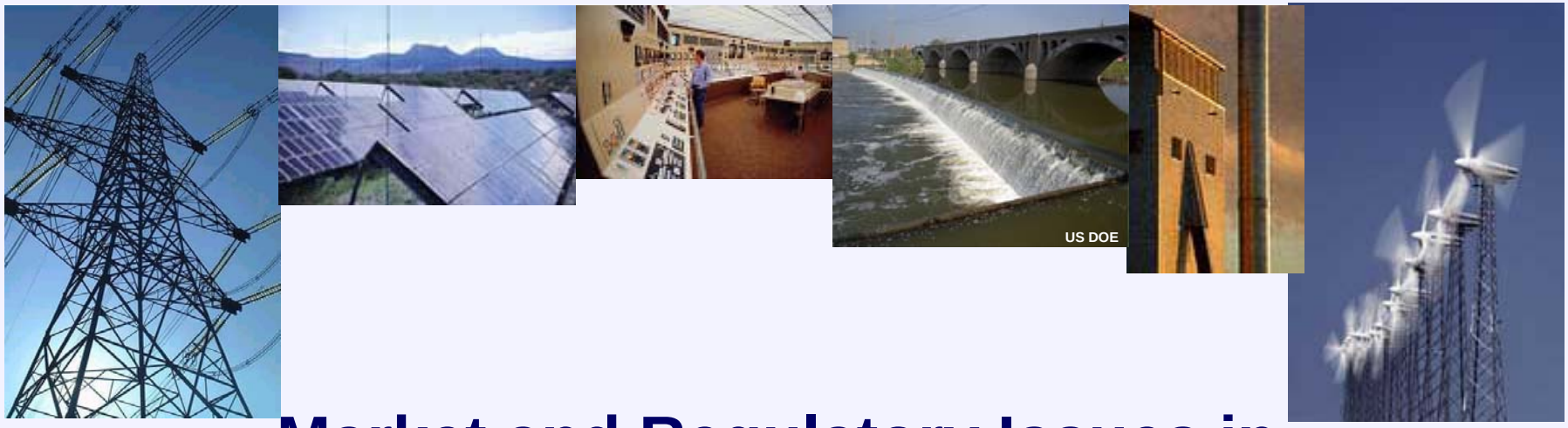


Market and Regulatory Issues in Alternative Energy and Louisiana Initiatives

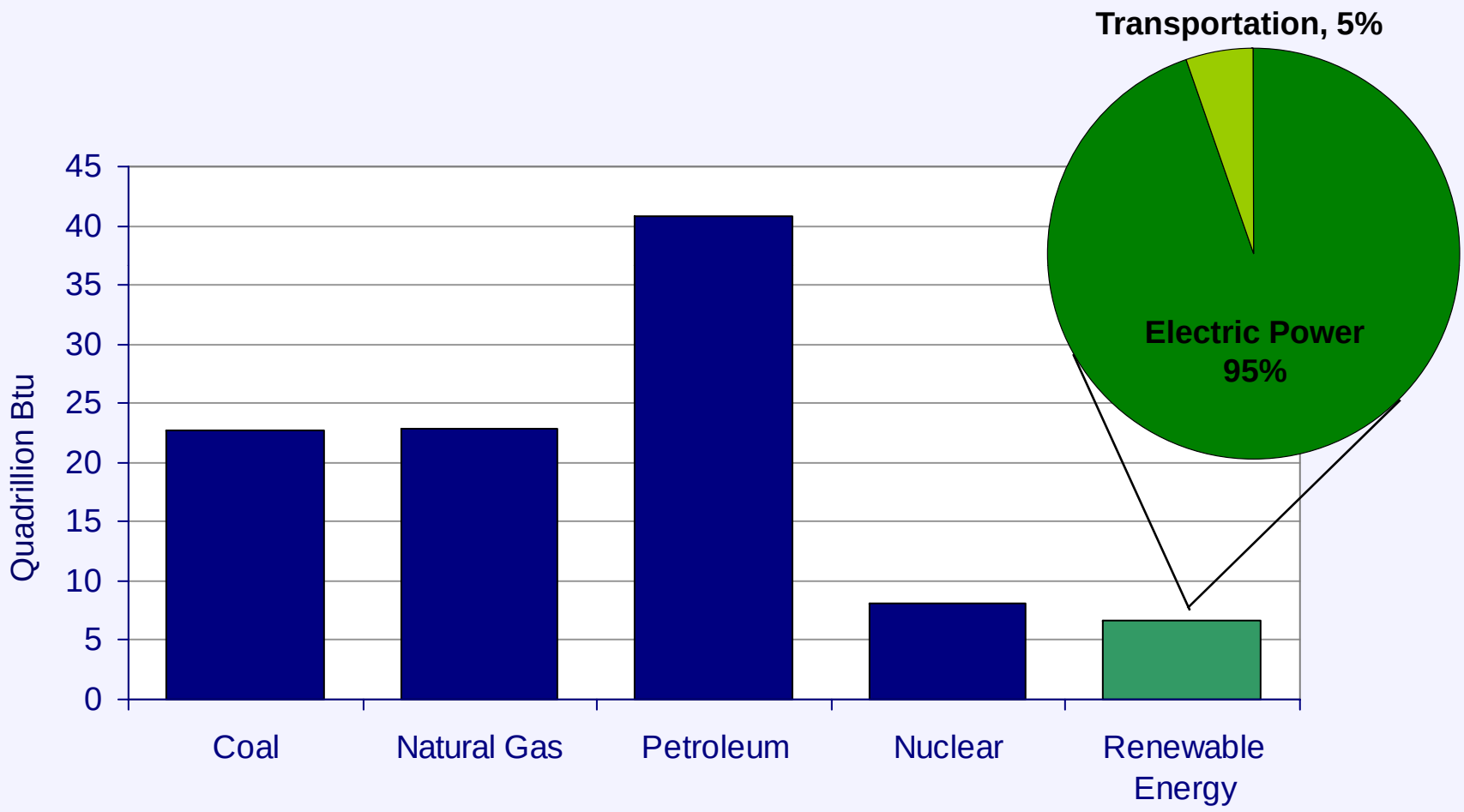
2008 Statewide Clean Cities Coalition Conference: Making Sense of Alternative Fuels and Advanced Technology

March 27, 2008

David E. Dismukes
Center for Energy Studies
Louisiana State University

Overview of
Alternative Energy Generation

U.S. Energy Consumption by Source



Source: Energy Information Administration, US Department of Energy

Louisiana Renewable Fuels Standard and Renewable Portfolio Standard

	MMBtu
Required by Renewable Fuel Standard (2%)	5,978,921
Required by 10% Renewable Portfolio Standard	31,023,816
Required by 20% Renewable Portfolio Standard	62,047,632

Source: Energy Information Administration, US Department of Energy

Louisiana Renewable Fuels Standard and Renewable Portfolio Standard

	5% Premium	10% Premium	15% Premium
	---------- (million $) ----------		
Required by Renewable Fuel Standard (2%)	$ 6.03	$ 12.07	$ 18.10
Required by 10% Renewable Portfolio Standard	$ 37.73	$ 75.47	$ 113.20
Required by 20% Renewable Portfolio Standard	$ 75.47	$ 150.93	$ 226.40

Source: Energy Information Administration, US Department of Energy

Types of Alternative Energy Generation

Hydroelectric

Biomass / Biogas

Wave Energy

Geothermal

Wind

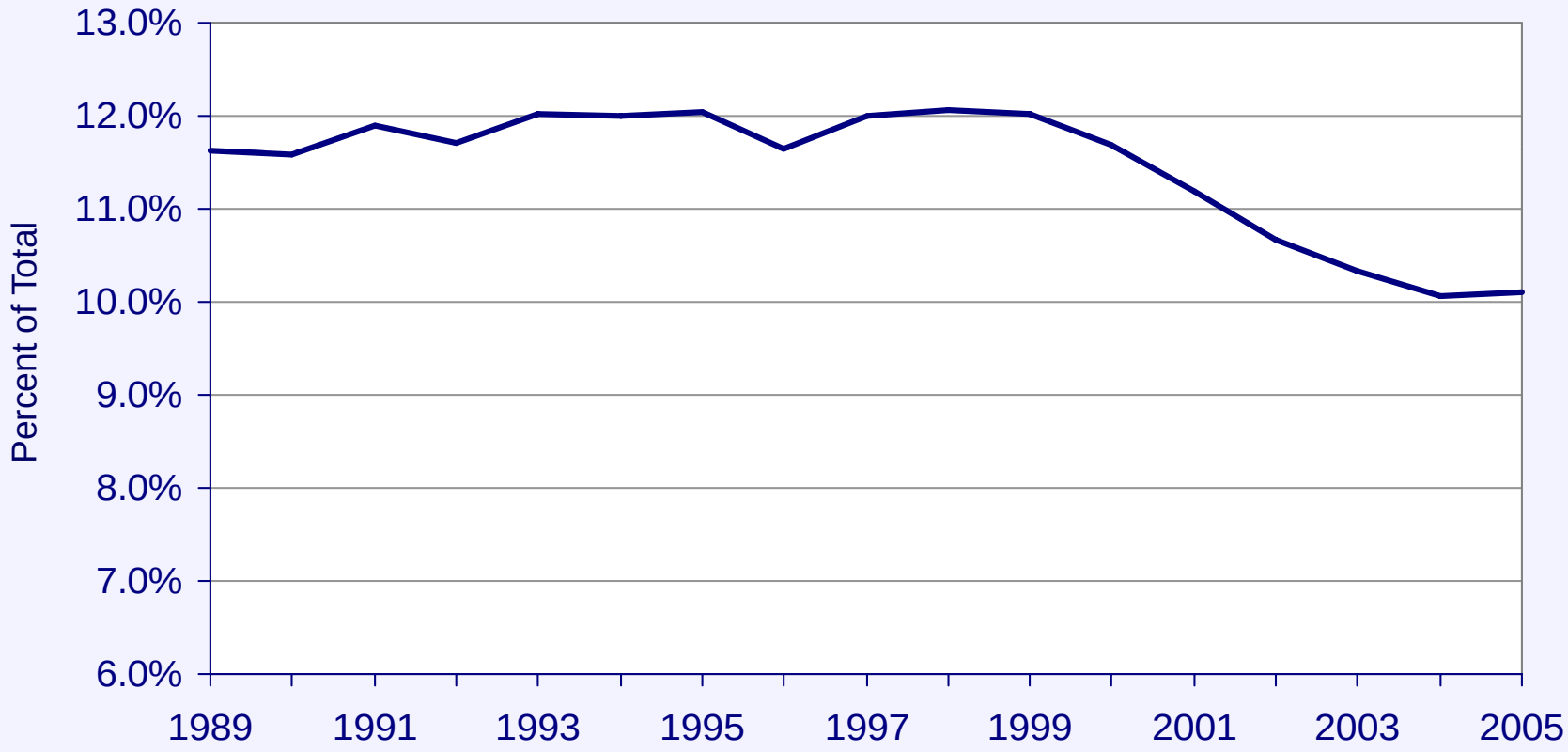
Solar

Renewable Energy Technologies

Renewable Energy Source	Generation Technology
Solar	Photovoltaic Thermal Energy Capture
Wind	Wind Turbines
Water	Hydroelectric Turbines
Ocean	Wave Energy Devices Tidal/Current Energy Turbines Thermal Energy Conversion
Geothermal	Steam Turbines Direct Use Geothermal Heat Pumps
Biomass	Combustion (direct fired, co-firing with coal Gasification / Pyrolysis
Biogas	Engine generators Combustion turbines Microturbines Fuel cells

Renewable Electricity Generation as a Share of Total US

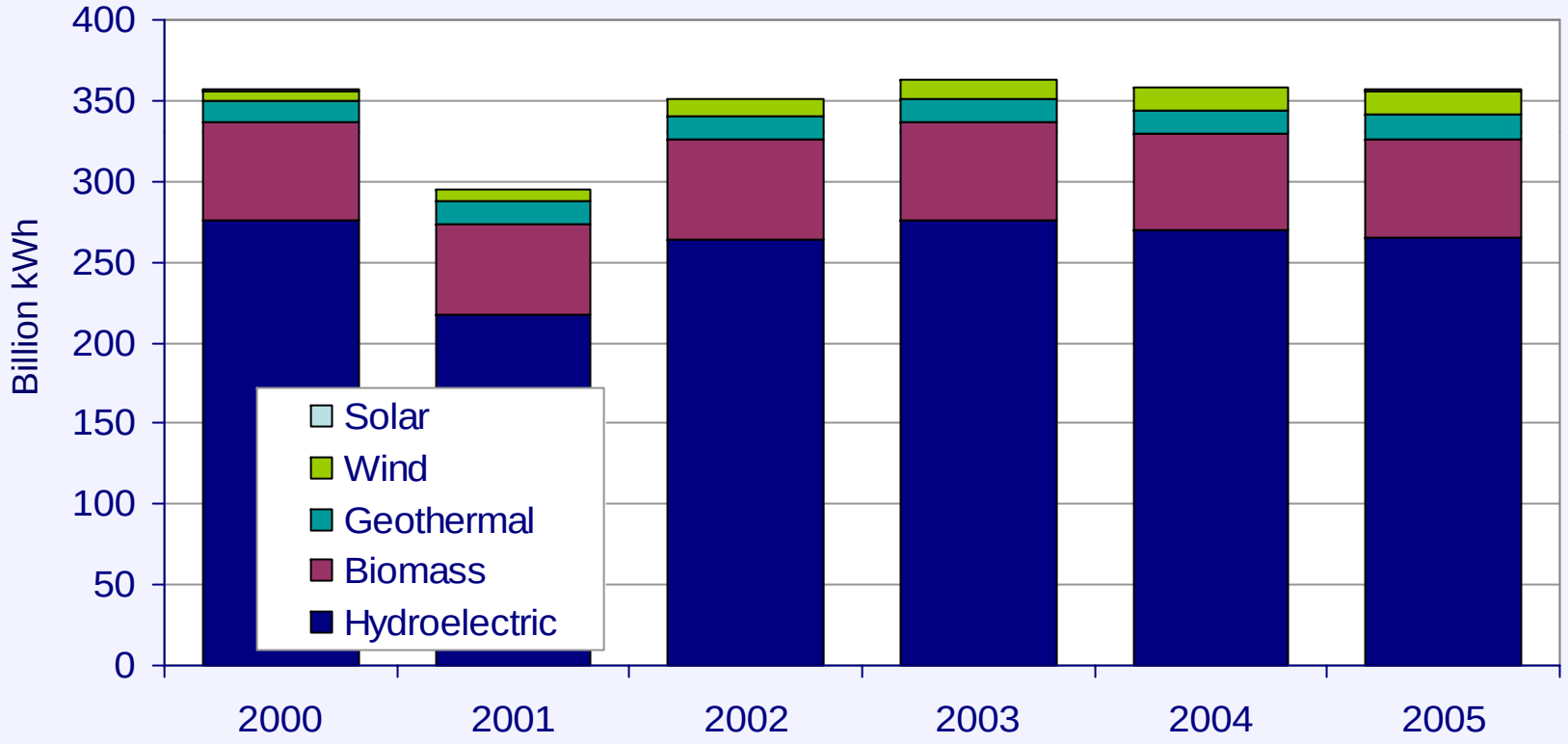
Renewable energy has fallen as a share of total U.S. power generation.



Source: Energy Information Administration, US Department of Energy

Electricity Net Generation from Renewable Energy

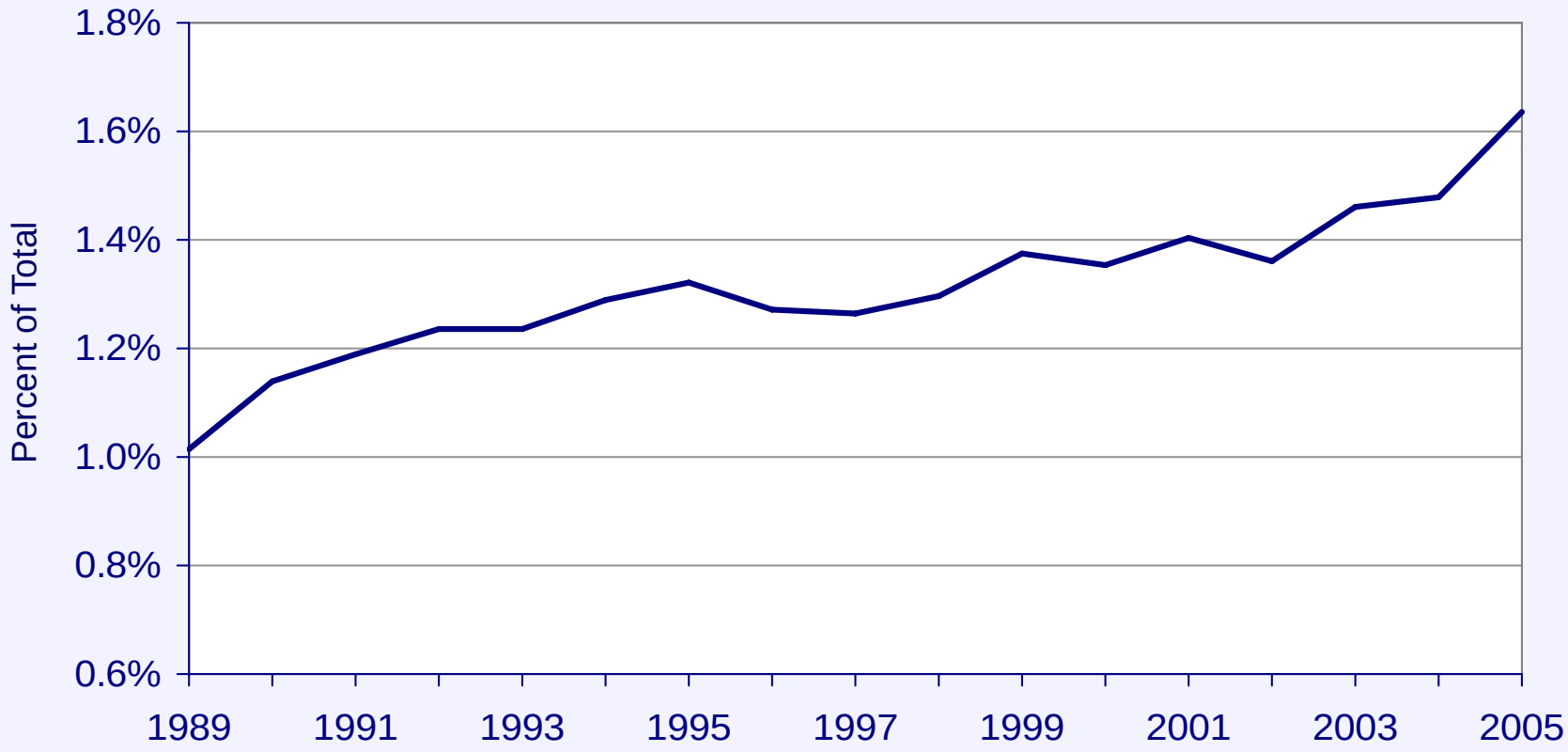
Current trends in renewable energy have been flat over the past several years and dominated by hydroelectric generation.



Source: Energy Information Administration, US Department of Energy

Non-hydroelectric Renewable Electricity Generation as a Share of Total US

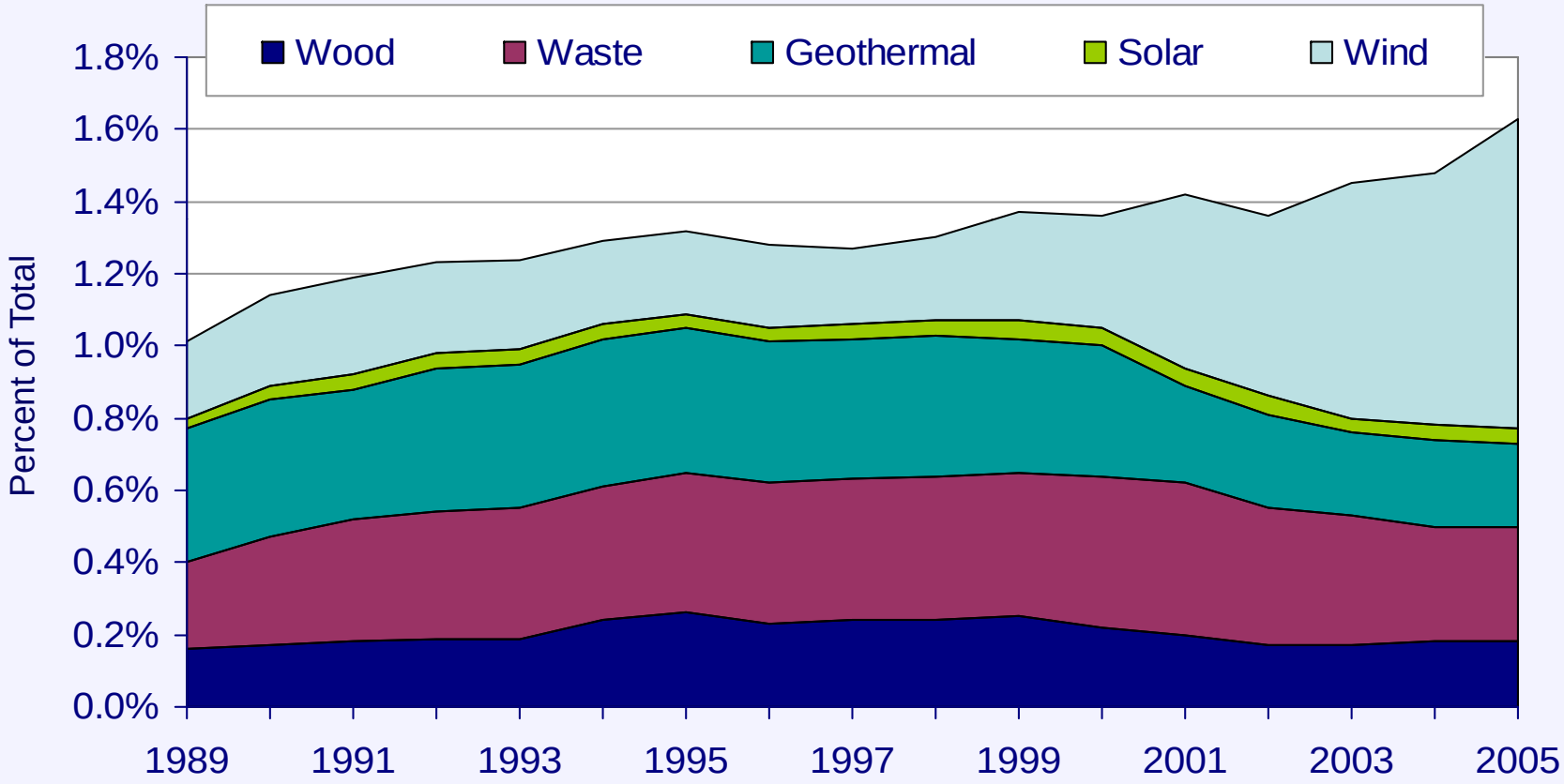
Non-hydroelectric renewable energy has increased as a share of total U.S. power generation.



Source: Energy Information Administration, US Department of Energy

Non-hydroelectric Renewable Electricity Generation as a Share of Total US

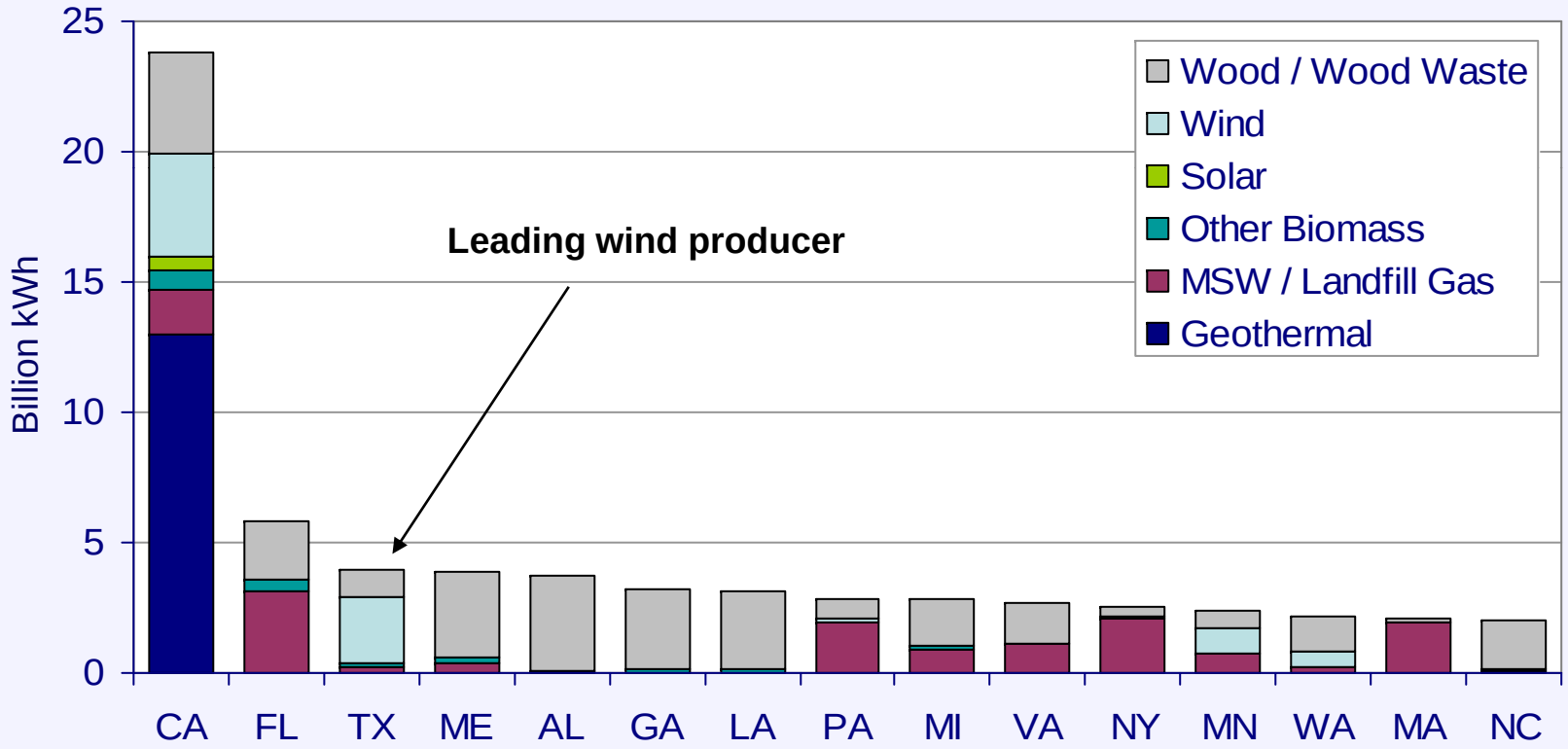
Wind energy is rapidly become the renewable energy resource of choice at the margin.



Source: Energy Information Administration, US Department of Energy

Top 15 States for Alternative Power Generation, 2003

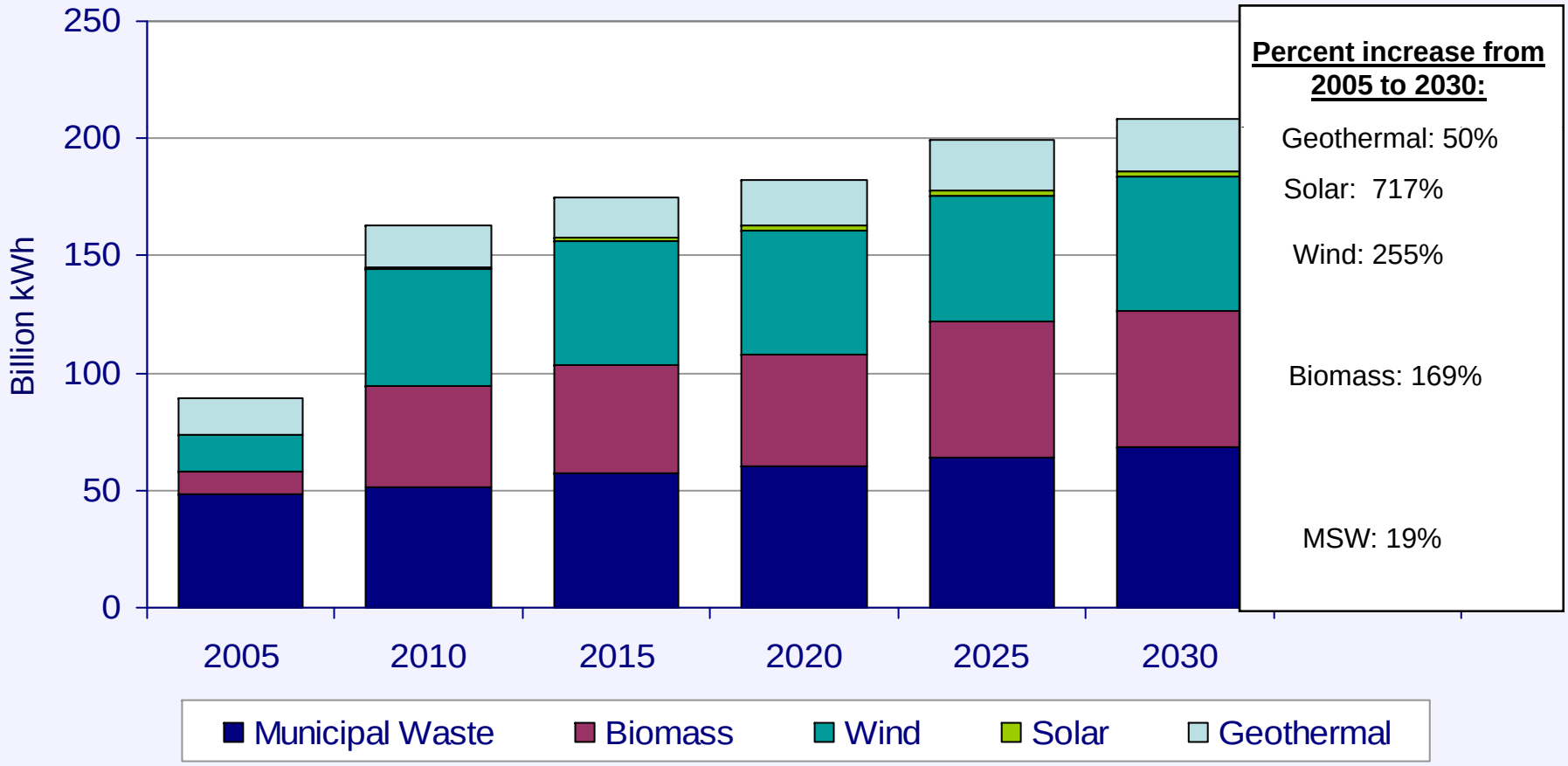
California leads the nation in renewable energy primarily because of its large geothermal resource.



Note: This excludes conventional hydroelectric generation.
Source: Energy Information Administration, US Department of Energy

Projected Alternative Energy Generation

Alternative energy is expected to increase significantly in the next 25 years. Solar leads on percentage basis; wind leads on absolute basis.



Source: Energy Information Administration, Department of Energy

Mechanisms Facilitating Development

- **Voluntary Markets for Alternative Energy:** renewable energy attributes are now assigned property rights and can be traded.
- **Power System Bypass:** interesting getting off the grid.
- **Federal Tax Credits:** several statutes offering tax incentives.
- **Renewable Portfolio Standards:** state-level renewable generation mandates.

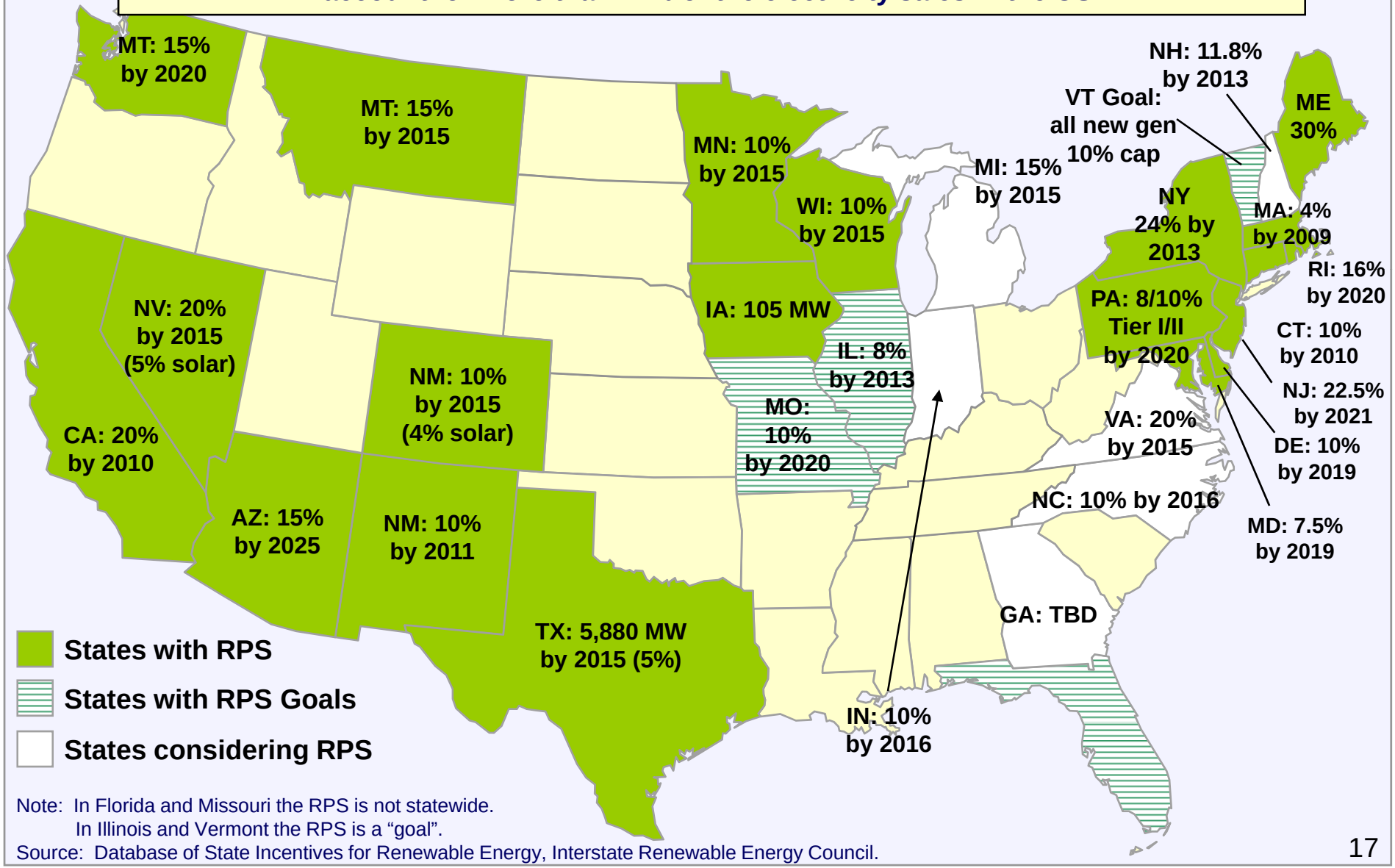
Policy Mechanisms for Alternative Energy

What is an RPS?

A renewable portfolio standard (RPS) is a state policy that requires electricity providers to obtain a minimum percentage of their power from renewable energy resources by a certain date.

States with Renewable Portfolio Standards

Currently there are 20 states that have RPS policies in place. Together these states account for more than 42% of the electricity sales in the US.



Note: In Florida and Missouri the RPS is not statewide.
In Illinois and Vermont the RPS is a "goal".

Source: Database of State Incentives for Renewable Energy, Interstate Renewable Energy Council.

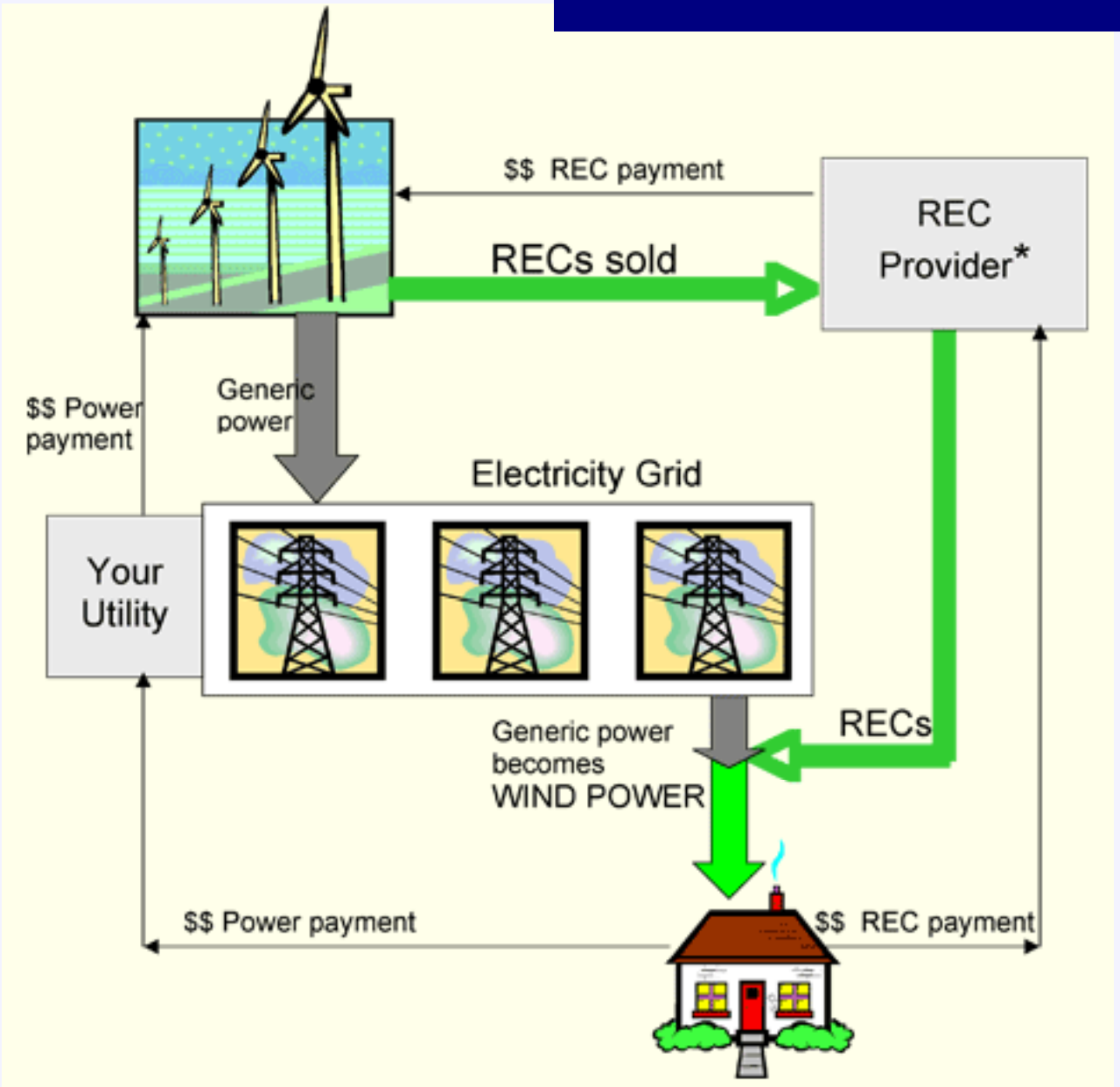
What is a REC?

"Renewable Energy Certificates" (RECs), also known as "green tags" or "Tradable Renewable Certificates" (TRCs), are the property rights to the environmental benefits from generating electric from renewable energy sources.

These certificates can be sold and traded and the owner of the REC can legally claim to have purchased renewable energy.

Thought of as "market-based" approach to promoting renewable energy.

Wholesale REC Transactions



Source: nativeenergy.com

Ongoing Challenges for Alternative Energy Development

Ongoing Challenges for Alternative Energy Development

- **Cost Issues:** what will be the nature of ongoing cost trends in light of past performance.

- **Dispatch / Availability Issues:** Ongoing challenges for renewable energy for both short term dispatch and long term planning.

- **REC Property Right Issues:** Who owns environmental attributes of existing resources contracted to utilities.

- **Regulatory / Contracting Issues:** What role does regulatory uncertainty play in the process.

- **Regional Technical Capabilities:** National markets are efficient, but lead to regional winners and losers.

How Does This Relate to Louisiana?

Mechanisms that Support Renewable/Alternative Energy in Louisiana

PURPA QF Requirements

- Requires utilities to purchase electricity from industrial facilities that have high efficiency power production. (also RE sources)

Green Pricing

- Program that purchases dedicated amounts of renewable energy on customers' behalf. Customers pay surcharge to support.

Geaux GREEN
It's A Good Choice For Louisiana.

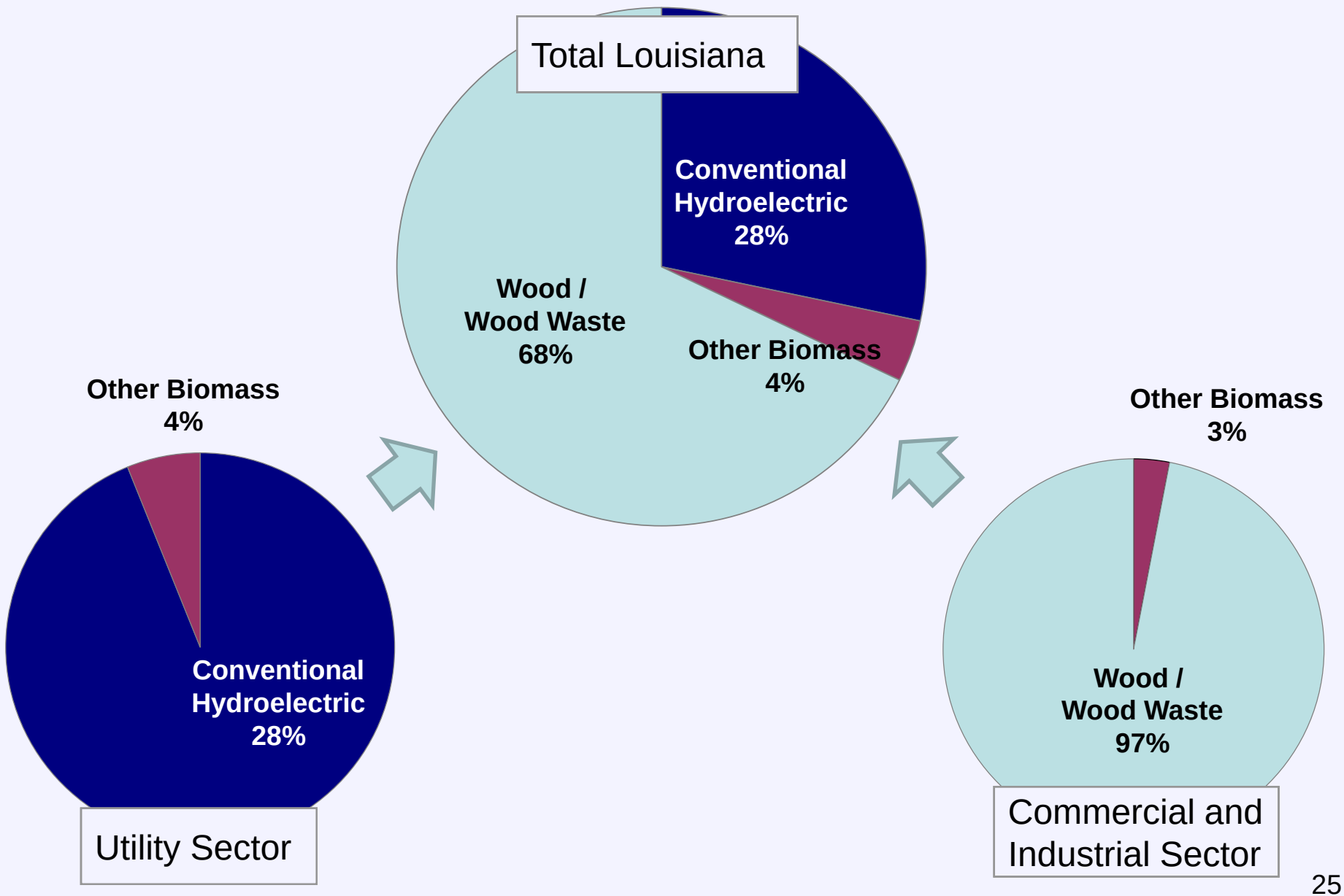
Net Metering

- Requires utilities to install meters that charge and credit for purchases AND sales of on-site energy production.

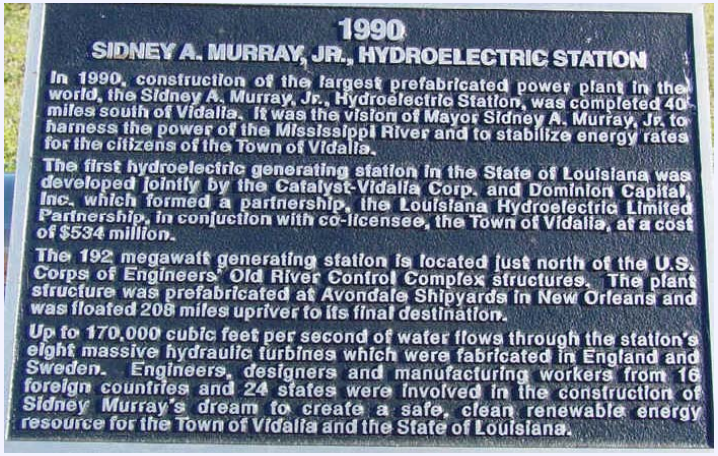
Commonly Cited Renewable Energy Applications for Louisiana

- Biofuels (ethanol, biodiesel)
- Biomass Generation
- Offshore Wind
- River and Tidal Power

Louisiana Renewable Net Generation



Vidalia Hydro



- **Largest prefabricated power plant in the world .**
- **192 MW generating station.**
- **Cost $354 million.**

- **Plant structure was prefabricated at Avondale Shipyards in New Orleans and was floated 208 miles upriver to its final destination.**

- **Up to 170,000 cubic feet per second of water flows through 8 massive hydraulic turbines (which were fabricated in England and Sweden).**

- **Engineers, designers and manufacturing workers from 16 countries and 24 states were involved in the construction.**

- **Developed jointly by the Catalyst-Vidalia Corporation and Dominion Capital, Inc, which formed a partnership, the Louisiana Hydroelectric Limited Partnership, in conjunction with co-licensee, the Town of Vidalia**

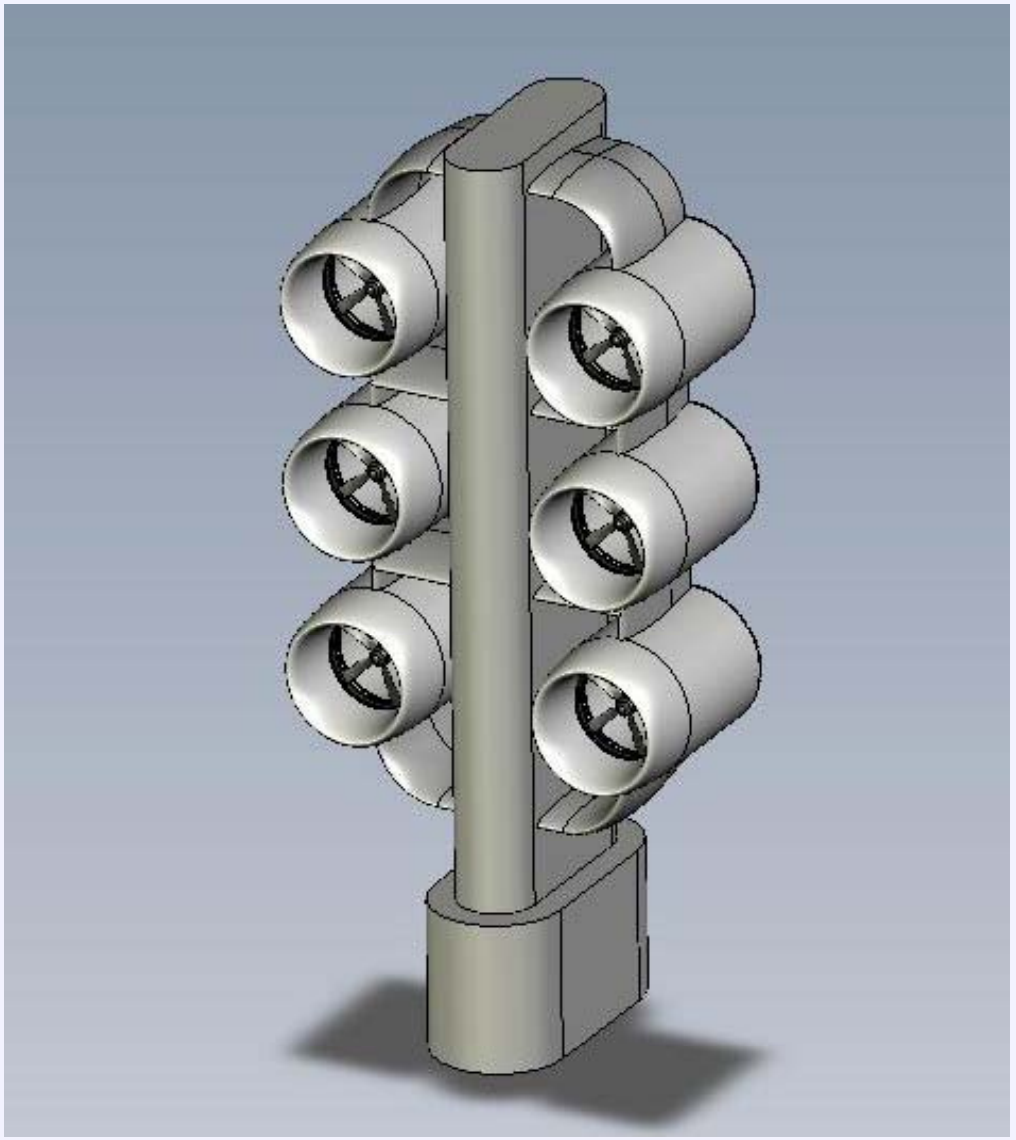
Agrielectric

- **Agrilectric owns and operates a 13 MW facility.**
- **Located adjacent to a rice mill near Lake Charles.**
- **Generates green power by burning rice hulls (300 tons per day).**
- **Built in 1984 and is a Qualifying Facility under PURPA.**
- **It supplies power to the adjacent rice mill and excess power is sold to the utility at avoided cost.**

Louisiana Green Fuels Ethanol Project

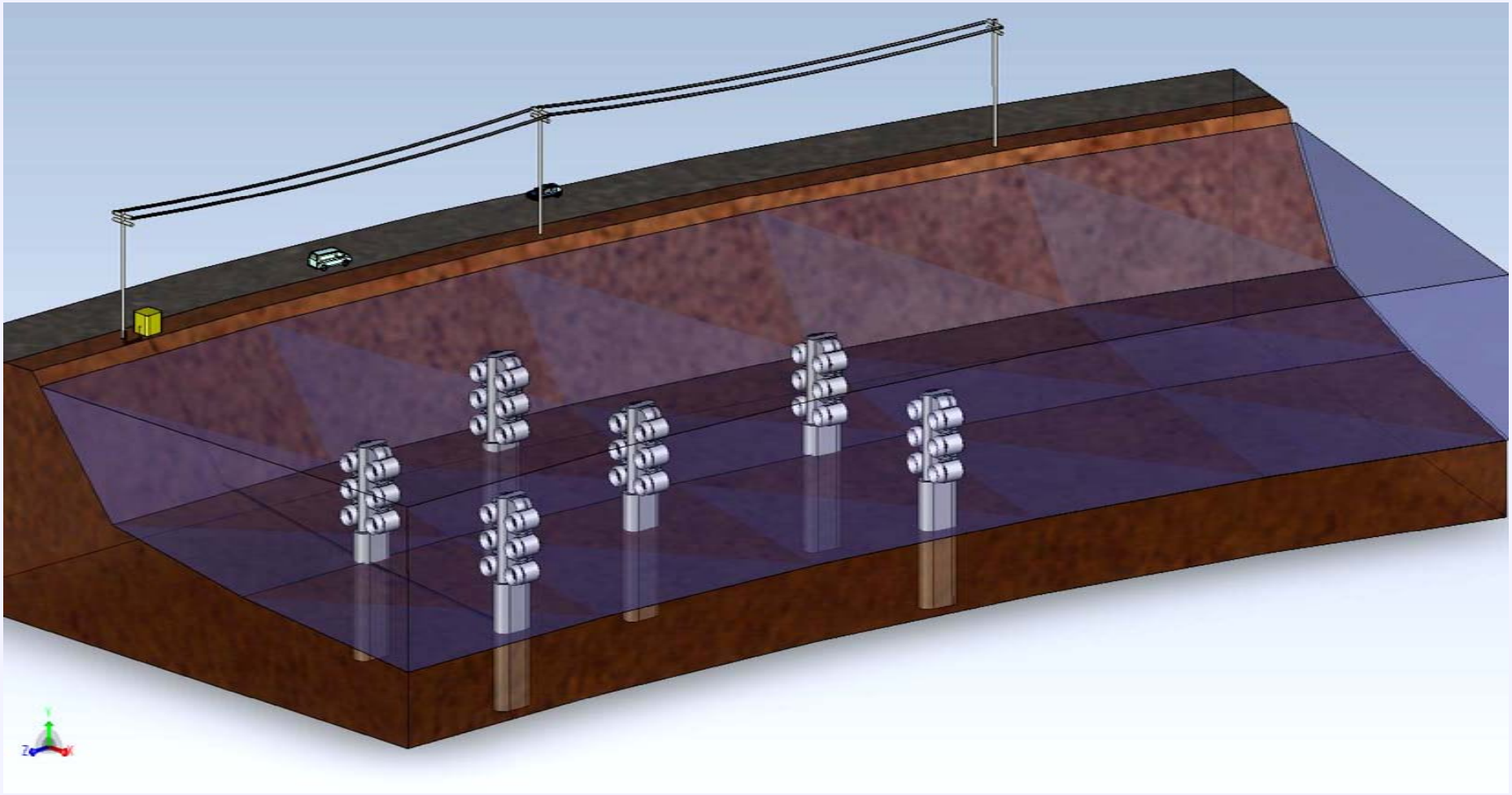
- **Located in Lacassine, next to facility that processes sugar cane and sweet sorghum**
- **Capacity: 22.4 million gallon per year, fuel alcohol**
- **Startup Target: 2009**
- **Will be first sugar cane-based ethanol plant in U.S.**

Proposed River Turbine



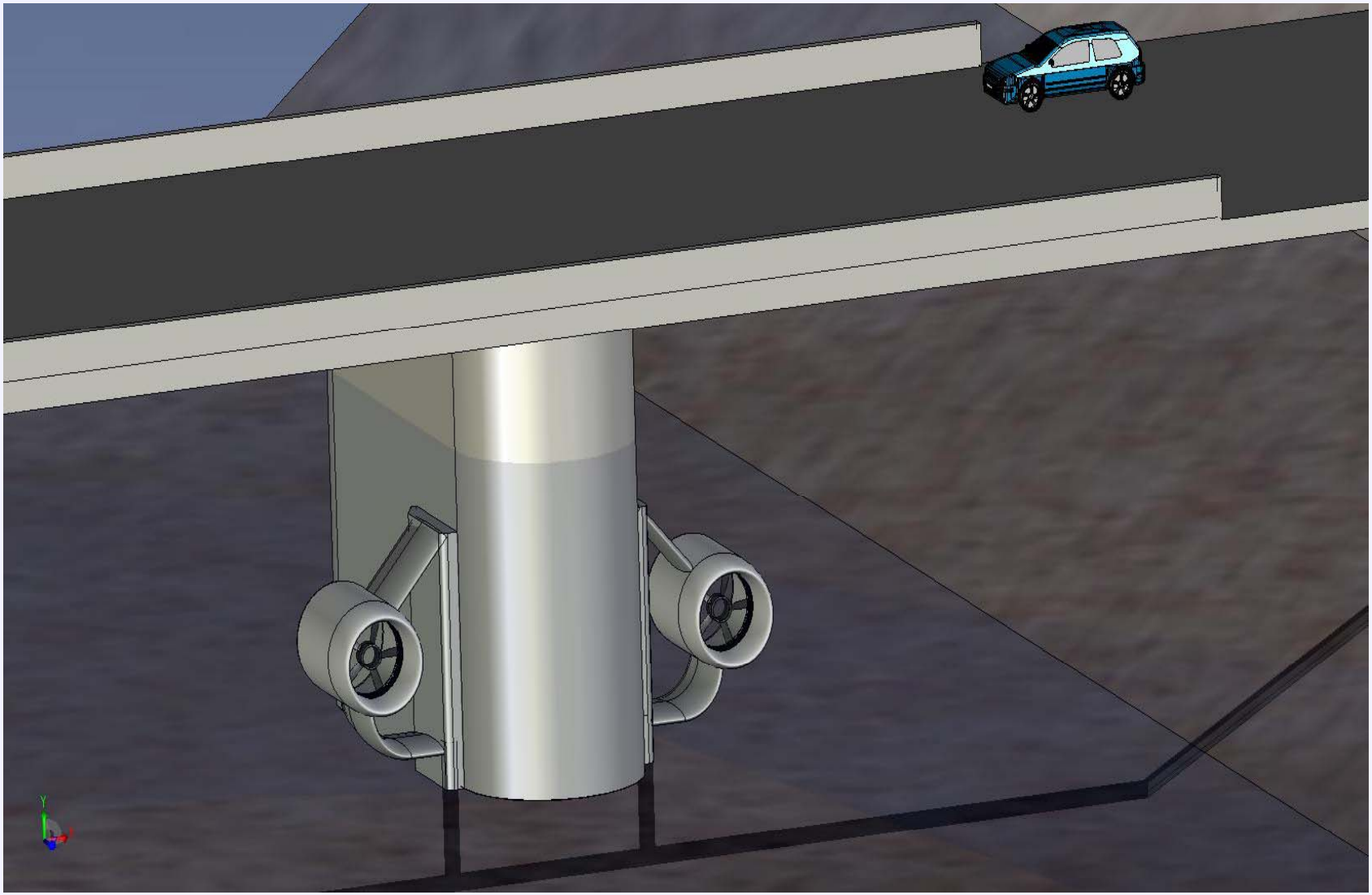
Source: Free Flow Power Corporation.

Schematic: River Bend Turbine Configuration



Source: Free Flow Power Corporation.

Schematic: Bridge Installed River Turbine



Source: Free Flow Power Corporation.

Example: Free Flow Power Corp. Hydro Applications Before the FERC

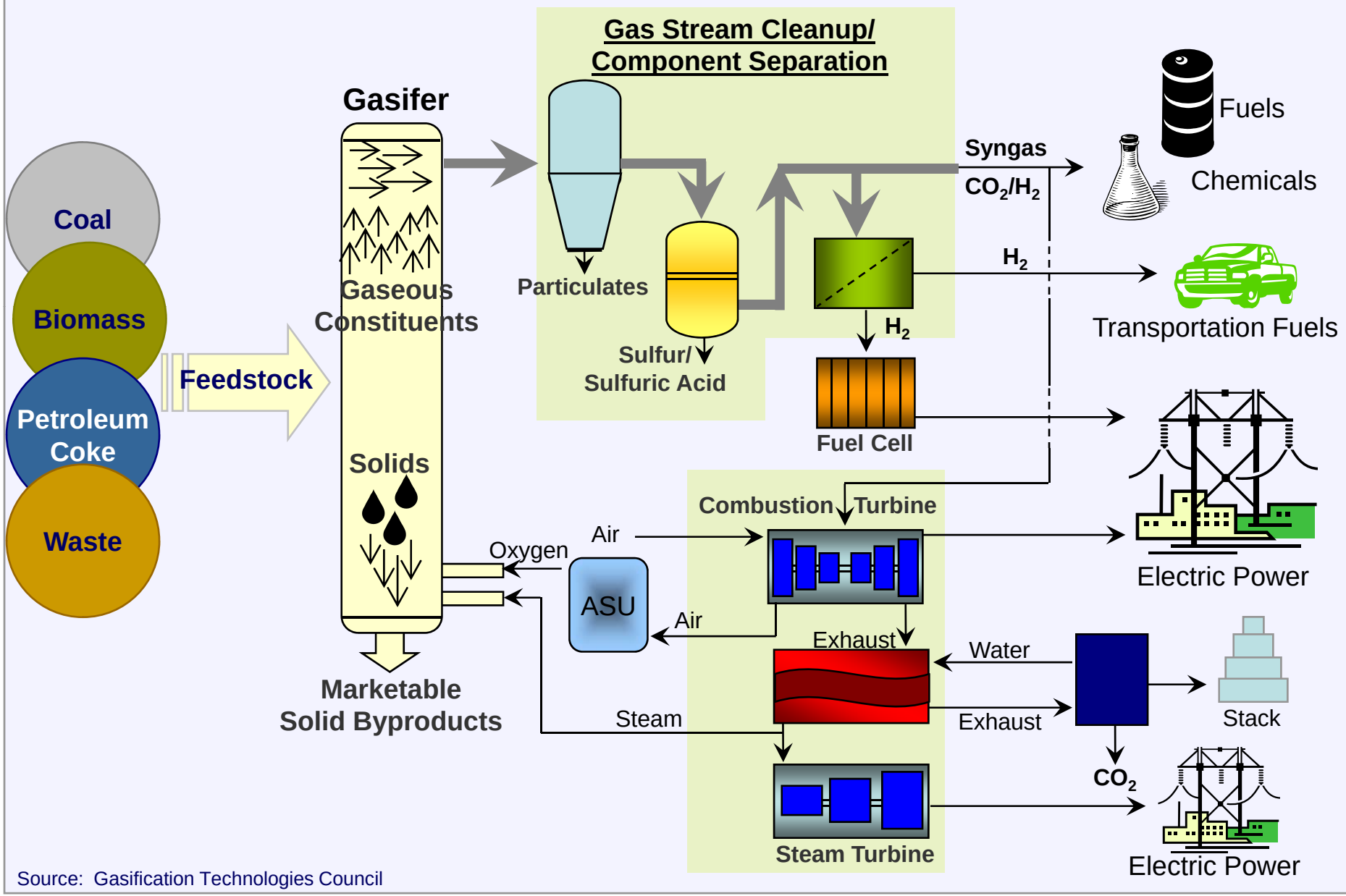
States	Projects	Turbines	Average Generation
LA	30	60,650	606.5 MW
LA / MS	6	20,950	209.5 MW
AR / MS	5	22,550	225.5 MW
AR / TN	4	18,100	181.0 MW
TN / MO	2	6,250	62.5 MW
MO / KY	4	13,750	137.5 MW
MO / IL	8	17,100	171.0 MW
Total:	**59**	**159,350**	**1,593.5 MW**

Source: Free Flow Power Corporation.

Other Alternative Energy Opportunities

- **Gasification**
- **Waste Heat**
- **Combined Heat and Power**

Gasification-Based System Concepts



Source: Gasification Technologies Council

Several Project Outputs Made Available to Louisiana Energy & Chemical Markets

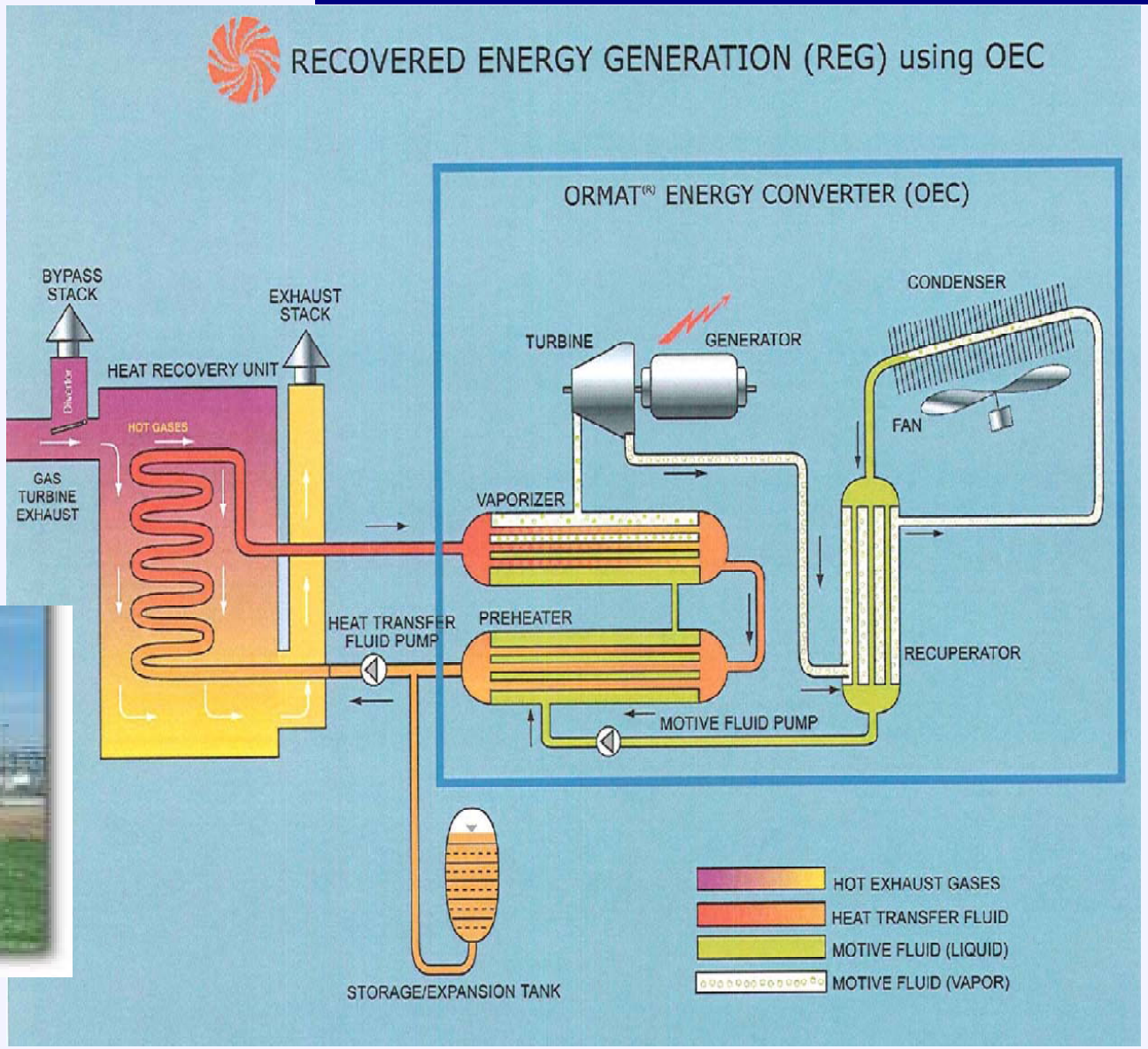
Hydrogen will be available to refineries

SNG will be available to electric and natural gas utilities and industrial users

Steam will be available to industrial users

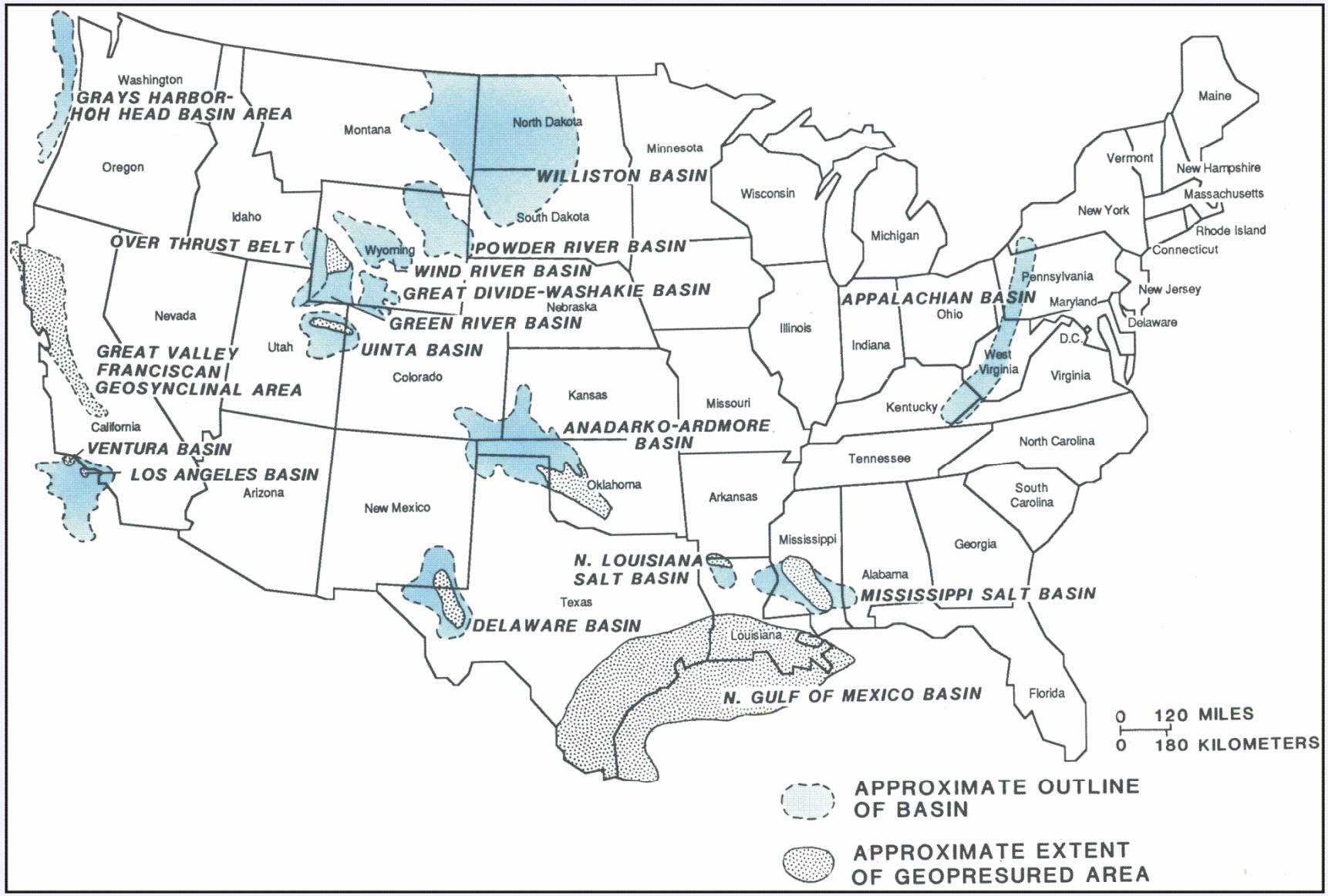
Pure CO_2 produced by the unit will be available for enhanced oil recovery.

Recovered Energy Generation



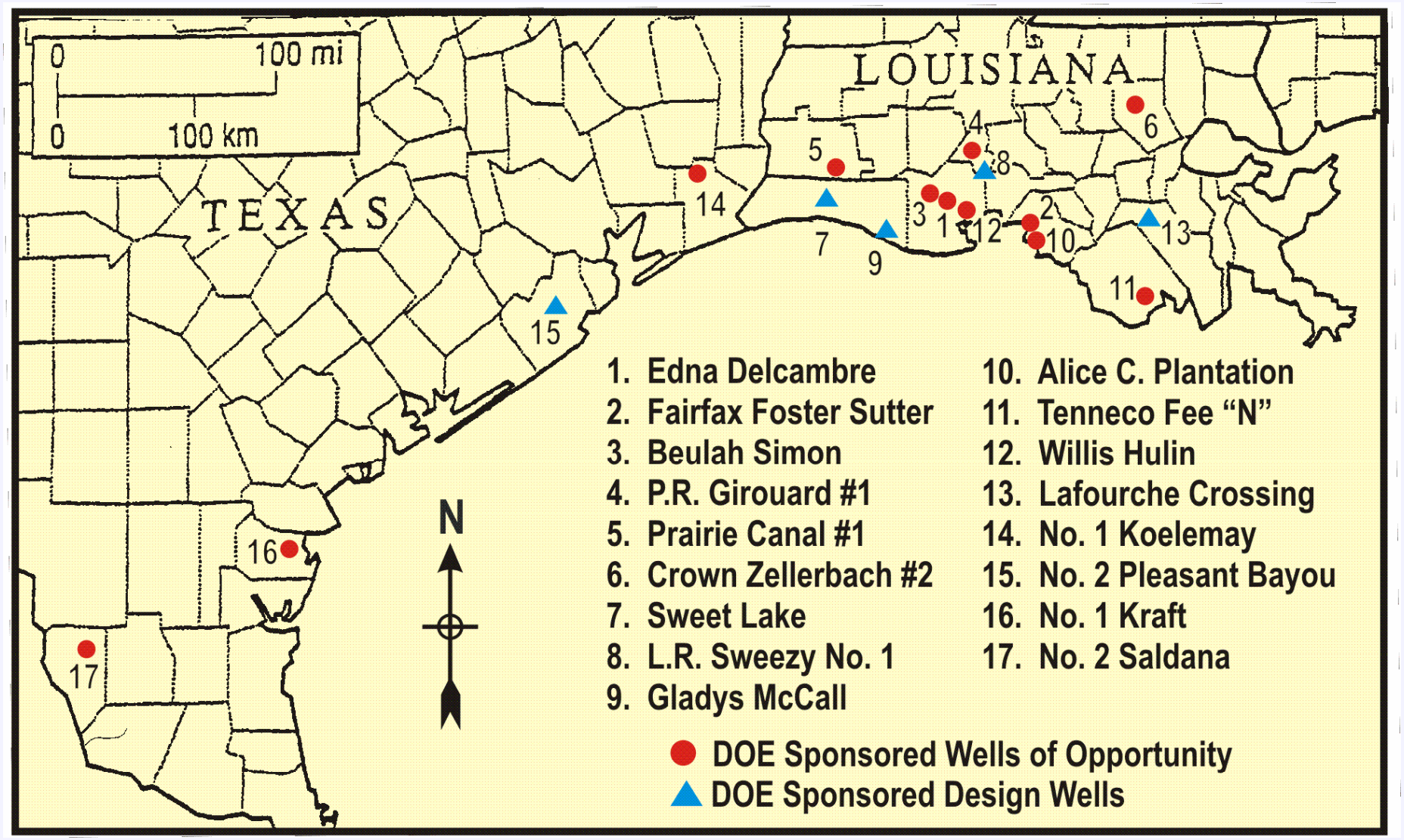
Source: Ormat Technologies

Geopressured basins of the United States
(modified after Wallace, 1982)



Source: Louisiana State University, Louisiana Geological Survey

Location of Wells Selected for Testing Under the DOE Geopressured-Geothermal Research Program



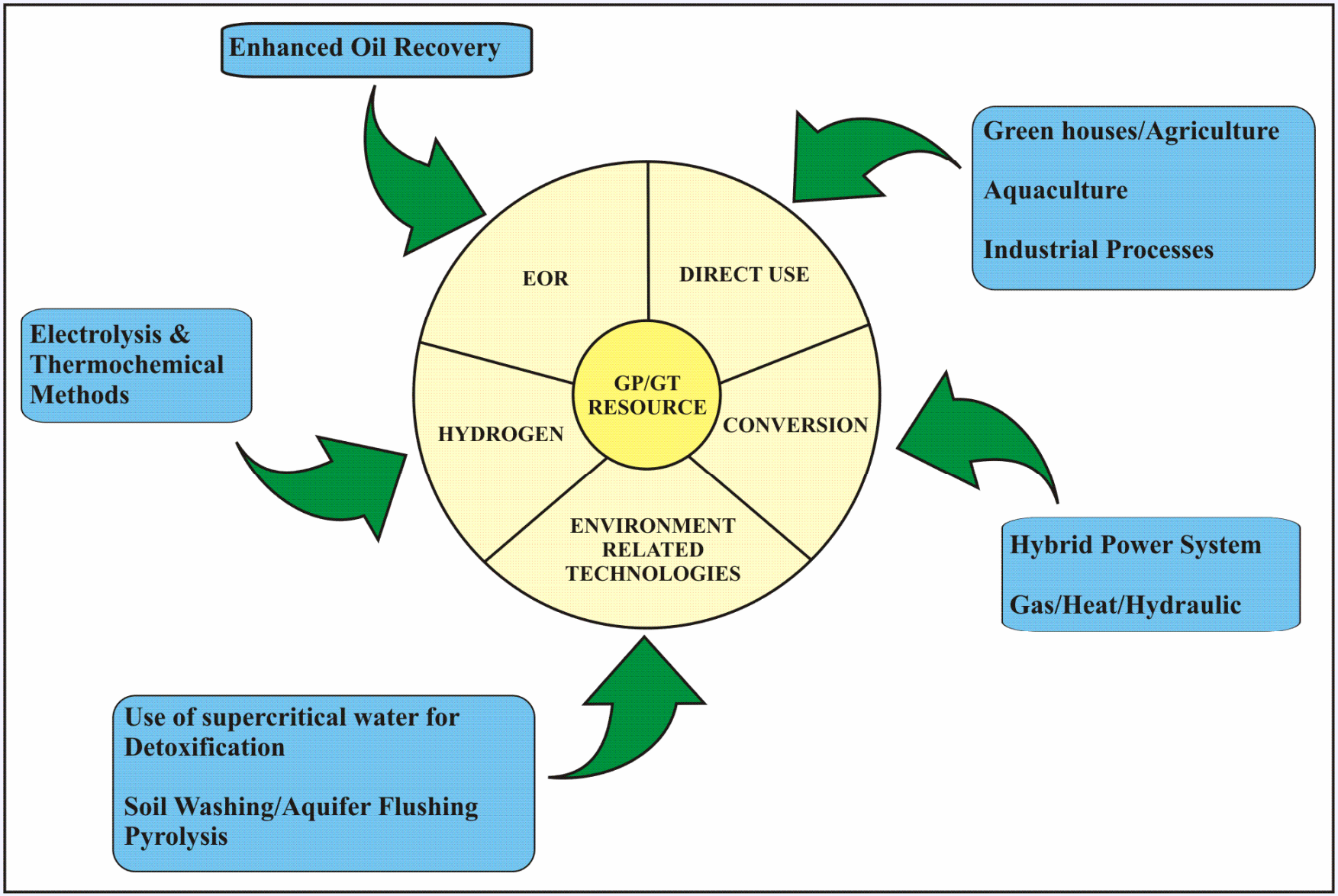
Note: **Ccourtesy of U.S. Department of Energy's Geothermal Program**
Source: Louisiana State University, Louisiana Geological Survey

Summary of Test Results from the Geopressured-Geothermal Wells Tested under the DOE program (John et al., 1998).

Well Name	Depth (ft)	Pressure (psi)	Temp. (ºF)	Salinity (ppm TDS)	Gas/Brine Ratio (SCF/STB)	Flow Rate (BPD)	Methane (mol%)	CO2 (mol%)	Other Gases (mol%)	Porosity (%)	Permeability (mD)
Delcambre 3sd	12,869	11,012	238	133,300	24.0	10,333	92.8	1.1	6.1	26.0	44.0
Delcambre 1sd	12,573	10,858	234	113,000	24.0	12,653	95.4	2.0	2.6	29.0	364.0
F.F. Sutter	15,781	12,220	270	190,904	24.9	7,747	89.6	7.9	2.5	19.3	14.3
Buelah Simon	14,722	13,015	266	103,925	24.0	11,000	88.9	7.7	3.4	17.4	11.6
P.R. Giroud	14,744	13,203	274	23,500	44.5	15,000	91.3	6.0	2.7	26.0	220.0
P. Canal	14,976	12,942	294	43,400	47.0	7,100	88.4	8.4	3.2	22.5	90.0
C. Zellerbach	16,720	10,144	330	31,700	55.7	3,887	71.0	23.5	5.5	17.0	14.1
Amoco Fee-Sweet Lake A	15,387	11,974	298	160,000	34.0	34,000	88.7	8.6	2.6	20.0	400.0
Parcperdue - L.R. Sweezy No. 1	13,395	11,410	237	99,700	30.0	10,000	94.0	2.5	3.5	29.4	500.0
Gladys McCall A	15,508	12,936	298	95,500	30.4	36,500	86.9	9.5	3.6	24.0	90.0
Gladys McCall B	15,158	12,821	288	94,000	30.4	36,000	85.9	10.6	3.5	22.0	130.0
Pleasant Bayou Well No. 2	16,465	9,800	302	127,000	24.0	25,000	85.0	10.0	5.0	19.0	200.0
Hulin No. 1	21,546	18,500	360	195,000	34.0	15,000	93.0	4.0	3.0	-	13.0
Riddle Saldana No. 2	9,745	6,627	300	12,800	41.0	1,950	75.0	21.4	3.75	20.0	7.0
Lear Koelemay No. 1	11,590	9,450	260	15,000	35.0	3,200	81.4	13.4	5.2	26.0	85.0
Ross Draft No. 1	12,750	10,986	263	23,000	45.0	-	-	-	-	23.0	39.0

Source: Louisiana State University, Louisiana Geological Survey

Potential Applications of the Geopressured-Geothermal Resource
(modified after Negus-de Wys and Dorfman, 1990)



Source: Louisiana State University, Louisiana Geological Survey

Questions, Comments, & Discussion

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