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PRINT DESIGN & PUBLICATIONS

WATER POWER TECHNOLOGIES OFFICE 2019 PROJECT PEER REVIEW

Project Evaluations

LOW-HEAD, SHORT-INTAKE FLOW MEASUREMENT RESEARCH
(WBS #: 1.1.1.601)

Recipient:	PNNL
Principal Investigator:	Marshall F
Project Type:	AOP
Project Category:	Completed Projects
Total Authorized:	\$524K
Total Costed:	\$412K

Project Description

The overall objective of this project is to develop improved flow (discharge) measurement technology to enable U.S. hydropower assets to produce more energy from available water. Achieving optimal long-term water-use efficiency, asset monitoring, and sustainable water management objective monitoring and control of hydropower unit operations. The availability of accurate flow-rate measurement technology is a primary factor in monitoring and controlling the instantaneous efficiency of hydropower production in the face of multiple constraints on hydropower asset operations. The ultimate objective is to develop measurement technology and site-specific analysis methods that can be applied to a wide range of U.S. hydropower fleet that cannot be readily measured using existing technology.

Weighted Project Score: 3.6
Weighting: Objectives -20%; Engagement -20%; Approach -20%; Accomplishments -40%

Average Score by Project Evaluation Criteria

Criteria	This Project Score	Activity Area Score	Score Range
Objectives	~4.0	~4.5	~3.5 - 4.5
Engagement	~3.5	~4.0	~2.5 - 4.0
Approach	~3.5	~4.0	~2.5 - 4.0
Accomplishments	~3.0	~3.8	~2.0 - 3.8

84 Hydropower Program Score Results

U.S. DEPARTMENT OF ENERGY
Office of ENERGY EFFICIENCY & RENEWABLE ENERGY

2019 PROJECT PEER REVIEW

U.S. DEPARTMENT OF ENERGY
WATER POWER TECHNOLOGIES OFFICE

SECTION 1

Hydropower Program

- Technology R&D for Low-Impact Hydropower Growth
- Modernization, Upgrades, and Security
- Grid Reliability, Resilience, and Storage
- Environmental R&D and Hydrologic Systems Science
- Big-Data Access and Management

Challenges

The cultural shift that AMI portends, and the significant amount of new data AMI generates, is raising expectations of regulators, advocates, and the utility about the types and timing of benefits. Regulators want customers to realize benefits from the investment sooner rather than later. While it can be difficult to assign numbers to intangible benefits, developing a methodology and providing estimates for these benefits can demonstrate that a utility has thought through what AMI will mean not only for customers but also for the utility. It can give confidence that the utility understands the magnitude of what will be needed for data storage or integration with other systems and can help identify future investment opportunities for realizing value. Utilities worry this can be another point of contention, and regulators find this challenging; however, analysis can provide a level of transparency and give regulators the information they need to approve a case.

At the end of the day, transparency and information around costs and benefits is essential. The utility is the expert about the AMI rollout and the only entity in the proceeding with a deep understanding of its system, its technical capabilities and challenges, and specifics about how AMI can be implemented. Openness about all future value streams and an explicit description about the operational benefits upfront can help regulators and advocates better understand the overall value of the investment in order to build and support a more complete record that is necessary for approval.



**“Utilities that de
AMI promised bene
haven’t been realiz
we wonder, is the in
worth the cos
- Advocat**

AMI IN REVIEW
Informing the Conversation

Advanced Grid Research
OFFICE OF ELECTRICITY
US DEPARTMENT OF ENERGY

ARE UTILITIES REACHING THE MAGIC PLAN FOR AMI?

AMI deployment can originate from multiple places and via different rationales and approaches will have an impact on the strategy of the utility, advocate, and regulatory worlds. The process of applications and conversations with participants for AMI typically originates in one of three places: the utility, the commission. A utility that sees the role of AMI in managing the distribution system or otherwise improving its operations may propose an AMI investment. In some cases, legislative action may require the deployment of AMI as the base metering standard. In other cases, utilities are asked to submit an AMI application in order to receive more information about potential AMI investments. At its starting point, the investment, costs, and benefits will be subject to regulatory review.

Once AMI has taken hold, the next step is deciding on an approach for implementation before the state regulatory commission. The analysis that follows reflects that, again, there is no singular approach. AMI is often proposed on a stand-alone basis, as part of a standard rate case, or as part of an overarching grid modernization proposal.

Type of Application Where AMI Was Proposed	Count
Standard Rate Case Proposal	26
Grid Modernization or Other Proposal	39
Other	15
TOTAL	80





Executive Summary

Strong scientific consensus tells us that rapid climate change is happening and will continue to worsen if we do not take action. The negative impacts of rapid climate change, such as increased severe weather and changes in water availability, will disproportionately affect urban areas. As a result, Denver and other cities are leading efforts to reduce greenhouse gas (GHG) emissions. Denver's first Climate Action Plan, released in 2007, set a goal to reduce GHG emissions by 10 percent per capita below 1990 levels (at that time, equivalent to an overall GHG reduction of 3 percent). Denver exceeded the per capita goal, mainly through innovative regional and statewide strategies in the energy sector, with notable reductions and efficiencies in the building and transportation sectors. Denver's 2020 Sustainability Goals call for an absolute reduction of GHG emissions to 1990 levels.

The 2015 Climate Action Plan integrates the most recent climate science, an updated GHG inventory, and ambitious GHG reduction strategies with an eye on long-term reduction goals. Under the leadership of Mayor Michael Hancock, Denver has committed to reduce its community-wide emissions below **1990 levels, or 11.8 million metric tons of carbon dioxide equivalent, by 2020**. This would require a 25 percent reduction of GHGs from

2013 GHG Emissions 12,985 mt-CO₂e

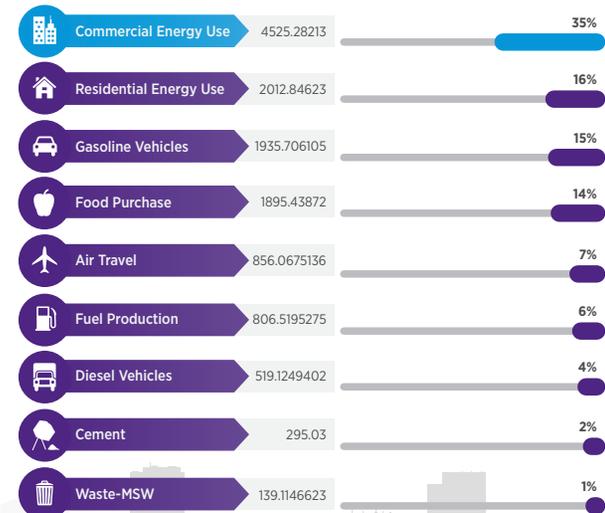
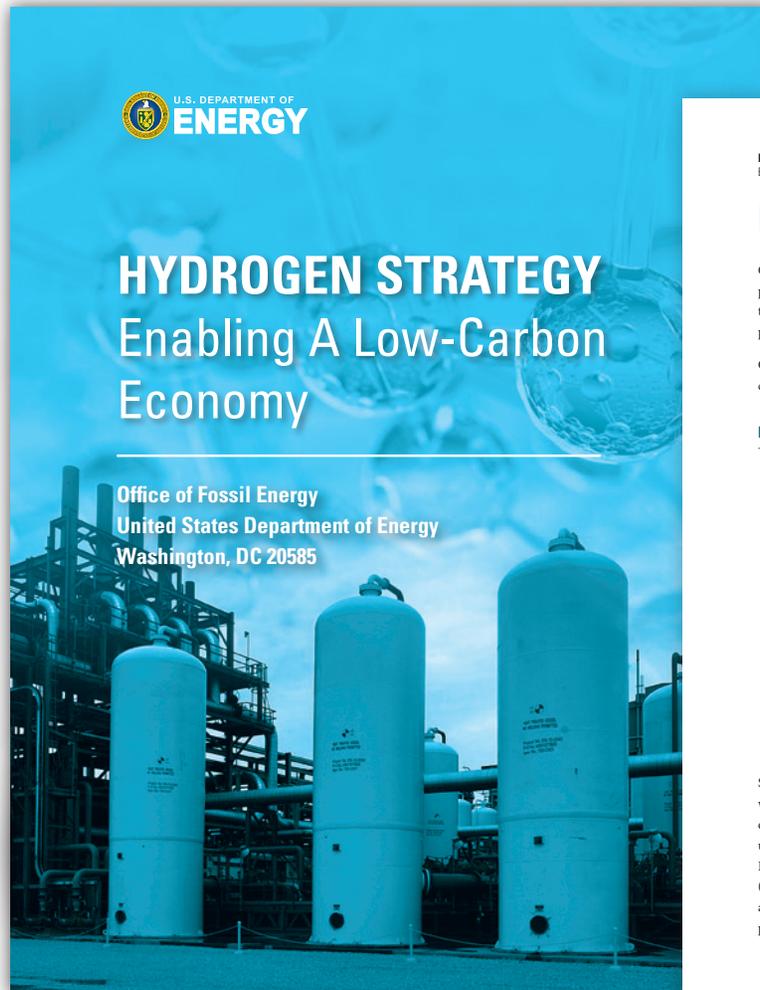


Figure 1. Denver's 2013 GHG inventory, which illustrates relatively large contributions from the building sector. Acronyms: metric tons of carbon dioxide equivalent (mt-CO₂e); municipal solid waste (MSW).



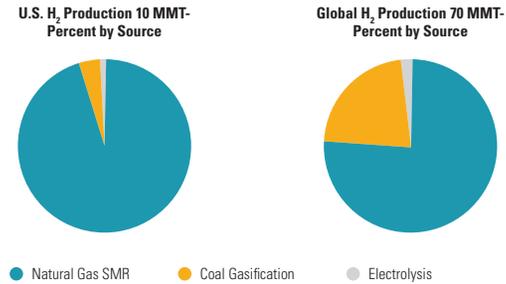
HYDROGEN STRATEGY
Enabling A Low-Carbon Economy

Hydrogen Production and Cost

Currently, 99% of U.S. hydrogen production is sourced from fossil fuels, with 95% from natural gas by SMR and 4% by partial oxidation of natural gas via coal gasification. Only 1% of U.S. hydrogen is produced from electrolysis.⁵ Annually, the United States produces more than 10 million metric tons (MMT) of hydrogen, and approximately 60% of it is produced in "dedicated" hydrogen production facilities as their primary product.

Global hydrogen production is approximately 70 MMT, with 76% produced from natural gas via SMR, 22% through coal gasification (primarily in China), and 2% using electrolysis (see Figure 3).

Figure 3. U.S. and Global Production of Hydrogen



SMR is a mature production process that builds upon the existing natural gas pipeline delivery infrastructure. Another well-developed, but more expensive approach for hydrogen production is splitting water. Methods used include electrolysis, photo-electrochemical cells, or solar thermochemical systems. Globally, supplying hydrogen to industrial users is a major business, and the demand has grown more than threefold since 1975, and it continues to rise.⁵ Industrial technologies for hydrogen production include catalytic steam reforming (800–1000°C) and partial oxidation (600–900°C) of hydrocarbons (e.g., natural gas) or renewable fuels (e.g., bioethanol); coal or coal blends with biomass and waste plastics gasification; water electrolysis; thermochemical water splitting at around 900°C; and biological production.

⁵ Water electrolysis is the electrochemical splitting of water into hydrogen and oxygen.

U.S. DEPARTMENT OF **ENERGY** Prepare. Respond. Adapt.

Infrastructure Security and Energy Restoration (ISER)

Achieving energy security and resilience is a national imperative for the United States. Energy infrastructure in the United States faces a growing range of hazards, from increasingly sophisticated physical and cyber threats, to severe weather and natural disasters.

The Infrastructure Security and Energy Restoration (ISER) Division, within the U.S. Department of Energy's (DOE) Office of Electricity Delivery and Energy Reliability (OE), coordinates a national effort to secure U.S. energy infrastructure, address all hazards, reduce impacts from disruptive events, and assist industry with restoration activities. ISER works closely with the electricity and oil and natural gas industries, other Federal agencies, and State, Local, Tribal, and Territorial (SLTT) communities to advance national energy security and prepare for, respond to, and adapt to evolving threats.



PREPARE.

Emerging threats make energy infrastructure security a constantly evolving challenge. ISER's programs help the energy sector understand and prepare for a range of potential risks.

SECTOR SPECIFIC AGENCY RESPONSIBILITIES

ISER, as the lead for DOE's efforts as the Sector Specific Agency (SSA) for the energy sector, serves as the day-to-day interface between the Federal Government and the private sector entities that own 87% of U.S. energy infrastructure. ISER co-chairs the Electricity Subsector Coordinating Council (ESCC), Oil and Natural Gas Sector Coordinating Council (ONG SCC), and Energy Government Coordinating Council (Energy GCC) to represent the needs and interests of the sector across the government.

STATE, LOCAL, TRIBAL, AND TERRITORIAL (SLTT) ENERGY ASSURANCE

ISER's SLTT Energy Assurance Program maintains strong relationships with state and local communities to build capacity through technical assistance, risk analysis, education, and exercises to facilitate response in times of energy sector emergencies.

ENERGY SECTOR EXERCISES

ISER conducts and participates in energy sector exercises at the national, regional, and local level to identify gaps in energy assurance planning, better understand interdependencies between energy and other sectors, and build and strengthen networks across the energy emergency response community.

CYBER PREPAREDNESS

ISER advances industry-wide cybersecurity risk management and practice by disseminating information through classified threat briefings and security workshops, and by providing access to tools and technical resources that are used to improve decision making and inform investments by our energy sector partners.

ISER has provided its Cybersecurity Capability Maturity Model (C2M2) to nearly **950** organizations.

ISER's annual Path exercise exercises Federal, regional, and state abilities to respond to disasters.

In 2016, Clear Path IV had more than **175** participants from **15** Oil & Natural Gas Companies, **18** Electric Utilities, and **7** States.

ISER works with all **50** states, **5** territories, and the District of Columbia.



RESPOND.

ISER plays a pivotal role in responding to severe events that affect the energy sector. From Superstorm Sandy to threats posed by electromagnetic pulses and space weather events, ISER addresses a full range of hazards in close coordination with infrastructure owners and operators and State and local government.

SITUATIONAL AWARENESS AND INFORMATION SHARING

ISER is the source for real-time information about the status of the energy sector (electricity and oil and natural gas) as emergencies unfold. ISER's EAGLE-I (Environment for Analysis of Geo-Located Energy Information) system provides a platform for visualizing disruptions to energy supplies as they occur and for modeling potential impacts and interconnections in the energy sector. Agreements with other agencies and DOE's National Laboratories allow us access to aerial imagery and other state-of-the-art tools to assist our partners with damage assessments.

CYBER INCIDENT COORDINATION

ISER is responsible for coordinating the Federal response to cyber incidents that affect the energy sector. In close collaboration with the Department of Homeland Security, the Federal Bureau of Investigation, and other government agencies, ISER offers access to information, technical assistance, and other support to the private sector. During a Presidentially declared energy sector emergency related to cyber, ISER facilitates the Secretary of Energy's far-reaching authorities to direct actions that protect the safety and well-being of the American people.

RESPONSE AND NATURAL DISASTERS

ISER supports the Federal Emergency Management Agency (as Emergency Support Function #12), State and local entities, and the private sector in facilitating the restoration of damaged energy infrastructure. In emergency situations, ISER works with its partners to:

- Assess the impacts of a disaster on local and regional energy infrastructure
- Provide regular situational awareness updates to Federal, state, and private sector decision makers
- Facilitate legal and regulatory waivers to accelerate reestablishment of damaged energy systems and components
- Provide technical and logistical assistance as requested



ADAPT.

In a landscape of ever-evolving threats, education, diligence, and innovation are vital. ISER illuminates risks to critical energy infrastructure by working with key stakeholders to characterize potential threats and hazards and explore mitigation strategies.

RISK AND HAZARDS

ISER works with DOE's National Laboratories, industry groups, and other Federal agencies to understand the most critical vulnerabilities of the electricity and oil and natural gas industries, and where and how the Federal Government can engage most effectively to enhance preparedness and response capabilities.

INTERNATIONAL AND DEFENSE

ISER, at the request of other Federal agencies or international governments, will facilitate access to expertise and information about how threats and hazards can impact foreign energy sector infrastructure, and steps that may be taken to mitigate these.

In an energy sector emergency, ISER is the lead Federal agency for coordination with the energy industry and Federal, state, and local partners

ISER coordinates security and resilience planning with:

23 Oil & Natural Gas associations in the Oil and Natural Gas Sector Coordinating Council (ONG SCC)

30 CEOs and other executives from all segments of the electric industry in the Electricity Subsector Coordinating Council (ESCC)

U.S. DEPARTMENT OF **ENERGY** | Infrastructure Security & Energy Restoration

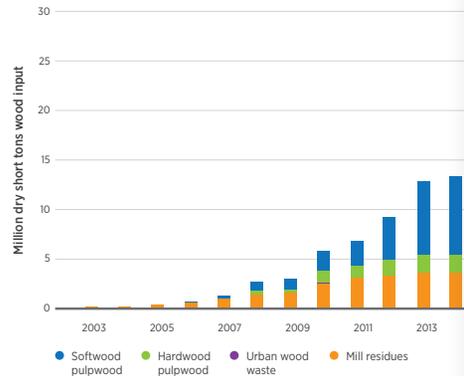
For more information about any of ISER's programs, please visit <https://energy.gov/oe/mission/infrastructure-security-and-energy-restoration-iser> or call 202-586-2264.

FOREST RESOURCES

Inputs to the pellet production process can consist of softwood pulpwood, hardwood pulpwood, mill residues, urban wood waste, and logging residues. Figure 3.25 shows the expected inputs from the announced

and screened facilities are do pulpwood, hardwood pulpwood. Only very small amounts of come from urban wood waste

Figure 3.25 | Historical and announced feedstock source for pellet production, 2003–2017



Source: Data from Forisk Consulting (2015).

Note: Quantities of logging residues and urban wood waste are small.

Much of the literature on wood energy assumes that logging residues will play a dominant role as a feedstock (Gan and Smith 2006; Perez-Verdin et al. 2009; Perlack et al. 2005). However, the Forisk survey shows that feedstocks for pellets will more likely be what is called “clean” feedstocks—softwood and hardwood small roundwood and mill residues, with only small amounts of input from logging residues and urban wood waste (fig. 3.25). These predictions from the announcing companies are subject to

change, however, if future production of softwood and mill residues rise, logging residues fall.

Output from the production of wood pellets is measured in the export statistics from the Bureau of Economic Analysis. Exports of wood pellets from the United States increased from 2.1 million dry short tons in 2009 to 4.5 million dry short tons in 2013, with 99% of those exports coming from southern ports.



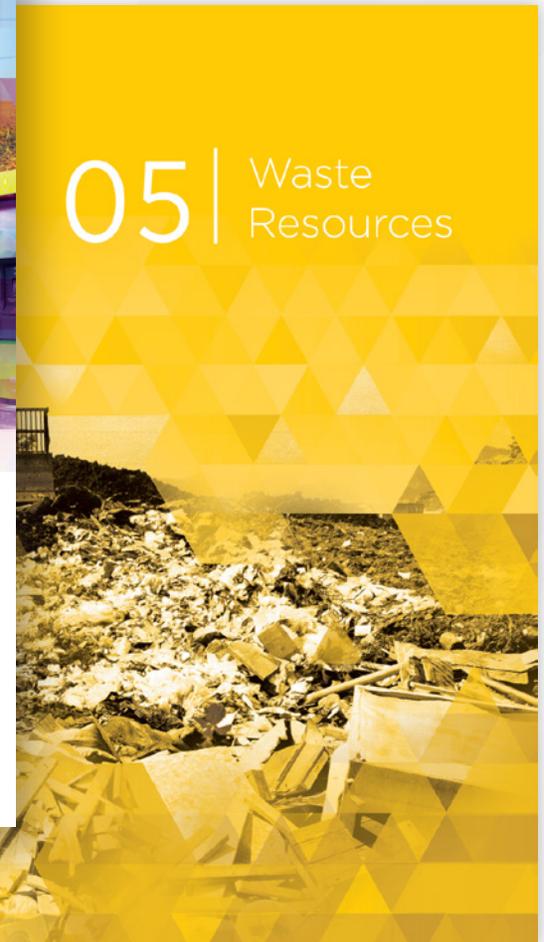
2016 BILLION-TON REPORT

Advancing Domestic Resources
for a Thriving Bioeconomy

Volume II | January 2017



05 | Waste Resources



U.S. DEPARTMENT OF **ENERGY** | Office of Fossil Energy

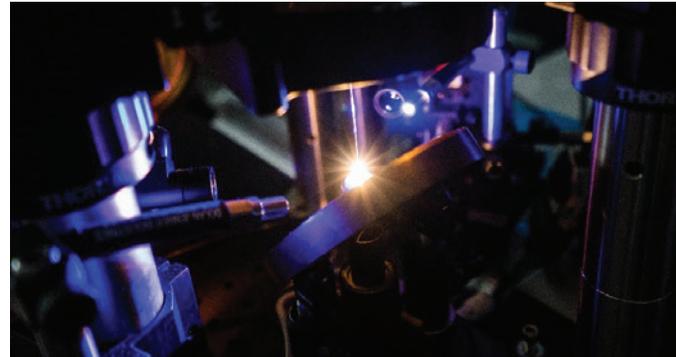
Office of Environment, Security, Safety and Health



Striving for Environmental, Security, Safety and Health (ESS&H) Excellence

Annual Report for Fiscal Year 2017

FIGURE 2 | A CO₂ laser melting a rod of alumina which will create a sapphire optical fiber, capable of withstanding the most adverse environmental conditions



universities, and other government entities. In turn, these partnerships, coupled with federally-owned laboratory research, allow NETL to pursue new systems and technologies that will promote affordable and sustainable energy solutions.

NETL also seeks to enhance America's energy security, improve the environmental acceptability of energy production and use, and ensure a robust U.S. energy future. NETL conducts research on topics including secure and reliable

energy; coal, oil, and natural gas efficiency; clean power generation from coal; CCUS; the future role of hydrogen; and critical infrastructure assurance.

With more than 1,200 federal and contractor employees across five sites located in Morgantown, West Virginia; Pittsburgh, Pennsylvania; Albany, Oregon; Sugar Land, Texas; and Anchorage, Alaska, NETL functions as both an on-site science and technology research center and as

FIGURE 3 | NETL Site Locations: Albany, OR; Pittsburgh, PA; Morgantown, WV



Oregon



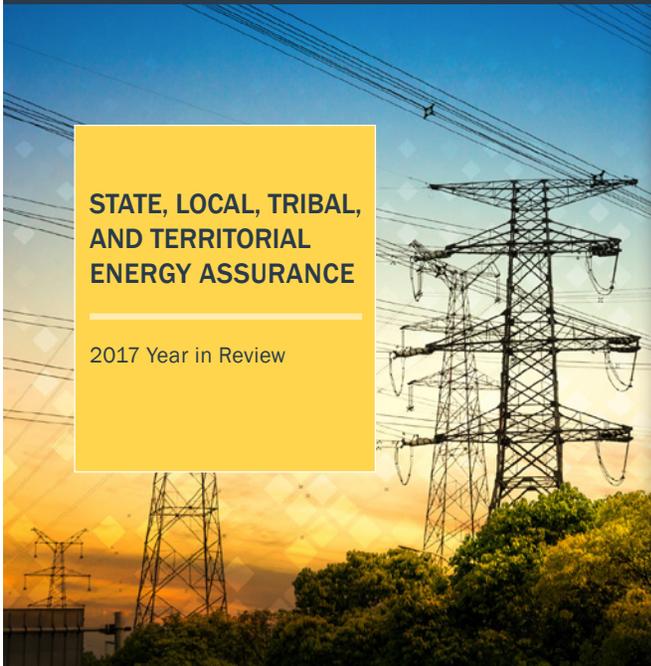
Pennsylvania



West Virginia



U.S. DEPARTMENT OF ENERGY | Infrastructure Security & Energy Restoration



STATE, LOCAL, TRIBAL, AND TERRITORIAL ENERGY ASSURANCE

2017 Year in Review



INTRODUCTION



Many energy disruptions start at the local level. A large majority of these incidents go unreported in national media and do not meet thresholds that beget a Federal response. Whether faced with heating fuel shortages in the wintertime or power outages during the middle of summer, state, local, tribal, and territorial (SLTT) officials must work amongst themselves and with local energy companies to ensure their constituents' energy needs are met on a consistent basis. When impacts from these events increase in size and do receive national media attention, and the sector and SLTT governments respond effectively, then stakeholders realize the value of energy assurance efforts.

In 2017, the SLTT Energy Assurance Program engaged with 289 individuals within all 50 states, four territories, and the District of Columbia, as well as their industry counterparts. All of these individuals play an important role in the reliable flow of energy for the jurisdictions they serve.

The U.S. Department of Energy (DOE), through its SLTT Energy Assurance Program, supports these SLTT stakeholders by providing Federal resources and expertise to foster an environment conducive to preparing for and responding to energy disruptions.

Situational awareness and information sharing are a cornerstone of these efforts. In 2017, DOE opened one of its most effective tools, the Environment for Analysis of Geo-Located Energy Information (EAGLE-I) System, to state energy emergency assurance coordinators and state emergency operations centers (EOCs) to assist in situational awareness and restoration of the electricity sector.

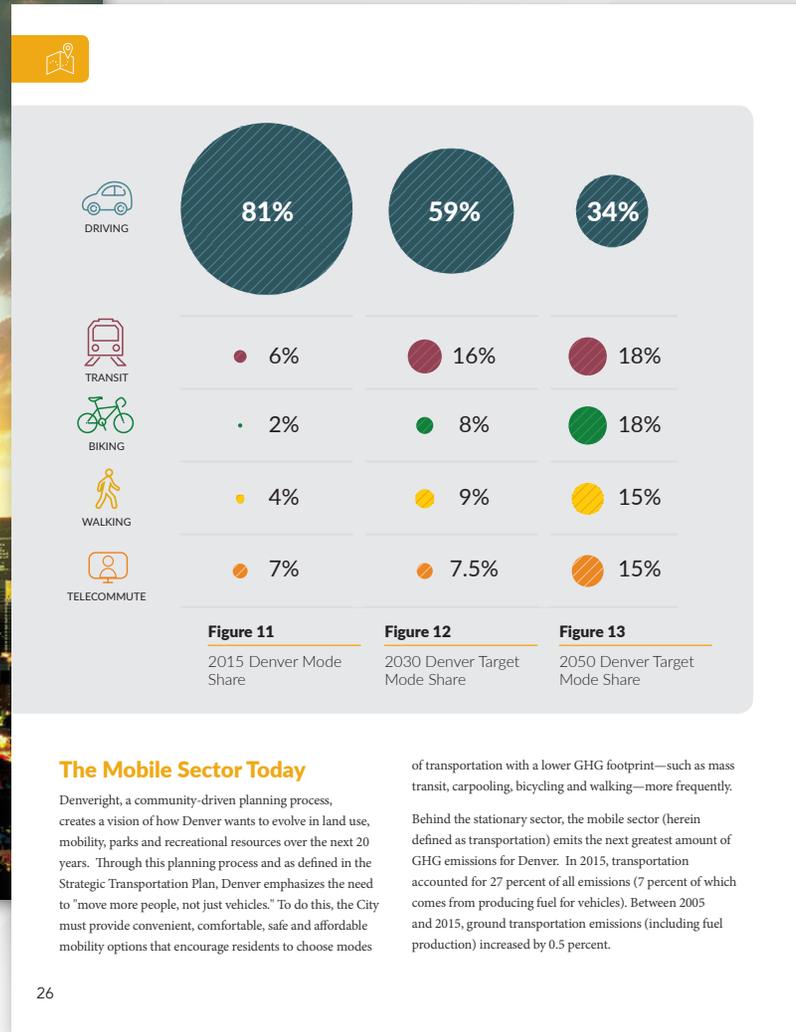
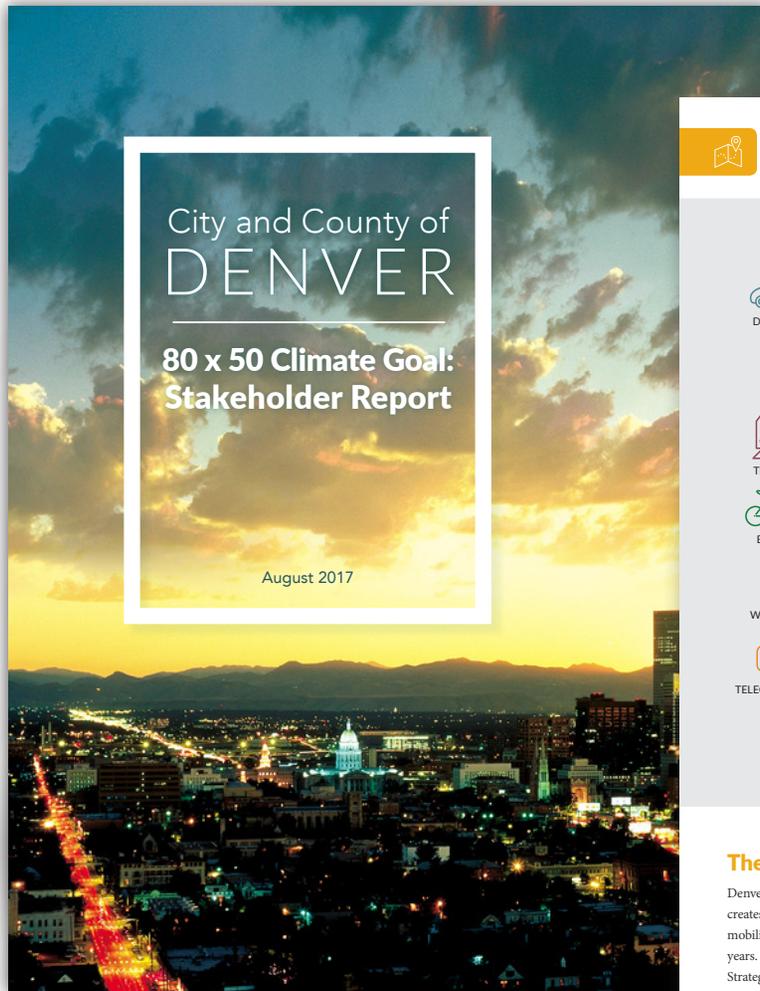


Crews from DOE's Western Area Power Administration work to restore St. Thomas's electrical backbone.

Despite the community's successes, challenges arise constantly with their own nuances and intricacies. In 2017, SLTT governments experienced this in the form of historic hurricanes, wildfires, and wind storms. These incidents not only directly affect the areas they impact, but also create shockwaves throughout the rest of the country's energy supply and resources. Events like this are reminders that continuous planning, preparedness, and cultivation of in-house expertise must remain consistent priorities for all who work to ensure adequate supplies of electricity and fuel are available to the communities they serve.

The *SLTT Energy Assurance 2017 Year in Review* highlights the actions taken by DOE, in partnership with several national associations, industry, and other SLTT stakeholders, that promote energy security at all levels of government and build the resilience of the Nation's energy sector.

SLTT Energy Assurance | 2017 Year in Review 1



The Mobile Sector Today

Denverright, a community-driven planning process, creates a vision of how Denver wants to evolve in land use, mobility, parks and recreational resources over the next 20 years. Through this planning process and as defined in the Strategic Transportation Plan, Denver emphasizes the need to “move more people, not just vehicles.” To do this, the City must provide convenient, comfortable, safe and affordable mobility options that encourage residents to choose modes

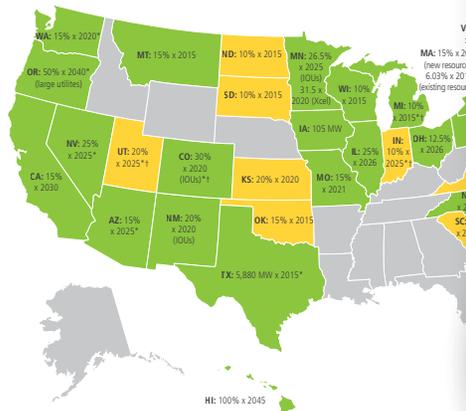
of transportation with a lower GHG footprint—such as mass transit, carpooling, bicycling and walking—more frequently. Behind the stationary sector, the mobile sector (herein defined as transportation) emits the next greatest amount of GHG emissions for Denver. In 2015, transportation accounted for 27 percent of all emissions (7 percent of which comes from producing fuel for vehicles). Between 2005 and 2015, ground transportation emissions (including fuel production) increased by 0.5 percent.

Chapter III: Building a Clean Electricity Future

In December 2015, the ITC and PTC were both extended by 5 years through 2021 and 2019, respectively, with each tax credit on a different declining schedule. Solar system owners have primarily claimed the PTC, which has higher capacity factors and lower capital costs, has benefitted from the PTC extension (Figure 3-4). A recent National Renewable Energy Laboratory (NREL) study estimates that the extension of the ITC and PTC could result in an additional 53 GW of renewable electricity capacity as compared to a case with no tax credit extensions, corresponding to 540 million metric tons of CO₂ avoided cumulatively by 2030, again compared to the no extension case.⁴⁶

State RPS policies are also key drivers of renewable energy growth. Twenty-nine states have renewable portfolio standards that require utilities or other electricity providers to meet a minimum percentage of their electricity supply with qualifying forms of renewable energy (Figure 3-5).⁴⁷ Of the 230 terawatt-hours (TWh) of total renewable electricity generation growth since 2000, over half (or 130 TWh) was to meet RPS requirements.

Figure 3-5. State RPS Policies, August 2016⁴⁸



- Renewable Portfolio Standard
- Renewable Portfolio Goal
- ★ Extra Credit for Solar or Customer-Sited Renewables
- † Includes Non-Renewable Alternative Resources

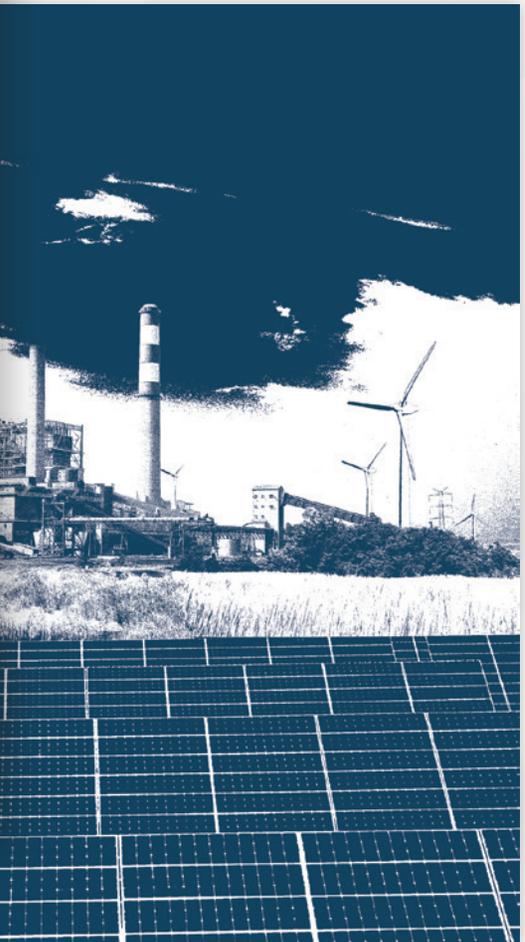
Twenty-nine states and the District of Columbia have an RPS, and an additional eight states have a renewable portfolio goal for solar or customer-sited renewables or include nonrenewable alternative resources. The RPS or renewable portfolio goal is the minimum percentage of electricity supply that must be met with renewable energy growth.

Acronym: IOU – investor-owned utility

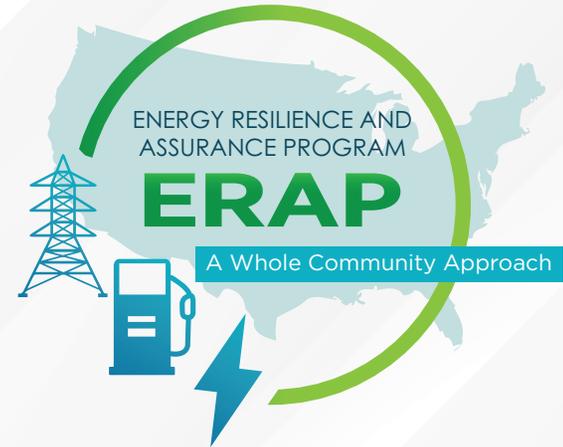
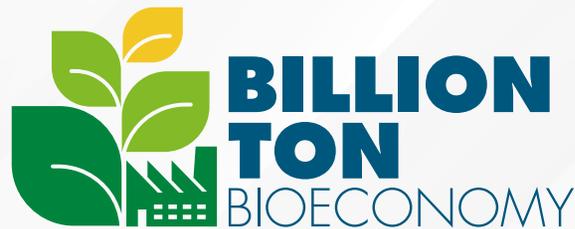
3-12 Transforming the Nation's Electricity System: The Second Installment of the QER | January 2017

QUADRENNIAL ENERGY REVIEW
TRANSFORMING THE NATION'S
ELECTRICITY SYSTEM: THE SECOND
INSTALLMENT OF THE QER

January 2017



LOGO DESIGN & BRANDING



DATA VISUALIZATION

HYDROGEN

A Clean, Flexible Energy Carrier

NATURAL GAS

SOLAR

WIND

1. SOURCES OF ENERGY

Hydrogen can be produced using diverse, domestic resources.

BIOMASS

NUCLEAR

FOSSIL FUELS

ELECTRICITY

2. PRODUCTION PATHWAYS

ELECTROLYSIS

BIOLOGICAL

DIRECT SOLAR WATER SPLITTING

STEAM METHANE REFORMING

Hydrogen can be produced using a number of different processes.

3. ENERGY CARRIER

10

metric tons of hydrogen are produced per year.

HYDROGEN

Hydrogen is the simplest and most abundant element known. It is an energy carrier, not an energy source and can deliver or store energy. It has a very high energy content and can be used in fuel cells to generate electricity or power and heat.

4. USES FOR H₂

FUEL CELL VEHICLES

ENERGY STORAGE

STATIONARY FUEL CELLS

PETROLEUM REFINING

Petroleum refining and fertilizer production are the largest uses of hydrogen today, while transportation and utilities are emerging markets. Hydrogen and fuel cells can provide energy for use in diverse applications, including distributed or combined-heat-and-power; backup power; systems for storing and enabling renewable energy; portable power; auxiliary power for trucks, aircraft, rail, and ships; specialty vehicles such as forklifts; and passenger and freight vehicles, including cars, trucks and buses.

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy
FUEL CELL TECHNOLOGIES OFFICE

One-year Anniversary of the First Installment of the QUADRENNIAL ENERGY REVIEW

On April 21, 2015, the first installment of the Quadrennial Energy Review (QER) proposed **63 policy recommendations** to inform the most pressing issues facing energy transportation, storage, and distribution.

46%

OF THE QER RECOMMENDATIONS MANAGED BY EXECUTIVE AGENCIES ARE COMPLETE OR BEING IMPLEMENTED ON SCHEDULE.

14

OF THE QER'S RECOMMENDATIONS HAVE HELPED INFORM FEDERAL LAWS, including the Fixing America's Surface Transportation (FAST) Act & the Bipartisan Budget Act (BBA) of 2015.

One of the greatest legislative accomplishments: authorization to raise

\$2 BILLION

IN FUNDING TO MODERNIZE THE STRATEGIC PETROLEUM RESERVE

Public Support for the QER

More than **60** publications mentioned the QER

The QER process engaged a broad range of stakeholders across the Nation. These engagements included **13 formal public stakeholder meetings** and numerous technical workshops.

16

state and national energy organizations provided public statements of support for the QER.

The QER received widespread international attention. Over **30 countries** as well as the European Union were briefed on its findings.

In the past 20 years, **37** federal agencies used the U.S. Department of Energy's Indefinite Delivery Indefinite Quantity (IDIQ) contract to award **369** energy savings performance contract (ESPC) task orders valued at over **\$4.9 billion**. These projects were implemented in **all 50 states** and at multiple foreign sites resulting in these U.S. taxpayer benefits:



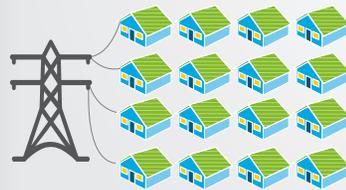
Total guaranteed energy and water cost savings of
\$11.8 Billion



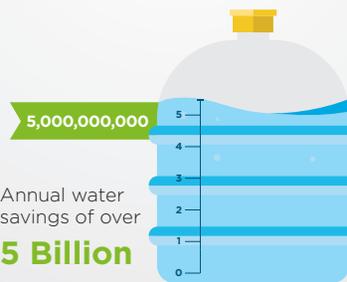
1997 -2017
ESPC IDIQ Contract



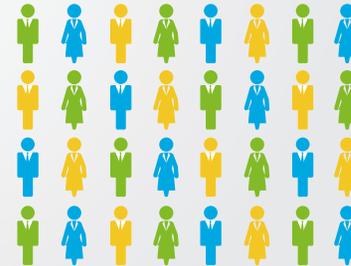
Support of U.S. based manufacturing across
35 States



Annual energy savings of over
27 Trillion Btu—
the equivalent energy usage of
300,000
average U.S. households



Annual water savings of over
5 Billion Gallons
per year



Creation of
40,000
job-years

WHAT ARE THE BENEFITS OF AN APPALACHIAN PETROCHEMICAL RENAISSANCE?

Rebuilding the petrochemical industry in the Appalachian area could lead to:

- 

\$36 BILLION
IN CAPITAL INVESTMENT
- 

101,000
NEW, STEADY JOBS
- 

\$2.9 BILLION
ON TAX REVENUES ANNUALLY
- 

\$28 BILLION
IN ECONOMIC EXPANSION

(American Chemistry Council)

Petrochemical production in Appalachia would provide diversity and reliability to the U.S. petrochemical manufacturing base and add to U.S. energy security.



THE APPALACHIAN PETROCHEMICAL RENAISSANCE



U.S. DEPARTMENT OF ENERGY | Fossil Energy

WHAT ARE PETROCHEMICALS?

Petrochemicals are chemicals obtained either directly from cracking (pyrolysis), or indirectly from the chemical processing of oil or natural gas. Major petrochemicals include acetylene, benzene, ethane, methane, propane, and hydrogen, from which hundreds of other chemicals are derived.



WHY ARE PETROCHEMICALS IMPORTANT?

American manufacturing relies on a steady source of petrochemicals to produce products such as plastics, paints, solvents, and automotive parts. The U.S. chemical industry is a \$528 billion enterprise (American Chemistry Council, 2019). It:

- SUPPORTS
25%
OF U.S. GDP
- PROVIDES
12%
OF THE WORLD'S
CHEMICALS
- SUPPORTS
529
THOUSAND
AMERICAN JOBS

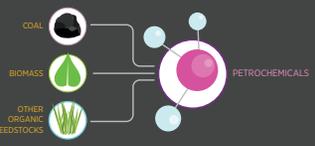
WHERE ARE THEY PRODUCED?

Most U.S. petrochemical production occurs in the Gulf Coast region, because that is near a majority of U.S. oil and natural gas production. U.S. petrochemicals are consumed all over the United States, as well as around the world, so depending on the type and form of petrochemical, they are transported by rail, barge, truck, or pipeline out of the Gulf Coast region to manufacturers of finished goods. For example 70% of polyethylene and 77% of polypropylene, petrochemical derivatives, are transported to the Midwest and East Coast.



WHERE DO PETRO-CHEMICALS COME FROM?

In the U.S., petrochemicals are derived primarily from oil and natural gas. Although, they can also be derived from coal, biomass, and other organic feedstocks. Natural gas liquids (NGLs), such as ethane and propane, are key feedstocks for the petrochemical industry in the United States. The shale gas revolution has produced abundant, affordable natural gas and NGLs. This abundance and affordability is leading to an American petrochemical and manufacturing renaissance.



WHAT DO PETROCHEMICALS MAKE FOR US?

Petrochemicals are the feedstock for many items that we use each and every day. They are used to manufacture phones, clothing, bedding, food casing, credit cards, bags, soaps and detergents, antifreeze, IV and blood bags, adhesives, appliances, batteries, insulation, paint, furniture, rubber, fibers, plasticizers, and as feedstock for the production of thousands of other products.



WHAT IS THE APPALACHIAN PETROCHEMICAL RENAISSANCE?

With the addition of the Marcellus and Utica shale plays, Appalachia now produces more than 32% of U.S. natural gas, and 600,000 bbls per day of NGLs. This creates an opportunity for a renaissance of the Appalachian petrochemical industry. Critical to this renaissance is NGL transport and storage, as well as petrochemical infrastructure.



32% OF U.S. NATURAL GAS | 600,000 BBLS PER DAY OF NGLS

..... BioenergizeME

Infographic Challenge

Understanding America's Bioenergy Choices



Take hold of your energy future:

Bioenergy is derived from organic matter to produce renewable fuels, products, and power. This national challenge aims to inspire students to explore America's bioenergy choices and share what they learn with others.

The Energy Department challenges you to investigate a bioenergy topic and design an infographic that illustrates your research.

Register by February 3, 2017, at 5:00 p.m. central time.

Follow us on **#BioenergizeME**.

HOW TO WIN

- Assemble a BioenergizeME team
- Research a BioenergizeME topic
- Design a creative and innovative BioenergizeME infographic
- Submit to OPERATION BioenergizeME.
- Share your infographic with your social media networks.

AWARDS

The Energy Department will reward winning participants by

- Promoting the infographics on a government website
- Recognizing the first-place infographic at a special event
- Recognizing all finalists with official letters and certificates.

For more information, please visit energy.gov/eere/bioenergy/infographic-challenge

Questions? Email BioenergizeME@ee.doe.gov

U.S. DEPARTMENT OF **ENERGY** | Energy Efficiency & Renewable Energy
BIOENERGY TECHNOLOGIES OFFICE

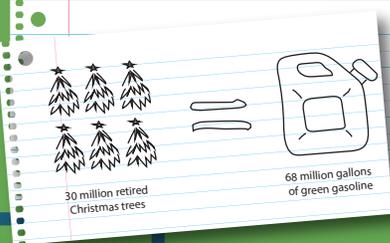
5 STEPS FOR BUILDING AN INFOGRAPHIC

- ### 1 RESEARCH

Research your topic fully. Pull together a list of thought-provoking facts that you think are important. Make sure to use credible sources, such as those found in the Library of Congress Resource Library.


- ### 2 SKETCH

Ultimately, you are going to share facts and data that tell a story. Outline the story, and draw a sketch for each key point.


- ### 3 DESIGN

Now it's time to bring everything together in one cohesive design. Create the layout, and choose a color scheme. Bring your sketches to life with hand-drawn or digital illustrations and icons. Be sure to use a consistent design style throughout the infographic.
- ### 4 TEST

Share your infographic with others and ask them for feedback.
- ### 5 FINALIZE

Consider the feedback that you receive, and implement constructive changes as you see fit to produce a final version of your infographic.



STRATEGIC PETROLEUM RESERVE

Providing energy security for America

BACKGROUND

The Strategic Petroleum Reserve (SPR) is the world's largest supply of emergency crude oil. Administered by the U.S. Department of Energy, these federally-owned oil stocks are stored in massive underground salt caverns along the Texas and Louisiana coastlines of the Gulf of Mexico.

Centrally located along the Gulf Coast, the SPR's oil can be distributed to nearly half of all U.S. oil refineries using interstate pipelines or barges.

HISTORY

In 1973, the Organization of Arab Petroleum Exporting Countries (OAPEC) imposed an oil embargo against the United States, triggering an energy crisis that sent the U.S. economy into a recession. To mitigate damage from any future shortages of oil, President Gerald Ford signed the Energy Policy and Conservation Act of 1975, which established the SPR.

BENEFITS

The SPR is a tool used to alleviate the market impacts of both domestic and international disruptions, caused by weather, natural disasters, labor strikes, technical failures/accidents, political disputes, or conflicts.

U.S. leaders also have the option of filling the SPR during times of demand destruction (in order to minimize the shut in of U.S. oil production) through the use of exchanges or an appropriation from Congress to purchase oil directly.

The SPR fulfills the Nation's obligations under the International Energy Program, which requires member nations to hold the equivalent of 90 days of net imports of oil and petroleum products as a reserve stock.

Offers the Nation an insurance policy against potential supply interruptions

Provides a deterrent to hostile threats to cut off oil supplies

Protects the U.S. economy

USE

With a storage capacity of up to 713.5 million barrels, the SPR currently holds 635 million barrels of crude oil. That amount of crude oil, refined into motor gasoline, could fill over 1.3 billion large sedans.

= 20 million sedans

The SPR comprises 60 salt caverns. Each cavern is roughly cylindrical in shape with an average diameter of about 200 feet and a height of 2,550 feet, which is large enough for Chicago's Willis Tower to fit inside with room to spare.

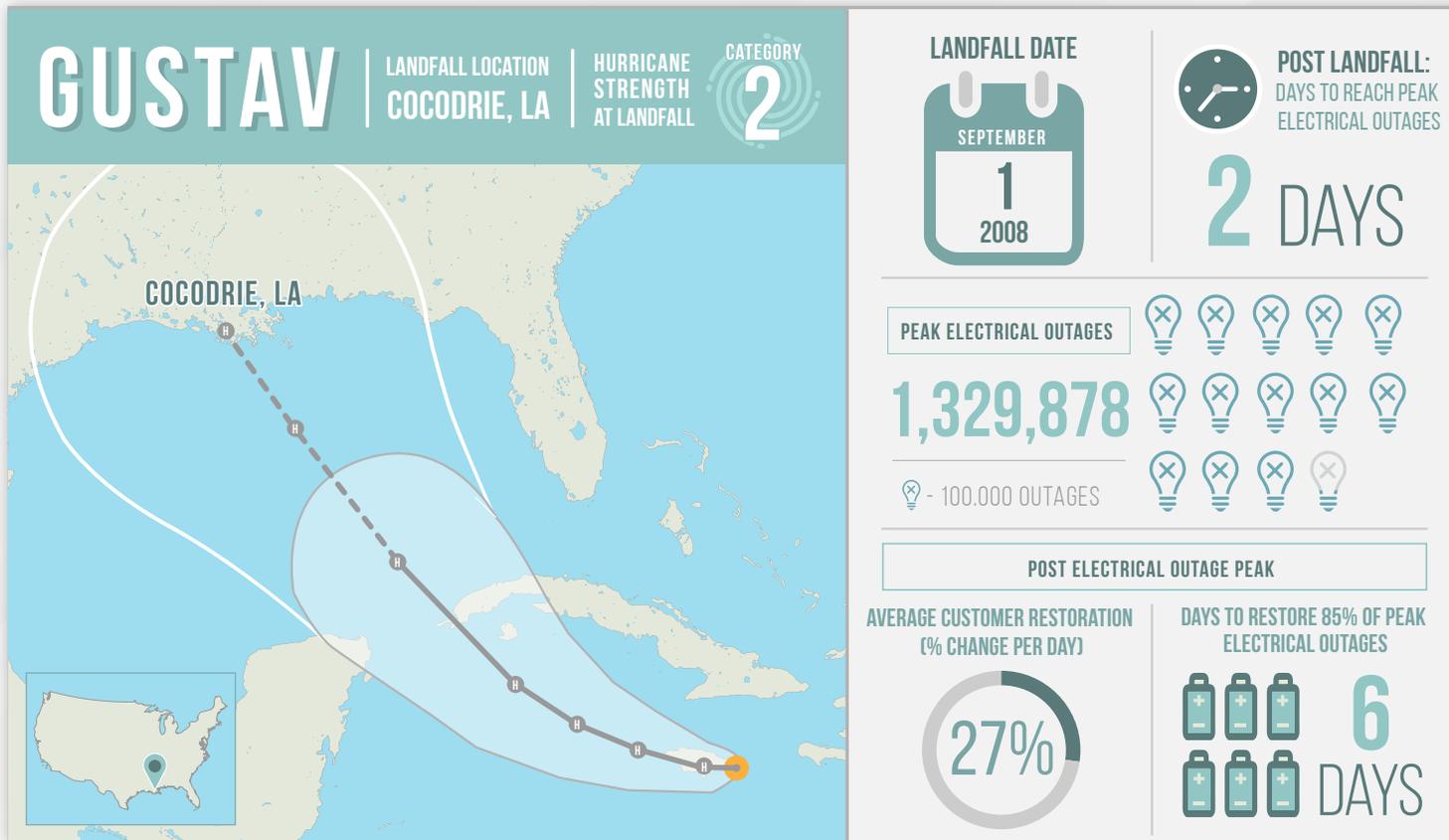
Decisions to withdraw crude oil in the event of an energy emergency are made by the President under the authority of the Energy Policy and Conservation Act. Generally, this is done through a competitive sale. The SPR is always drawdown ready, which means it stands ready to release crude oil to the market within 13 days of Presidential direction; this is the time it takes to conduct the sales process, award contracts, and to arrange the logistics for oil transportation.

In addition to the President's authority, the Secretary of Energy may also authorize limited releases in the form of a test sale of up to 5 million barrels. The Secretary may also conduct exchanges, or a crude oil loan, with non-governmental entities. This type of exchange agreement can be completed within a few days of an entity's request. In another type of exchange, an exchange for storage, the SPR receives crude oil through the Request for Proposals process and returns it at a later date. In any exchange, winning bidders "pay" a small premium of oil to cover the SPR's cost.

For more information on the SPR and the Office of Fossil Energy, visit fossil.energy.gov.

Last updated: April 2020

Fossil Energy



6 Things COAL

You May **NOT** Know About

1  **The U.S. has MORE COAL** than any other country

We have an estimated **477 billion** short tons of coal in the United States. Our coal resources are larger than our remaining oil and natural gas resources.

FIVE STATES produce over 70% of the nation's coal

2 

Wyoming, West Virginia, Kentucky, Illinois and Pennsylvania together produced **639 million** of the nation's **897 million** short tons of coal in 2015. Wyoming alone produced over 40% of our coal. West Virginia was second at about 11%.

3  **30.4%** of our **electricity is coal-generated**

Fossil fuels make up about **65%** of electricity generation. **Coal** is the second most used energy source to generate electricity after natural gas, which consists of **33.8%** of U.S. electricity generation. With new technologies, CO₂ from coal-fired power plants can be used in enhanced oil recovery and to help make valuable products like plastics and chemicals.

BENEFICIAL BYPRODUCTS of

coal-use include **rare earth elements** and **hydrogen**

4 

These byproducts have valuable uses. **Rare earth elements** are used to make **high-technology products**, including smart phones, lasers, DVDs, and LEDs. The **hydrogen** and other coal gases can be used in automobiles, power-generating fuel cells, fuel power-generating turbines, or as chemical "building blocks" for a **wide range of commercial products**. Additionally, coal is vital for making products like steel.

5  **There are a variety of ways to cleanly CONVERT COAL** into electricity

The Department of Energy has a long history of **developing technologies** that make coal use **cleaner**. These processes include coal gasification, advanced coal-energy conversion technologies, and advanced emissions control systems.

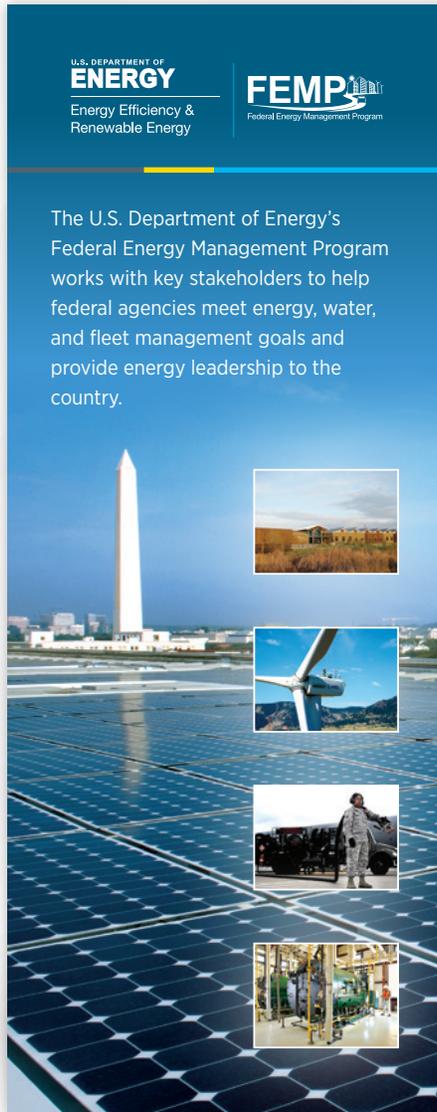
CLEAN COAL stimulates the economy and strengthens energy security

6 

Using coal cleanly **reduces** our **dependence** on other countries for natural resources, which **boosts** our **national energy security**. Additionally, clean coal can **create new jobs** and **grow economy**, particularly in high coal producing states.

Click [here](#) for more information on the Office of Fossil Energy's clean coal research. **U.S. DEPARTMENT OF ENERGY** Fossil Energy

POSTER & BANNER DESIGN



Banner design
U.S. Department of Energy, Federal Energy Management Program



Exhibit design
U.S. Department of Energy, Federal Energy Management Program

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Bioenergy Laboratory



SUCCESS

Sun Grant Initiative organizations, including Idaho National Laboratory and other national laboratories, universities, and industry, formed the Regional Feedstock Partnership to verify information about non-food crops that can be used to produce biofuels. Their 7 years of in-depth work provided a foundation for the *2016 Billion-Ton Report*, developing a sustainable biomass supply in the United States.



energy.gov/eere/bioenergy

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SUCCESS

Scientists from Argonne National Laboratory showed a type of biodiesel fuel produced from algae that can have 63%–68% lower greenhouse gas emissions than conventional diesel from petroleum. This and other life-cycle analyses are helping scientists to measure the environmental benefits of biofuels.



energy.gov/eere/bioenergy

U.S. DEPARTMENT OF ENERGY
Office of ENERGY EFFICIENCY & RENEWABLE ENERGY

BIO
Bioproducts are already part of our **EVERYDAY LIFE**

MADE WITH BIOMASS

The power of detergents and cleaners lies in their ability to remove unwanted substances from a soiled surface. They owe this unique characteristic to two classes of chemicals—surfactants and solvents—both of which can be produced from biomass. DOE is investing in technologies that will reduce costs and optimize the performance of these bioproducts.

Bioproducts are everyday products, materials, and chemicals derived from renewable biological resources. When bioproducts are produced alongside biofuels, profits from the sale of bioproducts can help offset the costs of biofuels production. This, in turn, contributes to more affordable and reliable energy choices for American families.

Learn more at energy.gov/eere/bioenergy

U.S. DEPARTMENT OF ENERGY
Office of ENERGY EFFICIENCY & RENEWABLE ENERGY

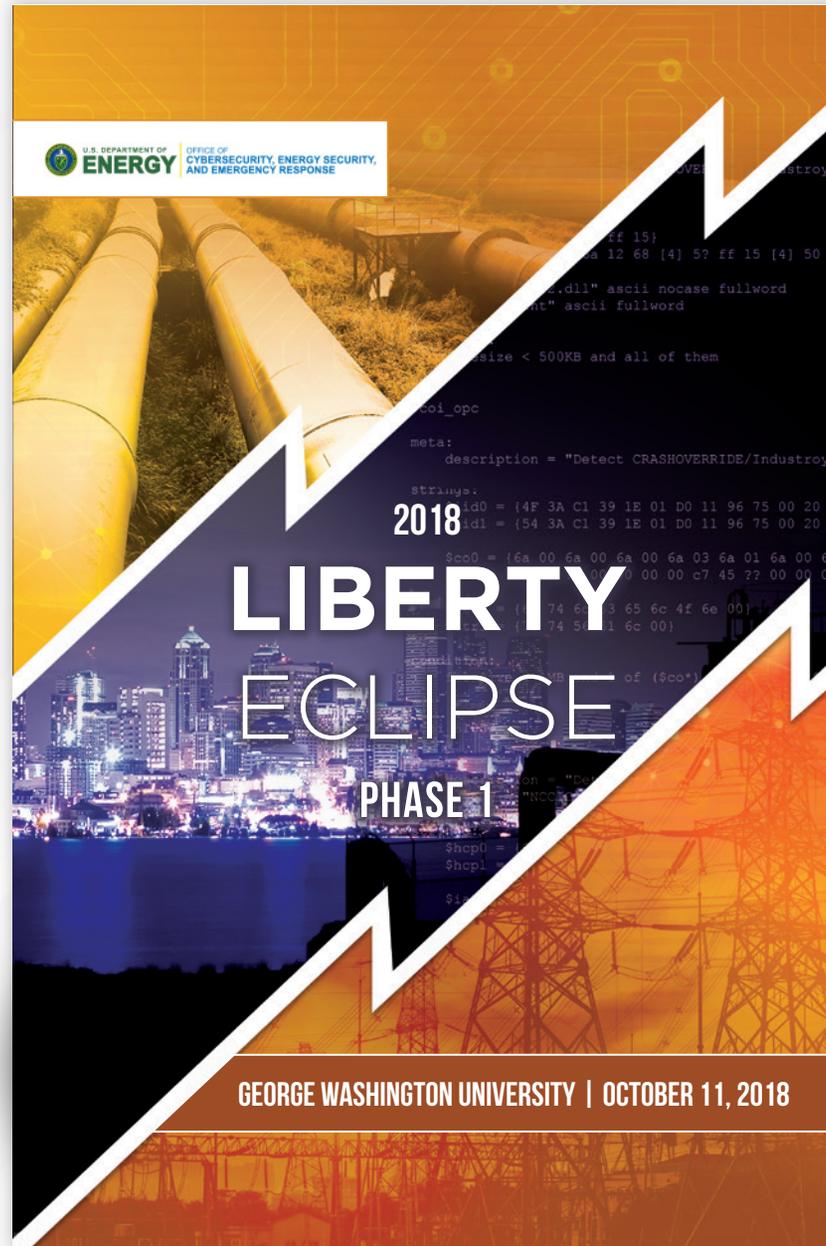
BIO
Bioproducts are already part of our **EVERYDAY LIFE**

MADE WITH BIOMASS

Biomass can be used to produce a range of personal care products, such as skin cream, shampoo, mascara, and more. For example, the palmitic acid that gives your hair that glossy shine after you condition it is one of the most common plant acids used to make these products. DOE is investing in technologies that will reduce costs and optimize the performance of these bioproducts.

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Poster design
U.S. Department of Energy, Office of Cybersecurity, Energy Security, and Emergency Response

CORE COMPETENCIES

Since 1989, BCS has been providing communications and marketing, program management and business support, systems engineering and technical support, and strategic analysis and organization performance services to clients in both the public and private sectors. BCS' award-winning creative team supports projects across the company for clients that include the U.S. Department of Energy, national laboratories, state agencies, and more. Through effective design, use of state-of-the-art tools and technologies, and clear visual communications, our designers translate highly technical information into products that are visually engaging, accessible, and informative for a diverse set of audiences. BCS' core design competencies include the following:

- **Print Design & Publications:** BCS designs and develops a wide variety of print materials, including reports, fact sheets, case studies, newsletters, brochures, posters, and more. Our creative team creates striking and professional looking designs that make products stand out and appeal to readers. We ensure fast turnaround, world-class service and stunning results.
- **Logo Design & Branding:** BCS understands the vital role visual identity plays in the way an organization presents itself to both internal and external audiences. We offer extensive experience in designing effective visual brand identities for businesses, organizations, programs, and events—from single logos, to corporate stationery, to brand identity packages.
- **Data Visualization & Infographics:** BCS excels at turning static data into striking interactive reports, interactive charts, maps, technical illustrations, interactive games, and training modules by utilizing cutting-edge technologies, including Adobe Flash, HTML5, XML, Javascript, Google Maps, Tableau, and Highcharts.
- **Web Design & Development:** BCS develops effective, modern, and responsive user interfaces for websites and applications with open-source content management systems (Drupal, WordPress) and SharePoint. Whether developing websites, intranets, or open-access portals, we apply effective solutions and always keep the end user and user experience in mind.
- **Short Films & Video Animations:** BCS considers online videos as one of today's most effective marketing tools. Videos are a great way to engage audiences, explain complex ideas or concepts, and tell compelling stories in a short span of time. We design media for different purposes. Depending on the content and the target audience, we develop and produce adequate and engaging formats.

TECHNOLOGIES AND SOFTWARE

Adobe Creative Suite (InDesign, Illustrator, Photoshop, Acrobat, After Effects)

Microsoft Office (Word, PowerPoint, Excel)

HTML5, Javascript, CSS3

Google Maps, Tableau, Highcharts

Drupal, SharePoint, WordPress

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