

INL Renewable Energy Activities, an Overview



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Biofuels and
Renewable Energy
Technology

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Biofuels and Renewable Energy Technologies Department

Mission

Perform R&D and engineering in support of the development and deployment of renewable energy and power system technologies

Product Areas

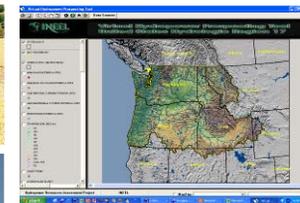
Geothermal Energy

Hydropower

Wind Energy

Power Systems

Bioenergy



Our Customers

- Department of Energy
- Department of Defense
- Department of Agriculture
- Work For Others

Our Department

14 - Scientists & Engineers

- 4 PhD's
- 7 Masters Degrees

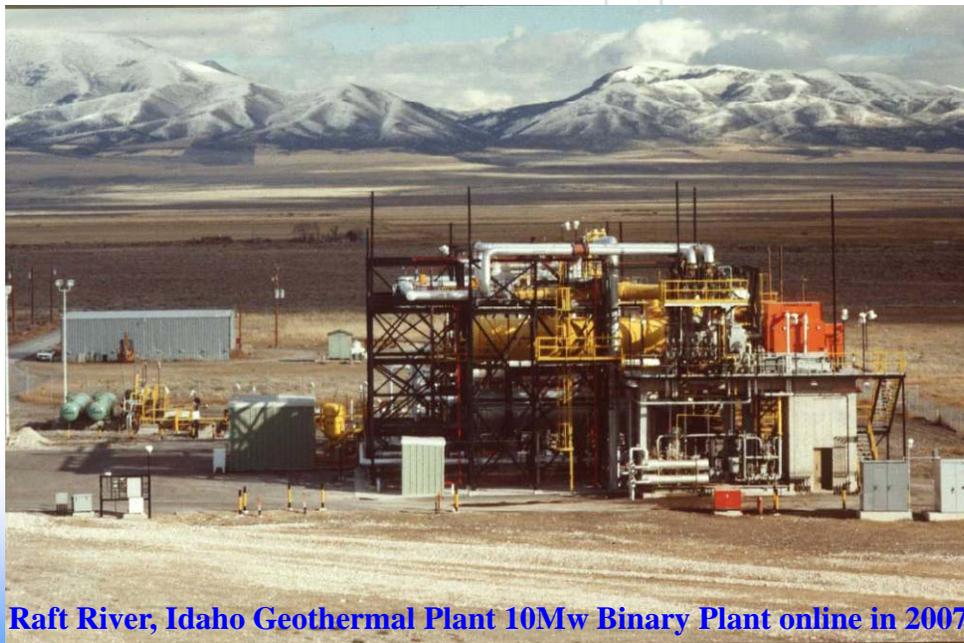
Mechanical Engineering	Biology
Electrical Engineering	Environmental Biology
Metallurgical Engineering	Toxicology
Physics	Environmental Toxicology
Math	Agronomy
Geology	Botany
Materials Science	Genetics
Industrial Management	Zoology

Over 100 different projects

Funding > \$10 Million in FY08

Geothermal Energy

The Idaho National Laboratory has a 30 year history of working geothermal energy



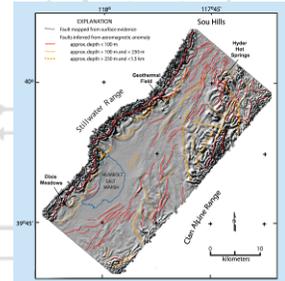
Raft River, Idaho Geothermal Plant 10Mw Binary Plant online in 2007

Geoscience Research

INL is the Lead Lab for Geoscience

EGS characterization & development

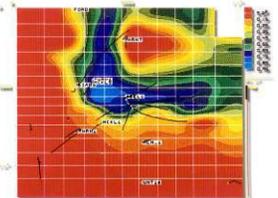
Numerical tools for reservoir management



Exploration and Drilling

Numerical methods for Basin & Range exploration

Optimum exploration strategy development

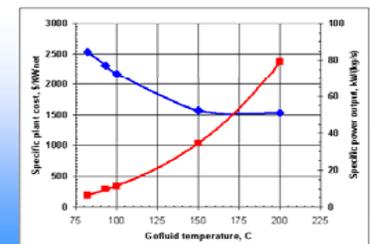


Energy Conversion

Coupled reservoir/power plant management

Performance enhancement

Process monitors



Geothermal Energy

Issues

Resource identification and assessment

Exploration and resource development
(risk and cost)

Resource productivity and sustainability

Resource expansion (Enhanced
Geothermal Systems)

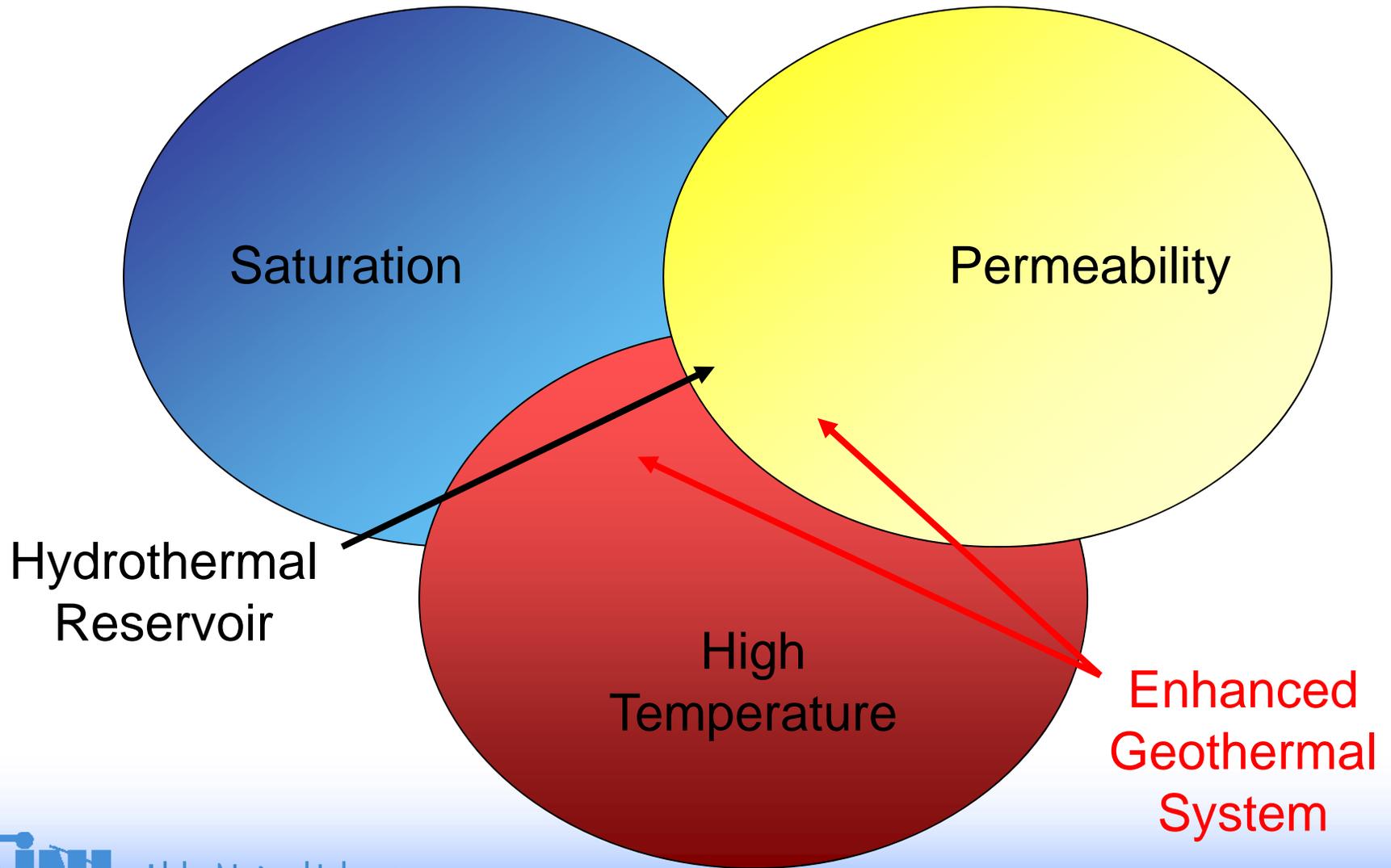
Energy conversion costs (capital and
operating)



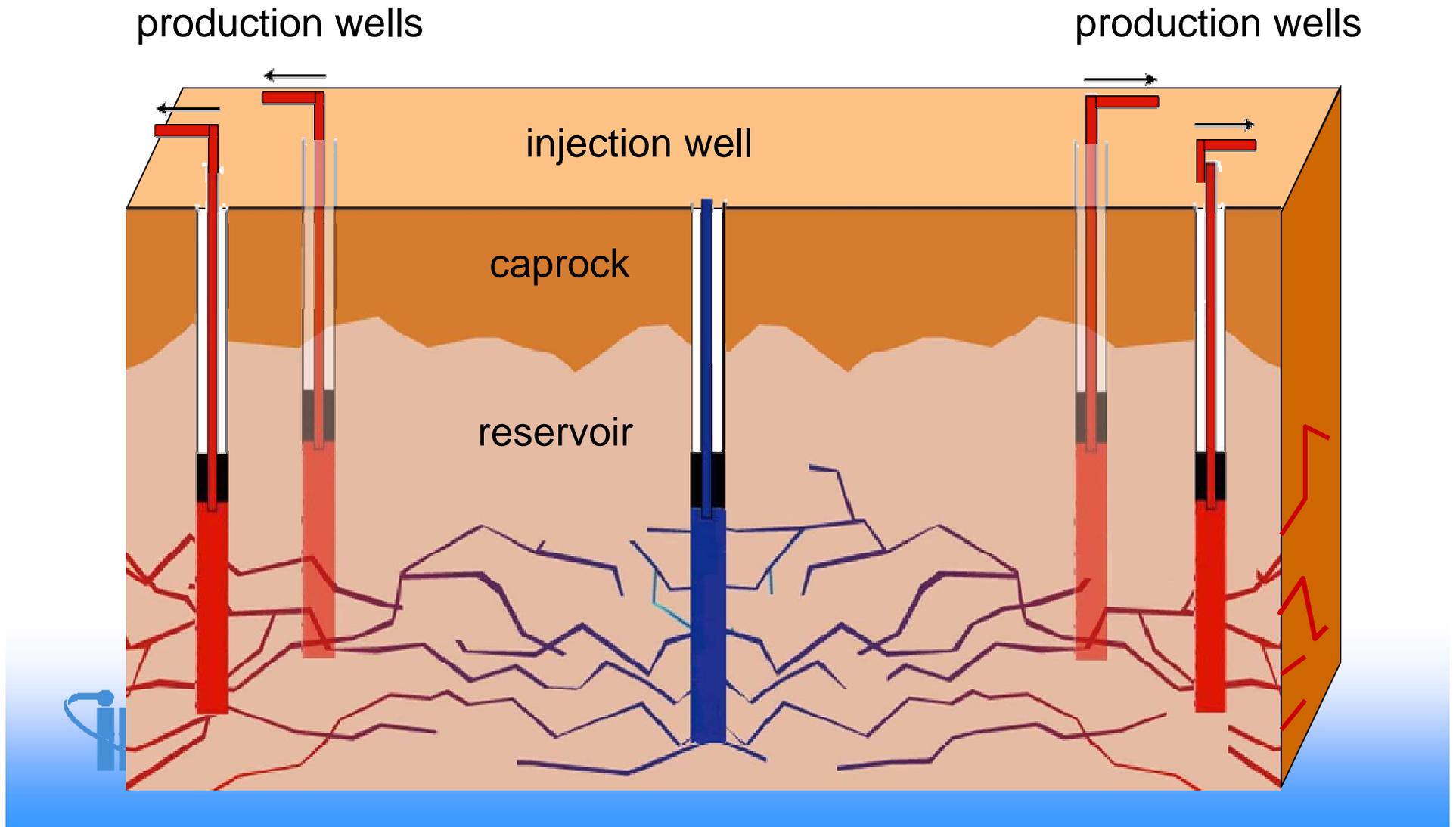
Sometimes it's obvious, Often it's not



Geothermal Domains

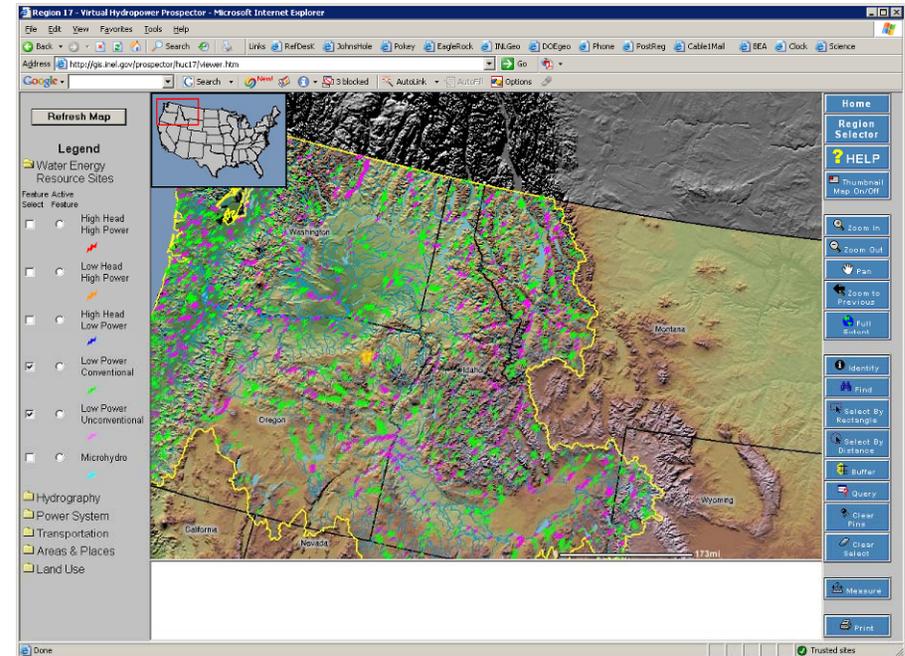


EGS Reservoir



Current Hydropower Work

- Hydropower resource assessment
- Small hydropower technology assessment
- Unconventional technology assessment
- Technology transfer and outreach



DOE Biorefining Industry 2030 Goals

Displace a significant fraction of gasoline demand
~ 60 billion gallons/year by 2030

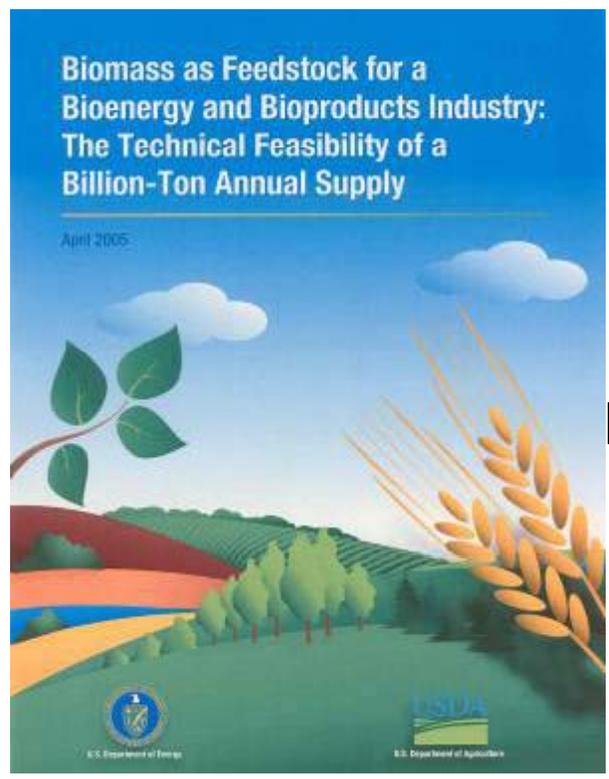


~1.3 Billion tons/yr
Biomass Potential
in the U.S.

Sugar Platform



Syngas Platform

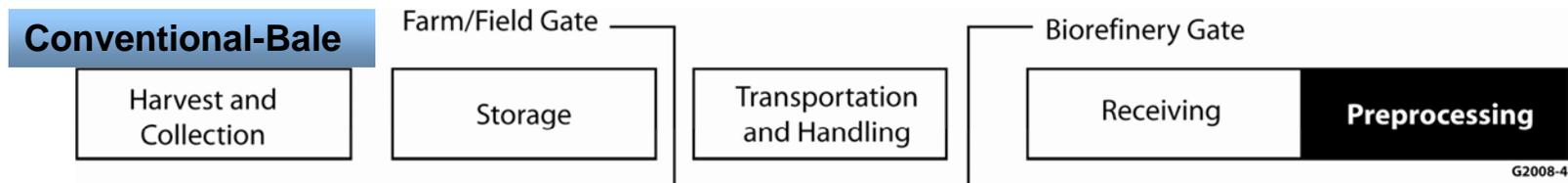


<http://bioenergy.ornl.gov>



Including Corn Grain, an Estimated 600 – 700 Million Tons of Biomass per Year is Needed for 60 B gal of ethanol.

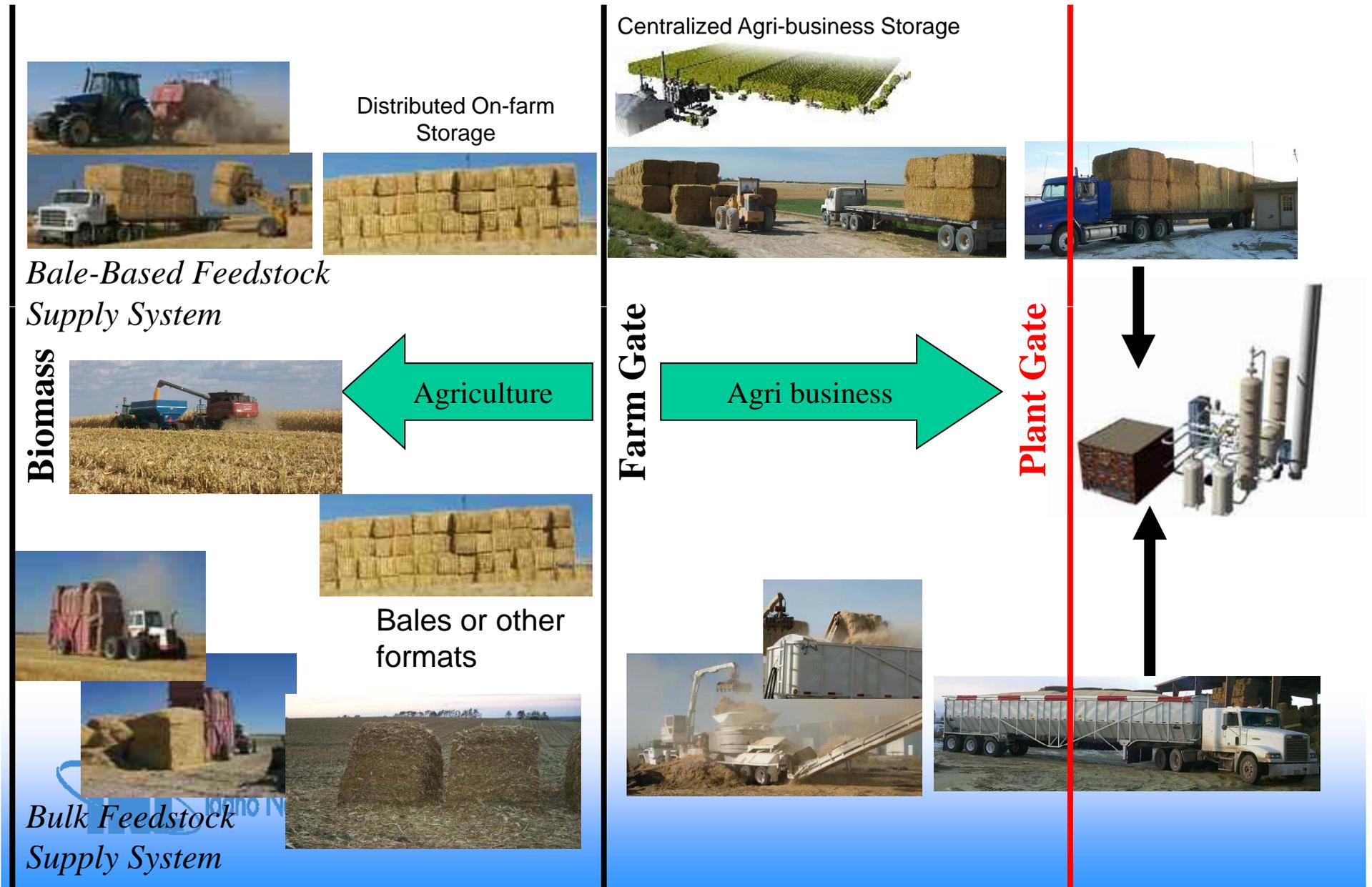
Conventional Square Bale Feedstock Supply System



- Same as the Livestock Forage System
- 10 material intermediates, 3 biomass format changes
- 14 process steps, 21 different types of equipment
- Supply system is bale format specific

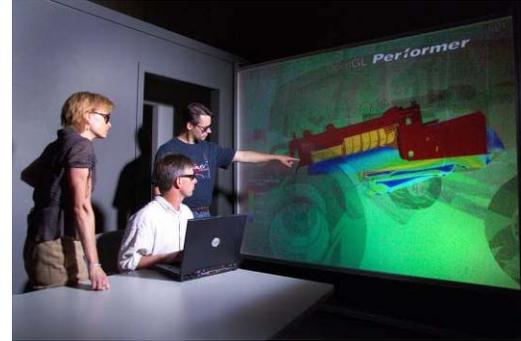


Feedstock Supply System Models, Business Elements and Interfaces

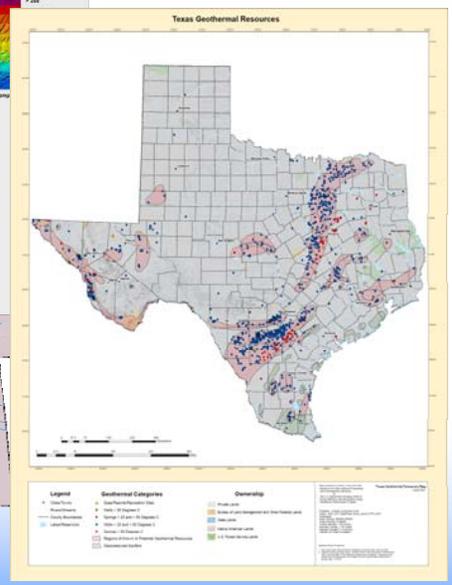
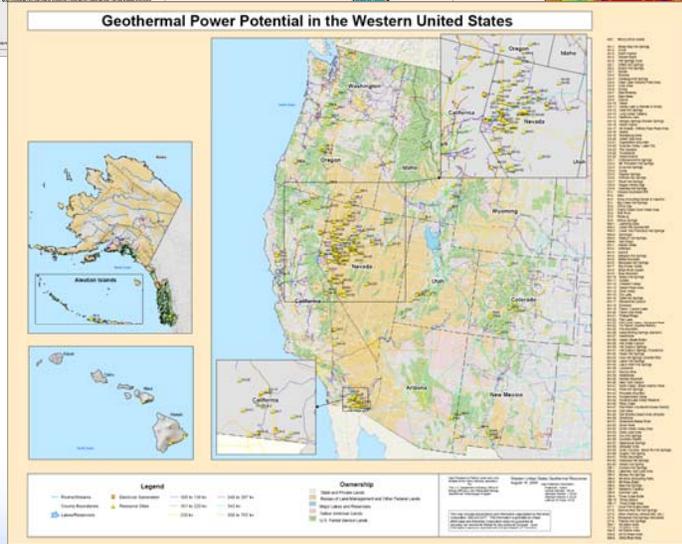
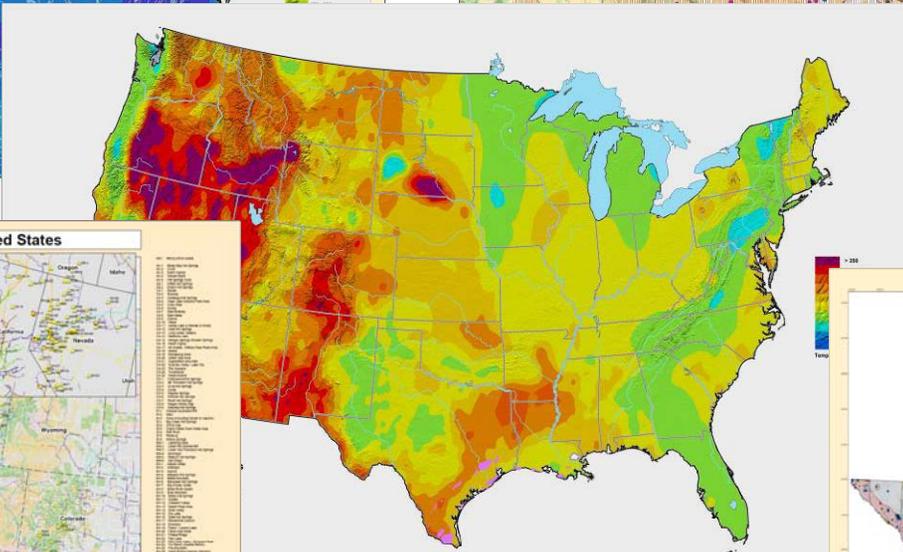
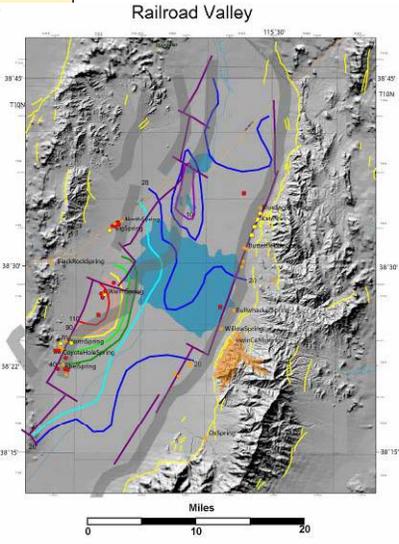
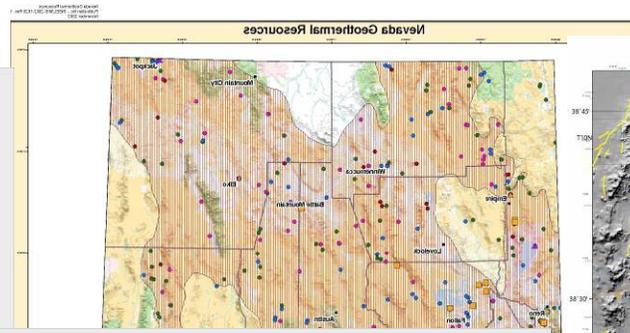
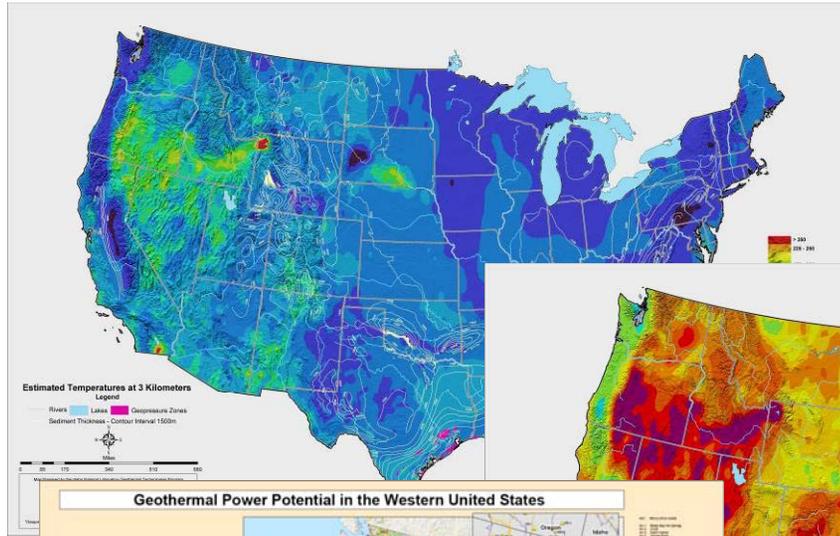


INL Facilities

- High bay laboratories
- Mobile Units
- INL field laboratory (existing)
- Research harvesters
- Modular, instrumented preprocessing systems
- Bins, hoppers and flow loops
- Partnerships
- Design
- Validation



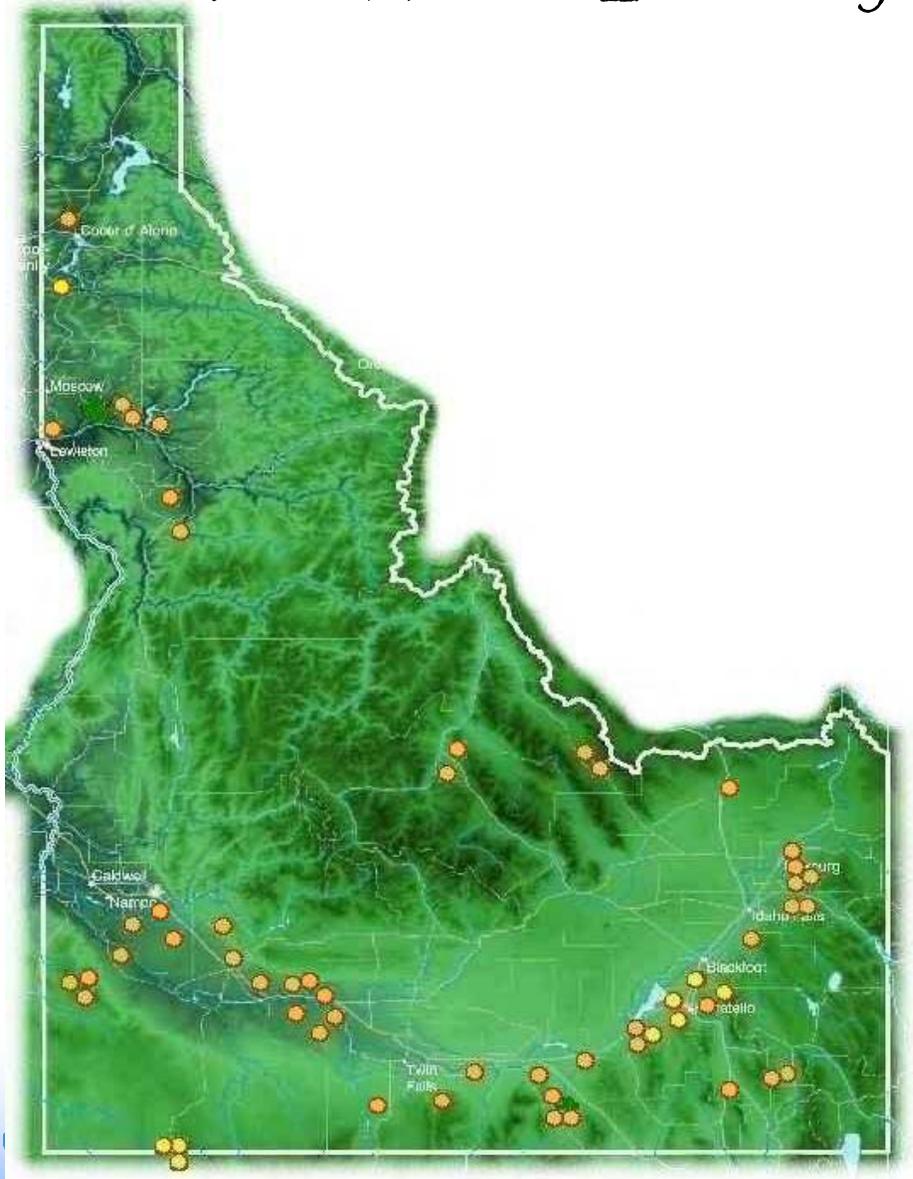
GIS Mapping



Wind Radar Interaction



Idaho National Laboratory (INL): Wind Power Program



- INL has an active State-Wide resource assessment and outreach program
- Wind Powering America, a Department of Energy program promoting wind energy.
 - Anemometer Loan Program. Gathering wind resource information on private and state land.
 - Over 50 sites across the entire Idaho region.
 - Identifying potential energy production sites.
 - Sharing data with the public through INL's web site.
 - Working with educators, students, communities, and interested parties in outreach and educational activities throughout the state.
 - More Info - www.inl.gov/wind

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“Montana ... alone has enough potential wind resources to supply one quarter of the electricity needs of the United States.”

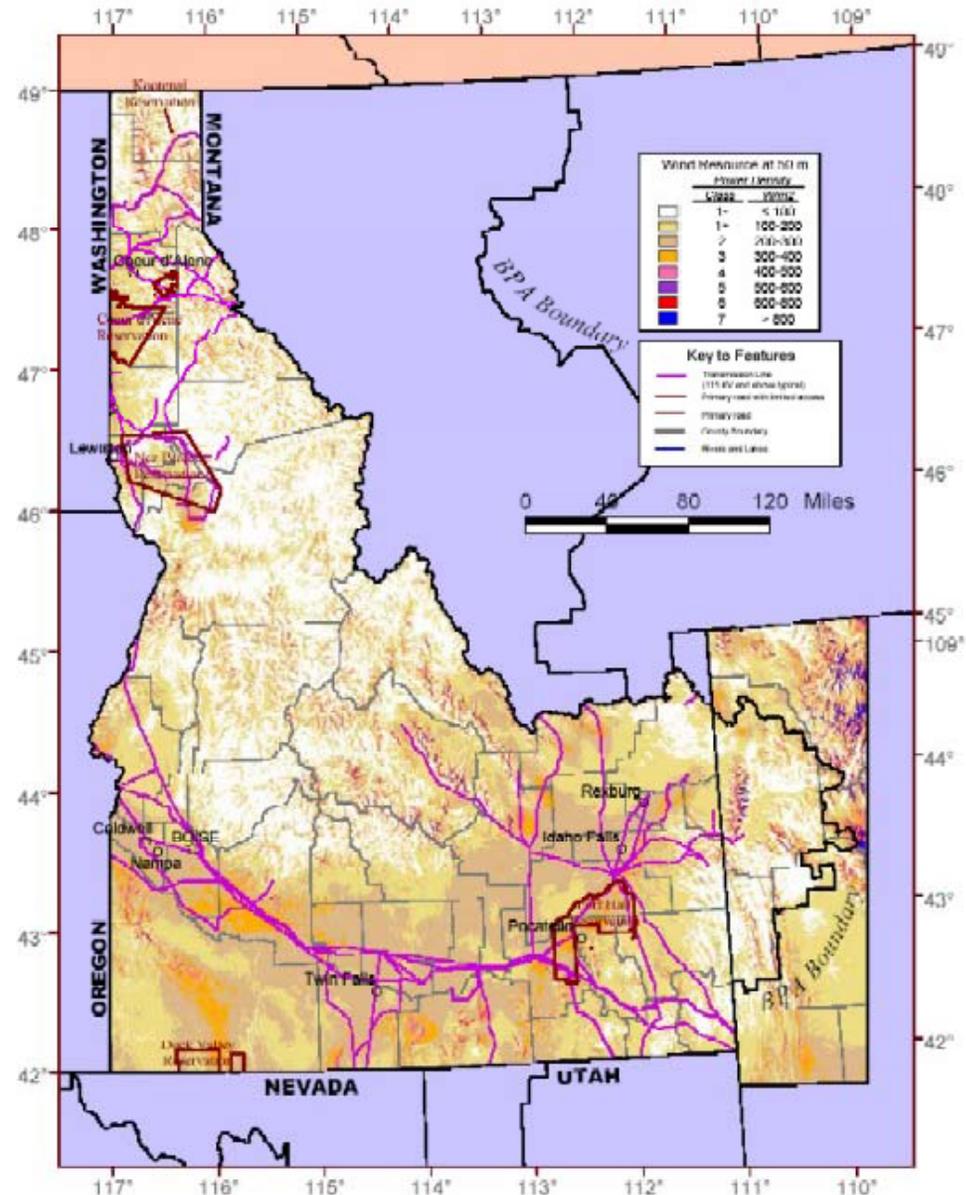
And

“Idaho has more wind energy than they consume.”

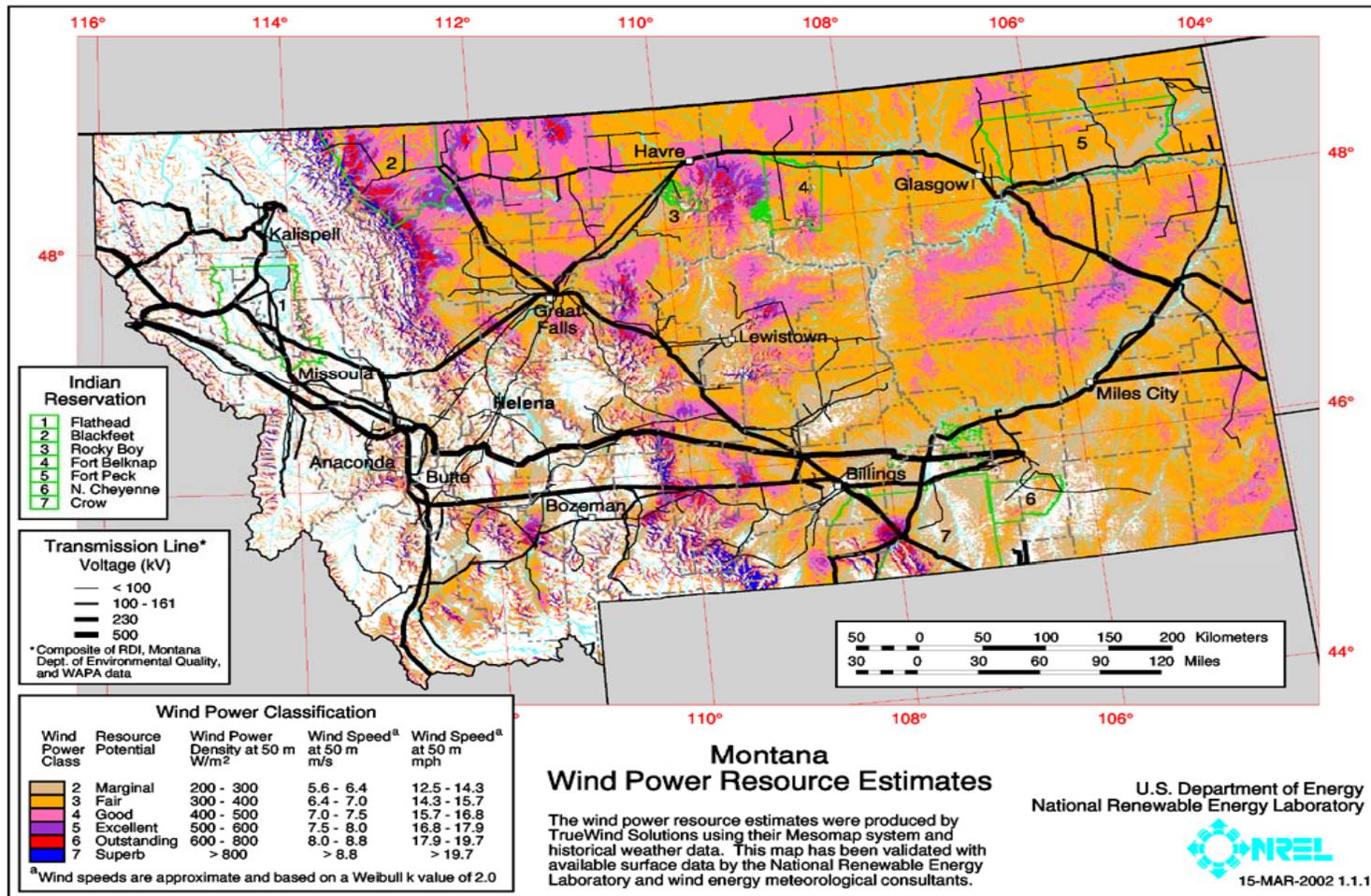
The Real Question - what are we going to do with it?

Wind Power Map of Idaho and Western Wyoming
at 50m

Idaho Wind



Montana Wind



The Wind is Available

State	Potential Capacity	Installed Capacity
Montana	116,438 MW	164 MW
Idaho	5594 MW >15000 based on testing	75 MW
Washington	7078 MW	1165 MW
Oregon	7991 MW	886 MW

Wind Potential?

- **Yes, there is excellent potential**
- **Large tracts of land**
- **Montana can support wind farms**
 - **Large Commercial**
 - **Small Community Size**
 - **Individual Homeowner**
- **Transmission and a market are all we need**



Long History of Wind In the West From Humble Beginnings to



***Refurbished
Wind Turbine***



Another Option for Farmers with Irrigation Loads

Many 65/80/100/200/300 kW units available

Renewable Energy Creates Jobs

- **Renewable energy creates long term high technology careers**
 - **Control Systems**
 - **Computer System**
 - **Construction**
 - **Maintenance**
 - **Supply Chain**
 - **Services**
 - **Etc**

Many Opportunities During Construction. From the Roads and Foundation, to the...



Erection, to the....



Towers, to the



Assembly, To the



Assembly, To the



Assembly, To the



Final Product



Wind Radar Concerns

- Ongoing activities
 - >3000 MW under risk
 - All wind states impacted
- Significance
 - Impacts All
 - Start Early
- Mitigation under development



INL Renewable Wind Energy Program

- **Regional Resource Assessment**
- **The West can support large wind farms**
- **Focus Areas**
 - **Wind Radar Interaction**
 - **Anemometer Programs**
 - **Air Force renewable installations**
 - **Regional Transmission Expansion**
 - **Demonstration Projects**



Research Opportunities

- **Transmission and storage**
 - **Both can reduce impact on variability**
 - **Storage helps all of the industry**
 - **Integrated storage**
 - **Break the paradigm**
 - **Why does it have to be hours**
 - **Why not short term smoothing?**
 - **What about using the components already there????**
 - **Storage – offsetting/deferring Natural Gas Consumption**
 - **Changing regional transmission paradigm/economics**

Research Opportunities

- **Stealth Blades**
- **Change tower to something shippable**
- **Reduce mass while increasing reliability**
- **Integrate SCADA control and wind controls**
- **Integrated forecasting, pricing, and business controls**
- **Optic based wind speed sensing**
- **Move the weight down tower**
- **Advanced wind forecasting and prospecting**

Research Opportunities

- **Bat Repellors**
- **Gap filling radar**
- **Improving gear box reliability**
- **Eliminating gear box**
- **Changing energy capture (air, fluids, heat, etc)**
- **CO₂ to CH₄ conversion**
- **Self Erecting systems**
- **Non Metallic Towers**
- **Space frame systems**
- **And More**

Questions

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