

# Charting a Course to Energy Independence

**Providence, RI**  
**August 9-12, 2009**

Renewable Energy Track Session I: Launching Pad  
Renewable Energy Goals and Qualified Technologies

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# Agenda

- Renewable Energy Characteristics
- Overview of Federal Goals
- Progress on DoD and EPAct Goal
- Potential Changes to Goals



# Renewable Energy Characteristics



**Wind**



**Ocean**



**Geothermal**



**Solar**



**Incremental  
Hydropower**



**Biomass**

[http://www.nrel.gov/analysis/power\\_databook/](http://www.nrel.gov/analysis/power_databook/)

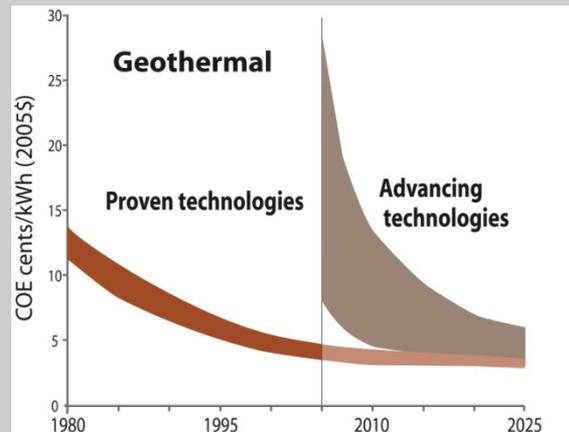
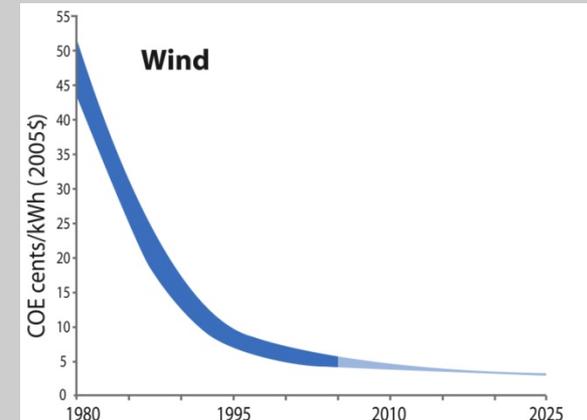
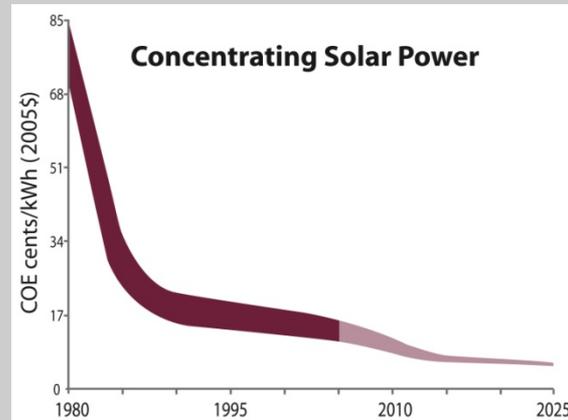
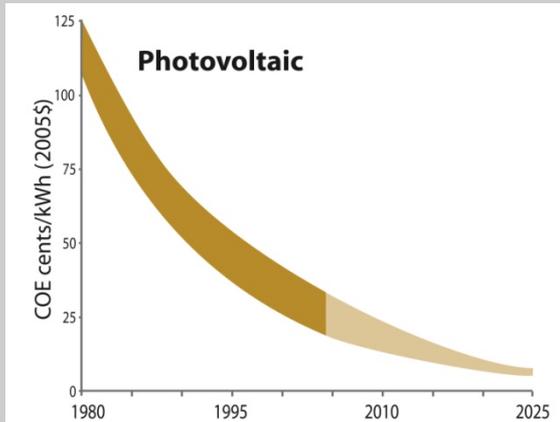


# Characteristics to Consider

- Output: Electricity, Thermal, Combined Heat and Power, Mechanical, Light
- Resource: Solar, Wind, Geothermal, Municipal Solid Waste, Landfill Gas, Incremental Hydropower, Hydrokinetic, Ocean
- Costs
  - ☐ Capital Costs
  - ☐ Variable Costs (Fuel, O&M)
  - ☐ Fixed O&M
  - ☐ Levelized Cost of Energy (LCOE)
- Footprint/Land Area
- **Available Incentives!**
- Electricity
  - ☐ Capacity Range
  - ☐ Capacity Factor
  - ☐ Dispatchability/Storage
- Thermal
  - ☐ Temperature ranges
  - ☐ Heat transfer medium – air, water, radiant
  - ☐ Practical volume of heat/cooling
  - ☐ Storage
- Other Considerations (i.e., water, environmental impacts, visual impacts, mission compatibility...)



# Characteristics: Cost Trends (\$2005)



Source:  
NREL Energy  
Analysis Office



# Solar Electric Characteristics

- Capacity Factor
  - ☐ PV: 16% to 32% with Tracking
  - ☐ Trough and Tower: 31% to 65% with Storage
  - ☐ Dish: 32% - 35%
- Capital Costs
  - ☐ PV: \$4000-\$9000/kW
  - ☐ Trough and Tower: \$3200 - \$5000
- LCOE
  - ☐ PV: 22¢-32¢/kWh
  - ☐ Trough and Tower: 7¢-20¢/kWh
- Other Considerations
  - ☐ Trough and Tower require cooling water
  - ☐ Trough easily hybrid with fossil fuels, CHP potential
  - ☐ Distributed PV competes against retail electricity, modular size
  - ☐ Trough and tower usually large scale, >80MW





# Wind Energy Characteristics

- Capacity Factor: 35% to 50%
- Capital Costs: \$900 to \$2000/kW
- LCOE: 2.9¢-6¢/kWh
- Fixed O&M: \$12-\$72/kW
- Other Considerations
  - ☐ Intermittent, not dispatchable
  - ☐ Small-scale or on-site competes against retail electricity
  - ☐ Size can range from <1kW to 1.5 MW/turbine, multiple turbine wind farms common
  - ☐ No water demand
  - ☐ Visual impacts, compatibility with radar, avian habitat require careful planning
  - ☐ Direct water pumping systems also available





# Ocean Energy and Marine Hydrokinetic Characteristics

- Wide Range of Potential Capacity Factors and Sizes, from 1 kW to 100 MW, capacity factors as high as 90% for OTEC
- Can have very predictable output based on tides, waves, water flows
- Capital Costs vary widely among technologies, as well as LCOEs
- Expected to be competitive with grid electricity at good resource locations, or high value sites like islands
- Other Considerations
  - ☒ Very little deployment experience to date
  - ☒ Little practical experience with potential transmission, siting, environmental issues
  - ☒ Ancillary benefits such as potable water production (OTEC)





# Hydrokinetic and Incremental Hydropower

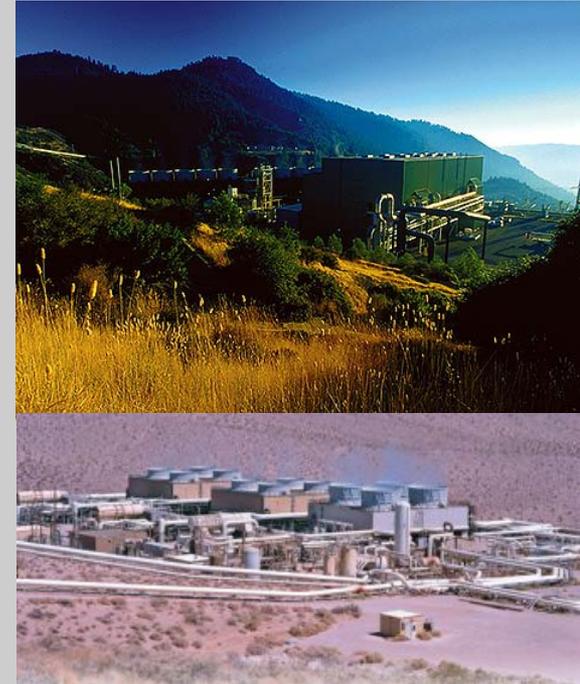
- Wide Range of Potential Capacity Factors and Sizes, from 1 kW and up, depend on nature of resource at site
- Seasonal variations common
- Incremental hydropower only allowed for new installations after 1/1/1999. Language in energy bills may push that back to 1/1/1992
- Incremental hydropower costs benefit from established transmission, environmental mitigation and other site savings
- Capital costs vary widely among sites, as well as LCOEs
- Expected to be competitive with grid electricity at good resource locations
- Other Considerations
  - ☐ Limited deployment experience with hydrokinetic
  - ☐ Little practical experience with potential transmission, siting, environmental issues with hydrokinetic
  - ☐ Hydrokinetic can tap man-made flows – i.e., in aquaducts or canals





# Geothermal

- High capacity factors, up to 90% and high availability
- Usually >10MW
- Highly competitive power from hydrothermal – 5-10¢/kWh
- Capital Costs can vary widely – exploratory wells are risky stage in development
- CHP potential
- Other Considerations
  - ☐ Enhanced geothermal revival can open development in areas without natural hydrothermal reservoirs
  - ☐ Impacts on hydrothermal features – geysers and hot springs – a concern
  - ☐ Cultural objections to some key sites
  - ☐ Rely on water for cooling
  - ☐ Waste heat generators (testing at DOE RMOTC) can turn low-temp geothermal heat from pumped water, oil or other sources into electricity





# Biomass, WTE, LFG

- High capacity factors, up to 90% and high availability
- Usually >10MW for biomass, as small as 100 kW for LFG microturbines
- Capital Costs \$3,500 to \$3,800/kW
- LCOE 8-10¢/kWh
- CHP and co-firing potential
- Wood-fired, mass-burn WTE, landfill gas well-established
- Energy crops (woody and herbaceous) emerging
- Other Considerations
  - ☐ Reliable, long-term fuel supply essential
  - ☐ Air emissions can require permitting
  - ☐ Thermal cycles require water for cooling





# Non-Electric Renewable Energy

- Resources/Technologies: Biomass, geothermal direct use, active solar thermal, passive solar thermal, daylighting, wind-powered water pumping
- Excluded from EPA Act goal but can contribute to EO requirement for new generation
- Solar water heating must be installed in new construction or major renovation to meet 30% of hot water needs, if cost-effective
- Temperature ranges and sizing from domestic hot water to industrial process heat
- Air, water and radiant heat systems available
- Many technologies very cost-effective, but often overlooked
- Zero-Energy buildings feasible today when thermal, electric and lighting technologies are combined effectively
- Often complement electric technologies in reducing peak demand





# Measurement, Verification and Warranties

- Renewable energy is like any other energy project – measure it, verify it, maintain it
- Meters – thermal and electric – should be standard on all but the smallest systems
- Third party design review and commissioning for major systems are standard before investors commit to large projects – think like the pros
- Vendors should commit to performance levels you require:
  - ☐ Efficiency: Initial, Stabilized, by Key Component
  - ☐ Output: Peak, Average, and Power Quality
  - ☐ Reliability: Planned and Unplanned Outages
  - ☐ Availability: Especially Performance When Needed
  - ☐ Actual vs. Promised Fixed and Variable Cost
  - ☐ Fuel quality
- Verify actual performance on delivered equipment if possible!
- Design and maintenance can be purchased with equipment
- The Solar Rating and Certification Corporation (SRCC) certifies solar thermal collectors and systems and EnergySmart solar water heaters are available
- Warranties – which components do they cover, for how long, and what do they cover



# FEDERAL GOALS



# Overview: Four and ½ Federal Goals

Source of Requirement	Produce, Use, or Both	Level...	Applies to...
EPAct 2005 Federal Use Goal	Use, Electric	3% FY07-09 5% FY10-12 7.5% FY13...	All Agencies
Executive Order 13423	Use, All RE	½ of EPAct Federal Goal from “New” Sources	All Agencies
DoD National Defense Reauthorization Act of 2007	Produce or Use, All RE	25% of electricity by 2025	DoD
EPAct 2005 BLM Production Goal	Produce, Electric	10,000 MW by 2015	BLM
EISA 2007 SWH Requirement	Use, Solar Water Heating	30% of hot water needs in all new buildings or major renovations	All Agencies



# Overview: EPAct Requirements

- Statutory renewable energy goals under EPACT 2005 Section 203 are:
  - ☐ 3% of electric energy by 2007
  - ☐ 5% of electric energy by 2010
  - ☐ 7.5% of electric energy by 2013
- Bonus Provision
  - ☐ Doubled if produced on Federal or Indian land and used by Federal agency
- Under EO 13423:
  - ☐ At least half of the statutorily required renewable energy consumed comes from new renewable sources
  - ☐ New means renewable sources placed into service after January 1, 1999
  - ☐ Encourages on-site projects
- Information: <http://www.ofee.gov/whats/e013423.pdf> (EO); and [http://www1.eere.energy.gov/femp/pdfs/epact05\\_fedrenewenergyguid.pdf](http://www1.eere.energy.gov/femp/pdfs/epact05_fedrenewenergyguid.pdf)



# Overview: Renewable Guidance (EPA Act and EO)

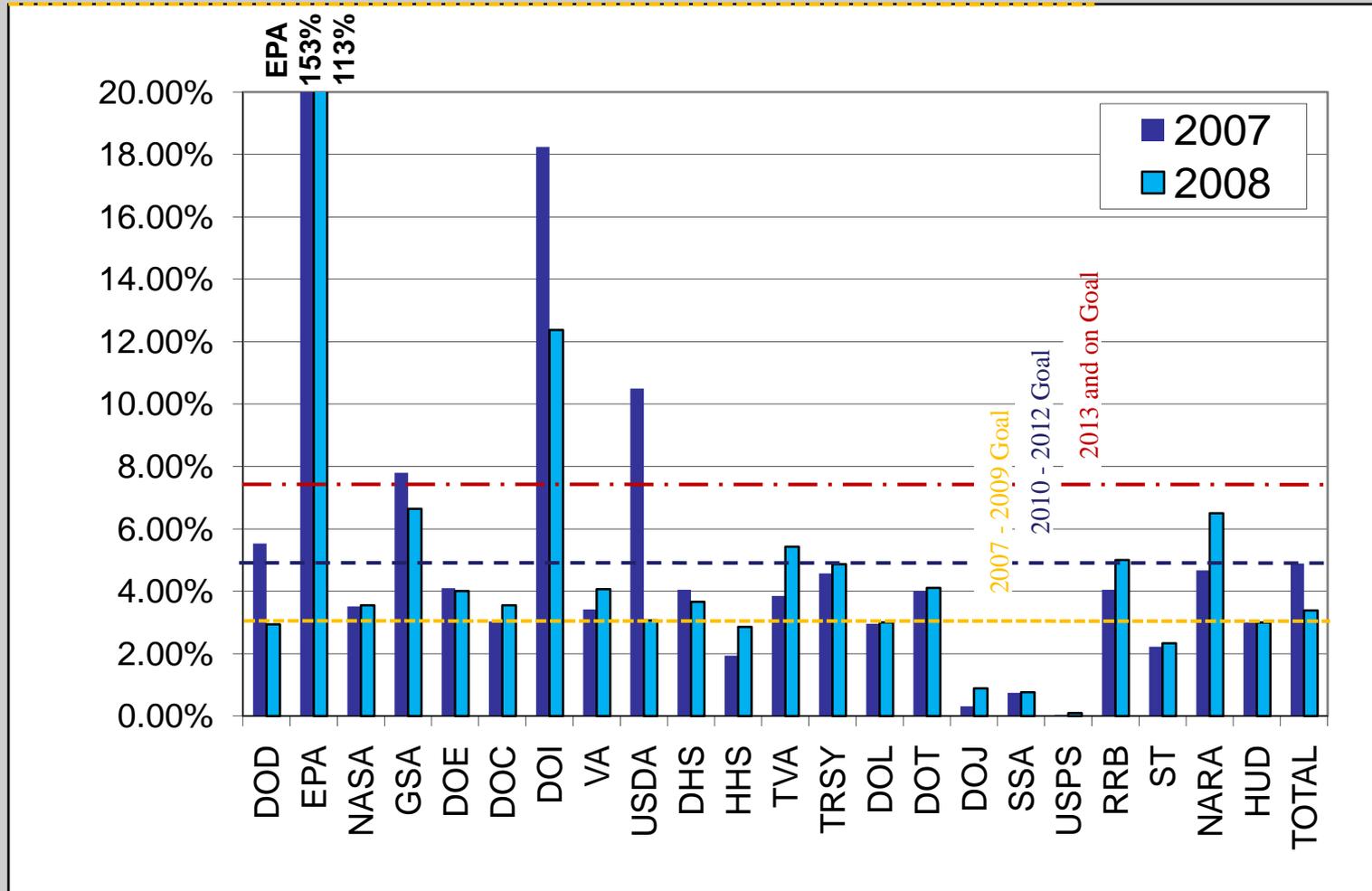
- Agencies must USE the renewable energy
  - For on-site projects, agency must retain or replace RECs to show use and get credit
  - Hosting a renewable energy project is good, but it does not help meet the goal
- New non-electric projects can count toward EO requirement for new generation (placed in service after 1/1/1999) but not EPACT.
- Existing purchases and projects which met old EO 13123 guidelines are Grand Fathered through 2011 .
- Excludes system mix energy and energy used to meet state RPS requirements



# GOAL PROGRESS

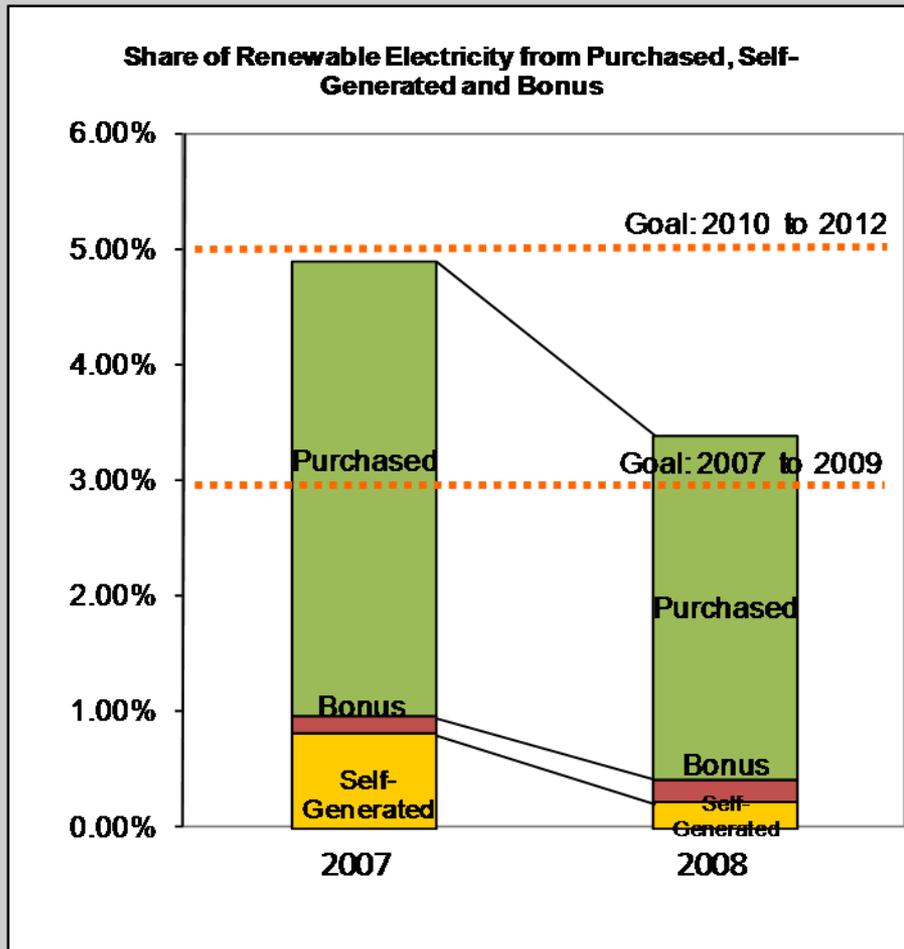


# Progress: EPA Act Goal





# Progress: EPA Act Goal



## How Agencies Buy

- High reliance on purchases – short-term
- Self-generated declined due to REC retention requirement and restrictions on existing
- Bonuses decline with self-generated
- Hard to recover this much by FY2010

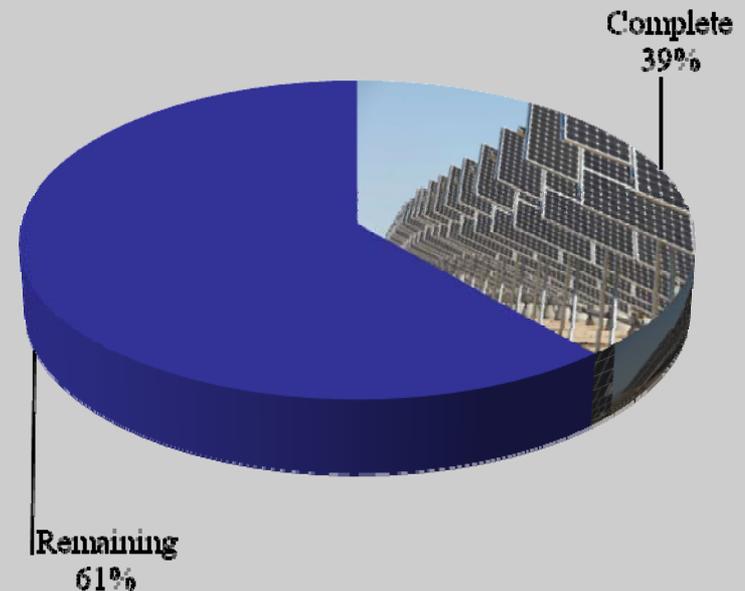


# Progress: DoD Goal

## Key Features of DoD Goal

- 25% by 2025
- All forms of renewable energy
- Procured **or** used
- Compared to facility electricity use
- No REC retention requirement

## DoD RE Procured or Used and Remaining Goal





# POTENTIAL CHANGES TO GOALS



# Pending Legislation and Federal Renewable Energy Goal

- HR2454, House Energy Bill Title I, Subtitle A – Combined Efficiency and Renewable Electricity Standards, Sec. 103 Federal Renewable Energy Purchases:
  - ☐ Amends PURPA: creates separate goal without removing EPC Act goal
  - ☐ Uses PURPA renewable energy definitions, not consistent with EPC Act
  - ☐ Electricity from renewable energy only, compared to facility electricity use on calendar year basis
  - ☐ **No bonus** for projects on Federal or Indian land
- Would allow **20 year contracts** for RE





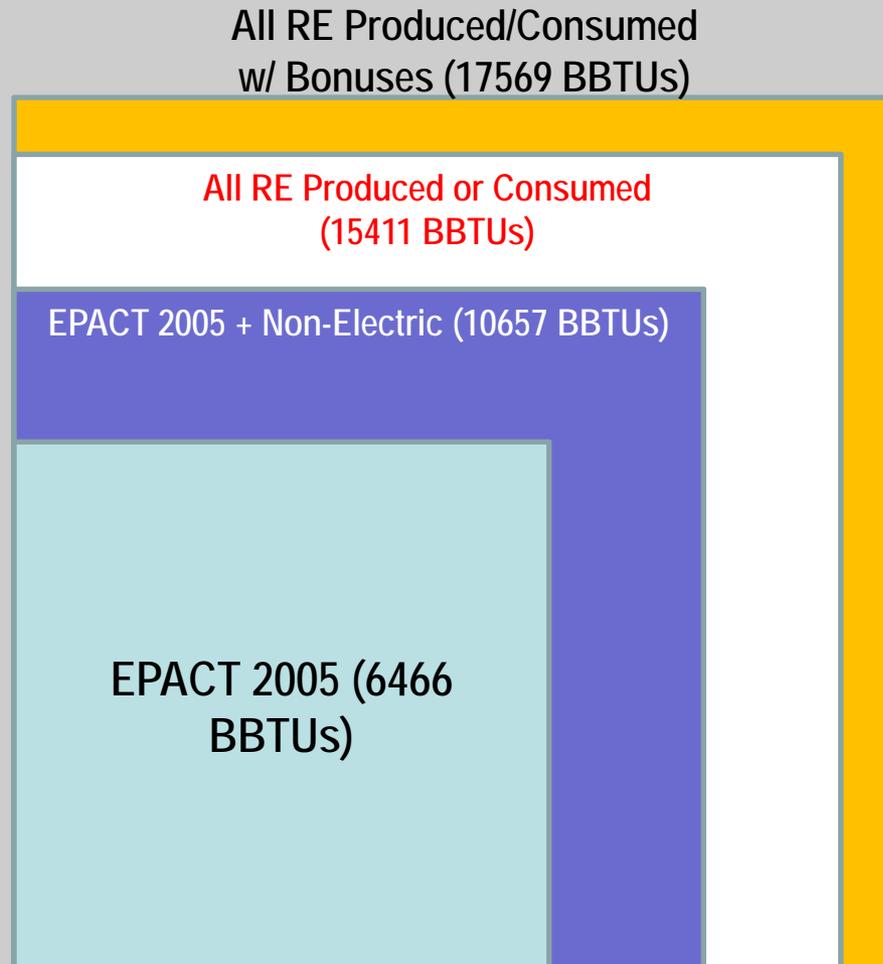
# Pending Legislation and Federal Renewable Energy Goal

- DRAFT Senate Energy Bill Subtitle C Part V, Sec. 271:
  - ☐ would allow all renewable energy, **not just electricity**, to apply to Federal goal
  - ☐ Would make goals a percentage of **all facility energy**
  - ☐ Allows **production** on Federal or Indian land to count toward goal
  - ☐ **Remove bonus** for projects on Federal or Indian land
- Would allow **30 year contracts** for RE





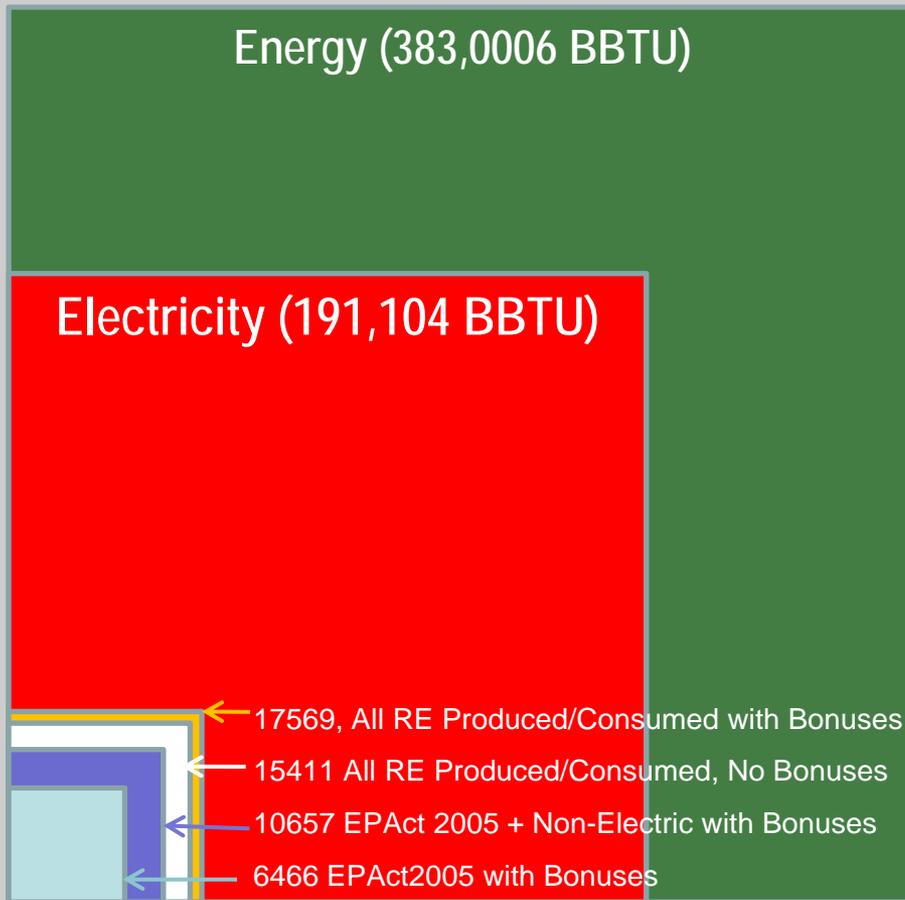
# Definitions Matter: What Counts?



All values are based on preliminary information from agency energy submissions for FY08.



# Definitions Matter: All RE Produced or Consumed Compared to Electricity Use and All Facility Energy



Electricity

$$\frac{15,411}{191,104} = 8.06\%$$

All Facility Energy\*

$$\frac{15,411}{383,006} = 4.02\%$$

\*Scenario from current draft Senate language, which remove bonus provisions for projects on Federal or Indian land.  
All values are based on preliminary information from agency energy submissions for FY08.



# Future (Hopes) for Federal Goals???

- Counting everything:
  - ☐ Produce or use
  - ☐ Electric, thermal, or other (light, mechanical...)
  - ☐ Compared to total facility energy use, not just electricity
- Continue bonuses for use from projects on-site and on Indian lands
- Continue requirement for new generation
- Allow as an offset for energy efficiency:
  - ☐ At least for on-site generation
  - ☐ Preferably for long-term REC purchases
- GHG Credits





# ADDITIONAL MATERIALS/DETAILS



# EPA Act Section 203, if amended by Senate...

- § 15852. Federal purchase requirement

(a) Requirement. The President, acting through the Secretary, shall seek to ensure that, to the extent economically feasible and technically practicable, of the total amount of **energy** the Federal Government consumes during any fiscal year, the following amounts shall be renewable energy:

- (1) Not less than 3 percent in fiscal years 2007 through 2009.
- (2) Not less than 5 percent in fiscal years 2010 through 2012.
- (3) Not less than 7.5 percent in fiscal year 2013 and each fiscal year thereafter.

(b) Definitions. In this section:

(2) Renewable energy. The term "renewable energy" means **energy** generated from solar, wind, biomass, landfill gas, ocean (including tidal, wave, current, and thermal), geothermal, municipal solid waste, or new hydroelectric generation capacity achieved from increased efficiency or additions of new capacity at an existing hydroelectric project.

“(c) CALCULATION.—Renewable energy **produced** at a Federal facility, on Federal land, or on Indian land (as defined in section 2601 of the Energy Policy Act of 1992 (25 U.S.C. 3501))—

“(1) shall be calculated separately from renewable energy used; and “(2) may be used individually or in combination to comply with subsection (a).”;

(4) by adding at the end the following: “(e) CONTRACT PERIOD.—“(1) IN GENERAL.—Notwithstanding section 501(b)(1)(B) of title 40, United States Code, a contract entered into by a Federal agency to acquire renewable energy may be made for a period of not more than 30 years.

“(2) TECHNICAL ASSISTANCE.—The Secretary shall provide technical assistance to Federal agencies to enter into contracts under this subsection.

“(3) STANDARDIZED RENEWABLE ENERGY PURCHASE AGREEMENT.—Not later than 90 days after the date of enactment of this subsection, the Secretary, acting through the Federal Energy Management Program, shall publish a standardized renewable energy purchase agreement setting forth commercial terms and conditions that can be used by Federal agencies to acquire renewable energy.”.



# House Language

## SEC. 103. FEDERAL RENEWABLE ENERGY PURCHASES.

(a) REQUIREMENT.—For each of calendar years 2012 through 2039, the President shall ensure that, of the total amount of electricity Federal agencies consume in the United States during each calendar year, the following percentage shall be renewable electricity:

<b>Calendar year</b>	<b>Required annual percentage</b>
2012 .....	6.0
2013 .....	6.0
2014 .....	9.5
2015 .....	9.5
2016 .....	13.0
2017 .....	13.0
2018 .....	16.5
2019 .....	16.5
2020 .....	20.0
2021 through 2039 .....	20.0

(b) DEFINITIONS.—For purposes of this section:

- (1) RENEWABLE ELECTRICITY.—The term “renewable electricity” shall have the meaning given in section 610 of the Public Utility Regulatory Policies Act of 1978 (16 U.S.C. 2601 and following).
- (2) RENEWABLE ENERGY RESOURCE.—The term “renewable energy resource” shall have the meaning given in section 610 of the Public Utility Regulatory Policies Act of 1978 (16 U.S.C. 2601 and following).





# House Language (continued)

- (c) **MODIFICATION OF REQUIREMENT.**—If the President determines that the Federal Government cannot feasibly meet the requirement established in subsection (a) in a specific calendar year, the President may, by written order, reduce such requirement for such calendar year to a percentage the President determines the Federal Government can feasibly meet.
- (d) **REPORTS.**—Not later than April 1, 2013, and each year thereafter, the Secretary of Energy shall provide a report to Congress on the percentage of each Federal agency’s electricity consumption in the United States that was renewable electricity in the previous calendar year.
- (e) **CONTRACTS FOR RENEWABLE ENERGY.**—(1) Notwithstanding section 501(b)(1)(B) of title 40, United States Code, a contract for the acquisition of electricity generated from a renewable energy resource for the Federal Government may be made for a period of not more than 20 years.
  - (2) Not later than 90 days after the date of enactment of this subsection, the Secretary of Energy, through the Federal Energy Management Program, shall publish a standardized renewable energy purchase agreement, setting forth commercial terms and conditions, that Federal agencies may use to acquire electricity generated from a renewable energy resource.
  - (3) The Secretary of Energy shall provide technical assistance to assist Federal agencies in implementing this subsection.

