Climate Change:
Implications for Nebraska Electric Utilities

Nat'l Climate Change Legislation & Opportunities for NE
UNL's Nebraska Center for Energy Sciences Research
November 6, 2008

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Nebraska Public Power District
"Always there when you need us"

Overview

I. Electric Utility Industry in Nebraska

II. Challenges to Reduce Greenhouse Gases

III. Opportunities to Reduce Greenhouse Gases

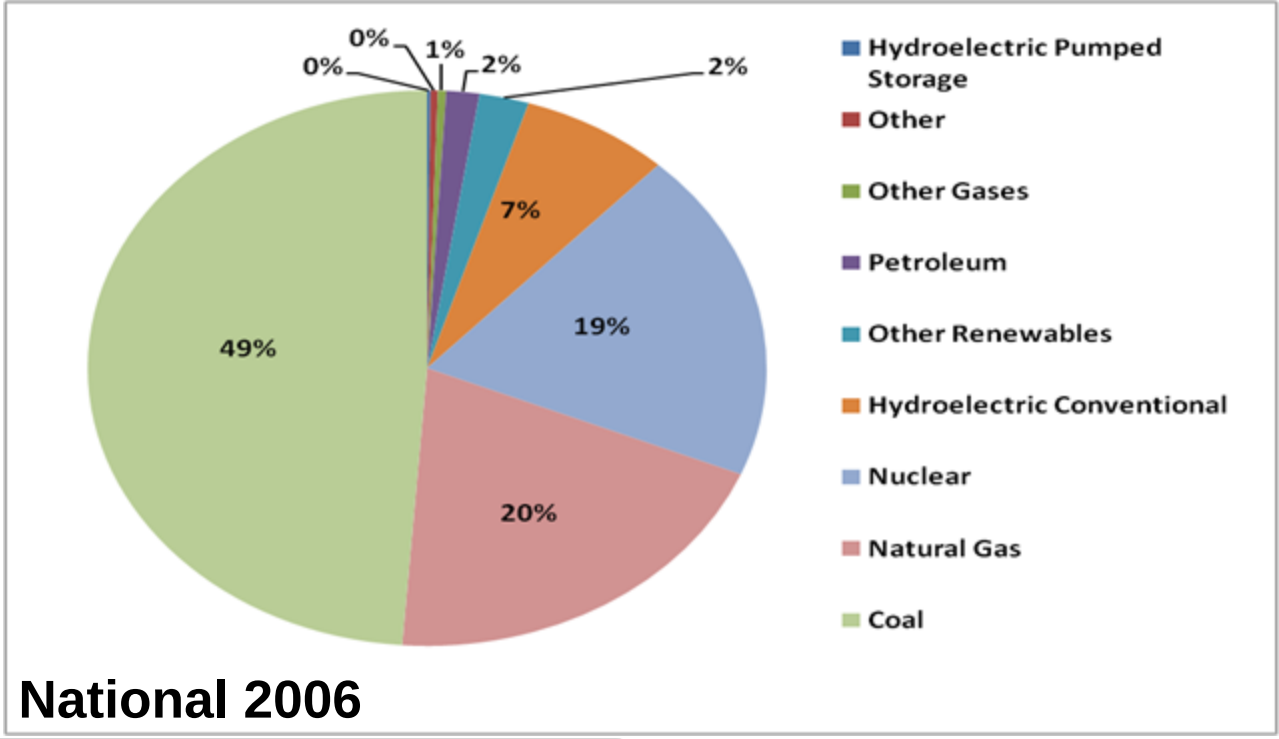
Nebraska's Electric Industry

- Nebraska's electric industry is unique
  - Only state with no investor-owned utilities providing retail electric service
- Industry accountable to customers, not shareholders
- Focus has been reliability and low cost as required by state law
  - Nebraska is consistently among the lowest cost states for average retail price of electricity

Nebraska Public Power District

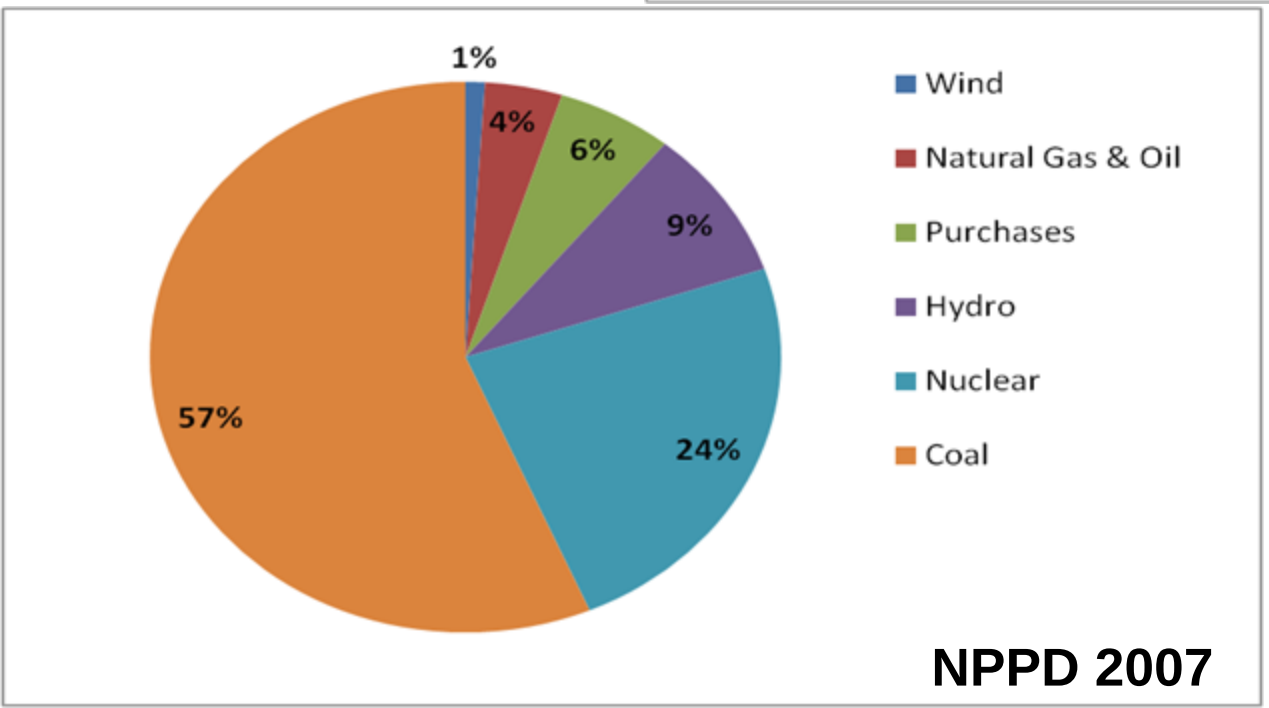
- Primarily a wholesale power supplier
  - Serve total requirements of:
    - 52 wholesale municipalities
    - 24 public power districts and cooperatives
    - 80 retail municipalities
- Provide nearly ½ the electricity consumed in Nebraska
  - 3,132 MW of accredited generation capacity
- Own and operate ~ 5,000 miles of electric transmission lines

Fuel Mix for Electricity



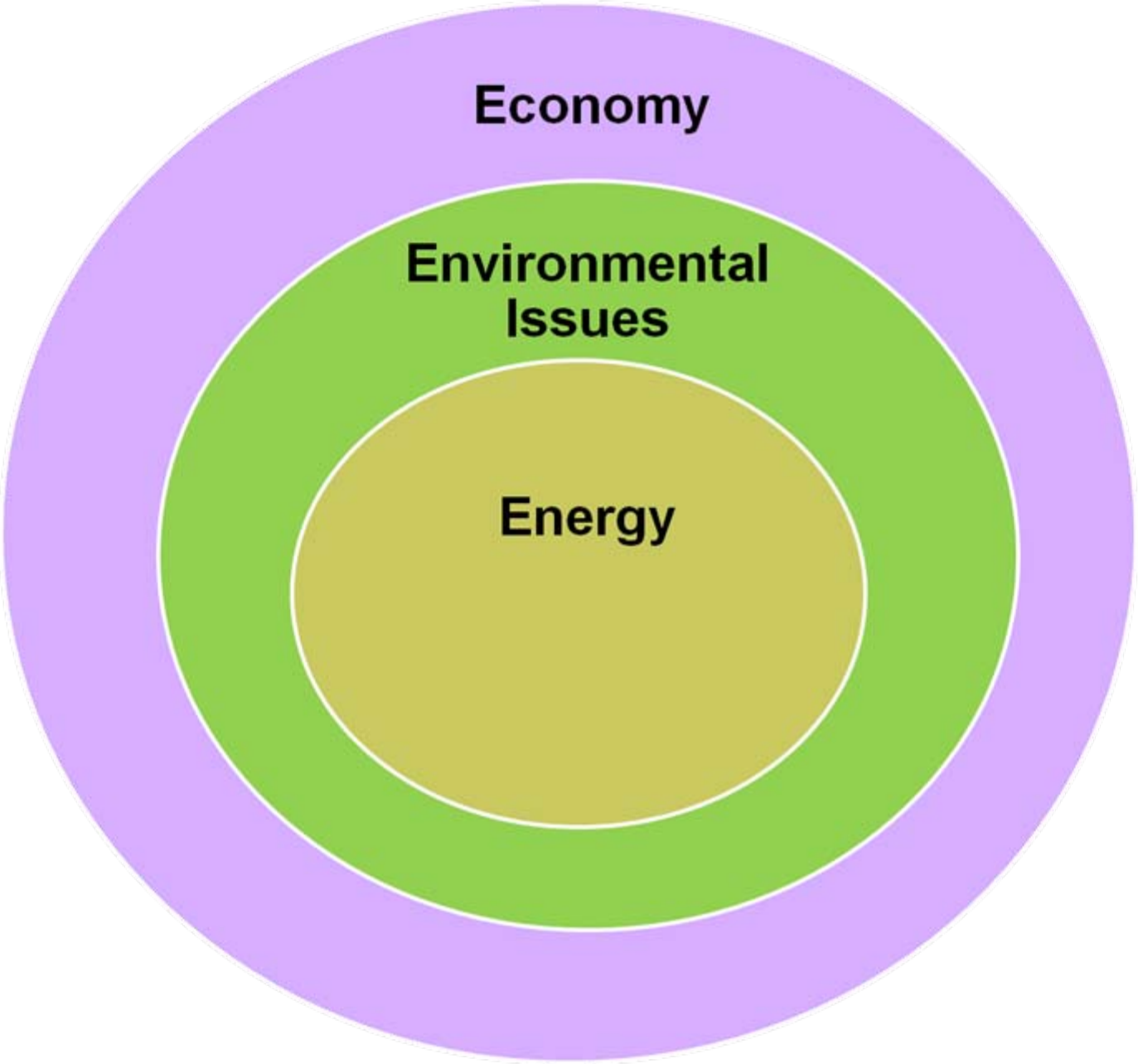
National 2006

Source: EIA Form 906



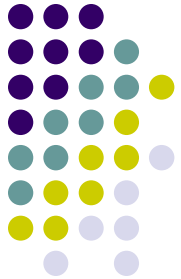
NPPD 2007

II



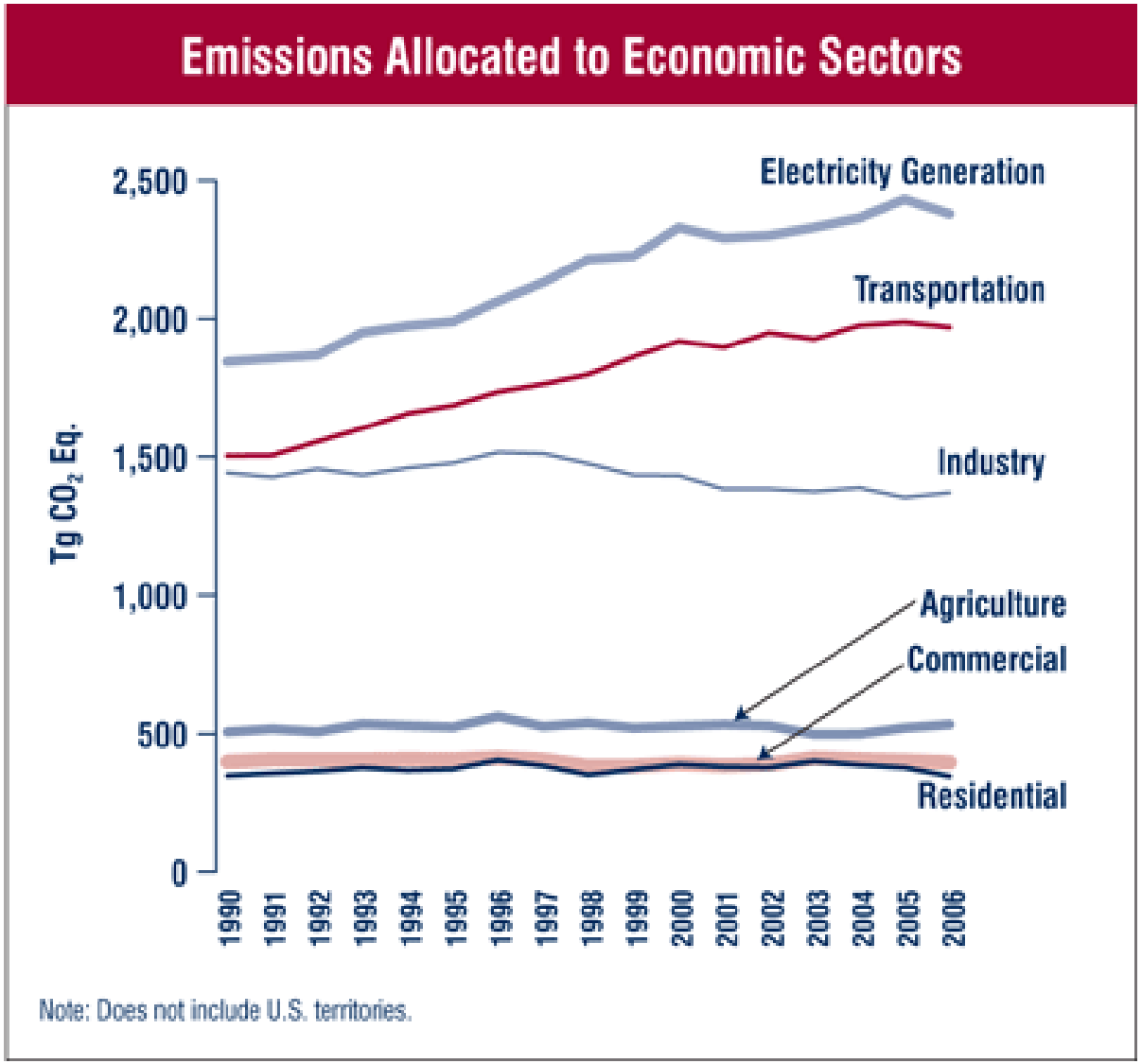
II

Dingell / Boucher
Discussion Draft Principles



- Emission levels and timetables should be realistic and scientifically driven
- Energy efficiency and development of clean energy technologies are vital GHG reduction strategies that also have economic benefits
- Limiting costs will protect U.S. jobs
- Economy-wide approach
- Proper allocation of allowances is critical and unresolved
- Implementation matters (must be workable and efficient)

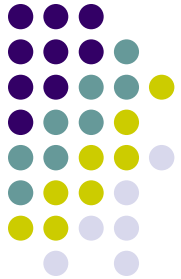
U.S. Greenhouse Gas Emissions



Reference: Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2006, USEPA #430-R-08-005

II

Electric Industry Resource Challenges



- Generation Must Constantly Match Demand
  - Limited storage capability
- Long-Term Planning Horizon
  - 20-40 years
- Capital Intensive
- Market & Fuel Price Volatility
- Environmental Uncertainty
  - What will be the amount and rate of carbon reduction?
- Technology Uncertainty
  - Generation choice
  - Smart Grid development
  - Electrification of transportation sector
- Economic Uncertainty
  - Global
  - National
  - Regional
  - State

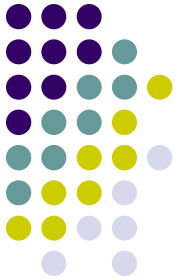
II

Climate Change Issues

- **Long-Term Challenge – slow, stop, reduce emissions**
- **Lack of commercial scale technology for Carbon Capture and Sequestration (CCS)**
  - Current technology estimated to be ~ 30% energy penalty
  - May require new national pipeline network for transportation to suitable storage areas
  - Expect major challenges to licensing sequestration tied to environmental and general liability concerns

II

Climate Change Issues (Cont'd)



- **Where will future electricity come from, how much will it cost, and will it be reliable?**
  - **Coal** – proposed new plants being rejected or withdrawn nationally
  - **Nuclear** – considerable uncertainty over cost and regulatory process
  - **Natural Gas** – increased use will raise the cost and stress supplies and delivery infrastructure
    - Emits CO_2 at approximately ½ the rate of coal
  - **Energy Efficiency & Renewables** – important, but can't totally offset growing needs for electricity and replace retiring baseload capacity

Opportunities to Reduce GHGs

- Supply side vs. Demand side options
  (producing electricity) (energy efficiency, conservation and demand-side management)
- 2008 NPPD Integrated Resource Plan
  - Increase energy efficiency, conservation and demand-side management
  - Add more renewable resources (primarily wind)
  - Complete studies on transmission expansions to support additional wind
  - Pursue co-generation with ethanol
  - Small power uprate at nuclear plant
  - Study pumped hydro storage
  - Evaluate carbon capture technologies
  - Implement cost-effective methane projects
  - Engage in energy-related research – UNL Center for Energy Sciences Research and Electric Power Research Institute (EPRI)

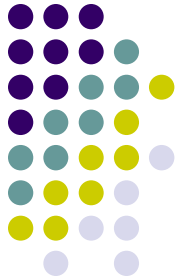
Demand Response Program

- NPPD has a very successful Demand Response Program. Effective reductions in 2006 and 2007 were:

	2006	2007
Irrigation	560 MW	515 MW
Energy Curtailment Program	73 MW	45 MW
Other	33 MW	12 MW
TOTAL	**666 MW**	**572 MW**

III

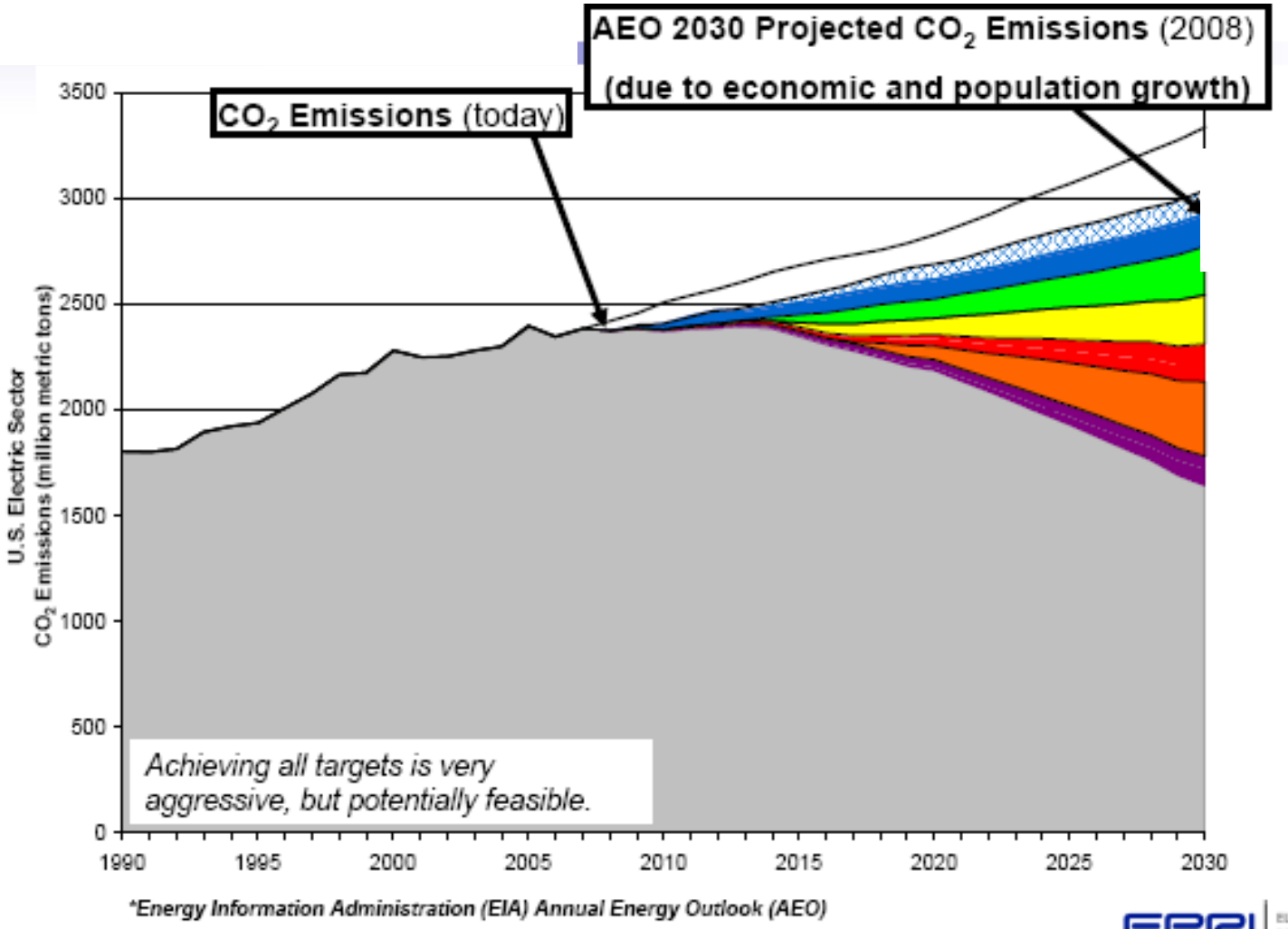
Energy Efficiency Initiatives



- High Efficiency Heat Pump Rebate Program
- Compact Fluorescent Lighting Promotion
- Refrigerator Recycling Program
- Low Interest Energy Efficiency Loan Program through the Nebraska Energy Office
- Irrigation Equipment Efficiency Testing & Incentives
- Commercial / Industrial Lighting Incentives

III

2008 Prism…Technical Potential for CO_2 Reductions



*Energy Information Administration (EIA) Annual Energy Outlook (AEO)

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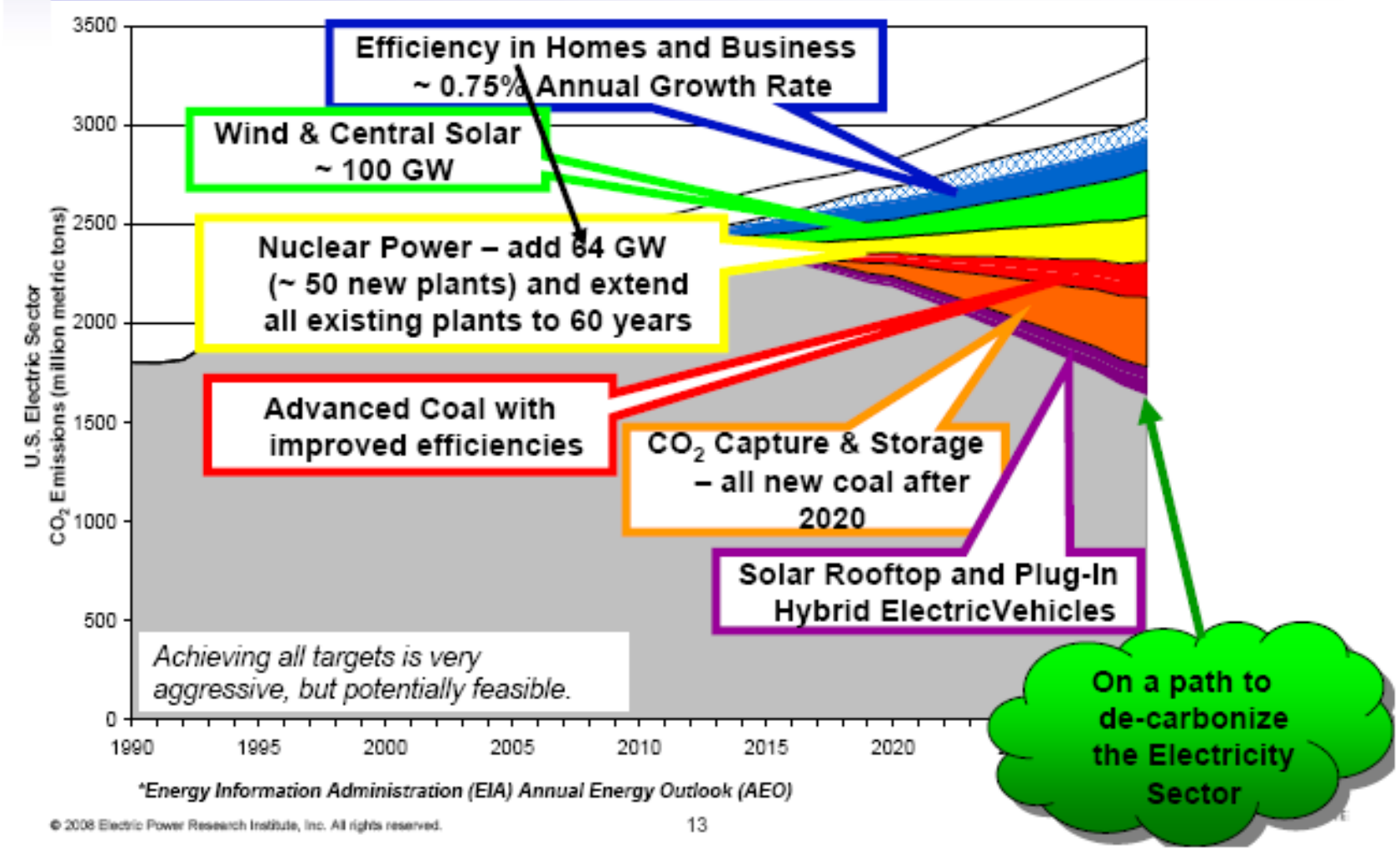
EPRI ELECTRIC POWER RESEARCH INSTITUTE

III

2008 Prism…Technical Potential for CO_2 Reductions

(Cont'd)



Opportunity for Wind

- Improving technology to produce electricity with wind
  - Economies of scale
    - Larger machines are more cost-effective
- Wind is a free fuel
- Wind requires no water use
- Wind has no air or water emissions to be controlled

BUT

- Intermittent source of electricity
- Wind facilities are subject to harsh environment
- Good wind sites may be far from transmission grid

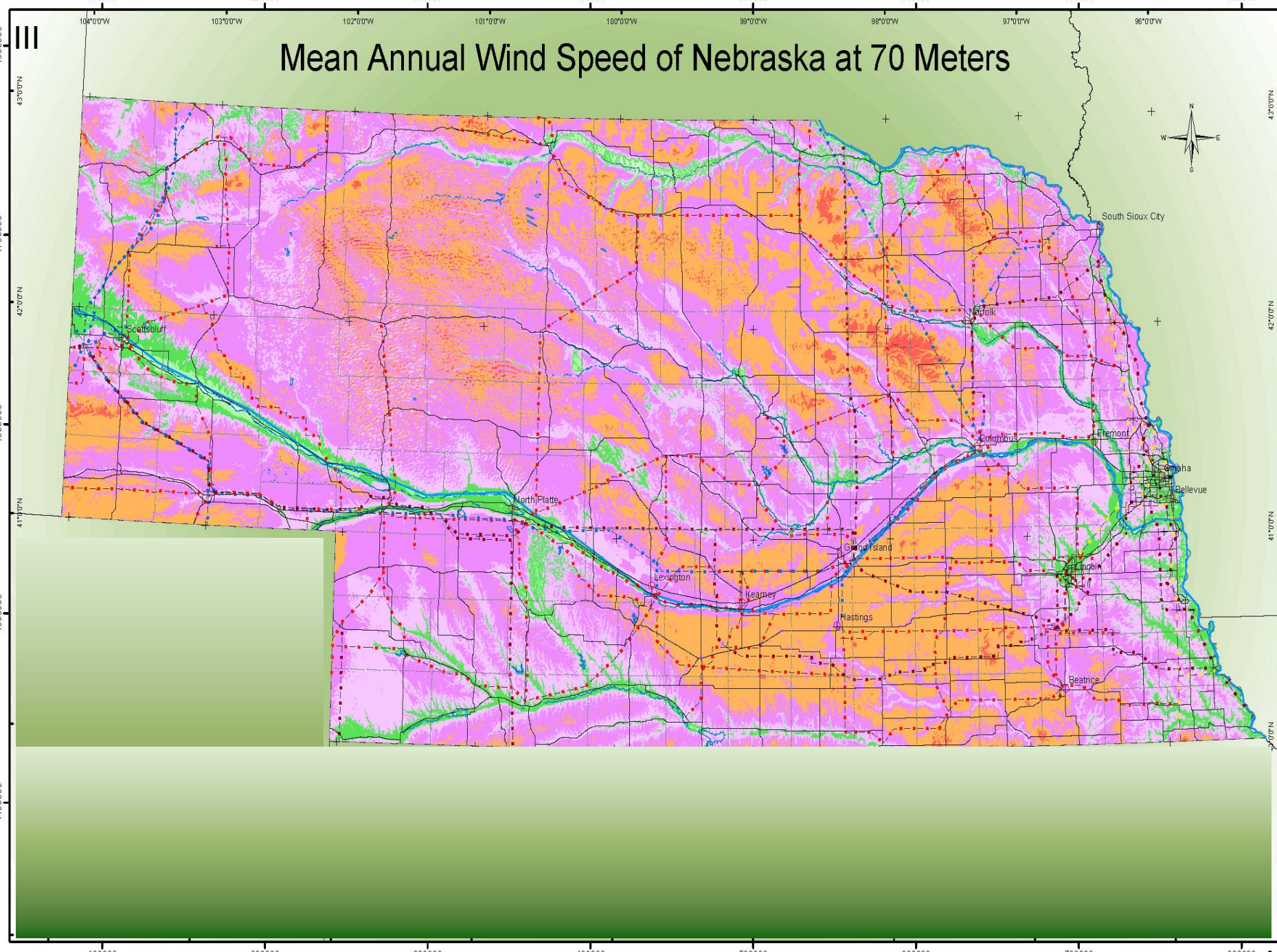
III

Why Nebraska is Behind Surrounding States in Wind Development

- Some surrounding states have a Renewable Portfolio Standard (RPS) requiring a certain percentage of electricity comes from renewable sources
- IOU's and other private developers can receive lucrative production tax credits which significantly reduce the capital cost of projects
- Nebraska existing generation surplus has been less expensive than adding wind – contrast Texas
- Limited transmission in best wind areas

III

Mean Annual Wind Speed of Nebraska at 70 Meters



NE_spd50m_033105.m

III

DOE 20% Renewable by 2030

Nebraska – Economic Impacts

7,880 MW new development

Wind energy's economic "ripple effect"

Direct Impacts

Payments to Landowners:
- $20 Million/yr

Local Property Tax Revenue:
- $30 Million/yr

Construction Phase:
- 12,900 new jobs
- $1.5 B to local economies

Operational Phase:
- 2,000 new long-term jobs
- $165 M/yr to local economies

Indirect & Induced Impacts

Construction Phase:
- 13,100 new jobs
- $1.2 B to local economies

Operational Phase:
- 1,500 local jobs
- $145 M/yr to local economies

Totals
(construction + 20yrs)

Total economic benefit = $8.9 B

New local jobs during construction = 26,000

New local long-term jobs = 3,600

Construction Phase = 1-2 years
Operational Phase = 20+ years

All jobs rounded to the nearest hundred jobs; Millions of dollars greater than 10 million are rounded to the nearest five million

III

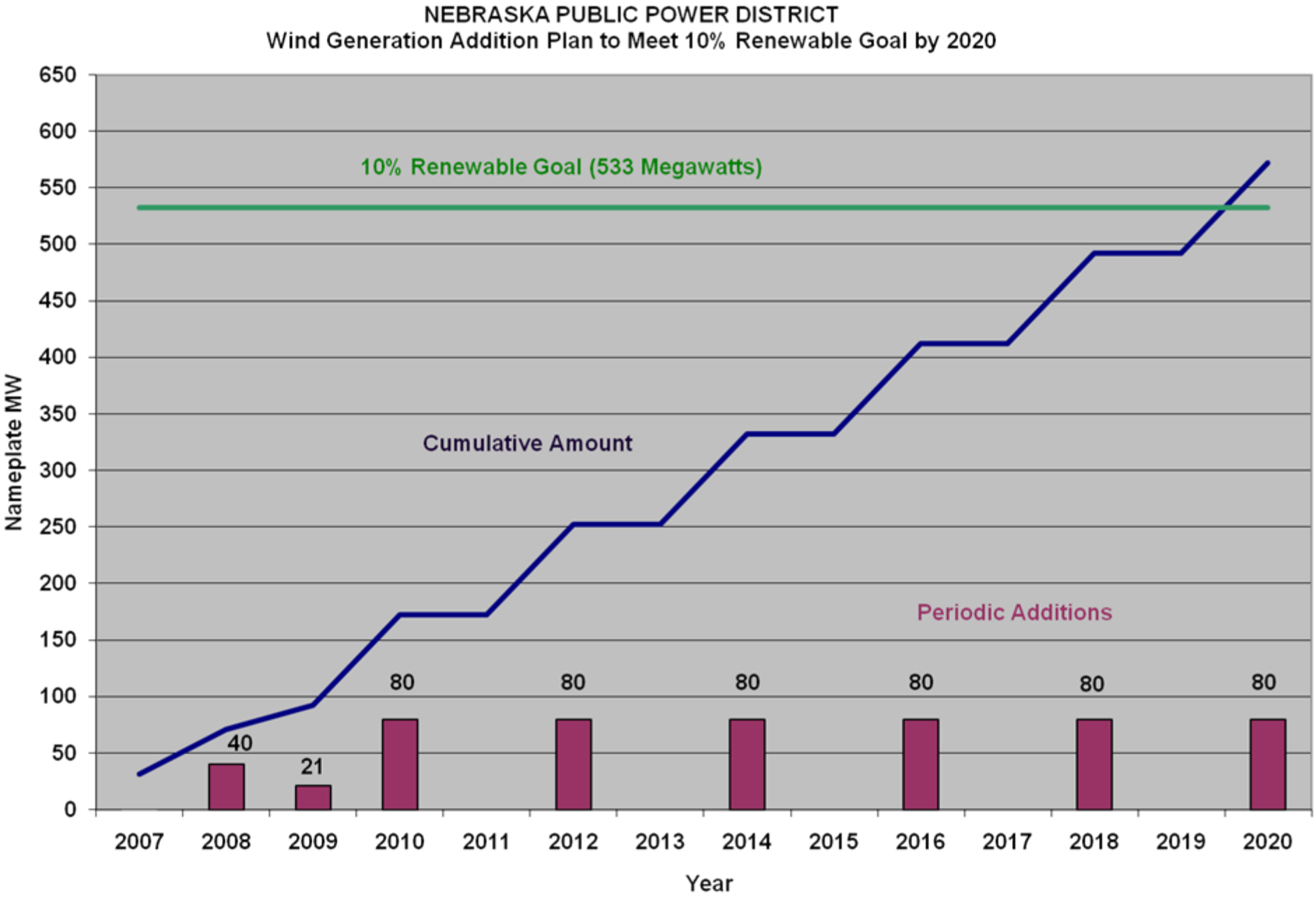
NPPD Wind Development

Year	Location	Total Capacity	Turbine	NPPD
1999	Springview (Decommissioned)	1.5 MW	Zond 750	Owned
2005	Ainsworth	59.4 MW	Vestas V82	Owned
2008	Bloomfield (Elkhorn Ridge)	80 MW	Vestas V90	PPA
2009	Bloomfield (Crofton Hills)	42 MW	Vestas V90	PPA

III

Elkhorn Ridge Wind Farm

III


NEBRASKA PUBLIC POWER DISTRICT
Wind Generation Addition Plan to Meet 10% Renewable Goal by 2020
10% Renewable Goal (533 Megawatts)
Cumulative Amount
Periodic Additions
Nameplate MW
Year
650
600
550
500
450
400
350
300
250
200
150
100
50
0
40
21
80
80
80
80
80
80
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020

Cost of Power Without Carbon Capture

($/MWh)	Pulverized Coal	Natural Gas Combined Cycle	IGCC Eastern	IGCC PRB	Nuclear	Wind	Solar	Biomass
Plant Capital Cost	35	13	42	44	69	62	113	36
Plant Fuel Cost	15	50	14	9	7	--	--	27
Plant Operations and Maintenance	8	6	12	12	13	9	39	28
Cost of Power without Carbon Capture	58	68	68	65	89	71	151	91

IGCC – Integrated gasification combined cycle. MWh – Megawatt-hour. PRB – Powder River Basin

Source: Reproduced with permission of Standard & Poor's, a division of The McGraw-Hill Companies, Inc., U.S. Utilities and Power Commentary, Nov. 2007 article "Which Power Generation Technologies Will Take The Lead In Response To Carbon Controls?" Author: Swami Venkataraman, Dimitri Nikas and Terry A. Pratt; Published May 11, 2007

III

Cost of Carbon Capture and Sequestration (CCS)

($/MWh)	Pulverized Coal	Natural Gas Combined Cycle	IGCC Eastern	IGCC PRB	Nuclear	Wind	Solar	Biomass
Carbon Dioxide Capture Capital and O&M	**13**	**9**	**7**	**7**	**--**	**--**	**--**	**--**
Carbon Dioxide Energy Penalty	**30**	**12**	**15**	**15**	**--**	**--**	**--**	**--**
Carbon Dioxide Transport and Storage	**19**	**7**	**12**	**14**	**--**	**--**	**--**	**--**
Cost of CCS per MWh	**62**	**28**	**34**	**36**	**--**	**--**	**--**	**--**
Cost of Power with CCS	**120**	**96**	**102**	**101**	**89**	**71**	**151**	**91**

IGCC – Integrated gasification combined cycle. MWh – Megawatt-hour. PRB – Powder River Basin

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Conclusions

- In a carbon constrained world, we need significant technology advances
- Increased renewable energy and increased energy efficiency are an important part of the solution
- Increased renewable energy will require substantial transmission additions
- Reliable, affordable, baseload generation must be available
- There is no silver bullet!