Annual Lignite Energy Council Education Program

Grant Submitted by
Lignite Energy Council

Principal Investigator
Lignite Energy Council

Grant Deadline: October 1, 2019

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.

The funding request is for a one-year program. The total budget for the Education Program as described is $207,800, 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 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 2020 Seminar will be held at the National Energy Center of Excellence on the campus of Bismarck State College in Bismarck, ND, on June 8 - 11. 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.

Beginning in 2014, the Lignite Education Program expanded into additional efforts for education about the North Dakota lignite industry. These additional outreach efforts are in various stages of use and progress, often depending on the time of year whether or not school is in session. Some of those efforts include:

- North Dakota Energy Activity Trunks
- Lignite Education Video Series
- NextGen ND Program
- Lignite Education E-Campus

STANDARDS OF SUCCESS

Each year, seminar attendees are asked a series of questions that mirror North Dakota and Minnesota public opinion studies. The same questions are asked to attendees before and after the Seminar. On average, the responses each year indicate:

- 93% respondents said that they favor the use of coal to produce electricity – about a 15% change.
- 77% strongly agreed that coal energy is vitally important to our region's power supply – a 20% change.
- 75% strongly disagreed that coal is a dirty form of energy and should not be part of our energy future – a 17% change.

In 2014, the LEC sent out a 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.

Another survey will be conducted for Seminar attendees from 2015 through 2019 in the fourth quarter of 2019.

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 3,400 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.

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.

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 12th 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.

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.

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 CO2 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. 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 2019, an NDSU economic study showed that 3,800 North Dakotans are directly employed in the lignite industry and another 10,200 indirectly. The industry is expected to generate almost $5.7 billion in annual business activity, as well as $130 million in annual local and 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, 2020, through December 31, 2020.

BUDGET

The Lignite Energy Council's Teacher Education Seminar annual budget, including in-kind services, from January 1, 2020, through December 31, 2020 is $207,800 (See page 13).

The Education Program budget encompasses three key items – expenses for the Lignite Education Seminar specifically, expenses for additional educational outreach efforts and office/staff expenses to administer the Education Program in its entirety.

Some items within the budget that may require additional explanation are as follows:
- Program Management – 50% of the program director's pay and benefits.
- Professional Services – 50% of professional services provided by Kent Ellis, the North Dakota Energy Career Awareness Coordinator. Mr. Ellis provides expertise, advisement,

speaking, in-classroom presentations and curriculum development for the Education Program.

- Additional Staff Resources – Hiring temporary assistance with material preparation for both Seminar and Outreach efforts.
- Office expenses/Overhead – Staff time dedicated to the Education Program throughout the year.
- Website/E-Campus/Video Development – Continual work to launch and maintain an e-campus for the Education Program. Funding has already been provided for a series of four videos approved in 2016 (one for each year), the fourth video has not been completed, but costs projected for completion include footage previously shot, thus greatly decreasing the forth video's cost.
- Energy Education Sponsorship – Each year, teachers request assistance for energy education whether it is for in-classroom materials, training or tours, etc. In 2020, a specific line-item would aid in improved accounting.

As seen on the budget, the Lignite Energy Council is requesting $80,000 towards the $150,000 in expenses for the 2020 Lignite Education Seminar. These expenses include recruitment, facility costs, meals, credits, program management, office expenses and educational expenses associated with the Seminar. The other portion of the request is $20,000 is included for a portion of professional services ($10,000), classroom material ($2,500), and website/E-Campus development and improvements ($5,000) and the remainder for program management and office expenses.

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
- Presenter credentials/Syllabus
- 2019 Teacher's Seminar Binder Material

Jason Bohrer, President & CEO
Lignite Energy Council

Lignite Energy Council Education Program Budget

9/30/2019

Income

	LRC Share	Applicant's Share	Applicant's In-Kind	
Teachers' Seminar	$80,000	$45,000	$25,000	**$150,000**
North Dakota Energy Education Outreach		$10,000		**$10,000**
Additional Materials/Outreach/Scholarship Program	$20,000	$27,800		**$160,000**
TOTAL	**$100,000**	**$82,800**	**$25,000**	

TOTAL EXPENSES	**$207,800**
Total grant request	**$100,000**
Lignite Energy Council	**$107,800**

Expenses

Facility Costs for Teachers Seminar		
• Meals	$15,000	
• Dorm Rooms	$7,000	
• Administration	$2,900	
• Facility Rental	$1,900	
• Audio	$600	$27,400

Recruitment Efforts		
• Brochures	$2,800	
• Postage	$2,800	
• Envelopes	$300	
• Advertising/Posters	$300	$6,200

Credits ($100/teacher – est. 120 teachers)		
• NDSU, UND and MSU	$12,000	$12,000

Speaker/Transportation/Participant Networking		
• Bus transportation	$5,600	
• Entertainment/Lodging	$1,800	
• Speaker Fees and Transportation	$1,800	
• Audience response/research	$500	$9,700

Management/Administrative Expenses		
• Program management	$58,000	
• Instructor of Record	$2,000	
• Professional services	$25,000	
• Additional staff resources	$2,500	
• Contingency/Misc.	$2,000	
• Office expenses/Overhead	$47,000	$136,500

Seminar, Outreach, Materials & Supplies		
• Classroom Materials, Promotional, Lesson Plans, Classroom development	$4,000	
• Website/E-Campus/Video Development	$10,000	
• Energy Education Sponsorship	$2,000	$16,000

TOTAL EXPENSES	**$207,800**

Lignite EDUCATION SEMINAR

June 10 - 13, 2019

Lignite Energy Council

www.lignite.com

2019 Lignite Education Seminar:

Energy, Economics & Environment
June 10-13, 2019

Monday, June 10

7:30 a.m. **Registration Begins**
National Energy Center of Excellence – Bismarck State College – 4th Floor

8:30 a.m. **Welcome, Introductory Remarks, Instructions & Pre-Test**
Kay LaCoe – Director of Membership Marketing, *Lignite Energy Council*
Lesson Plan Instructions – Q&A w/ Instructor of Record
Terry Hagen – Professor, University of North Dakota

UNIT I: LIGNITE 101 / INDUSTRY OVERVIEW

9:00 a.m. ***Video:*** Lignite 101: An Industry Overview
9:15 a.m. **Lignite: The Region's Best Kept Secret**
Steve Van Dyke – Vice President Communications, *Lignite Energy Council*
10:00 a.m. ***Group Classroom Activity:*** Economics

10:15 a.m. *Break, Questions & Discussion*

UNIT II: North Dakota Geology, Mining & Reclamation

10:30 a.m. ***Group Classroom Activity:*** Chocolate Chip Cookie Mining
Video: Mining & Reclamation
11:00 a.m. **North Dakota Geology: Coal-Bearing Rocks in the Northern Great Plains**
Kendra Braun – Geological Engineer, *The Coteau Properties Co. Freedom Mine*

11:45 a.m. *Lunch*

12:30 p.m. **Lignite Mining and Reclamation**
Kayla Torgerson – Environmental Specialist, *The Coteau Properties Co. Freedom Mine*
1:30 p.m. ***Group Classroom Activity:*** Cake pan mining and reclamation

UNIT III: Electricity Production and Coal Conversion

2:00 p.m. **Electricity Generation Choices**
John Bauer – Director of North Dakota Generation, *Great River Energy*
Classroom Activity: Pedal generation
Video: Optional/TBD

3:00 p.m. *Break, Questions & Discussion*

3:15 p.m. **Synfuels Production from Lignite**
Erin Huntimer – Project Coordinations Representative, *Basin Electric Power Cooperative*
Video: Synfuels video

4:00 p.m. *Break, Questions & Discussion*
Wrap-up, Day 2 Preview
Dorm Check-in

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

Tuesday, June 11

UNIT III: Electricity Production and Coal Conversion *continued…*

7:00 a.m. *Breakfast at National Energy Center of Excellence*

8:00 a.m. **Introduction to North Dakota Energy Curriculum**
Retha Mattern - Business & Outreach Coordinator, *National Energy Center of Excellence*

8:15 a.m. **Tour of Power Plant Program Facilities**

9:00 a.m. **Transmission – Transporting Electricity by Wire**
Matthew Stoltz – Director of Transmission Services, *Basin Electric Power Cooperative*
***Classroom Activity*:** *Power Line Siting*

UNIT IV: Environmental Impacts and Stewardship

10:00 a.m. **Enhancing Lignite's Future through Research & Development**
Mike Holmes – Vice President of Research & Development, *Lignite Energy Council*

11:00 a.m. ***Classroom Activity:*** Lignite Jeopardy

11:30 a.m. *Working lunch/Lesson Plan Collaboration*

12:30 p.m. **Plant Level Environmental Compliance**
Craig Bleth – Environmental Manager, *Minnkota Power Cooperative*

1:30 p.m. *Break, Questions & Discussion*

1:45 p.m. **Energy and CO2 Management: Carbon Capture and Storage**
Dan Daly – Senior Geologist, Energy & Environmental Research Center at the University of North Dakota

3:00 p.m. *Break, Questions & Discussion*

UNIT V: Electricity and People

3:15 p.m. **Wrap-up – Day 3 Preview**

3:30 p.m. **Industry Career Choices**
Kent Ellis – Special Projects Coordinator, *Bismarck Public Schools*
Classroom Activity: **Energy Education Demonstrations and Hands-On Demonstrations**

5:00 p.m. ***Dinner at Bismarck State College***

6:00 p.m. **Evening On Your Own**

Wednesday, June 12

7:45 a.m. *Breakfast at BSC Student Union*

Coal Country Tours

Load buses in front of Student Union

8:30 a.m. Bus # 1 loads for Coal Country Tour
8:45 a.m. Bus #1 leaves for Coal Country Tour

Group 1

10:00 a.m.	Arrive at Freedom Mine
10:15 a.m.	Tour Freedom Mine (photos)
12:15 p.m.	Bus leaves for Antelope Valley Station
12:30 p.m.	Arrive at Antelope Valley Station
12:45 p.m.	Lunch and tour at Antelope Valley Station
2:45 p.m.	Bus leaves for Bismarck State College
4:30 p.m.	Bus arrives at Bismarck State College

9:45 a.m. Bus #2 loads for Coal Country Tour
10:00 a.m. Bus #2 leaves for Coal Country Tour

Group 2

10:45 am.	Bus arrives at Center Mine
11:15 a.m.	Lunch and tour at Center Mine
1:45 p.m.	Bus leaves for Milton R. Young Station
2:15 p.m.	Bus arrives at Milton R. Young Station
2:30 p.m.	Tour Milton R. Young Station
4:00 p.m.	Bus leaves for Bismarck State College
4:45 p.m.	Bus arrives at Bismarck State College

10:15 a.m. Bus #2 loads for Coal Country Tour
10:30 a.m. Bus #2 leaves for Coal Country Tour

Group 3

11:15 a.m.	Bus arrives at Coal Creek Station
11:30 a.m.	Lunch and tour at Coal Creek Station
2:00 p.m.	Bus leaves for Falkirk Mine
2:15 p.m.	Bus arrives at Falkirk Mine
2:30 p.m.	Tour Falkirk Mine
4:30 p.m.	Bus leaves for Bismarck State College
5:30 p.m.	Bus arrives at Bismarck State College

4:30 p.m. ***Dinner at Bismarck State College***

6:30 p.m. **Bismarck Larks – First 50 Teachers signed up by May 31 receive one free ticket**

Thursday, June 13

7:00 a.m. *Breakfast at National Energy Center of Excellence*

UNIT V: Electricity and People *continued…*

8:00 a.m. **Economics and Electricity 101**
Brian Kroshus – Public Service Commissioner, *State of North Dakota*

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*
Jay Volk – Environmental Manager, *BNI Coal, Ltd.*
Bruce Emmil – Dean – *NECE, Bismarck State College*
David Farnsworth - Manager of North Dakota Power Generation & Engineering Services, *Great River Energy*

11:30 a.m. *Break*

11:45 a.m. *Working Lunch:* **Emerging Markets**
TBA

1:00 p.m. *Post Test & Collaboration – Finalize Lesson Plans*

1:30 p.m. **Seminar adjourns**

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

Attending the seminar today

- 109 teachers from five states (as of June 3, 2019)
- 75 from North Dakota
- 19 from South Dakota
- 4 from Montana
- 10 from Minnesota
- 1 from Alaska

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
- Final work must be completed via email submission by end of day **July 5, 2019**
- **PLEASE SEE INCLUDED LETTER FROM TERRY HAGEN FOR MORE REQUIREMENTS**

Other information:

- UND, NDSU, or MSU Academic Credit – Must register online BY MONDAY, JUNE 10 – 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.

Seminar Syllabus

2019 Lignite Education Seminar:
Energy, Economics and Environment
June 10-13, 2019

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 horses 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 9th 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 Braun 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 lives on a farm south of Beulah and has two sons ages 5 and 3 that keep her busy.

Lignite Mining and Reclamation Process

Kayla Torgerson is an environmental specialist at the Coteau Properties Company's Freedom Mine, the nation's largest lignite coal mine, located north of Beulah. She's worked at the Freedom Mine for more than four years, where she focuses on permitting, bond release, and native grassland management. Prior to her time at the mine, she worked at a consulting engineering firm where she specialized in federal permitting and project management. She serves as president for the ND chapter of the Society for Range Management, president of the Beulah Library Board, and on the Dolly Parton Imagination Library of Beulah. She received her bachelor's degree in Mathematics from the University of Mary and her master's in Natural Resources Science and Management from the University of Minnesota. Kayla lives in Beulah with her husband and their daughter.

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 and Spiritwood 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. John currently serves on the foundation board for Bismarck State College. 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

Erin Huntimer is the project coordinations representative for Basin Electric Power Cooperative. Erin has held various positions at Basin since beginning her career there in May 2002. Erin lives with her family on a small hobby farm near Hannover, ND. She has two children and is married to Rick. Erin holds an undergraduate degree in Communications with a public relations concentration and an MBA with an energy management concentration, both from the University of Mary. She is also a Certified Cooperative Communicator.

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.

Economics and Electricity 101

Brian Kroshus was appointed to the Public Service Commission in March 2017 by Governor Doug Burgum. Brian has a background in business, agriculture and energy. Brian's portfolio at the Public Service Commission includes electric and gas economic regulation, pipeline safety and damage prevention, weights and measures and consumer affairs.

Prior to his appointment to the Public Service Commission, Brian spent 30 years in business leadership and management including 17 years as enterprise leader of Farm and Ranch Guide, 13 years as division leader of Lee Agri-Media and 10 years as publisher of the Bismarck Tribune. During his private sector career Brian was recognized numerous times for operational excellence, finding new efficiencies and exceptional leadership.

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 CO2 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.

Energy and CO2 Management: Carbon Capture and Storage

Dan Daly recently retired from 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 then worked as a geologist at EERC in projects dealing with energy and the environment. From the fall of 2003 until his recent retirement, he was the lead for public outreach and education with the Plains CO2 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 Senior Manager of Power Production, in charge of the Milton Young Station.

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.

Lignite Industry Informational Pamphlet

Grade Level and Subject:

7th Grade Geography

Length of Time:

Three or four-- 40 minute classes

Learning Goals: (these are specific to my district content standards: adapted from ND standards)

1. I can accurately analyze human-environment interaction.
2. I can accurately integrate visual information (e.g., charts, graphs, photographs, videos, or maps) with other information in print and digital texts.

Objectives:

*Students will have a better understanding of the lignite industry

* Students will incorporate visuals to match their information

Materials needed:

*Students will need a computer with access to the internet

*Students will need access to the informational powerpoints & websites (adapted from Lignite Energy Council resources)

*Headphones (optional)

*Template of Pamphlets (links below)

Lignite Mining and Reclamation template

Synfuels Productions from Lignite

Electricity Generated from Lignite

Description:

Students will be making a pamphlet to represent their specific aspect of the lignite industry. Students will write their pamphlet from the perspective of someone from that industry who is trying to educate others about the importance of their industry. Assign each student one of the three different topics or let the students choose the topic they want to research (you may see lots of duplicates if they are given the choice). Encourage students to pre-read the questions so they know what to look for. Students will start by researching the lignite industry(resources provided(teachers approved)) to answer their specific questions. Students should be taking notes as they research. Students will then answer their questions based off the information they collected. Be sure to encourage students not to just list their information and to write from a person working in that industry. Students will then use paperrater to check their writing for basic grammar and spelling mistakes. Once the writing has been revised students will copy and paste the information into their template. Students will then use the resources to find appropriate pictures that match their information. Students will insert and link pictures into the template. Each picture will need a short explanation explaining to the reader what it is. Once complete, students will print off pamphlet. Teacher will post the pamphlets on the wall. Students will go around and read at least 2 of each of the other topics. For example, if they wrote a pamphlet on Lignite mining they would review 2 pamphlets on Synfuels and two on Electricity. *If you wanted to take it a step further you could ask students specific questions about the other two topics to ensure they have read and understood the basics of the other topics. Or if you choose to have students present their pamphlets, you can have the other students take notes from a few different presentations to check what they learned from the presentations.

The three main aspects of Lignite that we will focus on are: Lignite Mining and Reclamation, Synfuels Productions from Lignite, and Electricity Generated from Lignite.

Topic Questions:

Lignite mining & Reclamation:

1. What is Lignite? What is it used for?
2. How do we insure we are not impacting the environment in a negative way?
3. How does lignite mining improve the area's economy? Jobs?
4. What is the most important thing to understand or know about Lignite mining & Reclamation?

Synfuels Productions from lignite

1. What are Synfuels? What are they used for?
2. How do we insure we are not impacting the environment in a negative way?
3. How does Synfuels productions improve the area's economy? Jobs?
4. What is the most important thing to understand or know about Synfuels Productions from Lignite?

Electricity Generated from Lignite

1. How is electricity generated from Lignite? Who uses that electricity?
2. How do we insure we are not impacting the environment in a negative way?
3. What is the impact on the area's economy? What is the impact for the local people? How is pricing determined?
4. What is the most important thing to understand or know about Electricity Generated from Lignite?

Assessment:

* Students will hand in final pamphlet project.
* Optional: students will present their pamphlet to the class.

Rubric:

* There are two different rubrics to address the pieces of the pamphlet. One rubric for the written pieces (4 rubrics for the 4 questions: each question separately graded), one rubric for the pictures. *Some many wish to combine rubrics; however, separate rubrics make it easier to grade each part.

1. Rubric for written portions of pamphlet (question 1)

(Advanced)	3 (Proficient)	2 (Partially Proficient)	1 (Not Yet)	0 (No Effort)
- Answer goes beyond proficient in application of information.	- Complete sentences. - Listed evidence to support your perspective, **AND** explained why that evidence is important.	- Listed evidence to support your perspective, but did not explain why evidence is important. - May contain evidence that does not support your perspective.	- Listed little and/or incorrect evidence to support your answer. No explanations were provided.	No evidence.

Rubric for written portions of pamphlet (question 2)

(Advanced)	3 (Proficient)	2 (Partially Proficient)	1 (Not Yet)	0 (No Effort)
- Answer goes beyond proficient in application of information.	- Complete sentences. - Listed evidence to support your perspective, **AND** explained why that evidence is important.	- Listed evidence to support your perspective, but did not explain why evidence is important. - May contain evidence that does not support your perspective.	- Listed little and/or incorrect evidence to support your answer. No explanations were provided.	No evidence.

Rubric for written portions of pamphlet (question 3)

(Advanced)	3 (Proficient)	2 (Partially Proficient)	1 (Not Yet)	0 (No Effort)
- Answer goes beyond proficient in application of information.	- Complete sentences. - Listed evidence to support your perspective, **AND** explained why that evidence is important.	- Listed evidence to support your perspective, but did not explain why evidence is important. - May contain evidence that does not support your perspective.	- Listed little and/or incorrect evidence to support your answer. No explanations were provided.	No evidence.

Rubric for written portions of pamphlet (question 4)

(Advanced)	3 (Proficient)	2 (Partially	1 (Not Yet)	0 (No Effort)

		Proficient)		
- Answer goes beyond proficient in application of information.	- Complete sentences. - Listed evidence to support your perspective, **AND** explained why that evidence is important.	- Listed evidence to support your perspective, but did not explain why evidence is important. - May contain evidence that does not support your perspective.	- Listed little and/or incorrect evidence to support your answer. No explanations were provided.	No evidence.

2. Rubric of the pictures

(Advanced)	3 (Proficient)	2 (Partially Proficient)	1 (Not Yet)	0 (No Effort)
- Description demonstrates deeper understanding of perspective.	- Inserted and linked 2 relevant and clear pictures. - Description of image supports perspective. - Description is in complete sentences.	- Inserted 2 pictures and linked 2 pictures. - There is a description, but it doesn't support your perspective.	- Inserted 1-2 pictures. - Did not link the pictures. - There is no description provided.	No evidence.

UND UNIVERSITY OF NORTH DAKOTA

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
  - Lesson plans must be completed via email submission by end of day **July 5, 2019**

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 by end of day **July 5, 2019**

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

Seminar Participants
2019 Lignite Education Seminar:
Energy, Economics & Environment
June 10-13, 2019

Kyle Anderson
Zeeland Public School
Zeeland, ND
Grade(s) Taught: 4-6
Subject(s) Taught: Language Arts, Science, Social Studies/ND History, Health, Math

Jolene Beeson
Fairmount Public School
Fairmount, ND
Grade(s) Taught: k -12 special education; k-12 ELL
Subject(s) Taught: mostly reading but help with all subjects

Donna Blankenship
Mott Regent School District
Mott, ND
Grade(s) Taught: 7th- 12th Grades
Subject(s) Taught: Life, Earth, Physical, Biology, Chemistry, Applied Biology & Chemistry

Amy Bochman
Windswept Academy
Eagle Butte, SD
Grade(s) Taught: 6-12
Subject(s) Taught: Grammar and literature

Joe Brooks
White River High School
White River, SD
Grade(s) Taught: 9, 10, 11, 12
Subject(s) Taught: Algebra 1, Algebra 2, Geometry, Pre-Calculus

Emily Brunskill
Apple Creek Elementary School
Bismarck, ND
Grade(s) Taught: 3rd
Subject(s) Taught: All- Math, Reading, Science, Social Studies, Art, Phy Ed,

Heatherlynn Burback
Williston Trinity Christian School
Williston, ND
Grade(s) Taught: 4th, 9th, 11th, and tutor all ages
Subject(s) Taught: Language Arts

Beth Burchill
Griggs County Central
Cooperstown, ND
Grade(s) Taught: 3rd grade
Subject(s) Taught: ALl Subject areas to prepare for 4th grade

Heather Burkle
Gackle-Streeter Public School
Gackle, ND
Grade(s) Taught: 1st
Subject(s) Taught: All

Jeff Bye
Grand Forks Public Schools
Grand Forks, ND
Grade(s) Taught: 6
Subject(s) Taught: Social Studies, Language Arts, Science

Kelli Campbell
Fairmount Public School
Fairmount, ND
Grade(s) Taught: 2
Subject(s) Taught: all

Jessica Carlson
Medina Public School
Medina, ND
Grade(s) Taught: 1st
Subject(s) Taught: Math, Reading & Language Arts, Science, and Social Studies

Paulette Carlson
LaMoure Public School
LaMoure, ND
Grade(s) Taught: 4
Subject(s) Taught: All subjects: Math, Science, STEM, Social Studies, Language Arts

Stacy Carufel
Bismarck High School
Bismarck, ND
Grade(s) Taught: 7-12
Subject(s) Taught: Career and Technical Resource Education

Eileen Ciser
South Prairie School
Minot, ND
Grade(s) Taught: 5th Grade
Subject(s) Taught: Science, Math, English, Reading, Keyboarding

Heather Collins
Lower Brule Middle and High Schools
Lower Brule, SD
Grade(s) Taught: Grades 7 - 12
Subject(s) Taught: 7th and 8th grade Math; Tribal Government; ACT Prep; Reading Plus; Edgenuity Online coordinator; Proctor for interactive television/online 9th grade Physical Science; Geography, Government, History

David Combs
Johnson Corners Christian Academy
Watford City, ND
Grade(s) Taught: Administrator
Subject(s) Taught: Administrator

Kira Combs
Johnson Corners Christian Academy
Watford City, ND
Grade(s) Taught: Kindergarten
Subject(s) Taught: All subjects

Angela Cordell
Fairmount Public School
Fairmount, ND
Grade(s) Taught: 3rd Grade
Subject(s) Taught: All subjects

Breann Coughlin
Williston Trinity Christian School
Williston, ND
Grade(s) Taught: 7th thru 12th
Subject(s) Taught: 7th grade history; 8th grade; history; geography; World History; US History; POD; Archeology; Womens Past and Present

DeAnna Dathe
LaMoure Public School
LaMoure, ND
Grade(s) Taught: 6 - 12
Subject(s) Taught: Math, Junior High Social Studies, North Dakota Studies, U.S. History, SMART lab

Patricia DeMers
Colome Consolidated School
Colome, SD
Grade(s) Taught: 7-12
Subject(s) Taught: FACS-CTE Program; Careers-CTE Program; Personal Finances-CTE Program; 8th Pre-algebra; MS FACS-CTE Program; Sewing-CTE Program; Human Development-CTE Program

Deanna Dirks
Cheney Middle School
West Fargo, ND
Grade(s) Taught: 6th and 8th
Subject(s) Taught: Health
(Have taught Math in previous years also)

Sherry Dyke
Perkett Elementary
Minot, ND
Grade(s) Taught: 2nd
Subject(s) Taught: Science, Social Studies, Reading, Math, Language Arts

Carolyn Ebright
Brandon Valley High School
Brandon, SD
Grade(s) Taught: 9-12 Social Studies
Subject(s) Taught: Geography, Psychology, Sociology

Wanda Ellefson
Self
Grade(s) Taught: Primary
Subject(s) Taught: Math, reading, science

Debra Eszler
Brentwood Adventist Christian School
Bismarck, ND
Grade(s) Taught: Grades 1-8 (one-room school)
Subject(s) Taught: All subjects

Den Na Lee Fewson
Mary Stark Elementary
Mandan, ND
Grade(s) Taught: 5
Subject(s) Taught: All curriculum

Brooke Fleck
Sunrise Elementary School
Bismarck, ND
Grade(s) Taught: 3
Subject(s) Taught: Elementary

Kelly Froning
OAHE Special Education COOP
Java, SD
Grade(s) Taught: I am a student aid currently. In the past, I have been the elementary SPED teacher.
Subject(s) Taught: All subjects

Amanda Fuller
Apple Creek School
Bismarck, ND
Grade(s) Taught: Kindergarten
Subject(s) Taught: All subjects

Jackie Glaser
Prairie Rose Elementary
Dickinson, ND
Grade(s) Taught: 5th
Subject(s) Taught: Math

Jay Grover
Griggs County Central
Cooperstown, ND
Grade(s) Taught: 5-8
Subject(s) Taught: Social Studies and Math

Mary Jo Grover
Griggs County Central
Cooperstown, ND
Grade(s) Taught: 5th & 6th
Subject(s) Taught: Reading, Writing, Grammar

Wendi Hatlewick
Leola Public School
Leola, SD
Grade(s) Taught: 4th Grade
Subject(s) Taught: All subjects

Elizabeth Hazeldine
Woodrow Wilson High School
Fargo, ND
Grade(s) Taught: 9 - 12
Subject(s) Taught: Western Civ, Government, Psychology, Anthropology, Archeology

LeAnn Heid
Lincoln Elementary
Lincoln, ND
Grade(s) Taught: 4
Subject(s) Taught: All

Carol Helms
Camp Crook School
Camp Crook, SD
Grade(s) Taught: K-5
Subject(s) Taught: math, language arts, social studies, science, and art

Cammy Hornbacher
South Central High School
Bismarck, ND
Grade(s) Taught: 10 - 12
Subject(s) Taught: Government, US History, Economics, Global Studies

Mark Huber
New Rockford-Sheyenne Public School District
New Rockford, ND
Grade(s) Taught: 8-12
Subject(s) Taught: Earth Science, Physical Science, Ecology, Psychology, Sociology, Geology, Astronomy, Physics.

Brian Ingerson
Eureka Public School 44-1
Eureka, SD
Grade(s) Taught: 6 - 12
Subject(s) Taught: Industrial Arts; Technology

Francie Ingerson
Eureka Public School 44-1
Eureka, SD
Grade(s) Taught: K-12
Subject(s) Taught: K-12 Vocal Music, 7th Grade Language Arts

Kelli Isaacson
LaMoure Public School
LaMoure, ND
Grade(s) Taught: 9-12 Social Studies
Subject(s) Taught: Social 8; U.S, History; World History; Problems of Democracy; Area Studies; ND Studies

Amanda Johnson
Kodiak Middle School
Kodiak, AK
Grade(s) Taught: 6-8
Subject(s) Taught: STEAM and Agriculture

Jeremiah Johnson
Valley Middle School
Grand Forks, ND
Grade(s) Taught: 4-8th Grade
Subject(s) Taught: Orchestra

Jim Johnson
Goodridge Public School
Goodridge, MN
Grade(s) Taught: Grades 6-12
Subject(s) Taught: High School Curriculum - Academic Support

Brian Jorgensen
Corsica Stickney High School
Corsica, SD
Grade(s) Taught: 7-17
Subject(s) Taught: Ag, Construction, Welding and Manufacturing.

Anna Kemmer
Edgeley High School
Edgeley, ND
Grade(s) Taught: 7-12
Subject(s) Taught: Ag and FACS education

Mark Krippner
Sartell Middle School (Sartell-St. Stephen School District 748)
Sartell, MN
Grade(s) Taught: Eighth
Subject(s) Taught: Earth Science

Sandy Law
Discovery Middle School
Fargo, ND
Grade(s) Taught: Grade 7
Subject(s) Taught: English

Steve Lee
Martin Luther School
Bismarck, ND
Grade(s) Taught: 5-6
Subject(s) Taught: Math, Science, Social Studies, Language Arts, Phy Ed, Health

Briana Leier
Mandan Middle School
Mandan, ND
Grade(s) Taught: K-5th Grade Speech-Langauge Special Services

7-8th Grade Speech-Language Special Services
Subject(s) Taught: Speech-Language Special Services

Dora Lister
Circle of Nations Wahpeton ND
Wahpeton, ND
Grade(s) Taught: 4th through 8th
Subject(s) Taught: Math, Reading, Language Arts, Social Studies, Computers, and Health

Christopher Loff
South Middle School
Grand Forks, ND
Grade(s) Taught: 8th
Subject(s) Taught: Enriched Algebra, Math 8, Transmath 3

Jeff Lovin
Carl Ben Eielson MS
Fargo, ND
Grade(s) Taught: 7th
Subject(s) Taught: Pre-algebra, Math 7, Math 180, Science

ARNE LUNZMAN
Williston Hight School District #1Williston, ND
Grade(s) Taught: 11TH and 12TH
Subject(s) Taught: Automotive Technology

Anita Malsam
Leola School District
Leola, SD
Grade(s) Taught: 5-8
Subject(s) Taught: Math & Science

Frank Martin
Fort Yates public middle school
Fort Yates, ND
Grade(s) Taught: 6-8 This year
Subject(s) Taught: certified for all sciences, all social science 7-12 . This current year a fulltime substitute for all subjects.

Karen Mettler
Eureka Public School District 44-1
Eureka, SD
Grade(s) Taught: 6^{th} – 12^{th}
Subject(s) Taught: Family and Consumer Science; Personal Finance

Marcy Miller
Beulah Elementary School
Beulah, ND
Grade(s) Taught: Kindergarten
Subject(s) Taught: All kindergarten curriculum except PE and Music.

Amanda Mogen
Bottineau Public School
Bottineau, ND
Grade(s) Taught: 11th and 12th grade
Subject(s) Taught: American Government, Economics, and US History

Gene Nadeau
Dunseith High School
Dunseith, ND
Grade(s) Taught: 10-12
Subject(s) Taught: Facility Maintenance

Lexi Nistler
Solen High School
Solen, ND
Grade(s) Taught: 7 - 12 grade
Subject(s) Taught: 7th Geography, 8th US History and ND History, High School U.S. History

Katrina Nygaard
Thompson Falls High School
Thompson Falls, MT
Grade(s) Taught: 9-12
Subject(s) Taught: Math (Geometry, Algebra 2, Precalculus, Calculus)

Susan Oneil
McClusky School
Columbus, ND
Grade(s) Taught: K-12
Subject(s) Taught: Music

Heidi Perleberg
Medina Public School
Medina, ND
Grade(s) Taught: Kindergarten
Subject(s) Taught: All Subjects

Rob Peske
Solheim Elementary School
Bismarck, ND
Grade(s) Taught: 4-5 grade
Subject(s) Taught: Orchestra

Cassie Plienis
Beulah Little People Preschool
Beulah, ND
Grade(s) Taught: Beginning Learners (age 3); PreK (ages 4-5)
Subject(s) Taught: Math, reading, phonics, social studies, music, art, science, handwriting,

Mariann Prewett
Jordan Public Schools
Jordan, MT
Grade(s) Taught: 7-12
Subject(s) Taught: all science classes 7-12 including Earth Science

John (Jack) Raaen
Carl Ben Eielson Middle School
Fargo, ND
Grade(s) Taught: 8th grade
Subject(s) Taught: American History/North Dakota Studies

Michelle Racine
Dakota Memorial School at Dakota Boys and Girls Ranch-Minot
Minot, ND
Grade(s) Taught: 3rd-12th
Subject(s) Taught: School & Life Skills, Daily Living, Special Education

Jeffrey Radi
Ray Public School
Ray, ND
Grade(s) Taught: 8-12
Subject(s) Taught: US History, W. History, POD, Health and ND Studies

Tandy Reilley
Bowdle School District
Bowdle, SD
Grade(s) Taught: Kindergarten
Subject(s) Taught: Math, Reading, Language Arts, Computers, Science, Social Studies, Art

Carrie Reimche
Bottineau Middle School
Bottineau, ND
Grade(s) Taught: 5th Grade
Subject(s) Taught: Math and Science

Jessica Schafer
Century High School
Bismarck, ND
Grade(s) Taught: 10 through 12th graders
Subject(s) Taught: Medical Related Careers, medical terminology

Jon Schiltz
North Border-Pembina
Pembina, ND
Grade(s) Taught: 7-12
Subject(s) Taught: Science

Kim Schleicher
Fort Lincoln Elementary
Mandan, ND
Grade(s) Taught: 4th
Subject(s) Taught: general education

Nichole Seigman
Gackle-Streeter Public School
Gackle, ND
Grade(s) Taught: 2nd
Subject(s) Taught: All

Tracy Sipma
Dickinson High School
Dickinson, ND
Grade(s) Taught: 9-12
Subject(s) Taught: Entrepreneurship; Business and Personal Law; Introduction to Business; Computer Apps I; Advanced Computer Apps, Excel; Advanced Word

Carol Skalsky
Mandan Middle School
Mandan, ND
Grade(s) Taught: 7th grade
Subject(s) Taught: Life Science

Melissa Skillestad
Jefferson Elementary
Glendive, MT
Grade(s) Taught: Second grade
Subject(s) Taught: General Education

Duane Smith
Discovery Middle School
Fargo, ND
Grade(s) Taught: 7th
Subject(s) Taught: math 7 and pre-algebra

Kevin Swan
Mandan Middle School
Mandan, ND
Grade(s) Taught: Middle School/ High School
Subject(s) Taught: Geography/Alternative Education

Tammi Tate
Colome Consolidated School
Colome, SD
Grade(s) Taught: Kindergarten
Subject(s) Taught: All

Eric Telander
Rush City High School
Rush City, MN
Grade(s) Taught: 7th, 8th, 11th, 12th
Subject(s) Taught: Life Science; Earth Science; Environmental Science

Julie Tello
St. Mary's Grade School
Bismarck, ND
Grade(s) Taught: 4th Grade
Subject(s) Taught: All

Kit Tharaldson
Johnson Corners Christian Academy
Watford City, ND
Grade(s) Taught: 2nd and 3rd
Subject(s) Taught: Reading, Language, Math, Science, Social Studies, Health

Doree Thilmony
Thompson Falls High School
Thompson Falls, MT
Grade(s) Taught: 5-12
Subject(s) Taught: Physical Science, Chemistry, Physics, Biology, Earth Science

Matthew Tucholke
West Fargo High School
West Fargo, ND
Grade(s) Taught: 9-12
Subject(s) Taught: Math

Kari Ulven
North Sargent Public School
Gwinner, ND
Grade(s) Taught: 8th - 12th grade
Subject(s) Taught: Algebra 1 & 2; Geometry; Advanced Math; Consumer Math

Noah VanVoorhis
Lincoln Elementary
Lincoln, ND
Grade(s) Taught: 4
Subject(s) Taught: Science, Math, Reading, Writing, Social Studies, Health

Emily Ver Burg
Oldham-Ramona School
Ramona, SD
Grade(s) Taught: 5th and 6th
Subject(s) Taught: Spelling, grammar, writing, math, science, art

Kris Vogel
Mandan Public Schools
MANDAN, ND
Grade(s) Taught: Instructional coach at a K-5 school

Steve Volk
Herreid School
Herreid, SD
Grade(s) Taught: 6-12 Science
Subject(s) Taught: Chemistry, Anatomy, Biology, Physical Science, Earth Science

Tamara Wagner
Marmot High School
Mandan, ND
Grade(s) Taught: 5-12
Subject(s) Taught: all science and incorporate STEM

Lisa Wierschke
Waubun High School
Waubun, MN
Grade(s) Taught: 5-8
Subject(s) Taught: all middle school subject areas

Mark Wierschke
Lincoln Elementary
Fargo, ND
Grade(s) Taught: grade 3
Subject(s) Taught: all elementary subject areas

Julie Wiest
Zeeland School
Zeeland, ND
Grade(s) Taught: 2nd – 6th
Subject(s) Taught: English, phonics, spelling; Social studies

Tammy Winter
Eden Valley-Watkins Elementary
Eden Valley, MN
Grade(s) Taught: 4th
Subject(s) Taught: Reading, spelling, math, science

Lignite: The Region's Best Kept Secret!

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.

North Dakota's lignite industry employs about ________________ direct employees and _______________ indirect employees – or ______ indirect jobs for every ______ direct job.

Every ______ generates ______ by industry activity in the state of North Dakota; accounting for about ____________ in total business activity.

Notes:

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

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

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:

____
____
____
____

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.

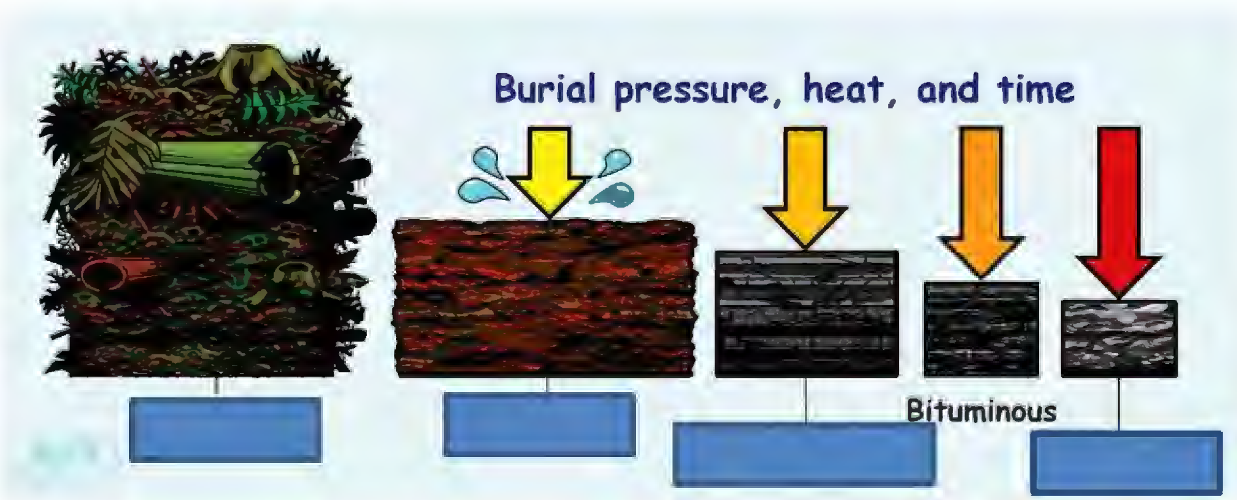
North Dakota contains an estimated _________ billion tons of economically mineable coal, enough to last for over ______ years at the present rate of about ______ million tons per year.

What group does the Sentinel Butte Formation belong to?

____

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.

What is the definition of Glauconite?

____

____

What is Paleosol?

____

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Notes:

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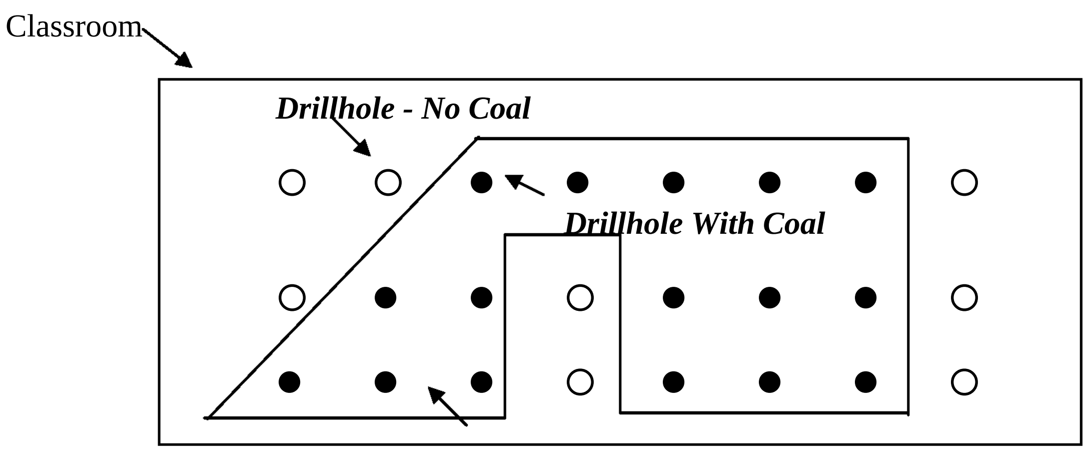
Geology Drilling Activity

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.

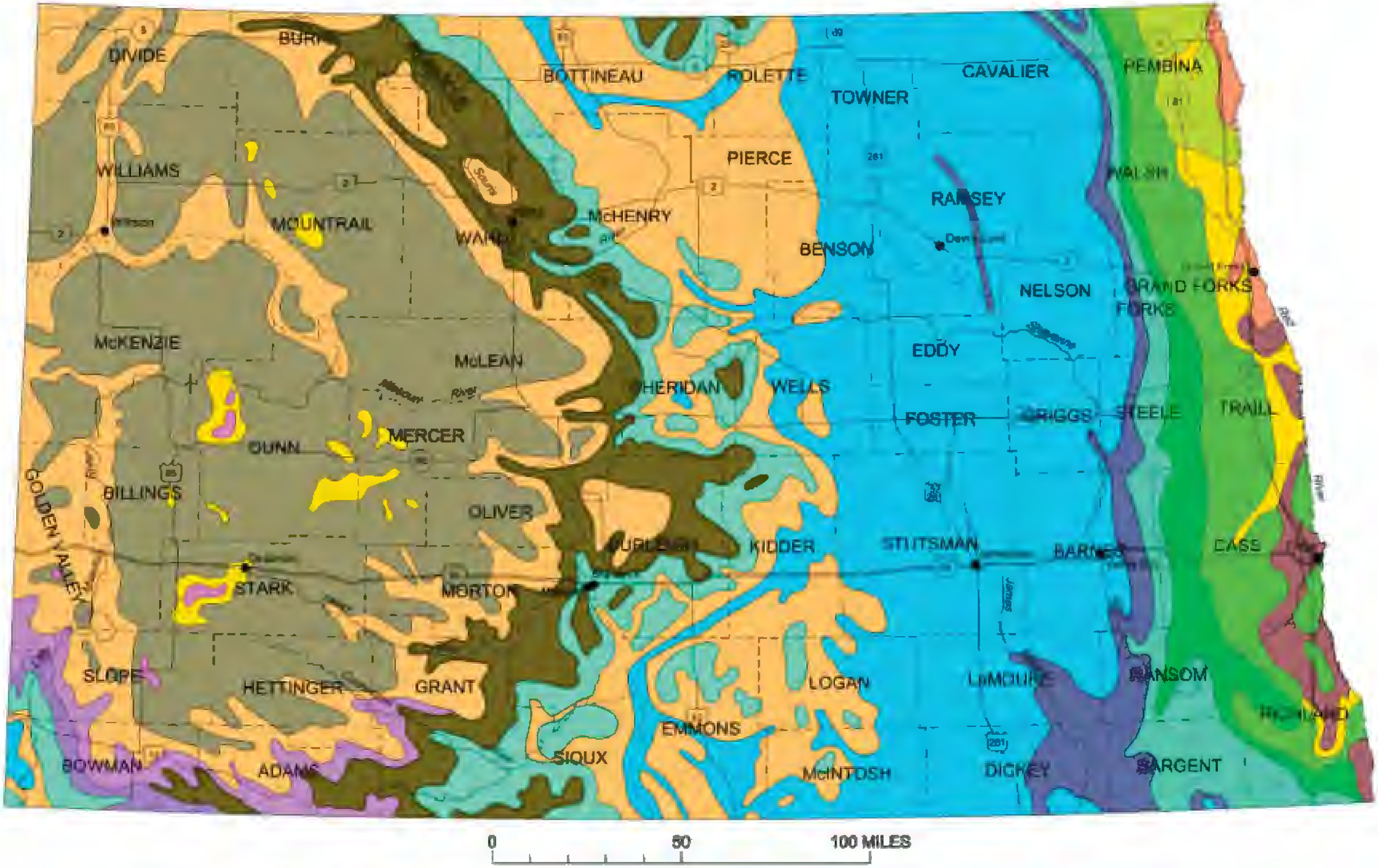
Differentiation:
To make the most of each student's strengths, arrange the teams so that each consists of students with good observational skills and students with good writing skills. Allow them to discuss their observations and prepare their journal entries together.

GENERALIZED BEDROCK GEOLOGIC MAP OF NORTH DAKOTA

Miscellaneous Map 36
2003

by
John P. Bluemle

North Dakota Geological Survey
John P. Bluemle, State Geologist



TERTIARY SYSTEM

- White River Group
- Golden Valley Formation
- Sentinel Butte Formation
- Bullion Creek Formation
- Slope Formation
- Cannonball Formation
- Ludlow Formation

CRETACEOUS SYSTEM

- Hell Creek Formation
- Fox Hills Formation
- Pierre Formation
- Niobrara Formation
- Carlile Formation
- Greenhorn Formation
- Belle Fourche, Mowry, Newcastle, and Skull Creek Formation
- Inyan Kara Formation

- JURASSIC ROCKS
- ORDOVICIAN ROCKS
- PRECAMBRIAN ROCKS

Lignite Mining and Reclamation Process

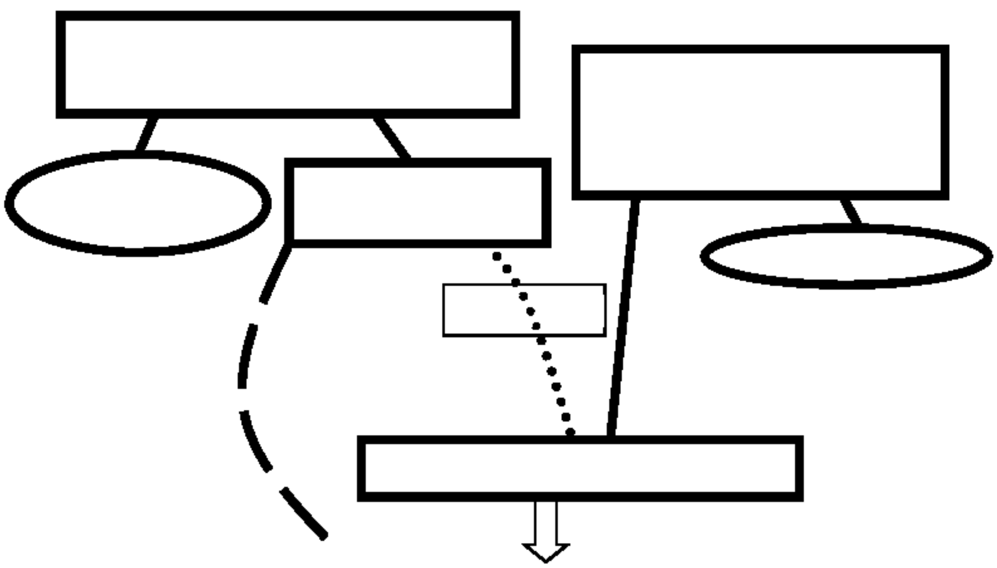
Sarah Flath – Environmental Manager | The Coteau Properties Co. Freedom Mine

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 ____________________________

Process of Mining and Reclamation:

1. ____
2. ____
3. ____
4. ____
5. ____
6. ____
7. ____

Notes:

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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!)

$50,0000 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:

____

____

I certify the information on this permit is correct:

____

(name and signature of applicant)

Approved for mining:

____

(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

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

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

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

Electricity Generation Choices

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:

____
____
____
____

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:

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Hydro advantages/disadvantages:

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Natural gas advantages/disadvantages:

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____ ____

Wind advantages/disadvantages:

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Solar advantages/disadvantages:

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Lignite advantages/disadvantages:

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Classroom Activities for Electrical Generation Lecture

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.

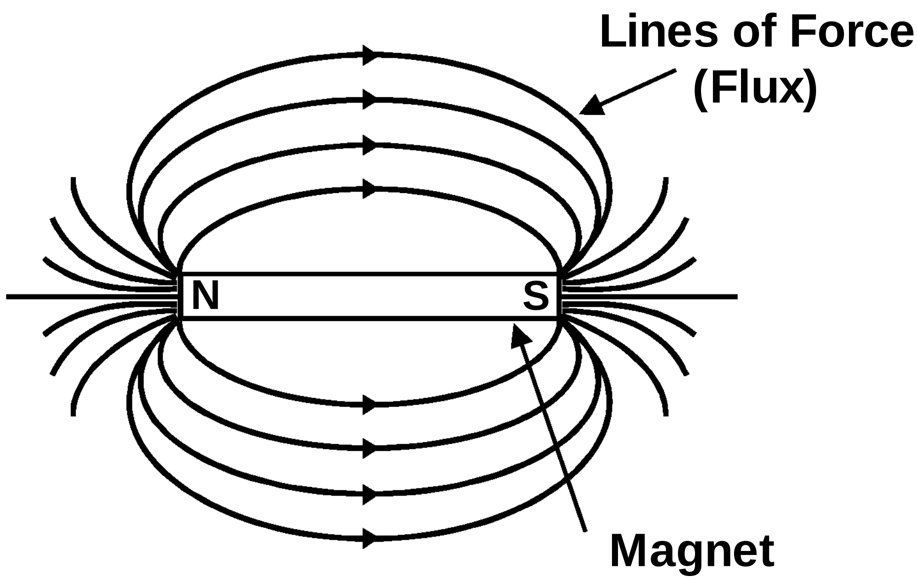
Activity: Fire-up model steam engine whose fly wheel is connected to a small generator. Light bulb connected to generator lights up when fly wheel starts to rotate.

Vacuum Cleaner Bag Demonstration

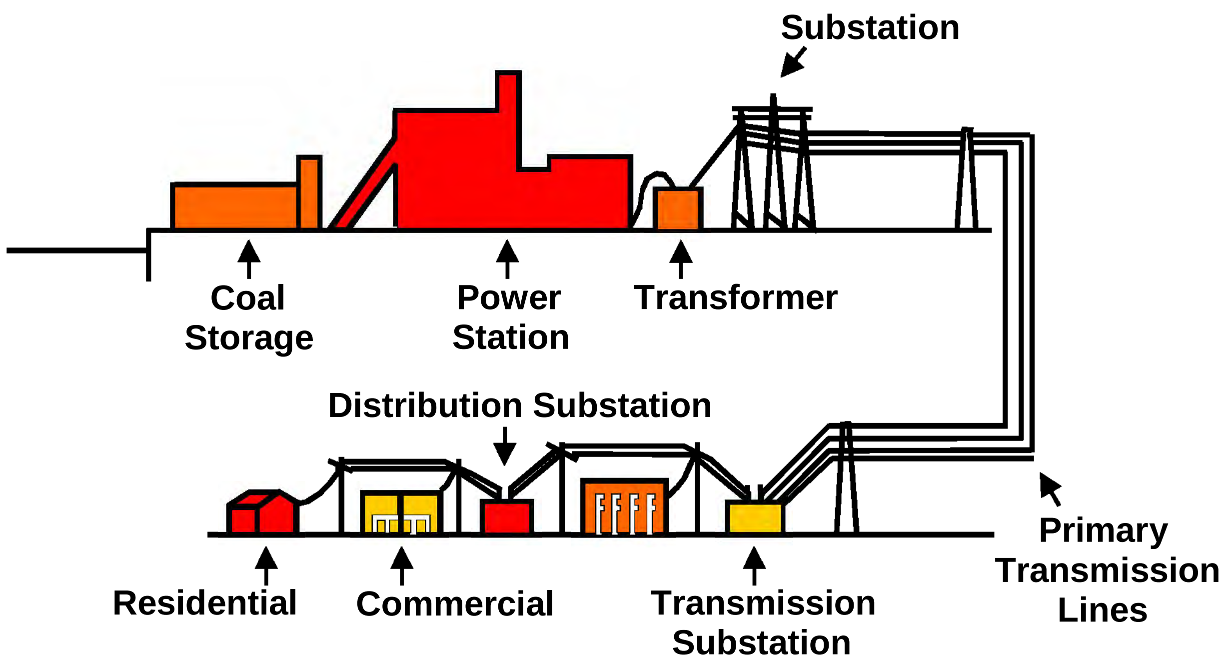
Purpose: Help demonstrate how power plant captures fly ash.

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@grenergy.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
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

<u>LEDs – general information</u>
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.

<u>Then, if they are so good, why are they so costly?</u>
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 stared 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 tub 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 CO_2 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?

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List some careers that are involved with the Synfuels Plant:

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Notes:

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Classroom Activity
Synfuels Production from Lignite

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 - CH_4) and water (two grapes attached to a grapefruit - H_2O).

Classroom Activity
Synfuels Production from Lignite

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

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).


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Map Features
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Existing Transmission
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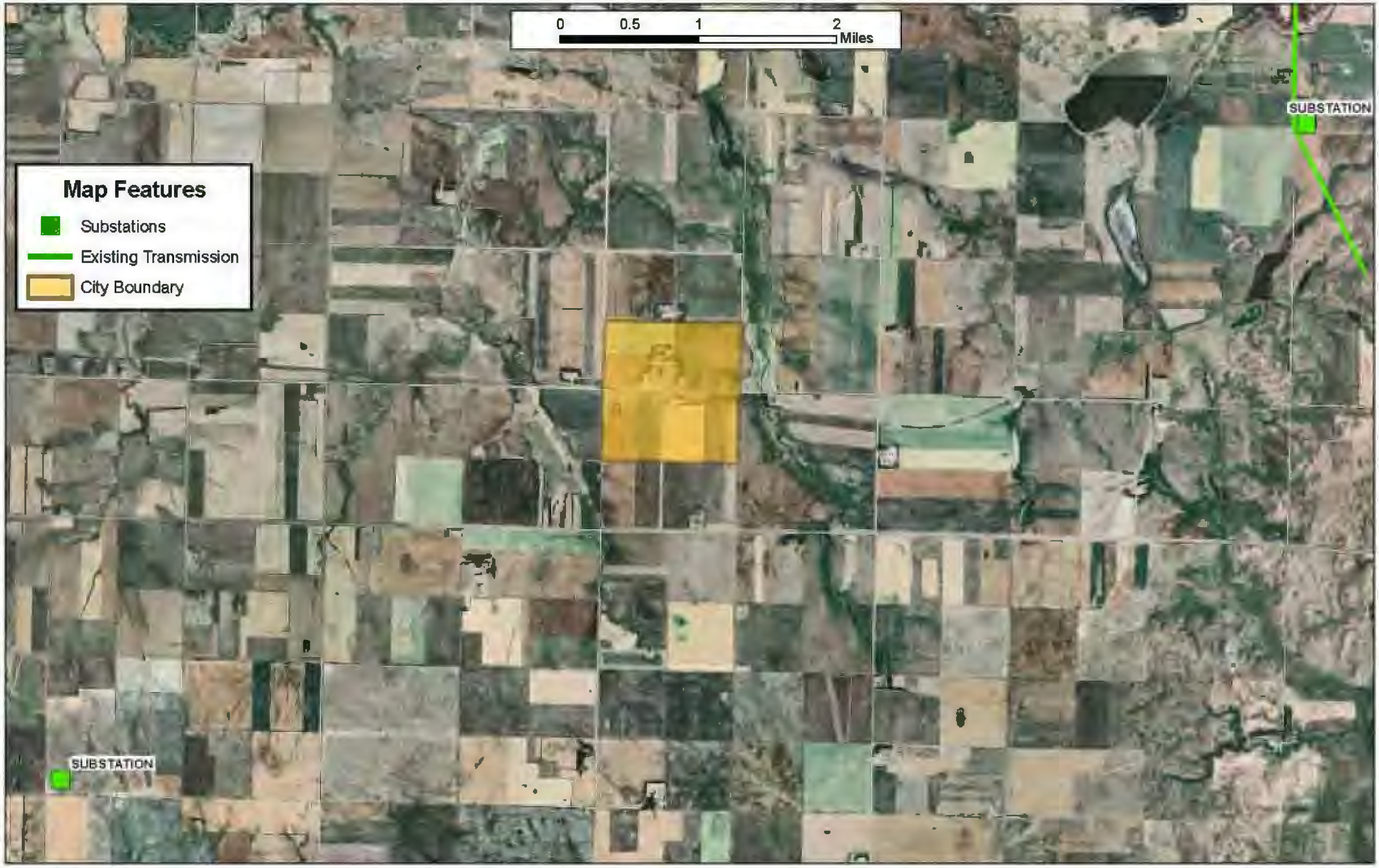
SUBSTATION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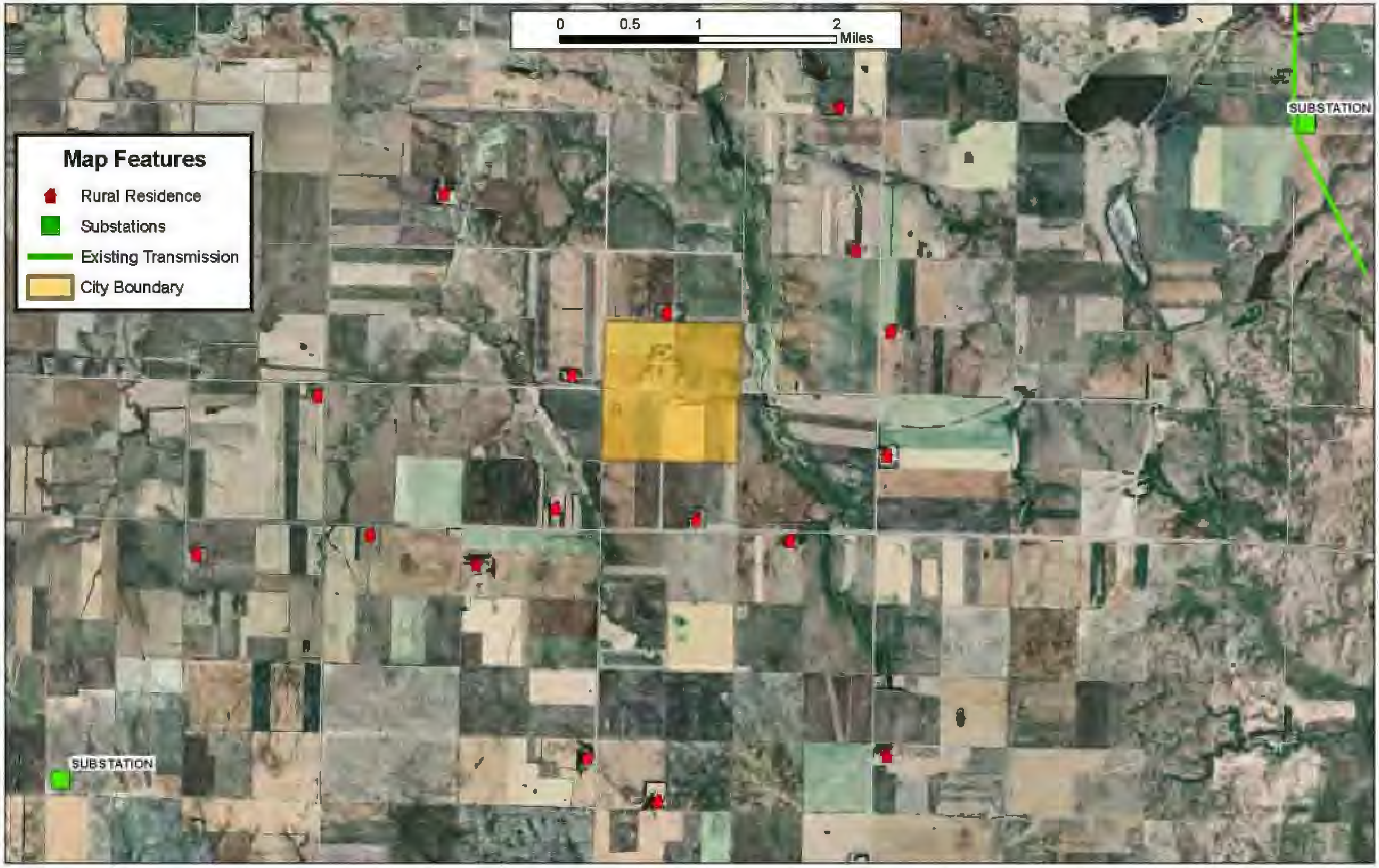
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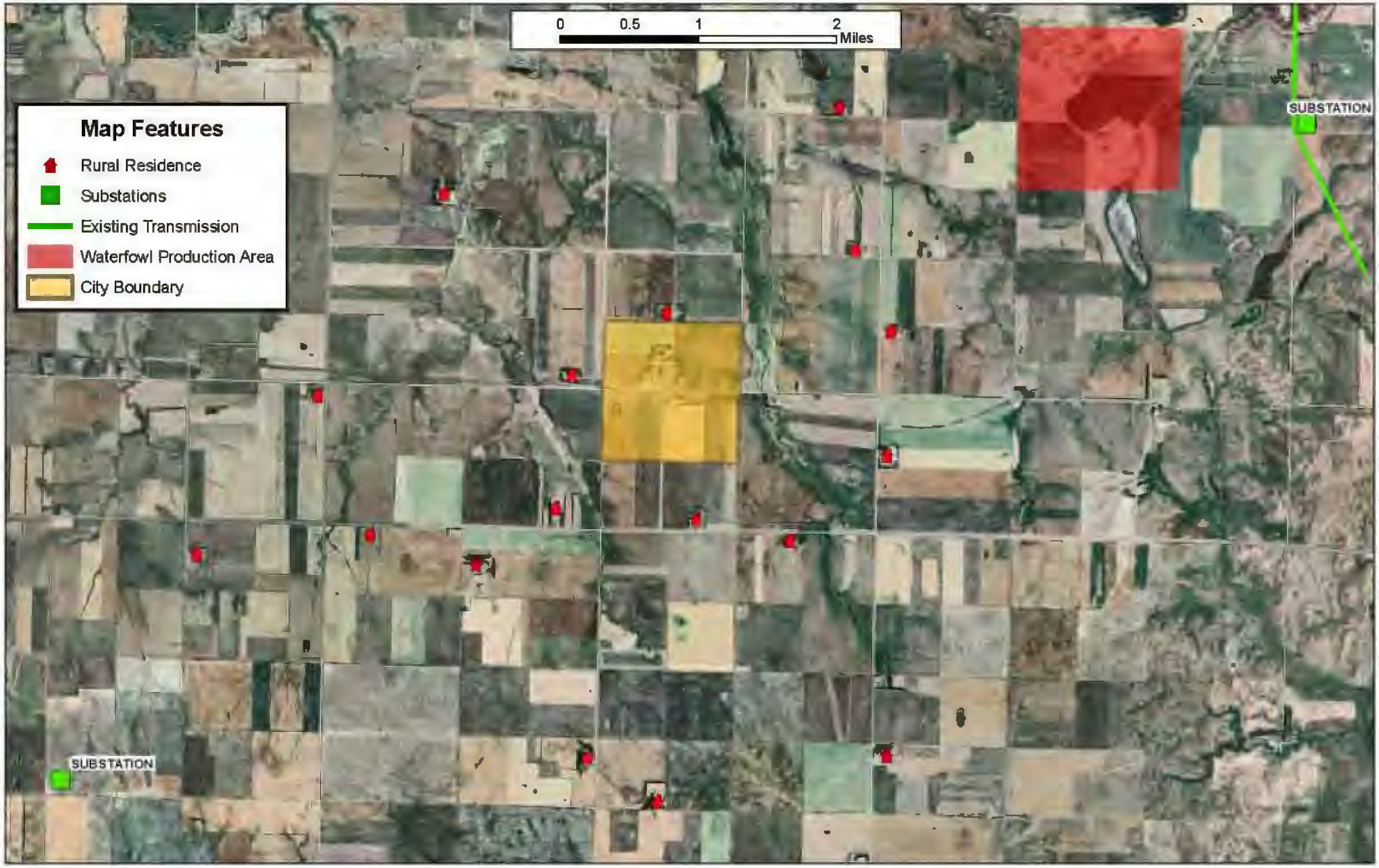
Map Features
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Waterfowl Production Area
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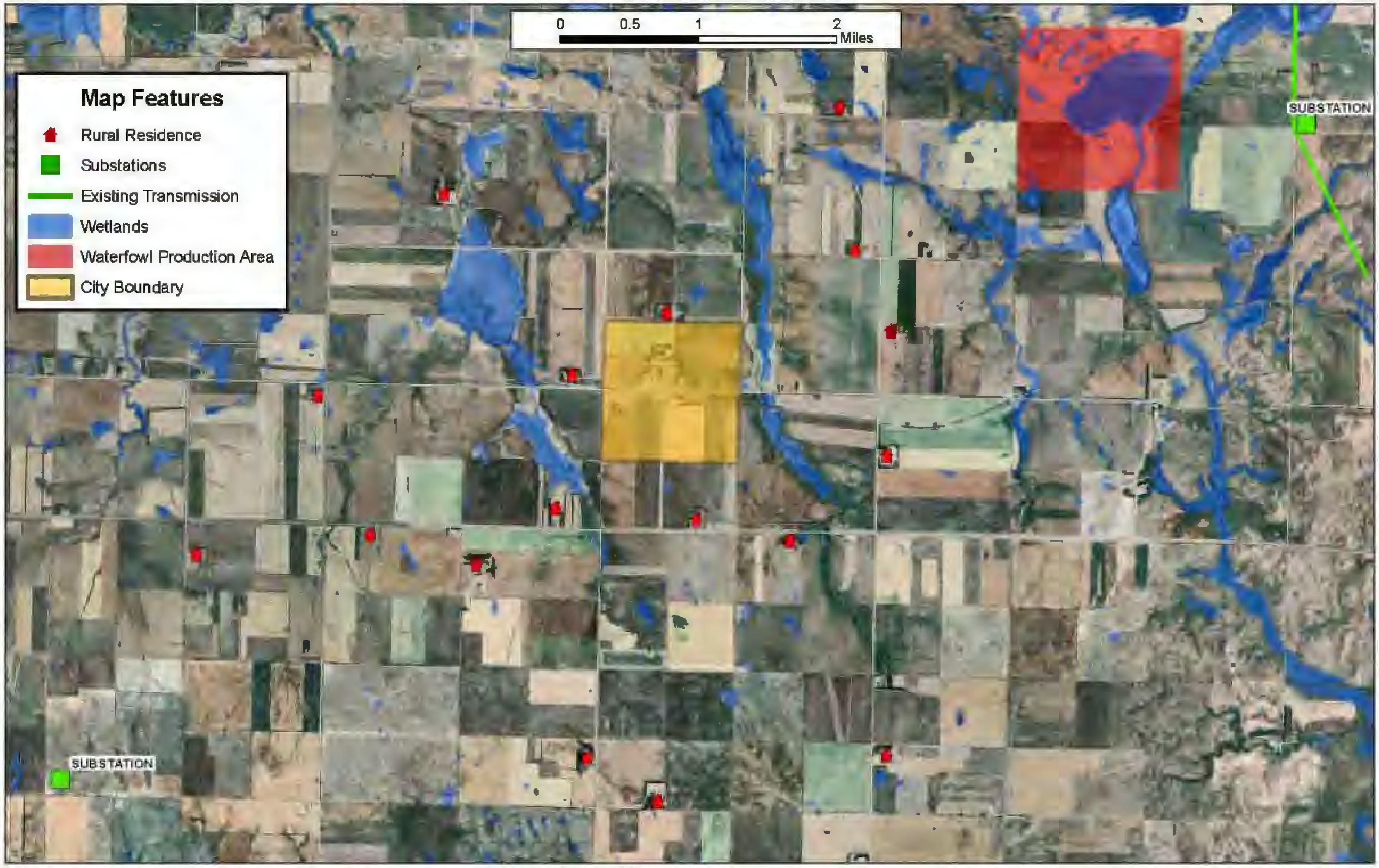
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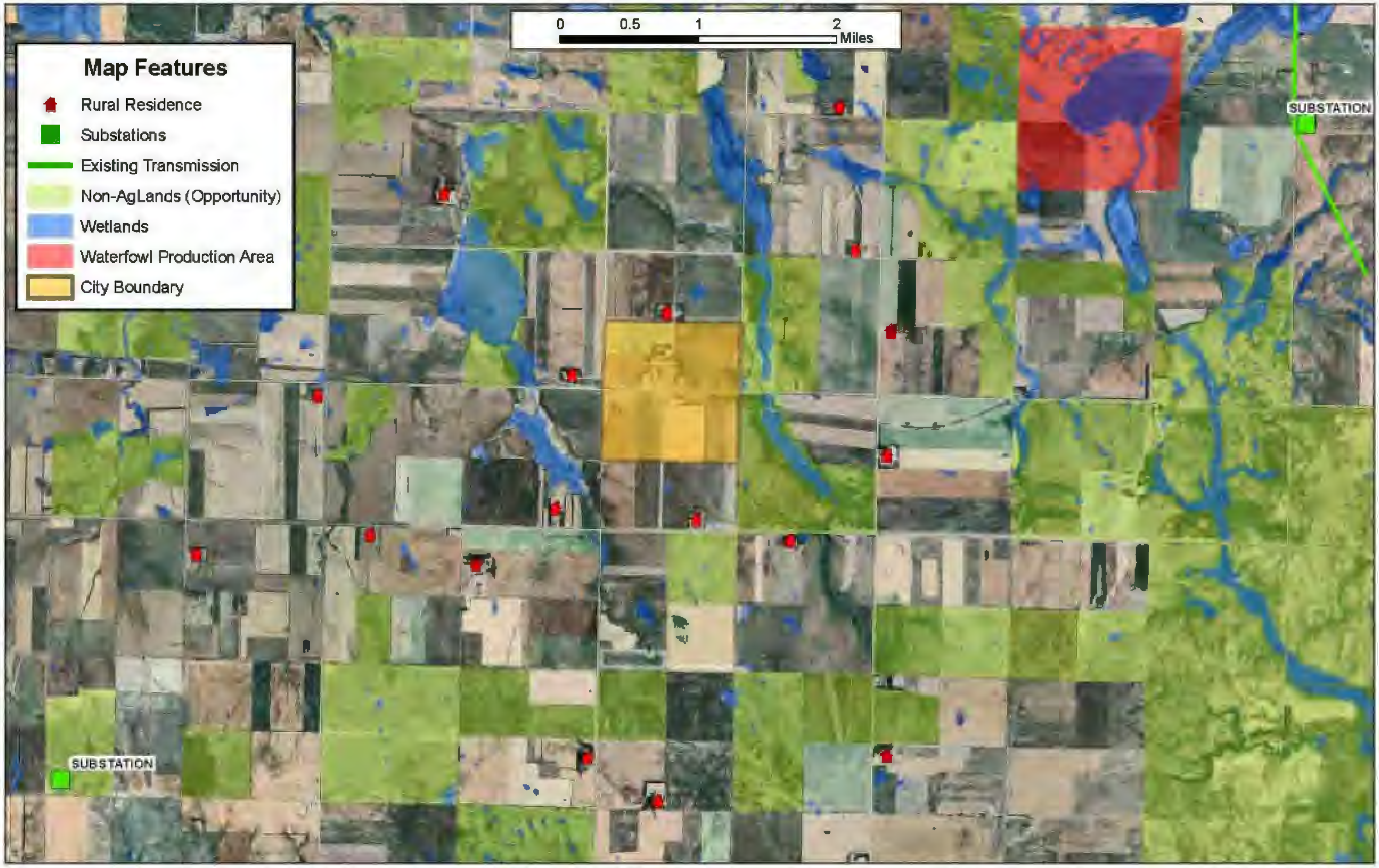
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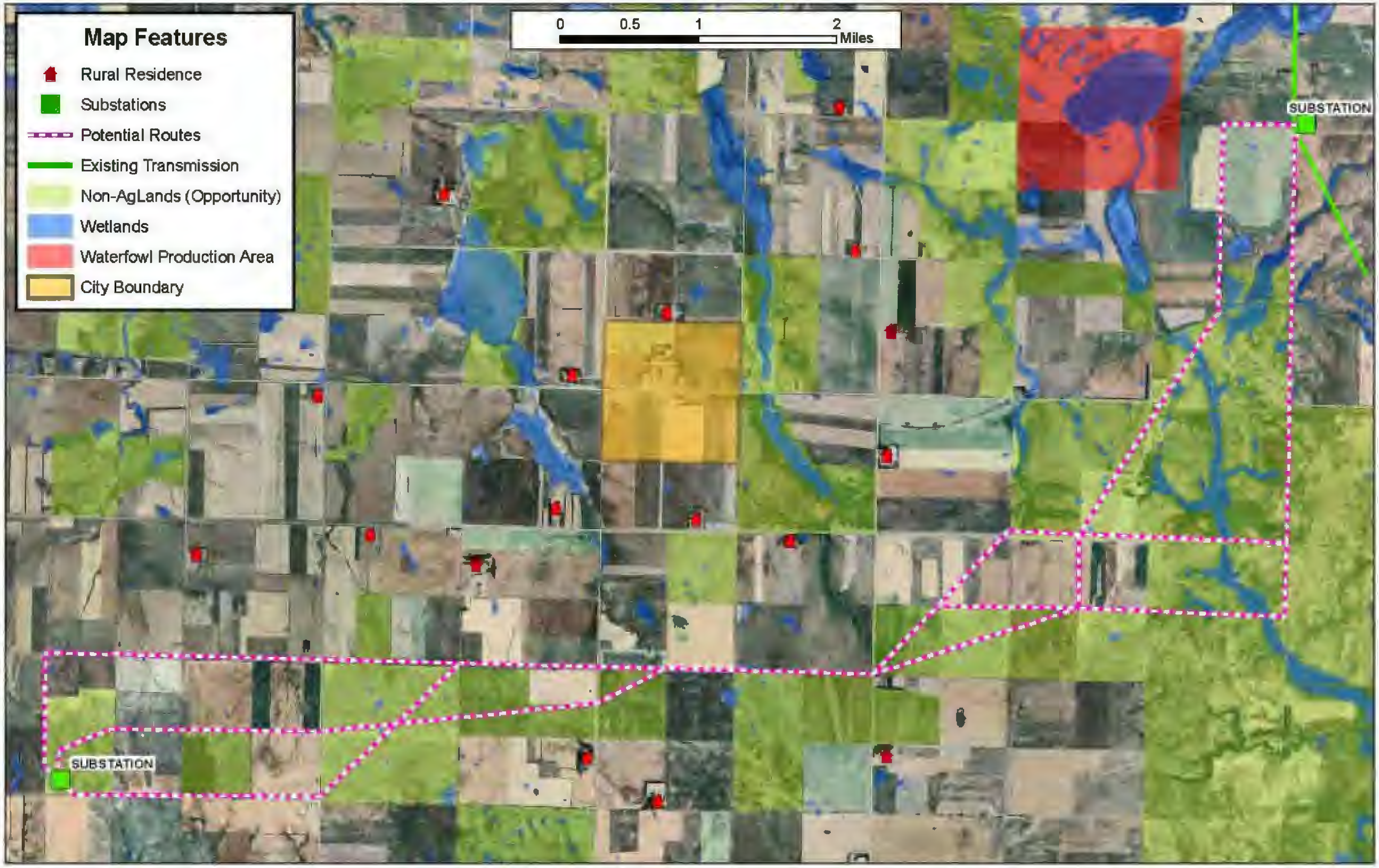
Map Features
Rural Residence
Substations
Existing Transmission
Non-AgLands (Opportunity)
Wetlands
Waterfowl Production Area
City Boundary
SUBSTATION
SUBSTATION


Map Features
Rural Residence
Substations
Potential Routes
Existing Transmission
Non-AgLands (Opportunity)
Wetlands
Waterfowl Production Area
City Boundary
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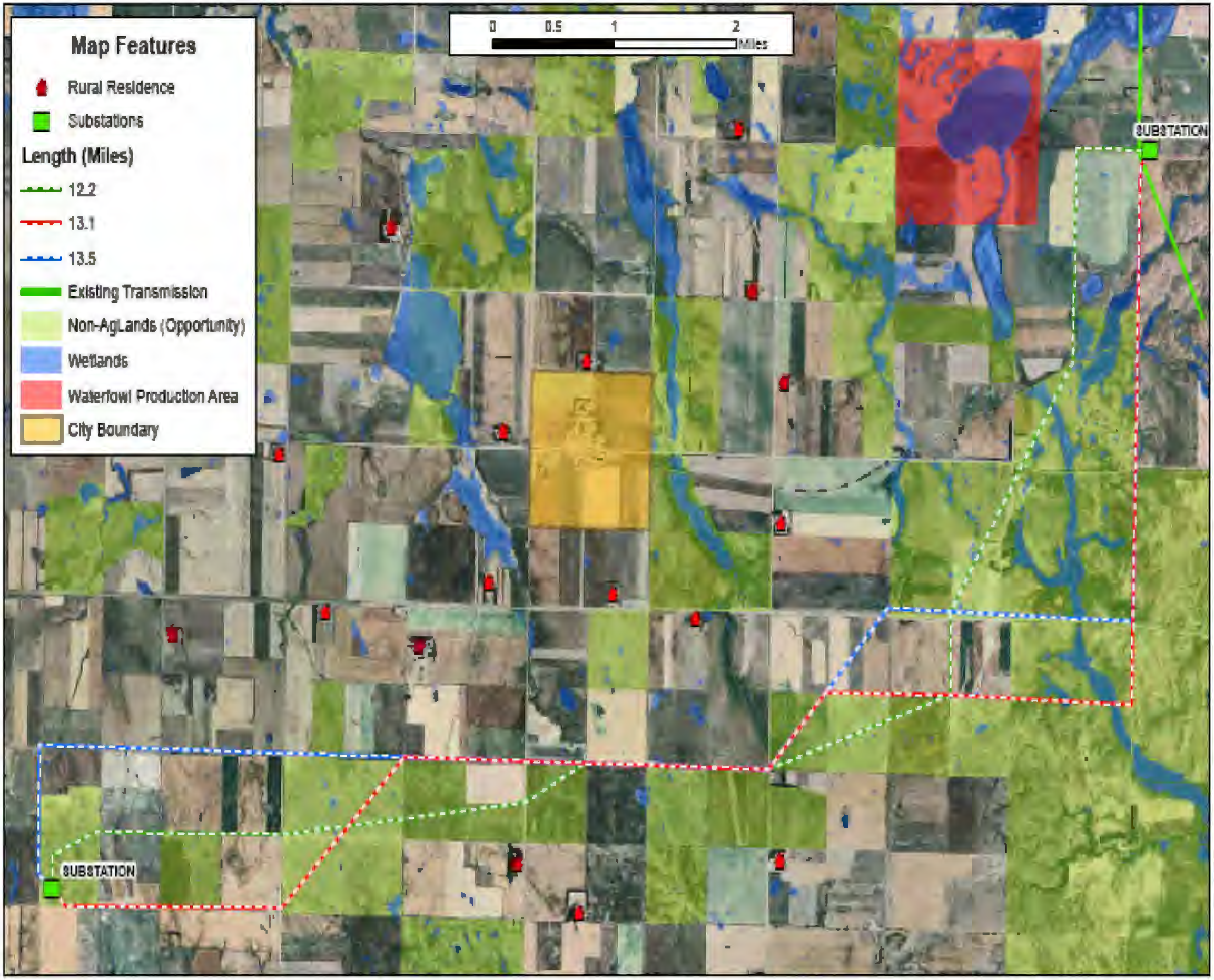
SUBSTATION
SUBSTATION


Map Features
Rural Residence
Substations
Length (Miles)
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Existing Transmission
Non-AgLands (Opportunity)
Wetlands
Waterfowl Production Area
City Boundary
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Miles
SUBSTATION
SUBSTATION

Enhancing Lignite's Future through R&D

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 CO_2 and other emissions
- ___________________________ – uses pure oxygen not air for combustion. This allows the flue gas to be basically CO_2 and water and allows for different strategies for CO_2 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 CO_2 as the working fluid and high pressure oxyfiring to release the chemical energy. Very high efficiency and capture 100% of the CO_2.

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_2 Management: Carbon Capture and Storage

Presented by Dan Daly, Outreach Task Manager, Plains CO_2 Reduction (PCOR) Partnership
Energy & Environmental Research Center, University of North Dakota
Presented at the 2014 Lignite Education Seminar
Bismarck, North Dakota

CO_2 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_2.

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 Niňo?
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_2 released to the atmosphere by human activities like burning fossil fuels, making cement, or plowing fields.

1. What is anthropogenic CO_2?
2. What is natural CO_2?
3. What is liquid CO_2?
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_2 is the amount of CO_2 in the atmosphere at any time.
- Carbon cycle CO_2 – Cycling CO_2 continually moves between the atmosphere, soils, plants, animals, the oceans, and back to the atmosphere.
- Biological deposition (fossils/rocks) – fossil CO_2 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_2 develops from natural processes deep in Earth and is released to the atmosphere by volcanoes.
- Fossil fuel combustion/lime production – CO_2 that was in long-term storage (fossil CO_2) 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_2 + H_2O.
- Biofuels generate CO_2 from today's atmosphere.
- Fossil fuels generate CO_2 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_2?
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_2 emissions.

- CO_2 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_2.
    - In 2000, they were about 25 billion metric ton CO_2.
    - By 2006, annual emissions reached 30 billion metric tons CO_2 (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_2 is estimated to have been around 280 ppm (0.028%).
    - In 2006, atmospheric CO_2 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_2 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_2 and stabilize CO_2 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_2 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).

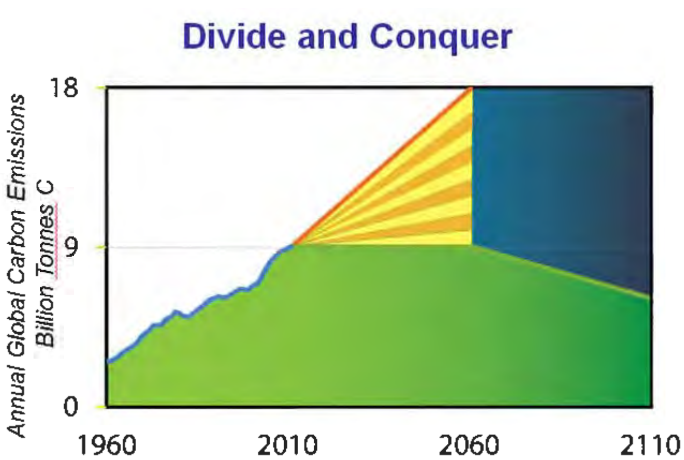


Figure 1. Cutting CO_2 emissions to stabilize anthropogenic contribution to the atmosphere over the next 50 years can be accomplished by dividing the task into smaller wedges and using a variety of strategies to reduce emissions. Each of the nine yellow or gold wedges represents 25 billion tons of carbon 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_2.

1. What is CO_2 localization?
2. What is CO_2 sequestration?
3. What is CO_2 serendipity?
4. What is the greenhouse effect?

No. 2 is correct.

Terrestrial sequestration absorbs CO_2 from the atmosphere and stores it in plant materials and soils.

Carbon capture and storage (CCS) captures CO_2 before it enters the atmosphere and puts it into storage deep underground for millions of years.

Geologic sequestration is also called:

- CCS.
- Geologic CO_2 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_2 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_2 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_2 sequestration puts the storage in CCS.

- Carbon capture – separate and capture CO_2 at a stationary source like a power plant.
- Transport – compress the CO_2 and transport the CO_2 by pipeline to a central storage location.
- Storage – inject CO_2 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_2 – to be pumped underground, CO_2 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 ($CaCO_3$).
  - Most sedimentary rocks have pores, and many are permeable.
- Right rocks
  - Rock layer for CO_2 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_2 into the formation without disrupting the injection zone. CO_2 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_2** 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_2 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_2. This includes approximately 930 stationary sources for a total of ~560 million tons of CO_2 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

Find related lesson plans:

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

Contact:

Dan Daly, Outreach Task Manager
Plains CO_2 Reduction (PCOR) Partnership
ddaly@undeerc.org
Telephone No. (701) 777-2822

Plant Level Environmental Compliance

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:

____

____

North Dakota utilities have invested ______________________ in technologies that reduce pollutants and keep the plants in compliance with all laws and regulations.

Notes:

Environmental Activities

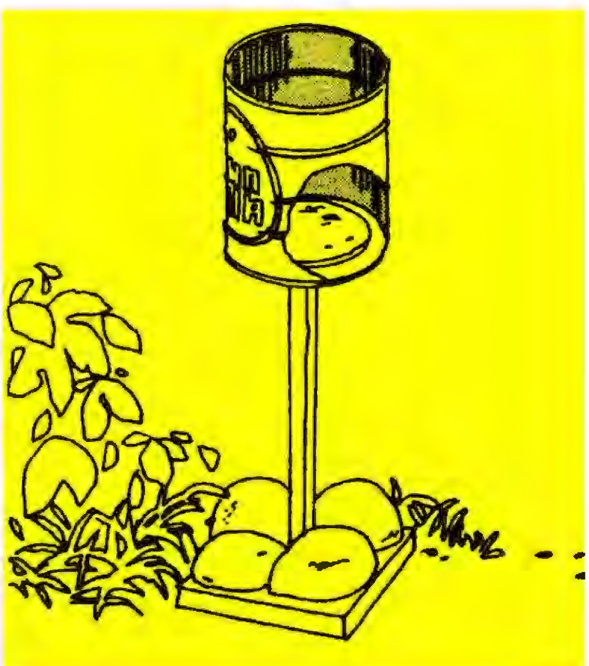
AIR MONITOR ACTIVITY

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.

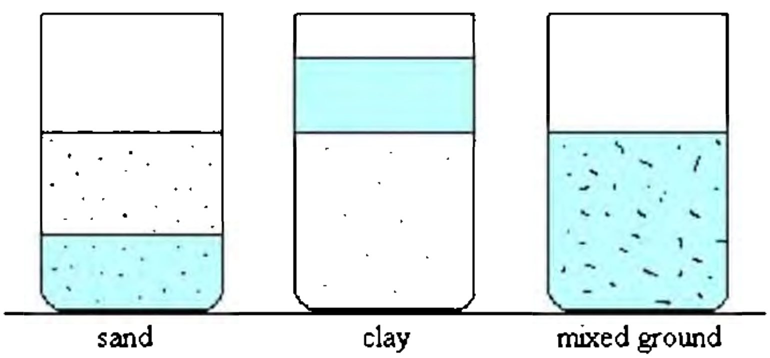


Figure 2 - Permeability of different types of soil components. In blue the distribution of water.

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

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.

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

August 2009

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?

Slide 1

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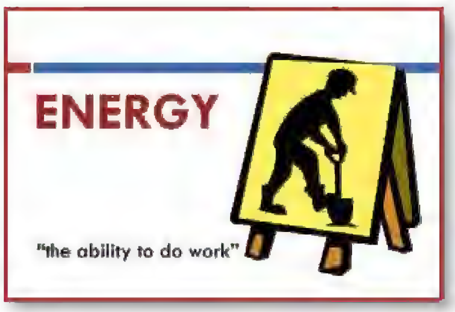


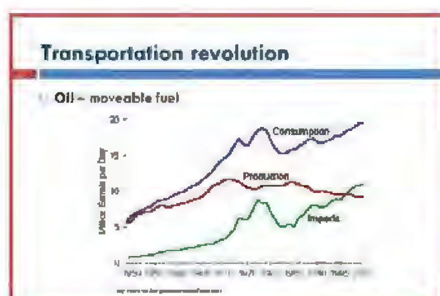
Slide 2

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.

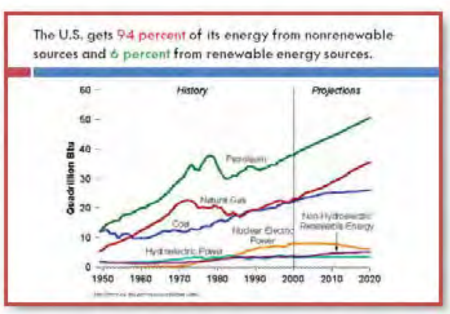
Slide 5

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



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.

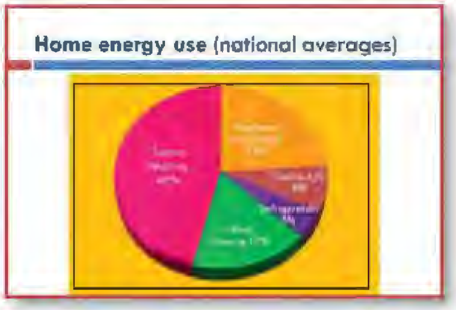
Slide 7

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.

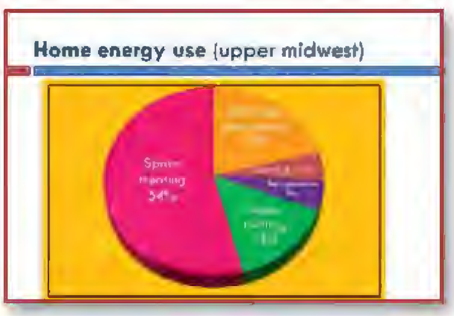
Slide 9



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 June 20, 2009.

Slide 11

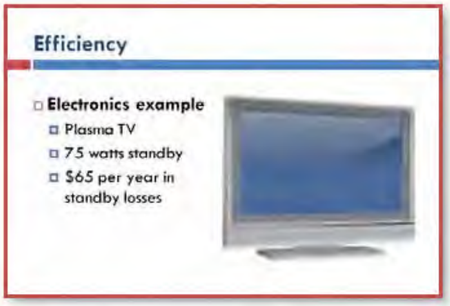
If heat is created in a home and it leaks out, the homeowner is paying to heat the outside air, which is a waste of energy and money.

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.

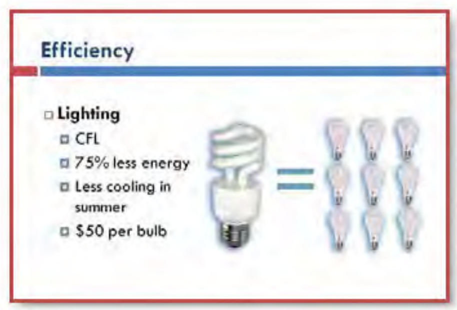
ENERGY STAR appliances also have very low standby power losses. Standby power losses occur when an appliance still will draw electricity even when turned off. If they have a clock, a soft-touch keypad or remote control, they use what is called standby power. The amount of electricity they use depends 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.

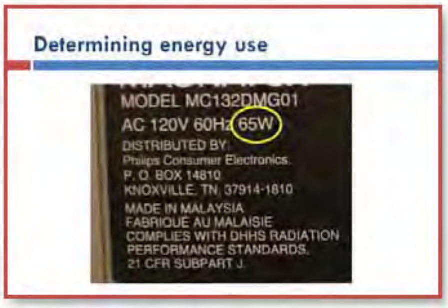
Natural Resources Defense Council. 2008. Lowering the Cost of Play, Improving the Energy Efficiency of Video Game Councils. Report accessed 20 June 2009 at www.nrdc.org/energy/consoles/files/consoles.pdf



Slide 15

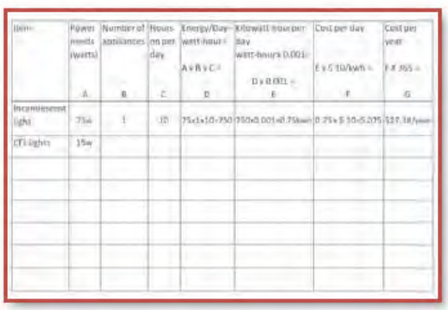
Switching from incandescent to compact fluorescent light (CFL) bulbs is a guaranteed money and energy saver. The bulbs consume around 75 percent less energy than an incandescent bulb and produce less heat. The majority of the energy used by incandescent light bulbs is used to produce heat, not light. 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).

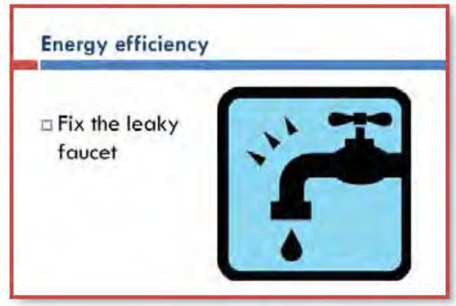
Slide 17



Item	Power needs (watts) A	Number of appliances B	Hours on per day C	Energy/Day—watt-hour = A x B x C = D	Kilowatt-hour per day watt-hours 0.001= D x 0.001 = E	Cost per day E x $.10/kWh = F	Cost per year F x 365 = G
Incandescent light	75w	1	10	75x1x10=750	750x0.001=0.75kwh	0.75 x $.10=$.075	$27.38/year
CFL lights	15w						

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.

For more information on this and other topics, see: www.ag.ndsu.edu

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

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

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 x 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 x B x 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.

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

November 2009

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						

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

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

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: mriedman@bepc.com

BNI Coal, Ltd.
Courtney Doll
Center Mine
2360 35th Avenue SW
Center, ND 58530-9499
Phone: (701) 355-5588
Email: 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@bepc.com

Great River Energy, North Dakota
Lyndon Anderson
2875 Third Street SW
Underwood, ND 58576-9759
Phone: (701) 442-7036
Email: landerson1@grenergy.com

Great River Energy, Minnesota
Therese LaCanne
12300 Elm Creek Blvd.
Maple Grove, MN 55369
Phone: (763) 445-5710
Email: tlacanne@grenergy.com

MDU Resources Group, Inc.
Mark Hanson
1200 W. Century Avenue
Bismarck, ND 58503
Phone: (701) 530-1093
Email: 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

North American Coal Corporation
David Straley
2000 Schafer Street, Suite D
Bismarck, ND 58501-1204
Phone: (701) 222-7596
Email: david.straley@nacoal.com

Otter Tail Power Company
Anne Taylor
215 S. Cascade Street
Fergus Falls, MN 56537
Phone: (218) 739-8250
Email: ataylor@otpco.com

Lignite Energy Council
Kay LaCoe
P.O. Box 2277
Bismarck, ND 58502
Phone: (701) 258-7117
Email: kaylacoe@lignite.com

Tour Contacts

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

BNI Coal, Ltd.

Center Mine, Center
Contact: Courtney Doll
BNI Coal, Ltd.
Center Mine
2360 35th Ave. SW
Center, ND 58530-9499
Phone: (701) 355-5588
Email: 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

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@grenergy.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@grenergy.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@grenergy.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

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
Or
Contact: Mary Schneider
Milton R. Young Station
Box 127
Center, ND 58530
Phone: (701) 794-8711
Email: 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: bzimmerman@otpco.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
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_3), 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_6H_6 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_2): 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_7H_{80}.

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 respreading 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^o to about 60^o 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' 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_4): 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_2O): 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 (NOx): Gases produced by the burning of fossil fuels. With volatile organic compounds, thought to be responsible for ozone formation. With SO_2 thought to be responsible for acid rain.

Ozone (O_3): 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-scrapers 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_2): 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

2019 Lignite Education Seminar:
Energy, Economics and Environment
June 10-13, 2019

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 horses 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 9th 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 Braun 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 lives on a farm south of Beulah and has two sons ages 5 and 3 that keep her busy.

Lignite Mining and Reclamation Process

Kayla Torgerson is an environmental specialist at the Coteau Properties Company's Freedom Mine, the nation's largest lignite coal mine, located north of Beulah. She's worked at the Freedom Mine for more than four years, where she focuses on permitting, bond release, and native grassland management. Prior to her time at the mine, she worked at a consulting engineering firm where she specialized in federal permitting and project management. She serves as president for the ND chapter of the Society for Range Management, president of the Beulah Library Board, and on the Dolly Parton Imagination Library of Beulah. She received her bachelor's degree in Mathematics from the University of Mary and her master's in Natural Resources Science and Management from the University of Minnesota. Kayla lives in Beulah with her husband and their daughter.

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 and Spiritwood 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. John currently serves on the foundation board for Bismarck State College. 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

Erin Huntimer is the project coordinations representative for Basin Electric Power Cooperative. Erin has held various positions at Basin since beginning her career there in May 2002. Erin lives with her family on a small hobby farm near Hannover, ND. She has two children and is married to Rick. Erin holds an undergraduate degree in Communications with a public relations concentration and an MBA with an energy management concentration, both from the University of Mary. She is also a Certified Cooperative Communicator.

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.

Economics and Electricity 101

Brian Kroshus was appointed to the Public Service Commission in March 2017 by Governor Doug Burgum. Brian has a background in business, agriculture and energy. Brian's portfolio at the Public Service Commission includes electric and gas economic regulation, pipeline safety and damage prevention, weights and measures and consumer affairs.

Prior to his appointment to the Public Service Commission, Brian spent 30 years in business leadership and management including 17 years as enterprise leader of Farm and Ranch Guide, 13 years as division leader of Lee Agri-Media and 10 years as publisher of the Bismarck Tribune. During his private sector career Brian was recognized numerous times for operational excellence, finding new efficiencies and exceptional leadership.

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 CO2 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.

Energy and CO2 Management: Carbon Capture and Storage

Dan Daly recently retired from 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 then worked as a geologist at EERC in projects dealing with energy and the environment. From the fall of 2003 until his recent retirement, he was the lead for public outreach and education with the Plains CO2 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 Senior Manager of Power Production, in charge of the Milton Young Station.

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.