Renewable Electric Energy: Cost and Integration Issues

Presented by

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Typical Renewable Resources

Resource	Potential
Municipal Solid Waste	Available
Biomass	Available
Solar Photovoltaic (PV)	Available
Solar Thermal (non-generating)	Available
Municipal Solid Waste	Available
Wind	Limited Availability
Ocean current	Available but unproven on commercial scale
Hydro generation	Not Available
Geothermal electric generation	Not Available

366.91, Florida Statutes defines renewables as hydrogen from non-fossil sources, biomass (including MSW), solar, geothermal, wind, ocean, hydro generation, and waste heat from sulfuric acid (phosphate production).

Issues with Renewables

- Florida has limited renewable resources
- Technology is unlikely to fundamentally alter the potential for renewables
- For the most part, renewables do not provide firm capacity resources
- Costs are and will likely remain higher than traditional fossil resources

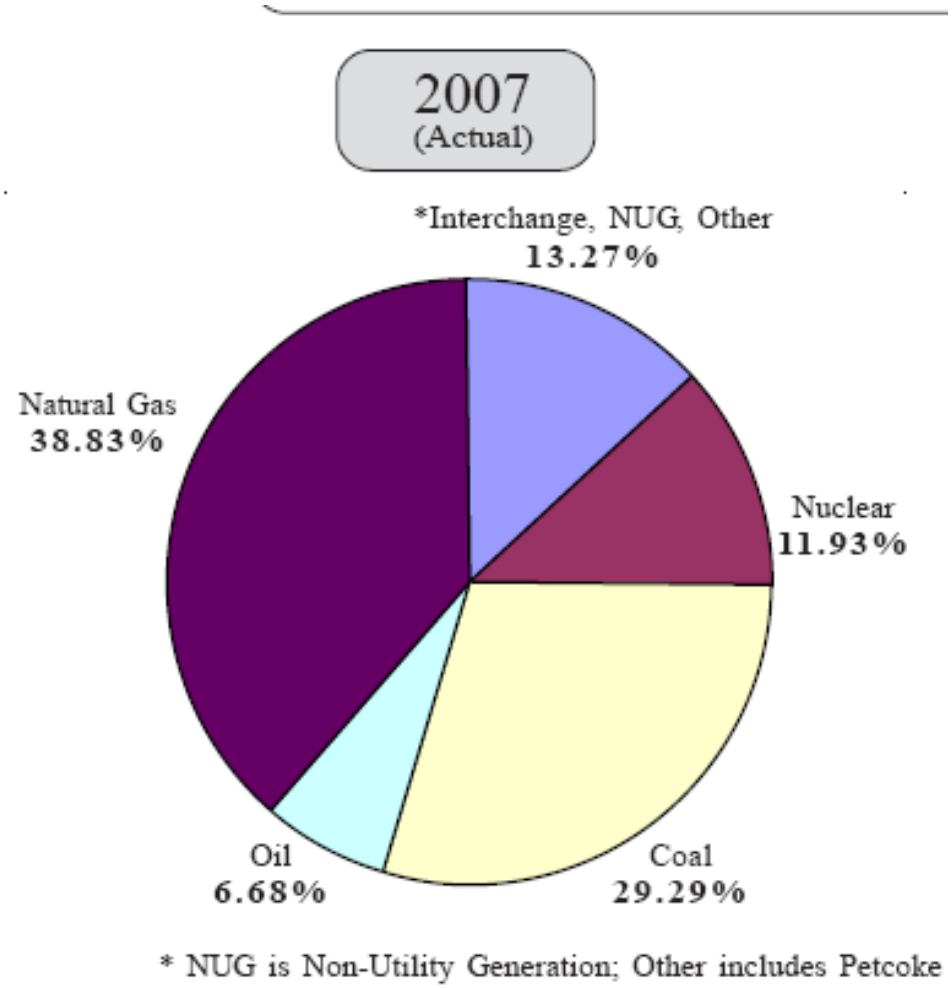
Important Terms to Understand

- Capacity is the ability to produce energy instantaneously.
- Demand is amount of capacity required at any given moment.
- Generation is the amount of energy produced over time.
- Consumption is amount of energy consumed over time.
- Example: Peak demand on a home may be 10 kilowatts. Typically monthly consumption might be 1400 kWhs.

Existing Installed Capacity (2008)

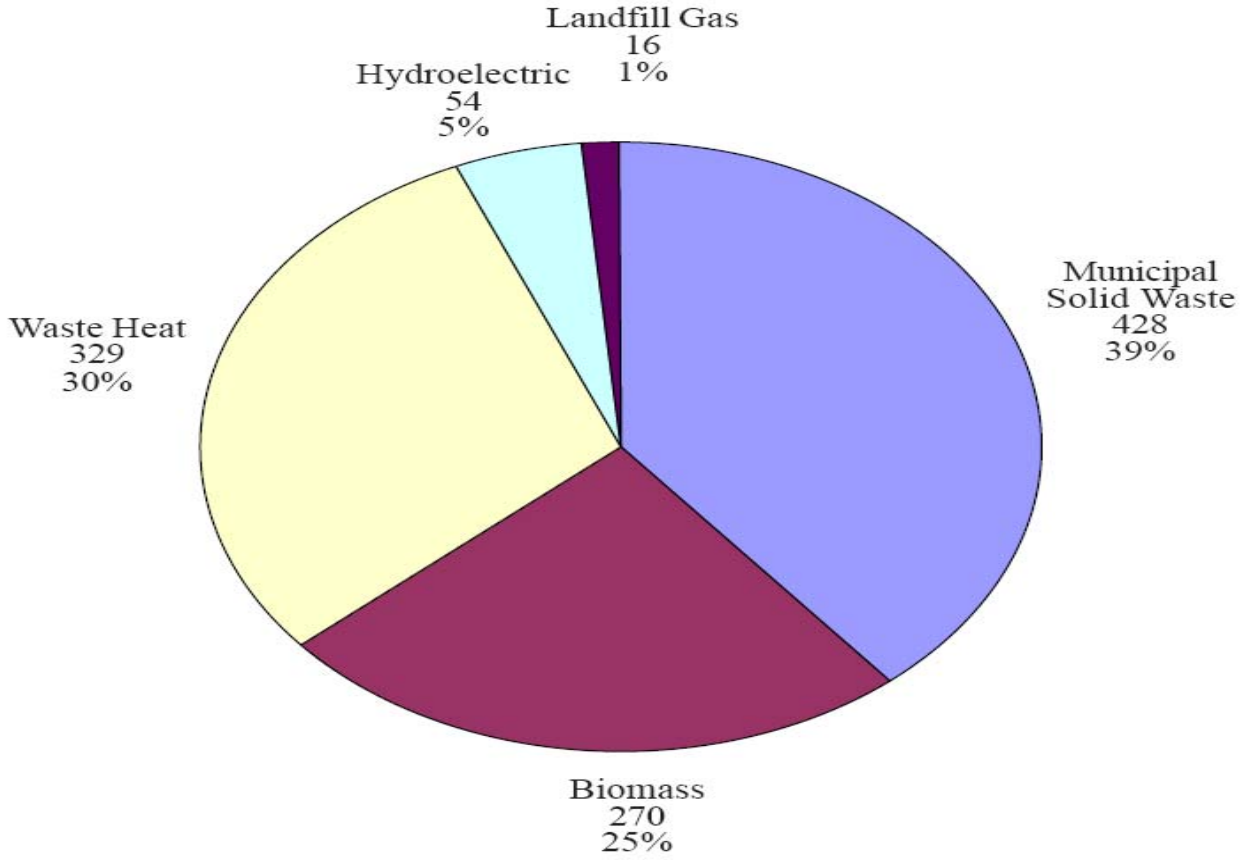
Fuel Type	Amount	Percent of Capacity
Nuclear	3,896	7.0
Coal	11,691	20.9
Natural Gas	22,172	39.6
Oil	10,959	19.6
NUG/IPP	5,202	9.3
Import	1,602	2.9
Firm Renewables	519	0.1
Total	56,041	100%

Existing Generation



* NUG is Non-Utility Generation; Other includes Petcoke

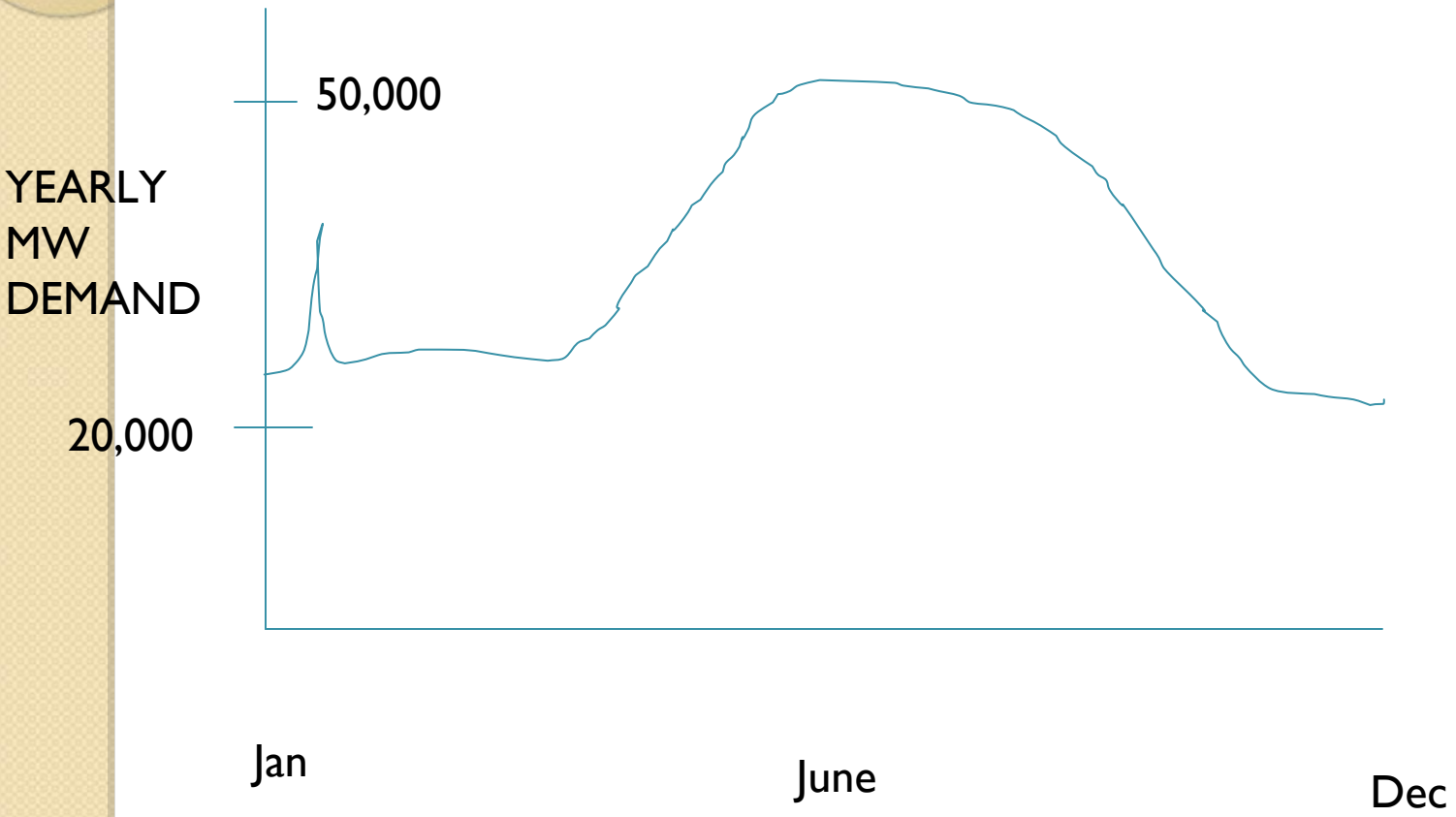
Existing Renewable Generation
Total Installed 1097 MWs



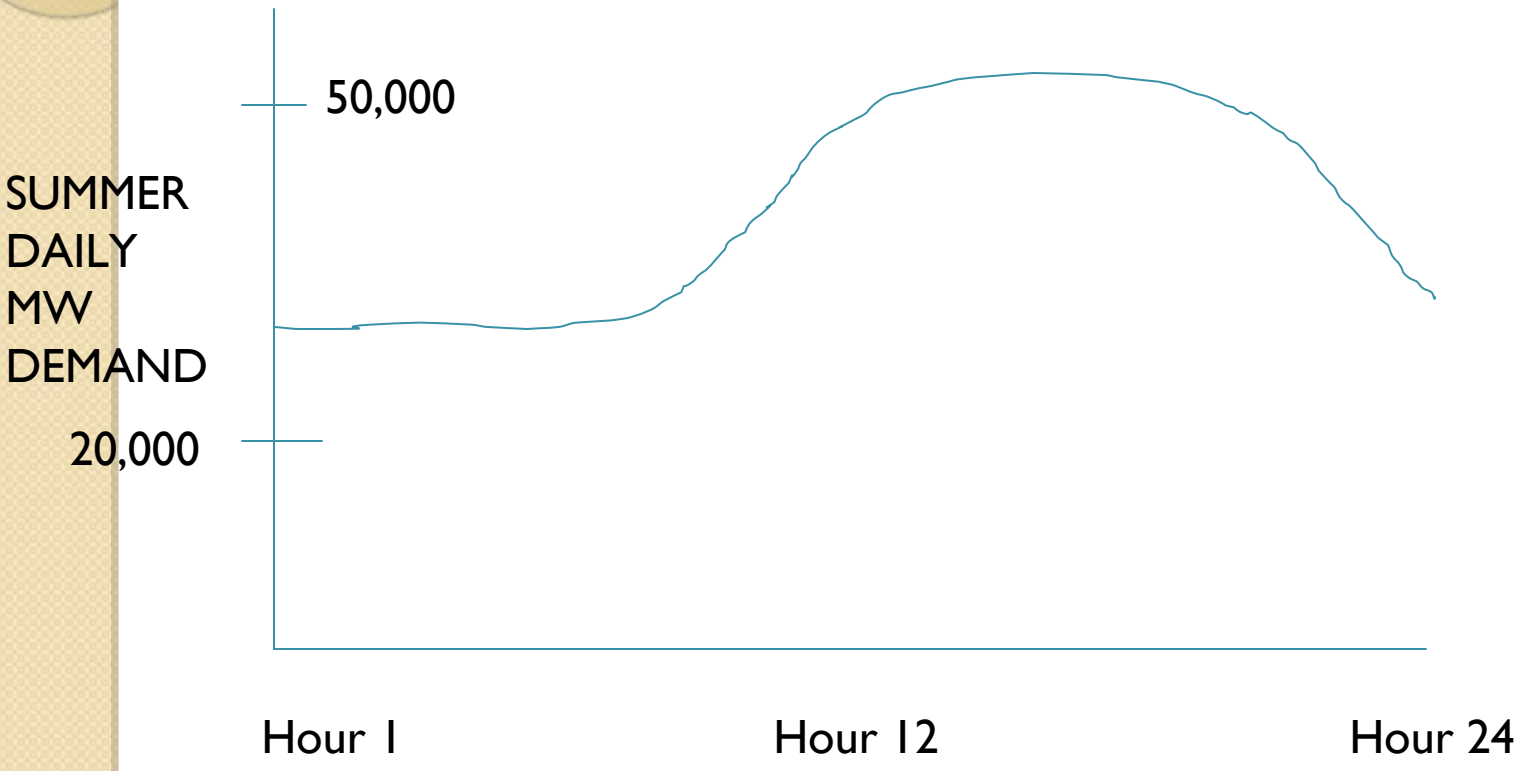
Typical Capacity Factors

Type of Technology	Capacity Factor
Solar PV	18 – 20 %
Onshore Wind	18%
Offshore Wind	36-40%
Biomass steam	Up to 85% (depends on fuel availability)
Municipal Solid Waste	>85%
Ocean current	>90%
Nuclear	≈92%
Coal	>85%
Combined cycle natural gas	60-85%

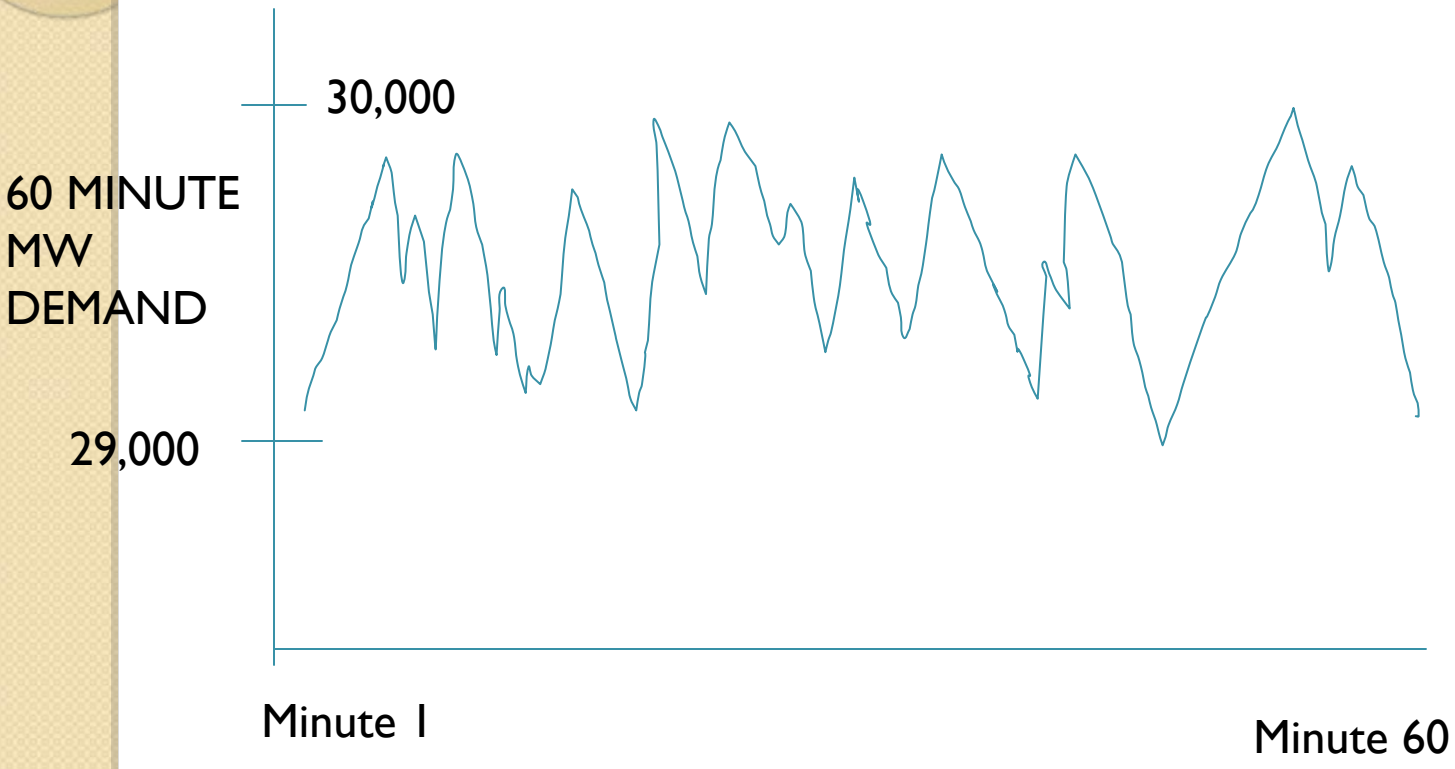
365 Day Load Profile



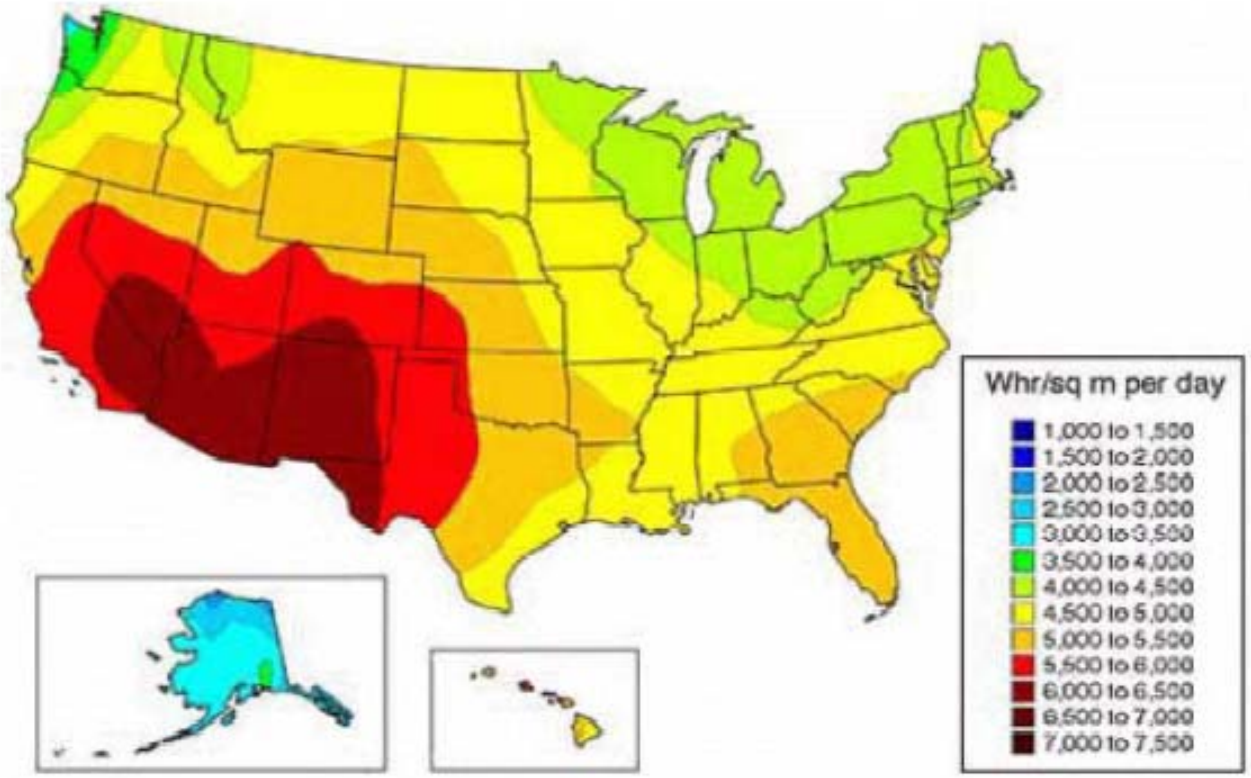
24 Hour Load Profile



One Hour Load Profile



Solar Radiation Map



Solar resource for a flat-plate collector

Solar Photovoltaic Costs

A recent raw material (polysilicon) shortage has caused upward pressure on installed costs, but Navigant Consulting expects costs to fall.

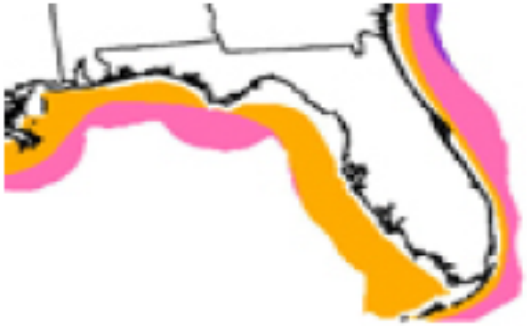
	Residential PV Economic Assumptions for Given Year of Installation (2008$)		
	2009	2015	2020
Plant Nameplate Capacity (kW)[1]	4	4	4
Project Life (yrs)	25	25	25
Development Time (yrs)[2]	0.3	0.25	.2
Installed Cost ($/kW)[3]	8,100	5,900	4,900
Fixed O&M ($/kW-yr)[4]	41	24	13
Non-Fuel Variable O&M ($/kWh)	0	0	0
Fuel/Energy Cost ($/kWh)	0	0	0

Sources: Stakeholder data submitted to the Florida Public Service Commission, September 2008; Navigant Consulting, October 2008

Notes:

Wind Resources in Florida

Map of FL Onshore Wind Resource



Wind Power Classification

Wind Power Class	Resource Potential	Wind Power Density at 50 m W/m^2	Wind Speed [a] at 50 m m/s	Wind Speed [a] at 50 m mph
1	Poor	0 - 200	0.0 - 5.6	0.0 - 12.5
2	Marginal	200 - 300	5.6 - 6.4	12.5 - 14.3
3	Fair	300 - 400	6.4 - 7.0	14.3 - 15.7
4	Good	400 - 500	7.0 - 7.5	15.7 - 16.8
5	Excellent	500 - 600	7.5 - 8.0	16.8 - 17.9
6	Outstanding	600 - 800	8.0 - 8.8	17.9 - 19.7
7	Superb	> 800	> 8.8	> 19.7

[a] Wind speeds are based on a Weibull k value of 2.0

Note: The map above is part of a national map produced by NREL. It shows all class one wind onshore.

Source: National Renewable Energy Laboratory (NREL) http://www.windpoweringamerica.gov/pdfs/wind_maps/us_windmap.pdf, Accessed November 24, 2008.

Offshore Wind Resource Costs

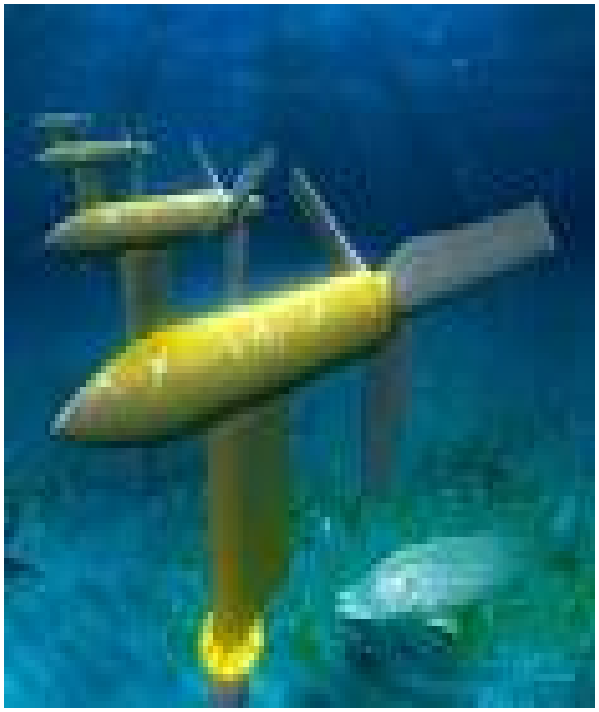
	Offshore Wind Economic Assumptions for Given Year of Installation (2008$)		
	2009[1]	2015	2020
Plant Capacity (MW)	NA	300	300
Project Life (yrs)	NA	25	25
Development Time (yrs)[2]	NA	5	5
Capital Cost ($/kW)[3]	NA	$4,630	$4,330
Fixed O&M ($/kW-yr)[4]	NA	$23	$23
Non-Fuel Variable O&M ($/MWh)[4]	NA	$26	$24
Fuel/Energy Cost ($/kWh)	NA	$0	$0

Sources: Navigant Consulting Estimates 2008. Interviews with developers, manufacturers, trade associations, and regulators throughout 2008. 20% Wind Energy by 2030. Increasing Wind Energy's Contribution to U.S. Electricity Supply. U.S. Department of Energy. June 2008. Musial, W and S. Butterfield, Future for Offshore Wind Energy in the United States: Preprint, NREL, June 2004.

Notes:

Ocean Current Turbine

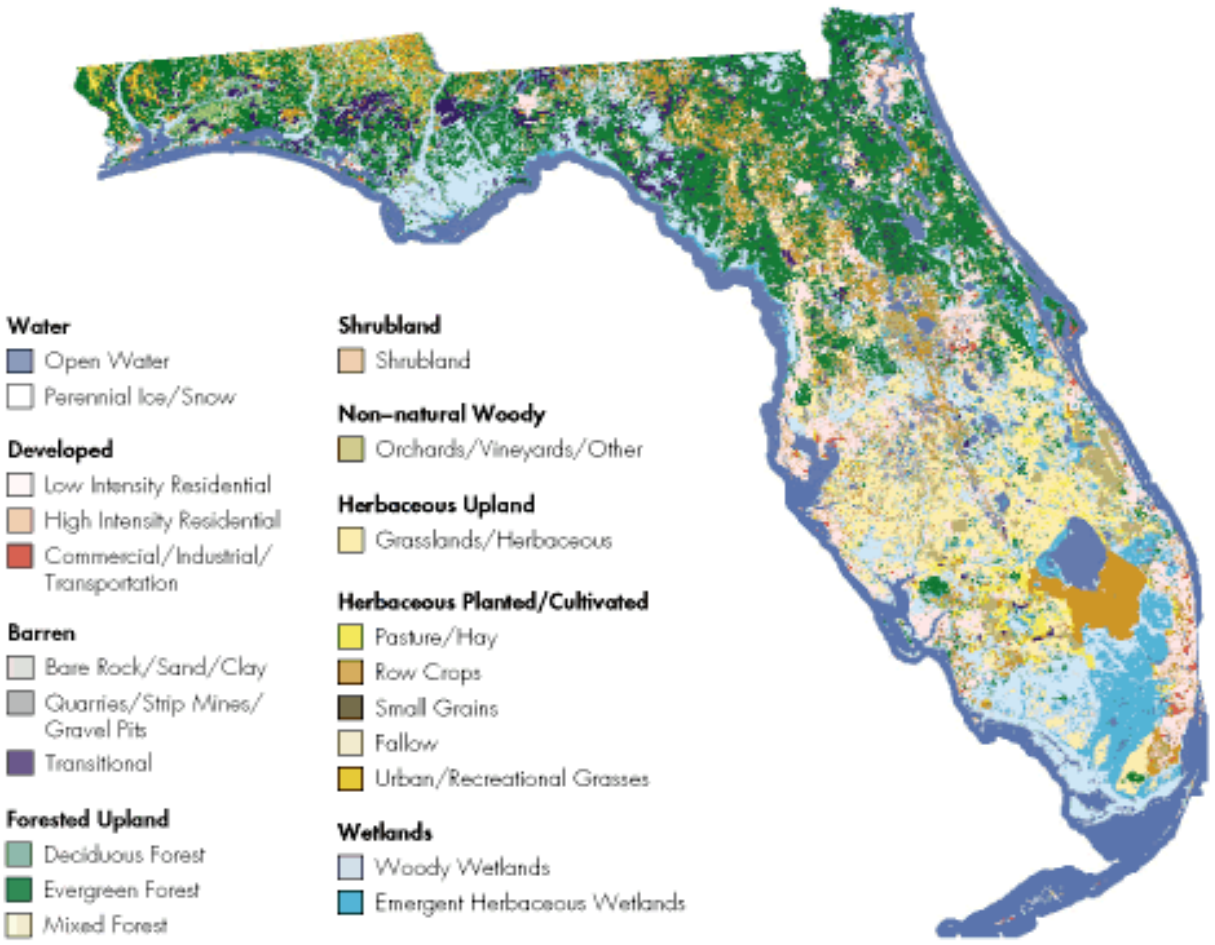
An artist's rendition of ocean driven mechanical turbines.



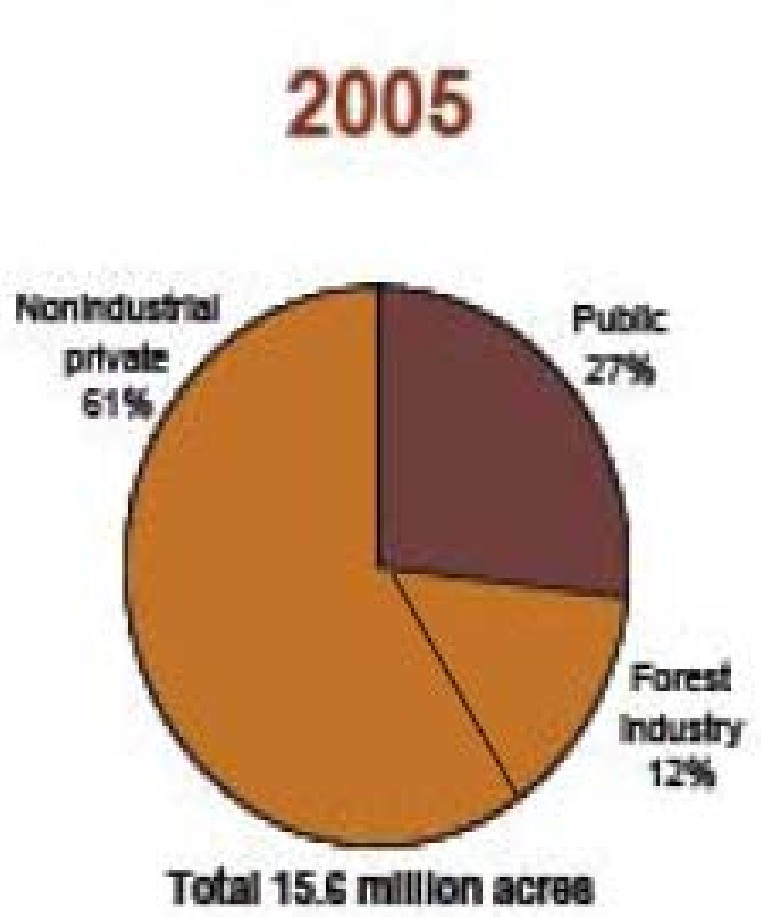
Biomass Power Plant Costs

	Biomass Greenfield Direct Combustion Economic Assumptions for Given Year of Installation (2008$)		
	2009	2015	2020
Plant Capacity (MW)[1]	100	100	100
Project Life (yrs)	25+	25+	25+
Development Time (yrs)	3-5	3-5	3-5
Total installed Capital Cost ($/kW)[2]	$4,000	$4,200	$4,400
Fixed O&M ($/kW-yr)[3]	$125	$117	$111
Non-Fuel Variable O&M ($/MWh)[4]	$2.50	$2.50	$2.50
Fuel/Energy Cost ($/MWh)[5]	$31-46	$30-45	$29-43

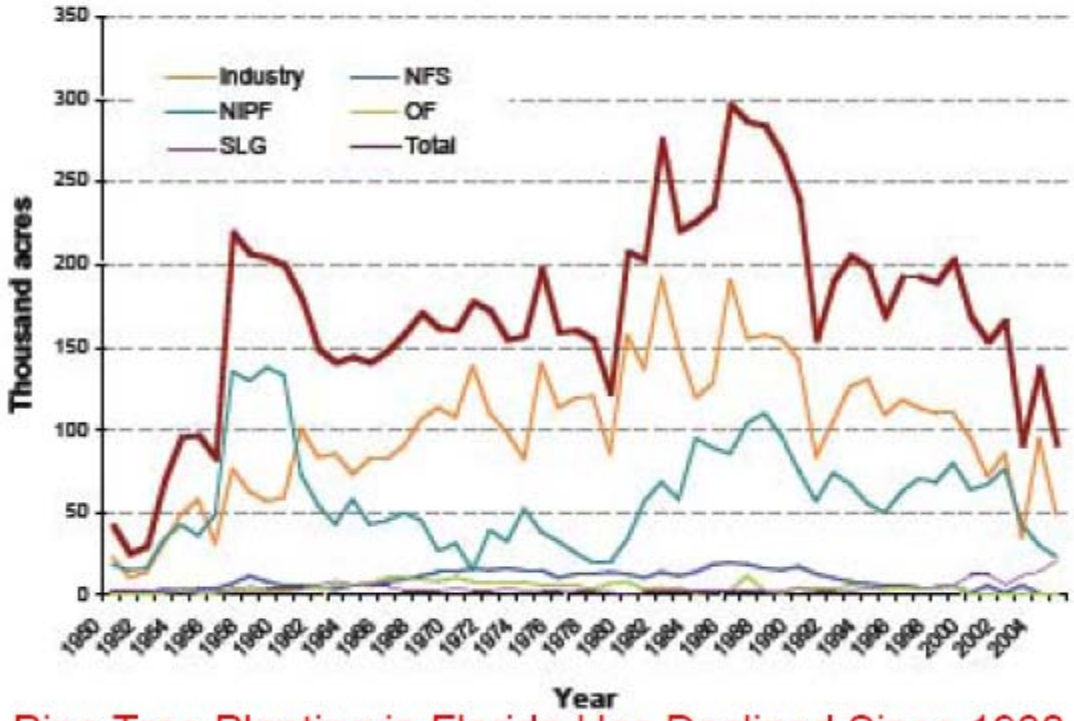
Florida Forest Cover



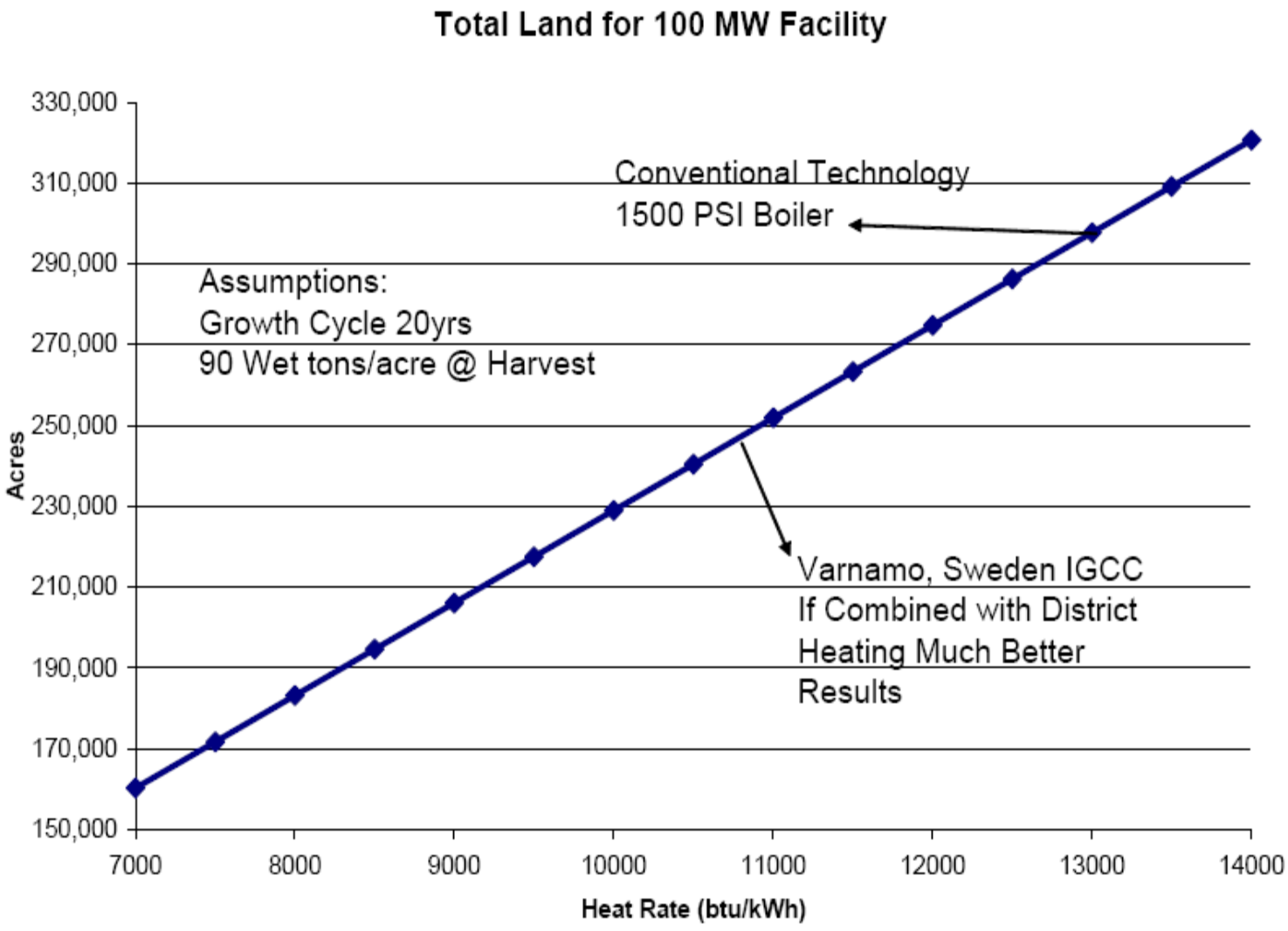
Forest Ownership



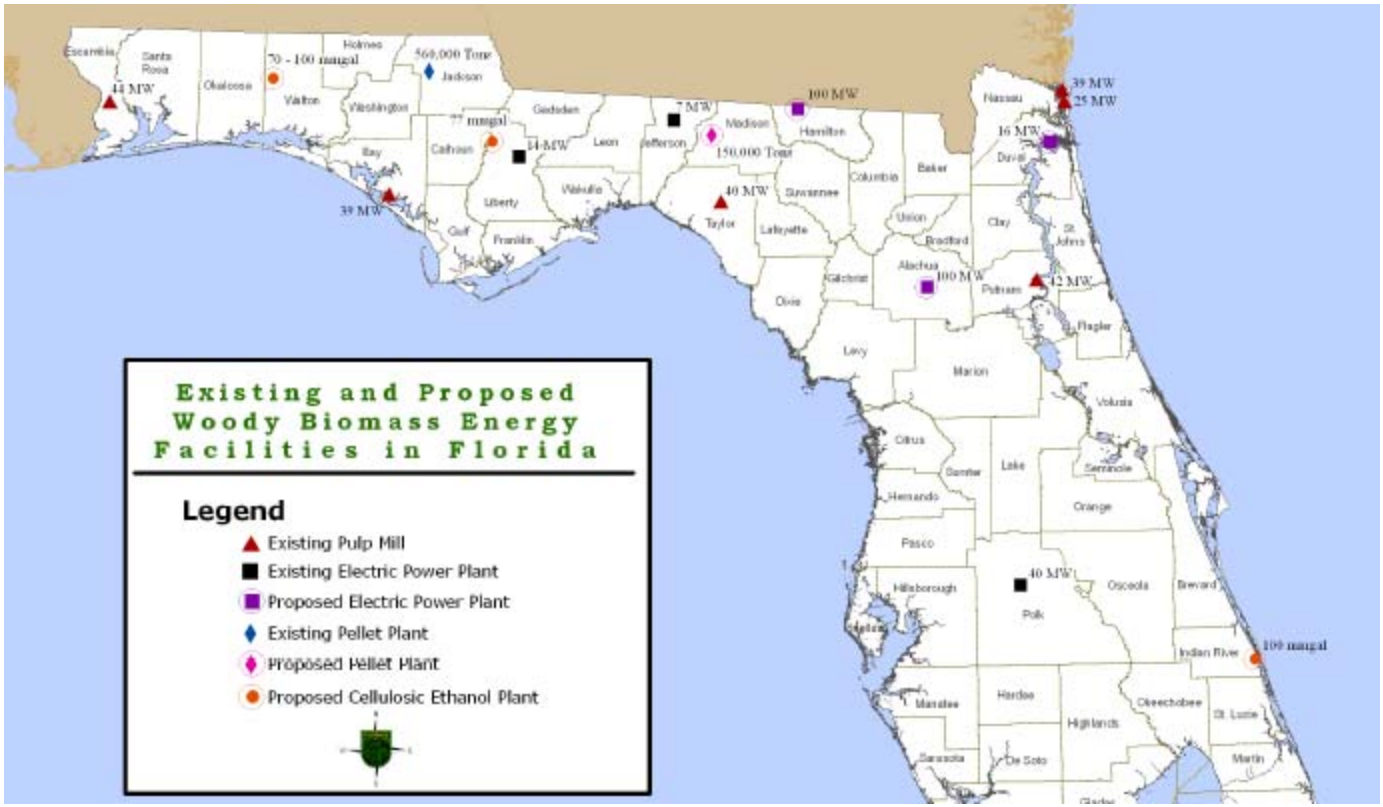
Tree Planting in Florida, 1950–2005



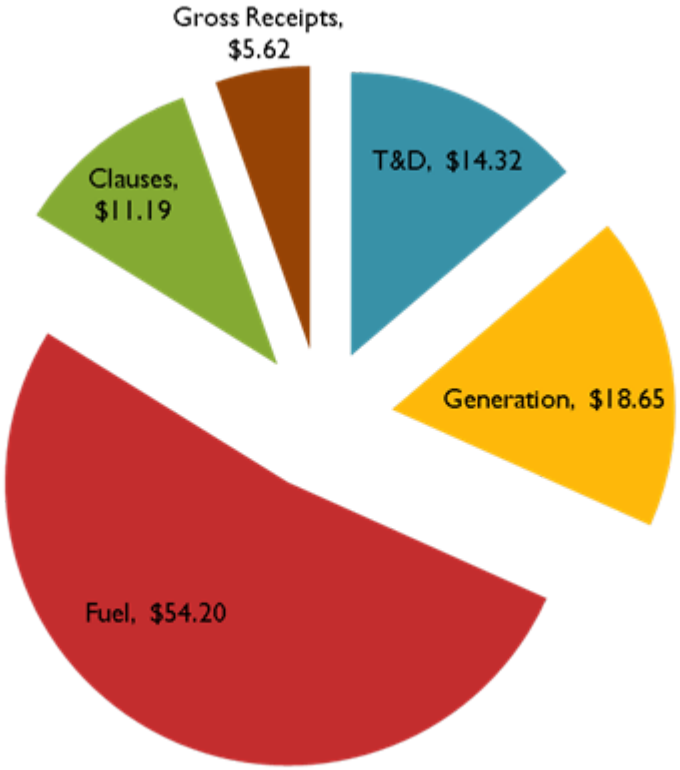
Pine Tree Planting in Florida Has Declined Since 1980


Total Land for 100 MW Facility
330,000
310,000
290,000
270,000
250,000
230,000
210,000
190,000
170,000
150,000
Acres
7000
8000
9000
10000
11000
12000
13000
14000
Heat Rate (btu/kWh)
Conventional Technology
1500 PSI Boiler
Assumptions:
Growth Cycle 20yrs
90 Wet tons/acre @ Harvest
Varnamo, Sweden IGCC
If Combined with District
Heating Much Better
Results

Existing Biomass Demands



Retail Rate Components 1 MWh
Total FPL Bill $103.98



Conclusions p. 1:

- Deployment of renewables will be impacted by carbon taxes or cap & trade allowances cost
- High capacity factor renewables are limited
- Generally entire Southeast US is renewable short
- Despite Pickens Plan – transmission will not be built from the plains

Conclusions p. 2

- Natural gas will continue as fuel of choice with or without carbon taxes
- Nuclear is being built (4200 MWs), but initial capital costs and completion risk are high
- Coal not in the future without carbon capture and sequestration