



Energy Efficiency, Renewable Energy and Green Jobs



Creating Energy Independence Since 1975

Dr. James Fenton, Director of the Florida Energy Center (FSEC)



Practicing What We Preach

A Research Institute of the University of Central Florida

Why Energy Efficiency and Renewable Energy?



- 1) Our geologists and hydrologists tell us that world oil and gas production is peaking
- 2) Our climate scientists tell us that our burning of fossil fuels is causing our climate to warm
- 3) Our economists tell us that aggressive action to curb global climate change will cost us 2-5% of global GDP

But . . .

That doing nothing will cost us about 20% of global GDP!



*The American Home**



- ❖ 107 million residential units in 2001
- ❖ 10,700 kWh a year in electricity
- ❖ 700 Therms Natural gas
 - or 730 gallons Fuel oil
 - or 488 gallons LPG
- ❖ ~12.5 tons of CO₂
- ❖ About 8.3 tons from electricity
- ❖ Represents 21% of U.S. primary energy use
- ❖ **Most Important:** about two-thirds of all buildings that will be in use in 2050 are already built.



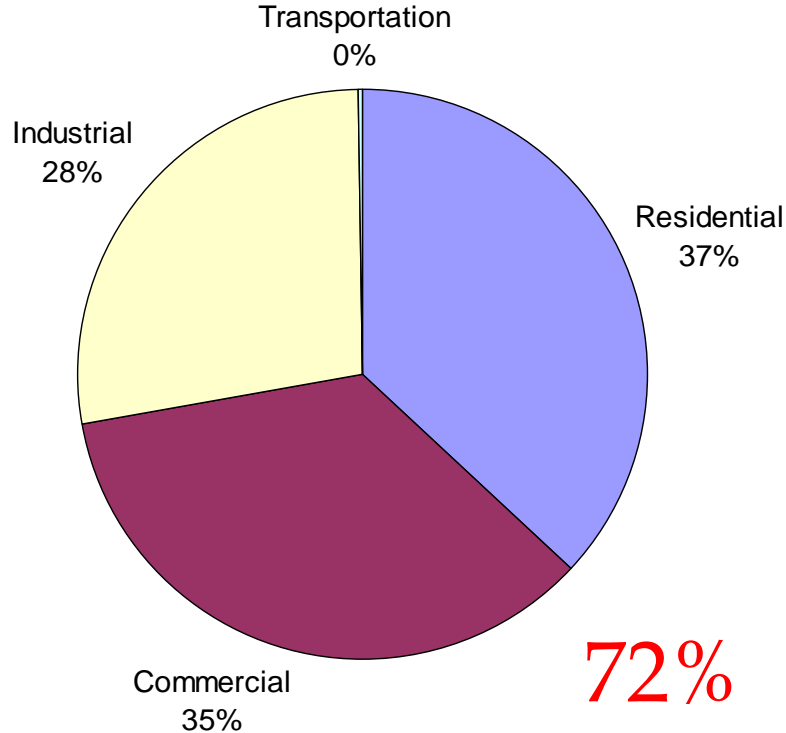
*RECS 2001: <http://www.eia.doe.gov/emeu/recs/>



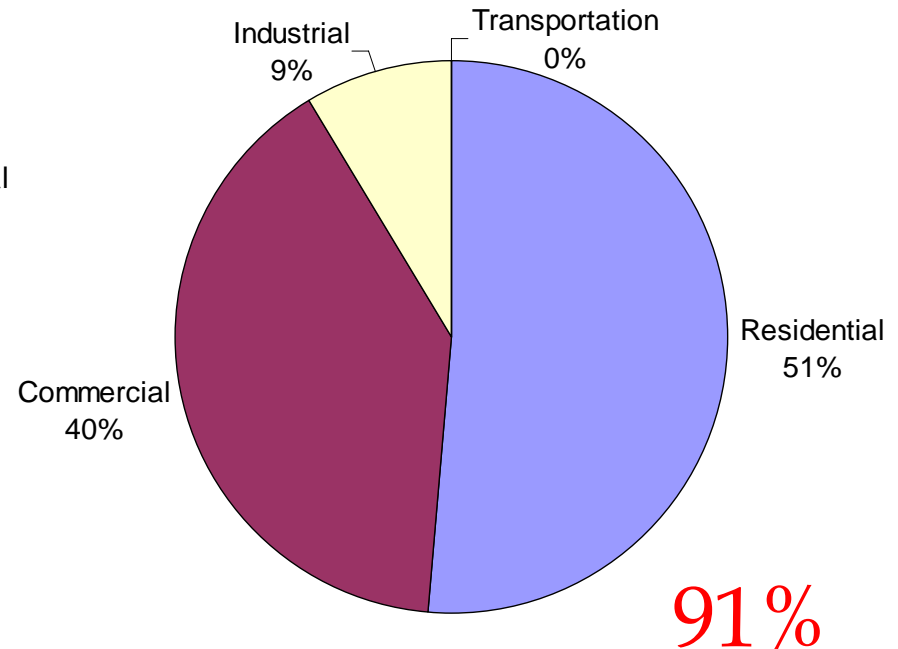
Residential Dominates use of Electricity



**U.S. 2006 Electric Sales by Sector
(3,670 TWh)**



**Florida 2006 Electric Sales by Sector
(228 TWh)**



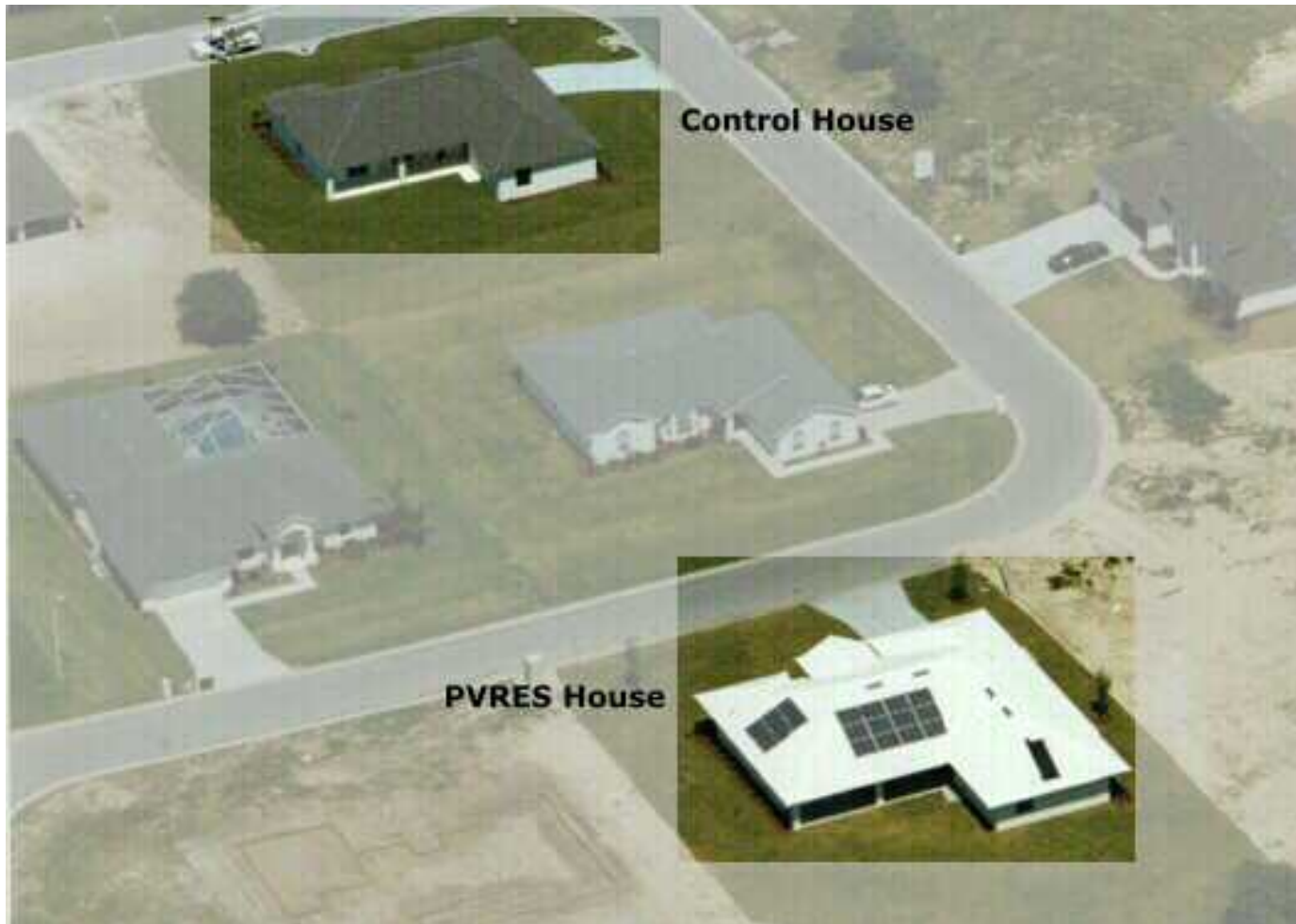
Source: EIA, "Retail Sales of Electricity to Ultimate Customers: Total by End-Use Sector"



The Art of the Possible

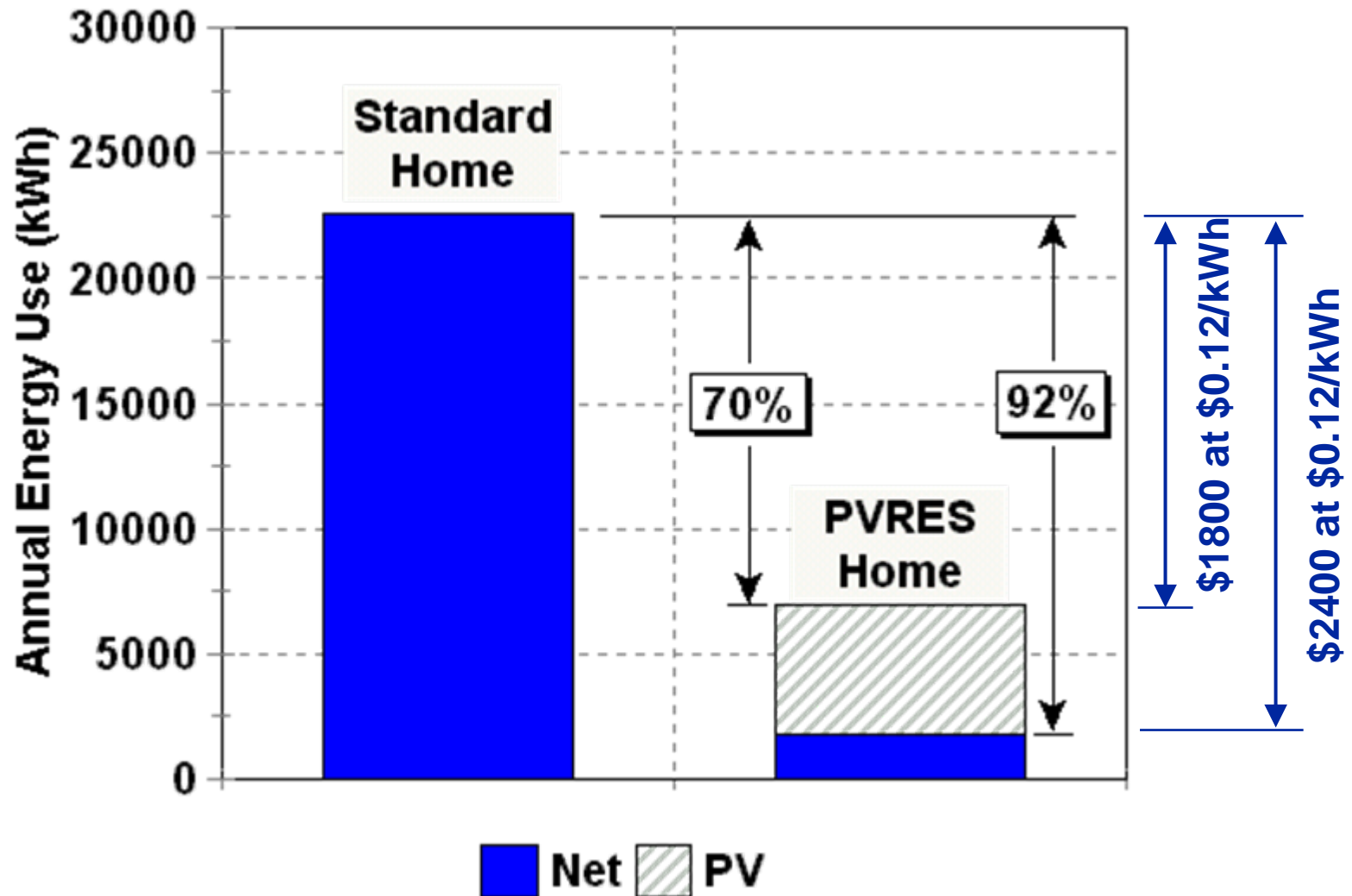


The Lakeland, Florida, House Project



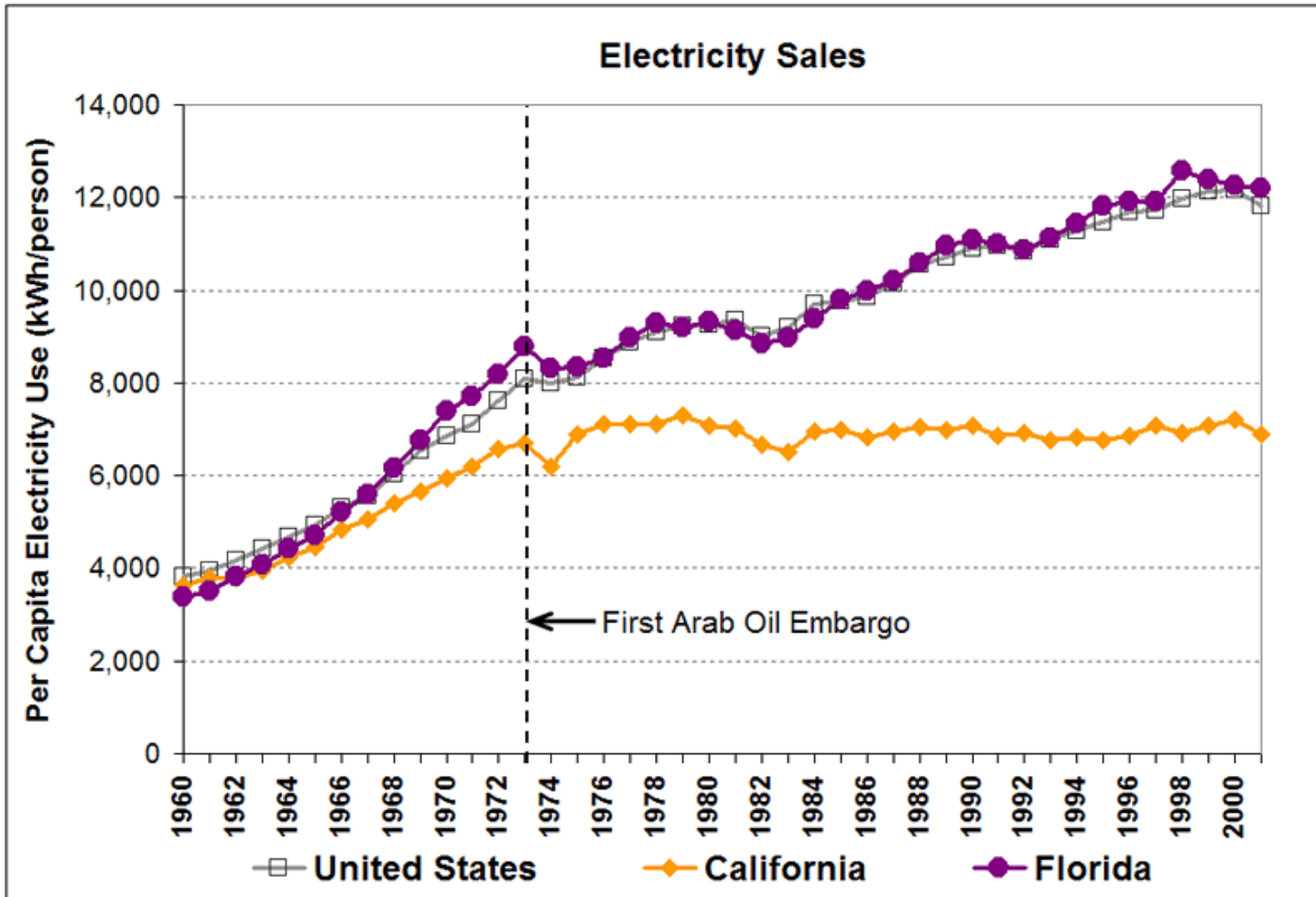


Efficiency First





California went Efficiency First Then it had a Million Solar Roofs





Florida's Cleanest and Cheapest Energy is Available Now



- ❖ Efficiency First – The least expensive kWh is the one that we do not use (or produce)
- ❖ New homes (~150,000 per year in FL) can cost effectively achieve almost 40% greater efficiency than 2007 code requirements¹
- ❖ Existing homes (8.5 million in FL) can be cost effectively improved by approximately 30%¹
- ❖ Achieving even a modest part of this cost-effective efficiency would result in 53 billion kWh savings at a levelized cost less than 8¢kWh (paying 12.5 ¢kWh today).¹

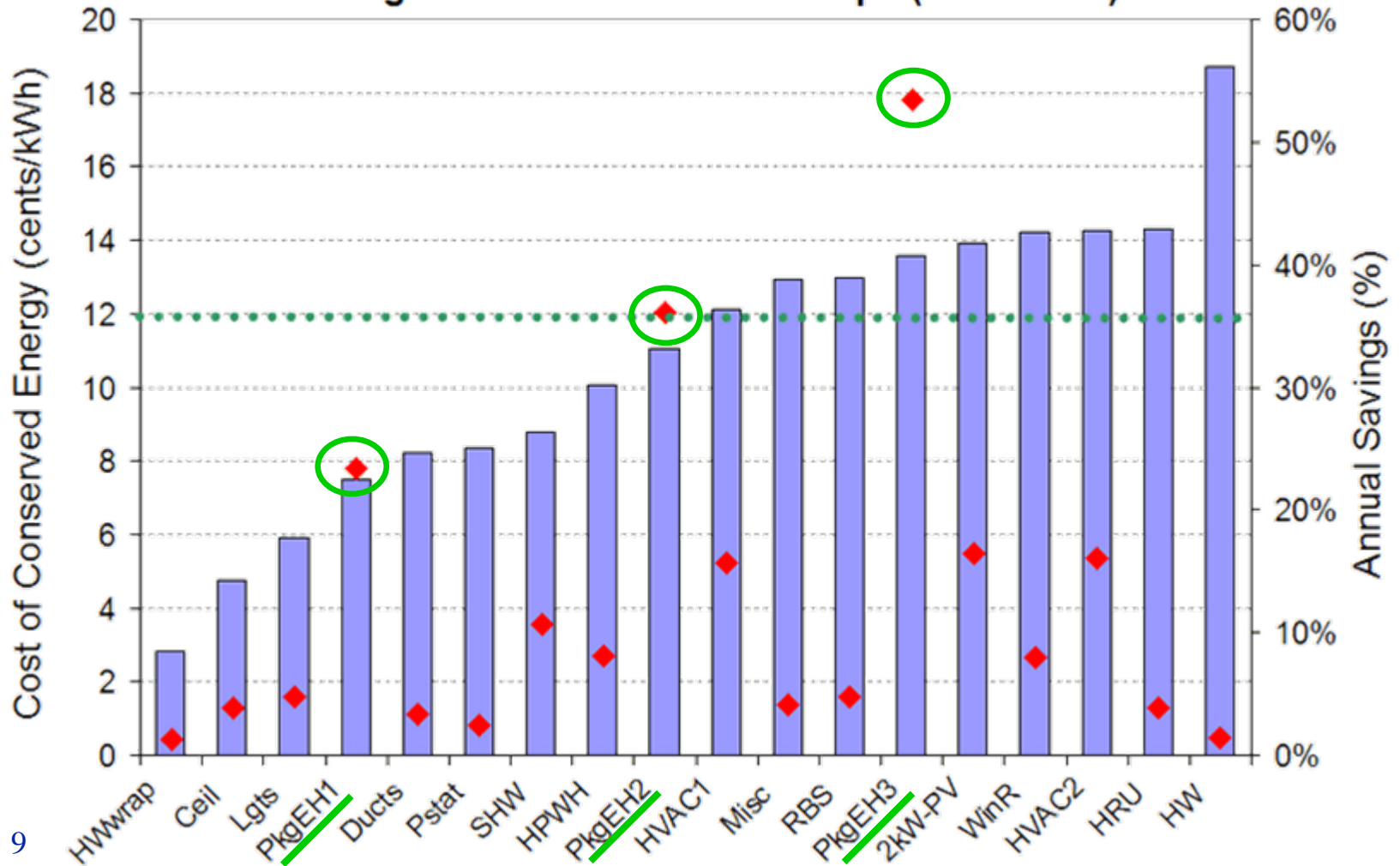
¹ ACEEE, 2007. *Potential for Energy Efficiency and Renewable Energy to Meet Florida's Growing Energy Demands*



Existing Home Potentials at Full Costs (2007)



Existing Home Measures for Tampa (Full Costs)





Improvement Packages



PkgEH1 (23% savings):

- ❖ Leak free ducts
- ❖ R-18 → R-30 ceilings
- ❖ **Solar hot water system**
- ❖ 50% CFL lights
- ❖ Programmable T-stat

PkgEH2 (36% savings):

- ❖ Leak free ducts
- ❖ R-18 → R-30 ceilings
- ❖ **Solar hot water system**
- ❖ 50% CFL lights
- ❖ Programmable T-stat
- ❖ SEER-15 / HSPF-9

PkgEH3 (54% savings):

- ❖ Leak free ducts
- ❖ R-18 → R-30 ceilings
- ❖ **Solar hot water system**
- ❖ 50% CFL lights
- ❖ Programmable T-stat
- ❖ SEER-15 / HSPF-9
- ❖ High-performance windows
- ❖ R-0 → R-10 walls
- ❖ White walls & shingles
- ❖ Energy Star refrigerator
- ❖ Reduced plug loads



Solar Water Heating



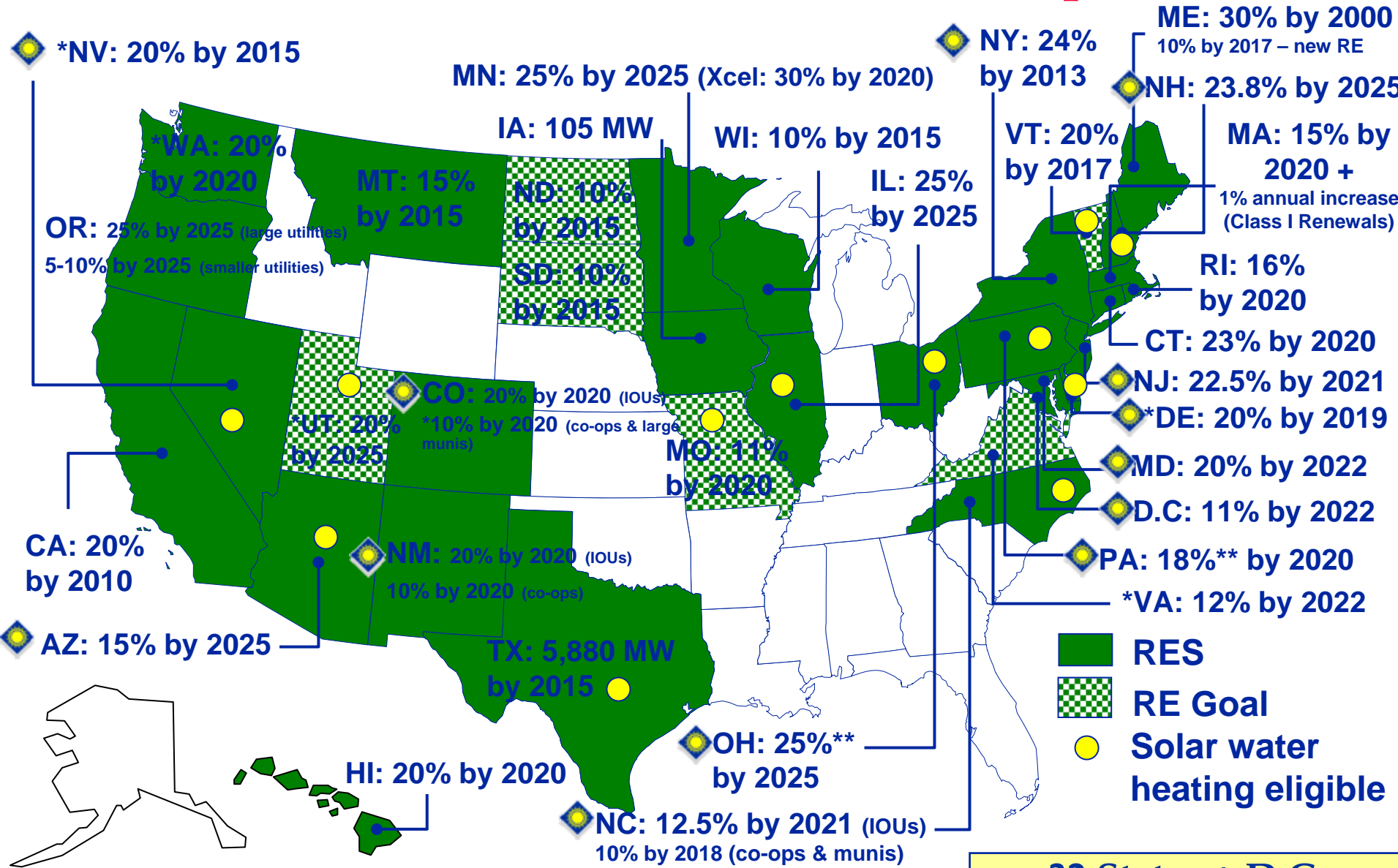


Solar Electric -Photovoltaics



Renewable Portfolio Standards

September 2008



Minimum solar or customer-sited RE requirement.

*Increased credit for solar or customer-sited RE

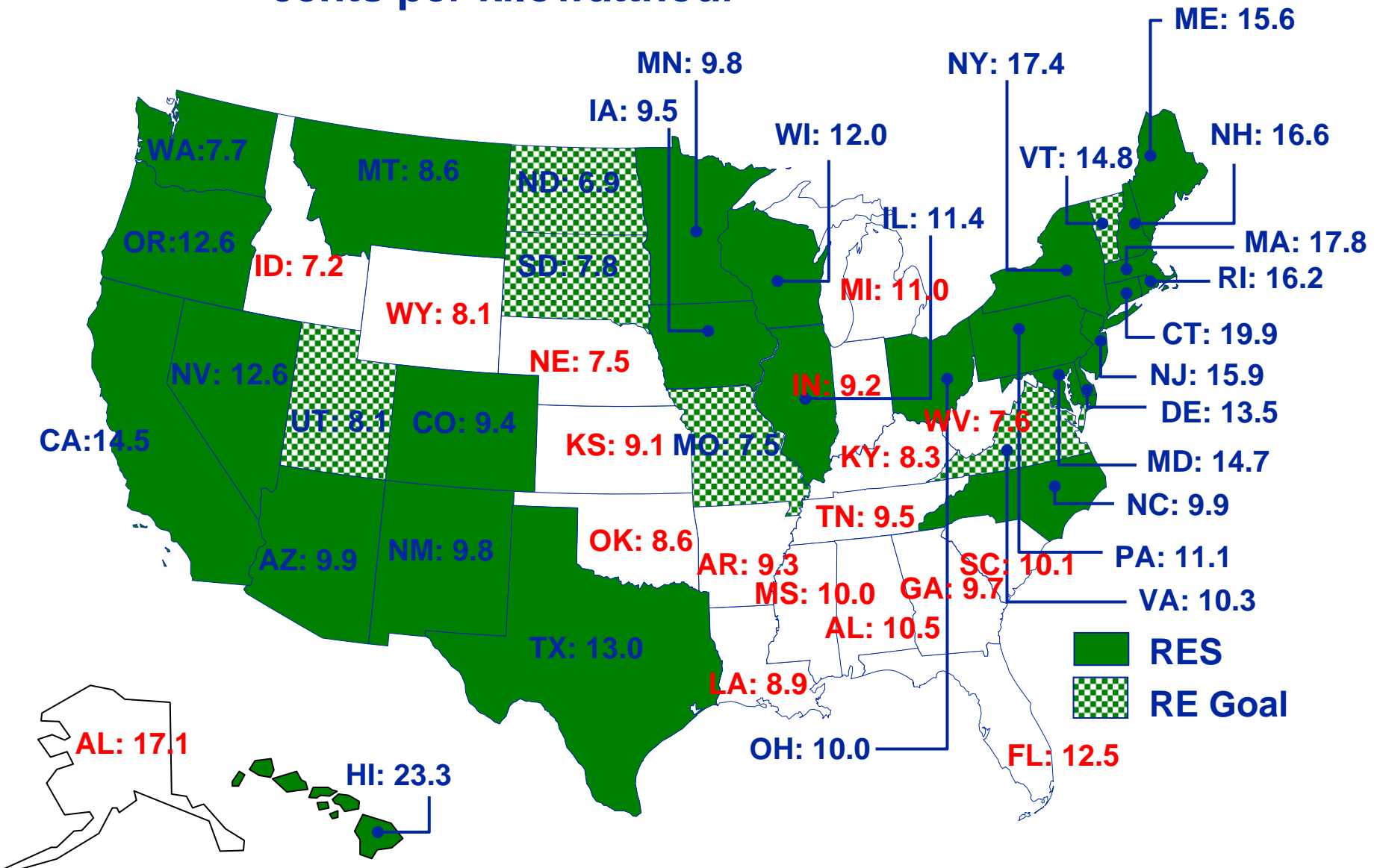
**Includes separate tier of non-renewable "alternative" energy resources

32 States + D.C.

taken from DSIRE: www.dsireusa.org

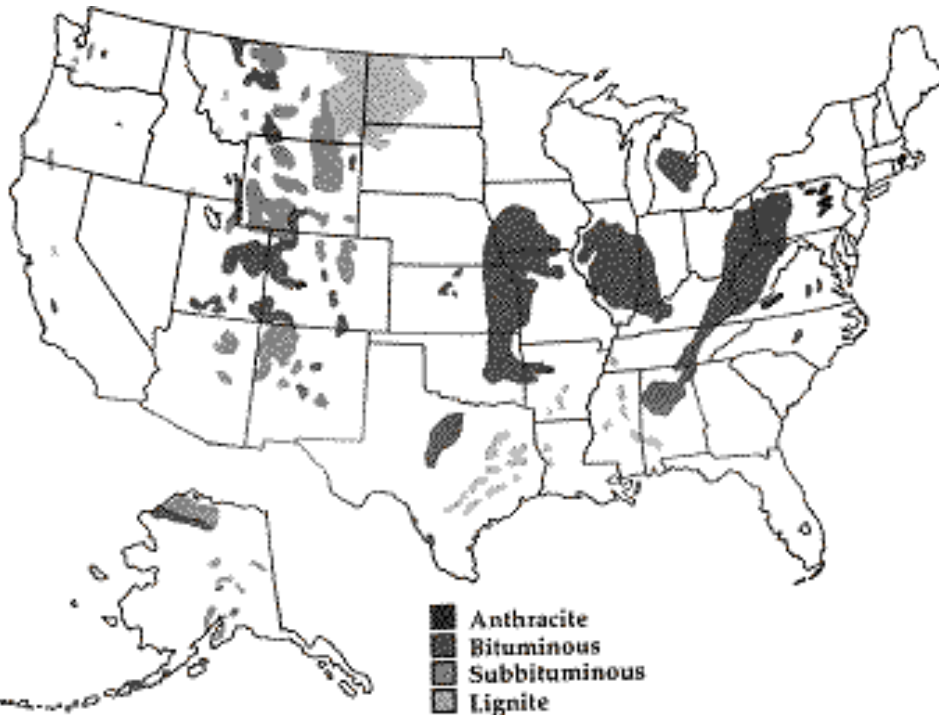
Average Residential Retail Price of Electricity cents per kilowatthour

Year to date April 2009



Electricity from Coal

Reserves as of December 2005



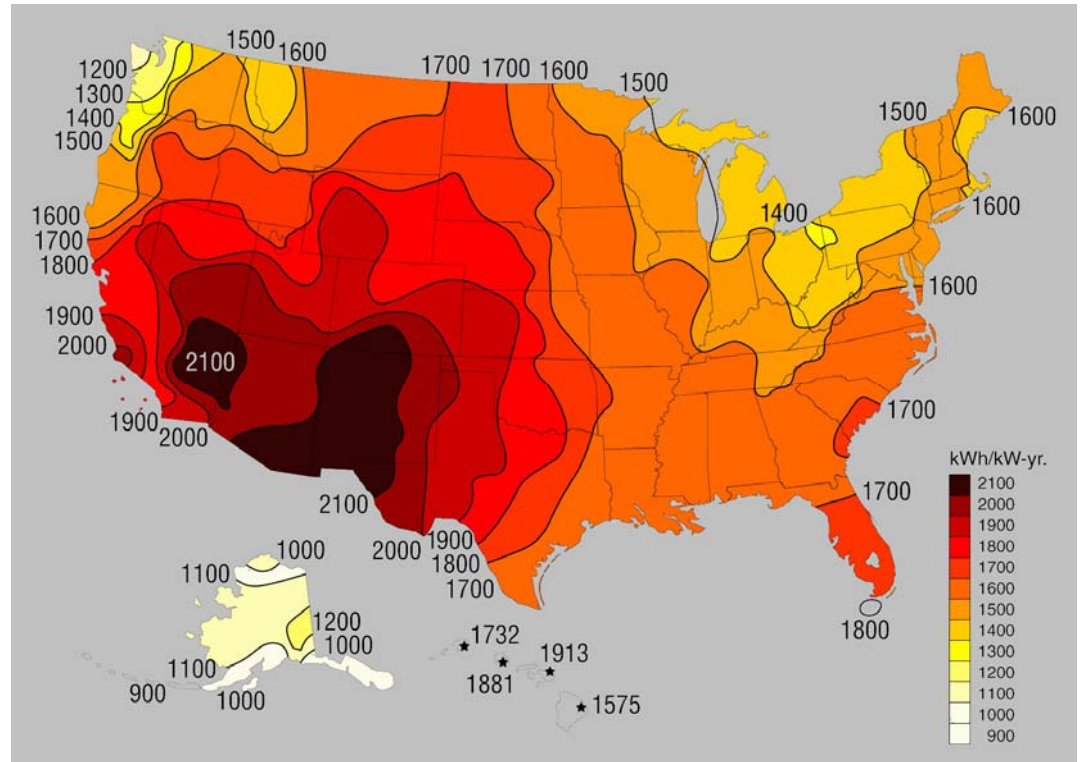
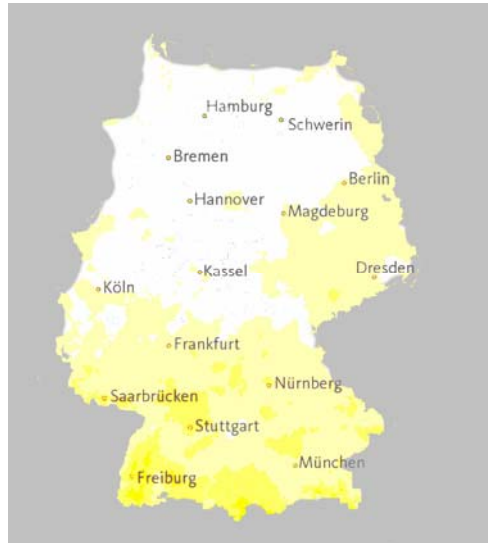
State (2009 res electricity cost kWhr)	Tons (billions)	% of U.S.
Montana (8.6¢)	120	25.4
Illinois (11.4¢)	78	16.5
Wyoming (8.1¢)	68	14.4
West Virginia (7.6¢)	37	8.0
Kentucky (8.3¢)	30	6.3
Pennsylvania (11.1¢)	29	6.1
Ohio (10.0¢)	19	4.0
Colorado (9.4¢)	17	3.6
Texas (13.0¢)	13	2.7
Indiana (9.2¢)	10	2.1
Other States	51	10.9
TOTAL (11.2¢)	472	100.0

Although 90 percent of the country's coal reserves are concentrated in 10 states, coal is mined in 27 states and can be found in even more. Montana has the most coal, 25 percent of demonstrated reserves. Wyoming, third among states with the most coal, is first in coal output, accounting for 18 percent of annual production.



Solar Energy - The Alternative

Most Abundant US Energy Resource



Florida Sunshine Resource 2X Today's Largest Market - Germany



Solar Industries & Jobs



Solar PV

- ❖ Average 13 direct job-years/MW
 - (VS study of 5 models)
- ❖ Industry estimates that:
 - Residential: 10 job-yrs/MW
 - Small Commercial: 9 job-yrs/MW
 - Large Commercial: 7 job-yrs/MW

Benefit of 2% Goal:

- ❖ **31,600 job-years (low)**
- ❖ **50,000 job-years (high)**

**Orange County Convention
Center 1 MW Solar PV**

Solar Thermal

- ❖ One job-year created for every 50 systems installed
- Benefit of 2% Goal:**
- ❖ **32,800 job-years**



Florida's Current Solar Water Heater Production



- ❖ Domestic Solar Water Heater >20 years life
- ❖ >139,000 Solar Water Heaters from 1978 - today each producing >2000 watts
- ❖ =152 MW of Solar Energy
- ❖ If 40% (instead of 2.2%) of Florida Homes by 2020
 - = 2,700 MW
 - = 5 TWh (2%) of Florida's Electricity
 - = **32,800 job-years**



A \$2,300 Investment Provides 20% Return



MYFLORIDA GREEN BUILDING

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- ▶ Programs
- ▶ Profiles
- ▶ Rating Systems
- ▶ Rebates & Incentives
- ▶ Resources
- ▶ Solar

Simplified Residential Solar Hot Water System Calculator

This calculator provides consumer information on the energy, cost and environmental savings potential of residential solar hot water systems in Florida. The calculations and assumptions were modeled on the solar system calculator tool ([SHW-calculator_simple.xls](#), 204k) available for Microsoft Excel and developed by FSEC's Deputy Director, Philip Fairey.

To use this calculator, answer the two questions under the heading "Basic Solar System Information" using the pull-down menus provided. For the input "Florida Climate Zone," if your home is north of Volusia County, select "North" and if your home is south of St. Lucie County, select "South." Otherwise, select "Central."

The calculator depends on a number of pre-selected assumptions. To view and change these assumptions, select the checkbox below and the additional input fields will appear. If you choose to not change these assumptions, simple uncheck the box below anytime.



Basic Solar System Information

Of People Living In Home: Florida Climate Zone:

I'd like to refine the assumptions used by this calculator.

Assumptions Used By This Calculator

Solar System Energy Factor:	<input type="text" value="7.1253"/>	Standard System Type:	<input type="text" value="Electric"/>
Hot Water Use Intensity:	<input type="text" value="Medium"/>	Discount Rate:	<input type="text" value="5.2"/> % per annum
Solar System Cost:	<input type="text" value="4000.00"/>	General Inflation Rate:	<input type="text" value="3.20"/> % per annum
IRS Credit (30% of Cost):	<input type="text" value="Yes"/>	Retail Electricity Price:	<input type="text" value="0.125"/> \$/kWh
FL State Rebate:	<input type="text" value="Yes"/>	Retail Natural Gas Price:	<input type="text" value="2.15"/> \$/therm
FL Utility Rebate Amount:	<input type="text" value="0"/>	Fuel Escalation Rate:	<input type="text" value="2.90"/> % per annum

Solar Savings Results

Annual Energy Cost Savings:	<input type="text" value="\$293"/> \$/year	Annual CO2 Savings:	<input type="text" value="3378"/> lb/year
Annual Solar Energy Savings:	<input type="text" value="2441"/> kWh/year	Annual Solar Fraction:	<input type="text" value="86"/> %

Economic Results

Internal Rate of Return:	<input type="text" value="19.8"/> % per annum	Simple Payback Period:	<input type="text" value="7"/> years
Cost of Solar Energy:	<input type="text" value="5.6"/> cents/kWh	Net Present Value:	<input type="text" value="\$7167"/> present \$'s

Initial cost \$2,300 (\$4,000)
 Cost of Energy 5.6 (10.2) ¢/kWh
 Return on Invest. 19.8 (12.8) %
 Payback 7 (12) years

Even without credits and rebates cheaper than electricity out of the wall at 12.5 ¢/kWh



Solar Hot Water Works at Stadiums. Even in Boston!



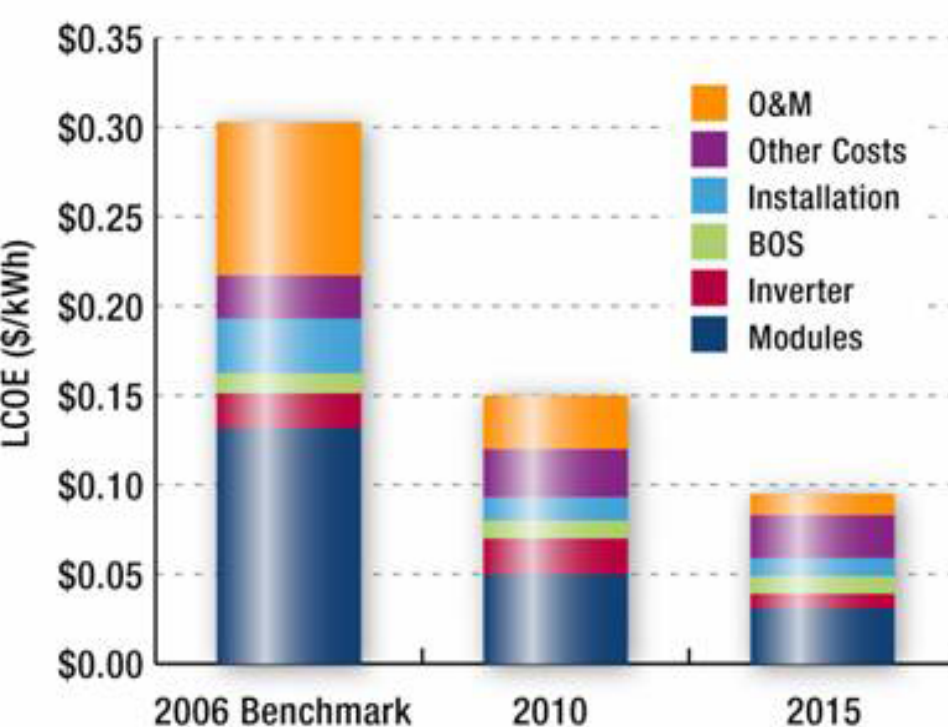
Solar Water Heating System installed by groSolar on Fenway Park provides one third of the stadium's hot water. *Photo Credit: Boston Red Sox*



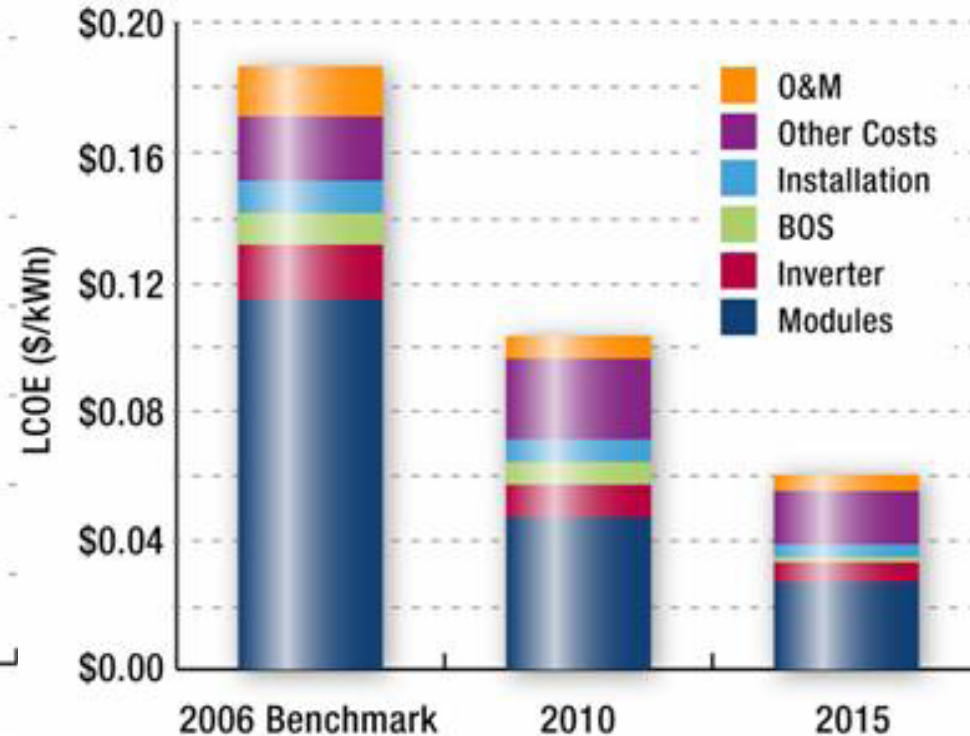
PV Electricity on Your Roof Cheaper than the wall in 2011?



Residential System Targets



Commercial System Targets



In 2006, residential PV at \$7.97/W, an LCOE of ~30¢/kWh over 30-year life.
FL Residential Electricity: 2005 10¢/kWh; 2007 12 ¢/kWh; 2009 12.5 ¢/kWh;
2015 more than PV??



FPL's 110 MW Solar

Space Coast Next Generation Solar Energy Center

10 MW solar photovoltaic facility

Enough power to serve nearly 2,600 people
Innovative partnership with NASA that will leverage engineering, design and operating expertise



DeSoto Next Generation Solar Energy Center

25 MW solar photovoltaic facility

Enough power to serve nearly 7,000 people
Will be the largest solar photovoltaic plant in the world



Martin Next Generation Solar Energy Center

75 MW solar thermal facility

Enough power to serve nearly 26,000 people
Largest solar thermal plant outside of California
The first hybrid solar facility in the world to connect to an existing combined-cycle power plant

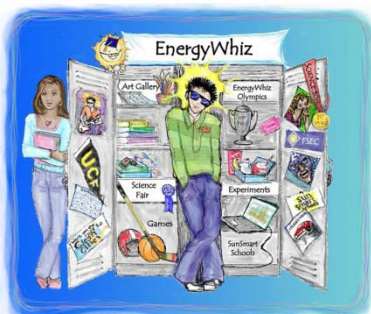


Solar PV on Emergency Shelters



At least 90 PV Florida Shelters

- (>1 per 67 counties)
- >10kW PV
- Grid/battery backup
- Teach students
- EnergyWhiz





Solar as Endorsed by Higher Powers



Questions?





Florida Solar Energy Center



- ❖ Created in 1975 by the Florida Legislature
- ❖ The energy research institute of the state of Florida
- ❖ Mission is research, testing and education
- ❖ More than \$9 - 12 million annually in external contracts and grants
- ❖ The experience, staff (>140) and capabilities to help solve our energy problems and help meet our energy needs
- ❖ Began as a “solar energy” center, but grew into many new research and development areas
- ❖ Housed in one of the world’s most energy-efficient buildings.



UCF's FSEC Leads the Nation in Research and Development



❖ **U.S. DOE**

- **Building America, Energy Efficiency** – Only University lead
- **Southeast RES – Photovoltaic** applications research
- **Solar Energy Grid Integration** – Only University lead
- **Fuel Cell Membranes** – FSEC leads 12 univer./industry team
- **Solar Hydrogen Production** from Water

❖ **Zero Energy Homes**

FSEC created the first “Zero Energy Home” in the nation.

❖ **Gossamer Wind[®] Ceiling Fan**

UCF's most productive patent. (> 1M sold, > \$20M annual energy)



UCF's FSEC Leads the Nation in Education and Training



Practitioner Training

- ❖ Weatherization Training
- ❖ Solar Thermal and Photovoltaics Training
- ❖ Home Energy Raters
- ❖ Energy Gauge Software

Florida Schools

- ❖ PV on schools – 48 now, **future 138**
- ❖ **K-12 Education**, PV for Schools, Florida Renewable Energy Curriculum Developed at FSEC



Education & Training





From Patent to Purchase




FSEC's Gossamer Wind[®] ceiling fan is the University of Central Florida's most productive patent, with sales exceeding 1,000,000 units, saving consumers more than \$20 million in energy costs annually.

THE HOME DEPOT

The most efficient & economical fan and light kit.

**gossamer
wind
series[®]**



The Gossamer Wind Series[®] ceiling fans were developed for Hampton Bay to maximize the energy efficiency and comfort level of ceiling fans. These revolutionary ceiling fans feature aerodynamically optimized fan blades that effortlessly cut through and move up to 40% more air than standard blades. Superior engineering improves efficiency and allows for ultra-quiet, wobble-free operation.

Thermostatic remote control
Superior remote control for efficiency and convenience at your fingertips: Advanced engineering allows thermostat to automatically increase fan speed as room temperature rises; turns fan off when room has cooled to desired temperature. Lighting level can be remotely dimmed. Manual or timed operation options.

Move up to 40% more air than traditional ceiling fans

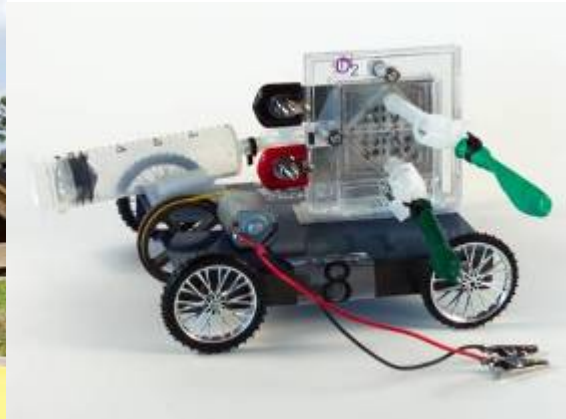


Aerodynamically optimized shape/pitch

Standard shape/pitch



EnergyWhiz Olympics





From Biomass to Bio-fuels



- ❖ Energy independence - renewable transportation fuels
- ❖ Energy reliability - based on locally sourced feedstocks)
- ❖ Sustainability - maximum use of resources



Citrus Pulp Pellets



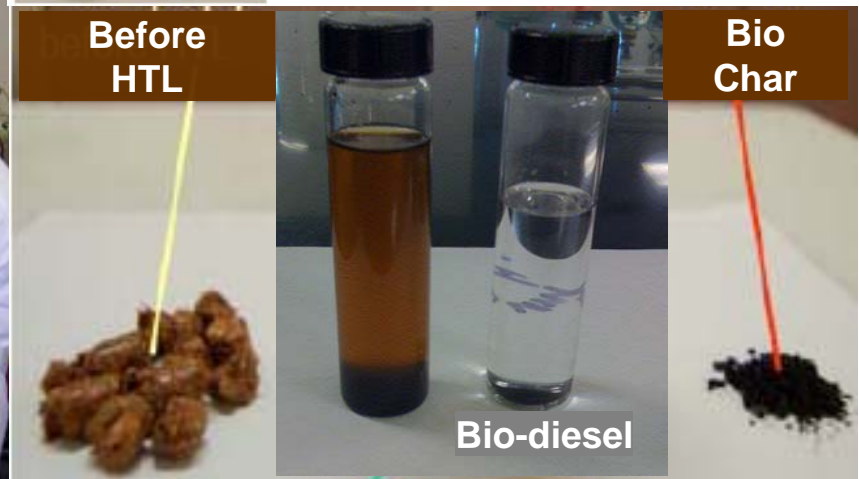
Brown algae

Ag wastes:
citrus waste
Bagasse

Aquatic biomass:
Algae
Seaweeds



FT
Syncrude



Before
HTL

Bio-diesel

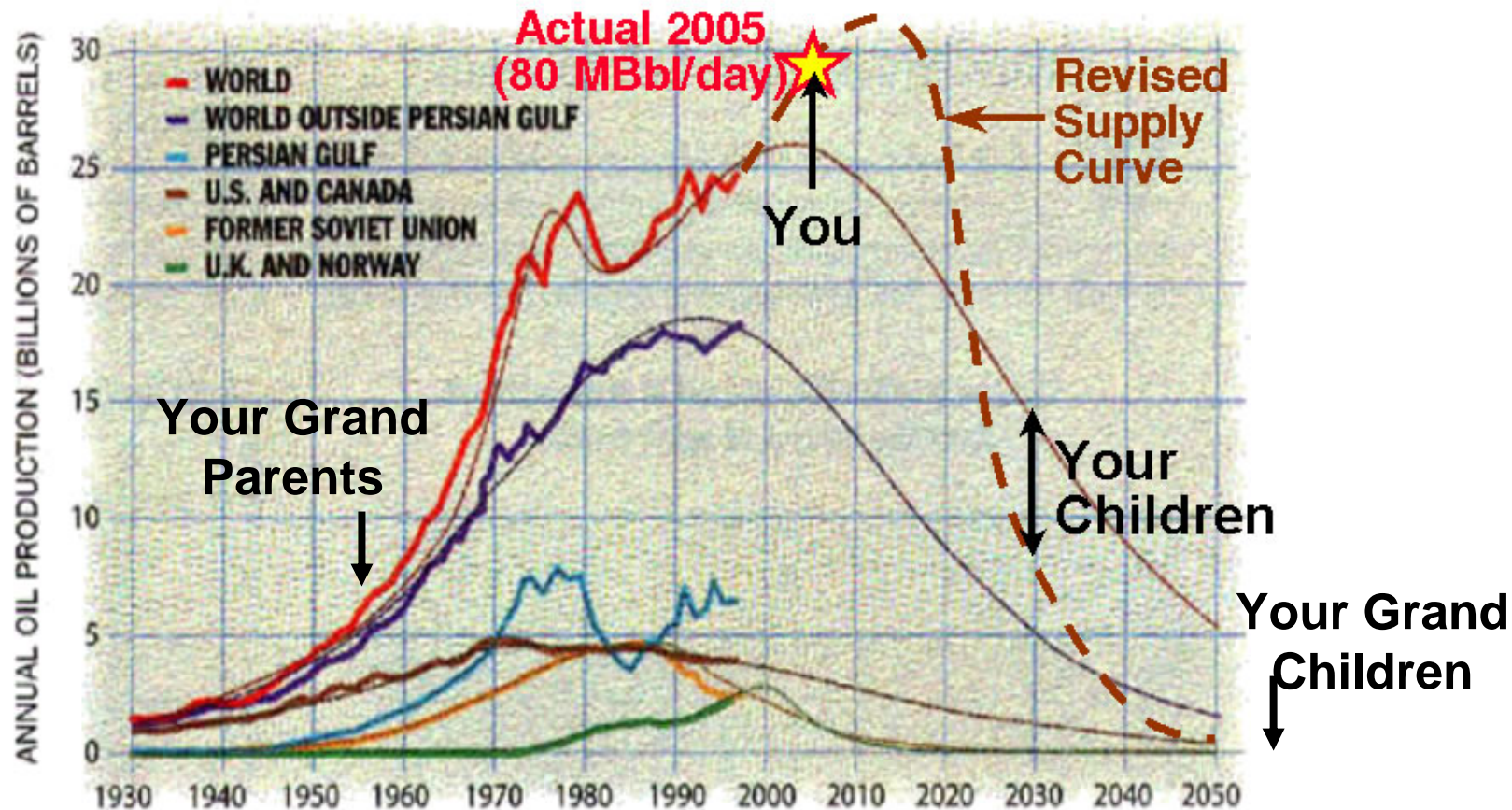
Bio
Char

Into the Storm





World Oil in Perspective



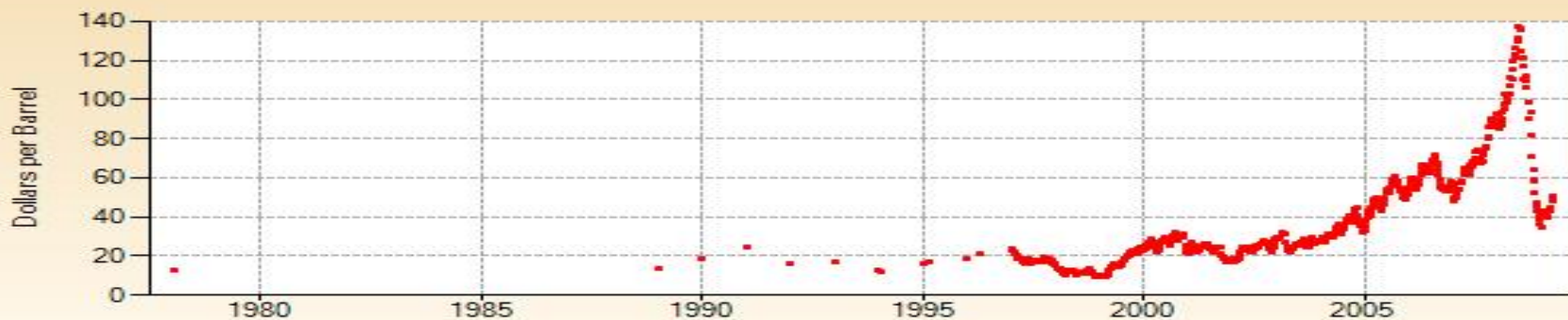
Source: Campbell, Colin J. and Jean H. Laherrere, "The End of Cheap Oil." *Scientific American*, March 1998.

Weekly U.S. All Grades All Formulations Retail Gasoline Prices



Source: U.S. Energy Information Administration

Weekly All Countries Spot Price FOB Weighted by Estimated Export Volume



Source: U.S. Energy Information Administration

Monthly U.S. Natural Gas Wellhead Price

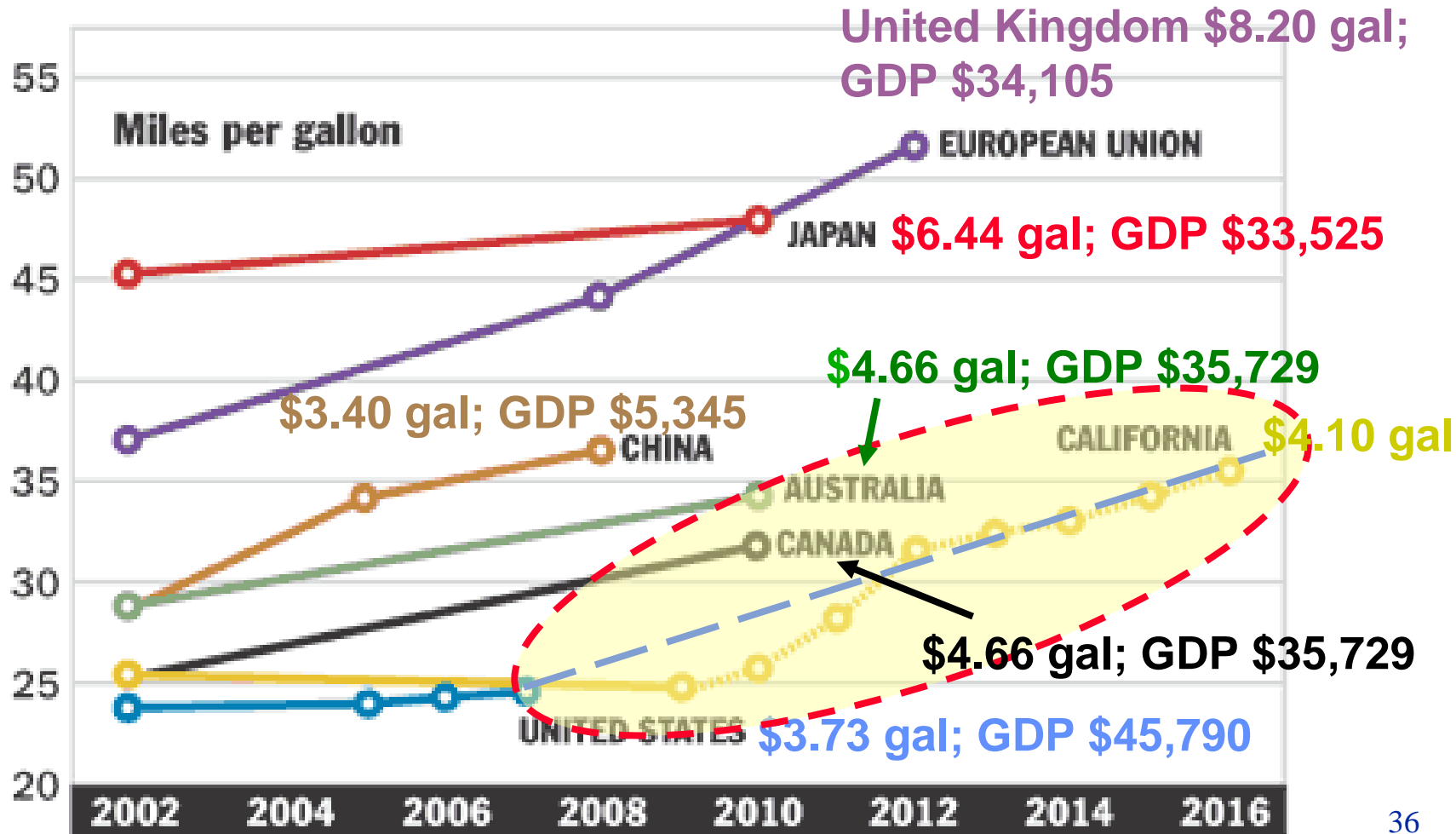


Source: U.S. Energy Information Administration

Transportation Energy Use

Efficiency, Efficiency, Efficiency.....,

Biomass to Feedstocks, then Fuels; Plug-Ins?

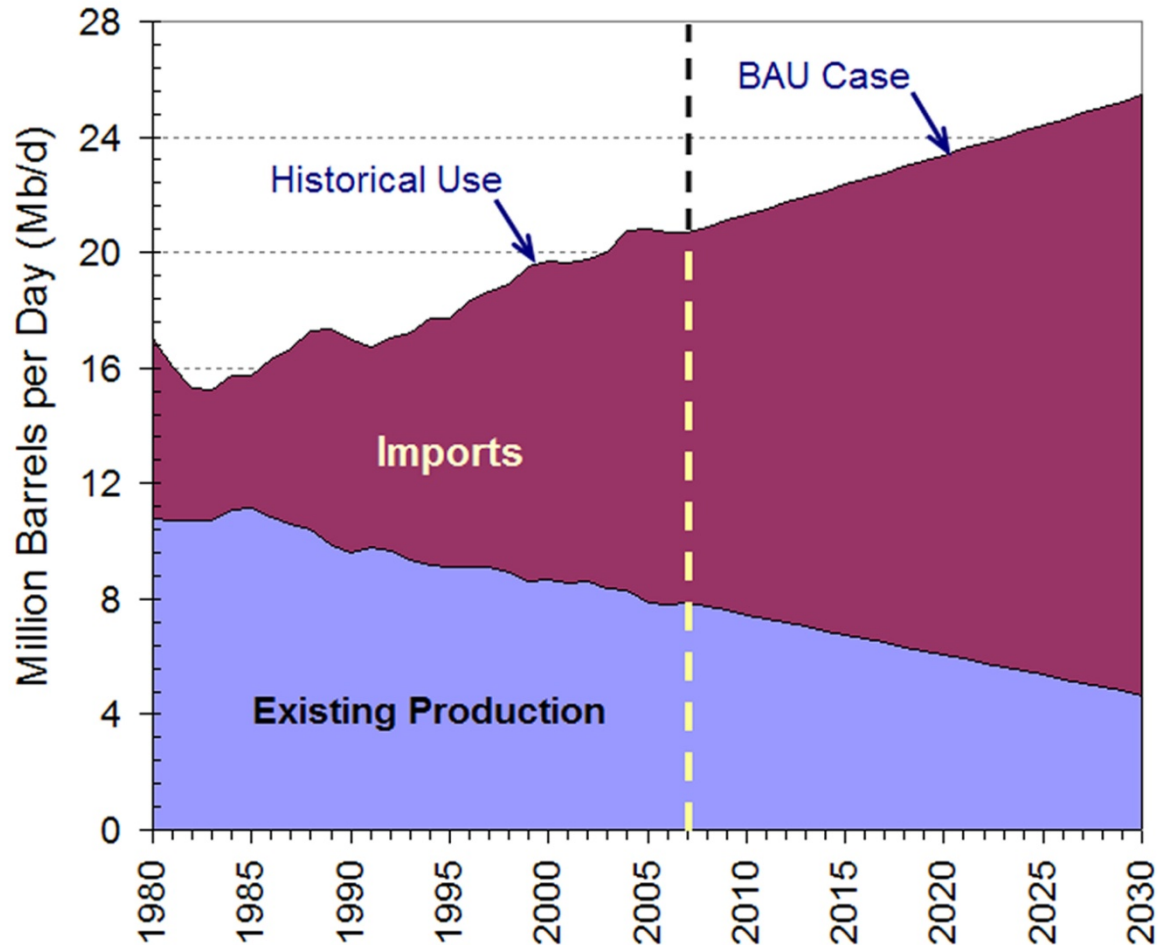




Business As Usual Model



U.S. Petroleum Wedges Analysis: BAU Case





Supply + Demand



U.S. Petroleum Wedges Analysis: All

