



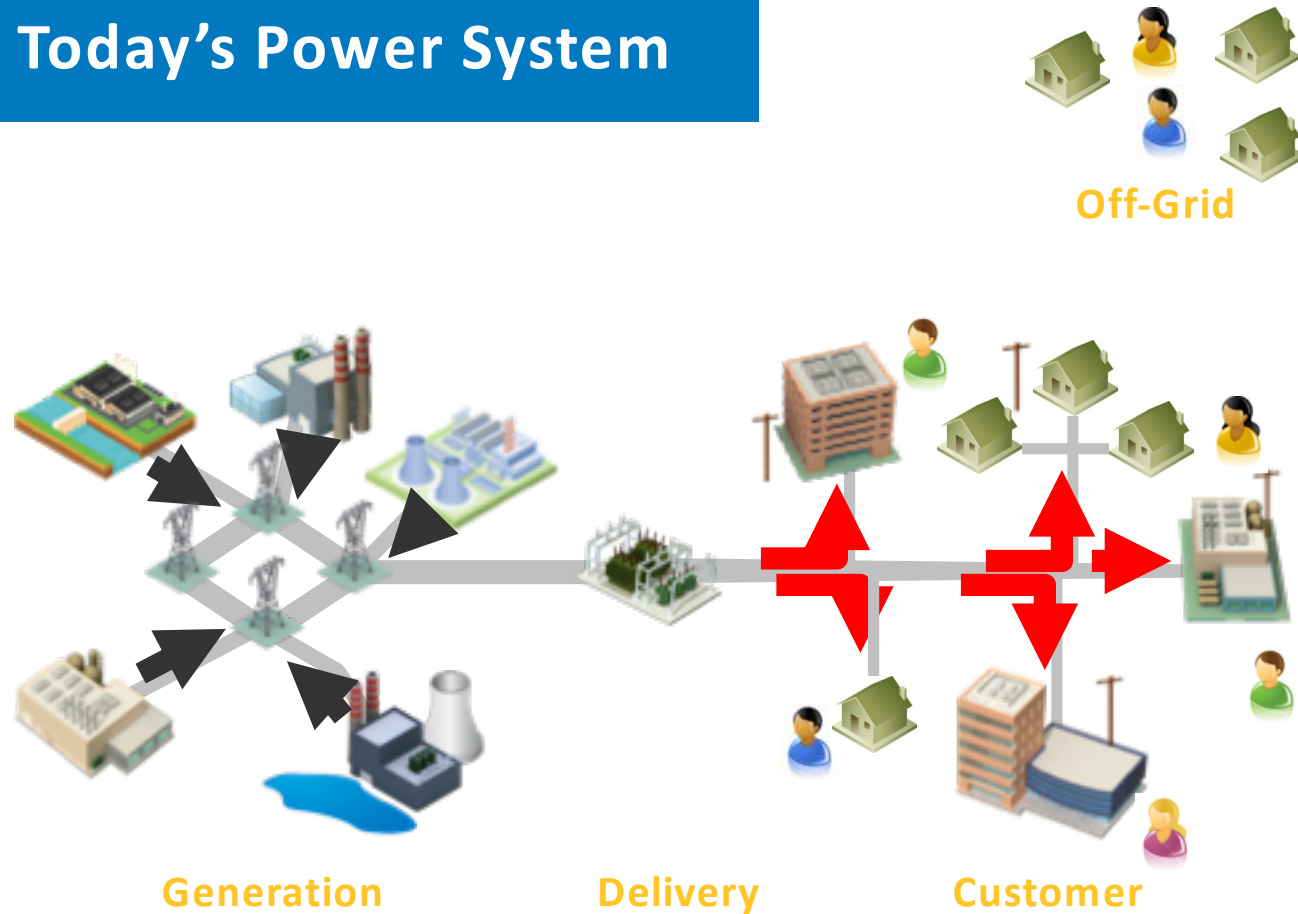
National Renewable Energy Laboratory Partnering with Tribes

Sherry Stout
Fort Berthold Technology and Innovation
Summit
June 2018

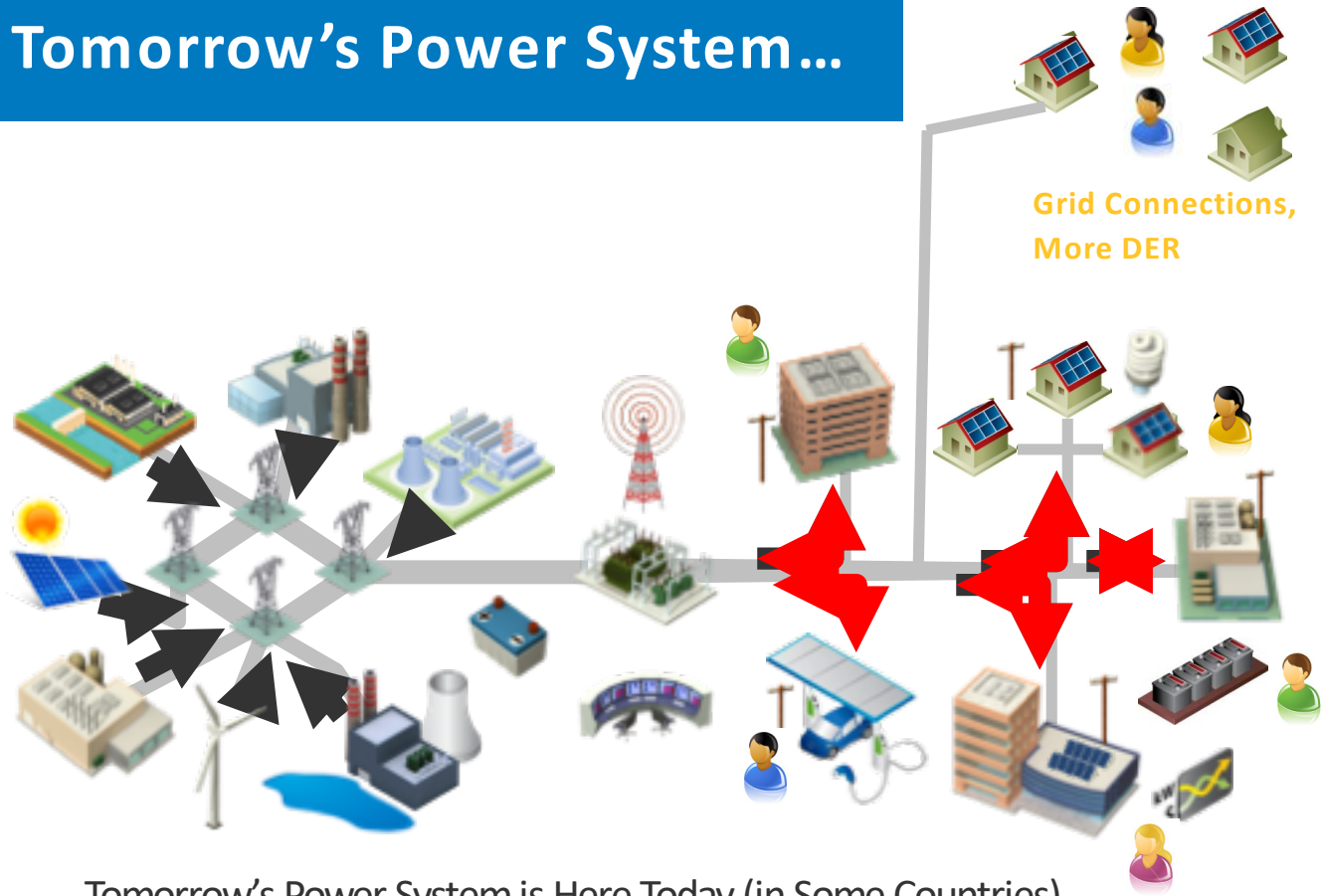
An energy **revolution** is
sweeping the nation




Today's Power System



Tomorrow's Power System...

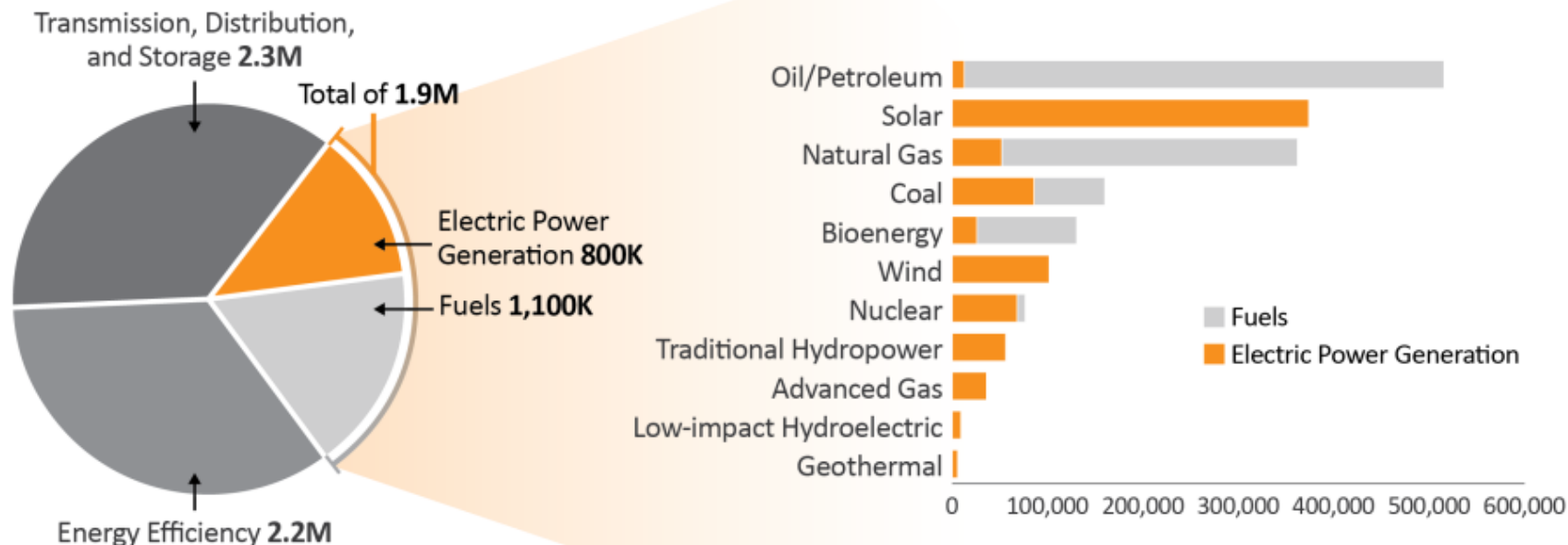




Creating American jobs
in advanced energy

Solar Employs 43% of the Electric Power Workforce

6.4 million Americans employed in energy sectors





NREL innovation drives
our nation's **economy**

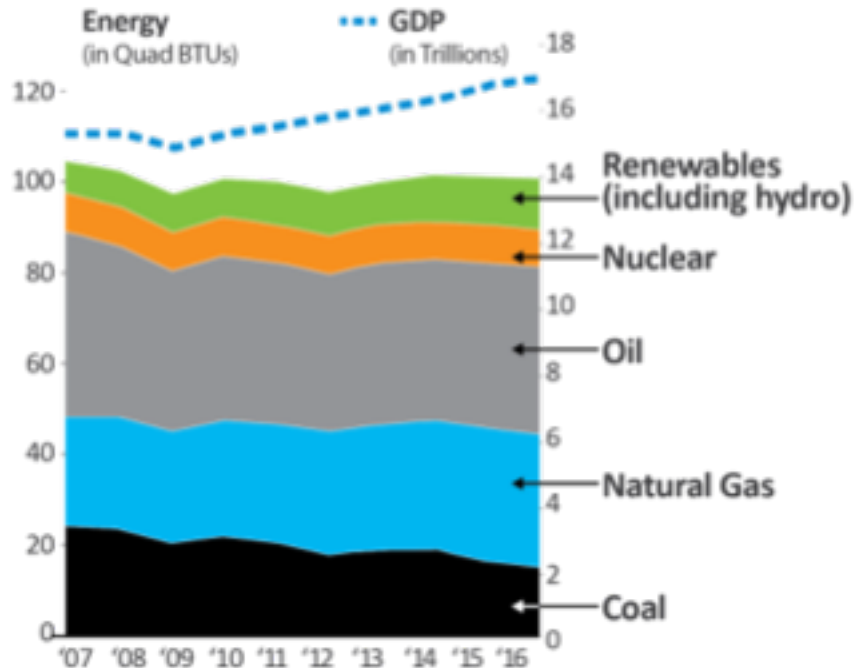


Creating a safer America
through energy security

The nation's **energy supply** is in the
midst of a remarkable **transformation**

The U.S. Economy is Growing While Energy Use is Shrinking

U.S. Primary Energy Consumption vs. GDP



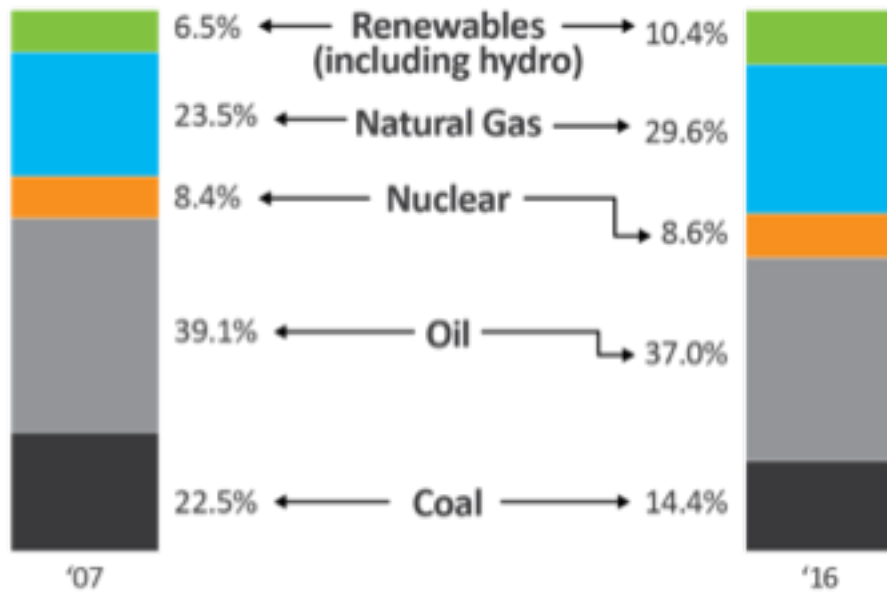
Gross domestic product (GDP) grew 12% since 2007, while total energy use fell 3.6%

So, the **energy productivity** of the U.S. economy—the ratio of U.S. GDP to energy consumed—**grew 16%**

Source: 2017 Sustainable Energy in America Factbook, Bloomberg New Energy Finance and the Business Council for Sustainable Energy, February 2017

U.S. Energy Supply is Shifting

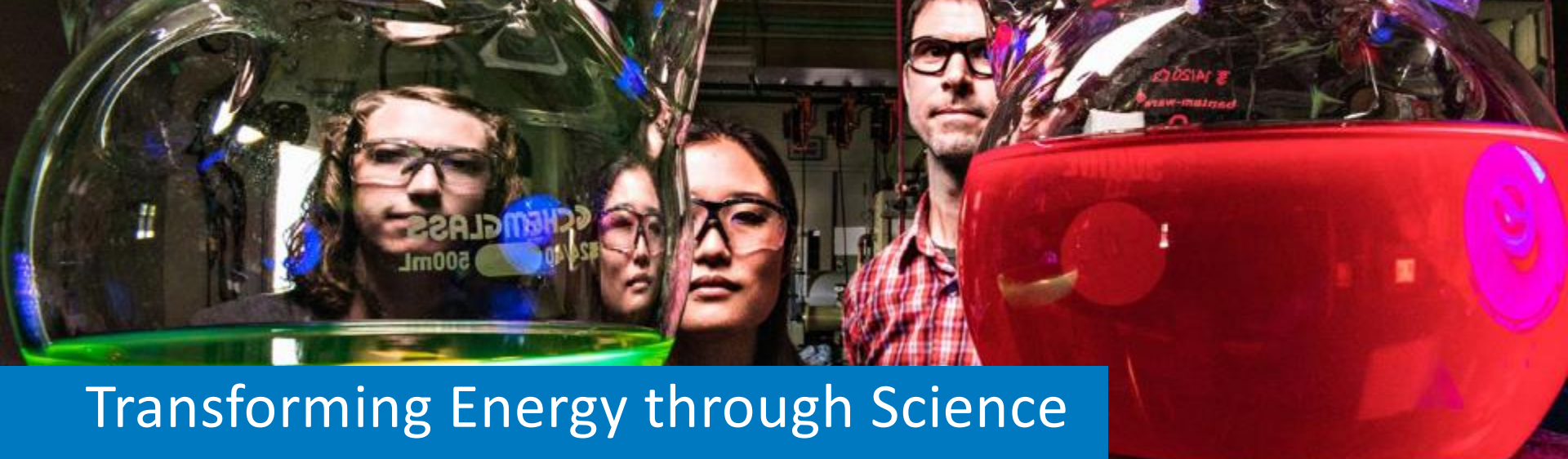
U.S. Primary Energy Supply by Fuel Type



In 2016, the use of natural gas and **renewable energy increased** in the United States:

- Natural gas provided **29.6% of total energy supply**
- Renewable energy provided **10.4% of total energy supply**

NREL's energy research
is making an **impact**



Transforming Energy through Science

NREL advances the science and engineering of **energy efficiency**, **sustainable transportation**, and **renewable power technologies** and provides the knowledge to **integrate and optimize energy systems**

NREL at a Glance

1,700

Employees,
plus more than

400

early-career researchers
and visiting scientists



World-class
facilities, renowned
technology experts

nearly
750

Partnerships
with industry,
academia, and
government



Campus
operates as a
living laboratory

\$872M
annually

**National
economic
impact**

NREL Core Capabilities: Foundation for Innovation



System Integration

Systems Engineering
and Integration

Large-Scale User
Facilities



Innovation and Application

Biological and Bioprocess Engineering

Chemical Engineering

Mechanical Design and Engineering

Power Systems and Electrical Engineering

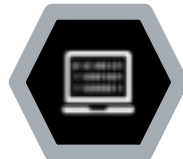


Foundational Knowledge

Applied Materials Science
and Engineering

Biological Systems Science

Chemical and
Molecular Science



Advanced Computer Science,
Visualization, and Data

Decision Science and
Analysis

Crosscutting

NREL's Science Drives Innovation



Renewable Power

Solar
Wind
Water
Geothermal



Sustainable Transportation

Bioenergy
Vehicle Technologies
Hydrogen



Energy Efficiency

Buildings
Advanced Manufacturing
Government Energy
Management



Energy Systems Integration

High-Performance Computing
Transmission Planning
Data and
Visualizations

Partnering with the Lab for Tribal Planning

Path to Cost-Effective, Energy-Saving Solutions



Key Research Areas

- **Federal Energy Management** – tools and expertise to help federal agencies achieve energy efficiency and water goals
- **Weatherization and Intergovernmental** – grant funding and technical assistance for state and local governments to manage weatherization and energy programs
- **EE and RE by State** – resource maps, energy information, and housing upgrades
- **Tribal Energy** – technical assistance to tribes to identify actionable opportunities for energy development
- **Clean Cities** – promoting the use of domestic fuels in transportation through technologies, resources, and strategies that improve vehicle efficiency
- **Resilience Preparedness and Planning** – technologies, tools, and long-term energy solutions for safe, resilient communities

Fort Berthold Transit Plan



Access to Vital
Services



Reconnecting
Communities



Road
Safety



Reduce Emissions
and Dust

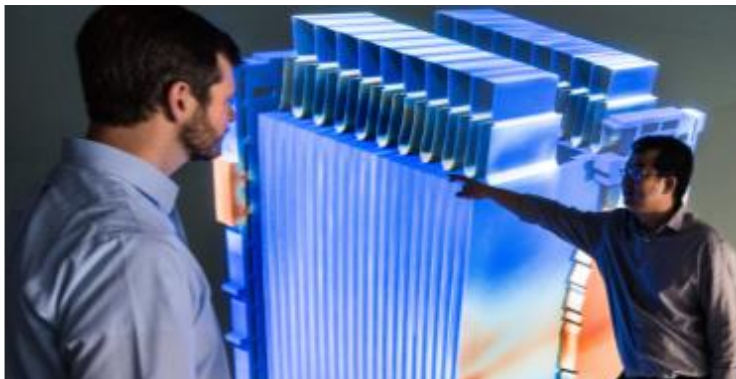


Tribal Self-
Determination



Transportation
Equity

Path to Sustainable Transportation Technologies



Key Research Areas

- **Co-optimizing fuels and engines** – R&D to maximize performance, efficiency, and compatibility with existing infrastructure
- **Increasing sustainable mobility** – connected and autonomous transportation innovations for intelligent, efficient, integrated network
- **Reducing expense of battery development** – Computer-Aided Engineering for Electric-Drive Vehicle Batteries (CAEBAT) tool
- **Improving efficiency of heavy-duty vehicles** – commercial truck fuel, engine, thermal management, and powertrain innovation
- **Demonstrating electrification of vehicles** – energy storage for plug-in electric and fuel cell electric vehicles; power electronics; and infrastructure R&D to boost performance and market viability

Web-Based Information and Tools

Clean Cities

Home About Coalitions Partnerships & Projects Technical Assistance News & Events Coordinator Toolbox



Building Partnerships to Reduce Our Reliance on Petroleum in Transportation

Find my local coalition
enter ZIP code or city, state

View coalition locations



National Network

Connect with our national network of local coalitions and stakeholders working to advance alternative fuels and advanced vehicles.

Partnerships

Learn how our partnerships provide funding opportunities and increase the availability of alternative fuels and advanced vehicles.

What's Happening?

EVENT | March 1, 2016
The Work Truck Show / Green Truck Summit

WEBINAR | Higher Education
Higher Ed Partnership Webinar

Add to calendar

Alternative Fuels Data Center

ENERGY Efficiency & Renewable Energy

Search by AFVC

FUELS & VEHICLES CONSUMPTION LOCATE STATIONS LAWS & INCENTIVES Maps & Data Case Studies Publications Tools About Home

HOME NEWS

Fuels & Vehicles

Biodiesel Electricity Ethanol Hydrogen Natural Gas Propane



Maps & Data

- U.S. Alternative Fueling Stations by Fuel Type
- Alternative Fuel Vehicles in Use
- U.S. Hybrid/Electric Vehicle Sales by Model

Fuel Prices



Tools

- Loans & Incentives
- Petroleum Reduction Planning Tool
- Vehicle Cost Calculator
- Vehicle Search

Station Locator

Find stations on your iPhone



Information by State

Get the scoop on your state.

State-specific data and information on incentives, fueling stations, vehicles, resources, and more.



www.fueleconomy.gov

ENERGY Efficiency & Renewable Energy

Official U.S. government source for fuel economy information

Find a Car Save Money & Fuel Benefits My MPG Advanced Cars & Fuels About EPA Ratings More...



Want to know more about hybrid and electric car options?

We can help.

My MPG

Calculate or Share Your MPG
Estimates from Drivers Like You
Enter Your MPG at the Pump

Save Money

Gas Mileage Tips
Fuel Cost Calculator
Find the Cheapest Gas

Hybrids & Electric

Hybrids
Plug-in Hybrids
All-Electric Vehicles

More on fueleconomy.gov...

Quick Picks

Related Links

Technical Assistance

Technical and Problem Solving Assistance

- Capture lessons learned and best practices
- Address unforeseen permitting & safety issues
- Identify chronic vehicle or infrastructure field problems
- Incident investigations



Tiger Teams

- Works directly with Clean Cities coalitions and stakeholders
- Tackle challenges that might otherwise stall alternative fuel vehicle projects
-



Technical Response Service

- Research and respond to general and technical inquiries
- Address challenging questions
- Educate policymakers and government officials
- Email TechnicalResponse@icf.com or call 800-254-6735 with technical questions
- 48-hour standard response time (indicate if you need it sooner)

Fort Berthold Electricity Plan



Energy
Assessment



Improve Service
and Reduce Costs



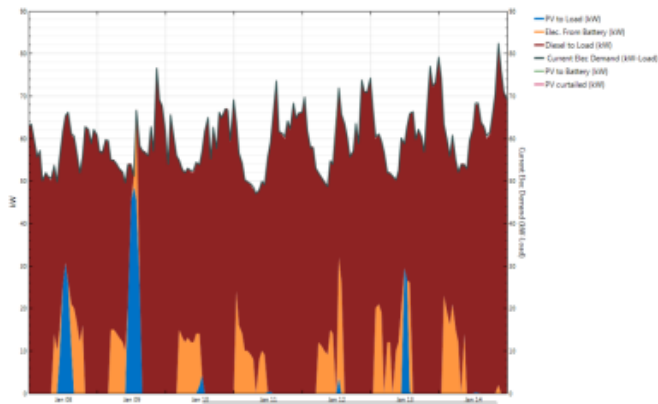
Informed
Decisions



Tribal Self-
Determination
and Sovereignty

Assessing Tribal Energy through Technical Assistance

Dispatch – Nominal battery cost

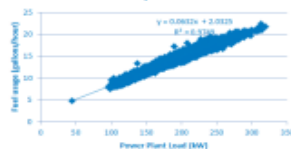


Power plant

- References**
 - "1 status scads.jpg" screen capture
 - Generator rated capacity only
 - Details on makes and models not provided
 - Power plant load data in file "kwethluk trending.csv"
 - Includes load and fuel consumption

	Size (kW)
Generator #1	410
Generator #2	410
Generator #3	250

Kwethluk Power Plant Fuel Consumption Data



- Fuel consumption rates**
 - Use best fit from data
 - Fuel [gal./hr.] = $0.0632 \times \text{Load} + 2.0325$
 - Assume two generators
 - 200kW, 50% minimum load
 - 400kW, 30% minimum load
 - Results in annual fuel use of 118,806 gallons
 - versus 117,818 gallons for 2013 per PDR report
 - 68% less

- O&M, nonfuel**
 - \$0.02/kWh from File "20141000 Electric Intertie Options for Several Rural Alaska Villages.pdf", p. 117
 - \$16/start assumption to limit cycling

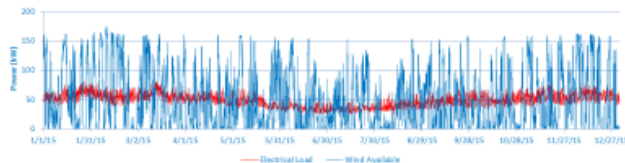
Wind Resource

- 34m meteorological tower installed on point extending into Iliamna Lake
 - latitude 59.448°, longitude -157.764°
 - From "Kokhanok, AK Wind Resource Report"
 - NREL generated power production profile for two Vestas V-17
 - Apply 15% losses assumption



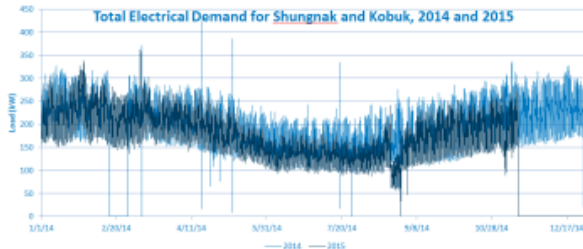
Turbine	Hub Height (m)	Average Wind Speed (m/s)	Annual Average net Power (kW)	Net Annual Energy (kWh/yr)	Net Capacity Factor
(2) Vestas V-17	26	6.9	48.6	425,858	27%

- On an annual basis available wind energy is 100% of village electricity needs



Electrical Load

- 15-minute load data provided for 2014 and 2015 from AVEC
 - Using 2015 as foundation. Have data from January 1 through November 14, 2015, 15:15.
 - Fill in hours after this point using 2014 data.
 - Apparent loss of intertie with Kobuk (~40 to 50kW drop in load for a period of ~8 days, 8/21-8/28/15)
 - Repair by taking the four days prior to the outage and replacing the 8 bad days with the four days (24).
 - Copy 8/22/2015 through 8/28/2015.
 - Apparent loss of intertie with Kobuk (~40 to 50kW drop in load for a period on Nov. 6)
 - Replace 11/5 and 11/6 with 24 hr period from 11/4
 - Replace 12/12/15 14:00 100kW drop by averaging hour just before and just after.
 - Replace 12/28/15 7:00 and 7:15 (actually from 2014 data set) with average of 6:45 and 7:30.



Recent Technical Assistance Topics



- Energy options analysis
- RE + Storage battery sizing
- Solar array RFP assistance
- Microgrids for resilience and demand response
- Relocation planning
- Cyber-security assessments
- Wind resource mapping
- Housing weatherization program design
- Strategic Energy Planning
- Transmission pre-feasibility studies
- Solar resource assessment
- Power quality trouble shooting
- Rooftop solar program design
- Tribal store refrigeration efficiency assessment



For More Information Contact

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