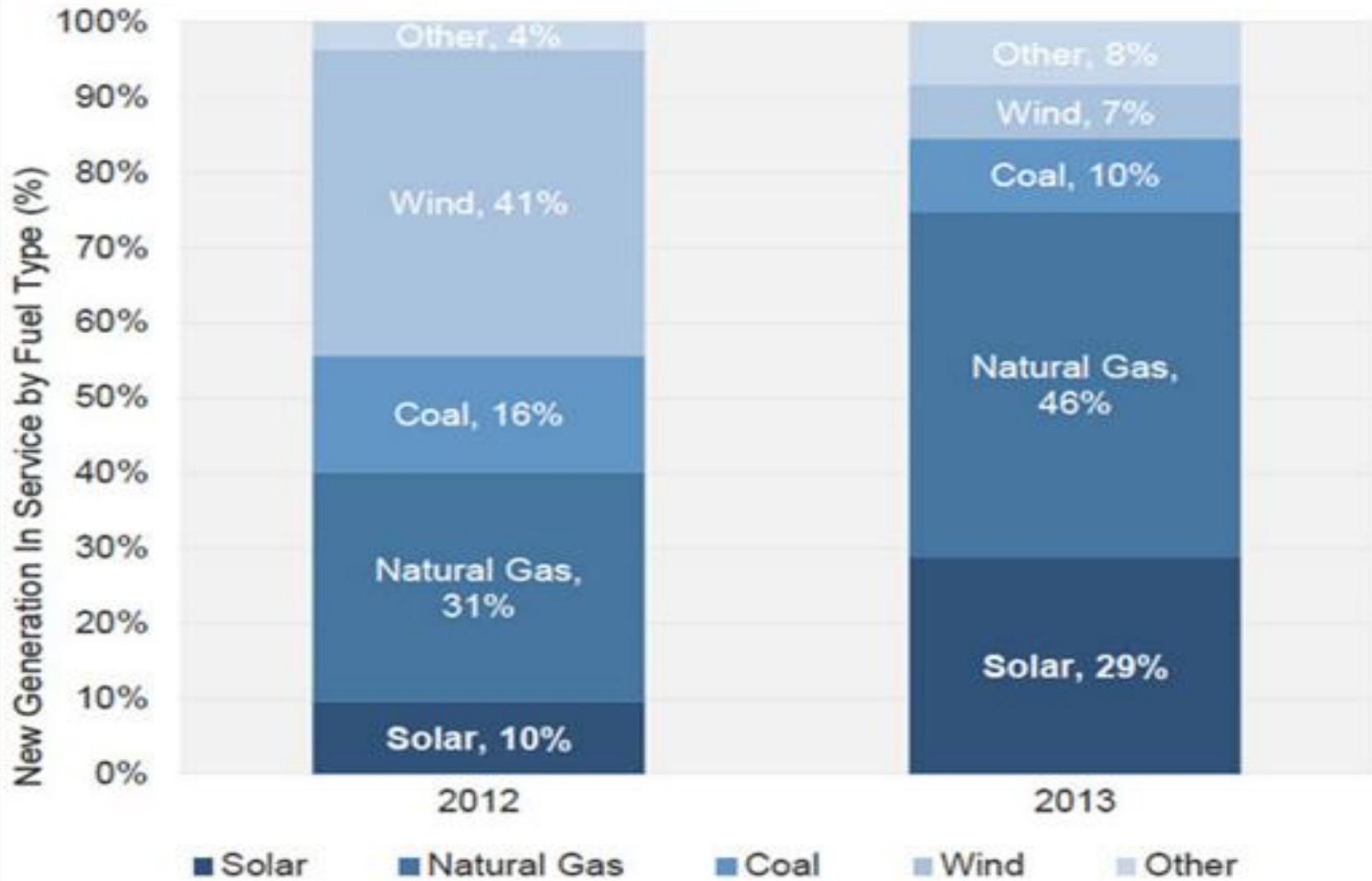


Figure 1.1 New U.S. Electricity Generation Capacity, 2012 vs. 2013





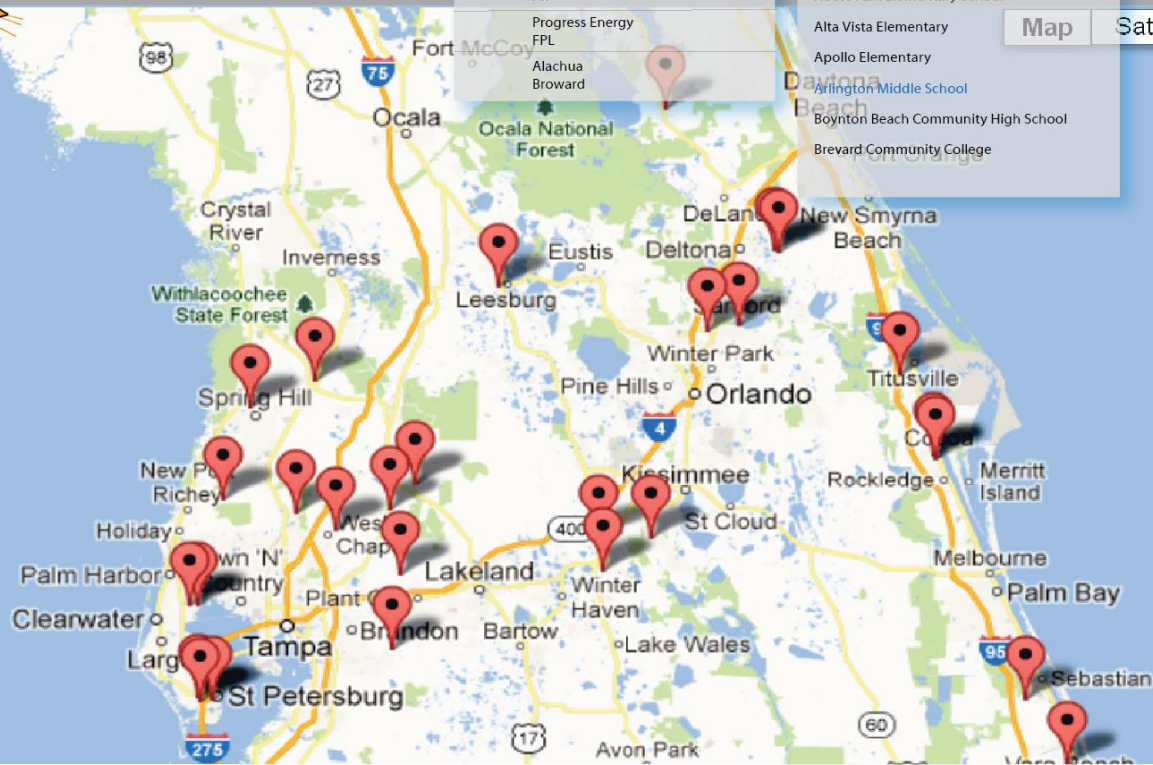
Map View

Select a Florida School

- All
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- Alachua
- Broward

- Abess Park Elementary School
- Alta Vista Elementary
- Apollo Elementary
- Arlington Middle School
- Boynton Beach Community High School
- Brevard Community College

Map Satellite



EnergyWhiz Schools:

Site Name	City	County	Utility	System Size
A. Crawford Mosley High School	Lynn Haven	Bay	Progress Energy	10 kWh
Jinks Middle School	Panama City	Bay	Progress Energy	10 kWh
Starke Elementary School	Starke	Bradford	Progress Energy	10 kWh
Everglades High School	Miramar	Broward	Progress Energy	10 kWh
Kingsway Elementary School	Port Charlotte	Charlotte	Progress Energy	10 kWh
Pinecrest Elementary School	Immokalee	Collier	Progress Energy	10 kWh
Eden Park Elementary School	Immokalee	Collier	Progress Energy	10 kWh
DeSoto Middle School	Arcadia	DeSoto	Progress Energy	10 kWh
Abess Park Elementary School	Jacksonville	Duval	Progress Energy	10 kWh
Arlington Middle School	Jacksonville	Duval	Progress Energy	10 kWh
LaVilla School of the Arts	Jacksonville	Duval	Progress Energy	10 kWh
Bellview Elementary	Pensacola	Escambia	Progress Energy	10 kWh
Lipscomb Elementary	Pensacola	Escambia	Progress Energy	10 kWh
East Gadsden High School	Havana	Gadsden	Progress Energy	10 kWh

Daily Program Performance Stats

AC Energy Generated	70 kWh
Dollars Saved	\$36.89
Carbon Saved	990 tons
No. of Schools Online	90

Progress Energy

Progress Energy has been a partner of the SunSmart Schools program since 2010. They have expanded the program and developed their own SunSense Schools Program. An additional 30 schools now have photovoltaic systems. Their monitored energy data is included on the EnergyWhiz website.

Materials/Devices Investigated

Photovoltaic Solar Cells

- Organic solar cells
- Amorphous Si solar cells
- CIGS and other I-III-VI₂ solar cells
- II-VI solar cells(world record efficiency for CdTe)
- Tandem solar cells
- Solar cell modeling and simulation

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