

DOE OFFICE OF INDIAN ENERGY

# Foundational Courses

# Renewable Energy Technologies

## Wind

Presented by the National Renewable Energy Laboratory



U.S. DEPARTMENT OF  
**ENERGY**

Office of  
Indian Energy

# Course Outline

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## What we will cover...

- About the DOE Office of Indian Energy Education Initiative
- Course Introduction
- Resource Map
- Technology Overview(s):
  - Siting
  - Costs
- Successful Project Example(s)
- Policies Relevant to Project Development
- Additional Information & Resources



# Introduction

The U.S. Department of Energy (DOE) Office of Indian Energy Policy & Programs is responsible for assisting Tribes with energy planning and development, infrastructure, energy costs, and electrification of Indian lands and homes.

As part of this commitment and on behalf of DOE, the Office of Indian Energy is leading *education* and *capacity building* efforts in Indian Country.

# Training Program Objective & Approach

Foundational courses were created to give tribal leaders and professionals background information in renewable energy development that:

- *Present foundational information on strategic energy planning, grid basics, and renewable energy technologies;*
- *Break down the components of the project development process on the commercial and community scale;*
- *Explain how the various financing structures can be practical for projects on tribal lands.*

# NREL's Presenter on Wind Energy is

Charles Newcomb  
[charles.newcomb@nrel.gov](mailto:charles.newcomb@nrel.gov)



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# NREL National Wind Technology Center

- The National Renewable Energy Laboratory (NREL) researches, installs, validates, and tests turbines across the range of sizes from residential to utility-scale
- NREL also provides direct technical assistance by request





# Commercial or Community Scale?

COMMERCIAL SCALE  
PROJECT

COMMUNITY SCALE  
PROJECT







# Key Takeaways

- Wind energy is a mature, yet evolving technology
- Wind energy comes in many sizes
- Wind energy is cost competitive today in many locations throughout the United States
- Large wind development has clear impacts to neighboring communities that are both positive and negative and therefore requires active stakeholder engagement



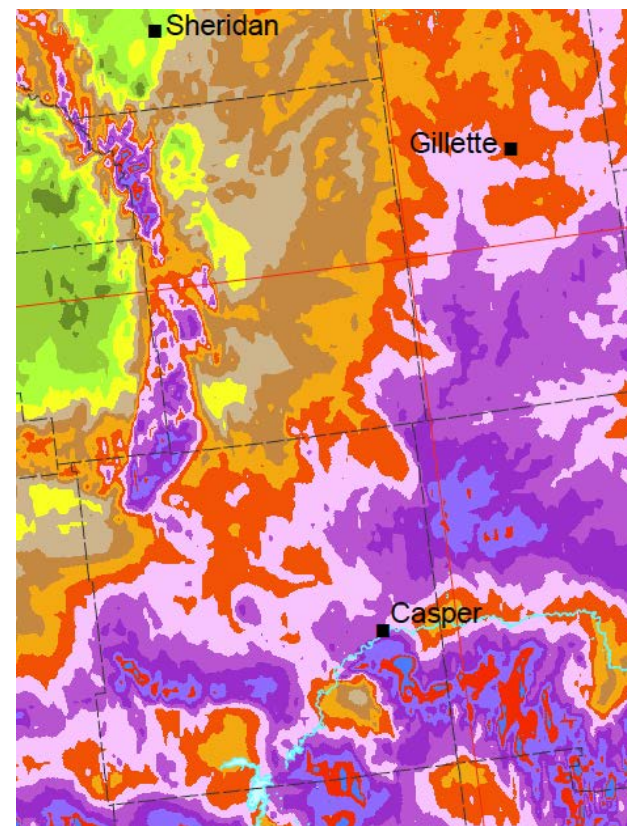
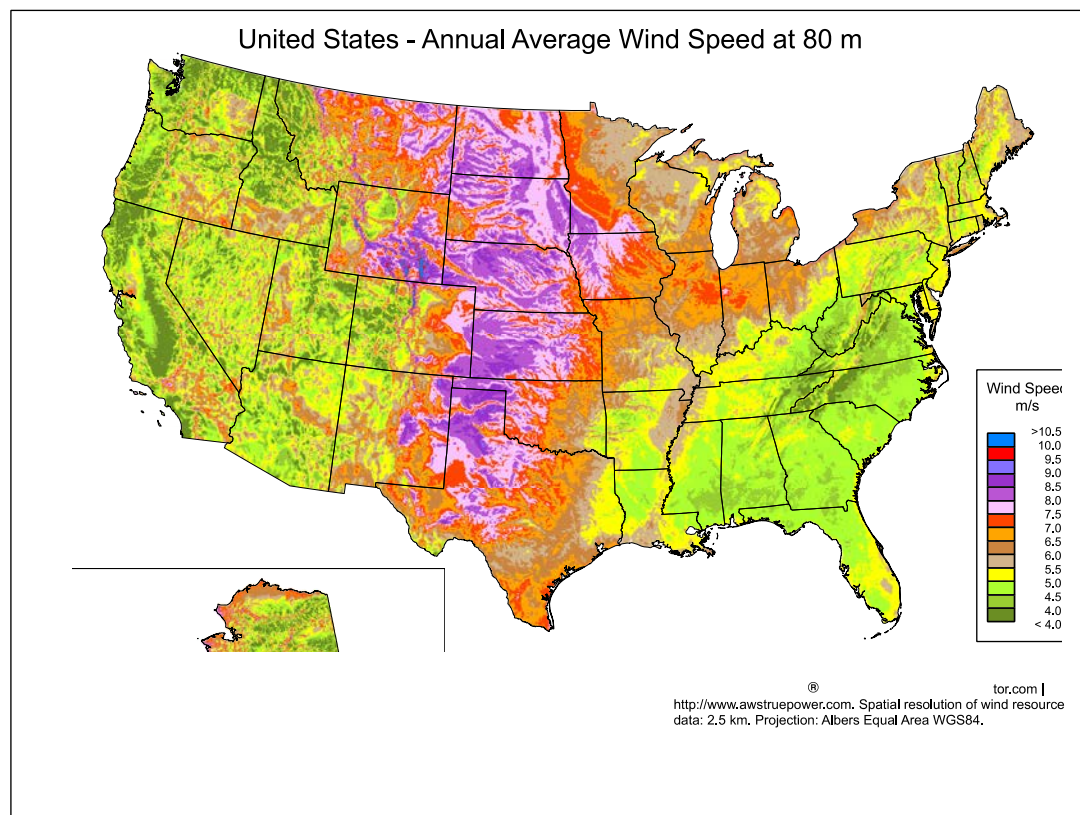
Source: NREL/PIX 05572



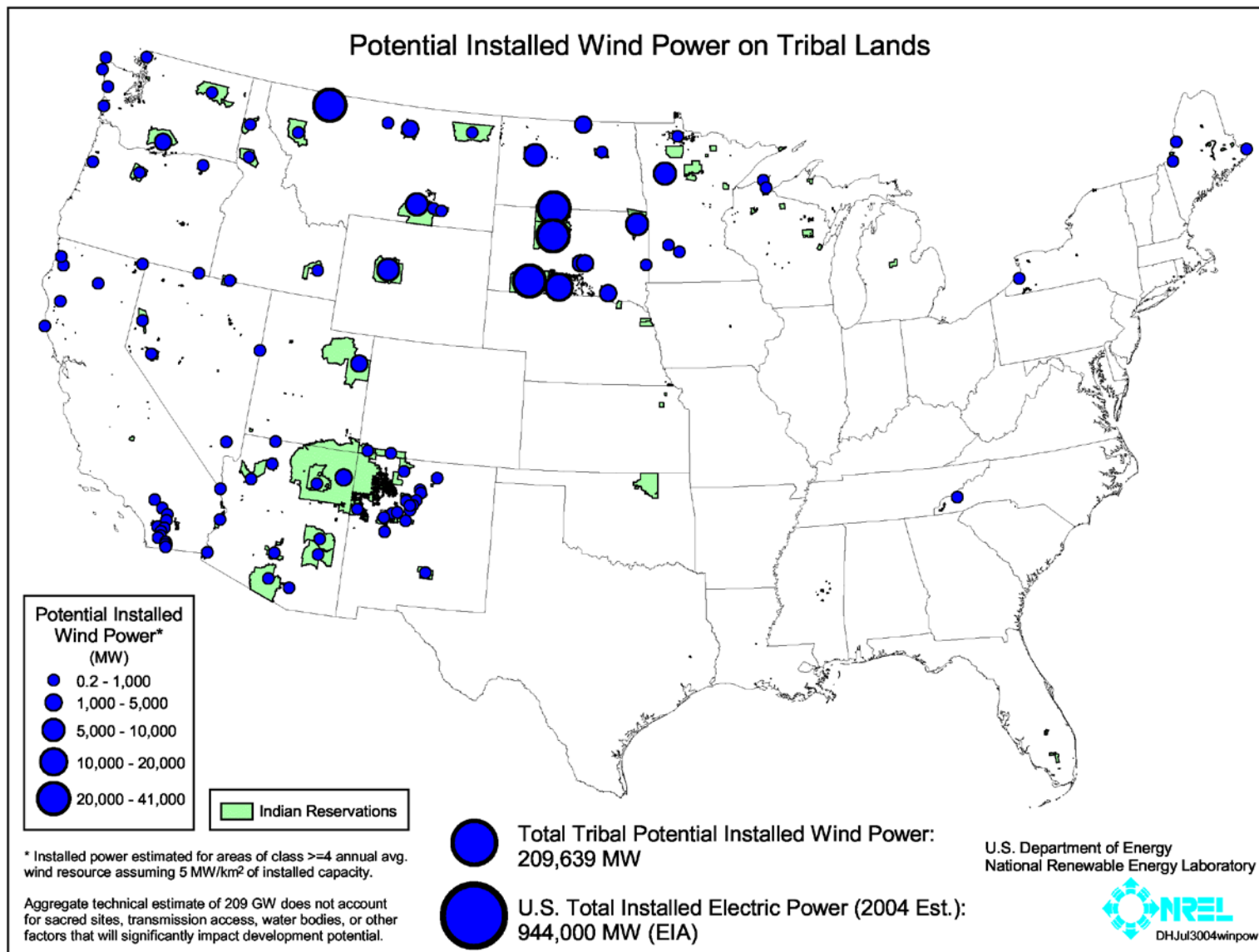
# Maps of Resources

Wind Powering America:

<http://www.windpoweringamerica.gov/windmaps/>



# Potential Installed Wind Power on Tribal Lands



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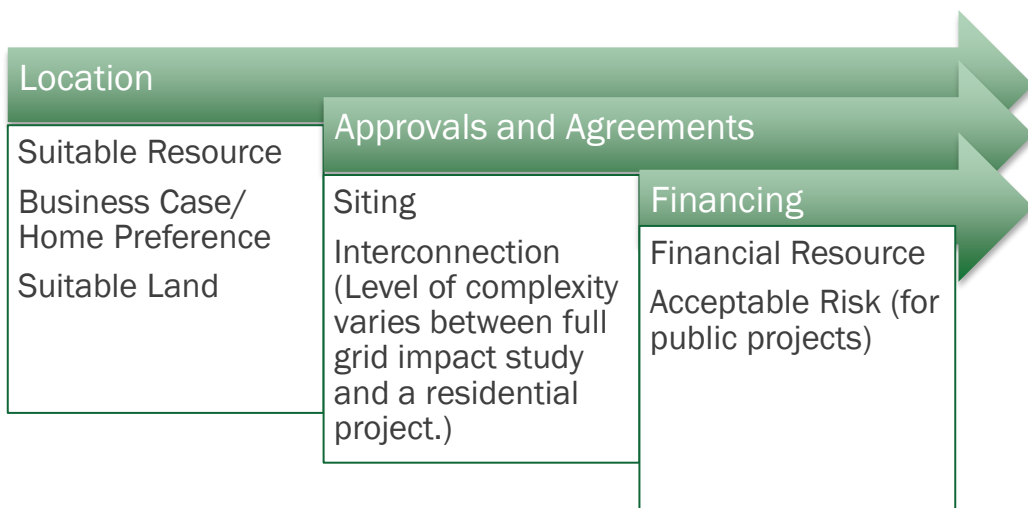
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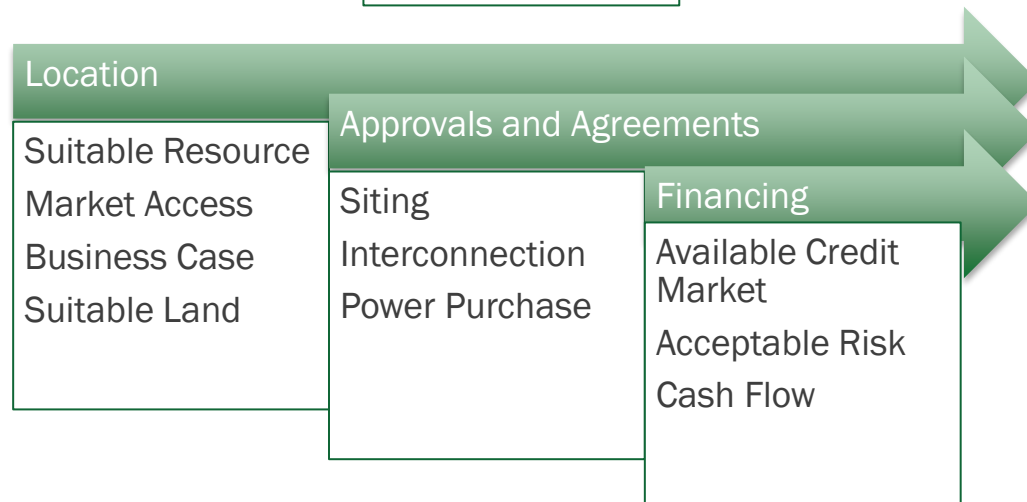


# Elements of Wind Projects (two ends of the spectrum)

Community



Commercial







# Technology Overview

## Primary Markets:

- Remote power
  - Remote communities
  - Remote uses (telecommunications, pumping)
- On-site energy production and consumption
  - Residential, commercial, industrial
- Energy for sale
  - Merchant power
  - Purchased power
  - Utility projects





# Wind Energy Technology Scales



Source: NREL/PIX 18890



Source: NREL/PIX 16730





# Wind Performance Characteristics

## Capacity Factor (CF)

- Fraction:  $\frac{\text{Actual}}{\text{Rated} \times 24 \times 365}$
- Small: 15% - 20%
- Medium: 20% - 25%
- Large: 30% - 40%

## Affected by:

- Temperature
- Altitude
- Siting
  - Terrain
  - Obstructions
- Roughness
  - Tower height



# Best Uses for Technology (size, installed cost)

## On-Site Power

- Remote (<10 kilowatt [kW], \$6-\$12/watt [W])
  - Water pumping, electrification
    - Water pump = 1 kW, House = 5 kW, Farm = 10 kW

## Grid Connected (\$7- \$3.50/W)

- Small (1 kW – 50 kW)
  - Residence, business, farm/ranch
- Mid-Size (100 kW – 1 megawatt [MW])
  - Facility, community, industrial
    - Convenience store = 50 kW, school = 250 kW

## Energy for Sale (\$2-\$3/W)

- Utility (>1MW)
  - Wind farm



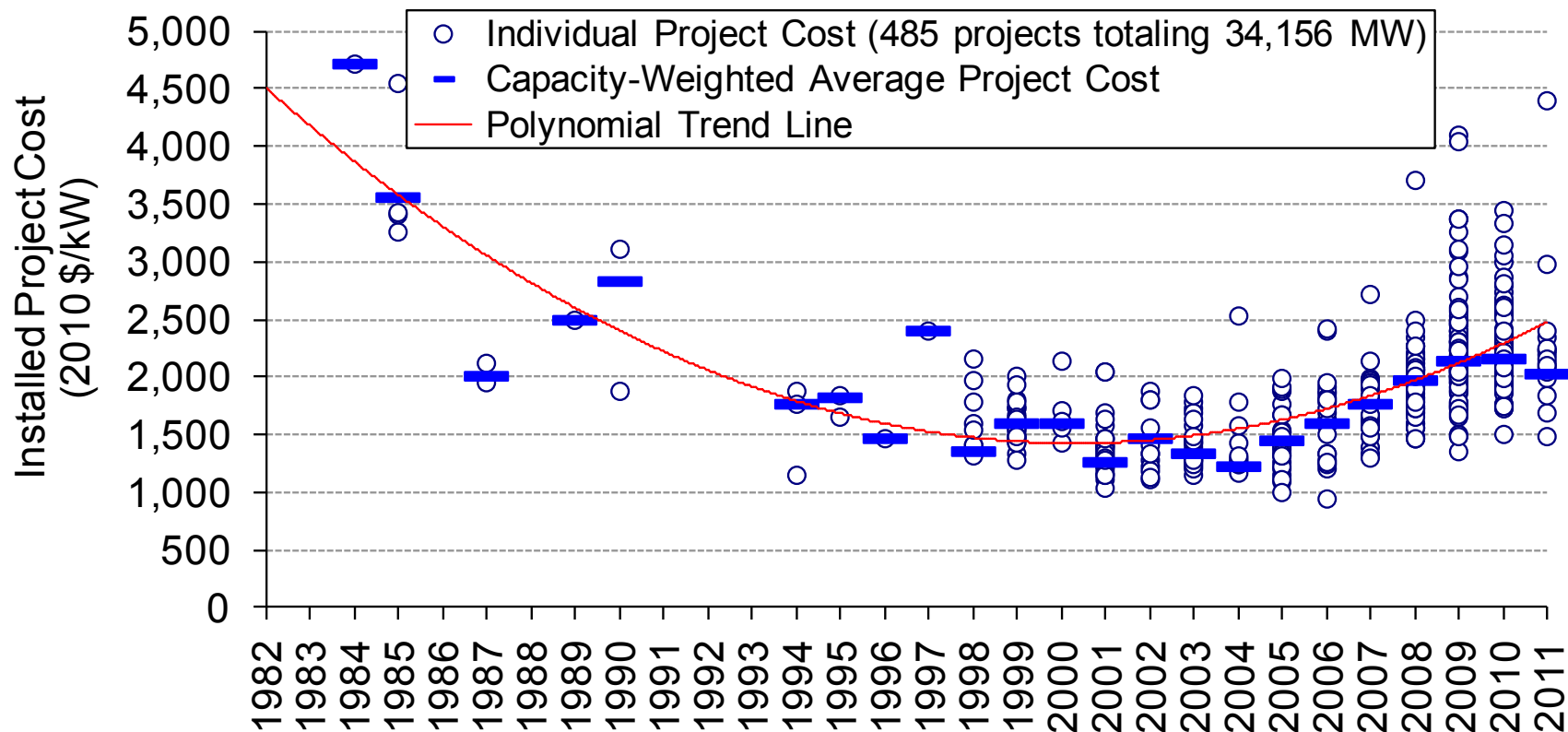
# Wind Energy Costs

- Costs vary considerably depending on local conditions including:
  - Topography
  - Require clearing
  - Land-holding size
  - Collection grid design
  - Environmental hurdles
  - Weather delays (wind/rain/soil)
- Total installed costs for utility-scale projects are averaging around \$2-\$2.5 million/MW (community campus or two rural hotels)



Sioux 750 kW Turbine  
Source: NREL PIX#12817

# Lower Turbine Pricing Working Its Way into Installed Project Costs: 2-Year Lag



Project costs bottomed out in 2001-04; rose by \$850/kW on average through 2009; held steady in 2010 (\$2,160/kW); appear to be dropping in 2011. Source: 2010 Wind Market Report, LBNL.



# Identifying Commercial Technologies

- Is it a recognized brand?
  - Certified or listed by recognized bodies
  - Third-party published performance
  - Listed on incentive websites
- How many units are installed in the United States?
  - What is the history/experience?
- Is there a domestic service system in place?
- Are there units nearby or is there local (established) service system in place?
- Reconditioned by reputable shop with a track record?



Wild Horse Wind Facility in Washington State  
Source: NREL/PIX 15462



# Wind at the Lakota Nation

- Refurbished wind turbine
  - Provides power to the KILI radio station
  - Tribal members trained to maintain the turbine
  - Project serves “beacon”
  - Maintenance funded through sale of renewable energy credits
- Benefits
  - Reduces operating costs
  - Demonstrates environmental stewardship
  - Provides training opportunity



Source: NREL/PIX 19538



# Avoided CO<sub>2</sub> Emissions and Water Use

- Carbon dioxide (CO<sub>2</sub>) and water savings depend on where the project is located

	CO <sub>2</sub> (million tons/year)	Water (billion gallons/year)
Tennessee	2.4	1.3
Massachusetts	2.6	1.3
New Mexico	2.6	1.1
North Carolina	2.9	1.6
Georgia	3	1.6
Indiana	3.1	1.7
Kansas	3.2	1.8
West Virginia	3.3	1.8
Nebraska	4.1	1.8



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# Federal Wind Policy

- Relevant Federal Legislation
  - These can be leveraged when partnering with certain partners
    - Production Tax Credit
    - USDA Farm Bill
    - U.S. Energy Initiative
- Permitting
  - National Environmental Policy Act (NEPA)
    - Fish & Wildlife
    - Historic Preservation



# State Wind Policy

- Renewable Portfolio Standards:
  - 29 states have enacted a Renewable Portfolio Standard (RPS)
  - States offer grants, rebates, sales tax, and tax credit incentives
  - Numerous states have incentives for small and community wind energy projects
- For information on your state:  
<http://www.dsireusa.org>

# Native American Outreach

- Native American Wind Interest Group outreach
- U.S. DOE/NREL wind project technical assistance
- Wind Energy Applications and Training Symposium
- Wind Powering Native America video
- Level of support and funding depends on level of requests
- DOE Office of Indian Energy Education Project Development and Finance Information



Photos left to right: NREL/PIX 12517 and Wind Powering America

# What we covered...

- About the DOE Office of Indian Energy Education Initiative ✓
- Course Introduction (Takeaways) ✓
- Resource Map ✓
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# Useful Resources

## RESOURCE

- <http://www.windpoweringamerica.gov/nativeamericans/>
- <http://www.windpoweringamerica.gov/>

## TECHNOLOGY

- <http://www.nrel.gov/wind/>
- <http://www.smallwindcertification.org/>

## POLICY

- [www.dsireusa.org](http://www.dsireusa.org)

# Thank You & Contact Information

For More Information:

DOE Office of Indian Energy Website:

[www.energy.gov/indianenergy](http://www.energy.gov/indianenergy)

NREL Technology Websites:

[www.nrel.gov/learning/re\\_basics.html](http://www.nrel.gov/learning/re_basics.html)

Charles Newcomb

[charles.newcomb@nrel.gov](mailto:charles.newcomb@nrel.gov)







# INFORMATION ON THE CURRICULUM PROGRAM & OFFERINGS

# Curriculum Structure & Offerings

## Foundational Courses

- Overview of foundational information on renewable energy technologies, strategic energy planning, and grid basics

## Leadership & Professional Courses

- Covers the components of the project development process and existing project financing structures

# Foundational Courses

## Energy Basics

Assessing Energy Needs  
and Resources

Electricity Grid Basics

Strategic Energy  
Planning

## Renewable Energy Technology Options

Biomass

Direct Use

Geothermal

Hydroelectric

Solar

Wind

All courses are presented as 40-minute Webinars online at

[www.energy.gov/indianenergy](http://www.energy.gov/indianenergy)