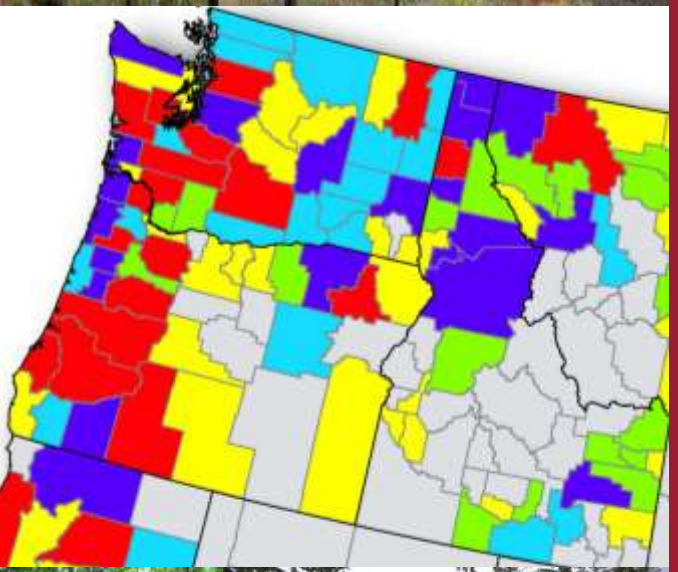

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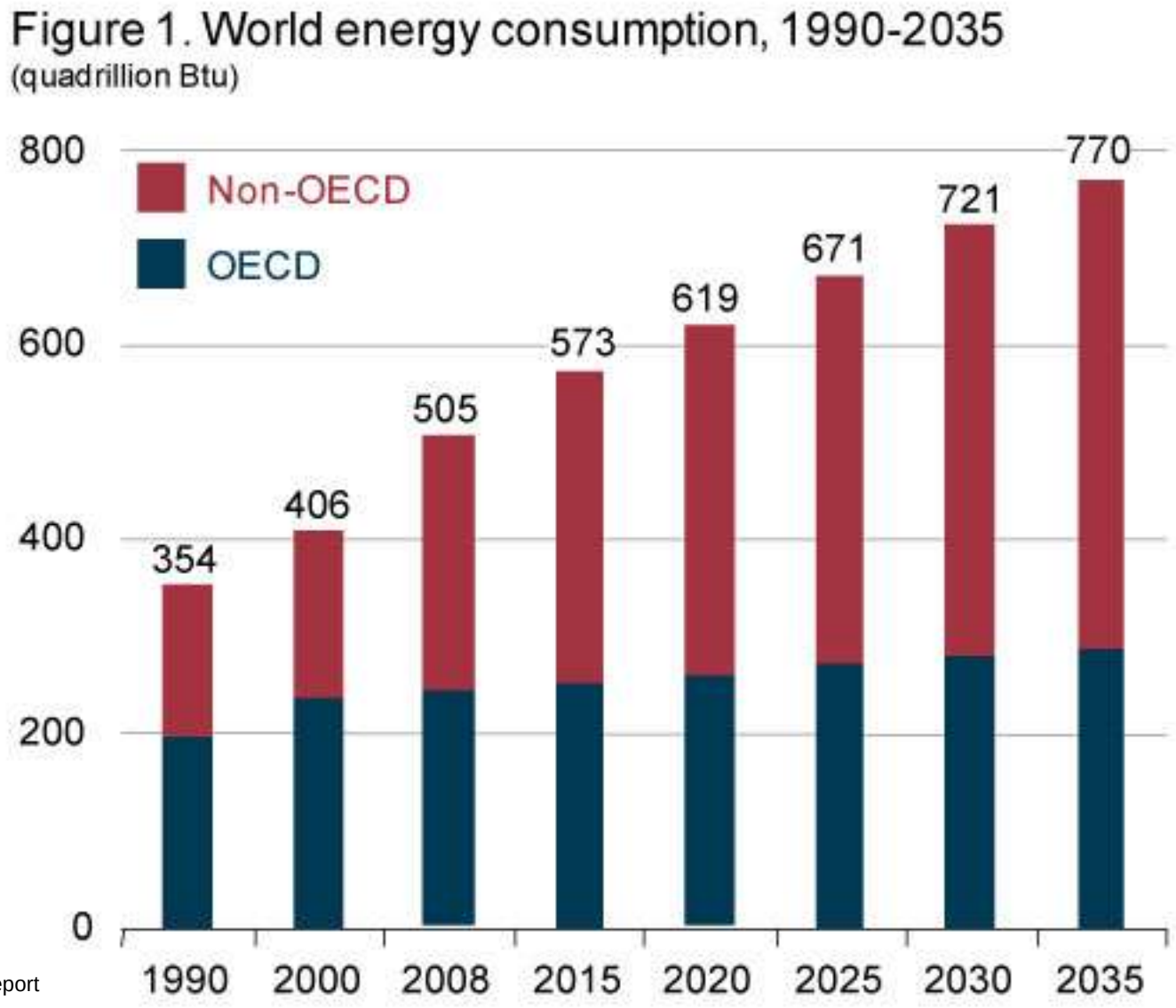
Perspectives and Priorities for Bioenergy Research in the Pacific Northwest

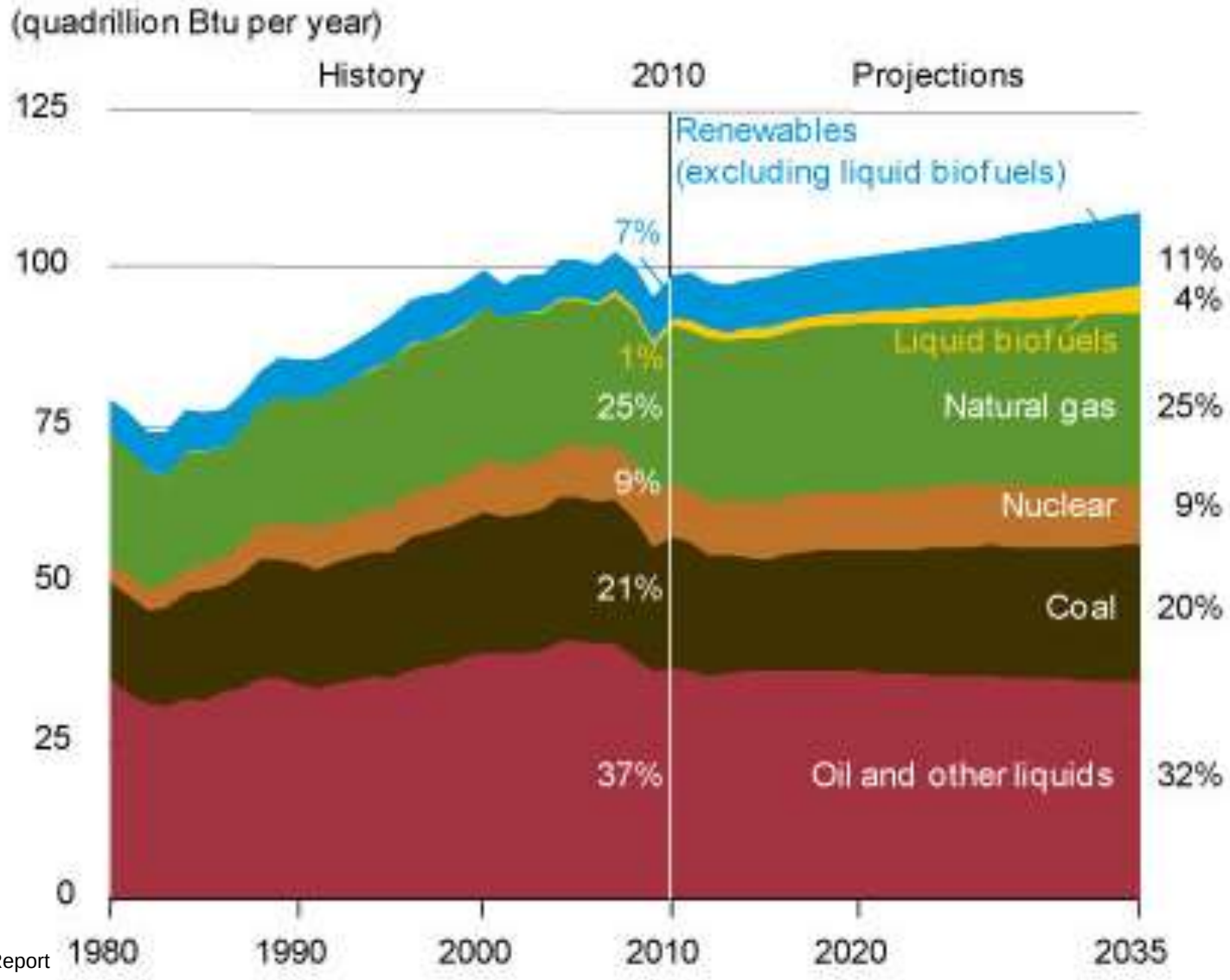
Ralph Cavalieri
Associate Vice-President for Alternative Energy
Washington State University

Challenge - Global Energy Consumption



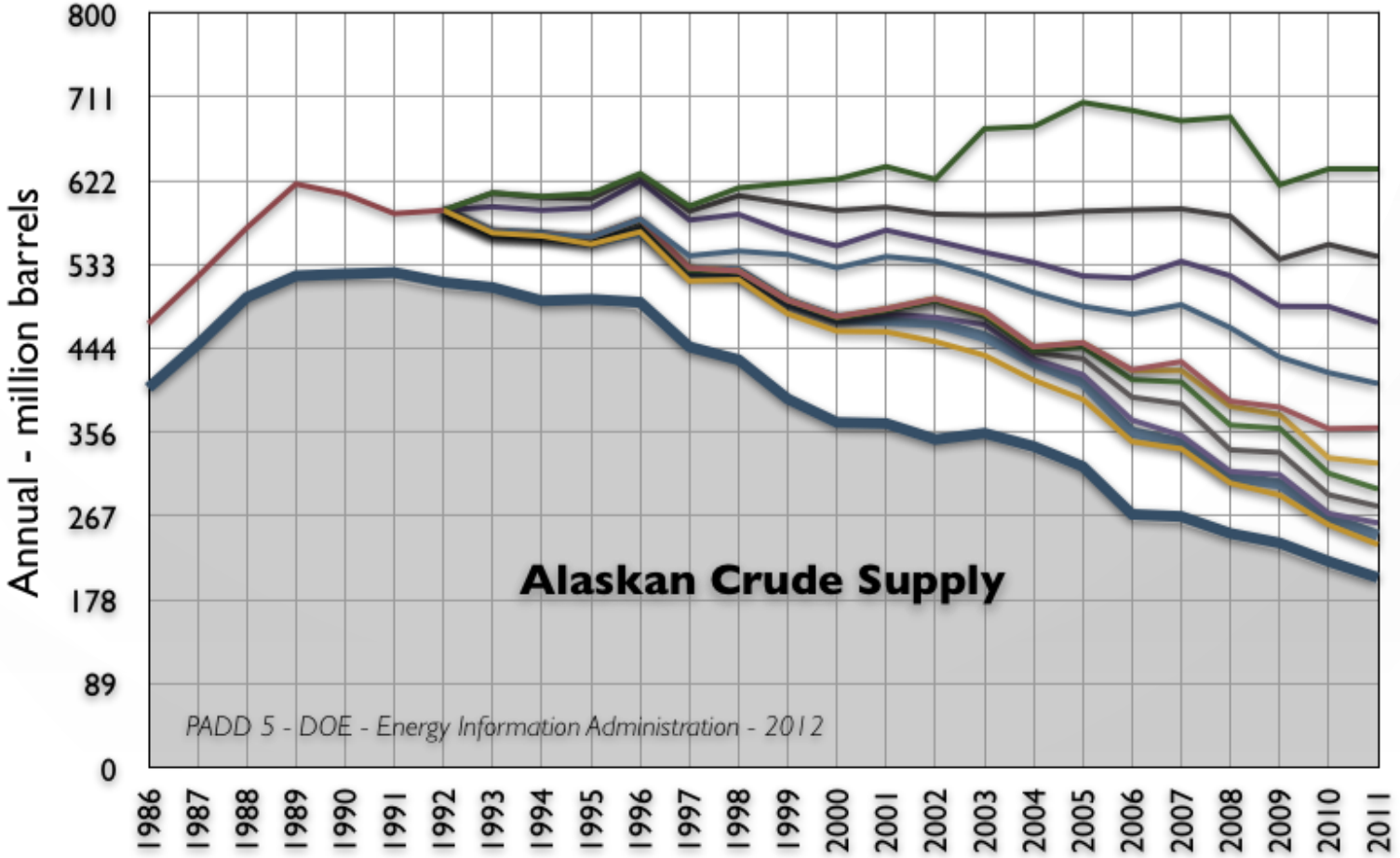
Source: US EIA 2012 Report

Challenge - US Energy Use



Source: US EIA 2012 Report

Challenge - Northwest Increasingly Depends on Imported Petroleum



Top Regional Importers

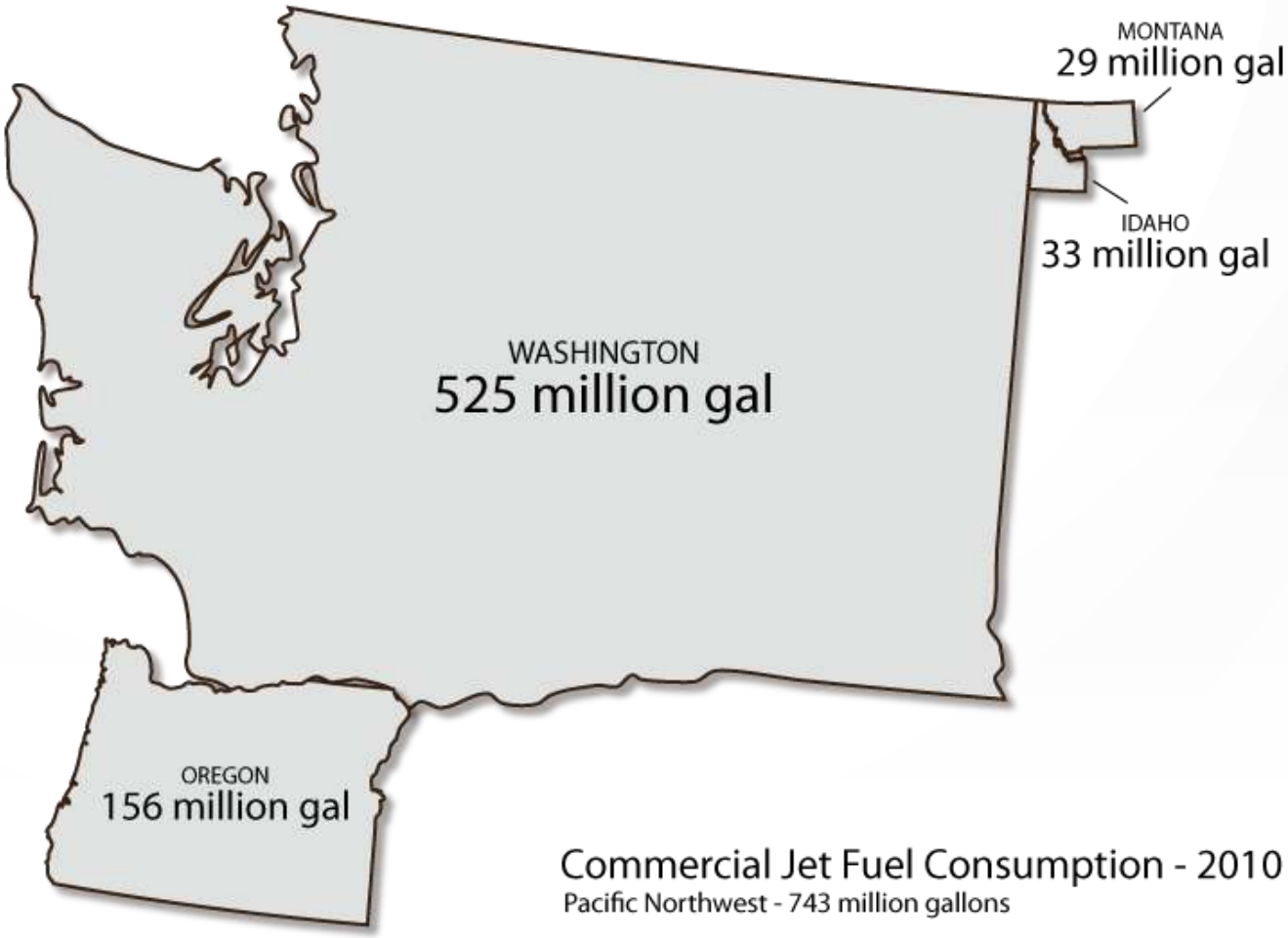
1. **Saudi Arabia**
2. **Ecuador**
3. Canada
4. **Iraq**
5. **Russia**
6. **Colombia**
7. Brazil
8. **Angola**
9. **Oman**
10. Argentina

Challenge – Economics and Policy

- $$$ - Private sector investment requires a good business plan and that will be marketable to the financial community beyond the the transient nature of government incentive policies

- Government can provide incentives, loan guarantees, and create markets through renewable fuel standards and other policies

Opportunity in Jet Fuel



Commercial Jet Fuel Consumption - 2010
Pacific Northwest - 743 million gallons

Opportunity in Jet Fuel & Co-Products

BIOJET

>$160 BILLION MARKET

UNITED

Alaska Airlines

RUBBER AND LUBRICANTS
>$4 BILLION

LANXESS

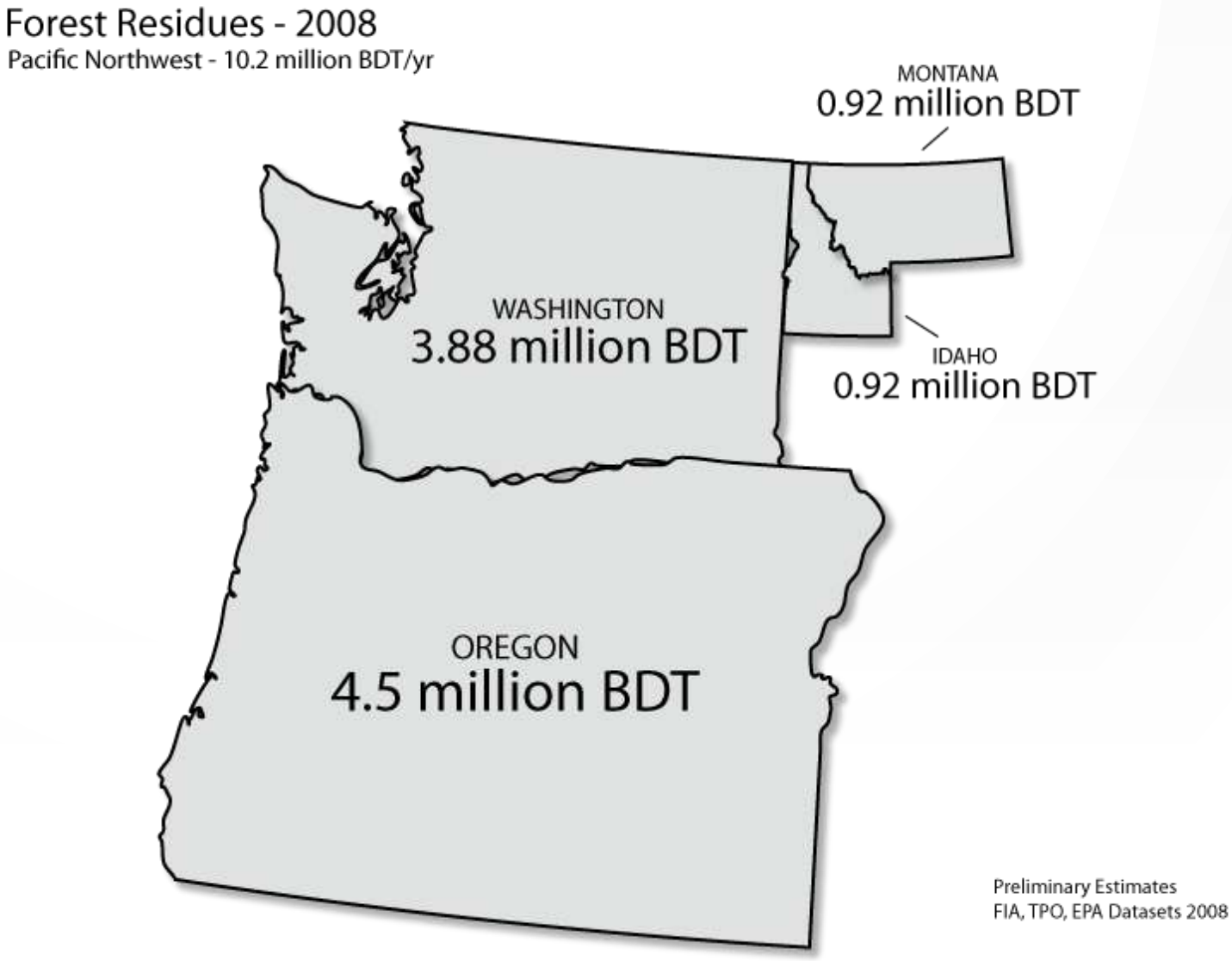
GASOLINE BLENDSTOCKS
>$5 BILLION

TOTAL

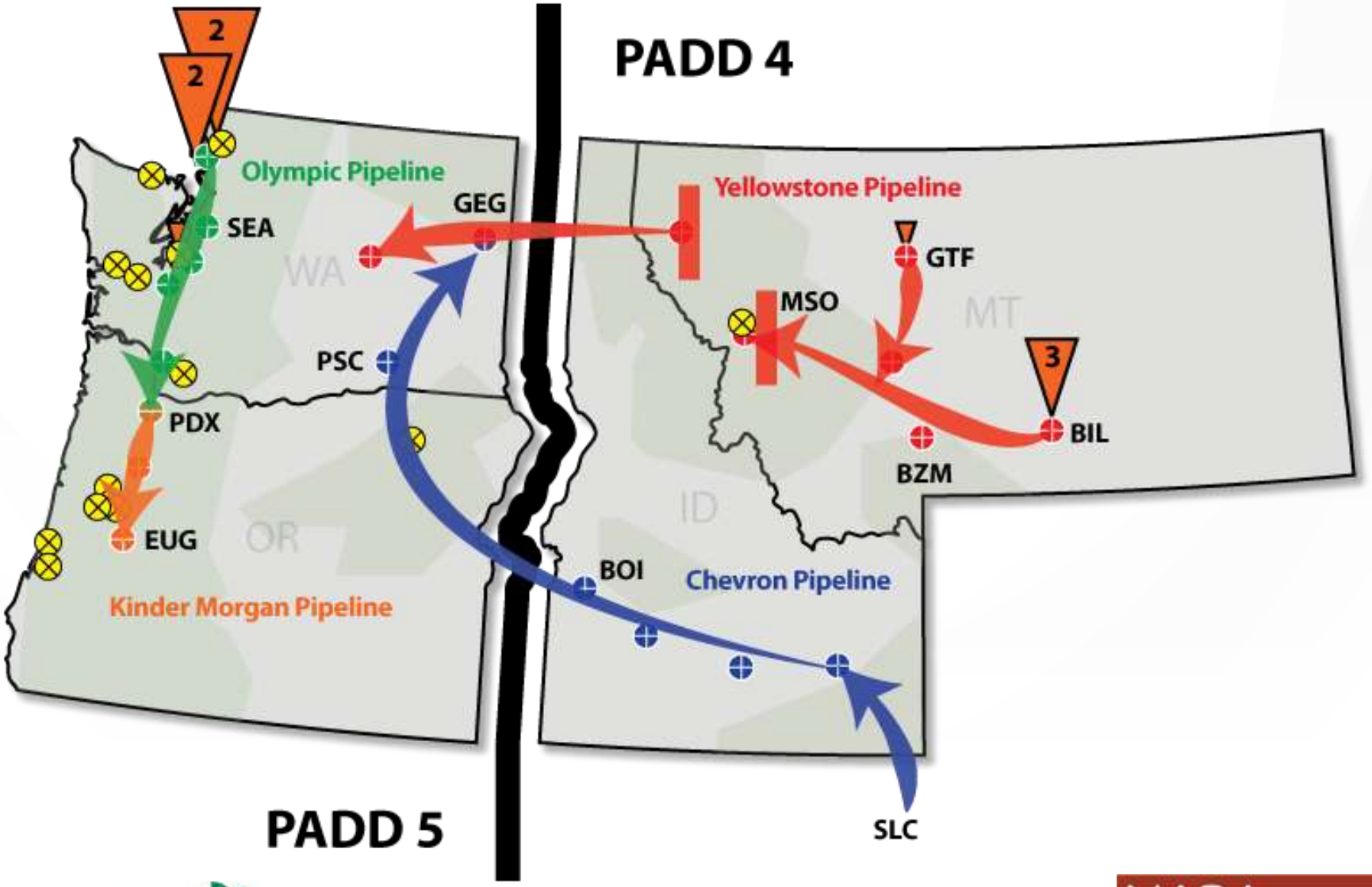
SOLVENTS
>$5 BILLION

sasol

Opportunity - Estimated Regional Supply of Forest Residuals



Opportunity - Dormant and Closed Pulp Facilities

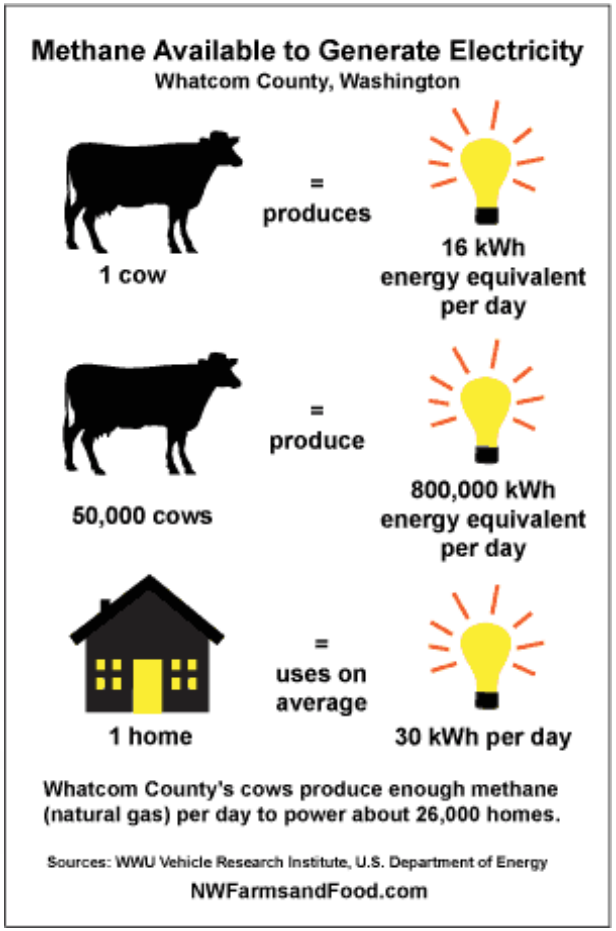


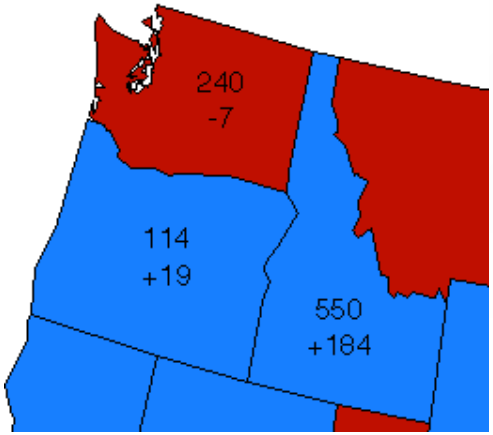
USDA NIFA

NARA
Northwest Advanced Renewables Alliance

Opportunity – Electricity Generation

Opportunity – Electricity Generation





Over 900,000 dairy cows in 2009
14 MWh potential per day

Research - Poised for the Future

Feedstock Diversity

Greenhouse & Field Crop Models

Genetic & Phenomic Equipment

Conversion Experts Thermal &Chemical

Regional Producers

Supply Chains

Delivery Networks

Regional Stakeholders

Cropping Systems

- Extensive Wheat and fallow
- <1% oilseeds

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Inland PNW Zone Acreage

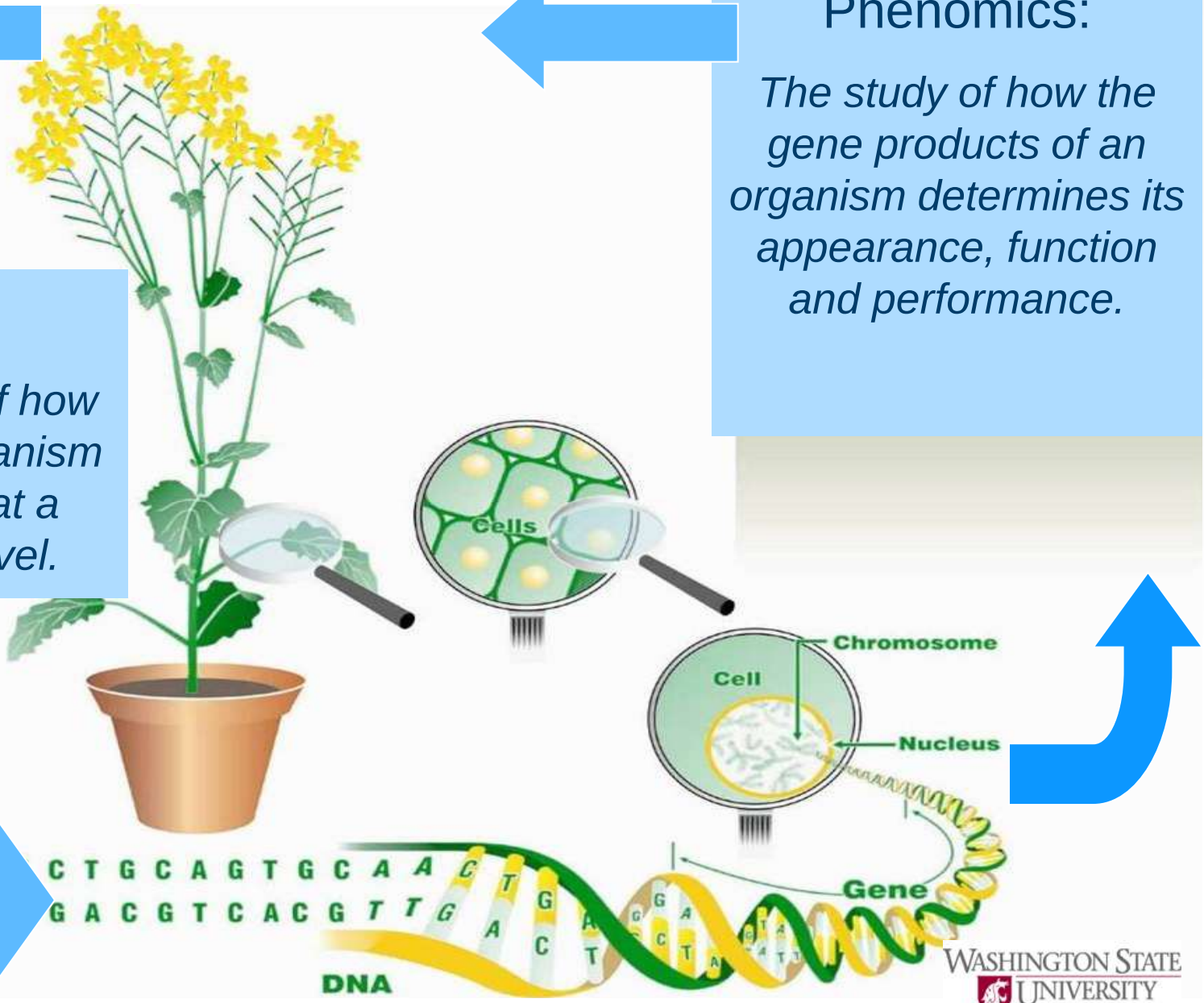
Plant Science Research

Phenomics:

The study of how the gene products of an organism determines its appearance, function and performance.

Genomics:

The study of how a whole organism operates at a genetic level.



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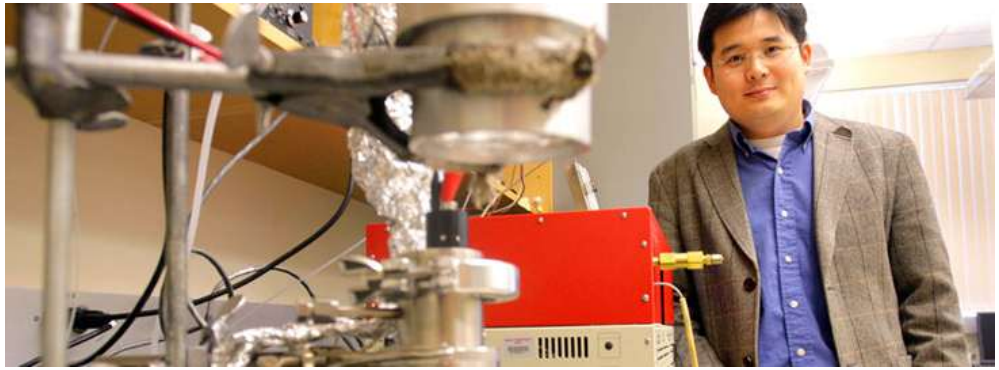
Engineering Research

Bioproducts, Sciences and Engineering Laboratory -BSEL



Voiland School of Chemical Engineering and Bioengineering

WSU TRI-CITIES & Pacific Northwest NATIONAL LABORATORY

Bioenergy & Bioproducts Engineering
Biological Systems Engineering

Composite Materials and Engineering Center
Civil & Environmental Engineering

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Economics, Policy, and Extension

School of Economic Sciences – areas of strength include

- Resource economics
- Energy policy
- Transportation economics

- In demand on research teams and by government agencies
  - e.g., Published legislature-requested study on oilseed crop policies

- WSU Extension – important connection to “real world”


The Northwest
Bioenergy Research Symposium
November 13, 2012
Seattle Washington

Thank you