Energy, Jobs & the Economy

Applied Sustainability Center
Sam M. Walton College of Business
University of Arkansas

Arkansas Advanced Energy Foundation

Arkansas Energy Office

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Welcome & Overview

Thanks to:

Introductions

- Your Name
- Office you are seeking
- District you represent

Agenda & Format

- Energy 101
- Energy Efficiency Panel
- Renewable Energy Panel
- Lunch – Greg Pool, Walmart
- Alternative Fuels Panel
- Closing Discussion
- Tour – Education/Workforce Development

Logistics

- Bio-Breaks – not scheduled
- Refreshments, Lunch
- Restroom Locations
- Format – Encourage questions & discussion

Issues Facing Arkansas Legislators

- Education
- Prison Reform
- Transportation
- Health Care
- Energy

Benefits of Advanced Energy

- Direct Jobs, Indirect Jobs, Induced Jobs
- Save money, better use of tax payer dollars
- Reduce risk, insulate against rising energy prices
- Extend grid capacity
- Avoid or delay investment in new infrastructure
- Stabilize energy prices

Energy 101 - A primer for Arkansas Lawmakers and Policymakers

July 2014

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ARKANSAS
Economic Development Commission
ENERGY OFFICE

Bio Energy Systems LLC

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Energy Price Pressure

- Worldwide energy use **grew five-fold** 1950-2000 and is expected to **double again** by 2030, straining supplies, prices, and delivery systems
- **$1.205 trillion** is spent on energy in the U.S. annually[1]

1) EIA, "State Energy Data 2010: Prices and Expenditures" (June 2012), Table E15.

Overview

- What are the basic forms of energy?
  - And what are some key terms?
- How much energy do we consume in Arkansas?
- What energy is produced in Arkansas?
- What are our options for meeting future energy demands?

Basic forms of energy

- Thermal
  - Space heating, water heating
  - steam & process heat for manufacturing
- Transportation fuels
  - Petroleum-derived (gasoline, diesel, jet fuel)
  - Compressed natural gas (CNG)
  - Biofuels (ethanol, biodiesel, drop-in fuels)
- Electricity
- Each conversion technology has an associated system efficiency
  - The amount of fuel required to produce a certain amount of energy
  - Think of miles per gallon, or the efficiency rating of a water heater

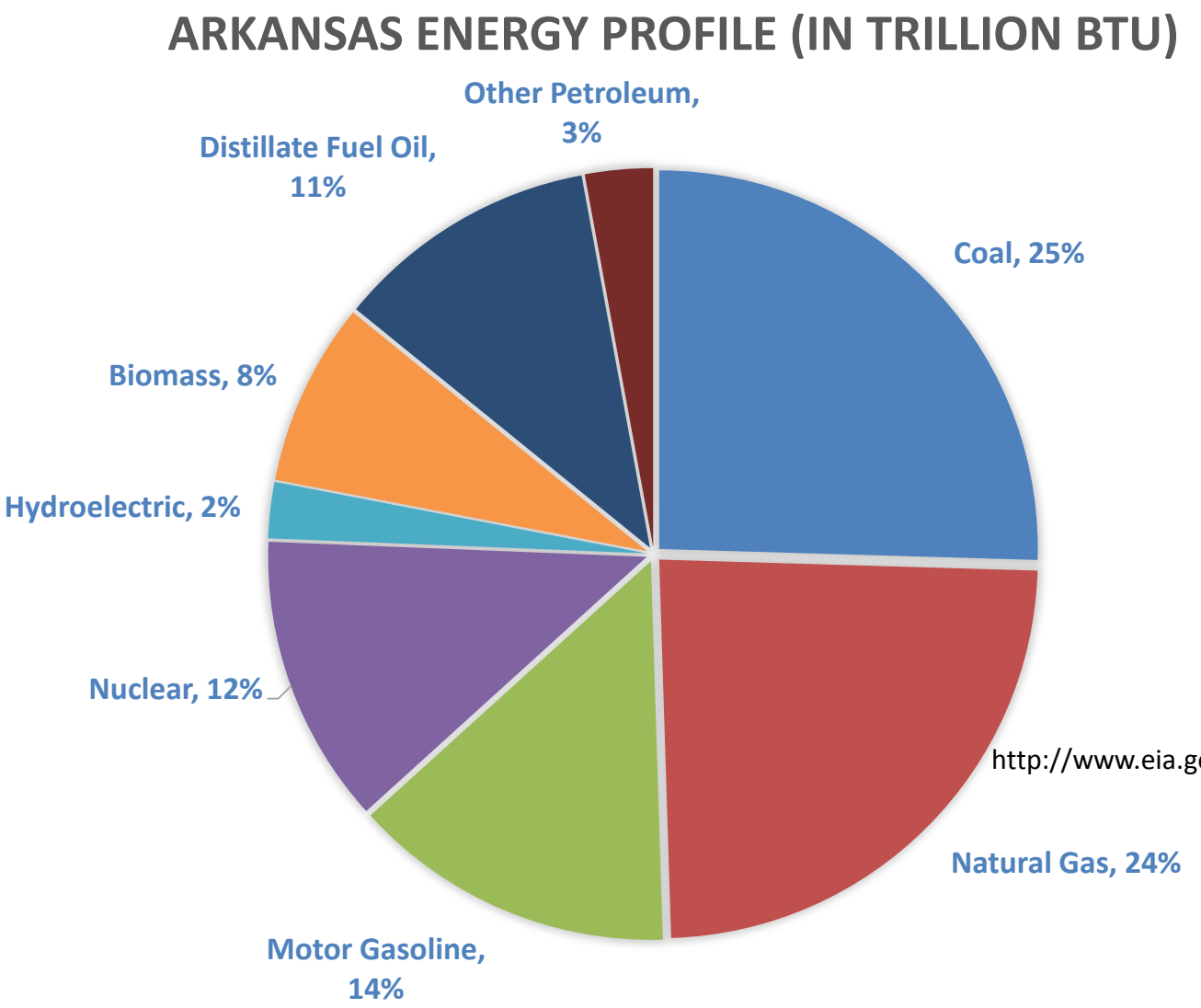
Each of these entails conversion of an energy fuel/resource into usable energy

Key terminology

- Energy production & consumption
  - Btu, kW, kWh, MW, MWh, capacity factor
  - DSM = demand side management
- "Conventional" (existing) energy in Arkansas
  - Fossil fuels (coal, natural gas, petroleum-derived)
  - Nuclear
  - Existing hydro
- Energy efficiency: using less energy to do the same things
- Renewable energy: wind, solar, biomass, hydro
- Clean energy: low emissions & high efficiency production
  - cleaner coal, safe nuclear, natural gas, renewables
- Advanced energy:
  - energy efficiency + renewables + clean energy + enhanced energy storage + smart energy

We will look at these terms in the next few minutes

Energy in Arkansas



http://www.eia.gov/state/print.cfm?sid=AR

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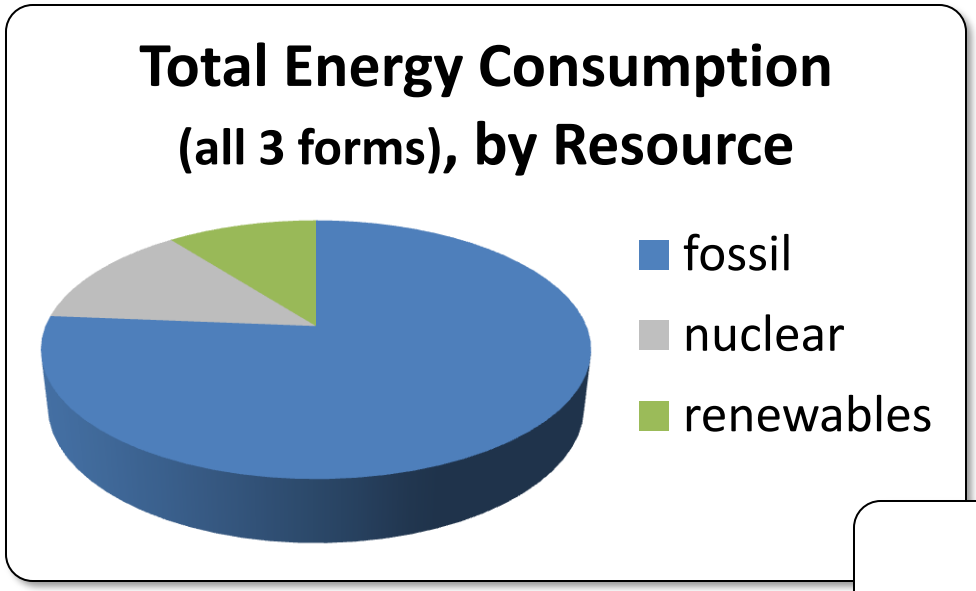
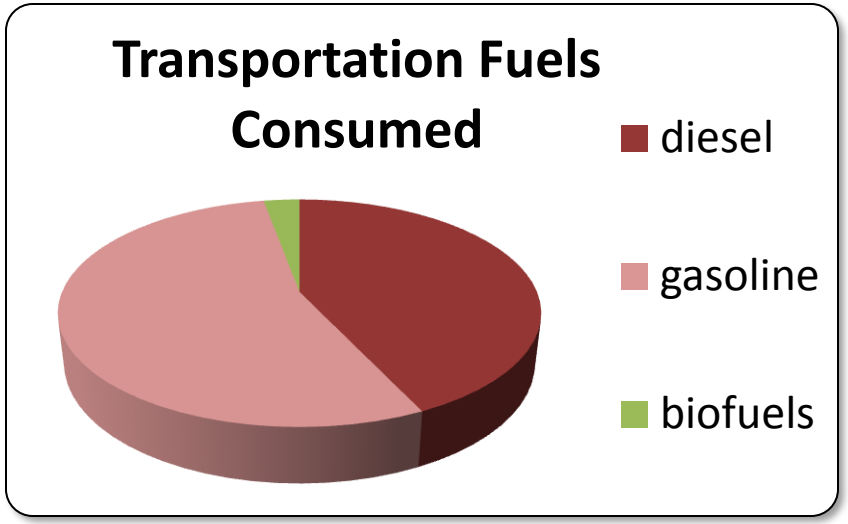
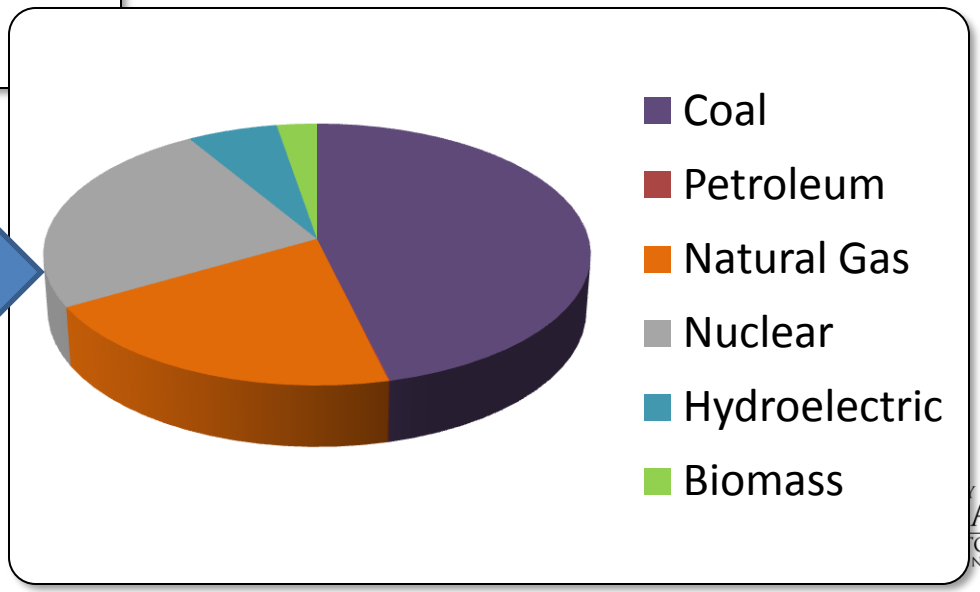
Energy in Arkansas



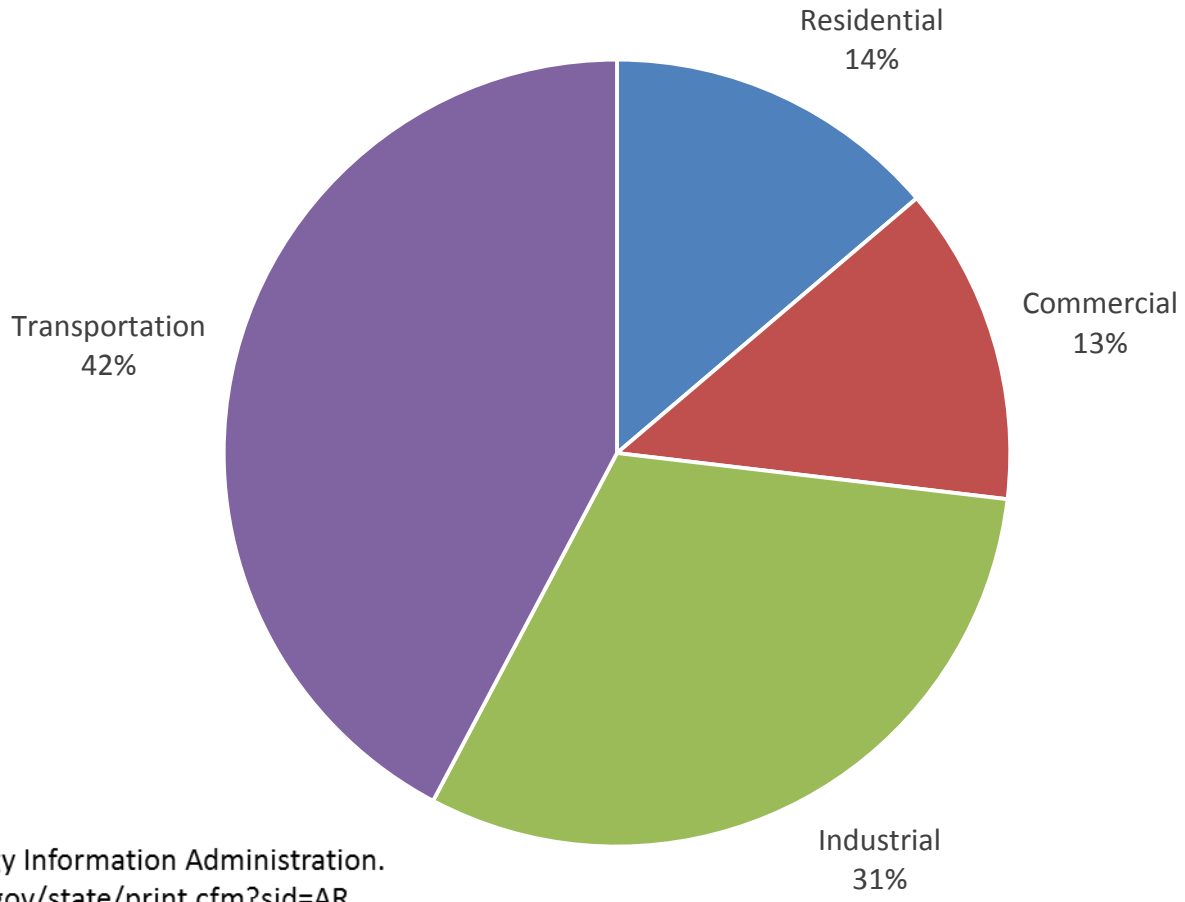


Electrical generation by resource



Data source:
US Energy Information Agency (2010)
http://205.254.135.7/state/seds/sep_use/total/pdf/use_AR.pdf

Arkansas Energy Consumption by Sector, 2012



Source: US Energy Information Administration.
http://www.eia.gov/state/print.cfm?sid=AR

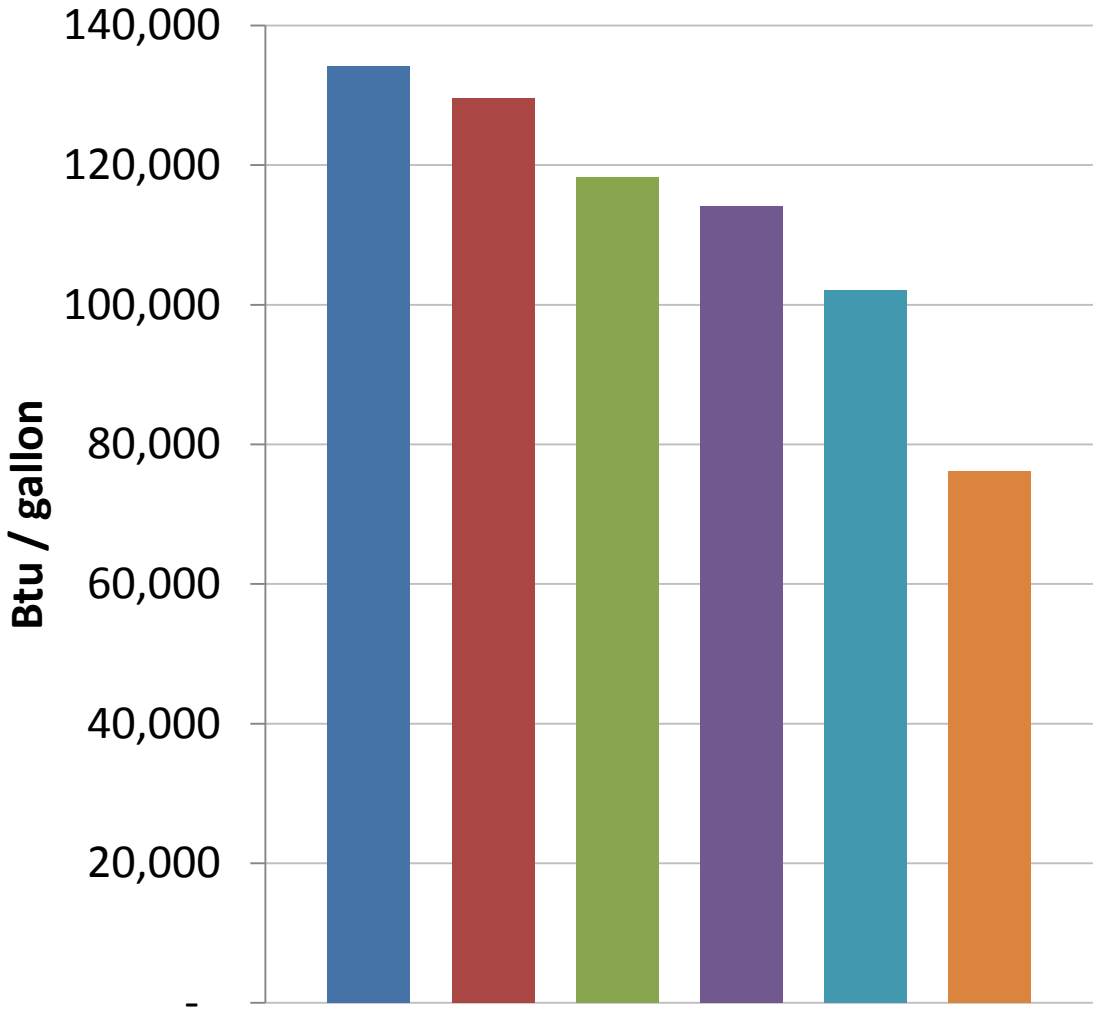
Flow of Arkansas Energy Dollars (in Millions)

Natural Gas	+1,500
Coal	-418
Gasoline	-2,100
Net Gain/Loss	-1,018

Energy basics: thermal

- Measured in Btu (a million Btu is denoted as MMBtu)
- To illustrate:
  - Let's assume a typical home heating system is 80,000 Btu output
  - Then if that system runs 40% of the time for 3 months, then total energy produced = 80,000 x 10 hours/day x 90 days = 69 MM Btu/season
    - Assuming 86% efficiency of the furnace, then fuel required = 80 MM Btu
  - Natural gas contains ~ 1.0 MMBtu per thousand cubic foot (MCF)
  - So, total NG consumption for this home would be:
    - 80 MM Btu/year x 1 MCF/MMBtu = 80 MCF/year (80,000 cu ft/year)
  - If the delivered cost = $5.00/MMBtu, then annual expense = $400/year

Energy basics: transportation fuels



- Renewable diesel from biomass
- Diesel from petroleum
- Biodiesel (B100)
- Gasoline from petroleum
- Drop-in gasoline from biomass
- Ethanol from corn

Note: vehicle mileage is affected by fuel energy content (and other factors)

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Source: http://en.wikipedia.org/wiki/Gasoline_gallon_equivalent

Energy basics: electricity

- Power production = kW or MW
- Power consumption = kWh or MWh
- Ten 100-watt light bulbs = 1,000 watts (1 kW)
  - Operate those for 1 hour…consume one kW-hour (1 kWh)
    - Operate those for 1000 hours = 1,000 kWh = 1 megawatt-hour (1 MWh)
    - Operate those 24x7x52 = 1 kW x 8,760 hours/year = 8,760 kWh/year (8.76 MWh)

- The average residential consumer in AR uses 1,125 kWh/month
  - 1,125 kWh/month x 12 months/year = 13,500 kWh/year (13.5 MWh)
  - @ 9.3¢/kWh, then 13,500 kWh/year x $0.093/kWh = $1,255/year

Note: in 2010, the average per HH was 1,179 kWh/mo.

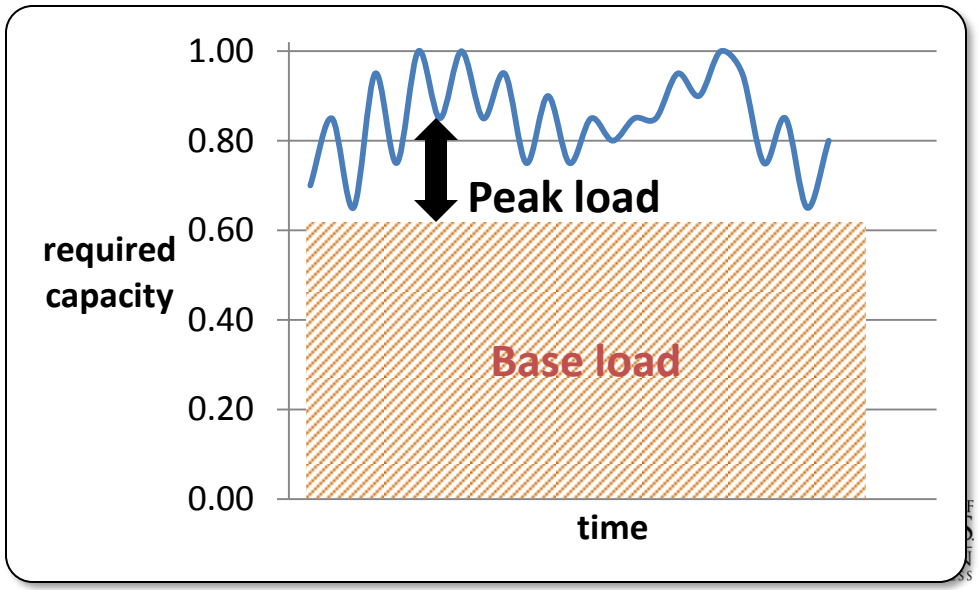
(2012 1,125 = 4.5% reduction)

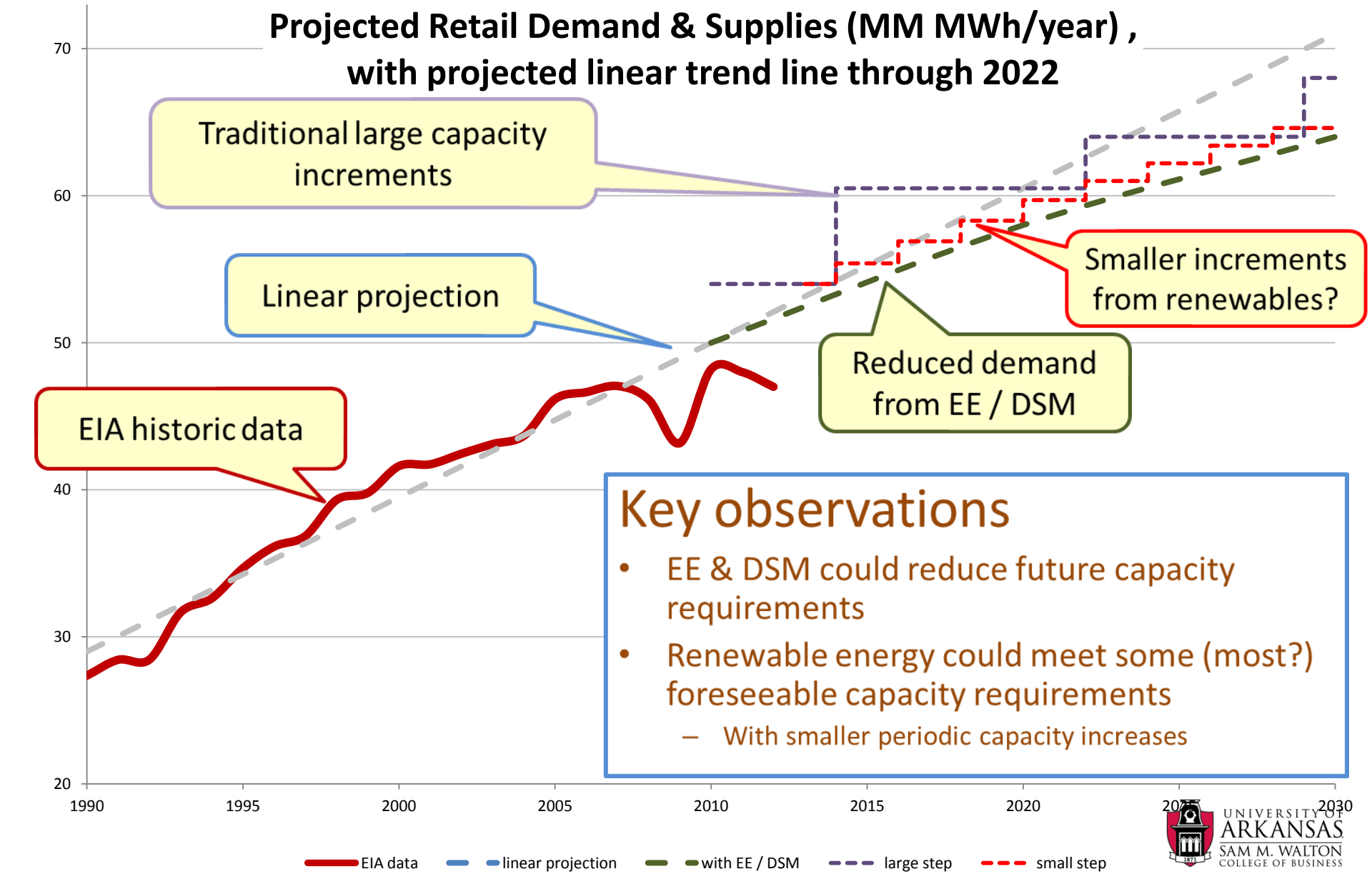
Energy Production in Arkansas

- Thermal
  - NG is the primary resource
  - Biomass is used as fuel at some facilities
    - particular forest products mfg
- Transportation fuels
  - Arkansas has one refinery
    - primarily using out-of-state oil
- Electricity
  - Key terms:
    - Capacity (MW)
    - Generation (MWh/year)
    - capacity factor (%)
  - Key forms of electricity
    - base load
    - peak load

Example:

- Capacity = 100 MW
- Operating time = 7000 hours/year
- Generation = 700,000 MWh/year
- Capacity factor = 80%
  (= 7000 ÷ 8760)





Key observations

- EE & DSM could reduce future capacity requirements
- Renewable energy could meet some (most?) foreseeable capacity requirements
  - With smaller periodic capacity increases

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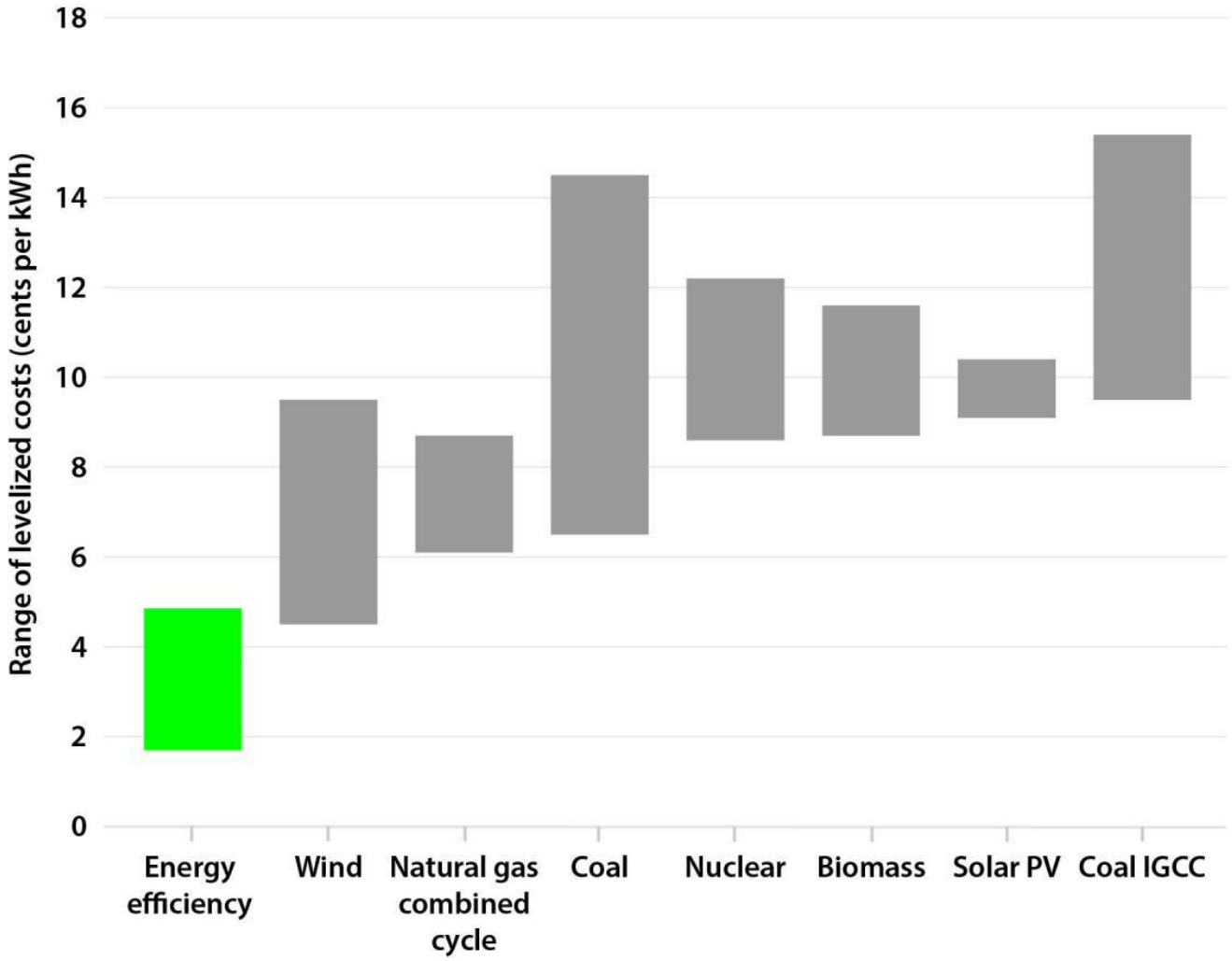
	Residential	Commercial	Industrial	Total
Average consumption per consumer, kWh/year	13,500	67,000	496,000	
# consumer	1,330,000	180,000	34,000	1,544,000
Total consumption, MWh/year	17,910,000	12,100,000	16,850,000	46,860,000
Average rate, ¢/kWh	9.30	7.71	5.76	
Average expenditure per consumer ($/year)	$1,255	$5,200	$28,600	
Total expenditure per sector ($MM/year)	$1,665	$933	$971	$3,569

Electricity Consumption (presented at EJE in 2012)

	Residential	Commercial	Industrial	Total
Average consumption per consumer, kWh / year	15,000	68,000	519,000	
# consumers	1,300,000	180,000	30,000	1,530,000
Total consumption, MWh / year	19,200,000	12,200,000	16,800,000	48,200,000
Average rate, ¢/kWh	8.9	7.3	5.4	7.3
Average expenditure per consumer ($/year)	$1,300	$5,000	$28,200	
Total expenditures per sector ($MM/year)	$1,700	$900	$900	$3,500

Levelized Cost of Electricity Resource Options



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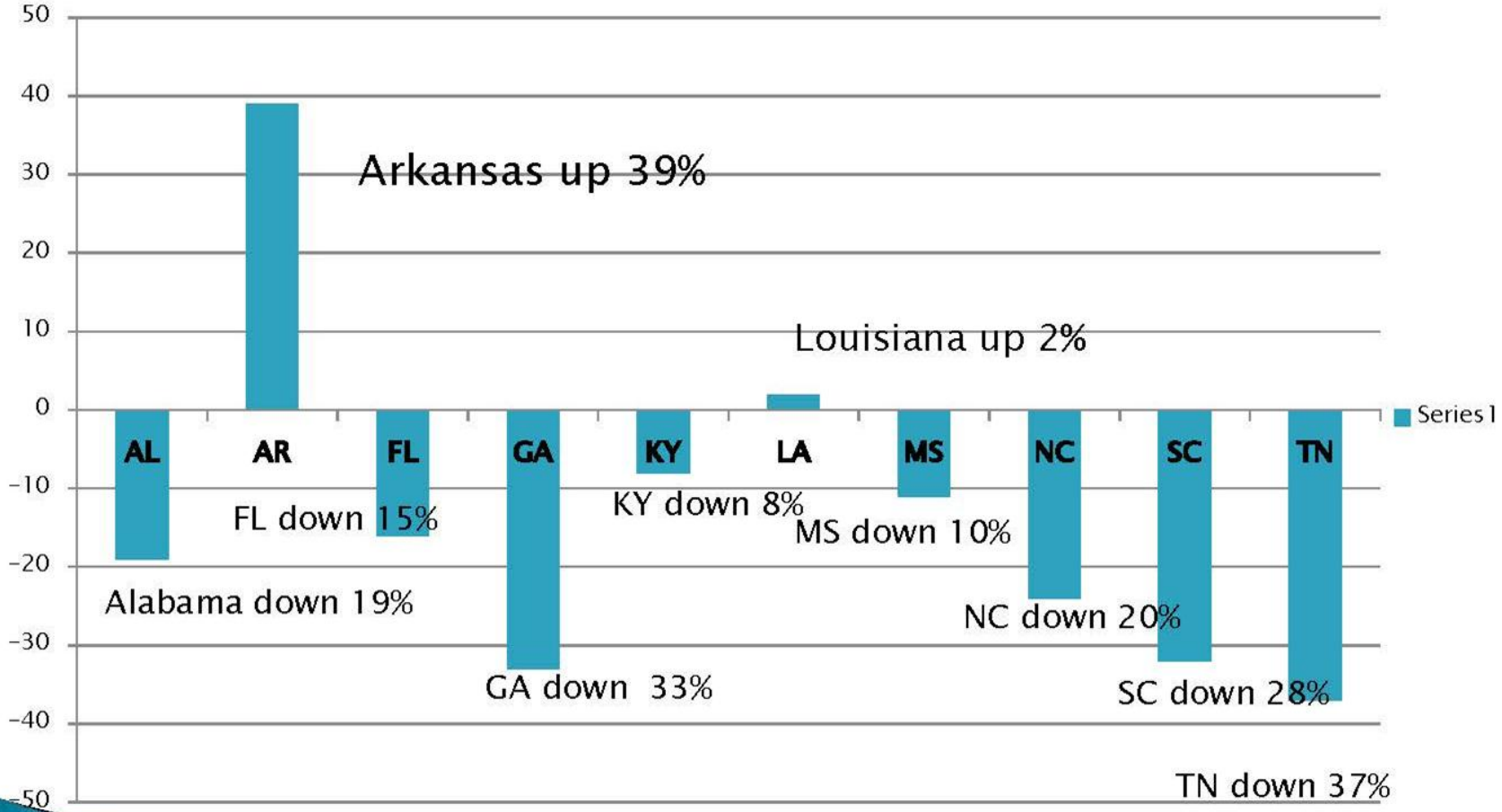
Cost of Electricity Resources

- Feed Stock – Coal, Nuclear, N.Gas, Solar, Wind, Biomass
- Conversion – Coal-fired Power Plant, Nuclear Power Plant, Solar Panels, Wind Turbines
- Transmission – losses between plant and end use, vulnerability to weather & other threats.

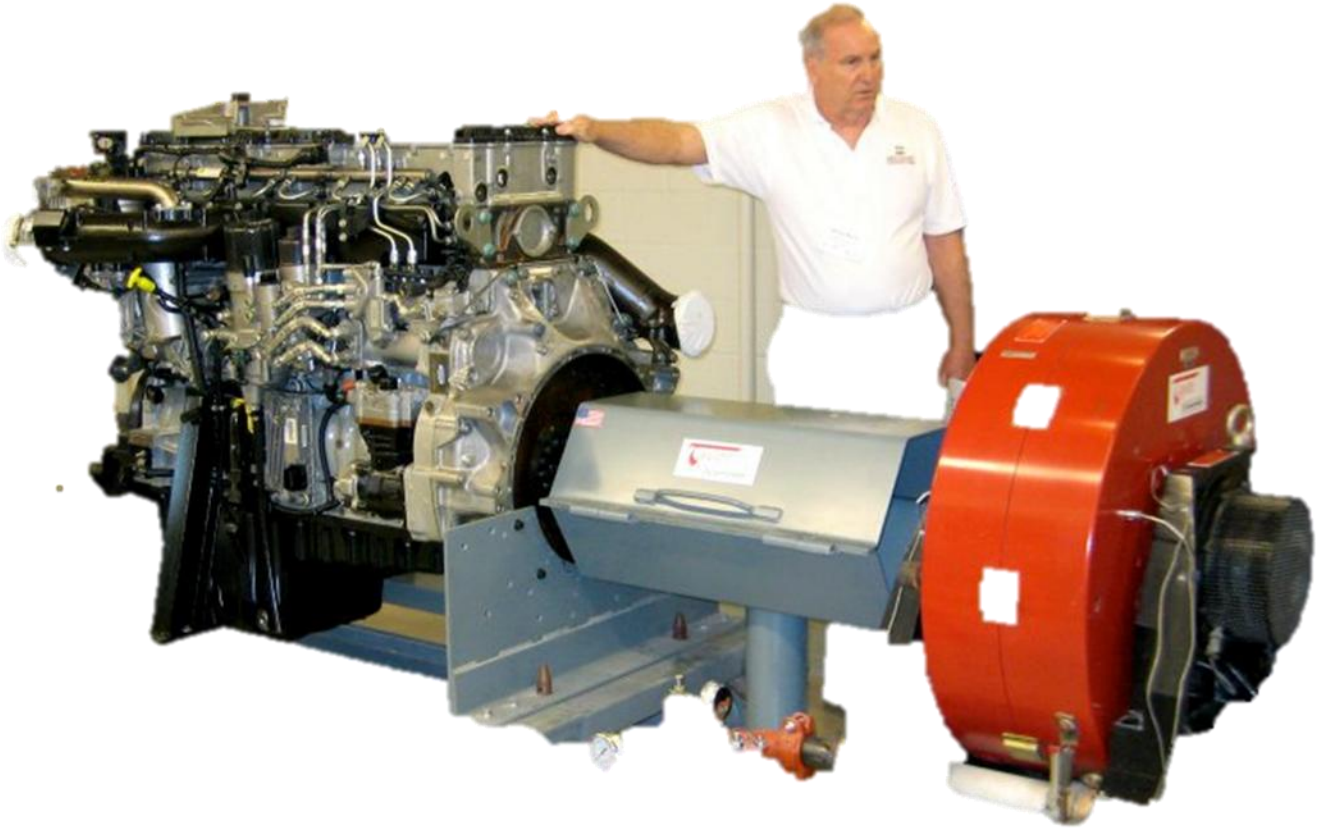
Southern States 2013 vs. 2005 Power Plant CO2 emissions



In summary

- There are three basic forms of energy
  - Thermal, electrical, & transportation fuels
- Understanding energy options & terminology is important…
  - For addressing future energy demands
  - For developing effective energy policies
- Our options for meeting future energy demands include:
  - Energy efficiency
  - Renewable energy (wind, solar, biopower/biofuels, hydro)
  - Other forms of cleaner energy (e.g., CNG)
  - Expansion of conventional energy resources (e.g., coal, NG, nuclear)

Arkansas Energy Facts



Mining Arkansas Energy Resources to Create Jobs

Energy Efficiency

Solar

Wind

Biomass

Energy Intensity

- Energy/Unit of output
- AT&T example – kWh per terabyte of data
- MPG
- kWh/SF
- kWh/Student

Hummer or Prius?

Arkansas' Energy Intensity

- Arkansas ranks **37th** on ACEEE 2013 State Energy Efficiency Scorecard
- **#17 highest** energy consumption per capita (US EIA)
- **#11 highest** energy consumption per real dollar of gross state product (US EIA and Neubauer, et al 2010)
- Significant energy use and potential for improvement in overall energy efficiency.

ACEEE 2014, ACEEE 2013 State Scorecard Ranking, American Council for and Energy-Efficiency Economy, http://www.aceee.org/sector/statepolicy/arkansas.

US EIA, US Energy Information Administration, http://www.eia.gov/state/rankings/?sid=US

Residential Energy Intensity

Energy Efficiency in **Arkansas**: Opportunities for a Clean Energy Economy, 2011

ACEEE (American Council for an Energy Efficient Economy) estimates the potential savings through energy efficiency statewide at **37%** in the residential sector alone.

Neubauer, M. & Nadel, S., (2010). "Advancing energy efficiency in Arkansas: Opportunities for a clean energy economy", American Council for and Energy-Efficiency Economy, June, Report #E104.

Residential Energy Intensity

- US 903 per month; 10,836/yr.
- Arkansas 1125 per month; 13,500/yr.

Average AR electric bill is $104.63/month or $1255.50 per year.

Arkansans use almost 25% more than the national average.

http://www.eia.gov/tools/faqs/faq.cfm?id=97&t=3

Economic Leak:

Residential Electricity AR	$1,665,000,000
20% Reduction	$ 333,000,000
30% Reduction	$ 499,500,000

ANNUALLY!

Equivalent to $100-$150 per person per year just on electricity.

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Energy Efficiency Standards by State

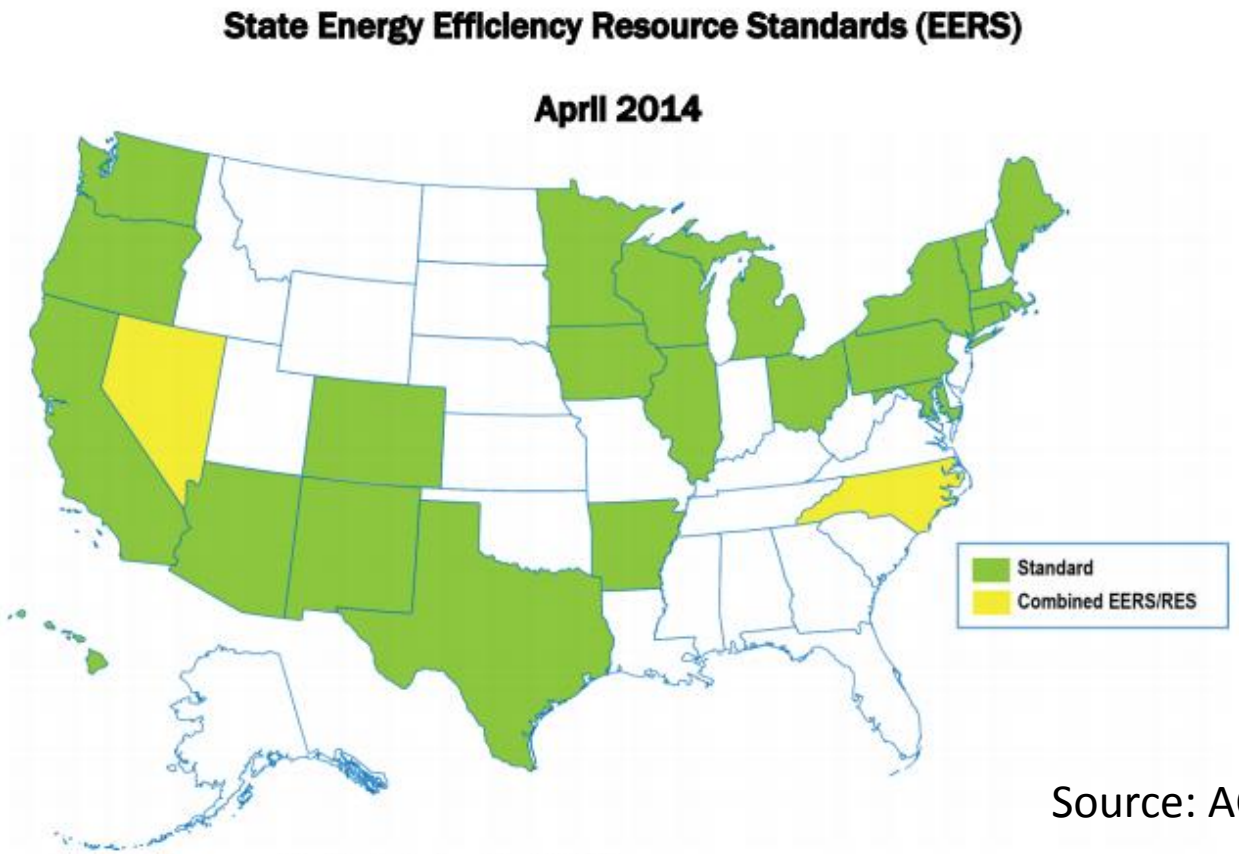


Figure 1. EERS policy approaches by state (as of April 2014).

Source: ACEEE April 2014

Energy Efficiency Standards by State

How does Arkansas' EES compare?

Range is 1.5% to 26.1%

- Arkansas 3.15% over 5 years
- Pennsylvania 2.98% over 3 years
- Iowa 6.3% over 5 years
- Texas 4.08% over 12 years
- Washington 11.74% over 12 years
- Massachusetts 26.1% over 12 years

Fayetteville
ARKANSAS

HOME PERFORMANCE LABEL

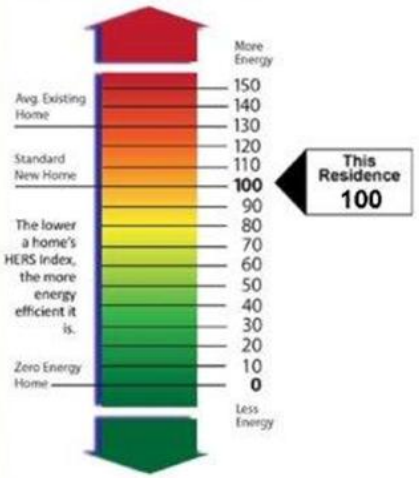
PROPERTY ADDRESS:
1234 Main Street
Fayetteville, AR
72701

Estimated Monthly Energy Cost *

$50

Estimated 5-Year Energy Savings: $1234
(compared to average existing home, HERS 130)

RESNET HERS® Index



☐ New Home - National Certifications
- ☐ HERS Rating
- ☐ ENERGY STAR® Qualified Homes
- ☐ LEED for Homes - Level _____
- ☐ NAHB Green Build - Level _____
- ☐ 2009 IECC
- ☐ Other _____

☐ Existing Home - Comprehensive Upgrade
- ☐ HERS Rating: _____% Improvement (Before_____ After_____)
- ☐ Home Performance w/ENERGY STAR®

This notice confirms that the structure at this address has met the 2009 International Energy Conservation Code (IECC) requirements & has been issued a Home Energy Rating System (HERS) rating score. The HERS Index score is a method of measuring the energy performance of the home. The City of Fayetteville has implemented this program to ensure quality energy efficiency standards and to allow potential residents to compare different structures equitably.

City of Fayetteville, AR

Issued by: First Last

Date of Issuance: xx/xx/xxxx

General Contractor: First Last

HVAC Subcontractor: First Last

*This sticker is intended for comparison purposes only. Actual energy use is dependent upon occupant actions. Estimates are based on HERS (Home Energy Rating System) calculations.

For more information on this structure's construction please contact the City of Fayetteville Building Safety Division

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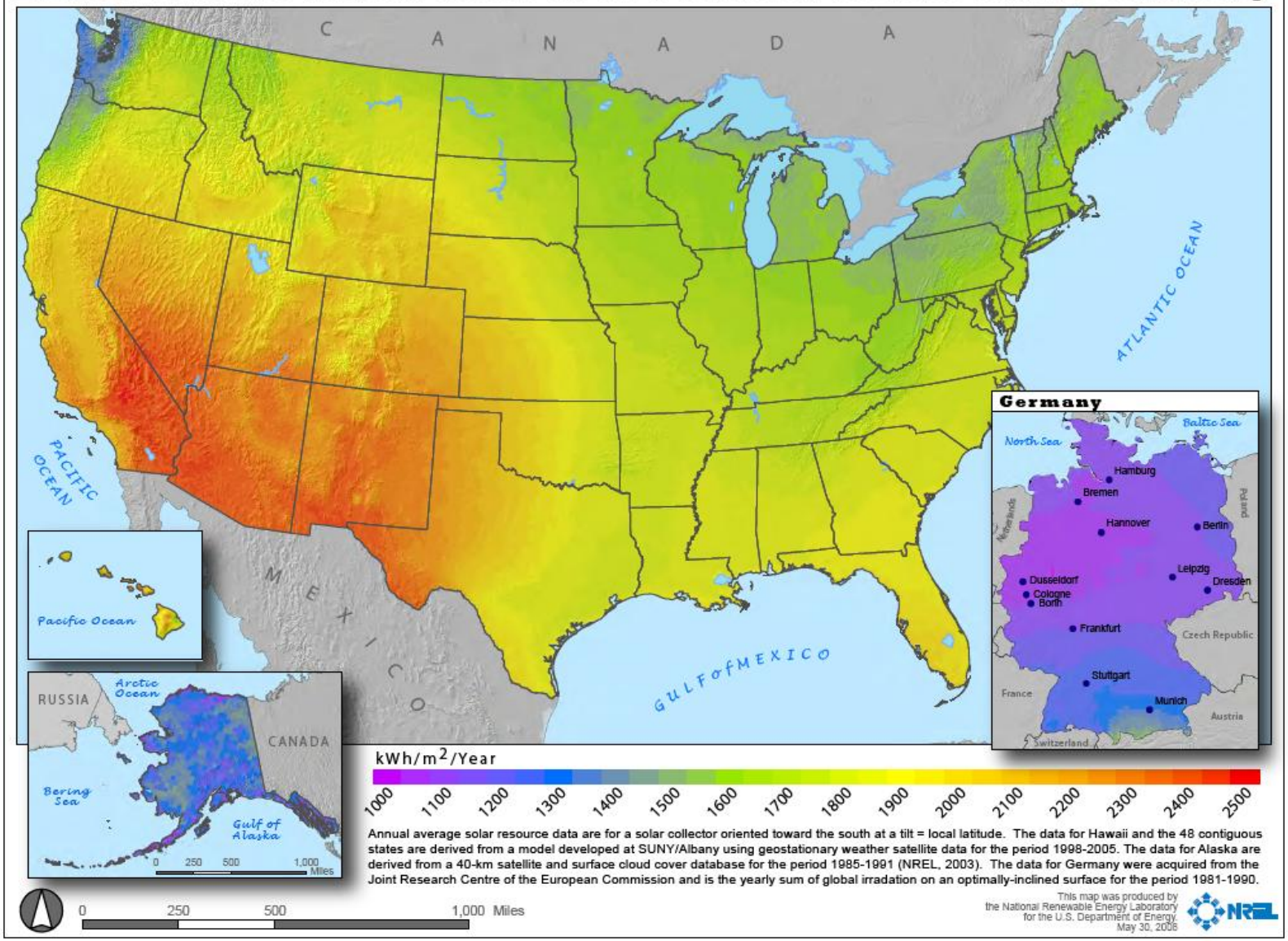
Energy Efficient Residential Code

- 1,824 SF Home
- $2,049 add'l cost to build to 2009 IECC vs. 2003 IECC standard
- Amortized over 30 yr. mortgage = $132/ yr or $11/month
- All Electric Home energy savings = $344/year or $28.67/month. Net = $212 savings annually or $17.67/month.
- Electric-N.Gas Home energy savings = $267/yr or $22.25/month. Net = $135/yr or $11.25/month.
- Note: Savings calculated at current energy prices.
- Ordinance & white paper (p. 16-24) in EE Folder

Solar Energy Rankings

- 1 Nevada 1.19
- 2 Arizona 1.18
- 3 New Mexico 1.16
- 4 California 1.00
- 5 Colorado 0.99
- 6 Texas 0.98
- 6 Oklahoma 0.98
- 7 Wyoming 0.96
- 8 Florida 0.95
- 8 Kansas 0.95
- 8 Utah 0.95
- 9 Idaho 0.93
- 10 Mississippi 0.92
- 10 Georgia 0.92
- 10 S. Carolina 0.92
- 11 Arkansas 0.91
- 12 Louisiana 0.90
- 12 N. Carolina 0.90

Photovoltaic Solar Resource : United States and Germany



Annual average solar resource data are for a solar collector oriented toward the south at a tilt = local latitude. The data for Hawaii and the 48 contiguous states are derived from a model developed at SUNY/Albany using geostationary weather satellite data for the period 1998-2005. The data for Alaska are derived from a 40-km satellite and surface cloud cover database for the period 1985-1991 (NREL, 2003). The data for Germany were acquired from the Joint Research Centre of the European Commission and is the yearly sum of global irradiation on an optimally-inclined surface for the period 1981-1990.

This map was produced by the National Renewable Energy Laboratory for the U.S. Department of Energy. May 30, 2008

NREL

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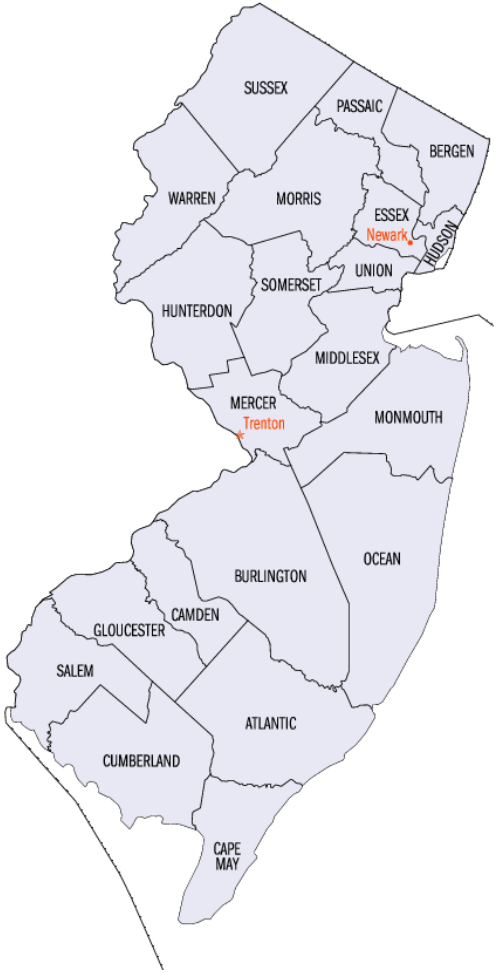
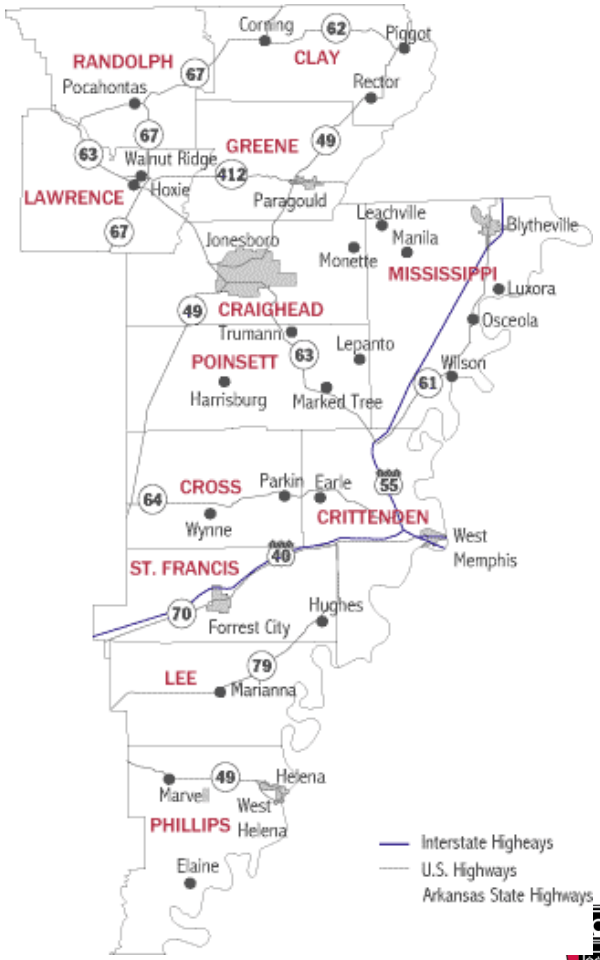
New Jersey vs. East Arkansas





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Arkansas & Wind

Arkansas Energy Office:

- Study completed in 2012 of 5 sites
- Mean wind speed at 80m averaged 5.72 m/s
- This is below the average 6.5 m/s at which most wind farms are installed
- However, larger blades are making commercially viable wind energy at speeds below 6.5 m/s, which could make wind a viable energy source in some parts of the state.

Arkansas Biomass potential

- Arkansas ranks 6th in forest residue resources
- Biopower technical potential of 15,444 GWh per year
- Current biomass power capacity is 399 MW

ACORE Report

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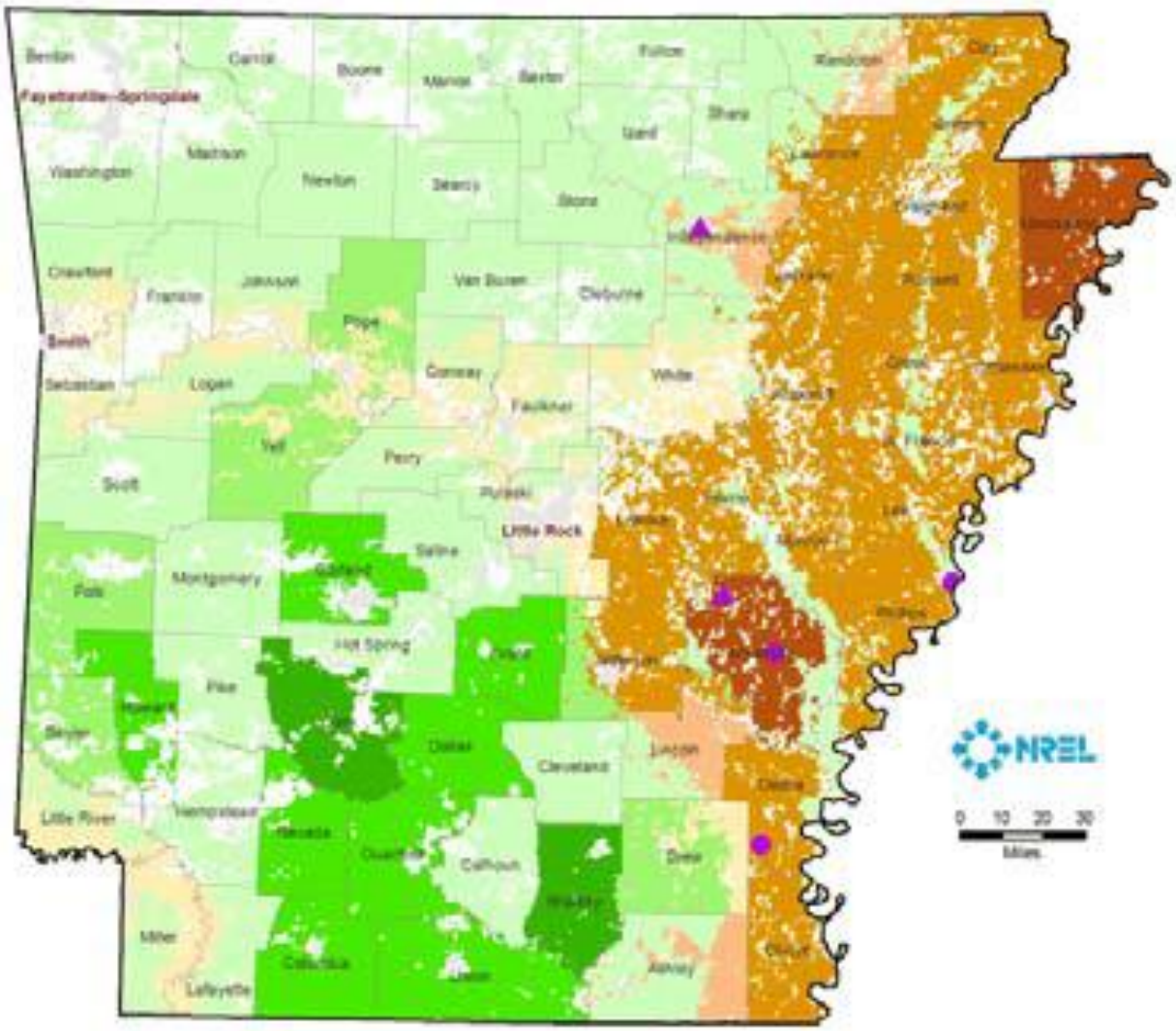
Arkansas Biofuel Potential



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25 X '25

National Impacts:

$640 Million new economic activity annually

4.7 Million new jobs mostly in rural areas

Reduce dependence on foreign oil; increase national security

15 States see the greatest impact including Arkansas

Arkansas Impacts:

109,200 new jobs mostly in rural areas

61,100 of those jobs would be in feedstock production

(University of Tennessee Report from 25x25 study)]

http://www.25x25.org/storage/25x25/documents/Economic%20Analysis/utenn_jobs_analysis_of_25x25_goal_sept_11.pdf

http://www.25x25.org/

DOD commitment to Biofuels

The US Air Force is testing different blends of biofuels and jet fuels. The Air Force hopes to acquire 50% of its domestic aviation fuel from alternative fuel blends by 2016.

DoD's Energy Efficiency and Renewable Energy Initiatives, Environmental and Environmental Study Institute, 1112 16th Street NW, Suite 300, Washington DC, 20036, www.eesi.org, July 2011.

Alternative Fuels

- Fred Smith, CEO FedEx – All of the Above strategy
- "30 by '30" Biofuels
- Increased fuel efficiency
- Electric Vehicles
- CNG

Fred Smith, CEO, FedEx

"You can't sit on the right or the left on this issue. You've got to be willing to maximize our resources and you've got to be willing to conserve and transition to non-petroleum-based transportation."

Interview on NPR, April 2, 2012

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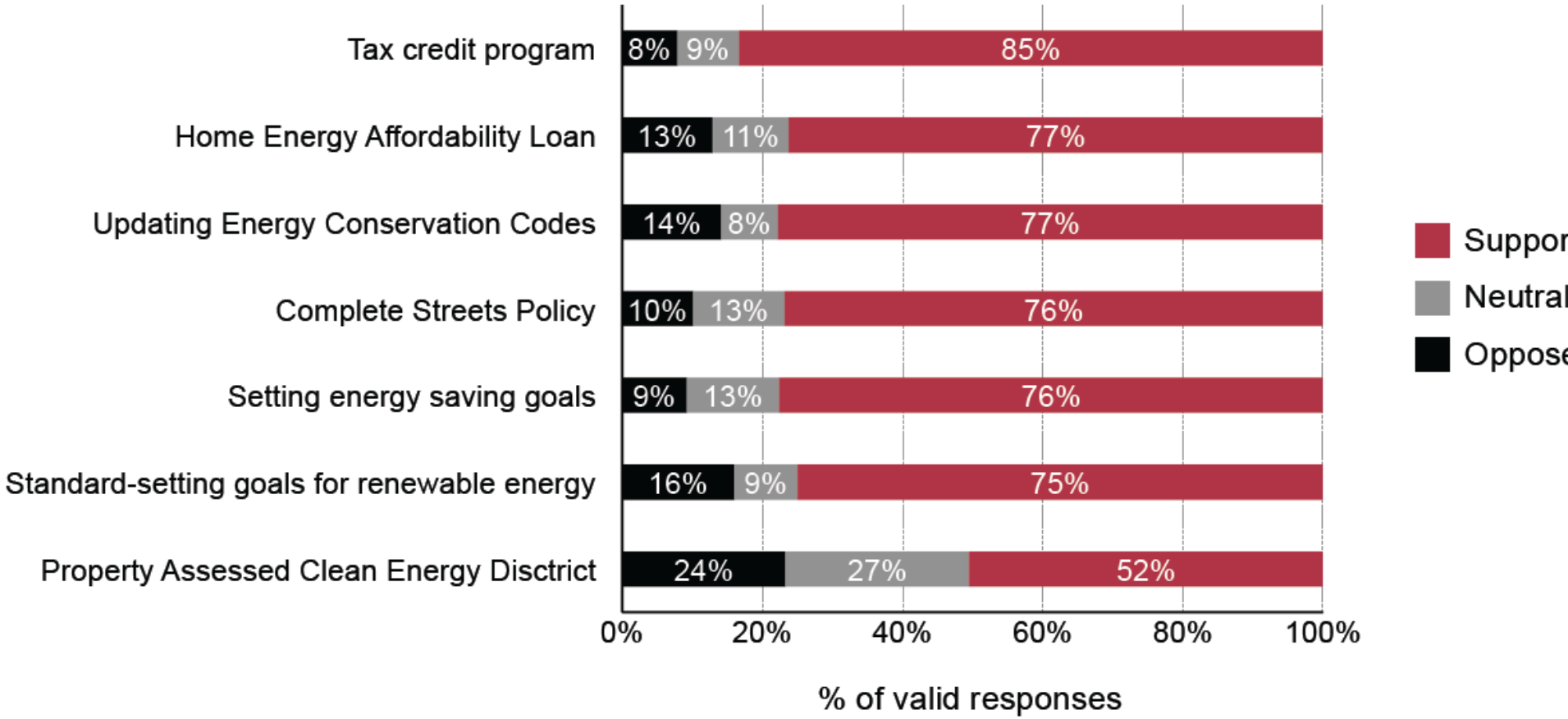
2014 Survey of NWA Policy Elites

Figure 3. "How do you feel about the following sustainable energy policies?"



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Listening for Jobs & Economy

- Arkansas' energy resources
- Potential to Create Jobs
- Enhance Prosperity
- Attract Investment
- Make Arkansas Competitive
- Increase Energy Security & Independence

The Role of the Legislature

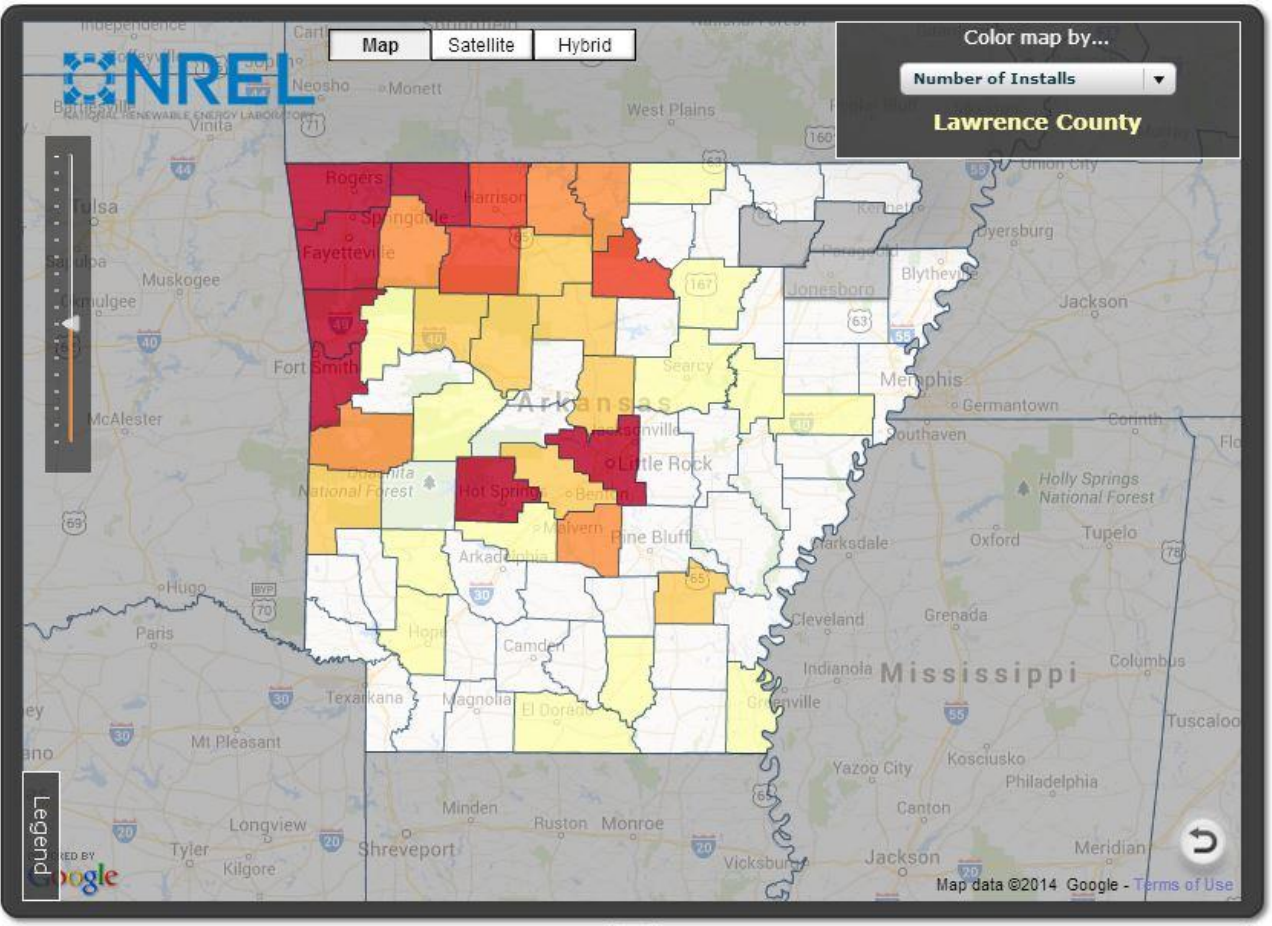
What is required for Arkansas to be competitive in the advanced energy sector?

- Policies?
- Investment by the State?
- K-12 Education?
- Workforce Development?

Resource Library

Jump Drive Contains:

- Reports
- Links to Websites
- Resources
- Slide Decks
- Panelist Bios



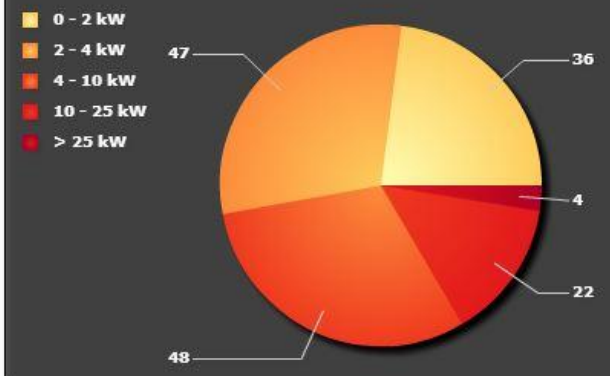
Statistics for AR

Total Number of Installs: 157
State Rank: 31 of 52
County Rank:

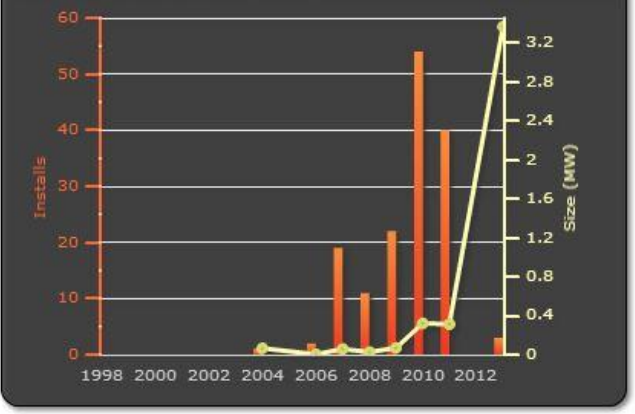
Installed Capacity (MW): 4.27
State Rank: 31 of 52
County Rank:

Avg Cost Last Year ($/W) 0
State Rank: 0 of 26
County Rank:

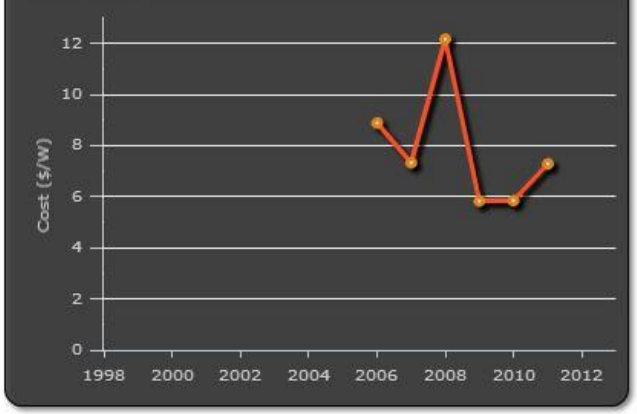
Size Breakdown for AR



Installs and Capacity by Year for AR



Cost by Year for AR



Cost Last 12 Months by Size for AR

No Data

DSIRESOLAR™

Database of State Incentives for Renewables & Efficiency

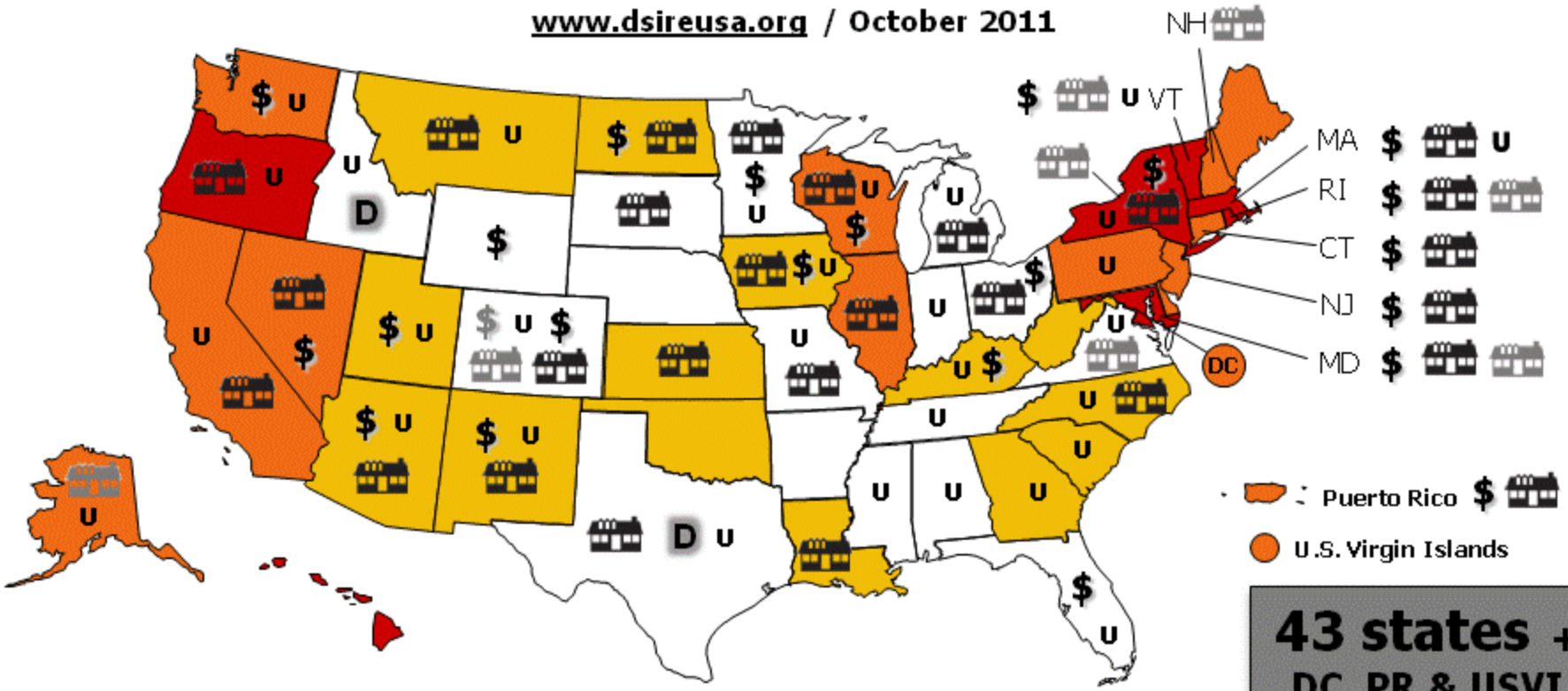
U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

IREC Interstate Renewable Energy Council

North Carolina Solar Center

Financial Incentives for Solar PV

www.dsireusa.org / October 2011



43 states + DC, PR & USVI offer financial incentives for solar PV

- Direct Cash Incentive
- Tax Credit
- Direct Cash Incentive and Tax Credit
- D Tax Deduction
- $ Sales Tax Incentive
- Property Tax Incentive
- U Utility Direct Cash Incentive(s)
- $ Local option to provide sales tax incentive
- Local option to provide property tax incentive

Poultry Growers save big $!

- 544,400 bird productions
- $12,316 in propane expenses
- $7,676 in electricity expenses

Energy Efficiency Renovation:

- LED light bulbs
- Air circulation fans
- Roll up seal doors
- Radiant brooders

*Over *$5000* in annual savings!

Avg. poultry farm can save 28%.

http://asc.uark.edu/Energy_Efficiency__Poultry_Farms.pdf

Poultry Farms

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Energy Efficiency Panel

Renewable Energy Panel

Alternative Fuel Panel

Words of Inspiration

"Find out what you can do to create the GREATEST GOOD

For the GREATEST NUMBER of people.

Get there as FAST as you can.

Work as HARD as you can."

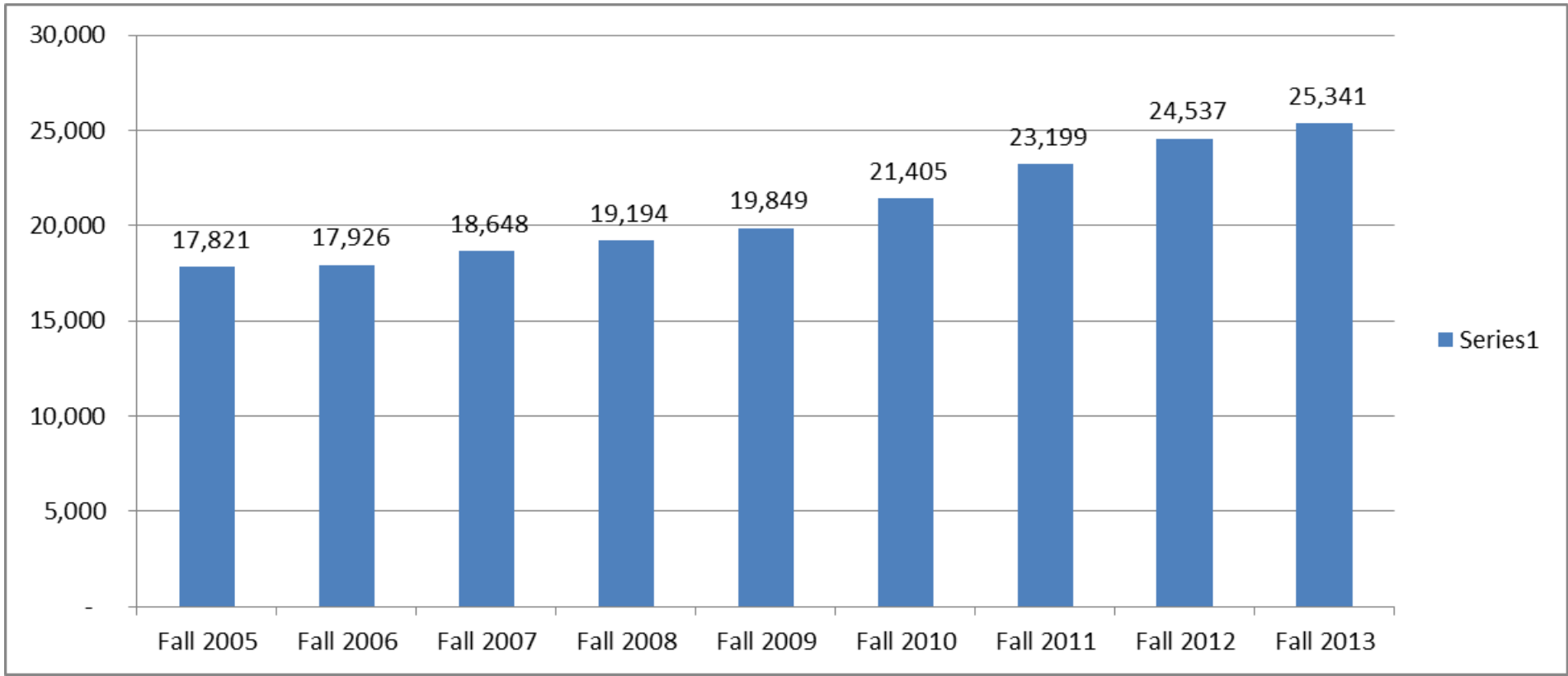
Case Studies

Is 30% Savings Possible?

Can you grow in size and still reduce energy use?

UA Enrollment Slide

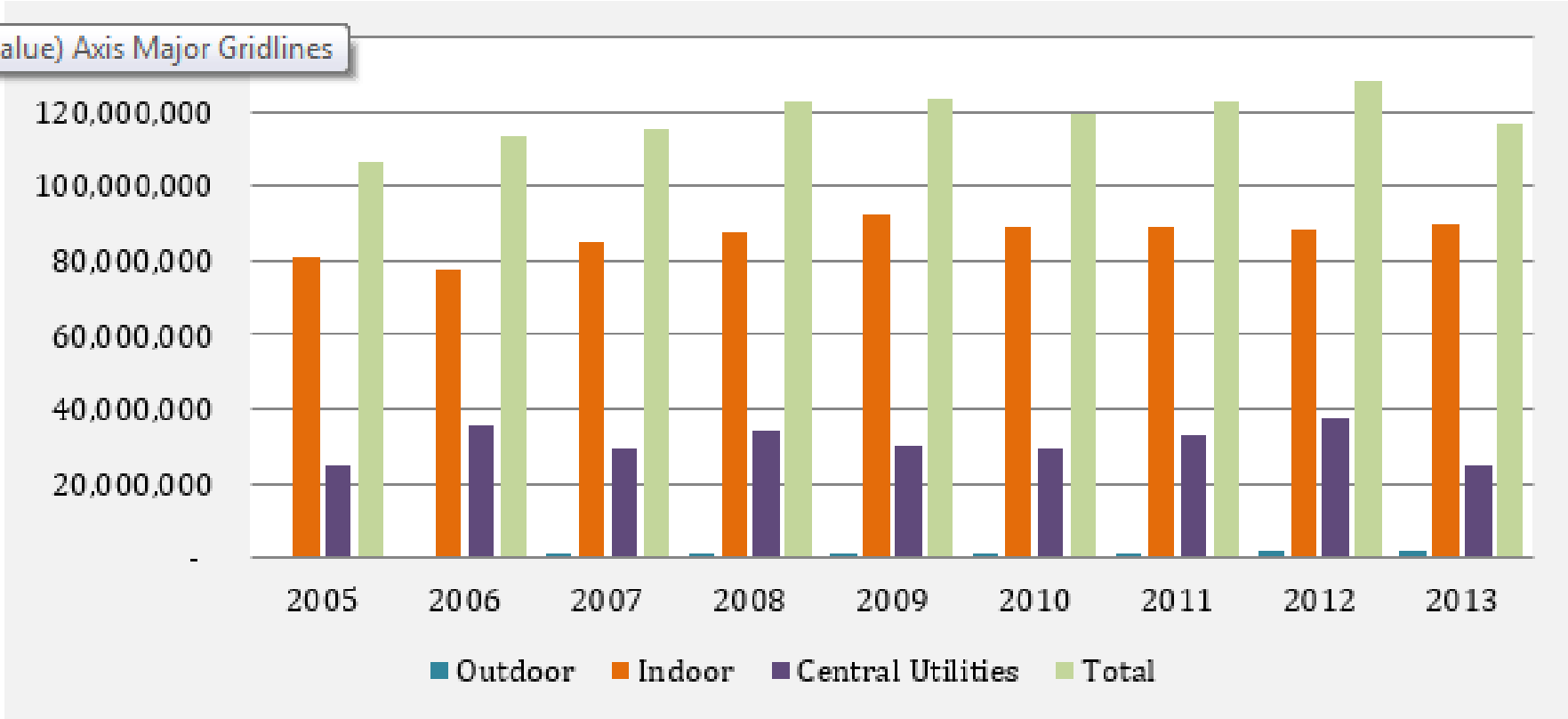
UA Student Enrollment has increased by almost 8,000 students in 8 years or 42% .



University of Arkansas
Demand Side Management

Since 2008, UA Energy Consumption has remained flat or is decreasing.

Figure1. Electricity Usage over Time at the University of Arkansas



Clinton School of Public Service

- Built in 1911
- Renovated in 2009
- $270,000 in EE retrofits
- Annual utility savings
  $30,000
- Reduction in kWh 45%
- Payout = 9 years
- Savings = 91 years

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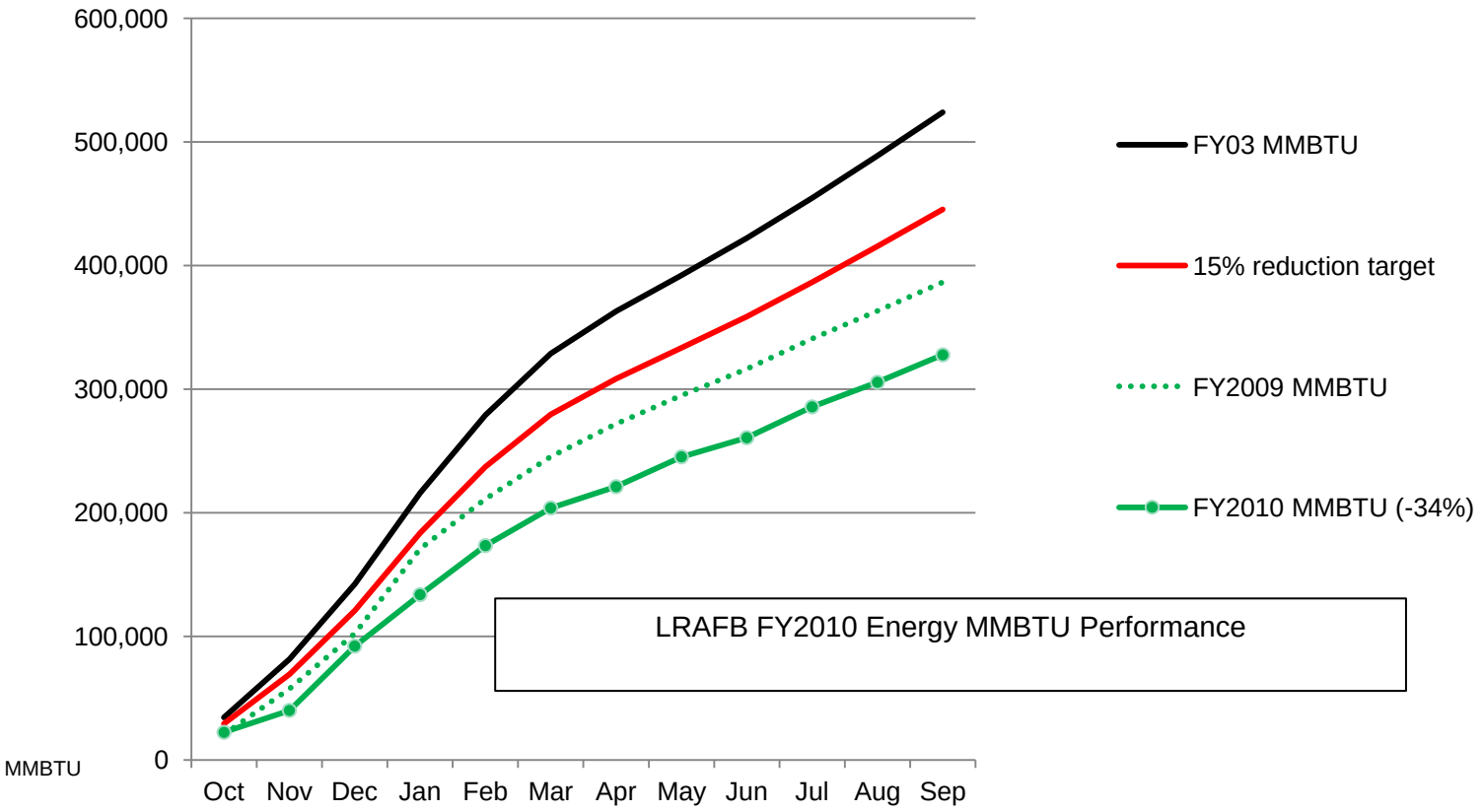
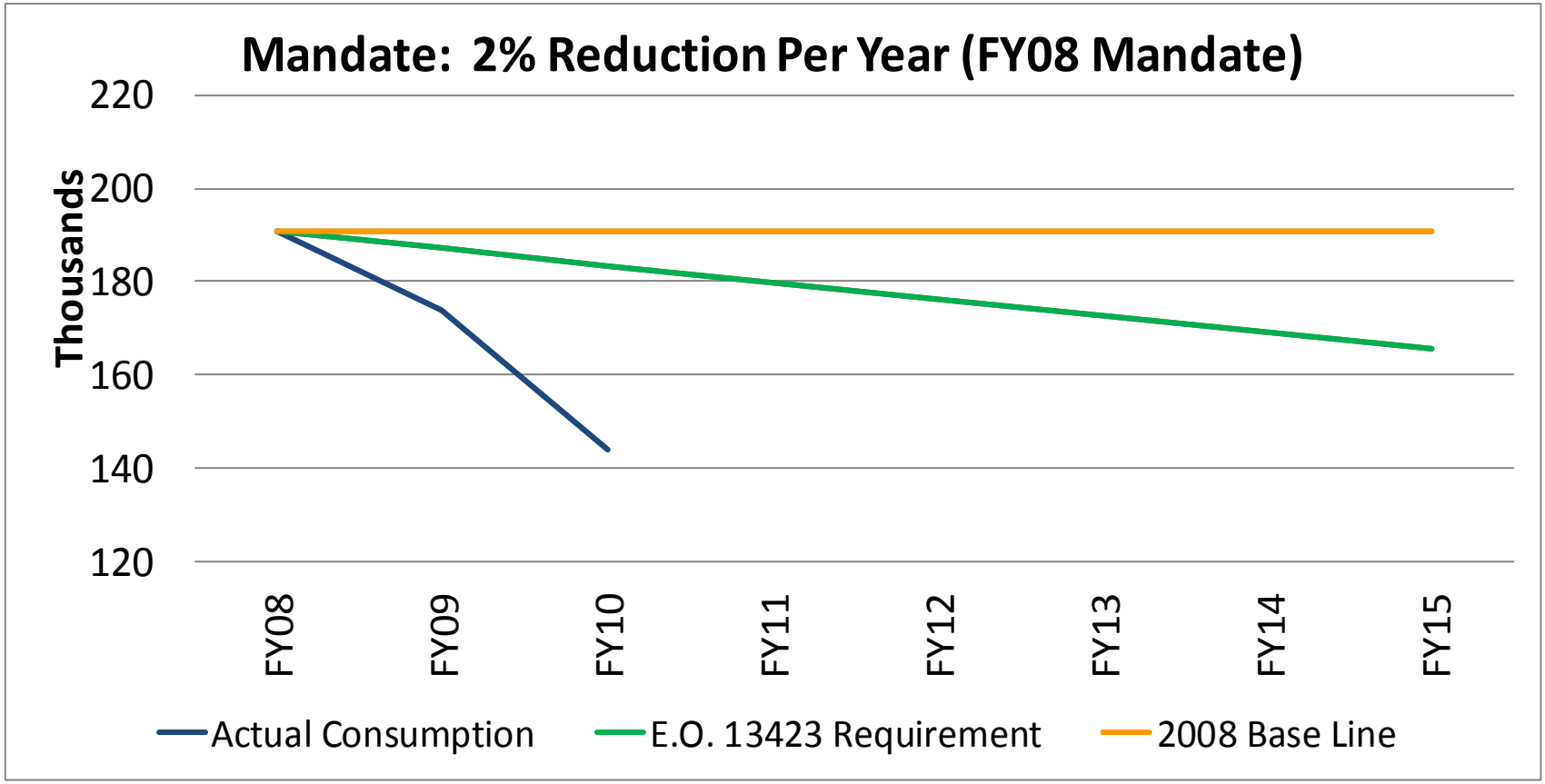
EE Success Stories

Example #1: Little Rock AFB

LRAFB Energy Performance in MMBTU's



LRAFB Energy Performance in MMBTU's



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Poultry Farms

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Growers saves energy with audit recommendations adaption

A case in focus: A grower in Lincoln County, Arkansas

Year farm built: 1996 House dimension: 40 ft. wide x 500 ft. long

Number of houses: 4

Annual chicken production: 544,400 bird (3.3 Million pounds live bird weight)

Annual propane usage: 7,643 gallons (cost: $12,316)

Annual electricity usage: 84,329 kWh (cost: $7,676)

Renovation—adaption of recommended energy conservation opportunities

- Energy efficient light bulbs, LED
- Air circulation fans underneath the ceilings to improve heating efficiency
- Infiltration/conduction improvement using roll up seal doors to replace double sliding doo
- Radiant brooders

Benefits:

- Savings on propane: 1,836 gallons ($2,956)/year; or 24% of annual gas usage
- Savings on electricity: 24,812 kWh ($2,258)/year; or 29% of annual electricity usage

Ozarks Electric Coop +NextGen

POULTRY LED
by NextGen Illumination, Inc.

- kWh Reduced 83%
- Mortality decreased
- Feed Conversion Ration Increased
- Yield Increased

http://poultryled.thebelfordgroup.com/Portals/192/Testing%20of%20LED%20Lights%20in%20Broiler%20Houses.pdf

Halsell Household

- 1951
- 2150 Sq.Ft.
- 1100 kWh/mo. 1998
- 545 kWh/mo. 2013
- **50% savings!**
- **Over $600/year on electricity!**

What if 1000 households saved $600/year?
What if 2000 households saved $600/year?

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