

UIC



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3rd DG/CHP Regulatory Workshop

Economic, Employment and Environmental Impacts of Increased CHP Investment in Illinois

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Study Background

- Prepared for Illinois Department of Commerce and Economic Opportunity
- Prepared by:
 - University of Illinois at Chicago, Energy Resources Center
 - The Regional Economics Application Laboratory, University of Illinois at Urbana-Champaign
- Study Scenario:
 - Increase Renewable Energy to 8% (from currently ~2%) of Electricity Generated in Illinois in 2012
 - Increase Renewable Energy to 16% in 2020



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Assessed Renewable & Environmentally Benign Technologies

- Wind, Solar, Hydro, Geothermal, IGCC Clean Coal
- Biomass from various feedstocks:
 - Landfill gas,
 - Animal manure
 - Biomass based on switchgrass, mill residues, forest residues
- Natural gas fired CHP



Based on
Small
Distributed
CHP
Technology

Capacity Potential

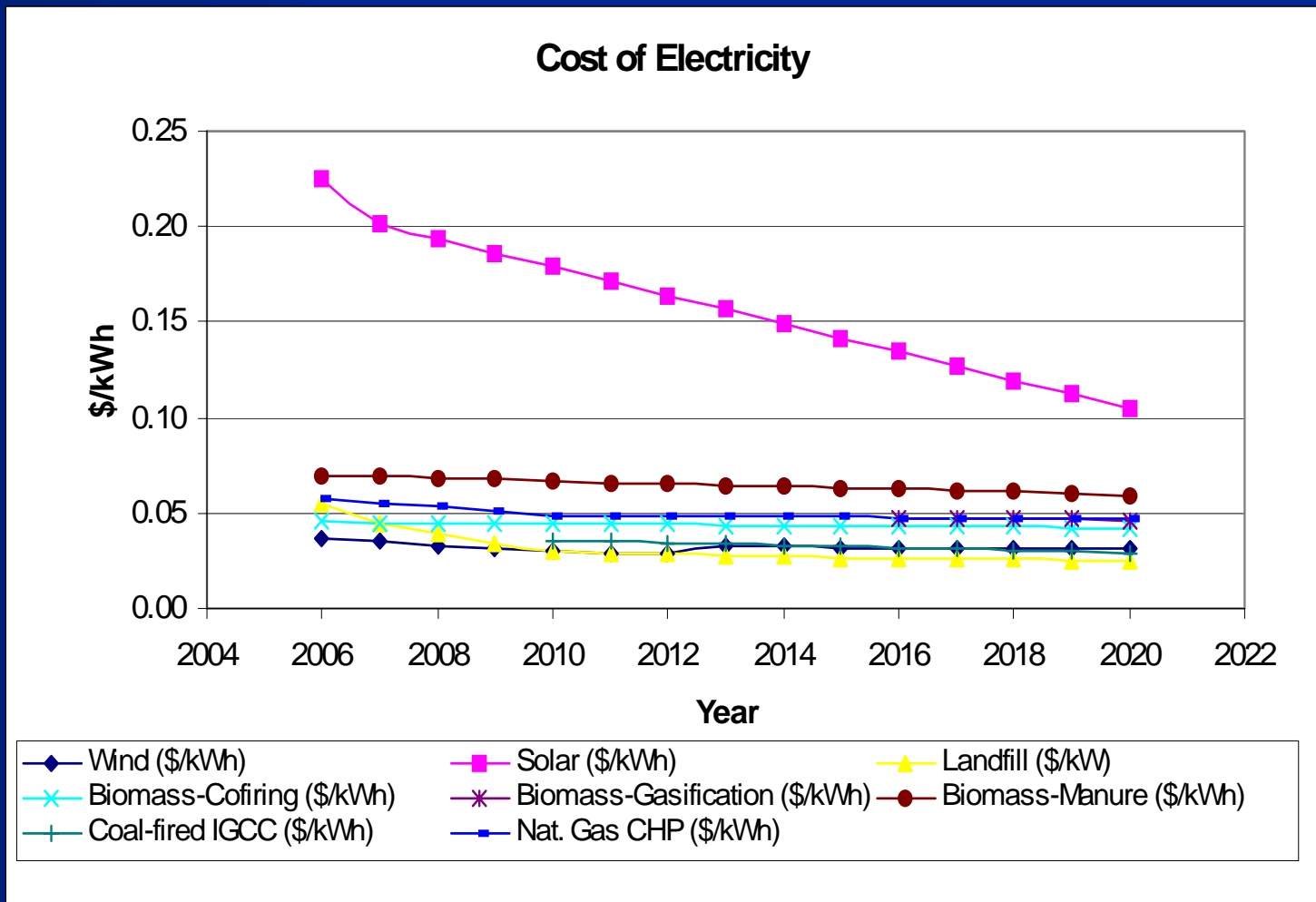
- **Calculated capacity potential for each technology in the state**
- **Capacity potential from biomass feedstocks:**
 - **For Landfill gas: Looked at Illinois landfill statistics (# of landfills, annual waste deposited). Used decay models to calculate capacity potential**
 - **For Animal manure: Looked at USDA animal and CAFO census, calculated IL manure production and from that biogas production in a digester and capacity potential**
 - **For other biomass feedstocks (switchgrass etc.): Utilized studies that assess available biomass in IL at certain prices, converted biomass to potential fuel input and from that assessed capacity potential for these feedstocks**
- **CHP capacity potential was assessed based on available studies that take into account the building stock within the state that qualifies for CHP**

Renewable Capacity Potential in Illinois

- **Wind: 9,000 MW (nameplate),**
- **Solar: Not established**
- **Hydro, geothermal: 0 MW**
- **Landfill gas: 200-650 MW**
- **Biomass Gasification: 1,500**
- **Biomass Co-firing: 1,200 MW**
- **Biomass Manure: 870 MW**
- **Natural gas fired CHP: 4,400 MW**
- **IGCC Clean Coal: > 2,000 MW**

Cost Assumptions

- With capacity potential in place we calculated the cost to generate electricity for each year until 2020 in \$/kWh
- Based on these prices we prioritized the deployment of these technologies to meet the renewable portfolio requirements



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CHP System Cost Assumptions

Year	Cumulative Capacity (MW)	Cost of Electricity Generation (\$/kWh)	Capital Cost (\$/kW)
Landfill Gas			
2006	42	0.055	1,340
2010	132	0.030	722
2015	254	0.027	714
2020	384	0.025	710
Biomass Manure			
2006	3	0.070	4,496
2010	14	0.067	4,232
2015	32	0.063	3,924
2020	53	0.060	3,638
Natural Gas			
2006	47	0.058	1,283
2010	234	0.048	622
2015	467	0.048	622
2020	701	0.047	622
Biomass Gasification			
2020	79	0.046	1,381



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From Costs to Jobs

- The economic effects were estimated using the Illinois Regional Economic Input-Output Model (ILREIM)
- Modeling work was performed by the Regional Economics Application Laboratory at University of Illinois at Urbana Champaign
- The state model estimates the direct and indirect economic effects on the local economy with respect to different economic sectors
- For the current study the model is used to estimate the economic effects of implementing a renewable resources scenario instead of conventional technologies in generating energy for the state

From Costs to Jobs

- The scenario involves a large investment in efficient generating equipment
- It is likely that some portions of the efficiency equipment will be manufactured in Illinois (i.e., generating equipment in Peoria)
- Similarly, part of the saved energy will come from imported fuels
- The state's economy will experience an economic adjustment comprised of the interplay between the reduced production of energy in centralized power plants and the increased production of efficiency equipment

CHP Capital Investment and O&M Investment

Year	Cumulative Capacity (MW)	Capital Investment (Million \$)	O&M Investment (Million \$)
Landfill Gas			
2010	132	16.7	21.4
2015	254	18.0	36.6
2020	384	18.7	52.9
Biomass Manure			
2010	14	10.5	1.8
2015	32	18.4	4.0
2020	53	23.5	6.6
Natural Gas			
2010	234	29.0	76.5
2015	467	29.0	151.6
2020	701	29.0	225.5
Biomass Gasification			
2020	79	21.8	19.2

Additional Jobs from CHP in Illinois

Year	Cumulative Capacity (MW)	Direct Jobs Added (No.)	Indirect Jobs Added (No.)
Landfill Gas			
2010	132	130	546
2015	254	190	798
2020	384	240	1,008
Biomass Manure			
2010	14	50	210
2015	32	70	294
2020	53	100	420
Natural Gas			
2010	234	360	1,512
2015	467	620	2,604
2020	701	880	3,696
Biomass Gasification			
2020	79	150	630

Emissions Analysis

- **The Study quantified the air emission reductions that could be obtained by substituting electricity generated from renewable and benign technologies for electricity generated using nonrenewable resources**
- **Focus on: Sulfur Oxides (SO_x), Nitrogen Oxides (NO_x), Mercury (Hg), and Carbon Dioxide (CO₂)**
- **For CHP Technologies Emissions were calculated based on AP-42 emission factors published by the Environmental Protection Agency's Office of Air Quality and Standards (except: emissions calculations from biomass gasification are based on published reports)**
- **Where emission factors are based on fuel input (lb/MMBtu) the factors were converted to lb/MWh using the appropriate heat rate**
- **Emissions estimates for existing coal-fired electric generation in Illinois are based on the EPA eGrid Database (provides output emission rates for average IL coal in lb/MWh)**



Emissions Comparison

Emissions Factor (lb/MWh)				
	SO _x	NO _x	CO ₂	Hg
Average IL Coal	10.62	5.73	2308	8.32*10 ⁻⁵
Landfill Gas	0.230	0.700	251	0
Biomass Manure	0.072	1.760	297	0
Natural Gas CHP	0.017	0.652	552	0
Biomass Gasification	1.440	0.183	0	0

In summary

- **Approximately 1-3 jobs additional direct jobs are created in Illinois per MW of installed CHP capacity**
- **An additional 2 to 11 indirect jobs are created in Illinois per MW of installed CHP capacity**
- **Emissions are reduced significantly (to 1/10th) for many pollutants compared to average IL coal**