Synergies in FEW in the Northern Great Plains: a North Dakota Perspective

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Energy & Environmental Research Center (EERC)

- Nonprofit branch of the University of North Dakota focused on energy and environmental solutions.
- More than 254,000 square feet of state-of-the-art laboratory, demonstration, and office space.
• World and US energy picture and challenges
• Challenges to traditional energy production
• Regional synergies and the rise of Middle America
• Research and sustainable clean energy
• ND energy synergies
- U.S. Energy Information Administration (EIA)
- 1990 – 2040 the world’s energy types and growth
- Every form increase; largest increases in gas and renewables but . . .
- Fossil fuels still dominate

Growth of Renewable Electricity (mostly wind and solar)

Nonhydropower renewable electricity generation by source, 1990-2014
million megawatthours

EPA’s New Source Performance Review, MATS, Clean Power Plan, and other regs
- Create tremendous investment risk even on clean power options such as ultrasupercritical boilers with full emissions control

EPA CPP: Cutting CO$_2$ from power plants by 32% by 2030 (as compared to 2005 levels).
- State plans by 2016 with 2-year extensions
- Implementation: 2022
- State plans going forward even with uncertainty of political process; lawsuits, etc.
- ND must cut back GHG emissions 45%.

Monday, August 3, 2015
President Obama released the final version of the Clean Power Plan (CPP)—an EPA program to cut carbon dioxide emissions from the nation’s power plants.
2014 shows coal dominance
2014–2015 showed dramatic change
Spring 2015: natural gas overtook coal as the top source of U.S. electric power generation for the first time ever
Renewable (13-17%)
- Hydro 8%
- Wind 5%
- Biomass 2%
- Solar-Geotherm-Other 2%

AP News July 2015-- Natural Gas Surpasses Coal as Biggest US Electricity Source
Jul 13, 2015, 12:56 PM ET
By TOM MURPHY AP Business Writer
Where Is the Middle America Going with Energy? What Can be Learned?

- World coal use is growing.

- U.S. coal use is steadily losing ground to natural gas but not going away anytime soon (Power-Gen 2014).

- Politics could change things.

- In the meantime EERC is engaged in several projects that could “gel” for prudent and environmentally sensitive resource, energy, water, and agricultural development; all in the context of booming economic impacts.
Regional Synergies

- Energy resources
  - Wind
  - Developing solar
  - Hydro
  - Coal – lignite
  - Oil, natural gas, and gas liquids
  - Biomass

- Agriculture/Food Production – ND alone leads nation in over a dozen crops

- Technology innovation via ND and regional universities/colleges

- Biggest challenge: lack of heavy manufacturing infrastructure and systems

- People
Coal Resources

Source: EIA
US Wind Resources

Square Km Areas with >35% Gross Capacity Factor at 110-Meter Hub Height, NREL 2015
Solid Biomass Sources by County

Quad County Corn Adding Cellulosic Ethanol—3.75 MGPY, Galva, Iowa
Operational Date: June 2014
Feedstock: Corn kernel Fiber

POET-DSM Project Liberty—25 MGPY, Emmetsburg, Iowa
Operational Date: June 2014
Feedstock: Corn cobs, leaves, husk and stalks

DuPont—30 MGPY, Nevada, Iowa
Operational Date: Q4 2014
Feedstock: Corn Stover

Abengoa—25 MGPY, 21MW biopower, Hugoton, Kansas
Operational Date: Q2 2014
Feedstock: Corn stover, wheat straw, milo stubble and prairie grasses
Geothermal Resources

Higher Temperature Resources
Medium Temperature Resources
Solar Resources
(Photovoltaic, NREL)
People: Middle U.S. Workforce
(Ingenuity, Grit, Work Ethic)

• “The U.S. is developing a new geography of power, and its focus is the vast energy and commodities corridor extending from the western Gulf to the northern tip of the continent. . . .” – Joel Kotkin

• Growth in population
• Growth in economics
• Growth in youth retention
• Growth in immigrants from eastern and western populous of the U.S.

** Odd indicator -- Growth in miles driven and gasoline-diesel-ethanol consumed.

Joel Kotkin’s New Geography of Power
Increasing Renewable with Fossil
North Dakota Lignites
ND Bakken Oil Fields
(Including the Bakken)

West-Central North Dakota Synergies

Map showing ND Bakken Oil Fields with various symbols indicating different features such as Coal Mines, Gas Plants, Oil Fields, Coal Basins, and Pipelines. Electric Utilities (CO₂ tonnes) are categorized into the following ranges:
- 15,000–750,000
- 750,000–2,500,000
- 2,500,000–7,500,000
- 7,500,000–15,000,000
- 15,000,000–20,000,000

Logos for EERC and UND The University of North Dakota are present.
Bakken and Three Forks Production

- **Production (January 2015)**
  - Over 9000 wells in North Dakota.
  - Over 1.1 Mbbl/day of oil (2\textsuperscript{nd} in U.S.)
  - Over 1.5 Bcf/day of gas (23 plants)
  - Horizontal wells and hydraulic fracturing technology enables prolific oil production from tight rocks.
ND Renewables

- **Solar**: Reasonable resource for small PV
- **Wind**: 1,884 MW of wind energy capacity, 1,050 wind turbines with design/planning for nearly 3000 MWs.
- **Hydro**: 580 MW Garrison Dam
- **Biomass**: residues and energy crops
  - ND leads the U.S. in flaxseed, canola, durum wheat, edible beans and peas, spring wheat, lentils, sunflowers, barley and oats (residues?)
  - High energy crop potential (camelina, pennycress, switch grass, and others)
- **Biofuels**: 5 ethanol plants, 1 biodiesel-ready plant
• Western ND
  – Lake Sakakawea reservoir brought coal power industry in mid 1960’s.
  – Surplus for ag & energy
• ND Water Commission derives funding from energy production
• State-wide water projects
  – Eastern ND: deep saline aquifer remediation, municipal water remediation, western source pipelines, and sustainable water.
• Middle ND: Prairie pot-holes fly way preservation
What Can Happen with FEW in the Northern Great Plains

- Next-generation low-C energy development.
- Sustained low-cost coal & ag resources use.
- Electricity to fulfill the need for 1000s of MWs of *new* power needs.
- CO₂ stored and utilized for new enhanced oil recovery (EOR) markets.
- 2–3.2 Bt of CO₂ yields 4–7 Bbbl of EOR oil.
- Energy crops for Northern Great Plains ag industry.
- New food-ag-energy-water technologies & innovations to fuel research/industry corridors.
- Establish region as the “tip of the spear” and an international model for sustainable FEW.
Polygen and Advanced Energy Systems

- **Polygen**eration: A facility or plant that produces multiple energy forms and products, as opposed to just electricity.

- Advanced energy systems: new lower C, higher efficiency systems for power and products.

- Utilizing coal, biomass, natural gas, and water sustainably.
An Example of Synergy

- $250,000 matching award from a state (ND) research program (with Accelergy Corp.)
- New catalyst technology for renewable, low-toxicity, biodegradable biolubricants, waxes, transformer fluids, solvents, and drilling fluids.
  - Technology development and university research
  - Agricultural industry feedstock
  - Oil and gas production use
  - Potential for manufacturing “green” or low-carbon biologically derived products for the chemical industry
Thank You!

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