

State Utility Forecasting Group Studies

*2008 Indiana Renewable Resources Study
Indiana Electricity Projections: The 2007 Forecast
The Projected Impacts of Carbon Dioxide Emissions
Reduction Legislation on Indiana Electricity Prices*

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Presented to:

Regulatory Flexibility Committee
Indiana General Assembly

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Renewable Resources Study

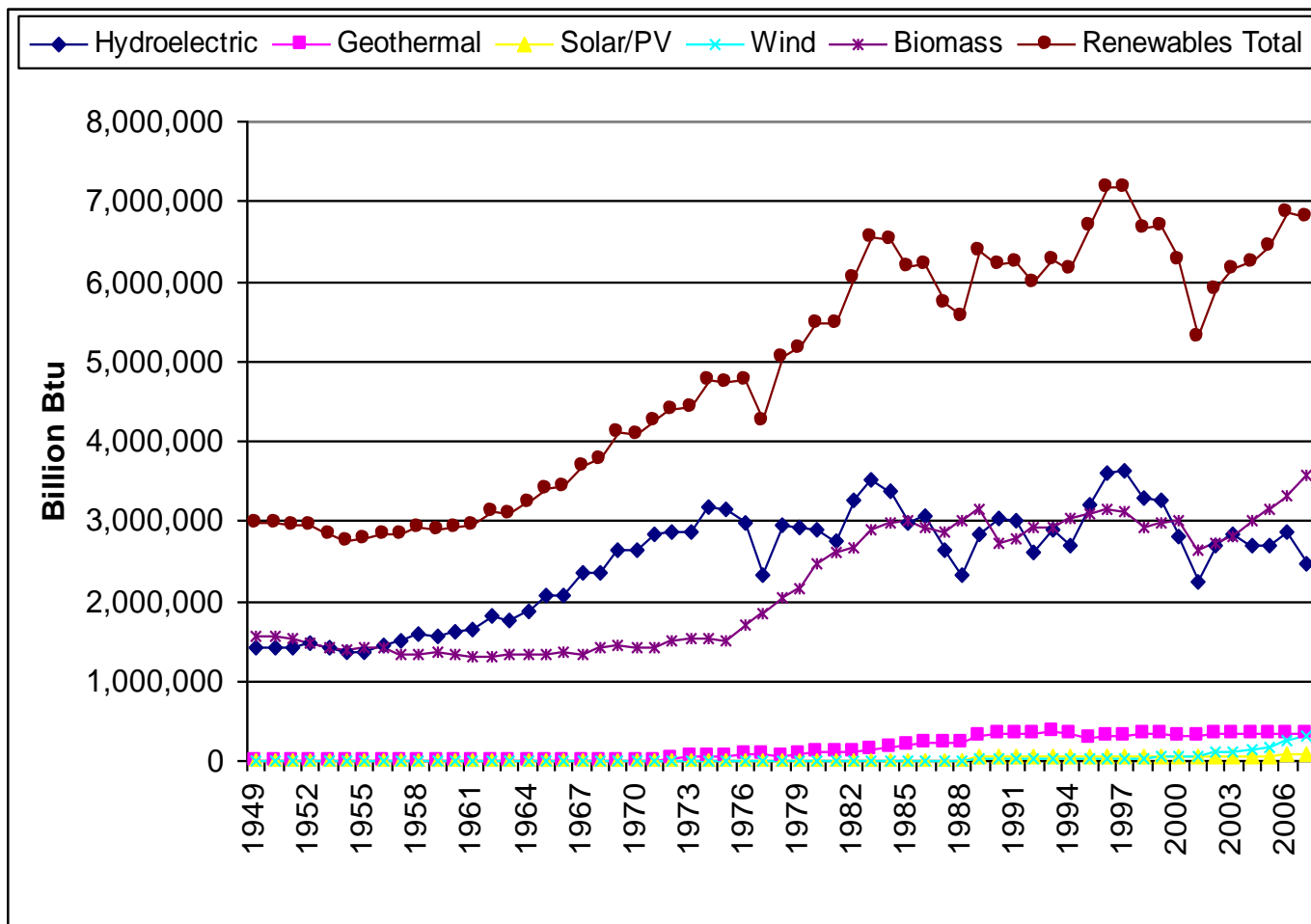


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2008 Renewable Resources Study

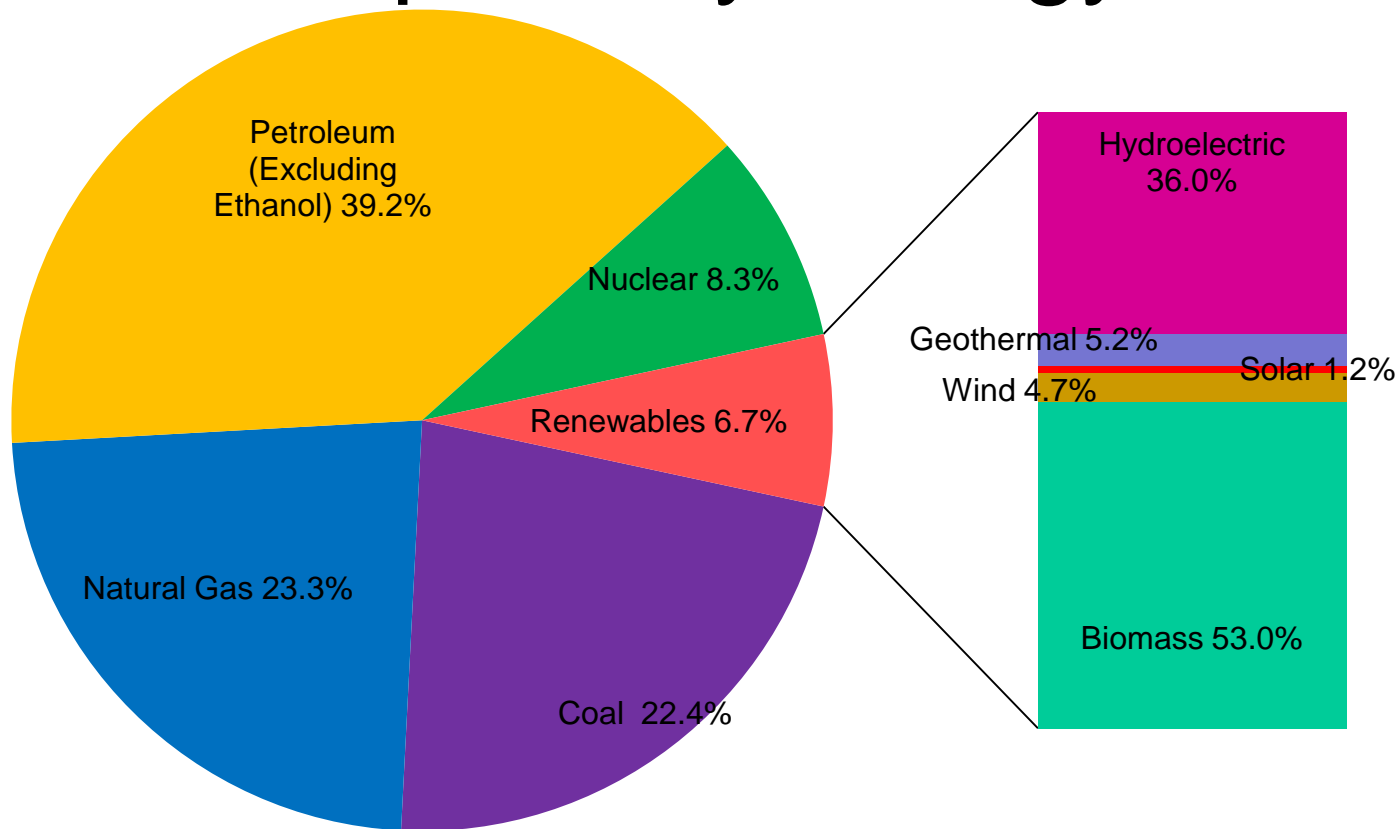
- Renewable energy trends
- Barriers and incentives
- Individual renewable resources
 - wind
 - energy crops
 - organic waste
 - solar/photovoltaics
 - fuel cells
 - Hydropower
- Appendix - Intermittent resources

Historical Renewable Energy in the U.S.



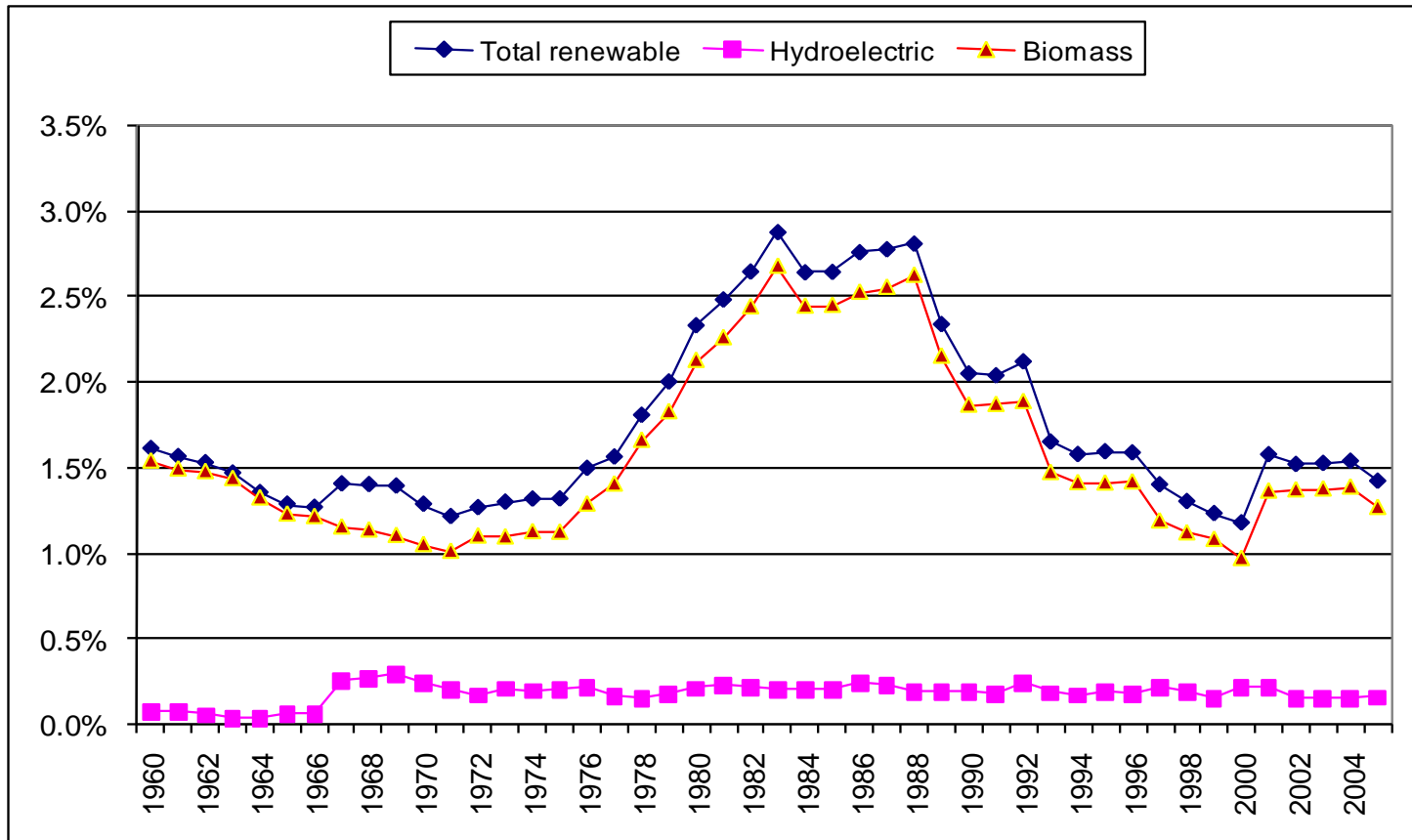
Data for geothermal, wind and solar was not available before 1960, 1982 and 1983 respectively. Source: EIA

2007 U.S. Total Energy Consumption by Energy Source



Source: EIA

Renewables Share of Indiana Total Energy Consumption



Source: EIA

Barriers to Renewables

- Major barrier is cost
 - most renewable technologies have high capital costs
 - Indiana had the 10th lowest electricity rates in the country in 2006, according to the Energy Information Administration (6.46 cents/kWh vs. national average 8.90 cents/kWh)
- Limited resources are also a problem for some technologies
 - solar/photovoltaics, hydropower, wind

Incentives for Renewables

- Federal
 - tax credits and exemptions (production tax credit)
 - grant programs
- State
 - net metering rule
 - grant programs
 - tax credits
 - emissions credits
- Utilities
 - green pricing programs

Wind Developments

Project Name	Counties	Developer	Rated Capacity (MW)	Construction Schedule	Status
Benton County Wind Farm	Benton	Orion Energy	130	Completed Spring 2008	Completed
Fowler Ridge Phase 1	Benton	BP Alternative Energy & Dominion	400	To be completed by end of 2008	Under construction
Hoosier Wind Project	Benton	enXco	100	2009	Pending w/ PPA
Fowler Ridge Phase 2	Benton	BP Alternative Energy & Dominion	350	Begin early 2009	Approved
Tri-County Wind Energy Center	Tippecanoe, Montgomery, Fountain	Invenergy	300-500	Begin 2010	Proposed
Meadow Lake Wind Farm	Benton, White	Horizon Energy	600-1000	Begin 2010	Proposed
	Randolph	Horizon Energy	100-200		Proposed
	Howard	Horizon Energy	200		Proposed

Indiana Utility Wind PPAs

Utility	Project	State	MW	Status
Duke Energy	Benton County Wind Farm	IN	100	Operational
SIGECO	Benton County Wind Farm	IN	30	Operational
WVPA	AgriWind	IL	8	Operational
Indiana Michigan	Fowler Ridge	IN	100	Approved
NIPSCO	Buffalo Ridge	SD	50	Approved
NIPSCO	Barton Windpower	IA	50	Approved
IPALCO	Hoosier Wind	IN	100	Pending

Intermittent Resources

- Some renewable resources are only available on an intermittent basis
 - Wind
 - Solar, PV
- This causes resource planning and operational challenges/costs

Mitigating Intermittency

- Dispatchable/backup generators
- Demand response
- Wind forecasting
- Energy storage
 - Hydroelectricity
 - Compressed air
 - Batteries
 - Hydrogen
- Geographic diversity

SUGF Forecast

Indiana Electricity Projections: *THE 2007 FORECAST*

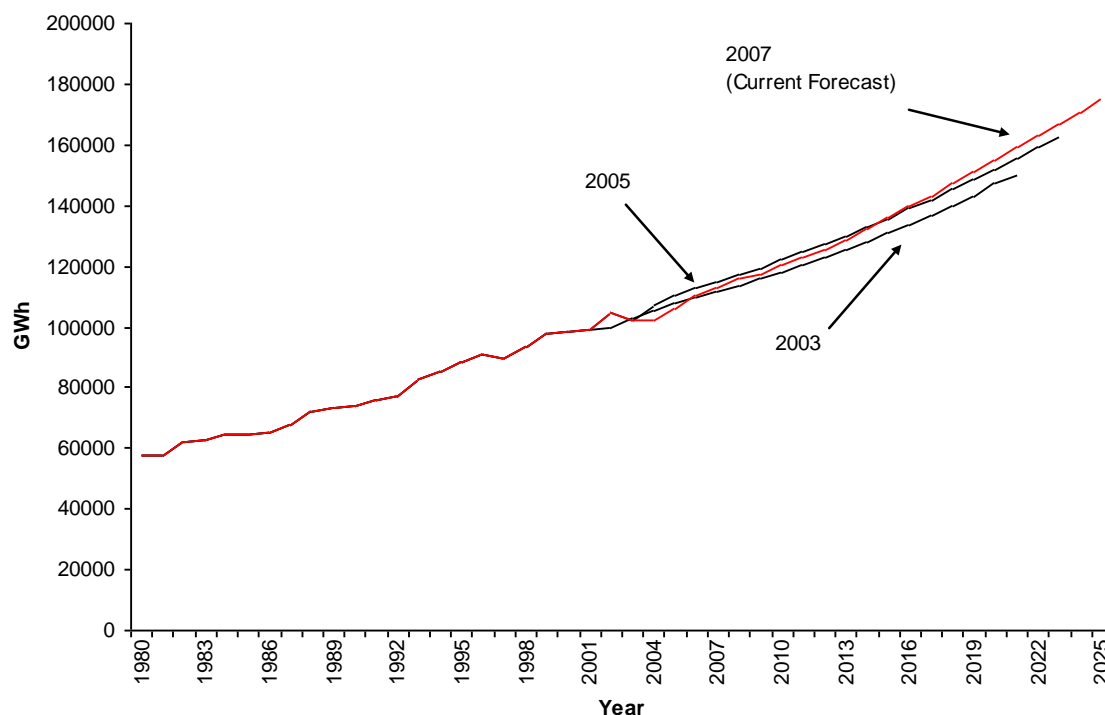


SUG Forecast Highlights

- Significant real electricity price increase through 2012, then leveling off
- Electricity requirements and peak demand projections are similar to the previous forecast in the first half of the forecast
- Electricity requirements and peak demand projections are higher than the previous forecast in the later years of the forecast
- Industrial electricity consumption is projected to grow faster than previously projected
- Resource requirements are down in the early years primarily due to new purchase contracts

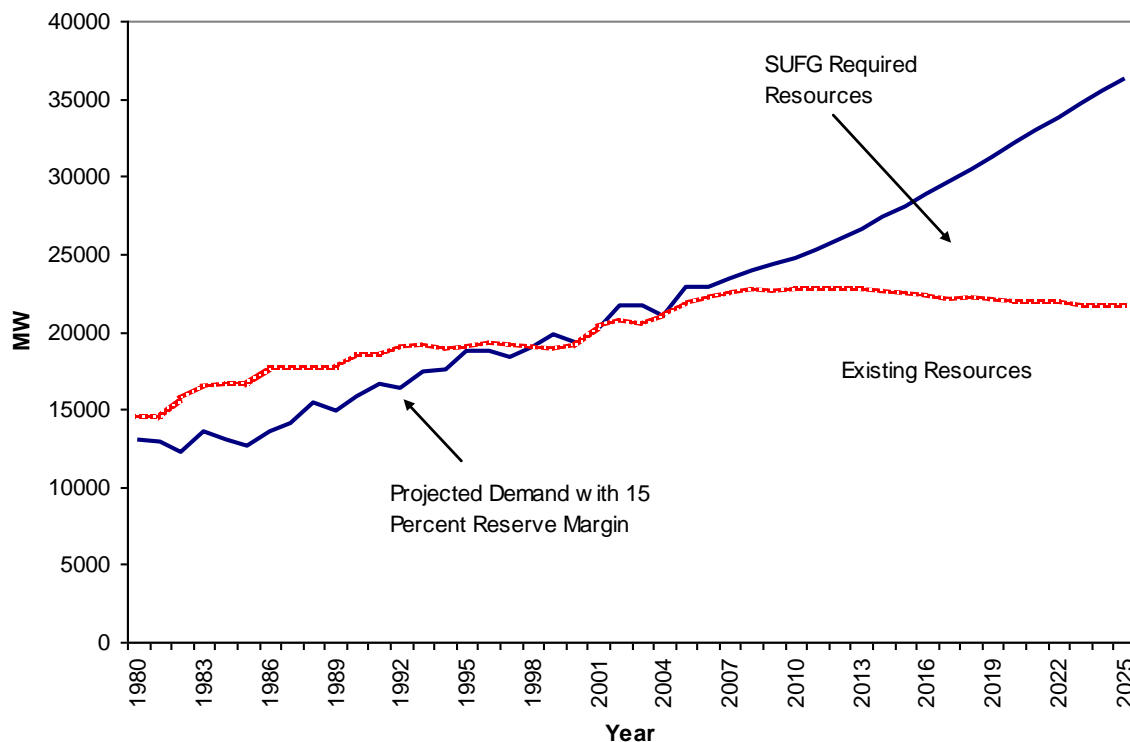
Indiana Electricity Requirements

- Retail sales by investor owned and not-for-profit utilities
- Includes estimated transmission and distribution losses
- Growth rates
 - 2007 forecast: 2.46%
 - 2005 forecast: 2.22%
 - 2003 forecast: 2.16%



Indiana Resource Requirements

- Resources may be provided by conservation measures, contractual purchases, purchases of existing assets, or new construction
- Existing resources are adjusted into the future for retirements, contract expirations, and IURC approved new resources
 - Does not include Duke IGCC, NIPSCO purchase of Sugar Creek, and most wind purchases



Indiana Resource Requirements

	Uncontrolled Peak Demand 1	Interruptible	Net Peak Demand 2	Existing/ Approved Capacity 3	Incremental Change in Capacity 4	Projected Additional Resource Requirements 5				Total Resources 6	Reserve Margin
						Peaking	Cycling	Baseload	Total		
2005				21,777							
2006	20,933	1,059	19,874	22,166	389	90	530	120	740	22,906	15
2007	21,393	1,062	20,331	22,519	353	140	620	90	850	23,369	15
2008	21,865	1,063	20,803	22,779	260	230	730	170	1,130	23,909	15
2009	22,163	1,065	21,099	22,554	-225	310	1,020	390	1,720	24,274	15
2010	22,608	1,067	21,541	22,719	165	330	1,100	620	2,050	24,769	15
2011	23,077	1,068	22,010	22,738	19	480	1,230	880	2,590	25,328	15
2012	23,590	1,071	22,520	22,685	-53	600	1,330	1,290	3,220	25,905	15
2013	24,177	1,073	23,104	22,685	0	770	1,430	1,710	3,910	26,595	15
2014	24,831	1,076	23,756	22,635	-50	1,000	1,510	2,180	4,690	27,325	15
2015	25,464	1,078	24,387	22,511	-125	1,240	1,620	2,710	5,570	28,081	15
2016	26,143	1,081	25,062	22,384	-126	1,440	1,710	3,300	6,450	28,834	15
2017	26,819	1,084	25,736	22,043	-341	1,700	2,090	3,760	7,550	29,593	15
2018	27,562	1,088	26,474	22,149	106	1,940	2,210	4,160	8,310	30,459	15
2019	28,277	1,092	27,185	22,072	-77	2,180	2,310	4,700	9,190	31,262	15
2020	29,016	1,096	27,921	21,909	-163	2,530	2,430	5,220	10,180	32,089	15
2021	29,746	1,100	28,647	21,909	0	2,700	2,520	5,820	11,040	32,949	15
2022	30,504	1,104	29,400	21,869	-41	2,940	2,600	6,400	11,940	33,809	15
2023	31,219	1,108	30,112	21,709	-160	3,100	2,700	7,120	12,920	34,629	15
2024	31,954	1,112	30,843	21,709	0	3,290	2,820	7,640	13,750	35,459	15
2025	32,678	1,116	31,562	21,628	-81	3,470	2,930	8,290	14,690	36,318	15

1 Uncontrolled peak demand is the peak demand with DSM in place but without any interruptible loads being called upon.

2 Net peak demand is the peak demand after interruptible loads are taken into account.

3 Existing/approved capacity includes installed capacity plus approved new capacity plus firm purchases minus firm sales.

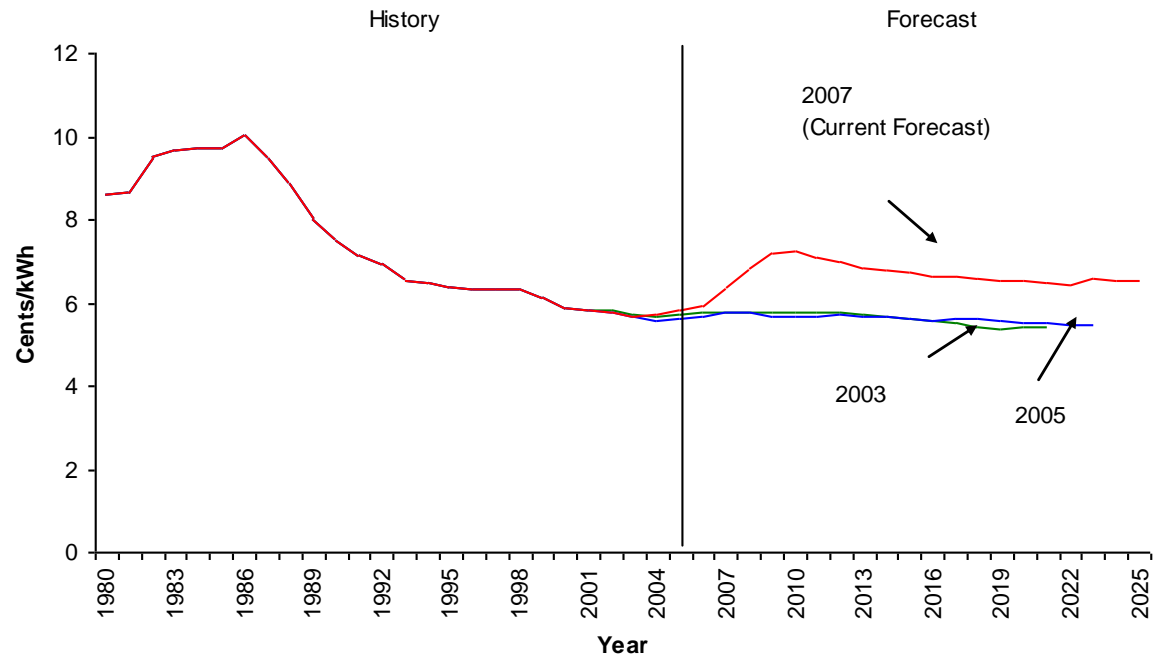
4 Incremental change in capacity is the change in existing/approved capacity from the previous year. The change is due to new, approved capacity becoming operational, retirements of existing capacity, and changes in firm purchases and sales.

5 Projected additional resource requirements is the cumulative amount of additional resources needed to meet future requirements.

6 Total resource requirements are the total statewide resources required including existing/approved capacity and projected additional resource requirements.

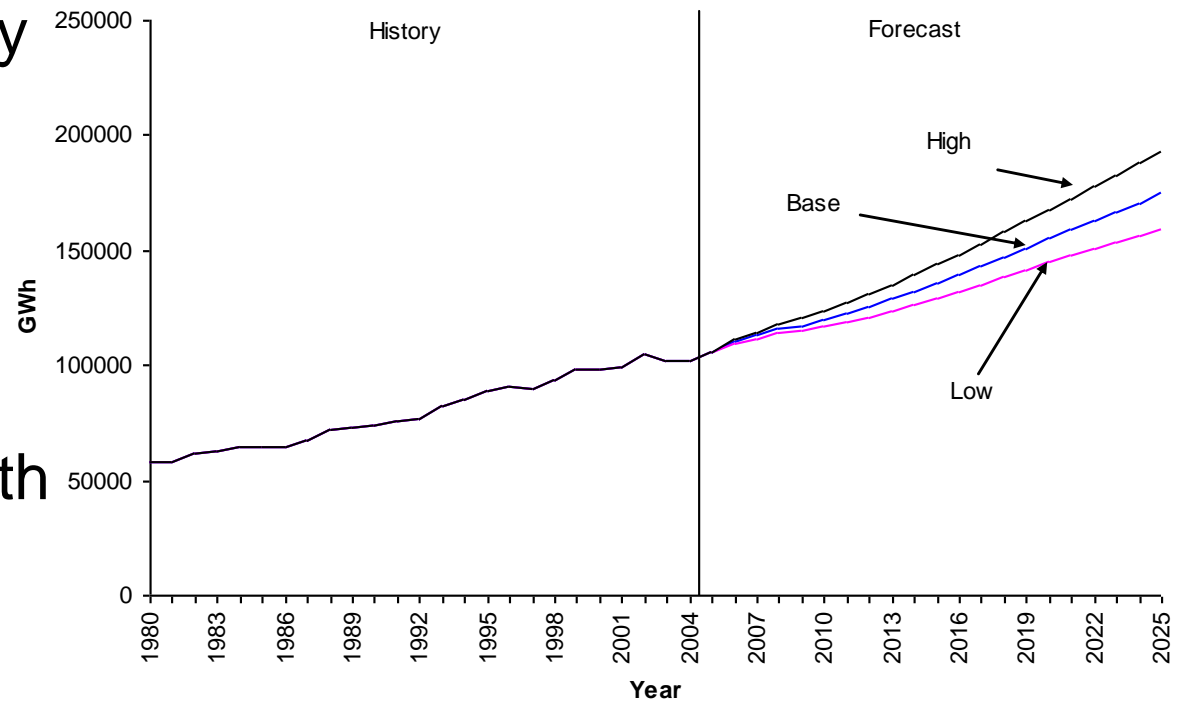
Indiana Real Price Projections (2005 \$)

- Effect of inflation removed
- Includes the cost of meeting CAIR and CAMR
- Does not include costs associated with CO2 or RPS
- Includes the cost of new resources



Alternative Scenarios

- Any forecast contains uncertainty
- CEMR provides alternative low and high growth econometric forecasts
- Low and high growth scenarios are intended to give a plausible bound to uncertainty



CO2 Electricity Price Impact Study

The Projected Impacts of Carbon Dioxide Emissions Reduction Legislation on Electricity Prices in Indiana



Background

- Analysis based on then proposed Lieberman-Warner Climate Security Act
- Focuses on price impacts of CO₂ limitations on Indiana's electric utility industry
 - does not address benefits
- Uses the traditional regulation forecasting model developed by the State Utility Forecasting Group (SUFG)
- Collaboration with the Purdue Climate Change Research Center

Lieberman-Warner Act

- “Cap and trade” reduction of six greenhouse gases
 - we focus on CO₂
- Declining cap from 2012 to 2050
- Emissions allowances can be traded, banked, or borrowed from the future
- An increasing percentage of allowances are auctioned over time
- Offsets can be purchased from non-covered sources

Methodology

- Reduce utility CO₂ emissions at the overall national rate specified by the proposed legislation
- Incorporate emission allowance purchase costs
- Incorporate emission offset purchase costs
- Adjust fossil fuel price projections
- Other model inputs kept the same as in SUFG 2007 forecast

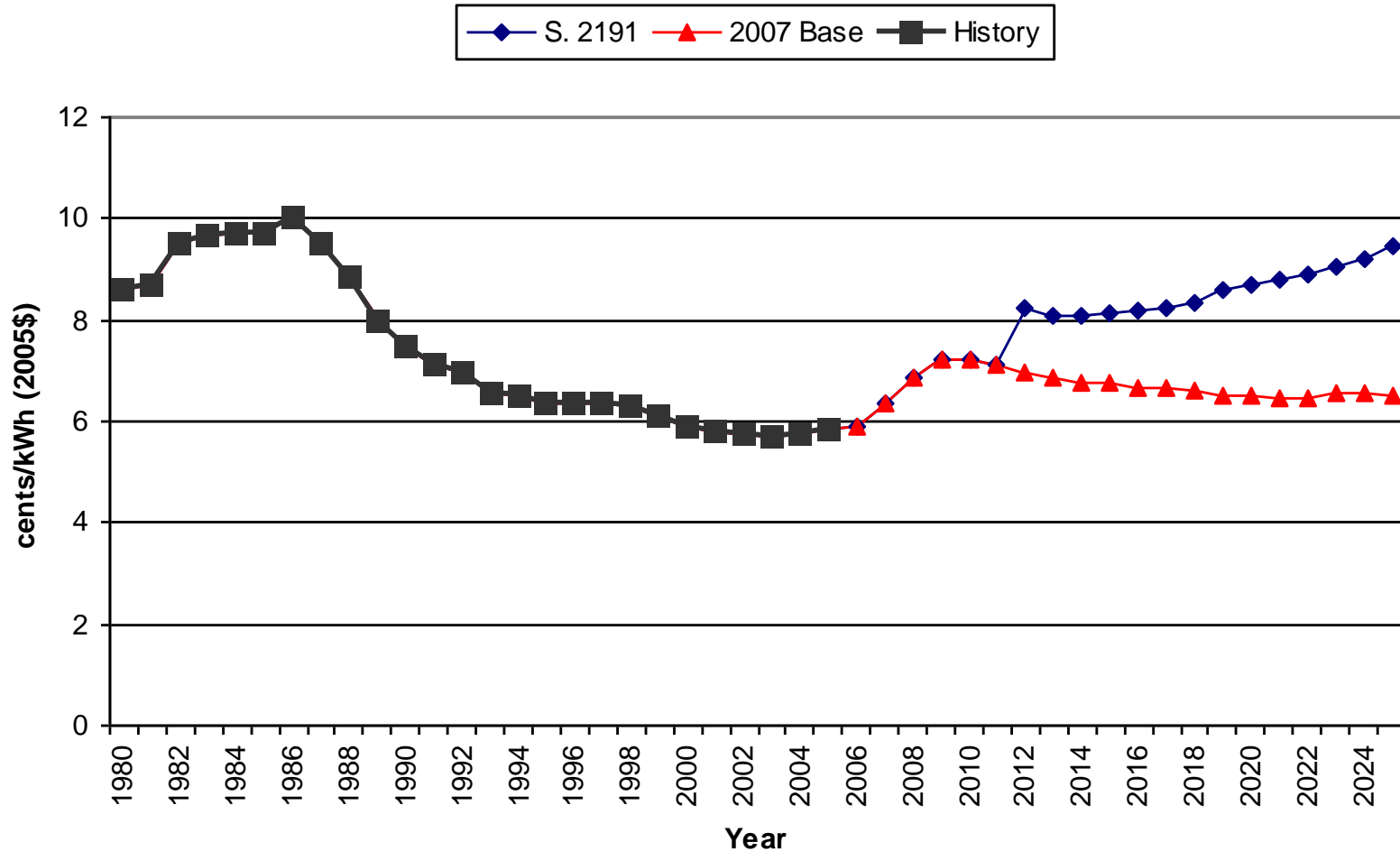
Compliance Strategy

- Purchase the maximum amount of offsets allowable
- Switch the basis for new baseload resources from pulverized coal-fired to a combination of wind and natural gas
- Retire older coal units that have not been retrofitted with equipment to remove SO₂ and NO_x
- Bank allowances in the early years for use in the later years

Other Resource Options

- Nuclear
- IGCC with carbon capture and storage
- Carbon capture from existing facilities
- Fuel switching
- Energy efficiency programs

Results



Electricity Price Changes

Indiana Real Electricity Prices in 2012
 (2005 cents/kWh)

Indiana Real Electricity Prices in 2015
 (2005 cents/kWh)

Sector	2007 Base	S. 2191	Change
Residential	8.766	9.915	13.1 %
Commercial	7.896	8.946	13.3 %
Industrial	5.294	6.662	25.1 %
Total	6.972	8.213	17.8 %

Sector	2007 Base	S. 2191	Change
Residential	8.327	9.671	16.1 %
Commercial	7.567	8.817	16.5 %
Industrial	5.280	6.647	25.9 %
Total	6.745	8.158	21.0 %

Electricity Price Changes

Indiana Real Electricity Prices in 2020
 (2005 cents/kWh)

Indiana Real Electricity Prices in 2025
 (2005 cents/kWh)

Sector	2007 Base	S. 2191	Change
Residential	7.803	10.101	29.4 %
Commercial	7.204	9.224	28.0 %
Industrial	5.318	7.315	37.6 %
Total	6.507	8.695	33.6 %

Sector	2007 Base	S. 2191	Change
Residential	7.637	10.670	39.7 %
Commercial	7.088	9.849	39.0 %
Industrial	5.513	8.209	48.9 %
Total	6.525	9.437	44.6 %

Caveats

- Large-scale wind development
 - 3,400 MW needed by 2012
 - 9,800 MW needed by 2025
 - significant transmission investment
 - operational issues due to intermittency
 - ability of turbine manufacturers to meet demand
 - analysis does not include federal production tax credit

Caveats

- Demand-side management (DSM)
 - higher cost makes DSM more attractive
 - quantifying amount and cost not feasible for this study
- Price elasticity
 - SUGF modeling system uses historical observations to project the future
 - price increases are greater than previously experienced

Caveats

- Macroeconomic effects
 - SUGF model captures microeconomic effects of price increases
 - customer switches from electricity to another resource
 - customer uses electricity more efficiently
 - SUGF model does not capture macroeconomic effects of price increases
 - customer shuts down business
 - customer elects not to open facility in the state

Caveats

- Technological innovations
 - Restrictions are likely to provide incentives for new developments
 - better carbon capture methods for fossil-fuel generators
 - better energy storage for wind intermittency
 - It is not possible to predict what developments will occur and when

Caveats

- Compliance strategy
 - least cost options have been chosen when possible, but should not be construed to be optimal
- Modeling of Lieberman-Warner bill
 - Analysis is based on the proposed legislation, but does not model it exactly
 - allowance allocation
 - carbon capture bonus allowances
 - fuel, allowance, and offset prices from analysis of earlier bill

Further Information

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