

October 1, 2018

Karlene Fine  
Executive Director  
North Dakota Industrial Commission  
Attn: Lignite Research Program  
600 East Boulevard Avenue  
Bismarck, ND 58505

Subject: Grant Application Submittal: "Annual Lignite Energy Council Education Program"

Dear Karlene:

The Lignite Energy Council (hereinafter Council), a regional trade association of producer, utility and business members who produce approximately 30 million tons of lignite and generate electricity from lignite that serves two million people in the Upper Midwest region, is pleased to submit the enclosed proposal to seek funding for the "Lignite Energy Council Education Program."

The Council will provide the matching funds for this project.

Thank you for the opportunity to submit this proposal.

Sincerely,

LIGNITE ENERGY COUNCIL

Jason Bohrer  
President

JB/kl

Enclosures: 2 Copies of Grant Application  
\$100 check

# **Annual Lignite Energy Council Education Program**

**Grant Submitted by  
Lignite Energy Council**

**Principal Investigator  
Lignite Energy Council**

**Grant Deadline: October 1, 2018**

**Amount Requested: \$100,000**

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## **ABSTRACT**

The objective of the Lignite Energy Council's (LEC) Education Program is to educate teachers, students and members of the general public about career opportunities, economic benefits and operations of the lignite industry.

With support from the Lignite Energy Council's Lignite Education Seminar, education website and other outreach efforts, the expected results of the Education Program include facilitating open communication between the industry and educators, increasing the awareness and understanding of the industry and improved favorability of the industry. Ultimately, a positive public opinion will attract workforce and create interest and awareness of the career opportunities afforded by the North Dakota lignite industry.

In 2014, a period of transition fostered the expansion of the Lignite Education Seminar to an all-encompassing Education Program.

The funding request is for a one-year program. The total budget for the Education Program as described is \$206,000, of which \$100,000 is requested from the Lignite Research Council. The matching funding for the Education Program comes from the Lignite Energy Council and in-kind services from the Lignite Energy Council and representatives of the lignite industry.

## **PROJECT SUMMARY**

The mission of the Lignite Research Council is to assist in marketing as well as research and development activities. The Education Program as outlined in this grant request is an effective way for the Lignite Energy Council to continue to market the industry, its economic benefits and its career opportunities to educators and students in the states of North Dakota, Minnesota, South Dakota and Montana.

Education and public outreach are critical to the future success of the energy industry in our state. Public awareness and support for the value of the industry to the state will be helpful when trying to attract a workforce. Providing educators with an understanding of the lignite industry and related career opportunities will likely provide them with the background knowledge to encourage students to consider the career opportunities in North Dakota's energy industry when they begin to look at career choices.

Attracting a future workforce is crucial as the industry faces a 50 percent retirement bubble in the next few years – both at the mines and coal conversion facilities. Environmental technology improvements that are needed at existing plants and new construction projects in the future will increase the demand for a highly skilled workforce.

The flagship piece of the Education Program is the Lignite Education Seminar. The four-day Seminar, which is held each June, includes tours of mines and coal conversion facilities along with presentations and panel discussions on a number of relevant issues including history, geology, mining and reclamation, converting lignite to electricity, converting lignite to synthetic

natural gas, economics of the lignite industry, career opportunities, environmental challenges, transmission and research and development topics.

Each participating teacher is eligible to receive two graduate credits, paid for by the Lignite Energy Council, from the North Dakota University system (UND, NDSU and Minot State University) upon the completion of the Seminar and submission of a lesson plan. Teachers also receive ancillary information for classroom work including classroom activities, videos about generation, mining and reclamation and samples of coal and coal combustion byproducts.

The Seminar focuses on sending teachers home with practical and applicable information and classroom tools. It places an emphasis on technology and hands-on learning to help the teachers prepare lesson plans.

The 2019 Seminar will be held at the National Energy Center of Excellence on the campus of Bismarck State College in Bismarck, ND, on June 10-13. The annual Seminar has attracted educators from a four-state area – North Dakota, South Dakota, Minnesota and Montana. School superintendents, principals and teachers of all grade levels from elementary to senior high attend the four-day Seminar. Approximately 125-135 educators attend annually.

## **STANDARDS OF SUCCESS**

In 2009, the Education Seminar expanded from a one-credit (two and a half days) to a two-credit (four-day) Seminar. This change required more face-to-face time between instructors and teachers. It also gave the LEC the opportunity to make some capital improvements, such as an electronic Audience Response System, which allows more interactivity between the instructor and the audience.

The Audience Response System has allowed staff to track changes in opinions about the industry, what participants have learned throughout the Seminar and what they are interested in learning more about.

During the last four Seminars, a survey of participants has indicated an increase in favorability opinions from the beginning of the Seminar to the conclusion of the Seminar. Additionally, most participants indicated that they will make use of material and knowledge gained through the Seminar when they return to their classrooms.

In 2017, Seminar attendees were asked a series of questions that mirrored a North Dakota and Minnesota public opinion study conducted in 2014. The same questions were asked to attendees before and after the Seminar. The findings following the conclusion of the Seminar were:

- 93.83% respondents said that they favor the use of coal to produce electricity – a 16.05% change.
- 77.92% strongly agreed that coal energy is vitally important to our region's power supply – a 20.78% change.
- 75% strongly disagreed that coal is a dirty form of energy and should not be part of our energy future – a 17.5% change. (This question demonstrated a 20% increase in the favorability of coal as compared to the responses in 2016.)

In the fourth quarter of 2014, the LEC sent out a similar survey to those who attended the Seminar since 2009, when the Seminar expanded to a two-credit program. Here are some notable results from that survey:

- 82% indicated that they have incorporated Seminar information into their teaching plans.
- 73.53% have promoted the job opportunities in the lignite industry to their students.
- 86.1% of the teachers indicated that the subject matter of the Seminar was applicable to the subject matter they teach.
- 70% of attendees indicated that learning more about the industry was the primary reason for attending.
- 62.10% indicated that receiving two graduate credits was a major factor in their attendance.

Similar studies conducted with 2015-2017 attendees also indicated that real life examples of why certain subjects are important for energy-related careers was what they felt they learned most about during the Seminar. Another study will be conducted in fourth quarter 2018.

### **North Dakota Energy Activities Trunks**

As a result of the findings from a Education Advisory Group, the Lignite Energy Council has been collaborating with the State Historical Society of North Dakota to build North Dakota Energy Activities Trunk with Objects (NdEATO). We have produced a product that are available for school districts to check-out and use in the classroom through the North Dakota Regional Education Association's Centers.

The NdEATO trunk contents go hand-in-hand with *Energy: Powered by North Dakota* energy curriculum, a product of the EmPower ND Commission. Additionally, the activities and instruction follow the syllabus of the *Lignite Education Seminar*.

### **Lignite Education Video Series**

As part of our continual improvement efforts, we have been focusing more attention and resources to update and broaden our library of videos that showcase various aspects of the lignite industry.

Completed video projects in 2017-18 include:

- **Teacher's Seminar Promo Video**
- **Electricity and Lignite Coal in North Dakota** – an educational animated video about how lignite coal produces electricity in North Dakota.
- Nine videos featuring North Dakota lignite mines and plants:
  - Freedom Mine
  - Coal Creek Station
  - Antelope Valley Station
  - Great Plains Synfuels Plant
  - Falkirk Mine
  - Milton R. Young Station
  - Center Mine
  - Leland Olds Station
  - Coyote Station

With funding from the 2017 LRC grant, the Lignite Energy Council continued the process to develop new education videos that would pair with the Lignite Education Seminar. As part of that process, the LEC has been working with local media company KAT Marketing to draft and carry out a plan for a series of four 15-minute videos. KAT Marketing was approved by the Lignite Research Council in 2016 and again in 2017 to act as an independent contractor.

The Lignite Energy Council and KAT Marketing have worked through all four phases of the project on videos one and two: Lignite 101/Industry Overview and Lignite Geology, Mining and Reclamation and will have completed two 15-minute videos to preview to the Lignite Research Council.

Work has also begun on the third video: Electricity Generation and Coal Conversion with funding from the 2018 Lignite Research Council grant. This video is expected to be completed in 2019.

### **Additional Education Outreach/Materials**

The Lignite Energy Council with the North Dakota Petroleum Council and the North Dakota Farm Bureau have created a youth advisory council for students in grades sixth through eleventh grade, so that today's youth will have a voice in public policies that will affect three of the state's largest industries. The 15 students were picked in July and have been attending tours and reading up on the respective industries. The first video-conference will be held in October with two more to follow. It's anticipated that the students will be giving their views on policy decisions that will be decided in the next Legislature. The goal of the NextGen ND program is to help students learn more about leadership while getting their input into issues that will effect each of our industries and the state's economy.

### **Lignite Education program branding and e-campus**

The LEC is working with KAT Marketing to develop a brand and subsequent website for the Lignite Education Program. The website will include lesson plans for multiple grade levels, hands-on activities and up-to-date workforce information. Through website analytics and follow-up with those who download the material, the LEC will be able to provide facts and figures on their usage.

In addition to the planned new education section on the website, the Lignite Energy Council employed KAT Marketing to video all the sessions of the 2017 Lignite Education Seminar and have incorporated slide presentations with presenters' spoken words into easily consumable videos which will be made available on the Lignite Energy Council website.

As part of a continual improvement plan, the Lignite Energy Council launched a new website in the first quarter of 2017. As part of this launch, there is a \$5,000 KAT Marketing in-kind contribution to the Education Program that will be utilized to create a 5-hour classroom lesson plan which will complement the Teacher's Seminar with readily available resources and teaching plan for teachers to educate their students about the lignite industry. This is expected to be completed during the 2019 calendar year and utilize submitted lesson plans and suggestions from past attendees.

## **Lesson Plans**

Finally, the Lignite Energy Council is working with local teachers to develop new and revamped lesson plans that would be available for all teachers to utilize. To start that process, the LEC worked with Instructor of Record, Terry Hagen, to identify the top five lesson plans submitted. Teachers at the 2016 - 2018 Seminars were given a cash award incentive to create their best possible lesson plan. Again, this fall, the Lignite Energy Council will be selecting the first, second and third place lesson plans. First place will be awarded \$100, second \$50 and third \$25. By incentivizing lesson plan submissions, the LEC will have a good pool of lesson plans to draw from for further development and implementation.

## **BACKGROUND**

The Lignite Energy Council has been offering the Seminars since 1986. The Seminar is reviewed by UND faculty member Terry Hagen, who oversees the Seminar as part of UND's School of Business and Public Administration. The coordination of the Seminar is handled by Kay LaCoe, the Director of Membership Marketing with the Lignite Energy Council. The various presenters work in the industry and speak from experience on their various topics.

More than 3,300 teachers in more than 600 schools have completed the Seminar and it is estimated that more than 60,000 students receive some education about lignite and its role in the regional economy every year. More than 750 of these teachers are from out of state.

## **Recruitment**

Each year, the Seminar's administrator works closely with recruitment representatives with each of the electric utilities that have customers in targeted states. The Lignite Energy Council provides these recruiters with printed and electronic promotional material. The recruiters are responsible for disseminating the information to schools and teachers within their service territories. Applicants are directed to the Lignite Energy Council's website (<https://www.lignite.com/teachers>) to complete an online application or print and submit a completed form.

In the past, a portion of the recruitment budget has been dedicated to printed material (approximately \$7,200 for 2014). Staff tested additional methods to recruit such as social media ads, direct email marketing and advertisements in school district publications. The goal is to use recruitment money in a more effective method. Research conducted in 2015 indicated that printed material and direct-mail remains the most effective way to recruit.

Recruitment in North Dakota consists of a printed direct-mail piece sent to every licensed teacher in the state. Additional recruitment methods used include a letter and several recruitment brochures sent to every school principal, targeted Facebook advertisements and advertisements in regional trade publications.

In the future, the Lignite Energy Council plans to work directly with school administrators to encourage participation in the Seminar by principals, career counselors and other administrators. The Lignite Energy Council and industry representatives believe that it is crucial that



administrators are made more aware of the benefits to teachers of their attendance at the Seminar. The best way to achieve that awareness, we believe, is to have them attend in person.

Additionally, the Lignite Energy Council plans to contract with one or more teachers to attend and outline the Seminar by educational standards – either as a Seminar as a whole or by session. We are told from the educational sector that this would help better connect the Seminar’s applicability to both teachers and administrators.

### **Seminar Attendance**

Accommodations are made at Bismarck State College to house teachers in dorm rooms on campus. This cost is paid for out of the Seminar budget. Sponsorships are available for transportation reimbursement to and from the Seminar for eligible teachers in Montana, South Dakota, Minnesota and Iowa. North Dakota teachers are responsible for their own transportation costs to and from the Seminar, but are eligible for housing during the Seminar.

The Seminar is open to kindergarten through 12<sup>th</sup> grade teachers from North Dakota, South Dakota, Minnesota or other states where North Dakota lignite-based electricity is used. Teachers are accepted on a first-come, first-served basis; however, preference may be given to those who teach math, science or social studies.

Seminars held 2013 – 2017 hosted 698 teachers, 414 of which were from North Dakota and 174 from other states such as Minnesota, South Dakota, Montana, Wyoming and Iowa. While participants represented every grade, subject matter and discipline, there is a well-balanced representation of approximately one-third grade school, one-third middle school and one-third high school teachers. Physical and earth sciences, math, and social studies teachers represented a majority of subject-specific teachers, while grade school teachers teaching all subject matters also make up a large portion of participants.

As part of the industry’s in-kind contribution, North Dakota and Minnesota cooperatives and investor-owned utilities provide sponsorships for out of state teachers to attend. These sponsorships typically cover transportation and meal costs incurred during travel to and from the Seminar. Additionally, industry devotes more than 150 hours for recruitment, activities, Seminar presentations and tours.

As part of the Seminar’s expansion in 2009, special consideration was made to add content to the Seminar to heavily stress the job and career opportunities associated with the North Dakota lignite industry. The Lignite Industry Career Choices section was a special addition that features a speaker who not only works as the Energy Career Awareness Program Coordinator for the Bismarck Public School System, but also owns an energy-related company doing business with the lignite industry. Additionally, each presentation has been specifically tailored to highlight specific education requirements or future learning opportunities directly related to current and future workforce needs. Finally, in 2015 a panel dedicated to workforce issues and needs was added to the agenda.

The Lignite Energy Council has also engaged in other educational and promotional opportunities to support and supplement the Education Seminar and the promotion of the industry.

The LEC also established a charitable 501(c)(3) organization. The primary goal of the Lignite Energy Foundation is to raise funds to support education and scholarship programs for students and teachers in the Upper Midwest who are served by coal-based electricity. The Foundation will provide funds for educational programs and activities which educate about the coal industry, processes, and economic impact; promote industry-related career opportunities; and aim to facilitate opportunities to actively engage students with the industry.

One program that the Lignite Energy Council is most proud of is the North Dakota license plate program. Funding for the scholarship program is derived, in part, through a special-interest license plate available from the North Dakota Department of Transportation. For an additional \$25 each year vehicles registered and licensed in North Dakota can display their pride for the coal industry and a portion of those sales support the Lignite Energy Foundation.

## **QUALIFICATIONS**

The Lignite Energy Council will be responsible for managing the Seminar. The Lignite Energy Council is a regional trade association representing the interests of producers and users of lignite and conducts programs in four separate areas including: government action; research, development and marketing; education; and public relations. Through these programs, the Council seeks to maintain a viable lignite industry and enhance development of North Dakota's abundant lignite resources in a clean, economical and efficient manner. These programs provide timely, accurate information that enables elected officials, government leaders and the public to make sound, informed decisions on lignite issues.

Representatives of the Lignite Energy Council who also serve as presenters at the Seminar include:

**Jason Bohrer** serves as President and CEO of the Lignite Energy Council. He also serves as the Chairman of the Lignite Research Council (LRC) which includes government, research, environmental and industry representatives. The LRC assists with development and administration of North Dakota's Lignite Research, Development and Marketing Program by providing recommendations to the Industrial Commission.

**Mike Holmes** joined the Lignite Energy Council in December 2016 as the vice president of research and development. He had been the director of Energy Systems Development at the Energy & Environmental Research Center (EERC) in Grand Forks, where he oversaw fossil energy research areas. His principal areas of interest and expertise include CO<sub>2</sub> capture; fuel processing; gasification systems for coproduction of hydrogen, fuels, and chemicals with electricity; process development and economics for advanced energy systems; and emission control technologies. Prior to his work at EERC, Holmes spent 15 years working on coal-related research and development and commercial projects for Babcock & Wilcox, a major supplier of advanced energy and environmental technologies for the power industry. He received a master's of science degree in chemical engineering from the University of North Dakota and a bachelor's of science degree in chemistry and mathematics from Mayville State University. He is a member of the National Coal Council and has been

an Executive Member and served on the Board of Directors of the Fuel Cell and Hydrogen Energy Association.

**Kay LaCoe** serves as the Director of Membership Marketing for the Lignite Energy Council. Kay has a Bachelor of Science Degree in Business Communications from the University of Mary. She has worked extensively with the Seminar since 2008 prior to assuming the role of the Seminar's facilitator in 2014.

In addition to Lignite Energy Council staff, the LEC relies on the expertise provided by industry and education representatives to provide the bulk of instruction for the Seminar. The proposed speaker slate is included as an appendix to the application.

### **VALUE TO NORTH DAKOTA**

The North Dakota Legislature has a long history of supporting the lignite energy industry. Specifically, the North Dakota Legislature has enacted legislation which "... declares that it is an essential government function and public purpose to assist with the development ... of North Dakota's vast lignite resources ... in order to maintain and enhance development of North Dakota lignite and its products; preserve and create jobs involved in the production and utilization of North Dakota lignite; ensure economic stability, growth and opportunity in the lignite industry; and maintain a stable and competitive tax base for our state's lignite industry for the general welfare of North Dakota ... "

The lignite energy industry is vital to North Dakota's economic health. The industry comprises four percent of the states' total economic base. Annual lignite production has been approximately 30 million tons since 1988, making North Dakota one of the 10 largest coal producing states in the nation. In 2017, an NDSU economic study showed that 4,000 North Dakotans are directly employed in the lignite industry and another 12,000 indirectly. The industry is expected to generate almost \$3.5 billion in annual business activity, as well as \$100 million in annual state tax revenues.

This Seminar project is part of the larger LEC mission which seeks to:

- Preserve and create jobs involved in the production and utilization of North Dakota lignite;
- Ensure economic stability, growth and opportunity in the lignite industry; and
- Maintain a stable and competitive tax base for North Dakota's lignite industry for the general welfare of North Dakota.

### **MANAGEMENT**

The Lignite Energy Council will manage and oversee the Seminar and its Board of Directors has authorized the program and budget. Kay LaCoe, Director of Membership Marketing, is the primary person responsible for the Seminar. Kay reports to Jason Bohrer, President and CEO of

the Lignite Energy Council. The University of North Dakota, North Dakota State University and Minot State University have approved the program for eligibility of two graduate credits for the Seminar.

### **TIMETABLE**

The Lignite Energy Council's Teacher Education Seminar described in this grant request runs from January 1, 2019, through December 31, 2019.

### **BUDGET**

The Lignite Energy Council's Teacher Education Seminar annual budget, including in-kind services, from January 1, 2019, through December 31, 2019 is \$206,500 (See page 13). Of note as it pertains to the Lignite Learn E-Campus. The portion of the website slated to be completed in 2019 has already been pre-paid through in-kind and LEC investments in the project up through 2018.

### **MATCHING FUNDS**

The Lignite Energy Council and its members will provide in-kind services and funding of at least \$100,000 for one year to match the Industrial Commission's funding of \$100,000 for one year. Total funding requested for the one-year period is \$100,000, which will be matched by the Lignite Energy Council and its members.

### **TAX LIABILITY**

I, Jason Bohrer, certify that the Lignite Energy Council is not delinquent on any tax liability owed to the State of North Dakota.

### **CONFIDENTIAL INFORMATION**

No confidential information is included in this proposal.

### **Appendix**

- Proposed Budget
- KAT video production proposal
- Recruitment pieces
- Presenter credentials/Syllabus
- 2018 Teacher's Seminar Binder Material
- Story board/script for Geology Video (video completed)
- Lignite Learns E-Campus estimate, wireframe

Jason Bohrer, President & CEO  
Lignite Energy Council



# Lignite Energy Council Education Program Budget

9/18/2018

## Income

	LRC Share	Applicant's Share	Applicant's In-Kind	
Teachers' Seminar	\$80,000	\$45,000	\$27,000	\$152,000
North Dakota Energy Education Outreach		\$10,000		\$10,000
Additional Materials/Outreach/Scholarship Program	\$20,000	\$24,500		\$162,000
<b>TOTAL</b>	<b>\$100,000</b>	<b>\$79,500</b>	<b>\$27,000</b>	
<b>TOTAL EXPENSES</b>	<b>\$206,500</b>			
<b>Total grant request</b>	<b>\$100,000</b>			
<b>Lignite Energy Council</b>	<b>\$106,500</b>			

## Expenses

<b>Facility Costs for Teachers Seminar</b>		
• Meals	\$16,000	
• Dorm Rooms	\$6,000	
• Administration	\$2,600	
• Facility Rental	\$1,900	
• Audio	\$600	\$27,100
<b>Recruitment Efforts</b>		
• Brochures	\$3,500	
• Postage	\$2,800	
• Envelopes	\$300	
• Advertising/Posters	\$500	\$7,100
<b>Credits (\$100/teacher – est. 120 teachers)</b>		
• NDSU, UND and MSU	\$12,000	\$12,000
<b>Speaker/Transportation/Participant Networking</b>		
• Bus transportation	\$7,000	
• Entertainment/Lodging	\$5,000	
• Speaker Fees and Transportation	\$1,800	
• Audience response/research	\$500	\$14,300
<b>Management/Administrative Expenses</b>		
• Program management	\$57,000	
• Instructor of Record	\$2,000	
• Professional services	\$25,000	
• Additional staff resources	\$2,000	
• Office expenses/Overhead	\$4,000	\$90,000
<b>Materials &amp; Supplies</b>		
• Classroom material/Website/E-Campus	\$5,000	
• Contingency/Misc.	\$2,000	\$7,000
<b>Education Outreach</b>		
• NdEATO Trunks, Classroom Materials	\$2,000	
• Lesson plan creation, classroom development	\$2,000	
• Video development	\$45,000	\$49,000
<b>TOTAL EXPENSES</b>		<b>\$206,500</b>



Proposal

# Video Production

Prepared for

## Lignite Energy Council

Submitted by:

KAT Communications, Inc.



September 28, 2016





Thank you for considering KAT Communications as your partner for your project. We work according to an ideology that includes our team getting on board with your team. The relationship we build together is critical to success. We'll work hard to ensure we are all on the same page. It's simple at KAT. Four steps take care of everything: Discover, Plan, Blueprint, and Build. The reason for this simplicity is to provide consistency in a world full of variables.

LEC's primary objective is clear—to inform and educate the audience about the lignite industry. This will be accomplished by targeting these audiences:

During more than 20 years of service to the lignite industry, we've been one of the industry's most engaged students and informed proponents. We understand how to take technical information and translate it into a language understood by those unfamiliar with the industry. For example, we worked with LEC to develop a video explaining the complicated Allam Cycle to a general audience. We will work hard for LEC's to become as THE source for credible information.

### **The KAT Four-Step Process**

We are devoted to our four-step development process; so much so that we created a video to explain it: [https://youtu.be/2sda9-cgc\\_o](https://youtu.be/2sda9-cgc_o).

1. **Discovery:** (Learn critical project elements) We'll ask questions and gather information about due dates, target audiences, messaging and other pertinent project information to make sure the videos are completed on scope, on time, and on budget. This early detailed communication gives both our teams a strong, confident start.
2. **Plan:** Development of a timeline, topic outline, and a project strategy including creative ideas in order to communicate project direction. We may need an email that tells us stakeholders are on board in order to move to the next step.

We understand the obstacles ahead for the coal industry, and turning the next generation into coal industry advocates requires smart strategies. We believe it's extremely important that we help younger people overcome the knowledge gap to understanding the benefits of the coal industry, especially the environmental benefits.

3. **Blueprint:** Development of the specific instructions to follow for building media to be utilized within the project. Examples include scripts & storyboards, and print layouts. We require a signature approval on the blueprint before we move to the Build step.
4. **Build:** The Build is just as it sounds. Information accumulated and developed during the first three steps is used as the detailed instructions to build media components.

**Pricing:** The pricing information below is indicative of the production value recommended to engage and maintain the attention of the target audience throughout the duration of the each of the four videos proposed.

Video #1: <i>Lignite 101 / Industry Overview (length = 15 minutes)</i>	Cost
<p><b>Discovery</b> (see description on page 2)            Project due date: TBD            Target audience: Primary = ND Students and Teachers, Secondary = General Public and Policy Makers</p>	\$2,500
<p><b>Plan</b> (see description on page 2)            Timeline: TBD            Topic Outline:</p> <ul style="list-style-type: none"> <li>• What is lignite</li> <li>• How was lignite formed</li> <li>• How do we get lignite out of the ground</li> <li>• What is lignite used for</li> <li>• What is the economic impact of the lignite industry on the region</li> <li>• Workforce</li> </ul>	\$3,500
<p><b>Blueprint:</b> Scriptwriting and Storyboard (see description on page 2)</p>	\$7,500
<p><b>Build:</b> (see description on page 2)</p> <ul style="list-style-type: none"> <li>• Pre-production: shot list development, shoot planning</li> <li>• Producing/Directing</li> <li>• Videography: 2 cameras, audio engineering, drone, GoPro, and up to four trips within 100 miles of Bismarck, ND</li> <li>• Graphic Design</li> <li>• 2D animation of processes and comparisons</li> <li>• Video Editing</li> <li>• Professional voice-over narration</li> <li>• Music bed (from a licensed music library)</li> <li>• Encode to Pro-resolution files and format compatible with online delivery</li> </ul>	\$46,500
<p>Estimate Total: \$60,000</p>	



<b>Video #2: North Dakota Lignite Geology, Mining and Reclamation (length = 15 minutes)</b>	<b>Cost</b>
<p><b>Discovery</b> (see description on page 2)            Project due date: TBD            Target audience: Primary = ND Students and Teachers, Secondary = General Public and Policy Makers</p>	\$2,500
<p><b>Plan</b> (see description on page 2)            Timeline: TBD            Topic Outline:</p> <ul style="list-style-type: none"> <li>• From dinosaurs to coal</li> <li>• Core sampling</li> <li>• Permitting</li> <li>• Mining process</li> <li>• Reclamation process</li> <li>• Bond release</li> </ul>	\$3,500
<p><b>Blueprint:</b> Scriptwriting and Storyboard (see description on page 2)</p>	\$7,500
<p><b>Build:</b> (see description on page 2)</p> <ul style="list-style-type: none"> <li>• Pre-production: shot list development, shoot planning</li> <li>• Producing/Directing</li> <li>• Videography: 2 cameras, audio engineering, drone, GoPro, and up to four trips within 100 miles of Bismarck, ND</li> <li>• Graphic Design</li> <li>• 2D animation of processes and comparisons</li> <li>• Video Editing</li> <li>• Professional voice-over narration</li> <li>• Music bed (from a licensed music library)</li> <li>• Encode to Pro-resolution files and format compatible with online delivery</li> </ul>	\$46,500
<p><b>Estimate Total: \$60,000</b></p>	

Video #3: <i>Electricity Generation and Coal Conversion (length = 15 minutes)</i>	Cost
<p><b>Discovery</b> (see description on page 2)            Project due date: TBD            Target audience: Primary = ND Students and Teachers, Secondary = General Public and Policy Makers</p>	\$2,500
<p><b>Plan</b> (see description on page 2)            Timeline: TBD            Topic Outline:</p> <ul style="list-style-type: none"> <li>• Once inside the power plant</li> <li>• Transmission</li> <li>• Other byproducts/products of lignite and processes (synthetic natural gas, dry fining, flex crete)</li> </ul>	\$3,500
<p><b>Blueprint:</b> Scriptwriting and Storyboard (see description on page 2)</p>	\$7,500
<p><b>Build:</b> (see description on page 2)</p> <ul style="list-style-type: none"> <li>• Pre-production: shot list development, shoot planning</li> <li>• Producing/Directing</li> <li>• Videography: 2 cameras, audio engineering, drone, GoPro, and up to four trips within 100 miles of Bismarck, ND</li> <li>• Graphic Design</li> <li>• 2D animation of processes and comparisons</li> <li>• Video Editing</li> <li>• Professional voice-over narration</li> <li>• Music bed (from a licensed music library)</li> <li>• Encode to Pro-resolution files and format compatible with online delivery</li> </ul>	\$46,500
Estimate Total: \$60,000	

# 2018 LIGNITE EDUCATION SEMINAR



ENVIRONMENT

ECONOMICS

ENERGY

## YOU'RE INVITED

to attend this **NO-COST** seminar for K-12 teachers located at the **NATIONAL ENERGY CENTER OF EXCELLENCE** at **BISMARCK STATE COLLEGE**

## JUNE 11 - 14, 2018

Bismarck State College

This seminar is designed to provide teachers with a broader understanding of the lignite coal industry and the important role it plays in providing electricity to consumers, farmers and businesses in North Dakota, Minnesota, South Dakota, Montana and Iowa.

The seminar includes discussions on how lignite coal is mined and converted into energy, and the economic impact of the industry on the region. It also includes a tour of a lignite mine, a lignite-based power plant and the Great Plains Synfuels Plant.

## GRADUATE CREDITS

Two professional development credits, paid for by the Lignite Energy Council, are available from:

- University of North Dakota (Teaching & Learning)
- North Dakota State University (Education)
- Minot State University (Science)

## MEALS, LODGING & TRANSPORTATION

Free lodging is available in a Bismarck State College dormitory (two per room). Both meals and transportation for the "Coal Country" tour will be provided by the Lignite Energy Council.

## TEACHING MATERIALS

Teachers attending the seminar will receive electronic copies of each presentation, examples of lesson plans, classroom exercises, coal and ash samples, audio-visual materials, and information on the facilities they tour.

## APPLY ONLINE [www.lignite.com/teachers](http://www.lignite.com/teachers)

Applications will be accepted until the seminar is full or until April 13, 2018, whichever occurs first.

A \$60 deposit is required to reserve your spot. This deposit will be returned when you check in at the seminar on June 11, 2018. This deposit will be forfeited if you cancel after May 1 and your spot is unable to be filled.

Typically, all eligible teachers are accepted. Should applications outnumber spots available, preference will be given based on the following criteria:

- 4th - 12th grade teachers
- Science, math or social studies teachers
- Career counselors

## FOR MORE INFORMATION

If you need to complete a hard-copy application, please contact Kay LaCoe • 701.355.2194 • 800.932.7117 • [Kay.LaCoe@lignite.com](mailto:Kay.LaCoe@lignite.com)



**NOW ACCEPTING APPLICATIONS**

[www.lignite.com/teachers](http://www.lignite.com/teachers)



**APPLY NOW**  
If you have attended since 2009, please pass along to a colleague



# 2018 LIGNITE EDUCATION SEMINAR



JUNE 11 - 14

Bismarck State College  
Bismarck, ND



Teachers receive **2**  
**FREE** professional  
development credits  
paid for by the Lignite Energy Council

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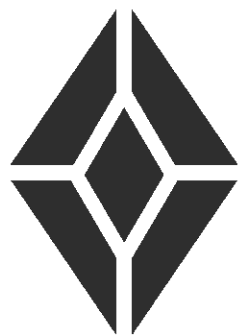
ENVIRONMENT

ECONOMICS

ENERGY

  
Lignite  
Energy Council  
1016 E. Owens Ave.  
Bismarck, ND 58501

YOU'RE INVITED!



# Lignite Energy Council

LEADING THROUGH ADVOCACY AND INNOVATION

January 2018

Dear School Principal/Administrator:

You may remember seeing our Lignite Education Seminar information in the past. Once again, we are asking if you would be willing to place the enclosed brochures in your staff lounge or somewhere teachers will see them.

**NEW – WIN A TECHNOLOGY GRANT:** This year, we would like to reach as many school administrators and career counselors (or comparable) as possible. As part of this initiative, schools and school districts that have a career counselor and/or a principal/vice principal complete the Seminar will be entered to win a technology grant to purchase technology improvement tools for the classroom\*.

Our seminar will again be a four-day, two-credit class at Bismarck State College and it is **“FREE”** to all teachers, administrators and counselors. The two credits are available through the University of North Dakota, North Dakota State University or Minot State University. We provide dorm rooms, meals and even pay for their two credits. The only expense is travel to and from Bismarck.

We have mailed brochures to all teachers listed with the Department of Public Instruction. There are two brochures enclosed for teachers who for some reason did not receive one. Additional information and registration can be found on our website <http://www.lignite.com/teachers>

If you have any questions, please call me at 1-800-932-7117 or contact me by e-mail at: [kay.lacoe@lignite.com](mailto:kay.lacoe@lignite.com). Thank you. Your assistance is appreciated.

Sincerely,

Kay LaCoe

Director of Member Marketing & Education - LIGNITE ENERGY COUNCIL

*\*For each principal/vice principal and/or career counselor (or equivalent) that successfully completes the Seminar, an entry will be placed in a drawing for a technology grant.*

1016 E. Owens Ave. | PO Box 2277 | Bismarck, ND 58502

☎ 701.258.7117

🌐 [www.lignite.com](http://www.lignite.com)

@ [LEC@lignite.com](mailto:LEC@lignite.com)



Client

File name

LEC	17-LEC-0380-Video 2 ND Lignite Geology, Mining and Reclamation-180221-tm-v4
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#	Actions/Video/Images	On-Screen Text	Dialogue/Narrator/Host	Production Notes
1	Beautiful shots of North Dakota. Birds chirping, sun setting, etc.		NARRATOR Just look at this view.	
2	Graphics appear representing a swampy area.		NARRATOR Many years ago, North Dakota looked quite different. Let's go back about 60 million years. Back then, the climate in the area we call home was something similar to the climate of Florida! Humid swamps with sprawling green plants and lush trees... If it wasn't for that climate, we wouldn't have the coal we use for electricity today. Who knew it took 60 million years to make a light switch work!	
3	Graphics representing the process described by narration appear.		NARRATOR You see, as the plants in these swamps died, they would fall to the ground and become what's called peat. Peat is a mixture of soil and partially decomposed plant material. Over time, that peat would get piled under more plants, mud and other sediment, which put a lot of pressure on it. This heated things up big time—the perfect recipe for coal.	
4	Text on-screen	Pressure + Heat + Time = Coal	NARRATOR It's easy—pressure plus heat plus time equals coal!	
5	Video of coal as well as graphics to represent the different types	Lignite Sub-bituminous Bituminous Anthracite	NARRATOR So, what exactly is coal? Well... Coal is actually a type of rock. It's dark brown or black, combustible and formed over millions of years through plant decomposition. There are four main types: lignite, sub-bituminous, bituminous and anthracite. They're different from each other depending on how old they are and how long that peat was compacted, pressurized and heated up.	

6	Video of lignite in the ground	10 feet of plant material = 1 foot of coal	<p>NARRATOR</p> <p>Lignite is the youngest type of coal, and the kind we mine here in North Dakota. For every 10 feet of plant material, one foot of lignite coal was created! While it has the lowest carbon content, meaning it burns more quickly than other types of coal, lignite is the closest to the ground's surface.</p>	
7	Photos of early coal miners	FUN FACT!	<p>NARRATOR</p> <p>Fun fact: early coal miners used simple tools to dig the lignite out of the ground. It's that close!</p>	
8	Video of modern home (to contrast from older pictures) using electricity, as well as visual representations of the different mines		<p>NARRATOR</p> <p>So how exactly do they turn million-year-old coal into electricity? Well, it starts by getting it out of the ground. There are five mines in North Dakota that do this—Beulah, Center, Falkirk, Freedom and Coyote Creek. Together, these mines dig up millions of tons of lignite coal every year.</p>	
9	Graphics appear representing the requirements and the layers in the ground.		<p>NARRATOR</p> <p>In order to mine lignite, certain requirements should be met. Ideally, the combined thickness of lignite needs to be at least ten feet thick in one or more different beds. Second, the lignite should be no deeper than 175 feet beneath the surface. And third, there needs to be no more than 10 feet of overburden for every foot of coal. Overburden is a layer of clay between the dirt and the coal. A process called core sampling, where miners drill and remove a cylinder-shaped sample of the ground below, can show if these requirements are met.</p>	

10	Video of miners working with farmers/land owners		<p>NARRATOR</p> <p>To start the mining process, lignite companies need to obtain the rights to mine the land from the people who own it, and then permission from the North Dakota Public Service Commission. That’s all made possible with the excellent relationship lignite companies have developed with local farmers and land owners.</p>	
11	Video showing the process described by narration		<p>NARRATOR</p> <p>Once miners have a right to mine, exploration drilling begins. This shows the quality of the coal as well as the amount of overburden that needs to be removed to get to it. The soils and wildlife are examined and any historical or archeological sites are studied and avoided. Once that’s all done, the digging begins!</p>	
12	Video showing the different equipment mentioned by narration		<p>NARRATOR</p> <p>First to be removed and saved for later are the layers of dirt on top of the overburden and lignite. These are called the topsoil and subsoil. For this job, mining companies bring in tractor-scrappers, shovels, backhoes and loaders—machines tailor-made to do some serious digging.</p>	
13	Video of soil monument, text on-screen	FUN FACT!	<p>NARRATOR</p> <p>Fun fact: soil “monuments” like this one are created to help mining companies keep track of just how much soil has been removed and needs to be replaced after mining.</p>	
14	Graphic showing the layers in the ground		<p>NARRATOR</p> <p>Once the top layers of soil are removed, we’ve reached the overburden! This layer is a bit heavier and denser than the soils above it so mining companies need heavy-duty machines to get this work done. Sometimes, miners run into layers of rock. Want to know how they get through that...?</p>	
15	Video of a controlled explosion			



16	Video of a dragline at work		<p>NARRATOR</p> <p>For the rest of the overburden removal, miners bring in...the dragline! Let's give you an idea of just how big draglines are... If you've ever taken a ride on a school bus, that school bus could fit into a dragline's bucket. Now that's a wild ride! Draglines scoop up the overburden, pile it nearby, and replace it after the coal is removed.</p>	
17	Video of different equipment at work		<p>NARRATOR</p> <p>Once the draglines expose the coal, rippers come in to break up the coal, making it easier to remove with haul trucks. Electric loading shovels...hydraulic excavators...and front-end loaders are also used. A lot of machines, each with a very specific job to do.</p>	
18	Video of coal being cleaned		<p>NARRATOR</p> <p>After the coal is removed from the ground, it's cleaned, crushed and delivered to power plants to be turned into electricity!</p>	
19	Video of mined land		<p>NARRATOR</p> <p>Even though lignite is close to the surface, making it fairly easy to reach, mining companies wanted to also preserve the beautiful land we have here in North Dakota. This is made possible through a process called reclamation, when mining companies return the land to how it was before it was mined.</p>	
20	Photos of early mining, transitioning to video of modern mining		<p>NARRATOR</p> <p>Mining for lignite gained popularity in the early 1900s, but it wasn't until the 1970s that laws were created to protect the lands that were mined. Since then, laws have required mined lands to be returned to their original state and productivity, meaning they have to be as good as or better than they were before mining.</p>	



Client	File name
LEC	17-LEC-0380-Video 2 ND Lignite Geology, Mining and Reclamation-180221-tm-v4

21	Video showing the reclamation process	Approximate Original Contour	<p>NARRATOR</p> <p>Reclamation starts by spreading the soil back on the land. In fact, miners replace the soil shaped in the same way it was before mining—restoring wetlands, hills and valleys. This is called the land’s approximate original contour. Seeds of local grasses or crops are planted and any wildlife habitats that existed in that area are also returned.</p>	
22	Video showing post-mined land	Public Service Commission	<p>NARRATOR</p> <p>Once that’s completed, the land is monitored for at least 10 years to make sure it’s as healthy as it once was! The growth of the grasses or crops is examined and the wildlife habitats are closely monitored to ensure that they’re thriving! This all must happen before mining companies can be released from their responsibility to the land. Once the Public Service Commission gives the okay, the coal mines are released from bond and the land can be used for agriculture or recreation once again.</p>	
23	Video of mining companies examining post-mined lands		<p>NARRATOR</p> <p>Reclamation is <i>really</i> important to miners in North Dakota. In fact, North Dakota’s lignite industry is a leader in the nation in protecting the environment before, during and after mining.</p>	
24	Photos of what Harmony Lake used to look like, transitioning to video of what it looks like today		<p>NARRATOR</p> <p>In some cases, land is transformed for newer and better purposes because of mining. Harmony Lake used to be an area that was mined, and because of reclamation, it was transformed into a beautiful recreational area that used its unique contour to create a lake stocked with fish and surrounded by wildlife. It was the first time in history that a coal mine was reclaimed for recreation instead of agriculture.</p>	
25	Text on-screen	20,000 acres released & 54,000 acres reclaimed	<p>NARRATOR</p> <p>Currently, more than 20,000 acres of mined lands have been released from their bonds and more than 54,000 acres have been fully reclaimed since 1970. That’s a lot of reclamation!</p>	



Client

File name

LEC	17-LEC-0380-Video 2 ND Lignite Geology, Mining and Reclamation-180221-tm-v4
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26	Video of opening shot of beautiful North Dakota land		<p>NARRATOR Take another look at this view. Would you believe this land was once mined? See? That's exactly the reason behind reclamation. North Dakota is beautiful and we want to keep it that way. Through mining and reclamation, we can benefit from the resources right here in our state while still preserving its unique beauty—something the lignite industry has been and will continue to be passionate about for many years to come.</p>	
				Total Running Time: 9:30

Content Title	2017 Conference	<a href="https://lignite.com/education">https://lignite.com/education</a> Content
General Info		
Videos		<a href="#">Lignite Rocks</a> <a href="#">The Allam Cycle</a> <a href="#">Introduction to Lignite</a>
Resource Guide		<a href="#">Resource Guide</a>
Glossary of Terms		<a href="#">Glossary of Terms</a>
Lignite: The Region's Best Kept Secret <i>Video Presentation by:</i> Steve Van Dyke Vice President of Communications Lignite Energy Council	Video	<a href="#">Handout</a> <a href="#">Handout Answer Key</a> <a href="#">Classroom Activity</a> <a href="#">PowerPoint</a> By Daryl Hill
North Dakota Geology <i>Video Presentation by:</i> Kendra Kungu, P.E. Geological Engineer The Coteau Properties Company Freedom Mine	Video	<a href="#">Handout</a> <a href="#">Classroom Activities</a> <a href="#">Map</a> <a href="#">PowerPoint</a> By Kendra Frank
Lignite Mining and Reclamation Process <i>Video Presentation by:</i> Sarah Flath The Coteau Properties Company	Video	<a href="#">Handout</a> <a href="#">Handout Answer Key</a> <a href="#">Classroom Activities</a> <a href="#">PowerPoint</a> By Kayla Torgerson (minor changes)
Classroom Activity: Dig for Coal (Sarah Flath)	Video	
Cookie Mining Activity		<a href="#">Cookie Mining</a>
		<a href="#">Mining Reclamation Infographic</a>
Electricity Generation from Lignite <i>Video Presentation by:</i> John Bauer Director, ND Generation Great River Energy	Video	<a href="#">Handout</a> <a href="#">Handout Answer Key</a> <a href="#">Classroom Activities</a> <a href="#">PowerPoint</a> (minor changes)
Video		<a href="#">Electricity and Lignite Coal</a>
Dakota Gasification Company Web Title: Synfuels Production from Lignite <i>Video Presentation by:</i> Joan Dietz Great Plains Synfuels	Video	<a href="#">Handout</a> <a href="#">Classroom Activities</a> <a href="#">PowerPoint</a> (minor changes)
		<a href="#">Power Plant Compliance Infographic</a>
Transmission: Transporting Energy by Wire <i>Video Presentation by:</i> Matthew Stoltz Basin Electric Power Cooperative	Video	<a href="#">Handout</a> <a href="#">Handout Answer Key</a> <a href="#">Classroom Activities 1</a> Classroom Activities 2-PPT <a href="#">PowerPoint</a> (minor changes)
Enhancing Lignite to Be the Fuel of Tomorrow Web Title: Enhancing Lignite's Future through R&D <i>Video Presentation by:</i> Mike Holmes VP Research and Development Lignite Energy Council	Video	<a href="#">Handout</a> <a href="#">Handout Answer Key</a> <a href="#">PowerPoint</a>
Economics and Electricity 101 <i>Video Presentation by:</i> Dr. Brian P. Kalk	Video	<a href="#">PowerPoint</a> By Brian Kroshus (minor changes)

Director of Energy Systems Development Energy & Environmental Research Center		
Classroom Activity: Economics	Video	
Family Budget Activity		<a href="#">Activity</a>
Energy and CO2 Management: Carbon Capture and Storage <i>Video Presentation by:</i> Dan Daly Plains CO2 Reduction (PCOR) Partnership	Video	<a href="#">Study Guide</a> <a href="#">PowerPoint</a> (minor changes)
Plant Level Environmental Compliance <i>Video Presentation by:</i> Craig Bleth Environmental Manager Minnkota Power Cooperative	Video	<a href="#">Handout</a> <a href="#">PowerPoint</a> (minor changes)
Workforce Issues and Needs Panel Discussion		<a href="#">Discussion Outline</a>
Lignite Industry Career Choices <i>Video Presentation by:</i> Kent Ellis Aurora Energy Solutions, LLC	Video	
Video		<a href="#">Success in the New Economy</a>
Energy Use		<a href="#">Classroom Activities</a> <a href="#">Leaders Guide</a> <a href="#">Worksheet</a>
Battle of the Bulbs		<a href="#">Classroom Activities</a>
Coal Drying		<a href="#">Classroom Activity</a>
Captain Coal		<a href="#">Captain Coal Coloring Sheet</a> <a href="#">Captain Coal Image</a>
Crossword Puzzle		<a href="#">Crossword Puzzle</a> <a href="#">Answer Key</a>
Classroom Activity: Jeopardy	Video	Jeopardy – not working on website

Menu Ideas:

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## Videos and Presenters from 2017 Teacher's Conference

- Lignite: The Region's Best Kept Secret
  - Steve Van Dyke
  - Vice President of Communications
  - Lignite Energy Council
- North Dakota Geology
  - Kendra Kungu, P.E.
  - Geological Engineer
  - The Coteau Properties Company Freedom Mine
- Lignite Mining and Reclamation Process
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- Enhancing Lignite to Be the Fuel of Tomorrow
  - Mike Holmes
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  - Lignite Energy Council
- Economics and Electricity 101
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  - Energy & Environmental Research Center
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  - Dan Daly
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  - Craig Bleth
  - Environmental Manager
  - Minnkota Power Cooperative
- Lignite Industry Career Choices
  - Kent Ellis
  - Aurora Energy Solutions, LLC
- Classroom Activity: Economics
- Classroom Activity: Dig for Coal (Sarah Flath)
- Classroom Activity: Jeopardy

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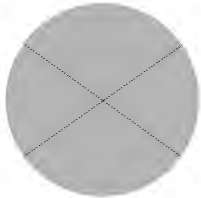
FAQs

# 2019 Lignite Education Seminar

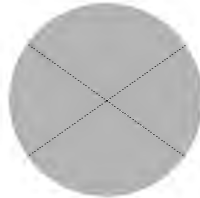
June 10-13, 2019  
Bismarck State College

Register Now

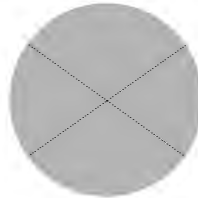
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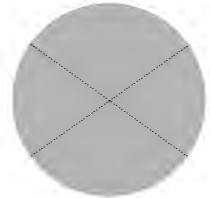
Join More Than 100  
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Tour a Lignite Coal Mine  
and Power Plant



Receive Teaching Materials  
for Your Classroom

More Information *(Links to FAQs page)*

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### Lignite: The Region's Best Kept Secret

Learn about the Lignite industry and the rich history behind it. It impacts our economy more than you may realize. Teach your students about life before electricity and the economic benefits of coal.

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### North Dakota Geology

What is coal and how was it formed? How do we find it? Activities include making coal, geology drilling, a state map, and quiz.

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### Lignite Mining and Reclamation Process

Learn about lignite mining, the reclamation process, and the history of regulations. Classroom activities include digging for coal, a word search and cookie mining!

Enter Course >

View All Courses *(Links to Courses page)*

## Get a free activity packet

Name

Email Address

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*(Images of activity packet)*

## Schedule a Speaker

Interested in a professional from the Lignite  
industry visting your classroom?

Schedule Speaker

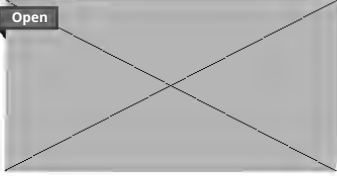
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# Courses

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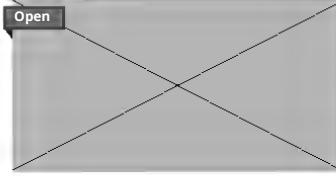


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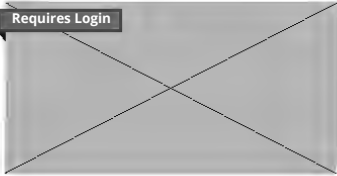


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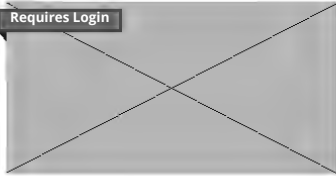


**Electricity Generation From Lignite**

You use electricity every day, but where is it coming from? What are the advantages of different energy sources? Where does Lignite fit into all of this? Enjoy a few different classroom activities and a quiz.

Login for Course >

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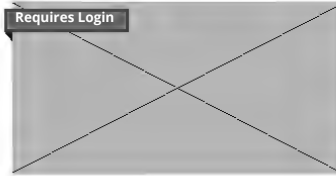


**Synfuels Production from Lignite**

Learn about the history and products of the Dakota Gasification Company and the Great Plains Synfuels Plant. Classroom activities teach students the chemistry behind synfuels.

Login for Course >

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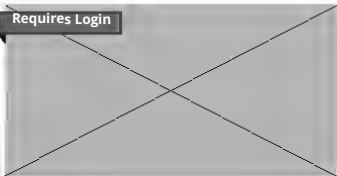


**Transmission: Transporting Energy by Wire**

There are different ways to generate electricity, but how is it transported? Try the transmission line routing exercise with your students to see how it can be easier said than done!

Login for Course >

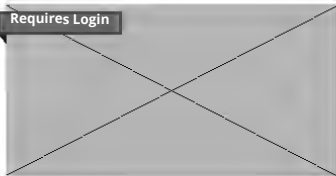
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**Enhancing Lignite to be the Fuel of Tomorrow**

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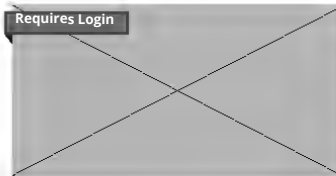
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**Economics and Electricity 101**

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**Energy and CO2 Management:**

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*(This page may change slightly depending if we connect to GrowthZone)*

# Synfuels Production from Lignite

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Or login with:



Please use the "Forgot your password" link to retrieve/reset your password using the email address registered with the Lignite Energy Council. If you experience any difficulties, please contact Laney DeGraw at laneydegrow@lignite.com or at 701.258.7117.

## Want to try a course?

See Open Courses

KAT MARKETING DRAFT

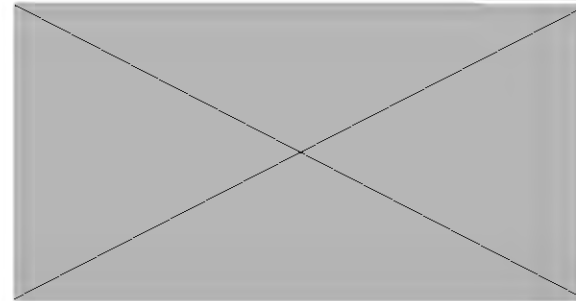
Logo

# Lignite Mining and Reclamation Process

Course Status: In Progress

KAT MARKETING DRAFT

Learn about lignite mining, the reclamation process, and the history of regulations. Classroom activities include digging for coal, a word search and cookie mining!



## Course Overview

Lessons	Status
Video	<input checked="" type="checkbox"/>
Classroom Handout	<input checked="" type="checkbox"/>
Classroom Activity 1- Dig for Coal	<input checked="" type="checkbox"/>
Classroom Activity 2- Word Search	<input checked="" type="checkbox"/>
Classroom Activity 3- Cookie Mining	<input checked="" type="checkbox"/>
Additional Information	<input checked="" type="checkbox"/>

KAT MARKETING DRAFT

# Lignite Mining and Reclamation Process

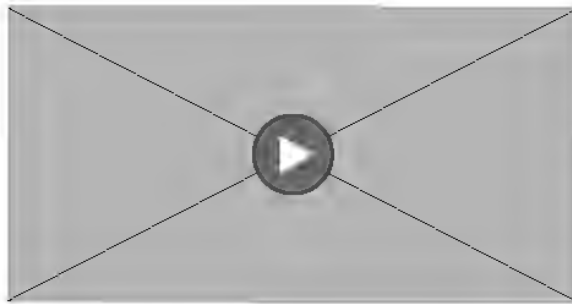
Classroom Activity 1- Dig for Coal

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To demonstrate the process of surface coal mining and land reclamation, set up a cake pan layered with coal at the bottom, then a thick layer of overburden (gray or brown dirt), then a thinner layer of topsoil (or potting soil). The objective is to remove the coal and return the land to as good a condition as existed prior to mining. The cake pan represents the mining permit area. No disturbance or spillage is allowed outside the cake pan, or permit area.

Watch the video demonstration of this classroom activity.



Download the activity instructions for students.



High School  
Handout



Grade School  
Handout

## Course Progress

33%

Back to course overview

## Lesson Content

- Video
- Classroom Handout
- Classroom Activity 1- Dig for Coal
- Classroom Activity 2- Word Search
- Classroom Activity 3- Cookie Mining
- Additional Information

## Tried this activity? Tell us what you think for a free gift!

\* 1. Is this applicate to the grade level that you teach?

- Yes  
 No

\* 2. Would you add this to your curriculum?

- Yes  
 No

\* 3. Any suggestions?

\* 4. Name

\* 5. Address





Submit Survey

Mark Lesson Complete

< Previous Lesson

Next Lesson >

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# LIGNITE EDUCATION SEMINAR

**JUNE 11 - 14, 2018**

**ENERGY**

**ECONOMICS**

**ENVIRONMENT**



**Lignite**  
Energy Council

[WWW.LIGNITE.COM](http://WWW.LIGNITE.COM)



## 2017 Lignite Education Seminar: Energy, Economics & Environment June 12-15, 2017

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### Monday, June 12

- 7:30 a.m.      **Registration Begins**  
National Energy Center of Excellence – Bismarck State College – 4<sup>th</sup> Floor
- 8:45 a.m.      **Welcome, Introductory Remarks, Instructions & Pre-Test**  
Kay LaCoe – Director of Membership Marketing, *Lignite Energy Council*
- 9:15 a.m.      **Lesson Plan Collaborative Work**  
Terry Hagen – Professor, University of North Dakota
- 9:45 a.m.      **Lignite: The Region’s Best Kept Secret**  
Steve Van Dyke – Vice President of Communications, *Lignite Energy Council*  
**Classroom Activity:** Economics  
**Video:** TBD
- 10:45 a.m.      *Break*
- 11:00 a.m.      **North Dakota Geology: Coal-Bearing Rocks in the Northern Great Plains**  
Kendra Kungu – Geological Engineer, *The Coteau Properties Co. Freedom Mine*  
**Classroom Activity:** Chocolate Chip Cookie Mining  
**Video:** Lignite Rocks (if time allows)
- 12:00 p.m.      *Lunch*
- 12:45 p.m.      **Lignite Mining and Reclamation**  
Sarah Flath – Environmental Manager, *The Coteau Properties Co. Freedom Mine*  
**Classroom Activity:** Cake pan mining and reclamation
- 2:15 p.m.      *Break*
- 2:30 p.m.      **Electricity Generation Choices**  
John Bauer – Director of North Dakota Generation, *Great River Energy*  
**Classroom Activity:** Pedal generation  
**Video:** Optional/TBD
- 3:30 p.m.      *Break*
- 3:45 p.m.      **Synfuels Production from Lignite**  
Joan Dietz – Communication and Creative Services, *Great Plains Synfuels Plant*  
**Video:** Synfuels video

4:30 p.m.

**Introduction to North Dakota Energy Curriculum**

Retha Mattern – Business & Outreach Coordinator, *National Energy Center of Excellence*

**Wrap-up, Day 2 Preview, Dorm Check-in**

5:00 p.m.

***Dinner at Bismarck State College***

**Evening on your own**

## **Tuesday, June 13**

- 7:00 a.m.      *Breakfast at National Energy Center of Excellence*
- 8:00 a.m.      **Transmission – Transporting Electricity by Wire**  
Matthew Stoltz – Director of Transmission Services, *Basin Electric Power Cooperative*  
**Classroom Activity:** *Power Line Siting*
- 9:00 a.m.      *Break*
- 9:15 a.m.      **Enhancing Lignite’s Future through Research & Development**  
Mike Holmes – Vice President of Research & Development, *Lignite Energy Council*  
**Classroom Activity:** *Lignite Jeopardy*
- 10:45 a.m.     *Break*
- 11:00 a.m.     **Economics and Electricity 101**  
Brian Kalk – Director of Energy Systems, Energy and Environmental Research Center at UND
- 12:00 p.m.     *Lunch*
- 12:45 p.m.     **Energy and CO2 Management: Carbon Capture and Storage**  
Dan Daly – Research Manager, Energy & Environmental Research Center at the University of North Dakota  
**Classroom Activity:** *Jeopardy*  
**Videos:** *PCOR Videos*
- 2:00 p.m.      *Break*
- 2:15 p.m.      **Plant Level Environmental Compliance**  
Craig Bleth – Environmental Manager, *Minnkota Power Cooperative*
- 3:15 p.m.      *Break*
- 3:30 p.m.      **Industry Career Choices**  
Kent Ellis – Special Projects Coordinator, *Bismarck Public Schools*
- 4:45 p.m.      **Wrap-up – Day 3 Preview**  
**Tour of Power Plant Program Facilities**
- 5:00 p.m.      **Dinner at Bismarck State College**  
**Energy Education Demonstrations and Hands-On**

## **Wednesday, June 14**

- 6:15 a.m.      *Breakfast at BSC Student Union*
- 7:00 a.m.      Load buses in front of Student Union
- 7:15 a.m.      Buses leave for Coal Country Tour

### **Group 1**

- 9:00 a.m.      Tour Freedom Mine
- 11:00 a.m.      Bus leaves for Antelope Valley Station
- 11:15 a.m.      Arrive at Antelope Valley Station - Photos
- 11:45 a.m.      Lunch at Antelope Valley Station
- 12:30 p.m.      Tour Antelope Valley Station
- 2:00 p.m.      Bus leaves for Great Plains Synfuels Plant
- 2:15 p.m.      Tour Great Plains Synfuels Plant
- 3:15 p.m.      Bus leaves for Bismarck State College

### **Group 2**

- 9:00 a.m.      Tour Great Plains Synfuels Plant
- 10:15 a.m.      Bus leaves for Coal Creek Station
- 11:15 a.m.      Arrive at Coal Creek Station - Photos
- 11:30 a.m.      Lunch at Coal Creek Station
- 12:15 p.m.      Tour Coal Creek Station
- 2:00 p.m.      Bus leaves for Falkirk Mine
- 2:30 p.m.      Tour Falkirk Mine
- 4:30 p.m.      Bus leaves for Bismarck State College

### **Group 3**

- 9:00 a.m.      Tour Great Plains Synfuels Plant
- 10:15 a.m.      Bus leaves for Center Mine
- 11:15 a.m.      Arrive at Center Mine
- 11:30 a.m.      Lunch at Center Mine
- 12:15 p.m.      Tour Center Mine
- 2:15 p.m.      Bus leaves for Milton R. Young Station - Photos
- 2:30 p.m.      Tour Milton R. Young
- 4:30 p.m.      Bus leaves for Bismarck State College

- 5:00 p.m.      ***Dinner at Bismarck State College***  
**Evening on your own**



## **Thursday, June 15**

- 7:00 a.m.      *Breakfast at National Energy Center of Excellence*
- 8:00 a.m.      **Energy Sense**  
Tom Butz - Senior Planning Engineer, *Power System Engineering, Inc.*
- 9:00 a.m.      *Break*
- 9:15 a.m.      **Workforce Issues and Needs Panel**  
*Moderator: Jason Bohrer – President & CEO, Lignite Energy Council*  
Dan Dorfschmidt – Operations Manager, *Butler Machinery*  
Jamey Backus – Plant Manager, *Leland Olds Station*  
Jay Volk – Environmental Manager, *BNI Coal, Ltd.*  
Bruce Emmil – Associate Vice President – *NECE, Bismarck State College*
- 11:00 a.m.      *Break*
- 11:15 a.m.      **From the Mine to the Electric Line – Making Connections**  
TBD
- 12:15 p.m.      *Lunch*
- 1:00 p.m.      **Post Test**
- 1:30 p.m.      **Seminar adjourns**

Seminar Participants  
2017 Lignite Education Seminar:  
Energy, Economics & Environment  
June 12-15, 2017

**Mark Anderson**

Theodore Jamerson Elementary School  
Bismarck, ND  
*Grade(s) Taught:* 2-7  
*Subject(s) Taught:* Science, Math, Reading, Gifted & Talented students

**Mike Anderson**

Martin Grade School  
Martin, SD  
*Grade(s) Taught:* 5-6  
*Subject(s) Taught:* Math

**Tammy Bakken**

Williston Middle School  
Williston, ND  
*Grade(s) Taught:* 7 - 8  
*Subject(s) Taught:* Direct Instruction Math, Science

**Jeff Baranick**

Beulah Middle School  
Beulah, ND  
*Grade(s) Taught:* 7-8  
*Subject(s) Taught:* 8th Grade Social Studies & 7th Grade Math

**Kasey J. Bitz**

ND Center for Distance Education  
Fargo, ND  
*Grade(s) Taught:* 7-12  
*Subject(s) Taught:* Health, First Aid & Safety, Drugs & Alcohol, Physical Education

**Tamara Bitz**

Theodore Jamerson Elementary  
Bismarck, ND  
*Grade(s) Taught:* 3  
*Subject(s) Taught:* Math, Reading, Science, Social Studies, Art, Language Arts

**Tami Bornemann**

Theodore Jamerson Elementary School  
Bismarck, ND  
*Grade(s) Taught:* 5  
*Subject(s) Taught:* All

**Jean Bowlds**

Lincoln Elementary School  
Glendive, MT  
*Grade(s) Taught:* 5  
*Subject(s) Taught:* All core subjects

**Kelsey Brashears**

Mandan High School  
Mandan, ND  
*Grade(s) Taught:* 9-12  
*Subject(s) Taught:* Technology & Engineering

**Sarah Bross**

Tiospaye Topa  
Ridgeview, SD  
*Grade(s) Taught:* 1  
*Subject(s) Taught:* Math, Science, Social Studies, Reading, Writing

**Erin Brurud**

Williston Middle School  
Williston, ND  
*Grade(s) Taught:* 5-8  
*Subject(s) Taught:* ELL (includes all content area subjects)

**Andrea Charlebois**

Grand Forks Central  
Grand Forks, ND  
*Grade(s) Taught:* 9-12  
*Subject(s) Taught:* Physical Education

**Mark Clark**

Selfridge Public School

Selfridge, ND

*Grade(s) Taught:* K-12

*Subject(s) Taught:* ND History, US History, PE

**Mary Cooper**

Little Heart Elementary School

St. Anthony, ND

*Grade(s) Taught:* 3-5

*Subject(s) Taught:* Spelling, Reading, English, Math, Social Studies, Science

**Sam Dawson**

Carpenter High School

Meadow Lake, SK

*Grade(s) Taught:* 10-12

*Subject(s) Taught:* Practical and Applied Arts (Energy & Mines), English, Arts, Science

**Lisa Deal**

Sunshine Bible Academy

Miller, SD

*Grade(s) Taught:* 4-6

*Subject(s) Taught:* Science, Health, History, English, Reading, Spelling, Math, Handwriting, Art

**David Del Padre**

Hope Christian Academy

Dickinson, ND

*Grade(s) Taught:* 7-12

*Subject(s) Taught:* Economics, History, Geography, Civics

**Lori Del Padre**

Hope Christian Academy

Dickinson, ND

*Grade(s) Taught:* 3

*Subject(s) Taught:* All

**Jason Dockter**

Kulm Public School

Kulm, ND

*Grade(s) Taught:* 7-12

*Subject(s) Taught:* Social Studies, Technology Education

**Leigh Dykins**

Beach High School

Beach, ND

*Grade(s) Taught:* 9-12

*Subject(s) Taught:* Spanish, English Language Arts

**Sara Echanis**

Our Redeemer's Christian School

Minot, ND

*Grade(s) Taught:* 7-8

*Subject(s) Taught:* English Language Arts, Math, Art

**Kara Eisemann**

Selby Area School

Selby, SD

*Grade(s) Taught:* 7-12

*Subject(s) Taught:* 7th Life Science, 8th Earth Science, 9th Physical Science, 10th Biology, 11-12 Adv Bio

**Maidie Enget**

Central Elementary

Tioga, ND

*Grade(s) Taught:* 6

*Subject(s) Taught:* Social Studies, Math, Language Arts, Health, Art

**Michael Frank**

Minot Public Schools

Minot, ND

*Grade(s) Taught:* 8-12

*Subject(s) Taught:* Technology/Engineering, Intro to Technology, Principles of Engineering, Communication & Entertainment Technology, Technology Education

**Tesha Frederick**

Glendo Elementary

Glendo, WY

*Grade(s) Taught:* K-1

*Subject(s) Taught:* All

**Craig Fricke**

Memorial Middle School

Minot AFB, ND

*Grade(s) Taught:* 7-8

*Subject(s) Taught:* Physical Education & Health Education

**Erica Gade**

Our Redeemer's Christian School

Minot, ND

*Grade(s) Taught:* 9-12

*Subject(s) Taught:* English Literature, Writing and Critical Thinking Skills

**Valerie Goldade**

District #1 Schools Williston

Williston, ND

*Grade(s) Taught:* Elementary

*Subject(s) Taught:* All Subjects

**Delwyn Groninger**

South Prairie #70

Minot, ND

*Grade(s) Taught:* PK - 5

*Subject(s) Taught:* Elementary Principal

**David Gumke**

Watford City High School

Watford City, ND

*Grade(s) Taught:* 10-12

*Subject(s) Taught:* Applied Math, Algebra II, Geometry, Pre-Calculus

**Dean Hagen**

Drake High School

Drake, ND

*Grade(s) Taught:* 10-12

*Subject(s) Taught:* Welding/Shop

**Neil Hamm**

Power Public School

Power, MT

*Grade(s) Taught:* 7-12

*Subject(s) Taught:* All JH & HS Sciences

**Jeremiah Hayes**

Bowman County

Bowman, ND

*Grade(s) Taught:* 7, 8, 10

*Subject(s) Taught:* Life and Earth Science, Biology

**Christian Helgeson**

Wilton Public School

Wilton, ND

*Grade(s) Taught:* 7-12

*Subject(s) Taught:* Social Studies, US History, World History, Economics, POD, Psychology, Sociology

**Cynthia Hendry**

Fort Yates Middle School

Fort Yates, ND

*Grade(s) Taught:* 6-8

*Subject(s) Taught:* Library & Computers

**Kim Henneberry**

Williston Middle School

Williston, ND

*Grade(s) Taught:* 7

*Subject(s) Taught:* Math

**Dr. Andrew Hennessey**

Burke Central High School

Lignite, ND

*Grade(s) Taught:* 7-12

*Subject(s) Taught:* Life Science, Earth Science, Physical Science, Biology, Environmental Science, Physics

**Lindsey Hettich**

Sunshine Bible Academy

Miller, SD

*Grade(s) Taught:* 8-12

*Subject(s) Taught:* Algebra I & 2, Geometry, Trigonometry

**Dallas Hinderer**

Wachter Middle School

Bismarck, ND

*Grade(s) Taught:* 6

*Subject(s) Taught:* Social Studies

**Danae Inman**

Homeschool

Berthold, ND

*Grade(s) Taught:* All

*Subject(s) Taught:* All

**Danielle Jansen**

LaMoure High School

LaMoure, ND

*Grade(s) Taught:* 7-12

*Subject(s) Taught:* Alternative Math, Daily Math Skills, Support in Social Studies

**Angela C. Johnson**

Max Public School

Max, ND

*Grade(s) Taught:* 7-12

*Subject(s) Taught:* English-Language Arts

**Kimberly Johnson**

South Middle School

Grank Forks, ND

*Grade(s) Taught:* 8

*Subject(s) Taught:* 8th Grade Math, Algebra I

**Jefri Jones**

Ben Franklin Middle School

Fargo, ND

*Grade(s) Taught:* 7

*Subject(s) Taught:* Life Science

**Rita Kaeding**

Warwick Public School

Warwick, ND

*Grade(s) Taught:* 8-12

*Subject(s) Taught:* Math (Pre-Algebra, Algebra 1, Geometry, Algebra 2, Trigonometry), Science (Physical Science, Chemistry, Astronomy, Meteorology)

**Josh Keller**

Rolette Public School

Rolette, ND

*Grade(s) Taught:* 6

*Subject(s) Taught:* Reading, Math, Science, Social Studies, English, Writing

**Marietta Keller**

Sidney Public Schools

Sidney, MT

*Grade(s) Taught:* K-5

*Subject(s) Taught:* Reading, Math, Social Studies, Science

**Kim Kightlinger**

Selby Area High School

Selby, SD

*Grade(s) Taught:* 8-12

*Subject(s) Taught:* AP Calculus, Precalculus, Geometry, SR Business Math, 8th Grade Math

**Geri Kirkpatrick**

Lincoln School

Glendive, MT

*Grade(s) Taught:* 5

*Subject(s) Taught:* All

**Stacey Knudson**

Miller Elementary

Bismarck, ND

*Grade(s) Taught:* K-5

*Subject(s) Taught:* Title I Reading

**Jean L. Kohlman**

Newburg United School

Newburg, ND

*Grade(s) Taught:* 7-12

*Subject(s) Taught:* Computer Applications, Multimedia, General Business, Accountin I, Personal Finance

**Brian Kollin**

Thompson Public School

Thompson, ND

*Grade(s) Taught:* 8-12

*Subject(s) Taught:* Geometry, Algebra I, Senior English, Pre-Calculus, Statistics, Applied Math

**Jenni Kranz**

Rutland School District

Rutland, SD

*Grade(s) Taught:* High School

*Subject(s) Taught:* English Language Arts, World History

**Angela Kuntz**

Wishek Public Schools

Wishek, ND

*Grade(s) Taught:* 1

*Subject(s) Taught:* ELA, Math, Social Studies, Science, Health

**Andrea Leinen**

Chugwater Jr. High/High School  
Chugwater, WY  
*Grade(s) Taught:* 6-12  
*Subject(s) Taught:* 6-12 Grade Math

**Shila Leno**

Center for Distance Education  
Fargo, ND  
*Grade(s) Taught:* 9-12  
*Subject(s) Taught:* Health Science and Military Careers

**Janet Linqvist**

Simile Middle School  
Bismarck, ND  
*Grade(s) Taught:* 7th  
*Subject(s) Taught:* Communications

**Amanda Lynch**

MMCRU  
Marcus, IA  
*Grade(s) Taught:* High School  
*Subject(s) Taught:* Biology, Environmental and Anatomy

**Jim Mahler**

Anamoose Public School  
Anamoose, ND  
*Grade(s) Taught:* 5  
*Subject(s) Taught:* English, Reading, Spelling, Social Studies, Math, Science, Art & Health

**Heather Malone**

South Prairie School  
Minot, ND  
*Grade(s) Taught:* 1  
*Subject(s) Taught:* All except gym & music

**Kaitlin Marthaller**

Beulah Elementary School  
Beulah, ND  
*Grade(s) Taught:* 3  
*Subject(s) Taught:* Math, Reading/Language Arts, Science, Social Studies

**Chantel McKay**

Beulah Elementary School  
Beulah, ND  
*Grade(s) Taught:* 2  
*Subject(s) Taught:* Language Arts, Reading, Math, Science, Social Studies

**Wendy Mead**

Hazen Middle School  
Hazen, ND  
*Grade(s) Taught:* 7-8  
*Subject(s) Taught:* Reading and Homeroom

**Kristi Meyer**

Wachter Middle School  
Bismarck, ND  
*Grade(s) Taught:* 8  
*Subject(s) Taught:* US History

**Becky Middlestead**

Ellendale Public School  
Ellendale, ND  
*Grade(s) Taught:* 4-8  
*Subject(s) Taught:* Math, English, Health, Social Studies, Science

**Whitney Muller**

McLaughlin School District 15-2  
McLaughlin, SD  
*Grade(s) Taught:* Middle School  
*Subject(s) Taught:* Science

**Darlene Musland**

Edgeley Public School  
Edgeley, ND  
*Grade(s) Taught:* 1-12  
*Subject(s) Taught:* Special Education

**Richard Myrvik**

Rutland High School  
Rutland, SD  
*Grade(s) Taught:* 9-12  
*Subject(s) Taught:* World History, World Geography, Current Events

**Nicole Nelson**

Jamestown High School  
Jamestown, ND  
*Grade(s) Taught:* 9-12  
*Subject(s) Taught:* Special Education, Transition Skills

**Laurene Nordloef**

Powers Lake Public School  
Powers Lake, ND  
*Grade(s) Taught:* K-12  
*Subject(s) Taught:* Library

**Cheryl Olson**

Williston High School  
Williston, ND  
*Grade(s) Taught:* 10, 11, 12  
*Subject(s) Taught:* Chemistry, Anatomy & Physiology,  
Biology

**Aimee Oyen**

Beulah Elementary  
Beulah, ND  
*Grade(s) Taught:* 3  
*Subject(s) Taught:* All Academic Areas

**Elizabeth Parliament**

Rutland Elementary School  
Rutland, SD  
*Grade(s) Taught:* 4  
*Subject(s) Taught:* General

**Ruthie Pederson**

South Middle School  
Grand Forks, ND  
*Grade(s) Taught:* Special Ed  
*Subject(s) Taught:* Reading, Math

**Molly Perkins**

Sunrise Elementary  
Bismarck, ND  
*Grade(s) Taught:* 4  
*Subject(s) Taught:* Math, Reading, Science, Social  
Studies, Writing, Health

**John Peterson**

Montpelier High School  
Montpelier, ND  
*Grade(s) Taught:* 7-12  
*Subject(s) Taught:* Math

**Torie Post**

Erik Ramstad Middle School  
Minot, ND  
*Grade(s) Taught:* 6-8  
*Subject(s) Taught:* Special Education - Emotional  
Disturbance

**Paul Prout**

Bakken Elementary  
Williston, ND  
*Grade(s) Taught:* 5 & 6/7-12  
*Subject(s) Taught:* Reading/language arts, Math,  
Science, Social Studies, High School Science, Boot  
camp, Social Skills

**Melanee Pulver**

Beulah High School  
Beulah, ND  
*Grade(s) Taught:* 9-12  
*Subject(s) Taught:* Physical Science, Chemistry,  
Physics

**Sheila Quick**

Mandan Middle School  
Mandan, ND  
*Grade(s) Taught:* 7  
*Subject(s) Taught:* ND Studies

**Matt Ragan**

Simle Middle School  
Bismarck, ND  
*Grade(s) Taught:* 6-8  
*Subject(s) Taught:* Math

**Deborah Reinowski**

Anamoose Drake Elementary  
Anamoose, ND  
*Grade(s) Taught:* 4-6  
*Subject(s) Taught:* Math and Science

**Joleen Risovi**

Maddock Public School

Maddock, ND

*Grade(s) Taught:* 4-8

*Subject(s) Taught:* Social Studies, ND History, Geography, Tech and Library

**Rhonda Roaldson**

Jamestown Middle School

Jamestown, ND

*Grade(s) Taught:* 6-8

*Subject(s) Taught:* TransMath Levels 1-3

**Joseph Roshau**

Northwest Area Schools

Isabel, SD

*Grade(s) Taught:* 9-12

*Subject(s) Taught:* Building Trades

**Ben Schiermeister**

Wachter Middle School

Bismarck, ND

*Grade(s) Taught:* 6

*Subject(s) Taught:* Physical Science

**Donna Schmit**

Kenmare Public School

Kenmare, ND

*Grade(s) Taught:* 6

*Subject(s) Taught:* All basic subjects

**Chad Schon**

St. Mary's Central High School

Bismarck, ND

*Grade(s) Taught:* 9-12

*Subject(s) Taught:* Social Studies and Health

**Dale Singer**

Spearfish Middle School

Spearfish, SD

*Grade(s) Taught:* 6-8

*Subject(s) Taught:* All

**Samantha Skinner**

Washington Middle School

Glendive, MT

*Grade(s) Taught:* 7

*Subject(s) Taught:* Science, Computer Technology

**Michelle Smith**

Centennial Elementary

Bismarck, ND

*Grade(s) Taught:* K-5

*Subject(s) Taught:* Reading & Math to gifted/talented students

**Brenda M. Stevens**

Parshall Elementary

Parshall, ND

*Grade(s) Taught:* 6

*Subject(s) Taught:* All subjects

**Chase Tyson**

Spearfish High School

Spearfish, SD

*Grade(s) Taught:* 9-12

*Subject(s) Taught:* Alt. Education, Lifetime Activities and Physical Education

**Pamela Wagner**

Wachter Middle School

Bismarck, ND

*Grade(s) Taught:* 6-8

*Subject(s) Taught:* Reading Strategies

**Gary Wald**

Maddock Public School

Maddock, ND

*Grade(s) Taught:* 7-12

*Subject(s) Taught:* Production Agriculture Education, Natural Resource Education, Wildlife Management, Agriculture Mechanics

**Angela Wescott**

Mandan Middle School

Mandan, ND

*Grade(s) Taught:* 8

*Subject(s) Taught:* Earth Science



**Marcia Wilkens**

Pioneer Elementary  
Bismarck, ND  
*Grade(s) Taught:* K-5  
*Subject(s) Taught:* Reading

**Terry Wilkins**

Divide County Elementary  
Crosby, ND  
*Grade(s) Taught:* 5-6  
*Subject(s) Taught:* 5th & 6th Math, 6th Grammar & Spelling

**Rachel Winckler**

Simle Middle School  
Bismarck, ND  
*Grade(s) Taught:* 6-8  
*Subject(s) Taught:* School Counselor

**Tod Winter**

Dickinson High School  
Dickinson, ND  
*Grade(s) Taught:* 9-12  
*Subject(s) Taught:* Art & Science

**Jane Wolf**

Wachter Middle School  
Bismarck, ND  
*Grade(s) Taught:* 6-8  
*Subject(s) Taught:* Library Media Specialist

**Tracy Wolf**

Wachter Middle School  
Bismarck, ND  
*Grade(s) Taught:* 6  
*Subject(s) Taught:* Social Studies

**Brad Wollum**

Wadena-Deer Creek Schools  
Wadena, MN  
*Grade(s) Taught:* 7-8  
*Subject(s) Taught:* 7th Grade Life Science & 8th Grade Earth Science

**Annette Zeller**

Selfridge High School  
Selfridge, ND  
*Grade(s) Taught:* 7-12  
*Subject(s) Taught:* Life Science, Earth Science, Physical Science, Biology, Chemistry, Physics, Anatomy, Meteorology

**John Zenz**

Watford City High School  
Watford City, ND  
*Grade(s) Taught:* 9-12  
*Subject(s) Taught:* Algebra, Geometry, Algebra 2, College Algebra

**Kasper Ziegler**

Burdick Job Corps  
Minot, ND  
*Grade(s) Taught:* Varies  
*Subject(s) Taught:* Carpentry/Construction

**Charlene Zins**

Mandan Middle School  
Mandan, ND  
*Grade(s) Taught:* 6  
*Subject(s) Taught:* Art & Health

**Dayna Zins**

Wachter Middle School  
Bismarck, ND  
*Grade(s) Taught:* 7  
*Subject(s) Taught:* ELA-speaking and listening standards

# Seminar Speakers

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## 2017 Lignite Education Seminar: Energy, Economics and Environment June 12-15, 2017

### Seminar Facilitator

**Kay LaCoe** is Director of Membership Marketing with the Lignite Energy Council. Kay joined the Lignite Energy Council in 2008 as a Communications Specialist. She is a graduate of the University of Mary with a Bachelor's of Science degree in Business Communications. Kay's background includes project management, writing, website development, graphic design, integrated marketing and social media management. Prior to joining the Council, Kay was a Communications and Marketing Coordinator at Agency MABU and an Intern at Basin Electric Power Cooperative. Kay lives with her husband, son and hunting dogs just outside of Bismarck. She is an avid hunter and also competes with her horse in the Cowboy Mounted Shooting Association.

### Lesson Plan Collaborative Work

**Terry Hagen** is the Instructor of Record for the Lignite Energy Council's Lignite Education Seminar. He will be grading your completed lesson plans. Terry is here today to discuss without some expectations of your lesson plans, suggestions on what to listen and look for in the upcoming days and answer questions you may have going into the Seminar regarding your lesson plans. Terry is an instructor at the University of North Dakota. He has a Master's degree in Regulatory Economics from the University of North Dakota. He has taught at the University of North Dakota and Lake Region State College since 1993 and has farmed the family farm west of Grand Forks since 1987. He has served on local Boards and on the Agriculture Advisory Committee for the 9<sup>th</sup> District Federal Reserve in Minneapolis.

### Lignite: The Region's Best Kept Secret

**Steve Van Dyke** has worked for the Lignite Energy Council since 2002 and is currently the vice president - communications. A 1980 graduate of the University of Montana's school of journalism, Steve has worked in the North Dakota energy industry since 1985. Prior to 2002, he worked for MDU Resources Group, Inc., as its corporate communications manager and contributed to the MDU history book: "The Mondakonians: Energizers of the Prairie." His background also includes working at newspapers in Beach, North Dakota; Baker, Montana; and Bismarck, North Dakota; along with serving as a community relations specialist with Mid-Rivers Telephone Cooperative in Glendive, Montana.

### North Dakota Geology: Coal Bearing Rocks in the Northern Great Plains

**Kendra Kungu** is originally from Dickinson, ND. She always loved the outdoors, playing in the dirt, and collecting rocks. Kendra attended Dickinson State University for 1 year, then transferred to South Dakota School of Mines and Technology in Rapid City, SD. She earned her Bachelor's Degree in Geological Engineering, graduating in 2009. She started at The Coteau Properties Company after graduation in 2009 and became a registered Professional Engineer in North Dakota in 2014. She has two sons.

## **Lignite Mining and Reclamation Process**

**Sarah Flath** is Environmental Manager for the Coteau Properties Company's Freedom Mine, the nation's largest lignite coal mine, located north of Beulah. She's worked for North American Coal in North Dakota since 1999. She started in Coteau's environmental and short range engineering departments, then worked for Coyote Creek Mine as part of the team to plan, permit and develop Coyote Creek Mine, the state's first new coal mine since the 1980's, before returning to Coteau as Environmental Manager. She serves on the American Society for Mining and Reclamation's National Executive Committee, the Mercer County Economic Development Board, the Hazen Chamber Board and has been a past president of the ND chapter of the Society for Range Management. She received her bachelor's degree in Range Science from North Dakota State University and her master's in Rangeland Ecosystem Science from Colorado State University. Sarah resides in Hazen, ND with her husband, Jesse, and their two daughters.

## **Electricity Generation Choices**

**John Bauer** is director, North Dakota generation, for Great River Energy. He oversees Great River Energy's generation facilities in North Dakota including Coal Creek Station, Spiritwood Station and Stanton Station. John attended the power plant technology program at Bismarck State College prior to starting his career at Great River Energy's Coal Creek Station in 1981 where he advanced through various operations positions before his most recent position as manager of North Dakota operations services. John currently serves on the power/process plant advisory board for Bismarck State College. As the "power plant" chair for the board, he provides recommendations on BSC's energy curriculum. He also serves as chair of the Electric Power Research Institute's operations management and technology program which collaborates and develops best practices on how people, process and technology can be best integrated to reduce cost, improve productivity and achieve safe, reliable, cost-effective and environmentally responsible power generation.

## **Synfuels Production from Lignite**

**Joan Dietz**, Dakota Gasification Company/Basin Electric Power Cooperative communications specialist, has worked for Dakota Gas and Basin Electric for nearly 32 years. Joan began her career at the Synfuels Plant, in Beulah, ND, working as a records management administrative assistant in August of 1984. She also worked in human resources prior to moving to the communications department in November 1988. Joan oversees various aspects of the communications department at the Synfuels Plant including external and internal public and employee communications. She administers the advertising program, the public tours program and publishes a weekly newsletter for the facility, as well as contributes to other company publications. She has worked at Dakota Gas' parent company, Basin Electric Power Cooperative offices in Bismarck, since December 2014 and travels to the Synfuels Plant site each week. Joan lives in Bismarck, with her husband, Jeff, after living in Hazen for 30 years. They have three adult children who live in the area, and one grandchild.

## **Transmission – Transporting Energy by Wire**

**Matthew Stoltz** earned a bachelor's degree in electrical engineering from North Dakota State University. He worked for the Western Area Power Administration in Loveland, Colorado and Boulder City, Nevada from 1986 through 1999. His positions with WAPA included transmission system planning, project management and operations and maintenance. He has worked for Basin Electric Power Cooperative in Bismarck, North Dakota, since 1999. He is the director of transmission services with Basin Electric and is responsible for transmission system planning, operations, and analysis.

## **Enhancing Lignite's Future through Research and Development**

**Mike Holmes** joined the Lignite Energy Council in December 2016 as the vice president of research and development. He had been the director of Energy Systems Development at the Energy & Environmental Research Center (EERC) in Grand Forks, where he oversaw fossil energy research areas. His principal areas of interest and expertise include CO<sub>2</sub> capture; fuel processing; gasification systems for coproduction of hydrogen, fuels, and chemicals with electricity; process development and economics for advanced energy systems; and emission control technologies. Prior to his work at EERC, Holmes spent 15 years working on coal-related research and development and commercial projects for Babcock & Wilcox, a major supplier of advanced energy and environmental technologies for the power industry. He received a master's of science degree in chemical engineering from the University of North Dakota and a bachelor's of science degree in chemistry and mathematics from Mayville State University. He is a member of the National Coal Council and has been an Executive Member and served on the Board of Directors of the Fuel Cell and Hydrogen Energy Association.

## **Economics and Electricity 101**

**Dr. Brian P. Kalk** is the Director of Energy Systems Development at the EERC, where he leads a multidisciplinary team of scientists and engineers focused on research, development, and commercialization of innovative energy technologies as they relate to coal utilization and emissions, carbon management, and alternative fuels and renewable energy. He holds a Ph.D. degree in Natural Resource Management and an M.S. degree in Environmental Engineering from North Dakota State University and a B.S. degree in Social and Political Science from Campbell University, Buies Creek, North Carolina. Dr. Kalk began his career in the Marine Corps, where he served overseas in Desert Storm, Bosnia, and Iraq. He retired in 2006 as a Major. Upon retirement, Dr. Kalk joined North Dakota State University, teaching courses in Natural Resources, Logistics, and Political Science. From 2009 to 2017, he served as a member and Chair of the North Dakota Public Service Commission, where he held portfolios in Electric Generation and Transmission, Pipeline Safety, and Telecommunications.

## **Energy and CO<sub>2</sub> Management: Carbon Capture and Storage**

**Dan Daly** is a research manager at the Energy & Environmental Research Center at the University of North Dakota in Grand Forks, ND. Dan earned a master's degree in geology from the University of North Dakota and has over 20 years of experience in issues related to energy and the environment. Since the fall of 2003, he has been the lead for public outreach and education with the Plains CO<sub>2</sub> Reduction Partnership (PCOR).

## **Plant Level Environmental Compliance**

**Craig Bleth** is a 1988 graduate of the University of North Dakota, with degrees in geological engineering and engineering management. He is a registered professional civil engineer in the state of North Dakota. Craig spent two years with the North Dakota State Water Commission before starting his career at Minnkota Power Cooperative, at the Milton R. Young Station in 1990. In his first 16 years at Minnkota Power, Craig worked mostly in the water and solid waste areas as a permitting and compliance engineer. From 2007 to 2011, Craig was named plant environmental superintendent, and project manager of a \$250 million dollar air pollution control upgrade project at the Young Station. After that, Craig led the plant engineering and environmental groups for several years. Craig is now Minnkota's Environmental Manager.

## **Lignite Industry Career Choices**

**Kent Ellis** took the scenic tour through college and graduated from the University of Northern Colorado. He began his energy career in 1980 as a contract petroleum landman in the Williston Basin; taught with the Bismarck Public Schools, served as the regional School-to-Work Coordinator and is currently the North Dakota's Energy Career Awareness Coordinator. He has significant professional career experience in the construction, energy and education industries. He is the owner of LS Hydrocarbyl, and a partner in White Butte Resources, an oil and gas development company. Kent also sits on the Great Plains Advisory Council for the Minneapolis Federal Reserve Bank.

## **Energy Sense**

**Tom Butz** has 30 years of both transmission and resource planning experience in the electric utility industry. Tom is currently employed with Power System Engineering as a Senior Planning Engineer, and is responsible for electric utility resource planning evaluations, Integrated Resource Plans, and a range of RTO market evaluations, including the MISO market. Tom's interest in strategic planning in the energy sector has spawned the beginning of the Energy Sense presentation, which has been presented to a number of conferences with updates based on the current energy trends.

## **Workforce Issues & Needs Panel Discussion**

### ***Moderator***

**Jason Bohrer's** background as an attorney, a communications director for the Idaho Republican Party and, most recently, chief of staff to U.S. Rep. Raul Labrador (R-Idaho) provide a diverse skillset in his role as president and chief executive officer of the Lignite Energy Council. He is a graduate of North Dakota State University and earned his law degree from George Mason University. For the past nine years he has lived in Washington, D.C. Besides his work with Rep. Labrador, he also is a former legislative counsel for U.S. Senator Jim Risch (R-Idaho).

### ***Panel Members***

**Dan Dorfschmidt** is Operations Manager for Butler Machinery in Western ND. Butler is your Caterpillar equipment dealer for North and South Dakota. During his career Dan has held various engineering and management positions in both the oil and gas and mining industries. Prior to joining the Butler Team, Dan was a Butler Machinery customer holding the position of Mine Superintendent at Goldcorp's Wharf gold mine in Lead SD. Dan has a degree in Geological Engineering from SD School of Mines.

**Bruce Emmil** is the Associate Vice President of the National Energy Center of Excellence at Bismarck State College. In this position, Bruce is responsible for the overall day-to-day operations of the NECE which consists of twelve Program Certificate and/or Associate in Applied Science degreed energy programs, one Bachelor of Applied Science in Energy Management degreed program and various non-credit energy training initiatives and apprenticeship programs. Before joining Bismarck State College in 2001, Bruce spent 13+ years working in the generation sector of the energy industry for Northeast Utilities.

**Jamey Backus** is the Plant Manager at the Leland Olds Station in Stanton, ND. He has worked at Leland Olds for nearly 10 years with roles including Results Engineer and Maintenance Superintendent. His responsibilities include the overall operation, maintenance and compliance of the station as well as workforce planning, labor relations, maintaining budgets and prioritizing capital expenditures. Prior to transferring to LOS he was a Mechanical Engineer at Dakota Gasification for 8+ years. He is originally from south eastern SD and has a degree in Mechanical Engineering from SD School of Mines.

**Jay Volk** is the environmental manager for BNI Coal where he has been employed for the last 11 years. His department's responsibilities include permitting, environmental compliance, land management, geology, and leasing. Prior to his mining career, Jay was involved in consulting and research. Jay earned a Ph.D. from North Dakota State University and is a native of Bismarck/Mandan.

**Kay LaCoe, Membership Marketing Director, Lignite Energy Council  
Seminar Facilitator**

**Attending the seminar today**

- 108 teachers from five states and one Canadian Province (as of June 1, 2017)
- 84 from North Dakota
- 13 from South Dakota
- 5 from Montana
- 2 from Wyoming
- 1 from Minnesota
- 1 from Iowa

**Things you will receive at the seminar**

- Binder: includes agenda, speaker bios, participant list, glossary, presentation worksheets and classroom activities
- Tour Folder: includes agenda for the day, photo list, evaluations of speaker and tour facilities that you will be visiting
- Resource Materials: Industry brochures (from all plants and mines), coal and ash samples, DVDs and information from UND-EERC – these items will be in a bag that we give you on the last day of the seminar

**Requirements to receive credit:**

- Must attend all sessions
- Submit lesson plans or summaries via email to: [terry.hagen@und.edu](mailto:terry.hagen@und.edu)
- Final work must be completed via email submission by end of day **July 7, 2017**
- **PLEASE SEE INCLUDED LETTER FROM TERRY HAGEN FOR MORE REQUIREMENTS**

**Other information:**

- UND, NDSU, or MSU Academic Credit – Must register online BY MONDAY, JUNE 12 – if it asks for payment, indicate Third Party Payer and they will bill the LEC.
- You CANNOT change your chosen school after you have registered or you will be charged.
- If you want a letter indicating you have completed 30 credit hours of training, let Kay know. Letters will be mailed in July.

**Transcript Request**

- They do not automatically send you a transcript. You must request it. All the information is in the binder under this tab – Transcript Information. You must pay \$5 by check or credit card to receive a transcript.

**Audience Response System**

- How you will respond to test questions and to speaker questions.
- This will also be how we take attendance so please respond to questions as that will tell us if you are here or not as we recorded the numbers on your devices.



**Welcome Teachers** to the Lignite Energy Council's Seminar. I'm am sure you will find it both enjoyable and informative!

Things to know:

- NDSU is letter grading **ONLY**
- UND is **EITHER** a letter or S/U grading
- Minot State is **ONLY** an S/U grade
- You cannot change the school with which you registered after the Seminar has begun

#### **Requirements to receive credit:**

Some of you need your grade recorded promptly to satisfy contractual qualifications so I cannot turn grades in late. **Anyone who is late will suffer at least one drop in your grade**, for instance a B to a C or an A to a B. **Anyone more than a week late will get an incomplete**. Which is a paperwork hassle so please do everything you can to get them to me on time!

- Must attend **all** sessions
- **Letter Grade:**
  - If you are taking this for a letter grade, I am requiring that you prepare a lesson plan based on at least one of the presentation topics and related to the Lignite industry. This is for **two professional development graduate credits**. Expect more than a couple paragraphs.
  - A rubric included so you know how they will be graded if you are taking for a letter grade
  - To achieve an (A) grade, there must be a rubric incorporated into the lesson plan. If the lesson plan is lacking a rubric, I will start at a (B) grade for your paper. I have included a template for you to follow for your rubric for those who feel they need some guidance. The rubric does not need to follow that exact form.
    - The definition of a Rubric (from Merriam Webster is: A guide listing specific criteria for grading or scoring academic papers, projects or tests.) A good website for learning how to set up a rubric is <http://www.ASCD.org>. I am sure there are many others as well.
  - Submit lesson plans via email to: [terry.hagen@und.edu](mailto:terry.hagen@und.edu)
  - Lesson plans must be completed via email submission by end of day **July 7, 2017**

***Satisfactory/Unsatisfactory instructions on second/back of this page.***



- **Satisfactory/Unsatisfactory:**

- Summary of each of the presentations. The summary should be at least a paragraph from each of the presentations and activities sponsored by the Lignite Council this week.
- Email your summary to [terry.hagen@und.edu](mailto:terry.hagen@und.edu) by end of day **July 7, 2017**.

Remember that if you want S/U grading, all I need from you is a summary of each of the presentations. The summary should be at least a paragraph from each of the presentations and activities sponsored by the lignite council this week.

I reserve the right to send anything back for rewriting that does not meet my requirements.

Enjoy your week in Bismarck and all the great presentations and the trip to the mines. Remember to thank the Lignite Energy Council team for all of their hard work to put this Seminar together. They do a great job!

Terry Hagen  
University of North Dakota  
Box 8369 ▪ Grand Forks, ND 58202  
[terry.hagen@und.edu](mailto:terry.hagen@und.edu)

### Rubric Template

Criterion (Score 0 if element is absent)	Below Expectations (1)	Meets Expectations (2)	Exceeds Expectations (3)	Score
Identify each grading element or criterion (example of a criterion element and descriptors follow below)	Describe typical problems, weaknesses, or errors that characterize student work that does not meet expectations for the assignment.	Describe characteristics of student work that meet expectations for quality on this criterion.	Describe characteristics of student work that make a submission stand out as exemplary work.	
Use of evidence to support assertions	Assertions based on personal opinion only. Assertions are based on empty citations: citation information is given as support for an assertion but no information is provided about the content of the cited work or how or why the cited work/author supports the assertion made. Factual errors: the cited work does not actually support the assertion made in the assignment and/or is described inaccurately.	Assertions are supported with appropriate evidence. Appropriate evidence includes an interpretation of empirical data, description of arguments and evidence presented in a scholarly source that supports the assertion (with appropriate citation of the source). Evidence provided in support of an argument is described and interpreted correctly.	Assertions supported with evidence (as described in <i>meets expectations</i> ). Assertions are supported with multiple sources of evidence based on primary sources. When relevant, opposing positions are considered and arguments discounting these positions are supported with relevant scholarly evidence. Synthesizes evidence to draw new, relevant, logical inferences.	
Criterion 2	Descriptions of typical problems	Descriptions of expectations for this criterion for the assignment	Descriptions of qualities that characterize exemplary work	
Criterion 3	Descriptions of typical problems	Descriptions of expectations for this criterion for the assignment	Descriptions of qualities that characterize exemplary work	
<b>TOTAL</b>				

# Sample Rubrics Packet

From Dannelle D. Stevens, Ph.D.,

## 3 to 5 level Rubric Example

Changing Communities in Our City

Task Description: Each student will make a 5 minute presentation on the changes in one Portland community over the past 30 years. The student may focus the presentation in any way s/he wishes, but there needs to be a thesis of some sort, not just a chronological exposition. The presentation should include appropriate photographs, maps, graphs, and other visual aids for the audience.

	Excellent	Competent	Needs work
Knowledge/ Understanding  20%	<b>The presentation demonstrates a depth of historical understanding by using relevant and accurate detail to support the student's thesis.</b>  <b>Research is thorough and goes beyond what was presented in class or in the assigned texts.</b>	<b>The presentation uses knowledge which is generally accurate with only minor inaccuracies, and which is generally relevant to the student's thesis.</b>  <b>Research is adequate but does not go much beyond what was presented in class or in the assigned text.</b>	<b>The presentation uses little relevant or accurate information, not even that which was presented in class or in the assigned texts.</b>  <b>Little or no research is apparent.</b>
Thinking/ Inquiry  30%	<b>The presentation is centered around a thesis which shows a highly developed awareness of historiographic or social issues and a high level of conceptual ability.</b>	<b>The presentation shows an analytical structure and a central thesis, but the analysis is not always fully developed and/or linked to the thesis.</b>	<b>The presentation shows no analytical structure and no central thesis.</b>
Communication  20%	<b>The presentation is imaginative and effective in conveying ideas to the audience.</b>  <b>The presenter responds effectively to audience reactions and questions</b>	<b>Presentation techniques used are effective in conveying main ideas, but a bit unimaginative.</b>  <b>Some questions from the audience remain unanswered.</b>	<b>The presentation fails to capture the interest of the audience and/or is confusing in what is to be communicated.</b>
Use of visual aids	<b>The presentation includes appropriate and easily understood visual aids which the presenter refers to and explains at</b>	<b>The presentation includes appropriate visual aids, but these are too few, in a format that makes them difficult to use or understand, and/or the</b>	<b>The presentation includes no visual aids or visual aids that are inappropriate, and/or</b>

20%	<b>appropriate moments in the presentation.</b>	<b>presenter does not refer to or explain them in the presentation.</b>	<b>too small or messy to be understood.</b> <b>The presenter makes no mention of them in the presentation.</b>
Presentation skills  10%	<b>The presenter speaks clearly and loudly enough to be heard, using eye contact, a lively tone, gestures, and body language to engage the audience.</b>	<b>The presenter speaks clearly and loudly enough to be heard, but tends to drone and/or fails to use eye contact, gestures, and body language consistently or effectively at times.</b>	<b>The presenter cannot be heard and/or speaks so unclearly that s/he cannot be understood.</b> <b>There is no attempt to engage the audience through eye contact, gestures, or body language.</b>

Figure 1.6: Part Four: 3 Level Rubric: Description of Dimensions with all levels of performance described.  
 © Stevens, D. D. & Levi, A. J. (2005). *Introduction to Rubrics*. Sterling, VA: Stylus Press.

# Scoring Guide Rubric Example

## Changing Communities in Our City

Task Description: Each student will make a 5 minute presentation on the changes in one Portland community over the past 30 years. The student may focus the presentation in any way s/he wishes, but there needs to be a thesis of some sort, not just a chronological exposition. The presentation should include appropriate photographs, maps, graphs, and other visual aids for the audience.

	Exemplary Performance	Comments	Pts.
Knowledge/ Understanding  20%	<p>The presentation demonstrates a depth of historical understanding by using relevant and accurate detail to support the student's thesis.</p> <p>Research is thorough and goes beyond what was presented in class or in the assigned texts.</p>		
Thinking/ Inquiry  30%	<p>The presentation is centered around a thesis which shows a highly developed awareness of historiographic or social issues and a high level of conceptual ability.</p>		
Communication  20%	<p>The presentation is imaginative and effective in conveying ideas to the audience.</p> <p>The presenter responds effectively to audience reactions and questions</p>		
Use of visual aids  20%	<p>The presentation includes appropriate and easily understood visual aids which the presenter refers to and explains at appropriate moments in the presentation.</p>		

Presentation skills  10%	The presenter speaks clearly and loudly enough to be heard, using eye contact, a lively tone, gestures, and body language to engage the audience.		
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Figure 1.5: Part Four: Scoring Guide Rubric: Description of Dimensions at highest level of performance.  
© Stevens, D. D. & Levi, A. J. (2005). *Introduction to Rubrics*. Sterling, VA: Stylus Press.

**Creative Expressions- Adding/affirming diversity 15 Points**

Application of what we know and can learn from our increasingly diverse student population is imperative. Honestly facing our own biases and reactions and grappling with them is very important. The arts, in particular, provide an avenue of comprehension and expression that often reveal our deeper values. Thus, you are expected to do ONE of the following:

Attend Lecture by Antonia Darter on January 16- take notes

OR Go to a foreign film (with English subtitles preferred)

OR Read a book furthering your understanding of diverse students or written by \_\_\_\_\_ a person from another culture

THEN... create an expression of your response to this experience of otherness that relates somehow to the lecture or debate/discussion themes in the class. This could be a POSTER, A POEM, A PIECE OF MUSIC, A PIECE OF ART, FOOD or A STORY. To make the connection to the class clear to other audiences, either add a written narrative piece to the work or tell us how this directly relates to the class.

For the last class we will share these connections with one another.

<b>Dimension</b>	<b>Description</b>	<b>Comment</b>	<b>Points</b>
<b>TOPIC &amp; OUTLINE</b>	Paragraph description of project Details of project, type of project, Link to class topic clear		2
<b>Content</b> Karen Dianna Jana Gwenda Tanya Denise Chisa Karen	Clear focus of Project- what lecture, reading, movie inspired the idea Grabs attention right from the beginning Identifies a significant cultural difference Describes values of that difference to the culture Describes how you viewed previous assumptions of the culture Includes brief summary of the movie, book Describes clear purpose behind this choice Clear connection to adding/affirming diversity		5
<b>Organization</b> Lori Sheila Debbie Tanya Julie	Clear beginning, middle, end Understandable to others, not confusing Clear directions and wrap up! Easy to see connections to adding/affirming diversity Clear link to class topics		2
<b>Creativity</b> Lori Gwenda Sherrie Tanya Chisa Bobbi Jennifer	Puts together a presentation that is "out of your comfort zone" Expresses emotional response Open/honest Attractive Visually pleasing Creates at least half of the images Obvious extra effort (not copied pages) Authenticity and uniqueness of effort		3

Brad	Thought/provoking Original Strong expression of "otherness"		
<b>Reflection</b> Bobbi Brad	Indication of how your perceptions and assumptions have changed Indicates how this might affect your future teaching and adding/ affirming diversity in your life		2
<b>Conventions</b> Sheila Chisa, Gwenda	All grammar, spelling, punctuation correct Neatly presented If typed, double-spaced and pages numbered.		1

PUT CHECK MARKS BY THOSE CRITERIA FOR THIS ASSIGNMENT

© Stevens, D. D. & Levi, A. J. (2005). *Introduction to Rubrics*. Sterling, VA: Stylus Press.



# NDSU TRANSCRIPTS

## OFFICIAL TRANSCRIPT REQUEST & ORDERING INSTRUCTIONS

Students and K-12 teachers who need an official copy of their transcript should order through [www.getmytranscript.com](http://www.getmytranscript.com) (secured site) and select North Dakota State University.

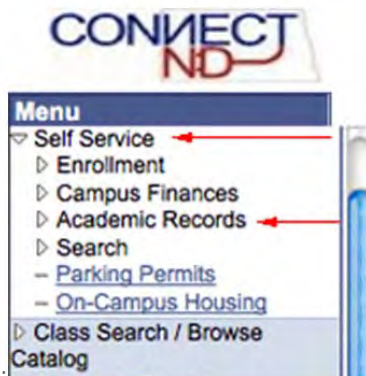
Students who are admitted to NDSU may also order their transcript through [Campus Connection](#). Students who are enrolled in K-12 teacher training classes designated as 600 (ex. EDUC 600) are not be able to order their official transcript through [Campus Connection](#) and must order through [www.getmytranscript.com](http://www.getmytranscript.com).

Reminder about transcript ordering: Individuals are encouraged to review their unofficial transcript to ensure all grades are posted prior to ordering an official transcript.

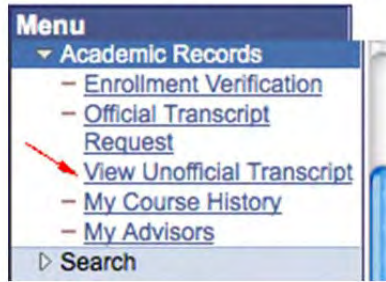
## UNOFFICIAL TRANSCRIPT ORDERING INSTRUCTIONS

To view or print unofficial copies of your transcript follow these directions exactly as stated to ensure you are viewing the most up-to-date version of your unofficial transcript.

1. Enter User ID & Password to login to [Campus Connection](#).  
To obtain your emplid, follow the directions at the bottom of this page.  
To obtain a username and password, follow the [directions listed on the NDSU Registration and Records website](#).
2. Under menu, click self service.



3. Then click academic records.



4. Then click view unofficial transcript.

5. In the next screen, choose North Dakota State University for the academic institution and choose either of the following options for the report type, then click the view report button.

**Unoff PDF Transfer Details** — (long form) displays detailed information about transferred courses

**Unoff PDF Transfer Summary"** — (short form) displays only a summary of transferred credits

### View Unofficial Transcript

Choose an institution and report type and press View Report

**\*\*this process may take a few minutes to complete. please do not press any other buttons or links while processing is taking place\*\***

Academic Institution: North Dakota State Universit  
Report Type: [Dropdown menu]  
Information For Student: [Dropdown menu]

view report

Unoff PDF Transfer Details  
Unoff PDF Transfer Summary

Note: Do not click on view all requested reports because you may be viewing unofficial transcripts prior to a grade being posted.



## WHAT IF I DO NOT KNOW MY USER ID AND PASSWORD?

To obtain your User ID follow the [instructions for obtaining your user id and password](#)

## WHAT IF I DO NOT KNOW MY EMPLID (STUDENT ID)?

To obtain your EMPLID you will need to follow these directions.

1. Go to [Campus Connection](#).
2. Under Menu click "What is My EMPLID" link.
3. Fill out information & submit, Write down your User ID.

**Note:** Your EMPLID will be a seven digit number. You may be asked for this number when communicating with our office.

Need assistance? If you need assistance in setting up your User ID and Password please contact the North Dakota University System help desk by phone at 1-866-457-6387 or by email at [NDUS Helpdesk](#)

# UND Transcript Request Information

An official transcript is the University's certified statement of your academic record. The official transcript is printed on security sensitive paper and includes the University seal and the signature of the Registrar. Potential employers, graduate schools, other universities or colleges, and professional associations most typically request that the student authorizes release of an official transcript. For your protection, we will not release an official transcript without your signature. For information on transcript codes see the [Explanatory Legend and Authenticity Confirmation Information](#), which is also provided on the back of an official transcript.

Current students with online Campus Connection access may view and print UNOFFICIAL transcripts **free** of charge at any time via the Campus Connection portal.

**NOTE:** If you are a former student that does not have a NDUS Account (firstname.lastname), you will need to order an official transcript. Former students that have already claimed their NDUS Account may contact UND Tech Support at (701) 777-6305 if they need assistance signing into their Campus Connection portal.

The University of North Dakota has authorized the National Student Clearinghouse to provide official transcript ordering via the Web. Transcripts are transmitted through US Mail and FedEx (extra fees apply) ONLY. You will need a valid major credit card and an e-mail account to order a transcript on-line. You can order official transcripts using any major credit card. Your card will only be charged after your order has been completed. The cost per transcript is \$5.00. There is an additional charge for Federal Express and rush order delivery options.

This service provides the following:

- Convenient access 24 hours a day, seven days a week.
- You can order as many transcripts as you like in a single session.
- Order updates will be emailed to you.
- You can also check the order status or history online.

## Ordering Transcripts Online

### Currently Enrolled Students

1. Login to [Campus Connection](#)
2. Go to Self Service > Academic Records > Official Transcript Request

## Official Transcript Fees

Cost per transcript	\$5.00
FedEx	United States Delivery Option is an additional charge of \$20.00 Canada/Mexico Delivery Option is an additional charge of \$35.00 International Delivery Option is an additional charge of \$45.00
Rush Orders	Transcript requests received on a business day by 3 PM CST will be available for pick up at the Registrar's Office the next business day. There is an additional fee of \$20 for rush orders.

## Holds

We are unable to fulfill transcript requests for students who have a financial hold. University policy prohibits official transcripts for any student indebted to the University.

## Ordering Transcripts by Mail

If you do not have access to a computer or do not have a credit card you may complete our Transcript Request form to insure that all required information is provided. The Transcript Request form can be found on our [Forms to Print](#) page. Please print, complete, sign and then mail (along with payment) to:

Office of the Registrar  
Twamley Hall Room 201  
264 Centennial Drive, Stop 8382  
Grand Forks, ND 58202-8382

If you cannot use the Transcript Request form above, please send a letter to the Office of the Registrar including the following information:

1. Your full name as it appears on your record. Indicate any other names you may have used while a student at the University of North Dakota.
2. Your Date of Birth
3. Your student ID number
4. Your address and telephone number
5. The approximate dates you attended the University of North Dakota
6. Address of transcript recipient
7. Enclose payment of \$5.00 per transcript ordered. Once your order is received by our office, your transcript will be mailed to recipient via regular 1st class US mail within 3-5 business days of order.
8. Federal Express delivery option is an additional charge of: \$20.00 for FedEx United States, \$35.00 for FedEx Canada/Mexico, and \$45.00 for FedEx International. Orders for Federal Express overnight delivery will be processed the same day if received by 3:00 PM Central Time.
9. Your signature and the date

# Minot State Transcript Request Information

## General Ordering Information

- \$5 per transcript, unless special ordering options are chosen. Only U.S. Funds are accepted.
- Transcripts will not be processed if a Business Office hold (delinquent account) has been placed on a student's account.
- Business Office holds must be cleared within 30 days of the receipt of the request. After 30 days, your order will be canceled and you will need to submit a new transcript request.
- Transcripts are mailed general USPS unless the FedEx option is chosen.
- Transcript requests cannot be accepted over the phone.
- Photo ID is required to pick up transcripts.
- Former MSU-Bottineau students should contact Dakota College at Bottineau directly with transcript orders.
- You can upload documents to be included with your transcript. These forms must contain a barcode. Any other documents will not be mailed with your transcript.
- Faxed transcripts are unofficial. Verify the type of transcript needed before requesting a copy to be faxed.
- Current and former students with online CampusConnection access may view and print an unofficial transcript free of charge through CampusConnection (Self Service>Academic Records>View Unofficial Transcript).
  - **NOTE:** Unofficial transcripts are only available online for students who were enrolled at MSU Fall 2005 or later.

**NOTE:** Unofficial transcripts are only available online for students who were enrolled at MSU Fall 2005 or later.

## Delivery and Payment Options

### Regular Delivery Methods:

#### General USPS Mail - \$5\* per Transcript

Once the transcript request is received in the Registrar's Office, your transcript will be processed and mailed from the Registrar's Office within 2-3 business days.

#### Hold for Pick up - \$5\* per Transcript

Once the transcript request is received in the Registrar's Office, your transcript will be available for pick up within two business days in the Registrar's Office. Photo ID is required for pick up.

### Rush Delivery Methods:

#### Official Mail/Unofficial Fax Combo (Same Day) - \$5\* per Transcript + \$10 Rush Fee

Once the transcript request is received in the Registrar's Office, your transcript will be processed and an unofficial transcript can be faxed the same day. The transcript will be shipped General USPS.

**Hold for Pick up (Same Day) - \$5\* per Transcript + \$10 Rush Fee**

Once the transcript request is received in the Registrar's Office, your transcript will be processed and available for pick up an hour after request is received. Photo ID is required for pick up. An unofficial transcript can be faxed.

**FedEx within the Continental U.S. - \$5 per Transcript + \$10 Rush Fee + \$15 FedEx Fee**

Once the transcript request is received in the Registrar's Office, your transcript will be processed and sent via FedEx to the destination. The FedEx tracking number will be sent to your email address. An unofficial transcript can be faxed.

**FedEx Internationally, HI, & AK - \$5 per Transcript + \$10 Rush Fee + Exact FedEx Fee**

Once the transcript request is received in the Registrar's Office, your transcript will be processed and sent via FedEx to the destination. The FedEx tracking number will be sent to your email address. An unofficial transcript can be faxed. You will be contacted with the total payment amount before your card will be charged.

NOTE: The FedEx option is not available on the National Student Clearinghouse. If you would like to FedEx an official transcript then you will need to complete the Minot State University Transcript Request Form.

\*Online orders require an additional \$2.25 convenience fee.

**TRANSCRIPT ORDERING****OPTION #1 - ONLINE****Current Students:**

Minot State University has authorized the **National Student Clearinghouse** to provide official transcript ordering securely online at anytime. You must have a major credit/debit card (Visa, MasterCard, or Discover) and a valid email account to request your transcript online. Your card will be charged only after your order has been completed.

The online service allows you to:

- Order as many transcripts as you like in a single session.
- Track your order status
- Receive timely email notices regarding your transcript request
- Review your order status history

Log into [CampusConnection](#)

Click on:

1. Self Service
2. Academic Records
3. Order Transcript
4. Minot State University
5. Order Official Transcript (This will direct you to the NSLC secured site)
6. Order
7. Complete the 5 step request process.

**Former and Alumni Students:**

Students who do not have a CampusConnection account may order official transcripts directly from the National Student Clearinghouse site.

- Go to: [www.studentclearinghouse.org](http://www.studentclearinghouse.org)
- Click Order
- Complete the 5 step request process.

**OPTION #2 - MAIL/FAX**

[Printable Transcript Request Form](#) [pdf]

Mail Payment and Request to:

Minot State University  
Attn: Registrar's Office  
500 University Ave W  
Minot, ND 58707

Fax: 701-858-3386

**OPTION #3 - IN PERSON**

Transcripts should be picked up in the Registrar's Office, 1st floor of the Administration Building.

**Transcript Resend Policy**

A student will be allowed one transcript resend to a company/school address as indicated on the initial transcript request with an address verification. The resend request will only be granted within 2-4 weeks of the initial request if it has not been received by the company/school. If a student wants the resend to occur prior to the 2-4 week waiting period, he/she must pay \$5.00 for the official transcript to be sent.

Resends will not be processed after modifications to the official transcript have been made (i.e. grade postings, degree postings or grade changes) and cannot be resent to a personal address.

If the transcript is going to a different address, it will be considered a new request and the student will have to pay the \$5.00 for official transcripts.



# Lignite: The Region's Best Kept Secret!

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*Steve Van Dyke –Vice President - Communications | Lignite Energy Council*

How much coal in North Dakota? \_\_\_\_\_. In the nation? \_\_\_\_\_

North Dakota produced \_\_\_\_\_ of lignite coal in 2014, or the equivalent of \_\_\_\_\_ barrels of oil – or enough energy to run \_\_\_\_\_ cars for a year.

The fact that if one power plant goes down for maintenance or goes off-line the transmission grid will still function is an example of \_\_\_\_\_.

Lignite-based plants are \_\_\_\_\_, which means we do not ship our coal by train, but rather by “wire”.

## History – Four distinct stages of coal mining in North Dakota

- 1873 – 1900 \_\_\_\_\_
- 1900 – 1920 \_\_\_\_\_
- 1920 – 1951 \_\_\_\_\_
- 1952 – present \_\_\_\_\_

## Present-day North Dakota Power Plants and Gasification Plant:

_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

## Present-day North Dakota/Eastern Montana Lignite Mines:

_____	_____
_____	_____
_____	_____

North Dakota has produced about \_\_\_\_\_ of lignite each year since 1985.

\_\_\_\_\_ of North Dakota's electricity is exported, supplying about \_\_\_\_\_ of Minnesota's electricity.



# **Classroom Activity**

## **Lignite Economics: Jobs, Business Volume, Tax Revenue**

---

### **Lesson 1 -- Illustrate how each direct employee results in an additional 3 indirect employees**

MN-DAK Mining Company -----      Sells six tons of coal at \$11/ton = \$66.00  
Give President \$66 for coal purchase

President pays Tax Commissioner for Severance and Conversion Taxes (\$1/ton) = \$6.00

President hires Self & two employees (3 X \$5) = \$15.00

Hires 3 Businesses to provide goods & services - gives them each \$15 (\$45 total)

Each business has a total of 3 employees (Owner + 2)  
(Each employee receives \$5)

\*3 Mining Company Employers = 9 Indirect Employees

### **Lesson 2 -- Illustrate how dollar circulates in economy (\$1 = \$3)**

Each employee (12) names personal goods or services needed -- pays businesses \$1 earned for desired goods and services

36 people plus Tax Commissioner now involved

### **Lesson 3 -- Illustrate how expenditures, salaries result in tax revenue and how tax revenue is used for services**

12 employees -- pay \$1 to Tax Commissioner (20% tax bracket)

Tax Commissioner (\$18) identifies various service and pays each service \$1

### **Summary of \$66**

\$12 -- keep for savings (Original 3 miners)

\$36 -- keep for savings (Identified 9 contractor/suppliers for goods and services)

\$12 -- Tax Commissioner (Personal and income tax)

\$ 6 -- Severance and Conversion Tax

\$66 -- Total

# Classroom Activity: Lignite Economics

## JOBS



=



Direct Job

Indirect Jobs

## BUSINESS ACTIVITY



## TAX REVENUE

*Tax \$ = Services*

## **Lignite Industry Contractors and Suppliers**

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**Heavy equipment supplier**

**Coal testing lab**

**Fuel supplier**

**Engineering services**

**Earthwork contractor**

**Legal services**

**Machine shop services**

**Maintenance services**

**Utilities (electricity)**

**Transportation services**

**Parts supplier**

**Explosives supplier**

**Environmental consultant**

**Tire supplier**

# **Lignite Industry Business Activity Generated**

---

**Doctor**

**Rent**

**Dentist**

**Bank (car or house payment)**

**Grocer (food)**

**Credit card payment**

**Telephone**

**Insurance payment**

**Gas/electricity**

**Home repairs/improvements**

**Water**

**Vacations**

**Clothing**

**Sporting events**

**Car repair/maintenance**

**Toys for children**

**Gasoline**

**New car or truck**

**Movies**

**Electronics (TV, stereo, home computer)**

# **Life Before & After Electricity**

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## **Classroom Activity**

Assign each student in a grade school or high school class to write a paper on what life was like just before a customer received electricity, and on what life was like just after a customer first received electricity. Have each student contact a senior citizen that they know, whether it be one of their grandparents or a neighbor (an alternative would be to talk to someone who has knowledge of such an experience, for example, someone who works in the energy industry, or someone who has heard about this experience many times from their parents). Ask this person questions such as:

- What was life like before electricity? How did you wash clothes, prepare food, read at night, dry your hair, etc.? Also, how did you get your work done, whether it be at a business or farm?
- When did you first get electricity? What did you have to do in order to be able to use that electricity (wire home, outlets)? What fuel source provided that electricity (lignite, hydro, etc.)?
- What were your first uses of electricity at your home and business/farm?
- Did the public eagerly anticipate the use of electricity, or were some people skeptical of its use?
- Do you have any personal experiences of electricity generated from lignite, whether it be working in the industry, or living near where it is generated?

Have the students write a report based on the interview with a senior citizen. Reports should be longer for high school students. An additional activity may be to have the students give a short oral presentation to the class on what they learned.

# North Dakota Geology

*Kendra Kungu, P.E. –Geological Engineer – Coteau Properties Co. Freedom Mine*

## Definition of Coal:

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What modern state has a climate that was similar to North Dakota’s climate during peat formation 55-60 million years ago? \_\_\_\_\_

In the United States, there is an estimated recoverable coal reserve of \_\_\_\_\_ short tons.

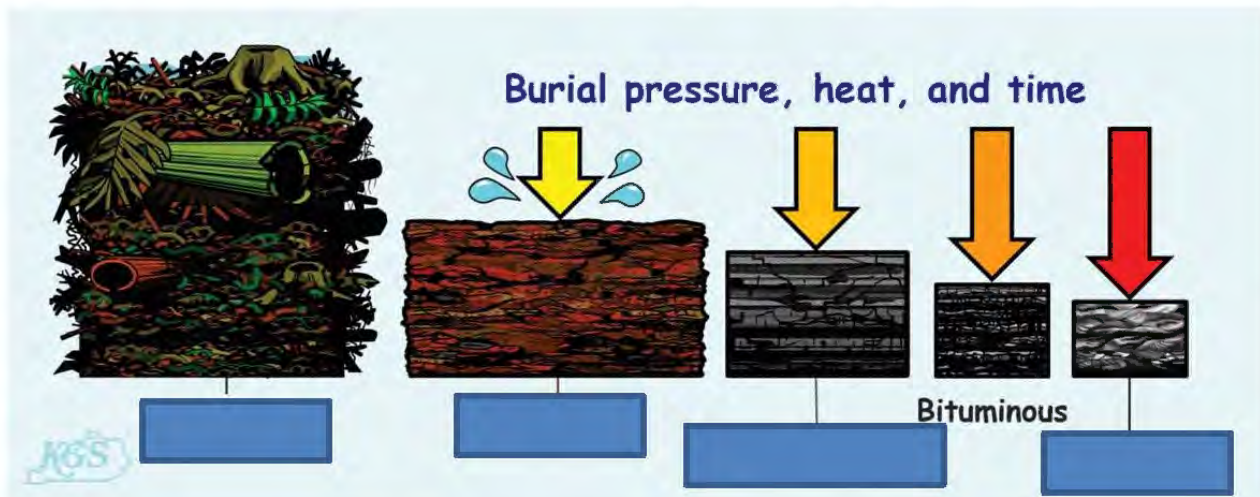
North Dakota contains an estimated \_\_\_\_\_ billion tons of economically mineable coal, enough to last for over \_\_\_\_\_ years at the present rate of about \_\_\_\_\_ million tons per year.

What group does the Sentinel Butte Formation belong to?

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The Sentinel Butte Formation generally consists of \_\_\_\_\_, \_\_\_\_\_ and \_\_\_\_\_ deposits and is located in the \_\_\_\_\_ Basin.

Fill in the blanks:



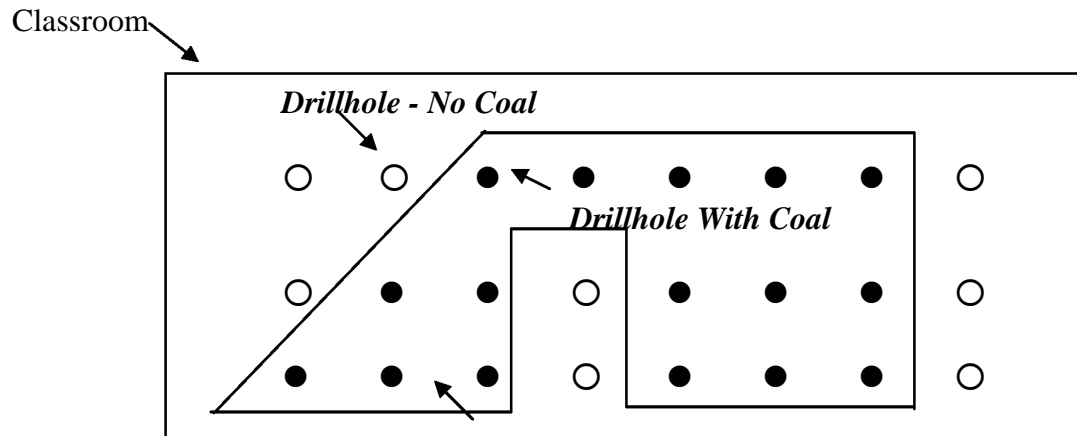
When was the latest Glaciation episode? \_\_\_\_\_ years ago.





## Geology Drilling Activity

This exercise allows the teacher to use the classroom as a potential mining property with each student becoming a potential drilling site. Hand each student a sheet of paper face down with either the words "COAL" or "NO COAL" written on them. Do not let the students turn over the sheets. The diagram below gives an example of where to hand out the "COAL" and "NO COAL" sheets. The teacher can modify this diagram to fit his/her actual classroom. Have the students decide where to drill the first hole and have the student turn over his sheet. Use a blackboard with a diagram of the room to show the location and if the student found coal. Ask where the students will drill next. As holes with and without coal are encountered, draw a line showing where the edge of the coal is. Until the first "NO COAL" hole is encountered, there should be coal everywhere. Modify the edge of the coal line as more drillholes are selected. The students should soon realize that as more drilling is completed, the edge of the coal line becomes more defined. Also, "NO COAL" areas within the field as shown in the diagram below can be identified.



## Cookie Mining Activity

Purpose: The purpose of this exercise is to give the player an introduction to the economics of mining. This is accomplished through the player purchasing "property" and "mining equipment," paying for the mining of the "ore," and for any reclamation costs. In return, the player receives income from the "ore" mined. The objective of the game is to make as much profit as possible.

### Instructions:

1. Each player receives a Mining Income and Expense Sheet and a sheet of grid paper.
2. Each player purchases his/her mining property (Cookie). Available properties include:

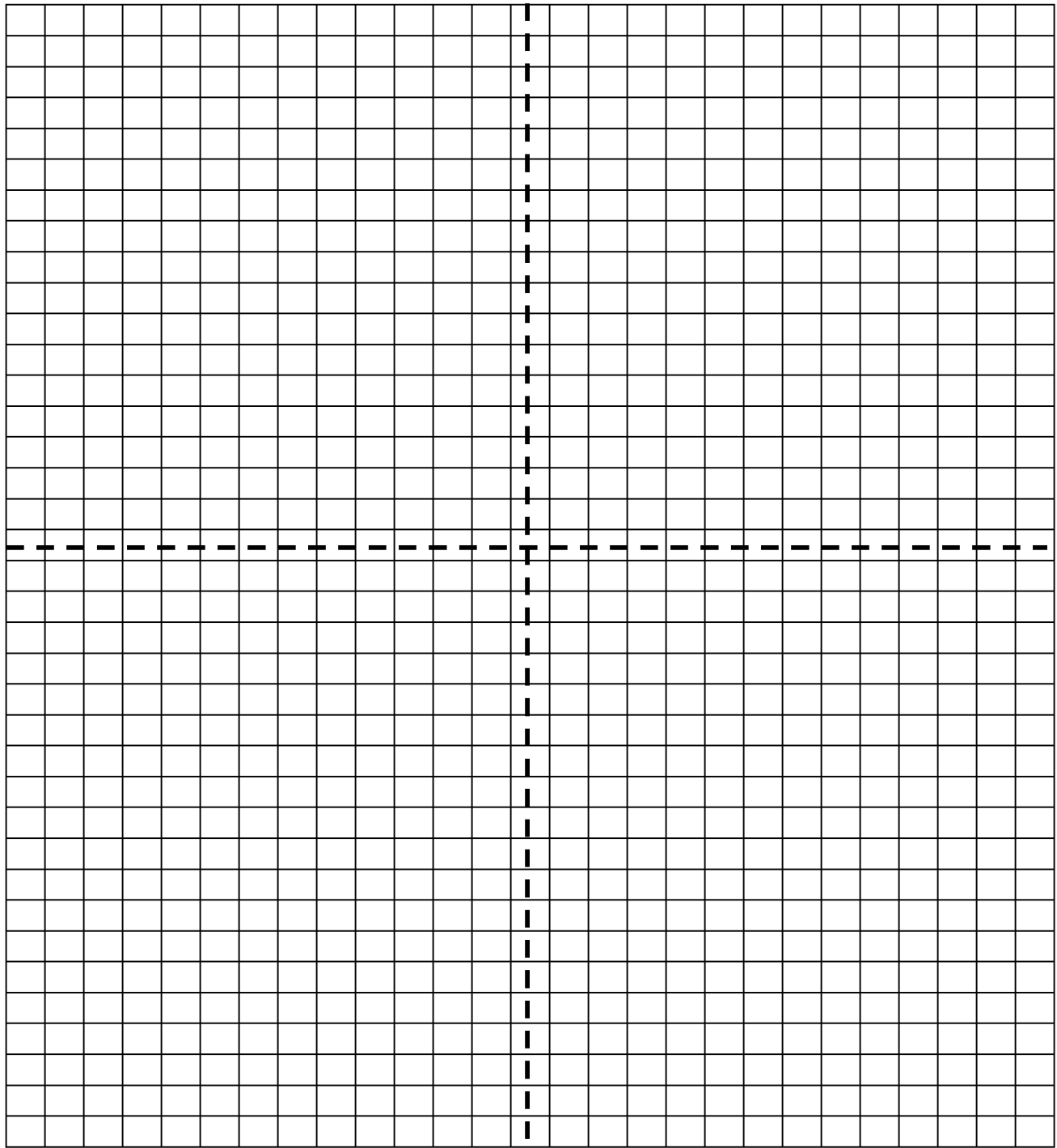
Brand X Cookie	\$2.00
Chips Ahoy	\$4.00
Chips Deluxe	\$6.00
3. The cookie is placed on the grid paper and the outline traced with a pencil. This outlines the limit of mining.
4. Each player then purchases his/her mining equipment. More than one piece or type of equipment may be purchased. Available mining equipment includes:

Flat Toothpick	\$1.00
Round Toothpick	\$2.00
Paper Clip	\$3.00
5. Each player uses his/her own equipment; equipment cannot be shared. Also, broken equipment cannot be replaced.
6. Mining costs are \$2.00 per minute. Each player declares when mining is complete at which time an inspector will state actual mining time. Before declaring mining complete, player should reclaim the mining area by moving all waste inside the cookie circle or a reclamation penalty of \$1.00 per grid square will be assessed.
7. "Ore" Chips should be moved outside the mining limit then counted for sale. Regular chips bring \$2.00 per chip while Deluxe chips bring \$3.00 per chip. Broken chips may be combined to make 1 whole chip.
8. Mining must be completed utilizing tools only, no hands or fingers are allowed to touch the "property" or "ore."
9. After completion of mining, player tallies up his/her income and expenses to determine if a profit or loss was made. Player may then consume all ore and waste.

Review: The game provides the player an opportunity to make a profit utilizing a mining property and the resources provided. Decisions are made by the player to determine which property to buy and which piece or pieces of mining equipment to purchase.

The player will learn a simplified cash flow for an operating mine. Also, the player will learn about the difficulty of reclamation, especially in returning the cookie back to its original size rather than be assessed a penalty.

**Cookie Mining (continued)**  
**cut this grid paper in four parts**



# Mining Income and Expense Sheet

\_\_\_\_\_ Mining Company

Expenses

## Mining Claim

Brand X \* \$2.00 = \_\_\_\_\_

Chips Ahoy \* \$4.00 = \_\_\_\_\_

Chips Deluxe \* \$6.00 = \_\_\_\_\_

Total Mining Claim Expense:

## Capital Equipment

Flat Toothpick \* \$1.00 = \_\_\_\_\_

Round Toothpick \* \$2.00 = \_\_\_\_\_

Paper Clip \* \$3.00 = \_\_\_\_\_

Total Equipment Expense:

Total Capital Required:  
(Mining Claim + Equipment Expense)

Total Equipment Expense:  
(Total Capital Required \* 10%)

## Mining and Reclamation

Minutes Mining Time \* \$2.00 =

Squares Reclaimed \* \$1.00 =

Total Mining and Reclamation Expense:

Total Expenses: -

Income

Chip Production:

Regular Chips \* \$2.00 =

Deluxe Chips \* \$3.00 =

Total Income: +

Net Profit/Loss:

# Making Coal Activity

## Overview:

Students conduct a simulation of the formation of coal and practice the essential laboratory skills of hypothesizing, observing, and explaining their findings.

## Objectives:

Students will:

1. observe change over time through the simulation of forming coal through fossilizing plant materials, and  
  
practice the skills of hypothesizing, observing, and describing the process and results of an experiment.

## Time Needed:

Approximately four class periods, over four or five weeks

## Materials:

- One small aquarium for classroom setup, or several 2-liter soda bottles with the tops cut off, for multiple small-group experiments
- Enough fine- to medium-grain sand to cover 2 inches of each aquarium
- Fern fronds (leaves)
- Twigs
- Plant leaves
- Screen(s) or sifter(s)
- Fine silt or mud
- Student science journals

## Procedure:

1. Explain to students that to simulate a process is to imitate it or create a model that shows how that process occurs. When we simulate a process like coal formation, for example, we study what conditions exist for coal to form from fossilized plant materials. A simulation does not need to be an exact replication of a process for it to demonstrate how something happens in the natural world.
2. Tell students they will create their own (or a classroom) "fossil fuel" over the course of the next four weeks and will observe how that fossil forms.



3. Explain that coal is an example of a fossil fuel. Remind students that a fossil fuel is a fuel that has formed in the earth from the remains of plants or animals that lived as long as 400 million years ago. Ask students: Can you think of other fossil fuels (e.g., oil, natural gas)? Coal is formed from a combination of plant material, heat, pressure, and time. The process of coal formation takes millions of years to complete and is still taking place today. Although students will not actually create coal in this activity, they will see how the fossilization process occurs.
4. Begin the experiment by separating students into small groups or by creating a single aquarium for the class to study. Line the aquarium(s) with plastic wrap so that you can lift the entire formation out when it is dry. Next, pour water into each aquarium to a depth of 4 to 6 inches. Then spread about 2 inches of sand on the bottom, followed by small leaves, sticks, and pieces of fern.
5. Once each aquarium is set up, have students record their observations in their journal. Students should describe what the aquarium looks like, as well as what textures and colors they notice in the sand and foliage. Ask them what changes they think might occur over a few weeks if the aquarium is left untouched. Have them record their hypothesis in their journal. Tell them to watch the aquarium change over the course of the next four weeks. Each day, have them record any changes in color and water level.
6. After two weeks, use the screen or sifter to gently sift fine silt or mud on top of the plant layer to a depth of 2 inches. This replicates the natural fossilizing process of contributing heat and pressure to the vegetation. Make sure students continue to document any changes they see. They should adjust their hypotheses if necessary.
7. Wait another two weeks and drain any water that remains. Let the formation sit and dry for another week or two. Once it is dry, carefully lift the entire formation out of the container(s). Tell the students they have simulated the early stages of coal formation. Gently break the formation into layers to reveal the fossil-like imprints from the plants.

**Assessment:**

Have students prepare a summary of the simulation, including how it was set up and how it changed (before and after intervention). Then have each student determine whether his or her hypothesis was correct.

**Differentiation:**

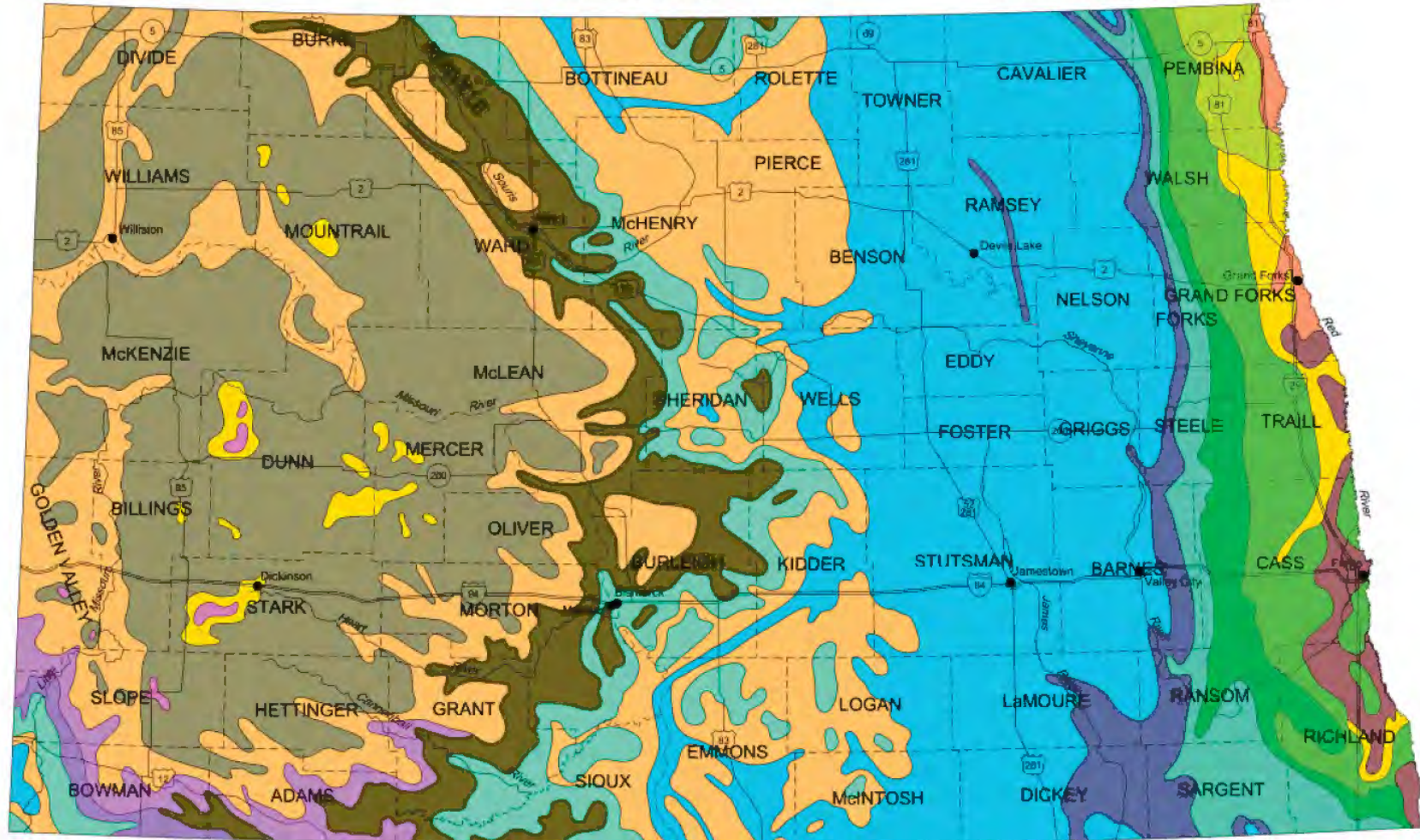
To make the most of each student's strengths, arrange the teams so that each consists of students with good observational skills and students with good writing skills. Allow them to discuss their observations and prepare their journal entries together.

# GENERALIZED BEDROCK GEOLOGIC MAP OF NORTH DAKOTA

Miscellaneous Map 36  
2003

by  
John P. Bluemle

North Dakota Geological Survey  
John P. Bluemle, State Geologist



0 50 100 MILES

- | TERTIARY SYSTEM |                          | CRETACEOUS SYSTEM |  | JURASSIC ROCKS |
|-----------------|--------------------------|-------------------|--|----------------|
|                 | White River Group        |                   | Hell Creek Formation                                       |                |
|                 | Golden Valley Formation  |                   | Fox Hills Formation  |                |
|                 | Sentinel Butte Formation |                   | Pierre Formation   |                |
|                 | Bullion Creek Formation  |                   | Niobrara Formation   |                |
|                 | Slope Formation          |                   | Carlile Formation  |                |
|                 | Cannonball Formation     |                   | Greenhorn Formation  |                |
|                 | Ludlow Formation         |                   | Belle Fourche, Mowry, Newcastle, and Skull Creek Formation |                |
|                 |                          |                   | Inyan Kara Formation                                       |                |

# Lignite Mining and Reclamation Process

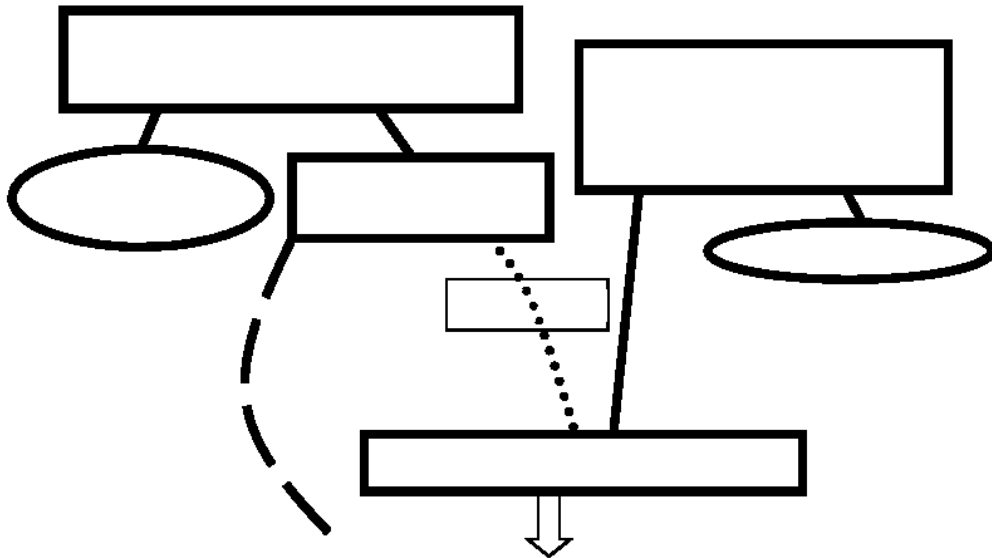
Sarah Flath – Environmental Manager | The Coteau Properties Co. Freedom Mine

Which mine(s) are NOT currently active in North Dakota? \_\_\_\_\_

## Regulatory developments:

- 1969 - \_\_\_\_\_
- 1971 - \_\_\_\_\_
- 1973 - \_\_\_\_\_
- 1975 - \_\_\_\_\_
- 1977 - \_\_\_\_\_

## Oversight:



## Criteria for Economically Recoverable Coal:

- Minimum of \_\_\_\_ feet cumulative thickness in not more than \_\_\_\_ beds.
- More than \_\_\_\_ feet beneath the surface.
- Not more than \_\_\_\_ feet beneath the surface.
- Stripping ratio of not more than \_\_\_\_\_.

Mining methods: \_\_\_\_\_ and \_\_\_\_\_



## **Lignite Energy Council Teacher's Seminar Classroom Exercise**

(grade school version)

To demonstrate the process of surface coal mining and land reclamation, set up a cake pan layered with coal at the bottom, then a thick layer of overburden (gray or brown dirt), then a thinner layer of topsoil (or potting soil). The object is to remove the coal and return the land to as good a condition as existed prior to mining. The cake pan represents the mining permit area. No disturbance or spillage is allowed outside the cake pan, or permit area.

Give students their "mining equipment" (spoons and spatulas). They must strip off the topsoil carefully, making sure they do not contaminate topsoil. Then the overburden is moved, then the coal is removed. Be careful not to mix dirt with the coal! After the coal is removed the overburden is replaced and smoothed out. This represents regrading the spoil. Then topsoil must be spread back over the top.

You can discuss the following

- How topsoil must be saved carefully;
- How you must carefully plan each operation to make sure you have room for topsoil stockpiling and overburden placement;
- The difficulties involved with staying within the permit area, and how great care must be taken to avoid spillage (or unnecessary land disturbance);
- How this exercise relates to real-life mining conditions, including environmental protection and land reclamation requirements;
- The importance of leaving the land as good or better than before mining occurred

## **Lignite Energy Council Teachers' Seminar Classroom Exercise**

(high school version)

This exercise reflects real-life challenges and opportunities faced by mining companies. Good business decisions must be made. Environmental laws and regulations must be followed. Speed is an important factor. Time is money.

Set up a cake pan layered with a known weight of coal, then overburden (gray or brown dirt can be used) and topsoil (or potting soil) on top. The object of the exercise is to "mine" as much coal as possible within a set time frame (10-20 minutes is suggested), while adhering strictly to environmental laws and regulations. Land must be reclaimed at the end of the exercise.

Prior to starting, assume each team has enough money to pay start-up expenses. In real life this money often must be borrowed, so they are charged \$10,000/minute in finance charges. The faster they work, the less finance charge they'll have to pay.

Prior to starting, each team must buy equipment. They can buy large, expensive equipment or small inexpensive equipment. A good business decision must be made to buy enough equipment to move a lot of dirt and coal as quickly as possible, without spending too much money.

Also prior to starting, each team must decide how many employees will actually be operating equipment. The more employees the team has, the faster they can mine. However, each employee will cost an additional \$50,000, so another business decision must be made.

Each team will have to put up a \$300,000 surface mining bond before starting. They get this bond money back from the state at the end of the mining only if all their land is reclaimed in the opinion of the inspector (the teacher). Some of the bond money may be retained by the state if the team does a poor job reclaiming their mined land. This can be very expensive.

Start the timer, but immediately let each team know they must complete a mining permit application first, before they are allowed to mine coal. The form is attached. Again, time is money. Time spent getting regulatory approval to mine coal is time lost from actual coal mining. The regulatory agency (the teacher) needs to be encouraged to make a fast review and give approval quickly so mining can begin.

Once permit approval is received mining can begin. Topsoil must be stripped off and stockpiled, then overburden moved, and then coal can be removed. Coal will be loaded into a container and later weighed. Remember:

- No spillage outside the “permit area”; everything must stay inside the permit area
- No mixing of topsoil and overburden

Failure to follow any of these rules can result in a violation notice from an inspector (the teacher). And you will be inspected! Each violation notice costs the team \$50,000. A pattern of violations (three violations) demonstrates willful negligence and the mine will be shut down, and the team’s entire bond will be forfeited. They can keep any money from the coal that’s already been mined. The inspector (the teacher) can hand out a notice of violation and charge the company at any time.

Also, be aware that getting a violation notice can significantly slow down the mining operation through time spent dealing with the regulatory agency. Remember that time is money. To keep from being slowed down by a regulatory agency it’s very important to strictly follow all rules and regulations. This makes good business sense.

To assure that a high quality coal product is delivered to the customer, great care must be taken to avoid contaminating the coal with dirt. Coal contaminated with large amounts of dirt is too poor to burn and cannot be sold. This can be a significant loss, so it’s important to mine coal as cleanly as possible.

After the end of the mining period the mined coal is weighed. Income is calculated. The regulatory agency inspects the quality of reclamation and determines how much of the team’s bond money they can get back. The total expenses are subtracted from the total income to see if the team has made a profit.

Discussion items include the importance of:

- Making sound business decisions regarding equipment, employees and how one operates a mine
- The economics of mining and reclamation
- How failure to follow environmental laws and regulations can have a large financial impact on mining companies
- How time is money

# Worksheet to Determine Expenses and Profit for the Mining Company

Start-up money: \$ 1,000,000

## SUBTRACT THE FOLLOWING:

Purchase of equipment (miner's option):

\$300,000 for each large spatula bought \$ \_\_\_\_\_

\$200,000 for each large spoon bought \$ \_\_\_\_\_

\$100,000 for each small spoon bought \$ \_\_\_\_\_

Hiring employees (include yourself!)

\$50,000 per employee \$ \_\_\_\_\_

Submit surface mining bond to state (will be returned at end if your reclamation is complete) \$ \$300,000

Finance charges: \$10,000/minute x \_\_\_\_\_ minutes \$ \_\_\_\_\_

Royalties, taxes and government fees  
\$1.50/ton x \_\_\_\_\_ tons mined \$ \_\_\_\_\_

Number of violations x \$50,000/violation \$ \_\_\_\_\_

**TOTAL EXPENSES** \$ \_\_\_\_\_

## INCOME:

Payment received for coal sold:  
\_\_\_\_\_ tons x \$10/ton \$ \_\_\_\_\_

Amount of bond money returned \$ \_\_\_\_\_

**TOTAL INCOME** \$ \_\_\_\_\_

**NET REVENUE (TOTAL INCOME – TOTAL EXPENSES) \$ \_\_\_\_\_**



*OFFICIAL*

Regulatory

Notice

of

Violation

**\$50,000 penalty**

**OFFICIAL**

**OFFICIAL MINING PERMIT APPLICATION**  
(must be approved before mining begins)

Name of mining company \_\_\_\_\_

Address of mining company \_\_\_\_\_

Location of permit area \_\_\_\_\_

Size of permit area \_\_\_\_\_

Describe how you will mine the coal and reclaim the land:

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I certify the information on this permit is correct:

---

(name and signature of applicant)

Approved for mining:

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(signed by regulatory agency)

# Mining and Reclamation Word Search

B	S	P	N	D	R	A	G	L	I	N	E	O	W	T
U	G	E	E	O	N	L	K	R	A	G	M	V	I	L
P	Z	R	E	C	L	A	M	A	T	I	O	N	N	H
D	F	M	Y	R	A	N	G	E	L	A	N	D	J	S
I	A	I	K	X	L	I	N	T	E	R	I	O	R	L
R	P	T	K	Z	S	R	B	L	A	S	T	I	N	G
E	F	F	L	U	E	N	T	C	U	B	O	Y	W	O
C	V	G	R	A	D	I	N	G	R	U	R	G	M	R
T	N	E	J	D	I	B	A	S	E	L	I	N	E	P
E	P	P	S	M	M	O	N	U	M	E	N	T	S	H
S	C	R	A	P	E	R	S	F	Y	D	G	Z	P	A
W	E	T	L	A	N	D	S	U	B	S	O	I	L	N
Z	U	C	O	N	T	R	O	L	E	A	S	E	S	Q
T	U	N	T	N	X	W	W	M	P	G	S	V	R	G
C	O	N	T	O	U	R	N	C	N	G	S	O	N	N

- The acronym 'SMCRA' refers to the Surface Mining \_\_\_\_\_ and Reclamation Act.
- SMCRA is administered by the US Department of \_\_\_\_\_.
- The \_\_\_\_\_ Division of the ND Public Service Commission regulates surface coal mining in North Dakota.
- Information collected for mining permit applications is referred to as \_\_\_\_\_ data.
- In the mine pit, coal is loosened or fractured by means of ripping or \_\_\_\_\_.
- Mined lands are regraded to 'approximate original \_\_\_\_\_'.
- The activity of spreading soil immediately after stripping is referred to as \_\_\_\_\_ respread.
- The \_\_\_\_\_ is the primary machine used to remove overburden.
- Collected runoff from disturbed mine areas can be discharged when it meets State \_\_\_\_\_ standards.
- Early reclamation rules only required the \_\_\_\_\_ of spoil peaks.
- Surface and coal \_\_\_\_\_ are secured from property owners prior to mining.
- Ground water information is collected from \_\_\_\_\_ wells.
- Small islands of soil left to indicate the depth of topsoil and subsoil removal are referred to as \_\_\_\_\_.
- Unreclaimed ridges of dirt remaining from pre-law surface mining are called \_\_\_\_\_ spoils.
- Baseline data, lease information, mining plans, and reclamation plans are compiled into a mining \_\_\_\_\_ application.
- The majority of lands disturbed by coal mining in North Dakota are reclaimed as cropland and \_\_\_\_\_.
- Topsoil, and in many cases subsoil, is handled by mobile equipment known as tractor-\_\_\_\_\_.
- The initial earthwork activity in the mining process is to construct \_\_\_\_\_ ponds.
- The second layer of earth removed by mining operations is referred to as \_\_\_\_\_.
- Unique reclamation features include shelterbelts, native tree and shrub plantings, stockponds, and \_\_\_\_\_.

# Mining and Reclamation Word Search



- (Control) The acronym 'SMCRA' refers to the Surface Mining \_\_\_\_\_ and Reclamation Act.
- (Interior) SMCRA is administered by the US Department of \_\_\_\_\_.
- (Reclamation) The \_\_\_\_\_ Division of the ND Public Service Commission regulates surface coal mining in North Dakota.
- (baseline) Information collected for mining permit applications is referred to as \_\_\_\_\_ data.
- (blasting) In the mine pit, coal is loosened or fractured by means of ripping or \_\_\_\_\_.
- (contour) Mined lands are regraded to 'approximate original \_\_\_\_\_'.
- (direct) The activity of spreading soil immediately after stripping is referred to as \_\_\_\_\_.
- (dragline) The \_\_\_\_\_ is the primary machine used to remove overburden.
- (effluent) Collected runoff from disturbed mine areas can be discharged when it meets State \_\_\_\_\_ standards.
- (grading) Early reclamation rules only applied the \_\_\_\_\_ of spoil peaks.
- (leases) Surface and coal \_\_\_\_\_ are secured from property owners prior to mining.
- (monitoring) Ground water information is collected from \_\_\_\_\_ wells.
- (monuments) Small islands of soil left to indicate the depth of topsoil and subsoil removal are referred to as \_\_\_\_\_.
- (orphan) Unreclaimed ridges of dirt remaining from pre-law surface mining are called \_\_\_\_\_ spoils.
- (permit) Baseline data, lease information, mining plans, and reclamation plans are compiled into a mining \_\_\_\_\_ application.
- (rangeland) The majority of lands disturbed by coal mining in North Dakota are reclaimed as cropland and \_\_\_\_\_.
- (scrapers) Topsoil, and in many cases subsoil, is handled by mobile equipment known as tractor-\_\_\_\_\_.
- (sediment) The initial earthwork activity in the mining process is to construct \_\_\_\_\_ ponds.
- (subsoil) The second layer of earth removed by mining operations is referred to as \_\_\_\_\_.
- (wetlands) Unique reclamation features include shelterbelts, native tree and shrub plantings, stockponds, and \_\_\_\_\_.

# Electricity Generation Choices

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*John Bauer – Director of ND Generation | Great River Energy*

## Types of Generation

- \_\_\_\_\_  
Example(s): \_\_\_\_\_
- \_\_\_\_\_  
Example(s): \_\_\_\_\_
- \_\_\_\_\_  
Example(s): \_\_\_\_\_

Every \_\_\_\_\_ megawatts of lignite-based electric generation requires about \_\_\_\_\_ jobs.

## Magnetism:

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The same amount of electricity used to light up one incandescent bulb will light up how many LED bulbs? \_\_\_\_\_

What are the primary sources of energy for generation of electricity?

_____	_____
_____	_____
_____	_____

## How electricity is made:

A source of energy \_\_\_\_\_ on a \_\_\_\_\_ which \_\_\_\_\_.

The most common method of generating electricity is using \_\_\_\_\_ turbines with \_\_\_\_\_ supplied from a \_\_\_\_\_ boiler.

**Other information related to making electricity using a steam turbine:**

- Most lignite-fired stations \_\_\_\_\_ the lignite into a fine powder
- They use \_\_\_\_\_ to carry the pulverized lignite to the burners in the \_\_\_\_\_.
- The heat from \_\_\_\_\_ generates \_\_\_\_\_ which is used to drive a steam turbine which turns the \_\_\_\_\_.
- Lignite is delivered to the power plant by \_\_\_\_\_.
- When lignite burns in the furnace, the temperature is \_\_\_\_\_.
- The steam in many boilers is around \_\_\_\_\_.
- North Dakota lignite is about \_\_\_\_\_ water.
- North Dakota lignite's heating value is about \_\_\_\_\_.

**Types of generation:**

- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_

**What influences fuel choices?**

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**Nuclear advantages/disadvantages:**

_____	_____
_____	_____

**Hydro advantages/disadvantages:**

_____	_____
_____	_____

**Natural gas advantages/disadvantages:**

_____	_____
_____	_____

**Wind advantages/disadvantages:**

_____	_____
_____	_____



# Classroom Activities for Electrical Generation Lecture

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## Matchbook Exercise

**Objective:** To illustrate what it takes to produce 1 British Thermal Unit (BTU) of energy.

**Activity:** Hold up a matchbook, an object everyone is familiar with. Tear off 1 match and strike it while explaining that the heat content of the match is 1.25 BTUs. The entire book of matches has a total of 25 BTUs.

## Magnet and Iron Filing Exercise

**Objective:** Demonstrate how bar magnet and iron filings create an electric current.

**Activity:** Put bar magnet on an overhead projector and cover with a plastic sheet. Sprinkle iron filings on top of the plastic sheet to show magnetic field. Then explain that the voltage is created by passing iron through magnetic field and explain the similarity of the process to a modern generator.

## Model Steam Engine Exercise

**Objective:** To demonstrate how heat energy is converted into electrical energy.

**Activity:** Fire-up model steam engine whose fly wheel is connected to a small generator. Light bulb connected to generator lights up when fly wheel starts to rotate.

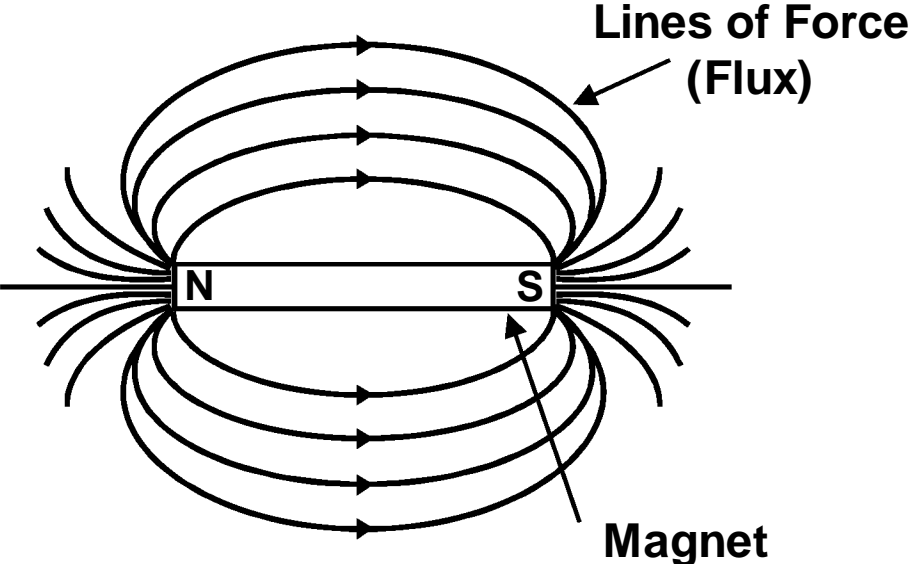
## Vacuum Cleaner Bag Demonstration

**Purpose:** Help demonstrate how power plant captures fly ash.

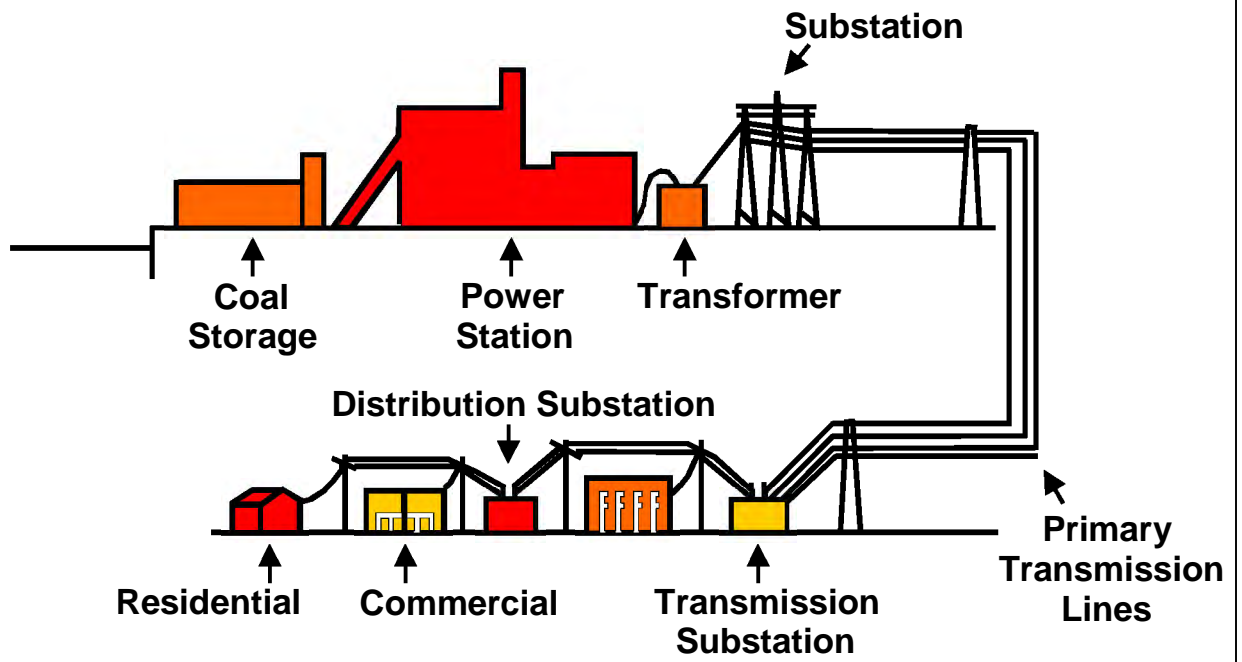
**Activity:** Hold up vacuum cleaner bag, and explain that it's similar to bags used by power plants to filter out fly ash from flue gases. Two big differences between the vacuum bag and those used by power plants is that the bags in power plants are 40 feet long and can withstand temperatures of up to 400 degrees.



# Magnetic Field Around Bar Magnet



# Electric Supply System



## Battle of the Bulbs

This lesson – Battle of the Bulbs was adapted from the Ohio Energy Project - <http://www.energybike.org/index.php>) by Lyndon Anderson, Great River Energy, [landerson1@greenergy.com](mailto:landerson1@greenergy.com) or (701) 391-0759. Materials required to conduct this lesson plan include the Energy Bike from the Ohio Energy Project.

Start-up discussion

### How have you used electricity today (energy associated with moving electrons)?

Get answers from students: *Lights, radio, TV, charge cell phones, alarm clock, computers, games, cooking, heating, dry grain, power tools, air conditioner, clothes washer & dryer, coffee maker, DVD player, curling iron, dishwasher, fan, grill, hair dryer, iron, microwave oven, oven, refrigerator, toaster, vacuum cleaner, water heater, freezer, etc.*

**We depend on electricity in our lives – it helps with our standard of living.**

### What energy resources do we have in the world to generate electricity?

Get answers from students.

- Coal --- a fossil fuel in the form of a solid black rock
- Nuclear --- energy resulting from fission, or the splitting of uranium atoms
- Natural gas --- a colorless, odorless fossil fuel mostly made of methane
- Petroleum --- a fossil fuel that is a thick black liquid
- Wind --- energy from moving air
- Hydropower --- energy produced by moving water
- Solar --- energy from the rays of the sun
- Biomass – energy from burning plants, trash and organic matter

**North Dakota produces electricity from three primary energy sources.**

Ask students what the three resources are (coal-87 percent, hydropower-10 percent, wind-3 percent) Compare them to what Minnesota uses for resources (coal, nuclear, natural gas, wind, hydropower, biomass).

Lesson – Battle of the Bulbs (adapted from the Ohio Energy Project - <http://www.energybike.org/index.php>)

1. Define **electricity**: *Electricity is energy associated with moving electrons.*
2. Ask for volunteer  
Start pedaling – no more than 12 volts  
Once the volt meter reaches 12 volts, switch one fluorescent switch to the on position  
Then, switch one LED switch to the on position  
Then, switch one incandescent switch to the on position

Ask the rider to stop  
Ask him or her to compare the amount of strength to light each bulb

The rider should indicate that the LED bulb was easier to light

If the rider can't tell the difference between the fluorescent or the LED, ask him to light up all four of those bulbs

3. **Define volts:** *Volts measure the difference in electric potential between two points of an electrical circuit*

One analogy might be water pressure. Think of a water faucet in your home, one that is shut off. There is a lot of water pressure in the pipe that is connected to the faucet. As a result, there is a lot of potential for water to come through the faucet.

Volts measure the difference in electric potential between two points of an electric circuit, or the potential to develop a current across a conductor (or electric line)

**Define amps:** *Amps measure the amount of electric current.*

In the water analogy, the amps or current is the flow of the water out of the faucet, similar to the flow of electrons through the conductor.

An increase in frequency in electrons passing through a certain point in the circuit per second represents an increase in amps, or electric current.

Define **watts:** *Watts measure electrical power*

Watts can be determined by multiplying volts (electric potential) by amps (current).  
Volts x Amps = Watts

**Next, we're going to figure out how many amps each bulb requires, and then we will figure out the watts.**

4. Ask for a volunteer to pedal the energy bike and light one of each of the various bulb types.

Adjust the rotary gauge switch to the 5 amp position for the fluorescent and incandescent bulb. For the LED, rotate the gauge selector switch to the 1 amp position.

Have the class determine which type of bulb requires more electricity to operate by reading the amp meter.

*Incandescent bulb = 4 amps*

*Fluorescent bulb = 1.25 amps*

*LED = 0.21 amps*

Have a student read both the volt and amp meter. Calculate the power of each bulb using the equation.

Volts x Amps = Watts

*Incandescent bulb = 50 watts (12x4)*

*Fluorescent bulb = 15 watts (12x1.25)*

*LED bulb = 2.5 watts (12x.21)*

Let's say we woke up tomorrow, and magically all light bulbs were placed with LEDs. What would be the impact at a power plant?

5. Ask a volunteer to first light incandescent bulbs, then fluorescent bulbs then finally LED bulbs one. Do either 1 or 2 or 3 or 4 of each bulb (be consistent). This might work better if the rider has to do anywhere from 2-4 bulbs.

Ask the students to determine which bulb(s) looks brighter.

You may wish to turn off the lights to help the students compare the brightness of the bulbs.

**Often they will answer fluorescent; However, sometimes the LED bulb appears brighter when observed head-on. If you look at the lumens for each bulb, and if the student pedals really fast for the incandescent bulbs, they will look very bright (but most don't pedal that fast).**

6. Since the incandescent bulb requires more "leg power," it seems as if it should be brighter. If the extra power is not being converted into light, to what other form of energy is it being converted?

*It is being converted to heat, or thermal energy.*

7. While a student is pedaling, have volunteers put their hands near each of the three bulbs. Instruct the students to take their hands away as soon as they start to feel warm.

Which bulb feels warmest?

*The incandescent feels warmest.*

Ask the students to guess what percentage of energy goes into thermal energy for each bulb.

Incandescent bulb energy	90 percent thermal energy 10 percent radiant energy
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Fluorescent bulb energy	60 percent thermal energy 40 percent radiant energy
-------------------------	--

LED bulb energy	10 percent thermal energy 90 percent radiant energy
-----------------	--

8. *Which bulb is most energy efficient and cost effective?*

Hours

Incandescent bulbs – 900 hours

Fluorescent bulbs – 10,000 hours

LEDs – 50,000 hours (5.7 years if left on all the time)

Cost

Incandescent bulbs - \$0.50 for the 12 volt versions

Fluorescent bulbs - \$8 to \$18 for the 12 volt versions

LEDs - \$20 to \$90 for the 12 volt versions

Watts

Incandescent bulbs – 50 watts

Fluorescent bulbs – 15 watts (produce 940 lumens)

LEDs – 2.5 watts (equivalent to about a 45 watt incandescent from head on with decreasing lumens provided as the angle of view decreases), makes them good for direct, focused applications.

Show an LED without the bulb to the class. Then, use the bike to light up that LED

LEDs – general information

The bulb remains cool after hours of operation.

They are 100 percent recyclable and contain no mercury.

They require over 90 percent less energy and last up to 30 to 50 times longer.

They are mercury free.

They are 100 percent recyclable.

Then, if they are so good, why are they so costly?

The technology is new and still developing

Few people use them (economies of scale)

9. At current electricity prices, when will a bulb pay for itself.

Let's start with incandescent bulbs.

Incandescent bulbs are being phased out in the United States except for special applications. New efficiency and labeling standards passed in 2007 took effect on January 1, 2012, and the phase out of the traditional incandescent bulbs started in 2012 with the 100-watt bulb. The phase out of the 75-watt bulb will begin in January 2013, followed by the departure of its 60-watt and 40-watt counterparts.

At current electricity prices, a compact fluorescent bulb is expected to pay for itself in only 1.7 years, a few years sooner than its more efficient LED counterpart;

10. Let's say we woke up tomorrow, and magically, all bulbs were replaced with LEDs. What would be the environmental benefits of using LED bulbs over fluorescent bulbs.
- Power plants would not have to burn as much coal, reducing air emissions and conserving nonrenewable resources.
  - There is less of a need for air conditioners to remove the heat output from the light bulbs.
  - The bulbs last longer, therefore you throw fewer bulbs away and conserve landfill space.
  - 100 percent recyclable and no mercury in landfills.

### **The Bulbs:**

#### **INCANDESCENT LIGHT BULBS**

- The filament of an incandescent bulb is a resistive element, similar to the wires in a toaster.
- The filament is a tungsten wire wound in a tight coil. Tungsten has a very high melting point.
- It glows much more brightly than heating elements.
- Due to a filament's high temperature, inert gases such as argon are placed inside the bulb to prevent the wire from burning.
- Incandescence is the emission of a glowing white light by an intensely heated material.

#### **FLUORESCENT LIGHT BULBS**

- A fluorescent bulb has a glass tube, whose inner surface has a phosphor coating.
- In compact fluorescent bulbs, the tube is folded back on itself.
- The tube is filled with argon gas and a small amount of mercury vapor.
- At the end of each tube are electrodes that emit electrons when heated by an electric current.
- When electrons strike the mercury vapor, the mercury atoms emit rays of ultraviolet (UV) light.
- When these invisible UV rays strike the phosphor coating, the phosphor atoms emit visible light.
- The conversion of one type of light into another is known as fluorescence.

#### **LED LIGHT BULBS**

- An LED emits light from a piece of solid matter --- a semiconductor.
- Stated very simply, an LED produces light when electrons move around within its semiconductor structure.
- A semiconductor is made of a positively charged and a negatively charged component. The positive layer has "holes" -- openings for electrons; the negative layer has free electrons floating around in it. When an electric charge strikes the semiconductor, it activates the flow of electrons from the negative to the positive layer. Those excited electrons emit light as they flow into the positively charged holes.

# Synfuels Production from Lignite

*Joan Dietz – Communication & Creative Services, Great Plains Synfuels Plant*

Today, coal makes up about \_\_\_\_% of our generation portfolio.

What three ingredients do they begin with for the gasification process?

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_

How many people does the Synfuels Plant today employ? \_\_\_\_\_ people

How many tons of lignite coal comes from Freedom Mine? \_\_\_\_\_ tons.

How many gallons of water from Lake Sakakawea is used during gasification that is then later produced to high pressure steam? \_\_\_\_\_ million gallons

What is pipeline-quality natural gas used for?

\_\_\_\_\_

In 16 years since capture began, \_\_\_\_\_ million tons of CO2 have been sent to the Canadian oil field.

How far does the Carbon dioxide Pipeline stretch? \_\_\_\_\_ miles

How many products does the Synfuels Plant currently produce?

\_\_\_\_\_

\_\_\_\_\_

List the Chemicals and Fuels:

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_
4. \_\_\_\_\_

List the Liquefied Gases:

1. \_\_\_\_\_
2. \_\_\_\_\_

List the fertilizers:

1. \_\_\_\_\_
2. \_\_\_\_\_

What is Urea?

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_





# Classroom Activity

## Synfuels Production from Lignite

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### How Carbon Monoxide and Hydrogen are Converted to Water and Methane

**OBJECTIVE:** Illustrate how the methanation unit at the Great Plains Synfuels Plant converts hydrogen and carbon monoxide molecules (products from gasifying lignite) to water and methane (natural gas).

**DEMONSTRATION MATERIALS:** Basketball  
Grapefruit  
Orange  
Six Grapes or Cherries  
Seven Toothpicks

**ACTIVITY:** The fruit is used as atoms to show the chemical reaction in the methanation unit, which uses a nickel catalyst bed to convert hydrogen and carbon monoxide to water and methane.

Orange = Carbon

Grapefruit = Oxygen

Grapes = Hydrogen

Link the orange and grapefruit together with a toothpick, while explaining that the gasifiers initially convert lignite into carbon monoxide (carbon attached to oxygen) and hydrogen (six grapes). The hydrogen and carbon monoxide are passed over a nickel catalyst symbolized by a basketball. The catalyst causes the molecules to rearrange forming methane or natural gas (four grapes attached to an orange -  $\text{CH}_4$ ) and water (two grapes attached to a grapefruit -  $\text{H}_2\text{O}$ ).

# Classroom Activity

## Synfuels Production from Lignite

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### How Components in the Gas Liquor Stream are Separated in the Separation Unit

The gas liquor stream is produced by gasifying lignite.

**OBJECTIVE:** Demonstrate how to separate the oils from the water liquids through cooling and salt additives. The oils and water in the gas liquor stream are difficult to separate since they are similar in density. Therefore, cooling and salts are used to separate tar oils, used as boiler fuel, and the water stream, which contains ammonia, phenol and water.

**MATERIALS:**

- Beaker
- Hot Plate
- Water
- Vegetable Oil
- Food Coloring
- Ice Cubes
- Salt

**ACTIVITY:** The vegetable oil represents tar oil in the gas liquor stream, while colored water represents the water components in the stream. The mixture is heated and stirred to simulate the gas liquor as it exits gasification at 400 degrees F. and 400 pounds of pressure. Three conditions help in the separation process:

- (1) slower flow rate;
- (2) cooling; and
- (3) salt.

Turn off the magnetic stirrer and heat, and add ice and salt. The oil and water separates, simulating gas liquor separation.

# Transmission – Transporting Energy by Wire

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*Matthew Stoltz – Manager Transmission Services | Basin Electric Power Cooperative*

Electrical energy \_\_\_\_\_ be stored in large amounts.

Major sources of electric generation are:

- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_

Electrical load \_\_\_\_\_ during the day by hour, and also seasonally as well. Therefore, in real time \_\_\_\_\_ sources of generation are blended into the grid to service the load.

\_\_\_\_\_ are set up to help schedule generation most economically.

Electricity follows the path of \_\_\_\_\_. This makes it difficult to route along a specific path and can result in transmission limitations.

Electricity transmission capacity and efficiency \_\_\_\_\_ with higher operative voltage. Electricity is most useful for the consumer at a \_\_\_\_\_ voltage. Bulk electric transmission uses as \_\_\_\_\_ of a voltage as possible. \_\_\_\_\_ allows easy conversion of voltage with transformers.

Transmission operators must respect the \_\_\_\_\_ standards. Loss of any single network transmission facility should not result in loss of customer load.

Notes:

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## **TRANSMISSION LINE ROUTING EXERCISE**

### **Activity Descriptions**

1. "Classroom Exercise"
  - a. Each person in the class is given a card randomly. 75-80 percent of the students receive blank cards while 20 to 25 percent receive cards that state a land use feature they represent. The land uses include such things as swamp, scenic river, cemetery, barn, national park, old growth forest and NIMBY. A rope is given to a selected person at the front of the class. The rope represents the transmission line. Each foot of rope represents a mile of transmission line and costs \$500,000. After the students show their cards, they need to design a transmission route using as little of the rope as possible. The end of the rope is passed to an adjacent person based on selecting the best feature to accommodate the line. The final result is a transmission line route from the front of the class (Point A - generator) to the back (Point B - customer) defined by the rope. The length of rope can be measured and compared with the straight-line distance to the back of the class. The difference between the routed rope and the straight-line distance can be figured in feet and multiplied by \$500,000 to determine the extra cost incurred by the transmission line builder based on exclusions and avoidances.
  
2. "Map Exercise"
  - a. The students route a transmission line on a given map using shown start and end points and the following siting criteria.

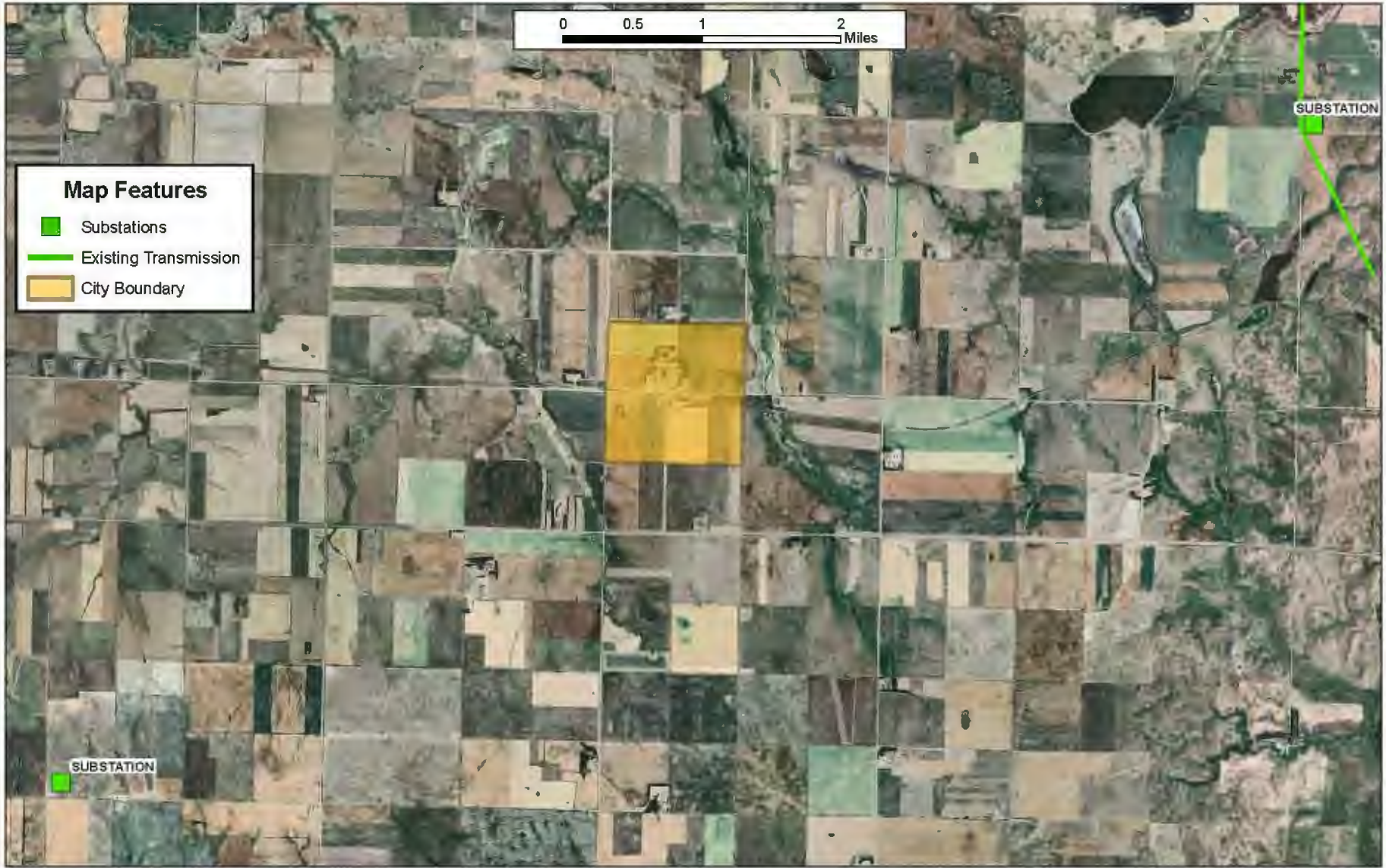
### **Transmission Line Information**

1. Structure Type
  - a. The type of structure selected to hold up the wires depends on many things, including cost, line voltage, and land use. Samples of the different types of structures are shown on attached pictures.
  
2. Voltage
  - a. Transmission lines are used to transmit large amounts of power and energy to substations where the power can be distributed to users. To transmit large amounts of energy, the line voltage must also be high. Typical transmission line voltages are 115,000, 230,000, or 345,000 volts. In special cases, voltage can be even higher.
  
3. Right-of-Way Width
  - a. Space on either side of the transmission line must be maintained clear to prevent electrical arcing to objects that are grounded. Electrical arcing can cause fires or injury to animals or humans. In addition, arcing will disrupt electrical service. The right-of-way space is also used by line maintenance crews to inspect and make repairs to the line. Typical right-of-way widths are 125-200 feet. The transmission line is usually located in the center of the right-of-way.

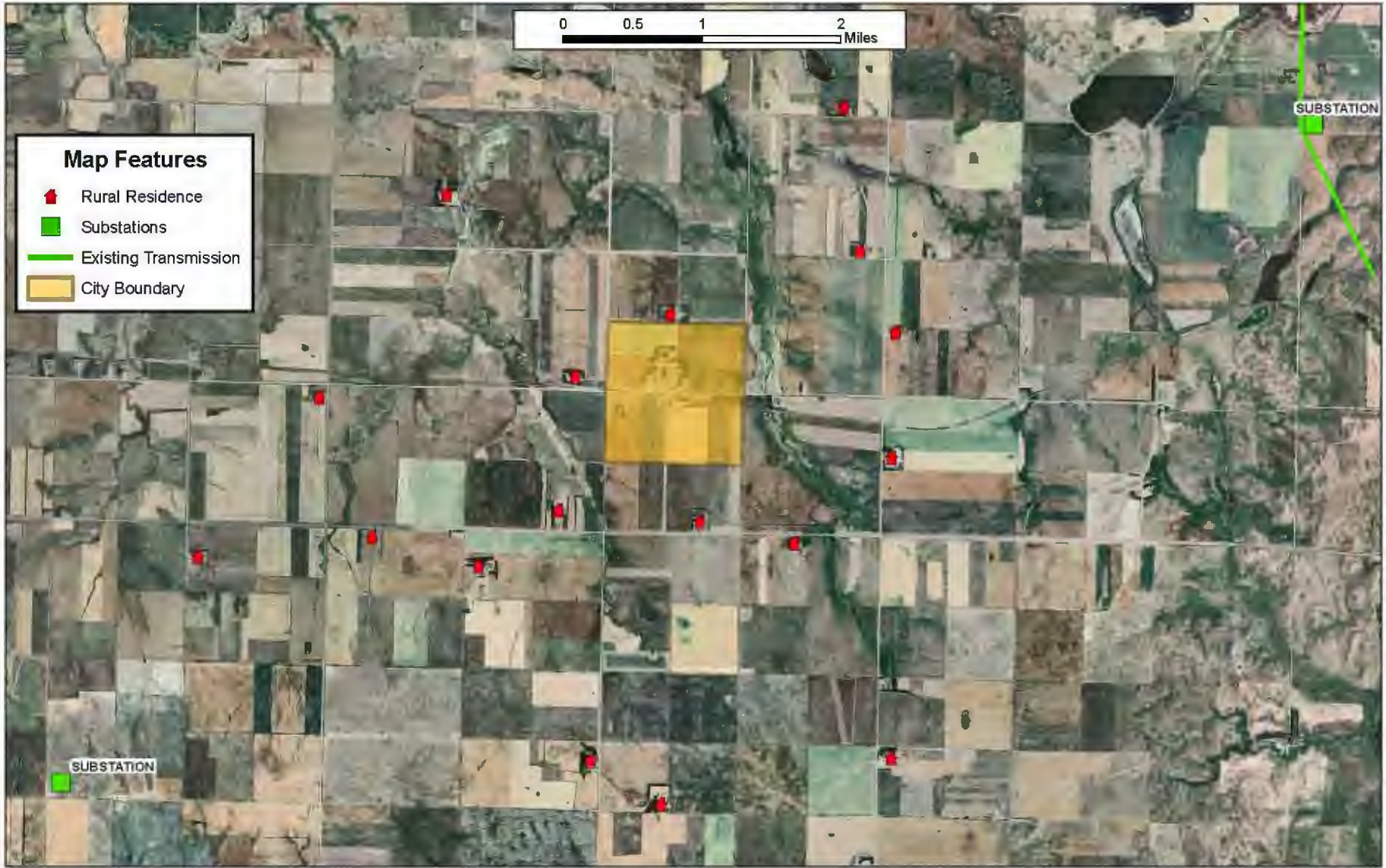
## **Transmission Line Siting Criteria**

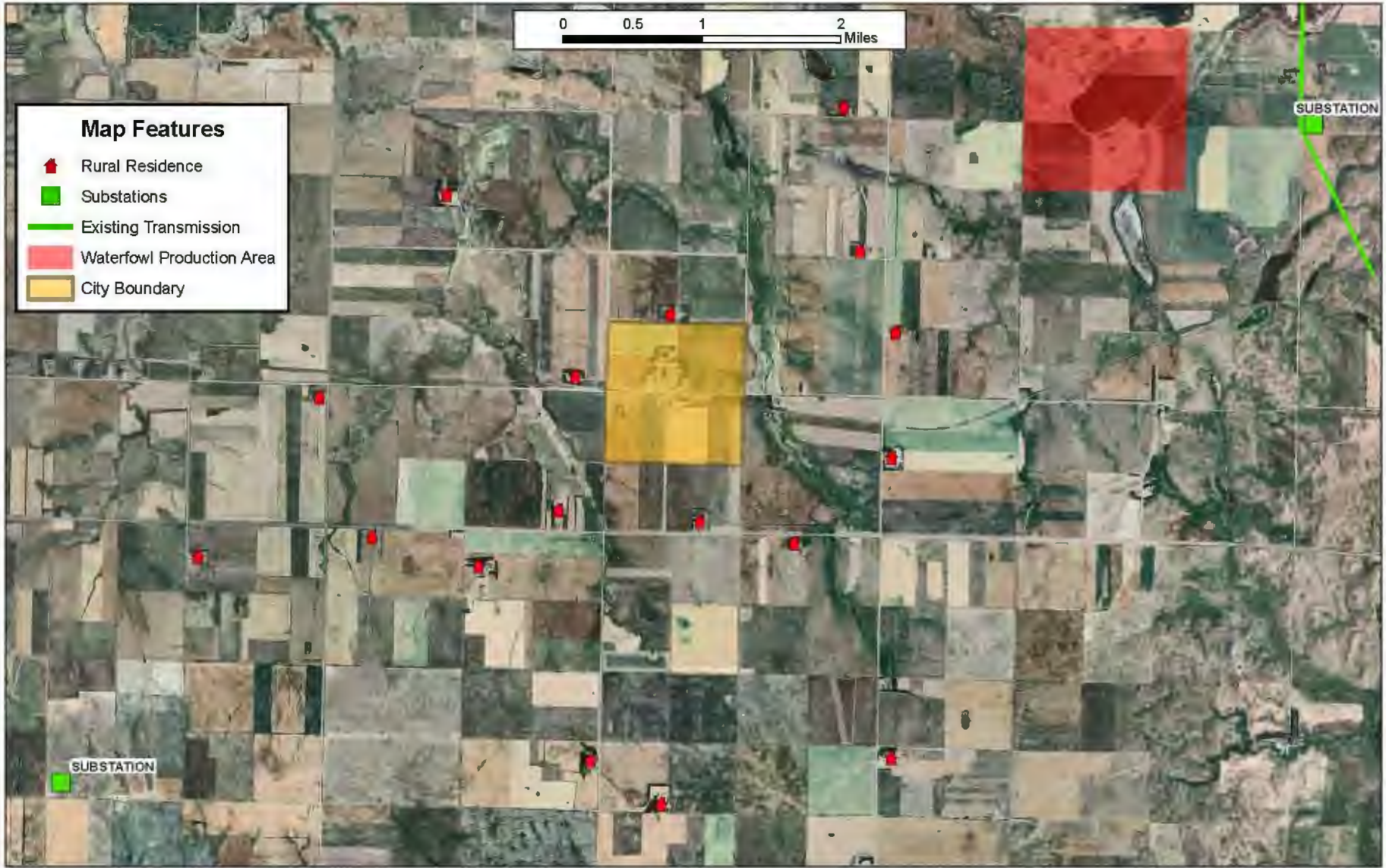
1. Exclusion Areas (must be completely avoided)
  - a. Parks, historic sites, landmarks, monuments, and wilderness areas.
  - b. Areas that are critical to threatened or endangered species.
2. Avoidance Areas (avoid unless there is no reasonable alternative)
  - a. Designated wildlife areas, scenic rivers, grasslands, game management, and forests.
  - b. Areas within 500 feet of a school, residence, or place of business.
  - c. Irrigated land.
3. Other Considerations
  - a. Minimize affect on regular agricultural or commercial activities.
  - b. Accommodate landowner requests when possible.
  - c. Follow local township and county zoning requirements.
  - d. Minimize overall cost of line (cost will affect rates paid by electricity users).

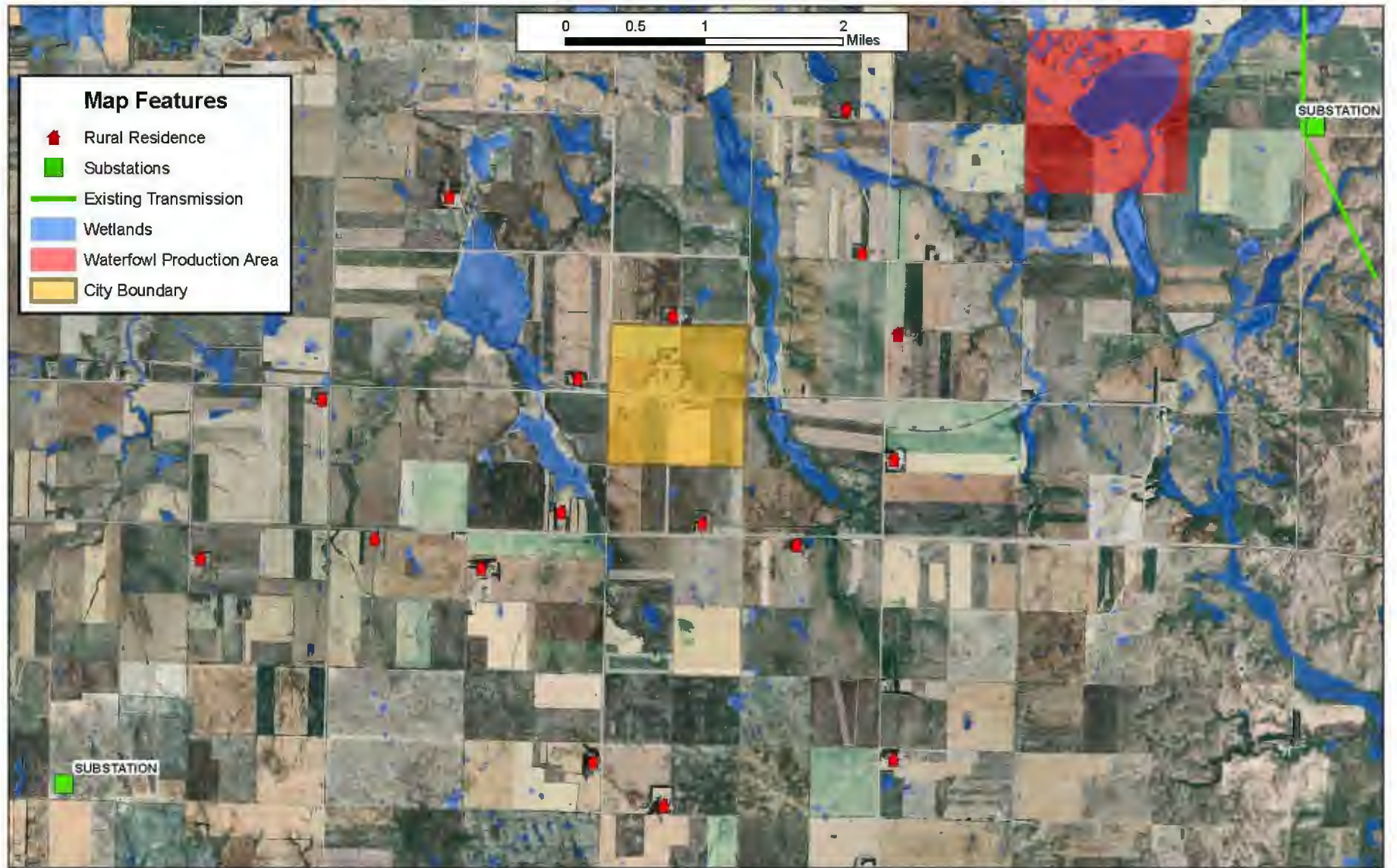


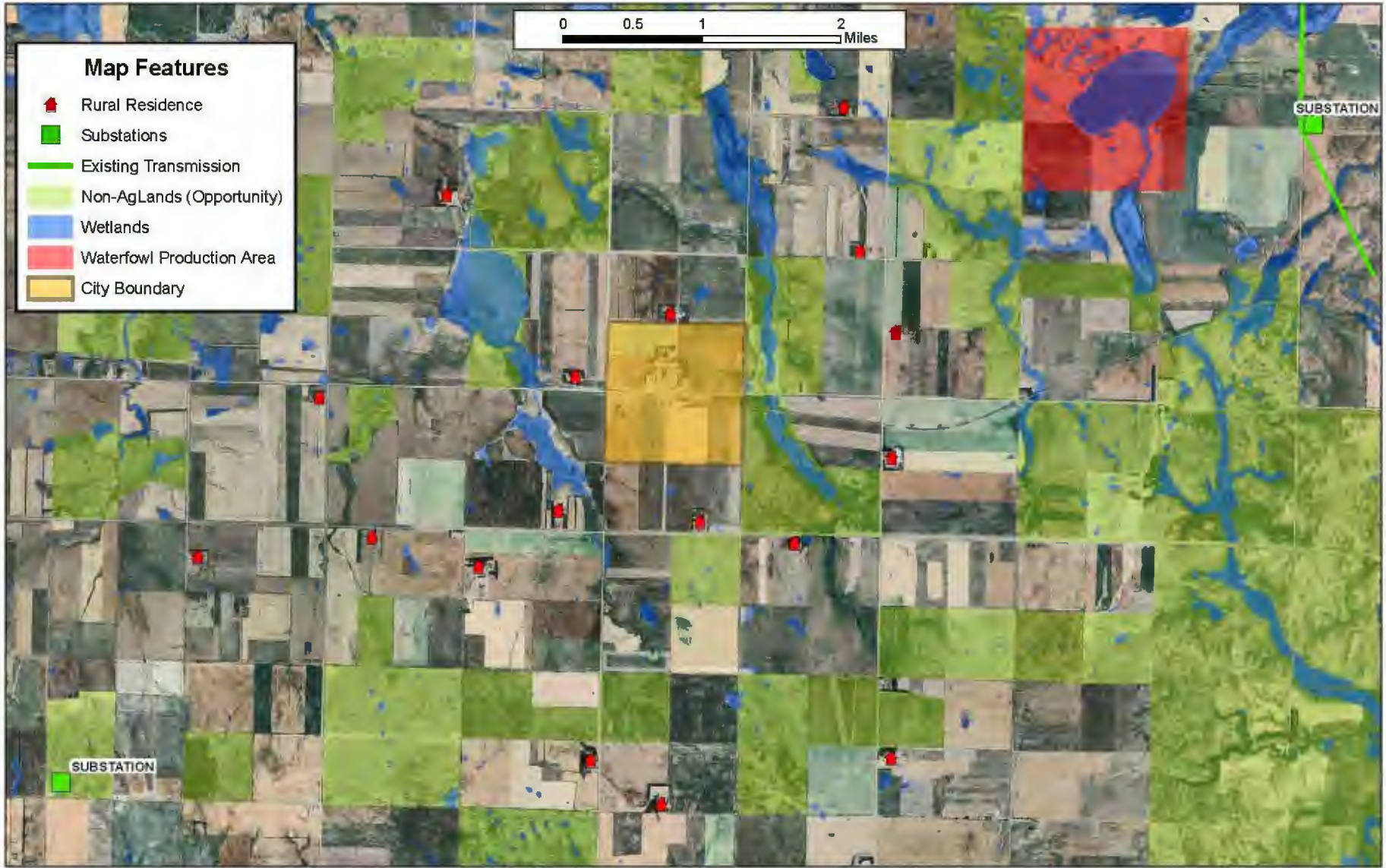


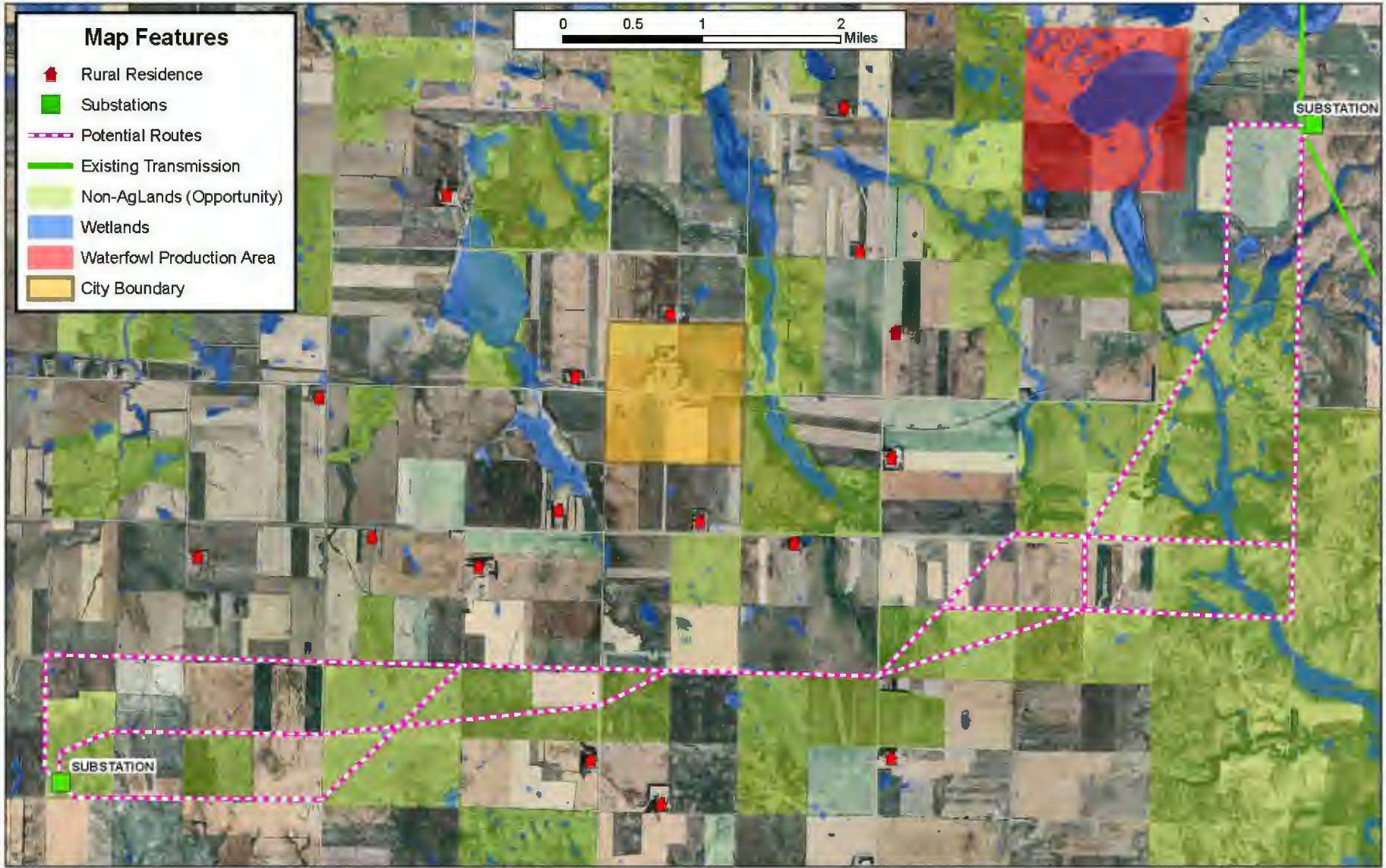


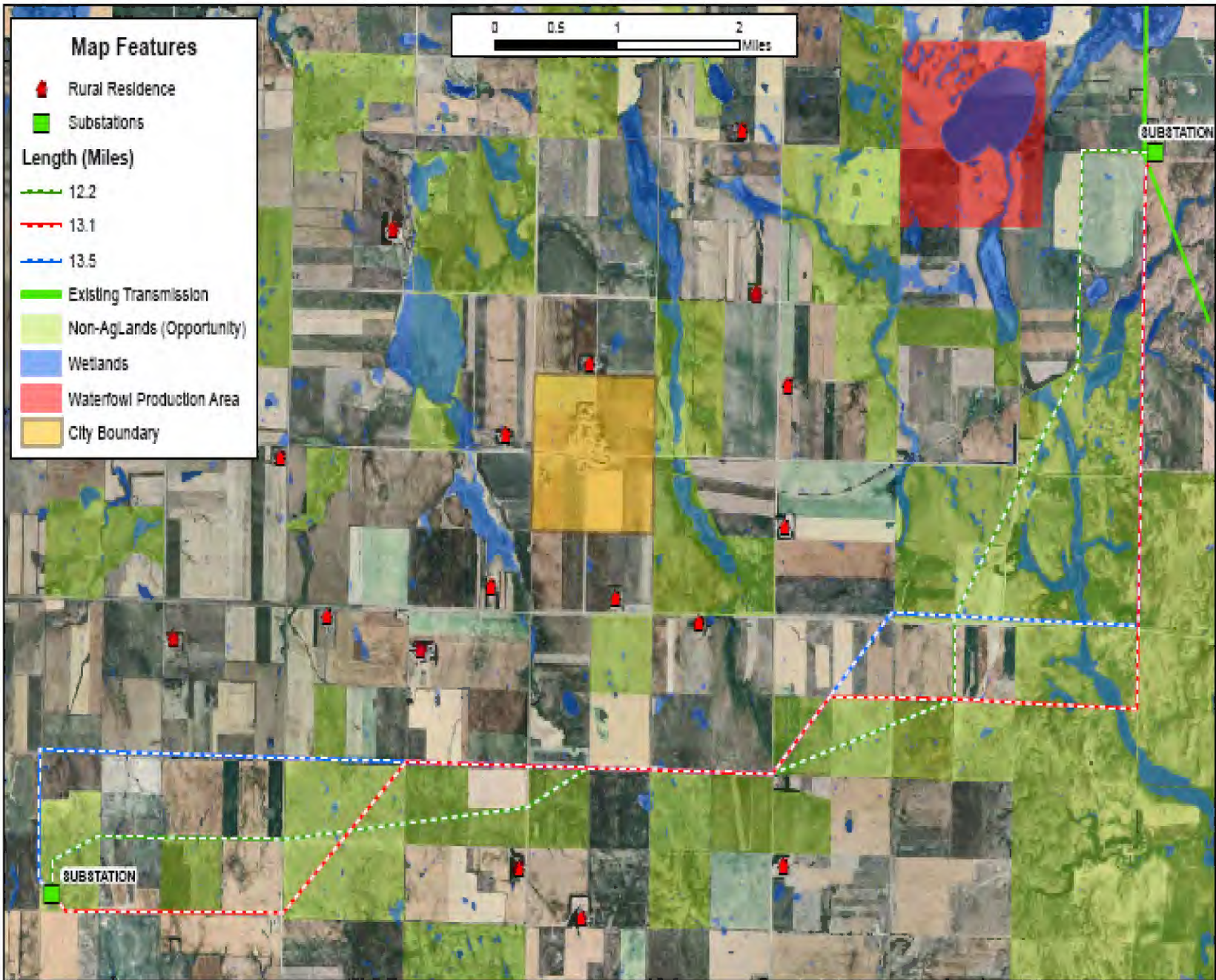












# Enhancing Lignite's Future through R&D

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*Mike Holmes – Vice President, R&D | Lignite Energy Council*

There is no challenge regarding the use of coal as a clean, efficient fuel that \_\_\_\_\_ been met by technology.

Nearly \_\_\_\_\_ of criteria pollutants from US coal-based power plants are now captured or reduced through the use of technology.

Over the last two years, coal use worldwide has \_\_\_\_\_.

Defined by Congress in the mid-1980s, \_\_\_\_\_ are technologies to reduce sulfur dioxide and nitrogen dioxides, or technologies that increase efficiencies and reduce emissions on a per unit energy basis.

The \_\_\_\_\_ is an industry/government partnership where for every state dollar, \_\_\_\_\_ dollars is invested from industry & other sources in lignite related R&D projects.

Consumption of North Dakota lignite can be broken down by:

- \_\_\_\_\_ Electric Power Generation
- \_\_\_\_\_ Synthetic Natural Gas
- \_\_\_\_\_ Specialty Products

\_\_\_\_\_ fired boilers use pulverized coal and are based on a concept of a single flame envelope and project both fuel and combustion air from the corners of the furnace. The flames are directed on a line tangent to a small circle lying in a horizontal plane at the center of the furnace. This action produces a fireball that moves in a cyclonic motion and expands to fill the furnace.

\_\_\_\_\_ use several water cooled horizontal burners to produce high temperature flames that circulate in a cyclonic pattern. The coal is not pulverized but instead crushed to a 4-mesh size. The crushed coal is fed tangentially, with primary air, to a horizontal cylindrical combustion chamber. In this chamber, small coal particles are burned in suspension while the larger particles are forced against the outer wall. The high temperature of the coal ash, causes the ash to form a molten slag, which is drained from the bottom of the furnace through a slag tap opening.

\_\_\_\_\_ technology uses air to suspend coal particles and an inert bed material. Burns at a significantly lower temperature which reduces the production of thermal NOx. The bed material can be an alkali or alkaline earth material that will capture SO2.

**Future generating technologies:**

- \_\_\_\_\_ – 3500 PSI Steam, Up to 1300 MW/Unit, 35-40% efficient, almost 17% reduction in CO2 and other emissions
- \_\_\_\_\_ – uses pure oxygen not air for combustion. This allows the flue gas to be basically CO2 and water and allows for different strategies for CO2 capture.
- \_\_\_\_\_ - chemical process that converts coal into a synthetic gas, this gas is used as a fuel. Highly efficient because the exhaust from the gas turbine is hot enough to boil water. The steam is then used to drive a turbine that creates a second source of electricity.
- \_\_\_\_\_ – refers to creating multiple products from coal
- \_\_\_\_\_ – uses supercritical CO2 as the working fluid and high pressure oxyfiring to release the chemical energy. Very high efficiency and capture 100% of the CO2.

**Gasification products:**

- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_

\_\_\_\_\_ will gasify coal and convert it to ultra-clean gasoline, LPG, propane & electricity

\_\_\_\_\_ will gasify lignite and convert it to hydrogen for use in combustion turbine.

**Emission Control Technologies**

- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_

\_\_\_\_\_ is the process of separating relatively pure carbon dioxide gas as a by-produce of industrial processes and electricity generated from fossil fuels.

**Notes:**

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## Coal Drying Activity

As it is mined, lignite is about one-third moisture. This makes it uneconomical to transport by rail. However, a coal drying project is now underway at Coal Creek Station that may make transporting lignite a more economical proposition. The coal drying project has its roots in a simple experiment that you can stimulate in the classroom.

### Coal Drying Procedure

- Weigh about 100 grams of lignite on a paper plate.
- Place the coal onto a cookie sheet and place it in an oven set at its lowest temperature – 100 or 120° F. for four hours.
- Reweigh the coal to determine the weight loss due to moisture and calculate the percent moisture.

### Alternate Drying Methods

- Dry the lignite using the “waste” heat from a light bulb. This method will model Coal Creek’s use of waste heat from its boiler.
- Simply place the lignite in a sunny window and let it dry. Weigh the sample each day until the weight is constant for two days.
- No matter which drying method is used, have students identify any physical changes, such as cracking. How would this property change affect dried lignite if it was transported by train?
- Cook Creek pulverizes the coal prior to drying; students can compare the rate of moisture loss and total amount of moisture lost between crushed and uncrushed coal.
- Pulverized coal has greater surface area and should dry faster than coal in larger pieces.

# Family Budget Activity

An activity designed to make the student aware of the effects of regulation on the family budget and how the change in family spending has an effect on the economy.

Grades 8-12 Lesson Plan

## Learner Outcomes

The students will be able to identify various effects of regulatory activities on the family budget and on the economic activity around them.

## Lesson Time:

20 minutes to one half hour

## Materials Needed

Budget Worksheet

Calculator

## Preparation

This should be done in Social Science after studying the economy and after the family budgeting lesson.

## Activity

1. Separate the class out into small groups of 4 or 5 students each.
2. Give them paychecks (if you want to make it realistic) and have them rearrange their budgets for the now higher energy prices. Remind them of the choices they would be making in each category. It might be useful to assign role playing: Designate someone as the mother, father, and children; have them try to think like they actually would in those roles. Their choices should be based on realistic changes in spending, i.e., wants should be reduced and not necessities.
3. For the budget activities they cut out, have them determine what kinds of jobs would be affected by their reduction in spending, assuming other families make similar choices.
4. Have them discuss what effect that might have on the economy as a whole. What industries would be most affected?

## Assessment

Collect the worksheets and determine how accurate they were in calculations. Were they realistic in the items they cut out of their budgets? How active was the group in general in discussing their decisions?

**Study Guide for**  
**Energy and CO<sub>2</sub> Management: Carbon Capture and Storage**  
Presented by Dan Daly, Outreach Task Manager, Plains CO<sub>2</sub> Reduction (PCOR) Partnership  
Energy & Environmental Research Center, University of North Dakota  
Presented at the 2014 Lignite Education Seminar  
Bismarck, North Dakota

## CO<sub>2</sub> Science

**Jeopardy Answer No. 1:** A molecule made of one atom of carbon and two atoms of oxygen.

1. What is carbon monoxide?
2. What is carbon dioxide?
3. What is calcium dioxide?
4. What is di-hydrogen oxide?

**No. 2 is correct.**

A colorless, odorless, noncombustible gas, it is a by-product of combustion.

We use it every day, e.g., coolant as dry ice, to make soda bubbly, in fire extinguishers.

One of nature's essential constituents:

- Critical to plant life
- An important greenhouse gas
- A trace gas (0.04%) in the atmosphere
- A by-product of respiration

It is also found in natural underground deposits like those for oil and natural gas and is present in oil and natural gas deposits.

The composition of the atmosphere is 78% nitrogen, 21% oxygen, and 1% other gases (mostly argon) including 0.04% CO<sub>2</sub>.

The global carbon cycle has many parts. Some carbon is in long-term storage (atmospheric, oceanic, rock, and fossil fuel storage [also called sinks]), and some moves through the environment (cycling between the atmosphere and oceans and between the atmosphere and plants/soil).

**Jeopardy Answer No. 2:** The natural phenomenon that makes Earth warm enough to support life as we know it.

1. What is the atmosphere?
2. What is a volcano?
3. What is el Niño?
4. What is the greenhouse effect?

**No. 4 is correct.**

Without the greenhouse effect, the average annual temperature of Earth would be like North Dakota in winter!

Major players are water vapor and some trace gases (carbon dioxide, methane, and nitrous oxide), collectively called greenhouse gases. Nonplayers include the major components of the atmosphere, nitrogen, oxygen, and argon. Greenhouse gas levels and temperature have fluctuated over geologic time.

**BONUS QUESTION:** Is this natural phenomenon **good** or **bad** for inhabitants of Earth?

**Good is correct.**

**Jeopardy Answer No. 3:** CO<sub>2</sub> released to the atmosphere by human activities like burning fossil fuels, making cement, or plowing fields.

1. What is anthropogenic CO<sub>2</sub>?
2. What is natural CO<sub>2</sub>?
3. What is liquid CO<sub>2</sub>?
4. What is exhalation?

**No. 1 is correct.**

Sources include:

- Fossil fuels (carbon in hydrocarbon fuels like coal, oil, and natural gas).
- Carbonates (carbon in seashells and limestone) heated to produce cement.
- Land use practices – soil microorganisms exposed to air by plowing, breaking down organic carbon stored in the soil (plant materials and other organic matter).

As part of the carbon cycle, carbon dioxide might form from several sources:

- Atmosphere – atmospheric CO<sub>2</sub> is the amount of CO<sub>2</sub> in the atmosphere at any time.
- Carbon cycle CO<sub>2</sub> – Cycling CO<sub>2</sub> continually moves between the atmosphere, soils, plants, animals, the oceans, and back to the atmosphere.
- Biological deposition (fossils/rocks) – fossil CO<sub>2</sub> used to be in the atmosphere but is now in long-term storage in geologic deposits like coal beds, oil reservoirs, and limestone rocks.
- Geothermal activity (e.g., volcanos) – new CO<sub>2</sub> develops from natural processes deep in Earth and is released to the atmosphere by volcanoes.
- Fossil fuel combustion/lime production – CO<sub>2</sub> that was in long-term storage (fossil CO<sub>2</sub>) but is now being released by human action.

Combustion is a chemical energy conversion.

- Carbon-based fuel + oxygen + a little heat → lots of heat + CO<sub>2</sub> + H<sub>2</sub>O.
- Biofuels generate CO<sub>2</sub> from today's atmosphere.
- Fossil fuels generate CO<sub>2</sub> from ancient atmospheres.

## Energy and Carbon

**Jeopardy Answer No. 4:** The fuel supplying 85% of the energy humans use today.

1. What is sunlight?
2. What is renewable energy?
3. What is electricity?
4. What is fossil fuels?

**No. 4 is correct** (Coal, oil, and natural gas)

How do we use these fuels?

- Oil used to make gasoline and diesel fuel for cars, trucks, airplanes, and ships.
- Coal used to generate electricity.
- Natural gas used to heat homes, offices, and stores.

**Jeopardy Answer No. 5:** The total amount of greenhouse gases humans release to the atmosphere.

1. What is anthropogenic CO<sub>2</sub>?
2. What is our carbon footprint?
3. What is barely significant?
4. What is 17?

**No. 2 is correct.**

How is this total partitioned?

- 70% energy
- 13% agriculture
- 10% land use
- 3% waste

**Jeopardy Answer No. 6:** The year 1865.

1. When was the opening volley of the U.S. Civil War?
2. When was the sinking of the Titanic?
3. When was the end of the War of 1812?
4. When was the beginning of significant use of coal in America?

**No. 4 is correct.**

**Jeopardy Answer No. 7:** The year 1900.

1. When was electricity replacing horses on streetcars?
2. When had the global use of energy by humans doubled?
3. When did the global use of fossil fuels surpass the use of wood fuels?
4. When did U.S. auto production reach 4000 cars?
5. When did North Dakota have 73 coal mines?

**All are correct.**

Global energy demand is 10 times greater than it was 100 years ago. The demand is currently met by a combination of biofuel, hydroelectricity, fossil fuels, and nuclear energy.

What energy source is providing the lion's share? \_\_\_\_\_

### **Fossil fuels**

With all this energy come more and more CO<sub>2</sub> emissions.

- CO<sub>2</sub> emissions from human activity to the atmosphere have been on the rise since the early 1800s.
  - In 1900, the annual emissions were around 2 billion metric tons CO<sub>2</sub>.
  - In 2000, they were about 25 billion metric ton CO<sub>2</sub>.
  - By 2006, annual emissions reached 30 billion metric tons CO<sub>2</sub> (which is 8.2 billion metric tons of carbon).
- Some of that anthropogenic carbon has been absorbed by the oceans and the terrestrial carbon cycle (trees, soils, etc.), but some remains in the atmosphere.
  - In 1800, atmospheric CO<sub>2</sub> is estimated to have been around 280 ppm (0.028%).
  - In 2006, atmospheric CO<sub>2</sub> was around 380 ppm (0.038%).
  - In June 2013, the concentration briefly topped 400 ppm.

**Jeopardy Answer No. 8:** Half again as much.

1. What is the amount of snow predicted for next winter?
2. What is the amount of energy needed in 2040?
3. What do you wind up paying in taxes?
4. What is how much longer should this presentation be?

**No. 2 is correct.**

Global energy demand is expected to increase by 50% in 25 years.

The video excerpt on the slide **Global CO<sub>2</sub> Emissions 1930 to 2006** is from the video clip “Energy and Carbon: The Big Picture” (and from the documentary *Global Energy and Carbon: Tracking Our Footprint*). The clip is available at <http://www.undeerc.org/PCOR/Video-Clip-Library/>.

We can control output of anthropogenic CO<sub>2</sub> and stabilize CO<sub>2</sub> in the atmosphere. BUT can we provide the energy we need, pay for the change, and maintain a strong economy?

## Cutting Carbon

The video excerpt on the slide **Cutting Carbon** is from the video clip “Energy and Carbon: The Big Picture” (and from the documentary *Global Energy and Carbon: Tracking Our Footprint*). The clip is available at <http://www.undeerc.org/PCOR/Video-Clip-Library/>.

There are a range of CO<sub>2</sub> management options.

- As individuals, we can:
  - Use energy wisely.
  - Install energy-saving appliances and devices.
- As societies, we can:
  - Improve energy efficiency (in fossil fuel-fired systems).
  - Seek noncarbon energy technologies.
  - Implement carbon management techniques.

Learn more about the myriad options discussed by Socolow and Pacala in their paper in *Scientific American*, August 21, 2006, “A Plan to Keep Carbon in Check.” That paper and other related information is available free online at <http://cmi.princeton.edu/wedges/articles.php> (accessed June 3, 2014).

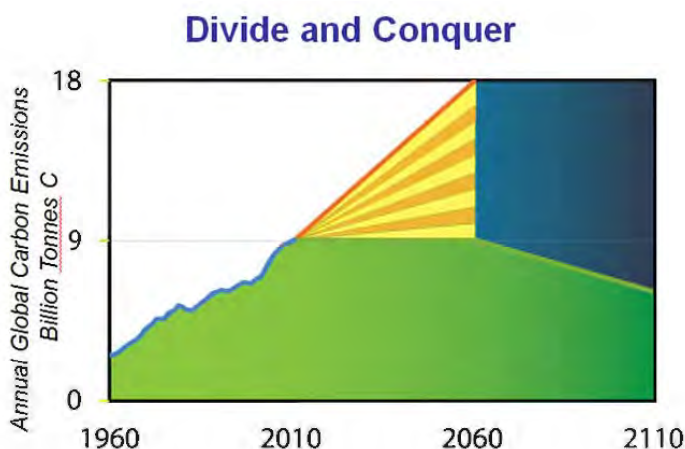


Figure 1. Cutting CO<sub>2</sub> emissions to stabilize anthropogenic contribution to the atmosphere over the next 50 years can be accomplished by dividing the task into smaller wedges and using a variety of strategies to reduce emissions. Each of the nine yellow or gold wedges represents 25 billion tons of carbon not emitted to the atmosphere by 2060 (with is also 1 billion tons of carbon in the 2060).

**Jeopardy Answer No. 9:** Capture and long-term storage of CO<sub>2</sub>.

1. What is CO<sub>2</sub> localization?
2. What is CO<sub>2</sub> sequestration?
3. What is CO<sub>2</sub> serendipity?
4. What is the greenhouse effect?

**No. 2 is correct.**

Terrestrial sequestration absorbs CO<sub>2</sub> from the atmosphere and stores it in plant materials and soils.

Carbon capture and storage (CCS) captures CO<sub>2</sub> before it enters the atmosphere and puts it into storage deep underground for millions of years.

Geologic sequestration is also called:

- CCS.
- Geologic CO<sub>2</sub> sequestration.
- Carbon capture, utilization, and storage.

The video excerpt is from the video clip “Carbon Capture and Storage” (and from the documentary *Managing Carbon Dioxide: The Geologic Solution*). The clip is available at <http://www.undeerc.org/PCOR/Video-Clip-Library/>.

## CO<sub>2</sub> Sequestration and CCS

**Jeopardy Answer No. 10:** 25 deposits on six continents.

1. What is the number of mafia bank accounts?
2. What is the number of pure carbon (diamond) mine areas?
3. What is the number of natural underground CO<sub>2</sub> deposits?
4. What is the number of major coal mines?

**No. 3 is correct.**

The video excerpt is from the video clip “World’s Finest Fire Extinguisher” (and from the documentary *Managing Carbon Dioxide: The Geologic Solution*). The clip is available at <http://www.undeerc.org/PCOR/Video-Clip-Library/>.

Geologic CO<sub>2</sub> sequestration puts the storage in CCS.

- Carbon capture – separate and capture CO<sub>2</sub> at a stationary source like a power plant.
- Transport – compress the CO<sub>2</sub> and transport the CO<sub>2</sub> by pipeline to a central storage location.
- Storage – inject CO<sub>2</sub> into formations deep below the surface (at least a half-mile deep).
  - Depleted oil and gas reservoirs
  - Unminable coal seams
  - Deep saline formations

Certain conditions must exist to safely implement CCS:

- Right form of CO<sub>2</sub> – to be pumped underground, CO<sub>2</sub> must be under enough pressure to flow into the rock formation. It will be on the supercritical or dense phase, which happens naturally at depths below 2500 ft. This also provides maximum storage capacity.
- Right conditions underground – sedimentary rock structures and stable environment (e.g., areas of low seismic activity).
  - Over time, sediments are buried, compacted, cemented, and...become ROCK.

- Rock-making, aka “lithification:”
  - Sand + lithification = sandstone.
  - Silt + lithification = siltstone.
  - Clay + lithification = claystone.
  - Coral reefs and shells + lithification = limestone = rock composed primarily of the mineral calcite (CaCO<sub>3</sub>).
- Most sedimentary rocks have pores, and many are permeable.
- Right rocks
  - Rock layer for CO<sub>2</sub> storage – porous and permeable rock layers like sandstones and some limestones.
  - Rock layer for seal – continuous, tight, impermeable rock layers like shales, mudstones, salts, and some limestones.
- Right operation – tailored design, expert personnel, and proven practices.
  - Drinking water protection is not only critical, it is the law. Regulations require that three layers of steel and two layers of durable cement surround the fluids of a well for the full extent of the drinking water zone (usually at least the first 500 ft of depth).
  - Injection pressure is high enough to get the CO<sub>2</sub> into the formation without disrupting the injection zone. CO<sub>2</sub> injection has been an industry practice in Texas for more than 35 years and at the Weyburn oil field for more than 10 years.
- Right safeguards:
  - Monitoring, safety protocols
- Right development path
- Regulatory process, community engagement

The video excerpt on the slide **What Works for Oil Works for CO<sub>2</sub>** is from the video clip “Reservoir Geology 101: Fluids in the Rocks” (and from the documentary *Managing Carbon Dioxide: The Geologic Solution*). The clip is available at <http://www.undeerc.org/PCOR/Video-Clip-Library/>.

The video excerpt on the slide **Geologic CO<sub>2</sub> Sequestration** is from the video clip “Carbon Capture and Storage” (and from the documentary *Managing Carbon Dioxide: The Geologic Solution*). The clip is available at <http://www.undeerc.org/PCOR/Video-Clip-Library/>.

## Local CCS: PCOR Partnership Region and Activities

North Dakota lies at the center of the PCOR Partnership Program region (North Dakota, South Dakota, Nebraska, Minnesota, Wisconsin, Iowa, Missouri, Manitoba, Saskatchewan, and parts of Wyoming, Montana, and Alberta) that:

- Covers 2.5% of Earth’s land surface.
- Accounts for 0.5% of Earth’s population.
- Accounts for 3.0% of global gross domestic product (GDP).
- Puts out 3.0% of Earth’s anthropogenic CO<sub>2</sub>. This includes approximately 930 stationary sources for a total of ~560 million tons of CO<sub>2</sub> emissions a year.

The region also comprises part or all of eight sedimentary basins that hold potential opportunities for CCS operations. There have already been several test activities and ongoing commercial projects.



## **More Information**

### *In your packet:*

DVDs

PCOR Partnership Atlas, 4th Ed.

Flash drive with this presentation and a link to our Web site and fact sheets

### *Visit our Web site:*

[undeerc.org/pcor](http://undeerc.org/pcor)

### *Find related lesson plans:*

[www.prairiepublic.org/education/teachers/media-resources/eerc-2011-lesson-plans](http://www.prairiepublic.org/education/teachers/media-resources/eerc-2011-lesson-plans)

### *Check out our next venue:*

Prairie Public Teacher Institute 2015 Integrating Digital Media in Your Classroom: The Arts, History, Culture, and STEM, Concordia College, Moorhead, Minnesota, June 23–24, 2015

[www.prairiepublic.org/education/teachers/professional-development/teacher-training-institutes/teacher-training-institute](http://www.prairiepublic.org/education/teachers/professional-development/teacher-training-institutes/teacher-training-institute)

### *Contact:*

Dan Daly, Outreach Task Manager  
Plains CO<sub>2</sub> Reduction (PCOR) Partnership  
ddaly@undeerc.org  
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# Plant Level Environmental Compliance

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*Craig Bleth –Plant Environmental & Engineering Manager | Minnkota Power*

The \_\_\_\_\_ has primary regulatory authority over North Dakota’s seven coal-based power plants.

Environmental laws and regulations cover three areas of power plant operations:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

The \_\_\_\_\_ set federal standards for six criteria pollutants. The three that affect power plants are: \_\_\_\_\_, \_\_\_\_\_ and \_\_\_\_\_. These standards were advanced through the Clean Air Act Amendments of \_\_\_\_\_ and \_\_\_\_\_ and accompanying regulations.

Power plants are equipped with \_\_\_\_\_ that provide real-time data of air emissions.

Reducing emissions:

- \_\_\_\_\_ removes sulfur dioxide.
- Nitrogen dioxide can be reduced during and after \_\_\_\_\_.
- Baghouses and electro static precipitators remove \_\_\_\_\_.

\_\_\_\_\_ stem from the North Dakota Pollutant Discharge Elimination System permits.

\_\_\_\_\_ stem from the Resource Conservation and Recovery Act. \_\_\_\_\_ from the power plants is a regulated waste.

Upcoming regulations include:

- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_

There are beneficial uses of coal combustion products such as:

\_\_\_\_\_  
\_\_\_\_\_



# Environmental Activities

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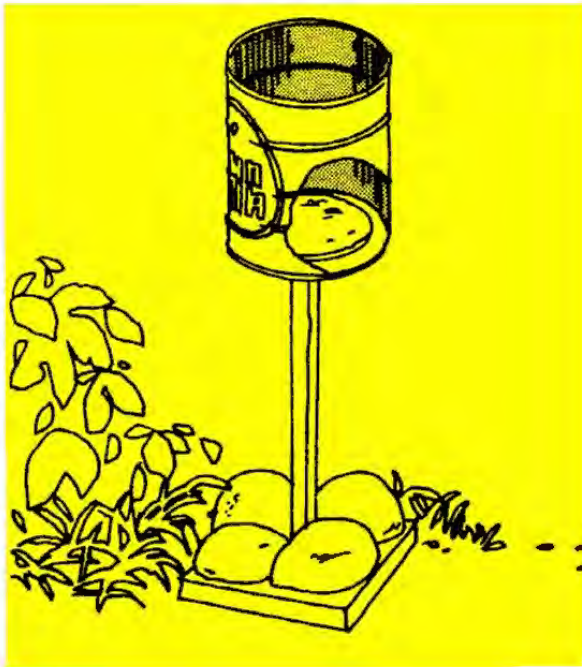
## AIR MONITOR ACTIVITY

*THINGS YOU NEED: Large coffee can. Shiny white cardboard or paper 10 inches by 20 inches. Petroleum jelly (such as Vaseline) masking or mending tape. Wood pole 4 feet long. Wood base 1½ feet by 1½ feet.*

According to the U.S. Environmental Protection Agency, millions and millions of tons of man-made waste products are released into the air each year in this country. The main ingredients in these waste products are carbon monoxide, sulfur and nitrogen gases, hydrocarbons, and very small solid and liquid particles.

Now of this huge amount released, probably around a third of it falls back to the earth. Some of it is visible as dust, ash, and smoke.

Technicians need special equipment to measure and study this fallout. But you can still get a general impression of how much dirt is in the air in your area by doing this simple experiment. In



the experiment, the coffee can is positioned on a stand with the open end facing upward. The sides of the can and the height of the stand will help to keep out the ground dust. After assembling the stand, punch a small hole in the bottom of the can. Then nail the can to the pole.

From one end of the cardboard, cut out a disk about 5 inches in diameter, and spread a thick coating of petroleum jelly all over the white surface. Lay the disk on the bottom of the coffee can (jelly side up, of course).

Now you can start the test by placing the stand out in an open area as far above the ground as possible. Put a few rocks on the base of the stand to keep it from being blown over. In a couple of weeks or so, you'll be able to tell how clean or dirty the air is around you.

# Environmental Activity

## Soil Permeability for Landfill Construction

The composition of soil has important consequences on its permeability. Some soils (clays in particular) have the ability to retard the flow of water. This is why compacted clay liners and covers are frequently required for landfill construction, and are typically specified by rules and by construction permits.

Experiment steps:

1. Put coarse sand in one glass
2. Put moistened well-mixed clay in another glass
3. Put a mixture of soil types (including topsoil rich in humus) in a third glass.
4. Assure that each material is carefully compacted into the glass to reduce as many air voids as possible.
5. Push a finger into each glass and smear the sample to the wall of the glass. This will prevent wall effects that will interfere with the experiment.
6. Pour some water with food coloring into each glass and observe what happens:
  - In the glass with sand, the water will fall to the bottom quickly.
  - In the glass with clay, water should remain on the top, or penetrate the clay only very slowly.
  - In the glass with mixed soil and humus, water is absorbed and distributed homogeneously.

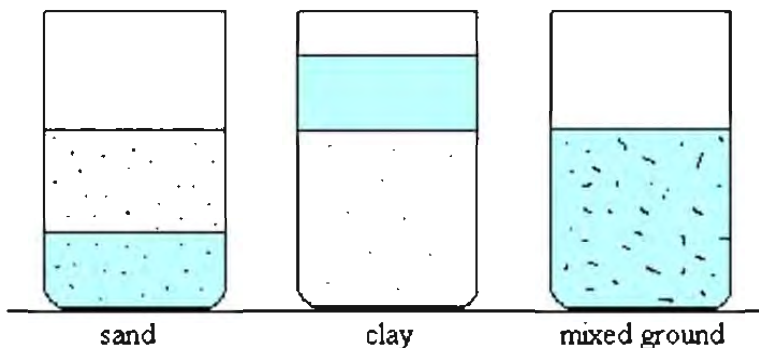


Figure 2 - Permeability of different types of soil components. In blue the distribution of water.

Q: Why are clay soils preferred (and usually required) to line and cap landfills?

A: *To control seepage from a landfill while it is operating, and to prevent precipitation from infiltrating closed landfills.*

Q: What properties do the three soil types have that account for the results in the experiment?

A. *Sand – coarse grains, rounder grains, large pore spaces, connections between pore spaces, high soil permeability*

*Clay – very small grain size, platy-shaped grains, small and poorly-connected pore spaces low soil permeability*

*Mixed Soil – random grain size, pore space, and pore connections; lower permeability than sand, but somewhat unpredictable*

## **Classroom Activity**

### **Power World Simulator**

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Power World Simulator – see a diagram of electric generators and loads, and observe what happens when the system has a line that is taken out of service. See how the generation and load are balanced across the system, and how the power flow changes with changes to the available transmission lines on the system.



# GO GREEN PROJECT: ENERGY USE

## Leaders Guide

Carl Pedersen, NDSU Energy Educator  
North Dakota State University

### Grade level

7-12. This is a basic lesson plan that can be expanded for high school grades or simplified for elementary students.

### Subjects(s)

Science  
Math

### Duration

One and a half 50-minute class periods

### Description

Most people have little idea of the cost to power the electronic appliances in their homes. This lesson gives students a brief history of energy and helps them develop tools to make better decisions in relation to home energy use.

### Objectives

1. Students will understand that life on Earth is affected by a series of interconnected cycles and that those cycles are affected by the way we use Earth's natural resources.
2. Students will use exploration and mathematical calculations to determine their home energy consumption.

### Materials

- EnergyUse PowerPoint
- Electrical appliances (one for every two students)
- Kill-A-watt™ home electricity monitor (optional)
- Home Energy Use worksheet

### Procedure

#### Day 1:

1. Begin with the PowerPoint provided on energy and the history of energy use on Earth. (25 minutes)
2. Demonstrate the use of the Home Energy Use evaluation worksheet (procedure included in PowerPoint)
3. Pass out one electrical appliance for every two students and have them determine the energy requirements of that appliance. Have students exchange appliances and determine the electricity requirements for at least five different ones.
4. Homework: Have students go home and determine the energy use of five more appliances in their home.

#### Day 2:

1. Revisit information from the previous day.  
*Discussion questions:* What is energy? What are some ways to reduce energy use? What is standby power? What appliances have standby power draws? What appliances in your home use the most electricity? How can people determine energy use of electronics and appliances when making purchases?

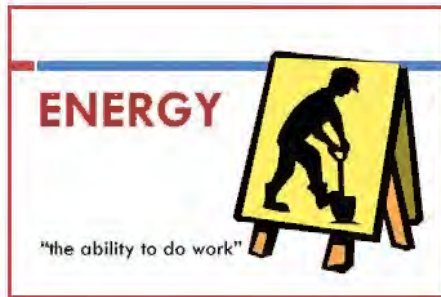
**NDSU**  
**Extension Service**  
North Dakota State University  
Fargo, North Dakota 58108

August 2009



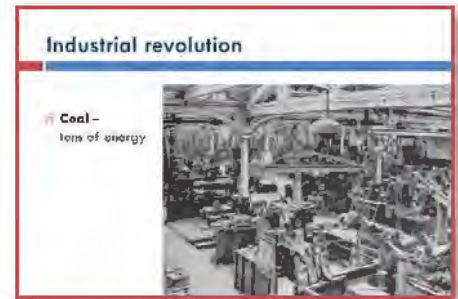
## Slide 1

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## Slide 2

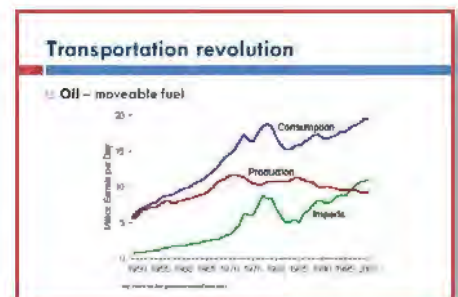
Energy simply defined is "the ability to do work." Heating a home, dribbling a basket ball or digging a hole all takes energy. The sources of that energy and the ways that energy is converted are extremely varied. You need to take an energy source and convert it so work can be done.



## Slide 3

The industrial revolution occurred as a result of the discovery of the amount of energy in coal. The amounts of energy released when coal is burned gave inventors the ability to operate larger and more productive steam engines. Previously, wood was used and did not have enough energy released to power steam engines and other machines. Once the energy in coal began being used, it changed the course of history.

This was the first time in history that people stopped paying attention to the organic cycles of the Earth and instead they began working against them. Before the industrial revolution, they had to grow crops when weather was good and store enough food and fuel sources to last through the winters. This was a dramatic shift in the way the resources on our planet were utilized; it was a switch from renewable to nonrenewable resource utilization, a switch from organic to inorganic economy, and a switch from resource use to resource depletion economy.



## Slide 4

The discovery of the process to refine oil into usable sources of energy fueled the transportation revolution, another explosion in the use of nonrenewable energy sources. In 1859, the first North American oil well was drilled in Titusville, Pa. The increased use of oil further changed the landscape from using natural sources of energy to working against the processes of the Earth.





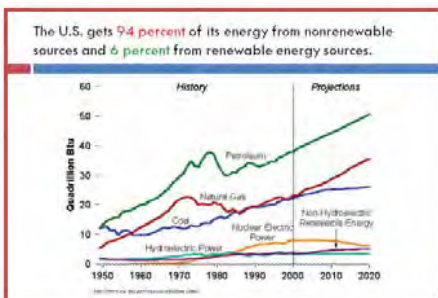
## Slide 5

The materials economy: extraction, manufacturing, distribution, consumption, disposal.

Our economy is based on a system of using things and then throwing them away. We produce, grow or mine things that then are processed. These materials are sent to a distribution center, where consumers purchase them and bring them home. After using them, they are discarded and either burned or enter a landfill. The vast majority of things we use are not returned to the environment to enter the ecosystem again. Our system of supply and demand is based on a linear system.

The Earth is not linear. It is an interconnected group of cycles: water cycle, carbon cycle, nitrogen cycle, etc. This system we are using is not sustainable. Eventually the ecosystem will be damaged past the point of where it can recover naturally.

For more information, visit [www.storyofstuff.com](http://www.storyofstuff.com)



## Slide 6

According to the U.S. Department of Energy's Energy Information Administration, the U.S. gets 94 percent of the energy it uses from nonrenewable resources and only 6 percent from renewable sources. Nonrenewable resources are ones that once used are no longer available for reuse. Examples are coal, oil and natural gas. Examples of renewable energy use are wind turbines, hydroelectricity generation and energy from solar radiation.



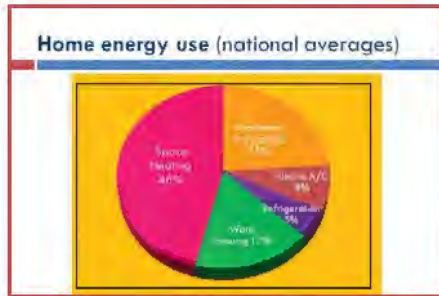
## Slide 7

Interest in the use of renewable energy sources is increasing. While these are not new ideas for energy use, interest in utilizing them is rekindled.



## Slide 8

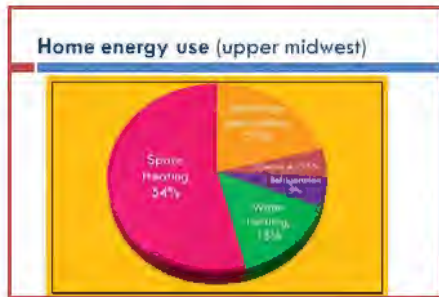
The most important source of energy that needs to be promoted is energy efficiency. Americans simply are using too much energy and until energy use is reduced, we will continue to experience the same problems. While energy efficiency is not actually a source of energy, many utility companies and industries are looking at increasing the amount of work done for the amount of energy consumed, or getting more bang for the buck.



### Slide 9

When trying to become more efficient with energy, looking at the largest energy users makes sense. In homes, that is heating and appliances.

According to the U.S. Department of Energy, Energy Information Administration, 2001 census data, 46 percent of home energy use in the U. S. is for heating and another 24 percent is for lighting and appliances. In North Dakota and the upper midwest, a much larger portion of energy use is for home heating. Home heating accounts for closer to 50 percent of energy use (See next slide).



### Slide 10

Data from for the Upper Midwest home energy consumption

Table CE1-10c. Total Energy Consumption in U.S. Households by Midwest Census Region, 2001  
 Data accessed at [www.eia.doe.gov/emeu/recs/recs2001\\_ce/ce1-10c\\_mw\\_region2001.html](http://www.eia.doe.gov/emeu/recs/recs2001_ce/ce1-10c_mw_region2001.html) June 20, 2009.



### Slide 11

If heat is created in a home and it leaks out, the homeowner is paying to heat the outside air, which is a waste of energy and money.

When trying to determine the greatest areas of heat loss in a building, start with these areas:

- Check insulation levels in the attic and walls if possible. Do not forget to check to see if foundation walls are insulated.
- Look to see if plumbing and heating pipes that leave the building are allowing heat to escape into the attic or outside.
- Interior walls often also are a serious culprit of heat loss. They can act as a funnel for heat losses. Heat passes into uninsulated interior walls. Heat rises as a result of convective processes. If those walls do not have insulation plugging the top of them, that heat could be lost to the attic and the surrounding area.
- Check for cracked seals around windows and doors.



### Slide 12

This image shows where the majority of heating leaks are in a home.



## Slide 13

Home electronics and lighting account for 24 percent of home energy use nationwide. The problem with most appliances is that you cannot determine easily how much they cost you to use. One of the best things to do is purchase ENERGY STAR electronics and appliances. The ENERGY STAR label ensures you the appliance is more energy efficient than government standards require.

ENERGY STAR appliances also have very low standby power losses. Standby power losses occur when an appliance still will draw electricity even when turned off. If they have a clock, a soft-touch keypad or remote control, they use what is called standby power. The amount of electricity they use depends on the appliance and the efficiency of that appliance. The average house has an estimated 20 appliances that use standby power. If you want to check, walk through the house at night with all the lights off and look for clocks or the little lights that tell you appliances still are using electricity. The cost of energy consumed by standby power in the United States is estimated at \$4 billion per year or the amount of electricity generated by seven power plants. What can you do? Put appliances such as computers on power strips that have an on/off switch. When you buy appliances, educate yourself about how much they cost to operate, including in standby mode.

For example, plasma televisions are generally huge energy wasters. Some can use as much as 500 watts of electricity when in use and as much as 75 watts when turned off. An appliance that uses 75 watts of standby power will cost \$65 per year at 10 cents per kilowatt-hour.



## Slide 14

Other appliances, such as video games, can be large consumers of electricity. According to the Natural Resources Defense Council, the Nintendo Wii uses only 16 watts of electricity when being played compared with 150 watts used by the Sony Playstation 3. In addition, many gaming systems do not come from the manufacturer with auto-sleep functions enabled. This means the game continues to draw maximum power until the user shuts the game off.

Natural Resources Defense Council. 2008. Lowering the Cost of Play, Improving the Energy Efficiency of Video Game Consoles. Report accessed 20 June 2009 at [www.nrdc.org/energy/consoles/files/consoles.pdf](http://www.nrdc.org/energy/consoles/files/consoles.pdf)



## Slide 15

Switching from incandescent to compact fluorescent light (CFL) bulbs is a guaranteed money and energy saver. The bulbs consume around 75 percent less energy than an incandescent bulb and produce less heat. The majority of the energy used by incandescent light bulbs is used to produce heat, not light. Less heat produced from each bulb means less energy to cool your house in the summer. In the winter, incandescent bulbs will provide heat to the home. You would need to do a fuel cost savings analysis to determine if electric heat is less expensive than the heat source you have in your house. You can save an average of about \$50 per incandescent bulb you replace with a CFL during the life of the CFL bulb.



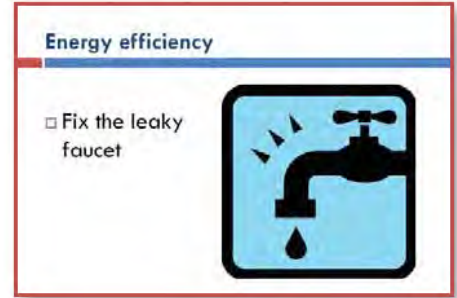
## Slide 16

Electronic appliances come with energy labels to inform consumers about how much electricity they require. The cost to use that appliance can be determined from this label. In the example on this slide, the piece of electronics is rated at using 65 watts of electricity. If you used this appliance for one hour, it would use 65 watt-hours of electricity. Electricity is sold by kilowatt hour, so you would need to convert watts to kilowatts to determine the cost. If you used this appliance for two hours, it would use 130 watts of electricity (2 hours x 65 watts).

Item	Power needs (watts)	Number of appliances	Hours on per day	Energy/Day (watt-hour)	Kilowatt hour per day (watt-hour x 0.001)	Cost per day	Cost per year
	A	B	C	$A \times B \times C = D$	$D \times 0.001 = E$	$E \times \$10/\text{kWh} = F$	$F \times 365 = G$
Incandescent light	75w	1	10	$75 \times 1 \times 10 = 750$	$750 \times 0.001 = 0.75 \text{ kWh}$	$0.75 \times \$10 = \$7.50$	$\$7.50 \times 365 = \$2737.50$
CFL light	15w						

## Slide 17

Use this worksheet to determine how much an appliance or piece of electronics will cost to use in a year. Start on the left side of the worksheet and fill in the blanks as you work across. The first example is done showing the cost of a 75-watt light bulb. One light bulb (A) on for 10 hours a day (C) uses 750 watt-hours (D) of electricity in a day. Since electricity is sold in kilowatt-hours, you need to multiply watt-hours by 0.001 to convert it to kilowatt-hours (E). Then to get the daily cost, multiply the kWh by the cost of electricity. The national average cost of electricity is 10 cents per kilowatt-hour, so that is the number used (F). Finally, multiply the daily use by 365 to determine how much that electronic device is costing per year. Complete the second row (the CFL light bulb) to determine the cost to use a comparable CFL for a year. Then use the rest of the columns on the worksheet to determine how much energy appliances use.



## Slide 18

Using energy more efficiently is like stopping a leaky faucet. We would not let a faucet continually run or drip in our homes, but we allow energy to be wasted. The way we use energy is like the analogy of trying to get a drink of water from a firehouse. Sure, you will be able to get a drink, but a lot of water will be wasted. We use a lot more energy than we need to simply because we do not try to utilize the most efficient means to accomplish each task.

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## For more information on this and other topics, see: [www.ag.ndsu.edu](http://www.ag.ndsu.edu)

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# HOME ENERGY USE WORKSHEET

Carl Pedersen, NDSU Energy Educator  
North Dakota State University

A rough estimate of the cost to use an appliance can be determined by using the wattage the appliance needs, the cost of electricity and the amount of time an appliance is used.

The worksheet walks the students through these calculations. By filling in the worksheet starting on the left hand column and working to the right, the yearly cost for an appliance can be determined.

## Procedure

1. The first step is to enter the watts used by the appliance in column A. An appliance's watt rating generally is stamped on the bottom or back or on a label. For fixed voltage appliances that do not have a watt rating, watts (W) can be determined by multiplying current (A or amps) x voltage (V). ( $W = A \times V$ )
2. A Kill-A-watt™ home electricity monitor can also be used to determine energy use by appliances.
3. Enter the number of appliances in column B. For example, if you have 10 75-watt light bulbs, you would enter 75 in column A and 10 in column B.
4. Enter the number of hours the appliance is in use during the day in column C.
5. The information for column D is determined by multiplying  $A \times B \times C$ . This gives you watt-hours per day.
6. Electricity is sold by kilowatt-hours, so a conversion from watt-hours to kilowatt-hours (kWh) is done in column E.
7. To determine the daily cost of an appliance, multiply the daily energy use by the cost for each kWh. An average cost of 10 cents per kWh is used as an example, but if you know the rate in your area, that number can be used in column F.
8. Then to determine the cost per year, multiply the daily cost (F) by 365 and enter that information in column G.

Power Max	240W
Frequency Range	50-60 Hz
AC Voltage	120V
Current Max	2A



# HOME ENERGY USE

Name \_\_\_\_\_  
 Date \_\_\_\_\_

Item	Power Needs (watts) (A)	Number of Appliances (B)	Hours on per day (C)	Energy/Day = Watt*hr = (A) x (B) x (C) = (D)	Kilowatt*hr per day Watt*hr x 0.001 = (D) x 0.001 = (E)	Cost per day (E) x \$0.10/kWh = (F)	Cost per year (F) x 365 = (G)
Incandescent light	75w	1	10	75 x 1 x 10 = 750	750 x 0.001 = 0.75kWh	\$0.075	\$27.38
CFL lights	15w						

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# **Workforce Issues & Needs Panel Discussion**

The purpose of this panel is to provide teachers with an open forum to discuss workforce issues, needs and concerns with representatives from the industry.

## **I. Introductions (See biographical sketches on following page)**

- Moderator
- Panel Members

## **II. Opening Statements**

- Panel members make opening statements explaining their involvement with lignite-related issues

## **III. Questions and Answers**

- Seminar participants ask panel members questions on lignite-related issues and concerns

## **IV. Closing Statements**

- Panel members make brief closing remarks

## **V. Conclusion**

- Moderator makes closing remarks

# Workforce Issues & Needs Panel Discussion

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## Workforce Issues & Needs Panel Discussion

### *Moderator*

**Jason Bohrer's** background as an attorney, a communications director for the Idaho Republican Party and, most recently, chief of staff to U.S. Rep. Raul Labrador (R-Idaho) provide a diverse skillset in his role as president and chief executive officer of the Lignite Energy Council. He is a graduate of North Dakota State University and earned his law degree from George Mason University. For the past nine years he has lived in Washington, D.C. Besides his work with Rep. Labrador, he also is a former legislative counsel for U.S. Senator Jim Risch (R-Idaho).

### *Panel Members*

**Dan Dorfschmidt** is Operations Manager for Butler Machinery in Western ND. Butler is your Caterpillar equipment dealer for North and South Dakota. During his career Dan has held various engineering and management positions in both the oil and gas and mining industries. Prior to joining the Butler Team, Dan was a Butler Machinery customer holding the position of Mine Superintendent at Goldcorp's Wharf gold mine in Lead SD. Dan has a degree in Geological Engineering from SD School of Mines.

**Bruce Emmil** is the Associate Vice President of the National Energy Center of Excellence at Bismarck State College. In this position, Bruce is responsible for the overall day-to-day operations of the NECE which consists of twelve Program Certificate and/or Associate in Applied Science degreed energy programs, one Bachelor of Applied Science in Energy Management degreed program and various non-credit energy training initiatives and apprenticeship programs. Before joining Bismarck State College in 2001, Bruce spent 13+ years working in the generation sector of the energy industry for Northeast Utilities.

**Jamey Backus** is the Plant Manager at the Leland Olds Station in Stanton, ND. He has worked at Leland Olds for nearly 10 years with roles including Results Engineer and Maintenance Superintendent. His responsibilities include the overall operation, maintenance and compliance of the station as well as workforce planning, labor relations, maintaining budgets and prioritizing capital expenditures. Prior to transferring to LOS he was a Mechanical Engineer at Dakota Gasification for 8+ years. He is originally from south eastern SD and has a degree in Mechanical Engineering from SD School of Mines.

**Jay Volk** is the environmental manager for BNI Coal where he has been employed for the last 11 years. His department's responsibilities include permitting, environmental compliance, land management, geology, and leasing. Prior to his mining career, Jay was involved in consulting and research. Jay earned a Ph.D. from North Dakota State University and is a native of Bismarck/Mandan.



# Educational Materials

## Our Region's Lignite Industry

The materials listed below are available from the Lignite Energy Council and the mining companies, utilities and rural electric cooperatives of our region's lignite industry. Also included is a listing of people who teachers can contact to obtain these materials. Some utilities may limit materials to teachers within their service area.

### Publications

1. **Five Facts About Your Electricity** (2017) - Lignite Energy Council - Fact sheets providing up-to-date information and statistics on North Dakota's lignite industry.
2. **Great Plains Synfuels Plant** (2015) - Dakota Gasification Company - Brochure describing the Great Plains Synfuels Plant at Beulah.
3. **Antelope Valley Station** (2017) - Basin Electric Power Cooperative - Brochure describing the Antelope Valley Station at Beulah.
4. **Leland Olds Station** (2015) - Basin Electric Power Cooperative - Brochure describing the Leland Olds Station at Stanton.
5. **Basin Electric Power Cooperative** (2015) - Brochure giving an overview of Basin Electric's generating resources.
6. **BNI Coal** - BNI Coal, Ltd. - Brochure describing the Center Mine at Center.
7. **The Falkirk Mining Company** - North American Coal Corporation - Brochure giving facts and figures on the Falkirk Mine at Underwood.
8. **The Coteau Properties Company** - North American Coal Corporation - Brochure giving facts and figures on the Freedom Mine at Beulah.
9. **Milton R. Young Station** - Minnkota Power Cooperative - Brochure describing the Milton R. Young Station near Center.
10. **The Facts** - Great River Energy - Brochure contains general information on Great River Energy.
11. **Coyote Electric Generating Station** - Otter Tail Power Company - Brochure describing the Coyote Station at Beulah, ND.
12. **R.M. Heskett Electric Generating Station** - Montana-Dakota Utilities Co. - Brochure describing the Heskett Station at Mandan, ND.

## **DVDs**

1. **Lignite Rocks** – 2012 – A video geared toward grade school and junior high students. Explains many facets of the lignite coal industry. 7 minutes. Available from Lignite Energy Council.  
  
**The Coteau Mining Story** – 2004 - A video describing mining operations at the Coteau Freedom Mine near Beulah. 17 minutes. Available from North American Coal Corporation.
2. **The North American Coal Corporation Falkirk Mine – The Mining Story** - Describes mining operations of the Falkirk Mine at Underwood. 14 minutes. North American Coal Corporation.
3. **BNI Coal – Our History...Our Future** – 2007 –Story about BNI Coal. 7 minutes. BNI Coal, Ltd.

## **Online Resources – Videos (Use your browser’s search bar to search)**

[More information can be found at: http://www.lignite.com/education](http://www.lignite.com/education)

1. Great River Energy Youtube Channel
2. Great River Energy News Youtube Channel
3. Basin Electric Power Cooperative Youtube Channel
4. Otter Tail Power Company Youtube Channel
5. Milton R. Young Station Tour – on Vimeo
6. Lignite Energy Council Youtube Channel

## **Education Contacts**

For more information on education materials or to receive any of the materials, please contact the appropriate person listed below.

### **Basin Electric Power Cooperative**

Michael Riedman  
1717 E. Interstate Avenue  
Bismarck, ND 58503  
Phone: (701) 557-5609  
Email: [riedman@becpc.com](mailto:riedman@becpc.com)

### **BNI Coal, Ltd.**

Courtney Doll  
Center Mine  
2360 35<sup>th</sup> Avenue SW  
Center, ND 58530-9499  
Phone: (701) 355-5588  
Email: [cdoll@bnicoal.com](mailto:cdoll@bnicoal.com)

### **Dakota Gasification Co.**

Joan Dietz  
420 County Rd 26  
Beulah, ND 58523-9400  
Phone: (701) 873-6667/701-557-5070  
Email: [jdietz@becpc.com](mailto:jdietz@becpc.com)

### **Great River Energy, North Dakota**

Lyndon Anderson  
2875 Third Street SW  
Underwood, ND 58576-9759  
Phone: (701) 442-7036  
Email: [landerson1@greenergy.com](mailto:landerson1@greenergy.com)

### **Great River Energy, Minnesota**

Therese LaCanne  
12300 Elm Creek Blvd.  
Maple Grove, MN 55369  
Phone: (763) 445-5710  
Email: [tlacanne@greenergy.com](mailto:tlacanne@greenergy.com)

### **MDU Resources Group, Inc.**

Mark Hanson  
1200 W. Century Avenue  
Bismarck, ND 58503  
Phone: (701) 530-1093  
Email: [mark.hanson@mduresources.com](mailto:mark.hanson@mduresources.com)

### **Minnkota Power Cooperative**

Sue Black  
P.O. Box 13200  
Grand Forks, ND 58208-3200  
Phone: (701) 795-4292  
Email: [sblack@minnkota.com](mailto:sblack@minnkota.com)

### **North American Coal Corporation**

David Straley  
2000 Schafer Street, Suite D  
Bismarck, ND 58501-1204  
Phone: (701) 222-7596  
Email: [david.straley@nacoal.com](mailto:david.straley@nacoal.com)

### **Otter Tail Power Company**

Anne Taylor  
215 S. Cascade Street  
Fergus Falls, MN 56537  
Phone: (218) 739-8250  
Email: [ataylor@otpc.com](mailto:ataylor@otpc.com)

### **Lignite Energy Council**

Kay LaCoe  
P.O. Box 2277  
Bismarck, ND 58502  
Phone: (701) 258-7117  
Email: [kaylacoel@lignite.com](mailto:kaylacoel@lignite.com)

# Tour Contacts

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## Mining and Conversion Facilities

Teachers are invited to schedule tours or field trips for their classes at mining and conversion facilities. If you are interested, please contact the appropriate people listed with the facilities below:

### Basin Electric Power Cooperative

#### **Antelope Valley Station, Beulah**

#### **Leland Olds Station, Stanton**

**Contact:** Erin Huntimer  
Basin Electric Power Cooperative  
1717 E. Interstate Avenue  
Bismarck, ND 58503  
Phone: (701) 223-0441  
Email: [ehuntimer@bepc.com](mailto:ehuntimer@bepc.com)

### BNI Coal, Ltd.

#### **Center Mine, Center**

**Contact:** Courtney Doll  
BNI Coal, Ltd.  
Center Mine  
2360 35<sup>th</sup> Ave. SW  
Center, ND 58530-9499  
Phone: (701) 355-5588  
Email: [cdoll@bnicoal.com](mailto:cdoll@bnicoal.com)

### Dakota Gasification Co.

#### **Great Plains Synfuels Plant, Beulah**

**Contact:** Joan Dietz  
Dakota Gasification Co.  
420 County Rd 26  
Beulah, ND 58523-9400  
Phone: (701) 873-6667 (Beulah)  
(701) 223-0441 (Bismarck)  
Email: [jdietz@bepc.com](mailto:jdietz@bepc.com)

### Great River Energy

#### **Coal Creek Station, Underwood**

**Contact:** Anne Hansen  
Great River Energy  
Coal Creek Station  
2875 Third Street SW  
Underwood, ND 58576-9759  
Phone: (701) 442-7036  
Email: [ahansen@greenergy.com](mailto:ahansen@greenergy.com)

#### **Great River Energy, Elk River**

**Contact:** Brenda Geisler  
Great River Energy  
Energy Recovery Station  
17845 E Hwy 10  
Elk River, MN 55330  
Phone: (763) 241-2318  
Email: [bhoskyns@greenergy.com](mailto:bhoskyns@greenergy.com)

#### **Resource Processing Plant, Elk River**

**Contact:** Janeen Wolfsteller  
Great River Energy  
Resource Processing Plant  
10700 165th Ave NW  
Elk River, MN 55330  
Phone: 763-445-5855  
Email: [jwolfsteller@greenergy.com](mailto:jwolfsteller@greenergy.com)

Montana-Dakota Utilities Co.

**Heskett Station, Mandan**

**Contact:** Dale Ziegler  
Heskett Station  
Box 40  
Mandan, ND 58554  
Phone: (701) 222-7861  
Email: [dale.ziegler@mdu.com](mailto:dale.ziegler@mdu.com)

Minnkota Power Cooperative

**Milton R. Young Station, Center**

**Contact:** Sue Black  
Minnkota Power Cooperative  
P.O. Box 13200  
Grand Forks, ND 58208-3200  
Phone: (701) 795-4292  
Email: [sblack@minnkota.com](mailto:sblack@minnkota.com)

Or

**Contact:** Mary Schneider  
Milton R. Young Station  
Box 127  
Center, ND 58530  
Phone: (701) 794-8711  
Email: [mschneider@minnkota.com](mailto:mschneider@minnkota.com)

Otter Tail Power Company

**Coyote Station, Beulah**

**Contact:** Brad Zimmerman  
Coyote Station  
Box 339  
Beulah, ND 58523  
Phone: (701) 873-2571  
Email: [brzimmerman@otpc.com](mailto:brzimmerman@otpc.com)

North American Coal Corp.

**Coyote Creek Mine, Beulah**

**Freedom Mine, Beulah**

**Falkirk Mine, Underwood**

**Indian Head Mine, Zap  
(Reclamation Tours Only)**

**Contact:** David Straley  
North American Coal Corp.  
2000 Schafer Street – Suite D  
Bismarck, ND 58501-1204  
Phone: (701) 222-7596  
Email: [david.straley@nacoal.com](mailto:david.straley@nacoal.com)

Or

The Coteau Properties Company  
Freedom Mine  
Phone: (701) 873-2281

Or

The Falkirk Mining Company  
Falkirk Mine  
Phone: (701) 442-5751

## Glossary of Terms

**Ammonia:** A colorless, pungent, gaseous compound of nitrogen and hydrogen (NH<sub>3</sub>), possessing strong alkaline properties when in solution. It is soluble in water to an unusual degree, one part of water absorbing 600 parts of the gas. It is used as a refrigeration gas because of the ease with which it is liquefied at moderately low temperatures by means of high pressure.

**Anhydrous:** Devoid of water.

**Annual System Load Factor:** The ratio of the average load over one year to the peak load occurring during that year. System load factor is calculated as follows:

$$ALF = \frac{KWH}{KW \times 8760 \text{ hrs.}}$$

where KWH equals the annual consumption, and KW is the annual peak.

**Anthracite:** The most highly carbonized and metamorphosed form of coal, containing 92 to 98 percent of fixed carbon. It is black, hard, and glassy.

**Approximate Original Contour:** That surface configuration achieved by backfilling and grading an area affected by surface mining so the reclaimed area closely resembles the general configuration of the land prior to mining.

**Aquifer:** A water bearing stratum of permeable rock, sand, gravel, or other geologic material.

**Argon:** A colorless, odorless gaseous element found in the air and in volcanic gases and used especially as a filler for electric bulbs and electron tubes.

**Ash:** Solid residue left where combustible material is thoroughly burned or is oxidized by chemical means.

**Base Load** - An electric utility's minimum power output over a given period of time. A base load generating plant is designed for continuous operation and generates electricity around the clock.

**BATF (Bureau of Alcohol, Tobacco and Firearms):** This federal agency, which is a division of the Department of Treasury, regulates and controls the storage and use of explosives.

**Beneficiation:** The processing of coal to remove unwanted constituents and to improve quality. Beneficiation may include ash and pyrite removal, coal drying and processing to improve stability and ease of handling.

**Benzene:** A colorless volatile flammable liquid aromatic hydrocarbon C<sub>6</sub>H<sub>6</sub> used in organic synthesis, as a solvent and as a motor fuel.

**Bituminous Coal:** A soft coal formed by an intermediate degree of carbonization and containing 15 to 20 percent volatiles. The most common grade of coal.

**Blasting Agent:** A product used by the mining industry that contains no explosive ingredient, but can be made to detonate when initiated with a high-strength explosive primer.

**British Thermal Unit (Btu):** The quantity of heat required to raise the temperature of one pound of water one degree Fahrenheit.

**Busbar Cost:** The total cost required to deliver electrical power to the generator bus, usually given in mills/kwh. This cost includes the fuel cost, fixed cost of the power plant, and operation and maintenance of the plant. Does not include the cost of the transmission system and general administrative costs.

**Capacity:** The electric load for which a generator, turbine, transformer, transmission circuit, apparatus, station or system is rated.

**Carbon Dioxide (CO<sub>2</sub>):** Gas formed in animal respiration, decay or combustion of organic matter, and absorbed by plants in photosynthesis. A greenhouse gas.

**Carbonaceous:** Said of a rock or sediment that is rich in carbon; coaly.

**Carbonization:** The progressive changes undergone by preserved organic matter and biochemical decomposition products between the death of the plant and the stage of essentially complete reduction to residual carbon.

**Catalyst:** A material which increases the rate of a chemical reaction but does not react itself.

**Chlorofluorocarbons (CFCs):** Man-made gases used for insulation, refrigerants and foam packaging. A greenhouse gas.

**Climate:** The average course of the weather at a place over a period of years as exhibited by temperature, wind velocity and precipitation.

**Coal:** a dark brown to black combustible rock of organic origin formed over millions of years by the partial decomposition of plant material in an airless atmosphere, with increased pressures and temperatures over millions of years

**Coal Gasification:** The conversion of coal into methane, carbon oxides and other related compounds by the addition of steam and oxygen under high temperature and pressure.

**Coalification:** The alteration or metamorphism of plant material into coal.

**Combustion:** The chemical process by which hydrocarbons are oxidized to synthesize carbon dioxide and water. Energy is released during combustion of hydrocarbons.

**Competition** - The economic force which regulates price in the marketplace.

**Continental Glaciation:** The increase in the size of the world's ice fields which covered major parts of the continents, in thicknesses of up to 1,500 feet in the Williston Basin area.

**Conversion:** The degree of formation of products from feeds in a chemical reaction. For example, in a shift conversion, the products are hydrogen and carbon dioxide; the feeds are carbon monoxide and steam. Changes in the amount of a feed, the process conditions, or catalyst activity changes the amount of conversion from feed to products.

**Core Sample:** A columnar sample of rock obtained by drilling with a hollow bit and core barrel.

**Cropland:** Land used for the production of adapted crops for harvest, alone or in a rotation with grasses and legumes and includes row crops, small grain crops, hay crops, nursery crops, orchard crops and other similar specialty crops.

**Cresols:** Any of three colorless crystalline or liquid isomeric phenols C<sub>7</sub>H<sub>80</sub>.

**Demand:** The rate at which electric power is consumed by a system, expressed in kilowatts or megawatts. Demand and capacity are normally considered synonymous.

**Deregulation** - Removal of barriers that limited competition for customers in the marketplace.

**Direct Respread:** A method of respraying soil in which the material is removed from an undisturbed area and immediately respread on a graded, approved site.

**Distillation:** A process that consists of driving gas or vapor from liquids or solids by heating and condensing to liquid products and that is used especially for purification, fractionation, or the formation of new substances.

**Domestic Coal:** A term used by the industry to designate coal that is to be used in homes and institutions in a mine's trade area.

**Dozer:** A highly versatile piece of earth excavating and moving equipment used in leveling spoil banks, building roads, benching pits and ripping coal. These machines can be of two types - track or rubber-tired.

**Dragline:** Large mobile excavator used to remove overburden, and sometimes interburden, from over the coal seams.

**Economics** - The study of the way we allocate resources among alternatives to satisfy human wants and needs.

**Effluent Limit:** The permitted limit on the amount of suspended solids, iron, or acidity/alkalinity that can be in water discharged from a permitted facility. Effluent limits may be placed for other chemical or physical parameters by regulation or permit.

**Energy:** Electrical power generated, measured in kilowatt hours.

**Environmental Protection Agency:** An agency of the federal government which establishes standards that coal mines meet prior to and during mining.

**Externalities** - The environmental and social costs of producing a product. They are not real costs, but perceived costs used to encourage use of one product over another.

**Fixed Carbon:** The solid residue, other than ash, obtained by destructive distillation determined by definite prescribed methods.

**Fixed Cost:** Those costs of a facility that are incurred on a continuing basis even though the facility may not be operating and would normally include depreciation, interest, taxes and insurance.

**Fluidization:** The process by which air or gases move through a bed of fine grained solids to cause the bed to flow like a liquid.

**Fluvial:** Of, or pertaining to, rivers; growing or living in streams or ponds; produced by river action, as a fluvial plain.

**Fuel Cost:** The sum of the cost of fuel delivered to the bunkers, including freight, and other transportation charges, the cost of unloading and reclaiming labor and maintenance.

**Fuel Oil:** Combustible matter, derived from crude oil, used as a source of heat energy.

**Gas Liquor:** Primarily water which has been used to scrub the gasifier raw gas stream and contains tars, oils, ammonia, phenol and dust.

**Gasification:** The conversion of coal to a gaseous fuel. The partial oxidation of coal to form a gaseous mixture containing carbon monoxide, hydrogen and methane.

**Generating Capacity** - The quantity of electric energy a power plant is capable of producing, usually measured in kilowatts or megawatts.

**Geology:** The science which studies the earth, the rocks of which it is composed, and the changes which it has undergone or is undergoing.

**Geophysical Logging Rig:** A vehicle setup for the logging of drilling holes using a probe which measures the geophysical properties of the subsurface strata (e.g., natural gamma radiation, density, electrical resistance, hole diameter).

**Global Climate Models (GCM):** Computer models used to predict changes in climate based on a variety of factors, including greenhouse gas concentrations.



**GPS:** Geographic Positioning System, used to replace traditional land survey techniques, locating spatial orientation and elevation with satellite transmissions and receivers mounted in vehicles, heavy equipment or hand carried.

**Grass Drill:** A specially designed machine that will seed various grass species. It is equipped with special seed boxes, agitators, depth bands and feed and calibration mechanisms.

**Greenhouse Effect:** Process by which most short-wave radiation from the sun passes through the earth's atmosphere while most of the reradiated long wave radiation is captured by the atmosphere. Responsible for warming average earth's temperature from about 0° to about 60° C.

**Greenhouse Gases:** Gases which capture long-wave radiation and warm the earth's atmosphere (carbon dioxide, CFCs, methane, water vapor, nitrous oxide).

**Gross Generation:** The total amount of electric energy produced by a generating station or stations, measured at the generator terminals. This includes net generation and station service.

**Ground Cover:** The area of ground covered by vegetation and the mulch that is produced naturally onsite, expressed as a percentage of the total area of measurement.

**Groundwater:** Water which is contained in the voids and cracks of the subsurface strata.

**Heat Rate:** The amount of BTUs (British Thermal Units) required to produce 1 KWH of energy, normally given as BTU per KWH.

**Heterogeneous:** A mixture of diverse or dissimilar ingredients or constituents.

**Highwall:** The steep overburden slope of the pit.

**Hydrocarbon:** A compound containing only hydrogen and carbon. They form the principal constituents of petroleum. The simplest hydrocarbons are gases at ordinary temperatures; but, with increasing molecular weight, they change to the liquid form and finally the solid state. Their boiling and melting points are, in general, proportional to their molecular weight.

**Hydrogen:** A gaseous element, colorless, odorless, tasteless, flammable, and lighter than any other isolated element. Its symbol is H, and in conjunction with carbon it forms many long series of compounds which are the most important constituents of petroleum.

**Hydrogenating:** To combine or treat with or expose to hydrogen; to add hydrogen to the molecule of an unsaturated organic compound.

**Installed Cost:** The capital investment or equivalent annual cost of a facility. The installed cost is the total investment cost of a facility including labor, materials, right-of-way, engineering, and overhead. Does not include variable costs such as operations, maintenance, and taxes.

**Interburden:** Material between coal seams.

**Introduced Species:** Plants which have been introduced into North America from other continents.

**Kilowatt:** Kilowatt (KW) is the instantaneous capacity or demand. KW is also the real power generated and/or sold to a consumer. KW is a thousand watts of electric power.

**Kilowatt-Hour (KWH)** - The basic unit of electric energy equal to one kilowatt of power supplied to or taken from an electric circuit steadily for one hour. This is the unit used to measure electric consumption on consumer bills.

**Krypton:** A colorless, odorless gaseous element found in air and used as a filler for electric light bulbs and in electronics manufacturing.

**KVA, MVA:** Kilovoltamperes, megavoltamperes is the total rated capacity of generation or transmission equipment. If the KVAR or MVAR is excessive, the KW or MW must be reduced to avoid exceeding the KVA or MVAR capacity.

**Lacustine:** Produced by or belonging to lakes, of, or pertaining to or formed or growing in, or inhabiting lakes.

**Land Use:** Specific uses or management-related activities, rather than the vegetation or cover of the land.

**Lignite:** Brownish-black coal in which the alteration of vegetal material has proceeded further than in peat but not so far as subbituminous coal. Heat content is less than 7,000 Btu (moist, mineral-matter-free).

**Liquefaction:** The process by which coal is chemically and physically altered to become liquid.

**Liquor Stream:** A process stream having a high concentration of organic and inorganic soluble compounds.

**Load Management** - The process of shifting customer demand to better meet a utility's generating capabilities.

**Load Shaping** - The process of changing customer demand for electricity from one time of day to another.

**Loading Shovel, Front-End Loader:** Equipment used to load coal into haulage trucks.

**MAPP** - Mid-Continent Area Power Pool - A group of power generation and transmission utilities who coordinate an electric power network in the Upper Midwest and Two Canadian provinces.

**Lurgi Process:** A coal gasification process which produces gas in a reactor through the controlled reaction of coal and oxygen in the presence of excess steam at elevated temperatures and pressures.

**Megawatt:** Megawatt (MW) is the instantaneous capacity or demand. A thousand kilowatts of electric power.

**Megawatt Hour:** Megawatt Hour (MWH) is the amount of electric energy provided by 1 megawatt in 1 hour.

**Marine Rocks:** Sedimentary deposits deposited under sea (marine) conditions.

**Mercaptans:** Sulfur compounds, analogous to alcohols, in which sulfur has replaced oxygen. They are colorless, flammable liquids with a strong, repulsive odor. There is a long series of organic mercaptans, many of which occur naturally in crude oil. Some types of mercaptans are added to natural gas to indicate gas leaks by odor detection.

**Metabolism:** The chemical change by which carbohydrates are oxidized and energy is provided for biological processes.

**Metamorphism:** The changes of mineralogy and texture imposed on a rock by pressure and temperature in the earth's interior, as well as the introduction of new chemical substances. Metamorphism does not include changes resulting from simple burial and the weight of subsequently accumulated overburden.

**Methanation:** A process of converting carbon monoxide and carbon dioxide present in synthetic gas to methane, using hydrogen, steam, heat and appropriate catalysts. This process increases the Btu content of SNG.

**Methane (CH<sub>4</sub>):** Gaseous hydrocarbon that is a product of the decomposition of organic matter and the burning of fossil fuels. A greenhouse gas.

**Methanol:** A flammable colorless liquid infinitely soluble in water. The simplest possible alcohol.

**MSHA (Mine Safety and Health**

**Administration):** This federal agency oversees the health and safety of miners on the job.

**Mulch:** Vegetation residues or other suitable materials that aid in soil stabilization and moisture conservation.

**Nameplate Capacity:** The maximum design of the electric capability as shown by the nameplates of generating units, turbines, synchronous condensers, transformers, or other equipment in a station or system.

**Naphtha:** The lightest liquid constituents of oil separated by distillation processes. The word was derived from the Persian word “nafata,” meaning to “exude,” and was originally applied to petroleum oils and shale oils indiscriminately. The term is now used in a very general sense, and has no specific scientific application to any particular liquid.

**Native Grassland:** Land on which the natural potential plant cover is principally composed of native grasses, grasslike plants, forbs and shrubs valuable for forage and is used for grazing.

**Native Species:** Plants which have evolved in North America.

**Natural Gas:** A mixture of gaseous hydrocarbons found in many places connected with deposits of petroleum, to which the gaseous compounds are closely related.

**Net Generation:** Gross generation less the station service energy used to operate the generating plant.

**Net Generation Available at Load:** Net generation, less reserves and transmission losses, which can be considered available at the delivery points to serve member loads.

**Nitrogen:** A colorless tasteless odorless gaseous element that constitutes 78 percent of the atmosphere by volume and occurs as a constituent of all living tissues in combined form.

**Nitrous Oxide (N<sub>2</sub>O):** A gas produced from fertilizers, fossil fuels and many natural processes. A greenhouse gas.

**Office of Surface Mining (OSM):** An agency of the federal government which insures all mines meet federal standards.

**Outcrop:** A segment of bedrock exposed by erosion to the atmosphere, visible to the eye.

**Overburden:** All of the earth and other materials, except SPGM, which lie above the lignite. After overburden is moved it is called spoil.

**Oxides of Nitrogen (NO<sub>x</sub>):** Gases produced by the burning of fossil fuels. With volatile organic compounds, thought to be responsible for ozone formation. With SO<sub>2</sub> thought to be responsible for acid rain.

**Ozone (O<sub>3</sub>):** Triatomic form of oxygen formed naturally in the upper atmosphere and also generated commercially. Desired in the upper atmosphere as a shield from harmful rays from the sun. Undesirable in lower atmosphere as a major agent in the formation of smog.

**Peak Demand** - The maximum customer use of electricity during a specific period of time.

**Peak Load** - The maximum electricity load consumed or produced during a specific period of time.

**Peaking Capacity:** Generating equipment normally operated only during the hours of highest daily, weekly or seasonal loads. Some generating equipment may be operated at certain times as peaking capacity, and at other times to serve loads on a round-the-clock basis.

**Peat:** A dark-brown or black structureless groundmass produced by the partial decomposition and disintegration of plant material in a marsh or swamp.

**Performance Bond:** A surety bond, collateral bond, self bond, deposit or alternative form of security approved by the Public Service Commission by which a mining company assures faithful performance of all requirements of the reclamation laws and regulations.

**Permit:** A document which allows a company to conduct surface mining and reclamation in North Dakota. It is prepared by the company and submitted to the ND Public Service Commission for its review. Following approval, it is valid for a five-year period.

**Phenols:** Any of various organic compounds which are hydroxyl derivatives of aromatic hydrocarbons.

**Photosynthesis:** The chemical process by which carbohydrates (hydrocarbons) are synthesized from carbon dioxide and water in the presence of light. Photosynthesis is a chemical process called reduction during which energy is stored.

**Pit:** The excavated hole dug by a dragline or auxiliary equipment.

**Plant Availability:** The time generating equipment is available for service, divided by the total time in a month or year.

**Plant Capacity Factor:** The total generating output of a plant for a known period of time divided by the capacity of the plant, times the hours on-line. This number is normally in percent and indicates the percent a plant is operated at rated capability while on-line.

**Plant Load Factor:** The total generating output of a plant for a known period of time, divided by the capacity of the plant, times the total time in a month or year. This is similar to Load Factor only in that it refers to the output of a power plant.

**Power:** The electrical energy sold or generated by a utility. Power normally means both capacity and energy.

**Pozzolan:** Finely divided silica and alumina materials that react with slaked lime in the presence of moisture to form a strong slow-hardening cement.

**Precipitation Event:** A rain or snowfall usually expressed in terms of magnitude compared to time; e.g., 10-year/24-hour event = 3.25 inches which means a 3.25 inch rainfall over a 24-hour period usually can be expected to fall sometime within a 10-year period.

**Probable Hydrologic Consequences:** An analysis of the probable effects of mining on the surface and groundwater hydrology in terms of water flows, availability, and quality. Required as part of a mining permit application. May be prepared by the mining company or regulatory agency.

**Productivity:** A measurement of vegetation production on a reclaimed area for specified time, usually expressed in pounds per acre or bushels per acre per year.

**PSIG:** Pounds per square inch gauge.

**Public Service Commission (PSC):** The State of North Dakota agency that promulgates and enforces reclamation and mining laws.

**Push-Pull Mode:** An industry term that describes the method used by tractor-scraper to increase their production efficiency by hooking the two machines together when in the loading phase of the cycle.

**Rank:** Those differences in the pure coal material due to geological processes whereby the coal material changes from peat through lignite and bituminous coal to anthracite or even to graphite.

**Reactor:** A vessel in which hydrocarbons are reacted with chemicals or other hydrocarbons to obtain the desired end products.

**Reclamation Plan:** Submitted by a company as part of a permit which sets forth a plan to reclaim a surface mine.

**Reserves:** Unloaded generating capacity available for service.

**Rectisol:** Processing section which removes carbon dioxide, naphtha, sulfur compounds and HCN from the mixed gas by contact with cold methanol.

**Scoria:** Informal name for porcelanite, which is a rock formed by the baking of clay materials by underlying, burning coal seams.

**Sedimentary Deposits:** Rocks formed by the accumulation of rock or mineral grains transported by wind, water, or ice to be deposited or chemically deposited.

**Side Stream:** A liquid product stream taken from one of the plates of a bubble tower.

**SNG:** Synthetic Natural Gas. Methane is the primary constituent of SNG.

**Soil Horizons:** Contrasting layers of soil lying one below the other, parallel or nearly parallel to the land surface. Soil horizons are differentiated on the basis of field characteristics and laboratory data. The three major horizons are:

*“A” horizon* - the uppermost layer of the soil profile, often called topsoil. It is the part of the soil in which organic matter is most abundant and where leaching of soluble or unsuspended particles is the greatest.

*“B” horizon* - the layer immediately beneath the A horizon. This middle layer commonly contains more clay, iron or aluminum than the A or C horizons.

*“C” horizon* - the deepest layer of the soil profile. It consists of loose material or weathered bedrock that is relatively unaffected by biologic activity.

**Soil Survey:** The identification and location of all SPGM within a permit area and an accompanying report that describes, classifies and interprets the nature and use of the material.

**SPGM:** Suitable Plant Growth Material is a collective term for topsoil and subsoil inventoried by a Professional Soil Classifier to a depth of several feet, that meets certain chemical and physical parameters.

**Specialty Products:** Products and markets for lignite other than fuel for large-scale coal-burning power plants and for the production of syngas.

**Spinning Reserves:** The amount of unloaded generation held in generating units capable of immediately picking up load following the loss of another generating unit. Spinning reserves of any generator shall not exceed the amount of generation increases that can be realized in 10 minutes.

**Spoil or Spoil Pile:** Overburden or interburden which has been removed from over the coal seam by the dragline.

**State Health Department:** North Dakota's lead agency for enforcing EPA regulations.

**Strip Mining:** The mining of coal by surface methods; the name comes from the shape of the pit containing coal.

**Stripping Ratio:** The ratio of earth moved per unit of coal uncovered, often yards of earth to move per ton of coal uncovered, sometimes vertical depth in feet to move per ton of coal uncovered.

**Sulfur Dioxide (SO<sub>2</sub>):** Gas produced by the burning of fossil fuels which contain sulfur. Thought to be responsible for acid rain.

**Synthesis Gas:** The materials from which product compounds are made synthetically. The primary components of synthesis gas are carbon monoxide and hydrogen.

**Tame Pastureland:** Land used for the long-term production of predominantly adapted, introduced species of forage plants to be grazed by livestock.

**Tipple:** Coal preparation facility that crushes the coal according to the customer specification.

**Tractor-Scrapers (Scrapers):** Two-axle earth moving units which load by lowering a cutting edge into the earth and moving forward producing an action similar to a cheese slicer. The resultant loose dirt is pushed into the scraper bowl until filled.

**Transmission Capacity Losses:** The power lost in transmission between one point and another.

**Variable Costs** - Those costs which vary with the level of output.

**Volatile Matter:** Gaseous materials that are readily lost from a system if not confined; also, substances such as water and carbon dioxide, which are loosely bound into a mineral structure and can escape from a rock if the minerals break down during metamorphism.

**Wholesale Rate:** The rate at which a utility must sell power to another utility in order to recover all investments and operating costs.

**Williston Basin:** The tectonic synclinal depression of strata with its center in North Dakota and extending over parts of three other states and part of Canada.

**Woodland:** Land where the primary vegetation is trees or shrubs, including natural wooded areas and shelterbelts and other man-made woody plantings.

# Seminar Syllabus

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## 2018 Lignite Education Seminar: Energy, Economics and Environment

Monday, June 11, 2018

### Welcome & Introductory Remarks

**Time:** 8:45 a.m. – 9:15 a.m.

**Topic description:** **Kay LaCoe** will give the class an overview of what will transpire during the four-day seminar; she will acquaint them with the binder of materials they received when they registered; she will tell them what is expected of them during the class (attendance at all sessions) and will discuss the lesson plan that they will need to write. Administrative announcements will be made and questions will be answered.

**Speaker:** **Kay LaCoe**, is Director of Membership Marketing with the Lignite Energy Council. Kay joined the Lignite Energy Council in 2008 as a Communications Specialist. She is a graduate of the University of Mary with a Bachelor's of Science degree in Business Communications. Kay's background includes project management, writing, website development, graphic design, integrated marketing and social media management. Prior to joining the Council, Kay was a Communications and Marketing Coordinator at Agency MABU and an Intern at Basin Electric Power Cooperative. Kay lives with her husband, son and hunting dogs just outside of Bismarck. She is an avid hunter and also competes with her horse in the Cowboy Mounted Shooting Association.

### Lesson Plan Collaborative Work

**Time:** 9:15 a.m. – 9:45 a.m.

**Topic description:** **Terry Hagen** will facilitate collaborative work and provide instruction

**Speaker:** **Terry Hagen**, is the Instructor of Record for the Lignite Energy Council's Lignite Education Seminar. He will be grading your completed lesson plans. Terry is here today to discuss without some expectations of your lesson plans, suggestions on what to listen and look for in the upcoming days and answer questions you may have going into the Seminar regarding your lesson plans. Terry is an instructor at the University of North Dakota. He has a Master's degree in Regulatory Economics from the University of North Dakota. He has taught at the University of North Dakota and Lake Region State College since 1993 and has farmed the family farm west of Grand Forks since 1987. He has served on local Boards and on the Agriculture Advisory Committee for the 9<sup>th</sup> District Federal Reserve in Minneapolis.

### Lignite: The Region's Best Kept Secret

**Time:** 9:45 a.m. – 10:45 a.m.

**Topic description:** Mining lignite in North Dakota is often overshadowed by tales of gold mining in the Black Hills, copper mining in Montana or even taconite mining on Minnesota's Iron Range. This presentation provides a history of the lignite industry dating back to the days of Lewis & Clark and moving forward to the present. Information is provided on the various utility companies involved in the North Dakota lignite industry, which provides electricity to 2 million customers in a four-state

region and synthetic gas to a quarter of a million customers. Activities include researching historical utility information for particular cities and demonstrating the economic impact on the region.

**Speaker: Steve Van Dyke** has worked for the Lignite Energy Council since 2002 and is currently the vice president - communications. A 1980 graduate of the University of Montana's school of journalism, Steve has worked in the North Dakota energy industry since 1985. Prior to 2002, he worked for MDU Resources Group, Inc., as its corporate communications manager and contributed to the MDU history book: "The Mondakonians: Energizers of the Prairie." His background also includes working at newspapers in Beach, North Dakota; Baker, Montana; and Bismarck, North Dakota; along with serving as a community relations specialist with Mid-Rivers Telephone Cooperative in Glendive, Montana.

## North Dakota Geology: Coal-Bearing Rocks in the Northern Great Plains

**Time:** 11:00 p.m. – 12:00 p.m.

**Topic description:** This presentation includes a discussion of ancient seas, deposition of materials and compaction to make lignite. Information is also given about the differences in coal varieties, how coal reserves are measured and what makes certain reserves more economical to mine than others. Physical geology is also examined to look at why coal reserves are found in certain areas and not in other adjacent areas. Activities include a classroom "coal formation" experiment and an experiment with a chocolate chip cookie to determine economical mining.

**Speakers: Kendra Kungu** is originally from Dickinson, ND. She always loved the outdoors, playing in the dirt, and collecting rocks. Kendra attended Dickinson State University for 1 year, then transferred to South Dakota School of Mines and Technology in Rapid City, SD. She earned her Bachelor's Degree in Geological Engineering, graduating in 2009. She started at The Coteau Properties Company after graduation in 2009 and became a registered Professional Engineer in North Dakota in 2014. She has two sons.

## The Mining and Reclamation Process

**Time:** 12:45 p.m. – 2:15 p.m.

**Topic description:** A mining engineer provides a history of mine regulations in North Dakota over the past 40 years and identifies various permitting and regulatory aspects of surface coal mining required today, including surface water management and ground water monitoring. The presentation takes a step-by-step approach to mining from removing and stockpiling top soils and subsoil, to removing the coal, which is followed by reclamation. The presentation serves as an introduction to the mining and reclamation area teachers will tour the following day. Activities include a reclamation experiment that simulates the regulatory environment that surrounds surface mining.

**Speaker: Sarah Flath** is Environmental Manager for the Coteau Properties Company's Freedom Mine, the nation's largest lignite coal mine, located north of Beulah. She's worked for North American Coal in North Dakota since 1999. She started in Coteau's environmental and short range engineering departments, then worked for Coyote Creek Mine as part of the team to plan, permit and develop Coyote Creek Mine, the state's first new coal mine since the 1980's, before returning to Coteau as Environmental Manager. She serves on the American Society for Mining and Reclamation's National Executive Committee, the Mercer County Economic Development Board, the Hazen Chamber Board and has been a past president of the ND chapter of the Society for Range Management. She received her bachelor's degree in Range Science from North Dakota State University and her master's in



Rangeland Ecosystem Science from Colorado State University. Sarah resides in Hazen, ND with her husband, Jesse, and their two daughters.

## Electricity Generation Choices

**Time:** 2:30 p.m. – 3:30 p.m.

**Topic description:** A power plant manager gives teachers an “insiders” view of how coal is converted from chemical energy to thermal energy – electricity. The presentation begins with a look at different ways electricity is produced, including hydro-power, wind energy and nuclear plants. Zeroing in on coal-based power plants, teachers see the various steps it takes to change coal to electricity and see how power plants use modern technology to increase efficiency and decrease wastes, including emissions. This presentation serves as an introduction to the power plant teachers will participate in on the third day of the Seminar. Activities include riding a bike to produce electricity and how magnets create an electronic field.

**Speaker: John Bauer** is director, North Dakota generation, for Great River Energy. He oversees Great River Energy’s generation facilities in North Dakota including Coal Creek Station, Spiritwood Station and Stanton Station. John attended the power plant technology program at Bismarck State College prior to starting his career at Great River Energy’s Coal Creek Station in 1981 where he advanced through various operations positions before his most recent position as manager of North Dakota operations services. John currently serves on the power/process plant advisory board for Bismarck State College. As the “power plant” chair for the board, he provides recommendations on BSC’s energy curriculum. He also serves as chair of the Electric Power Research Institute’s operations management and technology program which collaborates and develops best practices on how people, process and technology can be best integrated to reduce cost, improve productivity and achieve safe, reliable, cost-effective and environmentally responsible power generation.

## Synfuels Production From Lignite

**Time:** 3:45 p.m. – 4:30 p.m.

**Topic description:** The Synfuels Plant is a unique coal conversion facility, the only one of its kind in North America. This presentation will introduce teachers to the history of the Synfuels Plant – what events lead to its initial need, why it has flourished and the future plans for the plant. This presentation serves as an introduction to the tour of the Synfuels Plant teachers will participate in on the third day of the Seminar.

**Speaker: Joan Dietz**, Dakota Gasification Company/Basin Electric Power Cooperative communications specialist, has worked for Dakota Gas and Basin Electric for nearly 32 years. Joan began her career at the Synfuels Plant, in Beulah, ND, working as a records management administrative assistant in August of 1984. She also worked in human resources prior to moving to the communications department in November 1988. Joan oversees various aspects of the communications department at the Synfuels Plant including external and internal public and employee communications. She administers the advertising program, the public tours program and publishes a weekly newsletter for the facility, as well as contributes to other company publications. She has worked at Dakota Gas’ parent company, Basin Electric Power Cooperative offices in Bismarck, since December 2014 and travels to the Synfuels Plant site each week. Joan lives in Bismarck, with her husband, Jeff, after living in Hazen for 30 years. They have three adult children who live in the area, and one grandchild.

## Introduction to North Dakota Energy Curriculum

**Time: 4:30 p.m. – 5:00 p.m.**

**Topic description:** Launched in 2014, Energy: Powered by North Dakota features five modules teaching students about energy resources in North Dakota, how they're used and how they affect everyone. Teachers are given an overview of the online curriculum and shown how it can be used.

**Speaker: Retha Mattern,** Retha Mattern is the Business & Outreach Coordinator for the Bismarck State College National Energy Center of Excellence. She primarily works to expand awareness of the 12 energy-related degree and certificate programs BSC offers to energy companies and their employees, encouraging partnerships for training and technical development, along with raising awareness of the career opportunities in the energy industry to the future workforce.

Retha came to BSC after a career in television news first brought her to North Dakota from her home in Maryland, where she graduated from the University of Maryland with a degree in Journalism. She now teaches a media course in broadcasting at BSC as well. She is the incoming president of the North Dakota State Staff Senate, and past president of the BSC Staff Senate. Outside of work, she enjoys running, both half and full marathons, as well as running after her kids, ages two and four.

Tuesday, June 12, 20178

## Transmission – Transporting Electricity by Wire

**Time:** 8:00 a.m. – 9:00 a.m.

**Topic description:** Transmission issues are as important to reliable, low cost electricity as the generation sources themselves. The director of North Dakota’s Transmission Authority provides a history of transmission and how federal policies for greater competition in the electric industry have spawned changes in who owns and controls transmission facilities. Currently, there is a constraint on transmission lines. However, more transmission facilities need to be built. Regulation is changing regarding who will own, control and pay for new transmission.

**Speaker: Matthew Stoltz**, earned a bachelor’s degree in electrical engineering from North Dakota State University. He worked for the Western Area Power Administration in Loveland, Colorado and Boulder City, Nevada from 1986 through 1999. His positions with WAPA included transmission system planning, project management and operations and maintenance. He has worked for Basin Electric Power Cooperative in Bismarck, North Dakota, since 1999. He is the director of transmission services with Basin Electric and is responsible for transmission system planning, operations, and analysis.

## Enhancing Lignite’s Future through Research and Development

**Time:** 9:15 a.m. – 10:45 a.m.

**Topic description:** The director of the Lignite Research, Development and Marketing Program, a partnership between the state and lignite industry, provides an overview of current and future coal conversion technologies along with R&D projects. This presentation provides a scientific look at lignite and explores the possibilities of further development and enhancement through ongoing research projects. For instance, projects are underway to dry lignite, thus reducing emissions and increasing plant efficiencies. Activities include a coal drying experiment and a material separation simulation.

**Speaker: Mike Holmes**, joined the Lignite Energy Council in December 2016 as the vice president of research and development. He had been the director of Energy Systems Development at the Energy & Environmental Research Center (EERC) in Grand Forks, where he oversaw fossil energy research areas. His principal areas of interest and expertise include CO<sub>2</sub> capture; fuel processing; gasification systems for coproduction of hydrogen, fuels, and chemicals with electricity; process development and economics for advanced energy systems; and emission control technologies. Prior to his work at EERC, Holmes spent 15 years working on coal-related research and development and commercial projects for Babcock & Wilcox, a major supplier of advanced energy and environmental technologies for the power industry. He received a master’s of science degree in chemical engineering from the University of North Dakota and a bachelor’s of science degree in chemistry and mathematics from Mayville State University. He is a member of the National Coal Council and has been an Executive Member and served on the Board of Directors of the Fuel Cell and Hydrogen Energy Association.

## Economics and Electricity 101

**Time:** 11:00 a.m. – 12:00 p.m.

**Topic description:** An economics teacher takes a look at the electric industry from a business standpoint and explains why there are different types of utilities – investor-owned, cooperatives and

municipals. The presentation also delves into the economic factors involved in various forms of generation, such as coal-based, wind, nuclear, hydro and natural gas. The instructor also provides insights into how rates are determined by public utility regulators and how the needs of the utility are balanced with the needs of the consumer.

**Speaker:** Brian Kroshus, *not received yet*

## Energy and CO<sub>2</sub> Management: Carbon Capture and Storage

**Time:** 12:45 p.m. – 2:00 p.m.

**Topic description:** Traditional fossil-fuel-based energy and the environmental protection have been interwoven topics for years. Now as countries look at ways to reduce greenhouse gases, the challenges facing the lignite industry include developing technologies to both capture and store carbon dioxide safely. A representative of the Energy and Environmental Research Center will provide information about researchers who are working with industry to advance technologies that will dramatically reduce CO<sub>2</sub> emissions from coal-based power plants and store the gas safely in geologic formations.

**Speaker:** Dan Daly, is a research manager at the Energy & Environmental Research Center at the University of North Dakota in Grand Forks, ND. Dan earned a master's degree in geology from the University of North Dakota and has over 20 years of experience in issues related to energy and the environment. Since the fall of 2003, he has been the lead for public outreach and education with the Plains CO<sub>2</sub> Reduction Partnership (PCOR).

## Plant Level Environmental Compliance

**Time:** 2:15 p.m. – 3:15 p.m.

**Topic description:** Speaker looks at issues related to the lignite industry: air quality, Clean Air Act amendments, sulfur dioxide, nitrogen oxides, and mercury regulation. North Dakota is one of 9 states in the nation to meet all federal ambient air quality standards. This presentation looks at existing regulations such as the Clean Air Act and how they impact coal conversion facilities. Future regulations, such as regional haze and the Mercury Rules are also addressed.

**Speaker:** Craig Bleth, is a 1988 graduate of the University of North Dakota, with degrees in geological engineering and engineering management. He is a registered professional civil engineer in the state of North Dakota. Craig spent two years with the North Dakota State Water Commission before starting his career at Minnkota Power Cooperative, at the Milton R. Young Station in 1990. In his first 16 years at Minnkota Power, Craig worked mostly in the water and solid waste areas as a permitting and compliance engineer. From 2007 to 2011, Craig was named plant environmental superintendent, and project manager of a \$250 million dollar air pollution control upgrade project at the Young Station. After that, Craig led the plant engineering and environmental groups for several years. Craig is now Minnkota's Environmental Manager.

## Lignite Industry Career Choices

**Time:** 3:30 p.m. – 4:45 p.m.

**Topic description:** Jobs in the lignite industry represent some of the best paying vocations in the region. Many of these jobs require only a two-year degree. The presenter, Kent Ellis, has been speaking before North Dakota teachers discussing the opportunities presented in the

industry and how educators can help prepare their students for rewarding careers in the North Dakota energy industry.

**Speaker: Kent Ellis**, took the scenic tour through college and graduated from the University of Northern Colorado. He began his energy career in 1980 as a contract petroleum landman in the Williston Basin; taught with the Bismarck Public Schools, served as the regional School-to-Work Coordinator and is currently the North Dakota's Energy Career Awareness Coordinator. He has significant professional career experience in the construction, energy and education industries. He is the owner of LS Hydrocarbyl, and a partner in White Butte Resources, an oil and gas development company. Kent also sits on the Great Plains Advisory Council for the Minneapolis Federal Reserve Bank.

## Tour of Power Plant Program Facilities

**Time:** 4:45 p.m. - 5:30 p.m.

**Topic description:** Presentation on the Power Plant Technology Program at Bismarck State College and then a tour of the facility (National Energy Center of Excellence).

## North Dakota Energy Education Hands-On Demonstrations

**Time:** 6:00 p.m. – 6:30 p.m.

**Topic description:** Teachers break out into groups and enjoy hands-on activities that demonstrate various facets of the lignite industry. Examples include a power plant puzzle, making take-home core samples and trying their hand at reclaiming mined land in virtual reality.

**Wednesday, June 13, 2018**

Tours of power plants and mines

**Time:** 7:00 a.m. – 5:00 p.m.

**Topic description:** Teachers take a “hands-on” tour of North Dakota’s “coal country.” The tour features information provided during the bus rides, stops at lignite mines, power plants and the nation’s only lignite-based Synfuels Plant. Teachers have a chance to see huge mining machinery at work and see mine reclamation for themselves. At the plants, teachers see how lignite is converted to either electricity or synthetic natural gas in an environmentally compatible way. During the tour, teachers will hear a lecture by the manager of the Great Plains Synfuels Plant. As the largest coal conversion facility in the state, the Synfuels Plant converts lignite to pipeline-quality synthetic natural gas. The plant’s origin began in the 1970s when the United States policy makers wanted to be less reliant on foreign sources of energy. Today the plant produces not only synthetic natural gas but a host of other valuable byproducts, including carbon dioxide, which is sent via a pipeline to Canadian oil fields for tertiary oil recovery in partially depleted fields. Activities include showing how hydrogen and carbon monoxide can be transformed into water and methane.

Thursday, June 14, 2018

## Energy Sense

**Time:** 9:00 a.m. – 9:45 a.m.

**Topic description:** With all of the discussions on energy today, talking about renewable energy, the need for a smarter electric system, and the need to move into the new generation of resources, how is reliability being evaluated? Is a wind and solar electric portfolio with electric storage something that is viable in the near-term? What about electric vehicles? Energy sense provides an understandable and technically clear discussion of where we are today and what options are viable in the future.

**Speaker: Tom Butz** – has 30 years of both transmission and resource planning experience in the electric utility industry. Tom is currently employed with Power System Engineering as a Senior Planning Engineer, and is responsible for electric utility resource planning evaluations, Integrated Resource Plans, and a range of RTO market evaluations, including the MISO market. Tom's interest in strategic planning in the energy sector has spawned the beginning of the Energy Sense presentation, which has been presented to a number of conferences with updates based on the current energy trends.

## Workforce Issues and Needs Panel

**Time:** 9:15 a.m. – 11:00 a.m.

**Topic description:** The purpose of this panel is to provide teachers with an open forum to discuss workforce issues, needs and concerns with representatives from the industry.

**Speakers: Jason Bohrer** is president and chief executive officer of the Lignite Energy Council. He is a graduate of North Dakota State University and earned his law degree from George Mason University.

### Panel Members

**Dan Dorfschmidt** is Operations Manager for Butler Machinery in Western ND. Butler is your Caterpillar equipment dealer for North and South Dakota. During his career Dan has held various engineering and management positions in both the oil and gas and mining industries. Prior to joining the Butler Team, Dan was a Butler Machinery customer holding the position of Mine Superintendent at Goldcorp's Wharf gold mine in Lead SD. Dan has a degree in Geological Engineering from SD School of Mines.

**Bruce Emmil** is the Associate Vice President of the National Energy Center of Excellence at Bismarck State College. In this position, Bruce is responsible for the overall day-to-day operations of the NECE which consists of twelve Program Certificate and/or Associate in Applied Science degreed energy programs, one Bachelor of Applied Science in Energy Management degreed program and various non-credit energy training initiatives and apprenticeship programs. Before joining Bismarck State College in 2001, Bruce spent 13+ years working in the generation sector of the energy industry for Northeast Utilities.

**Jamey Backus** is the Plant Manager at the Leland Olds Station in Stanton, ND. He has worked at Leland Olds for nearly 10 years with roles including Results Engineer and Maintenance Superintendent. His responsibilities include the overall operation, maintenance and

compliance of the station as well as workforce planning, labor relations, maintaining budgets and prioritizing capital expenditures. Prior to transferring to LOS he was a Mechanical Engineer at Dakota Gasification for 8+ years. He is originally from south eastern SD and has a degree in Mechanical Engineering from SD School of Mines.

**Jay Volk** is the environmental manager for BNI Coal where he has been employed for the last 11 years. His department's responsibilities include permitting, environmental compliance, land management, geology, and leasing. Prior to his mining career, Jay was involved in consulting and research. Jay earned a Ph.D. from North Dakota State University and is a native of Bismarck/Mandan.