

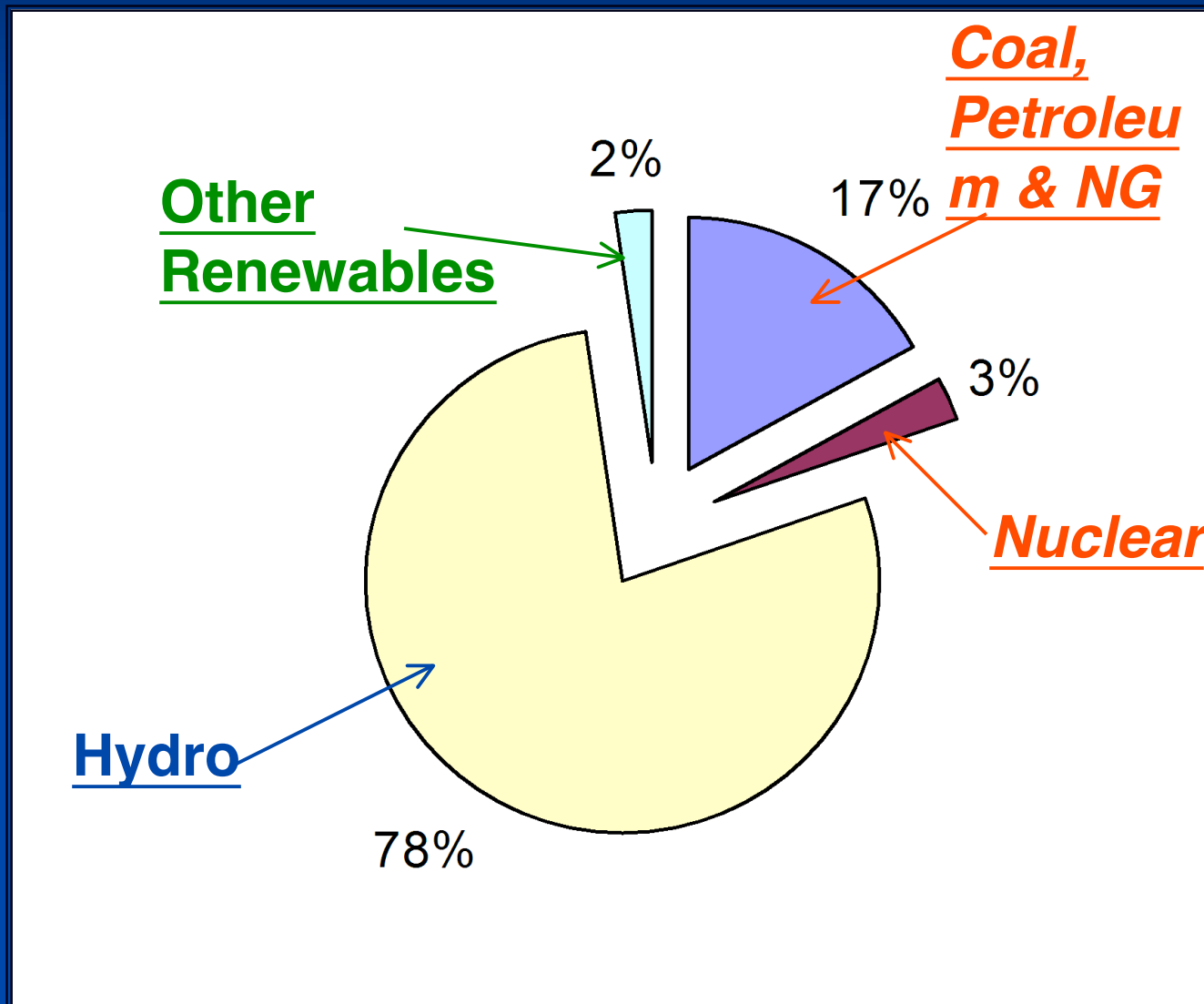
V2G and Wind Power

Amardeep Dhanju & Phillip Whitaker

**College of Marine Studies, University of
Delaware**

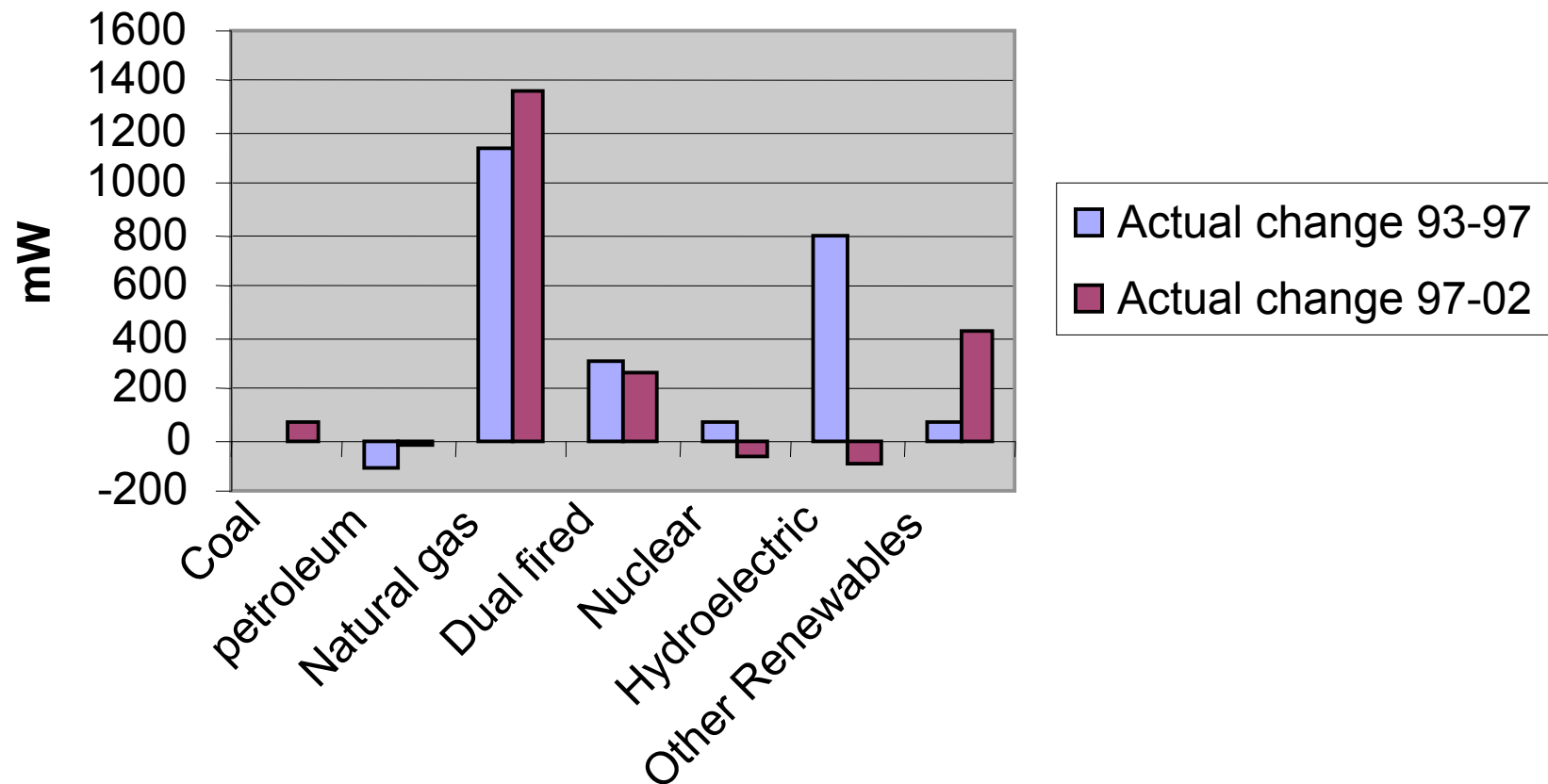
**Seattle V2G Technical Symposium
June 6, 2005**

Pacific Northwest Source of Energy for Electric Vehicles



Installed Capacity Trends

Changing energy mix



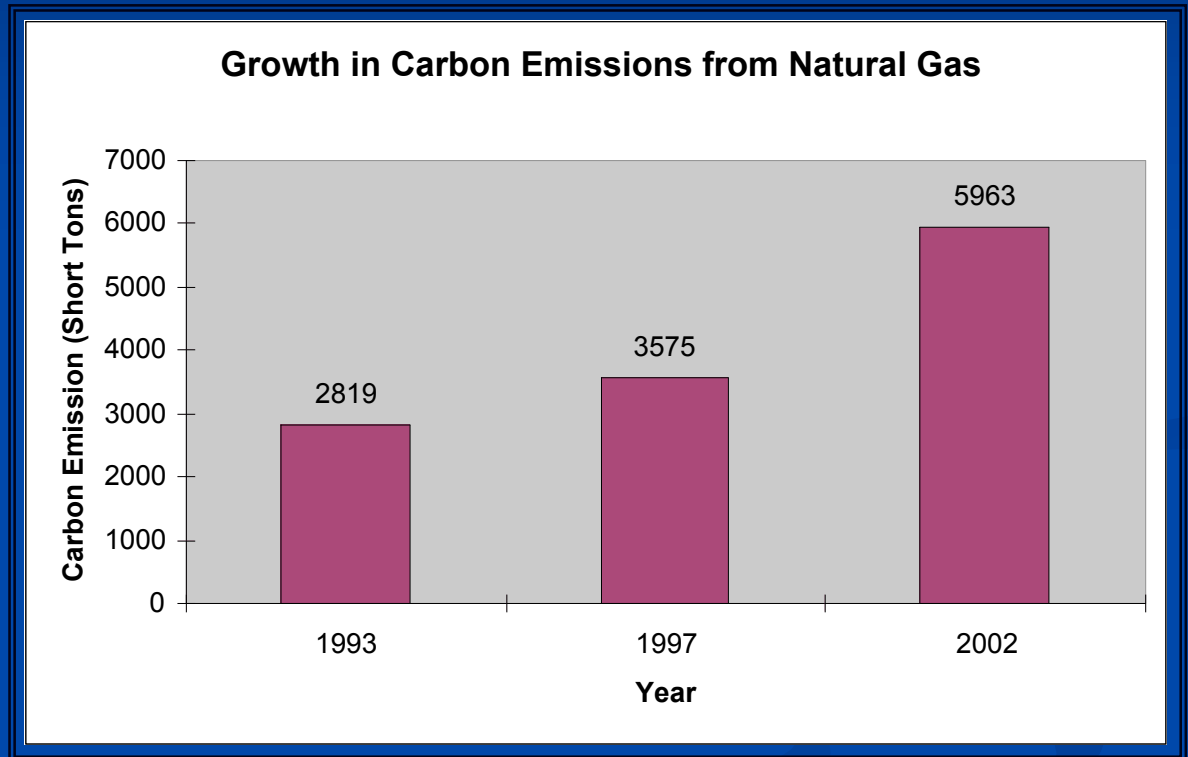
Negatives of Natural Gas: Price Volatility and Carbon Emissions

Jan 2005:
\$6.65



Jan 2002 : \$
3.10

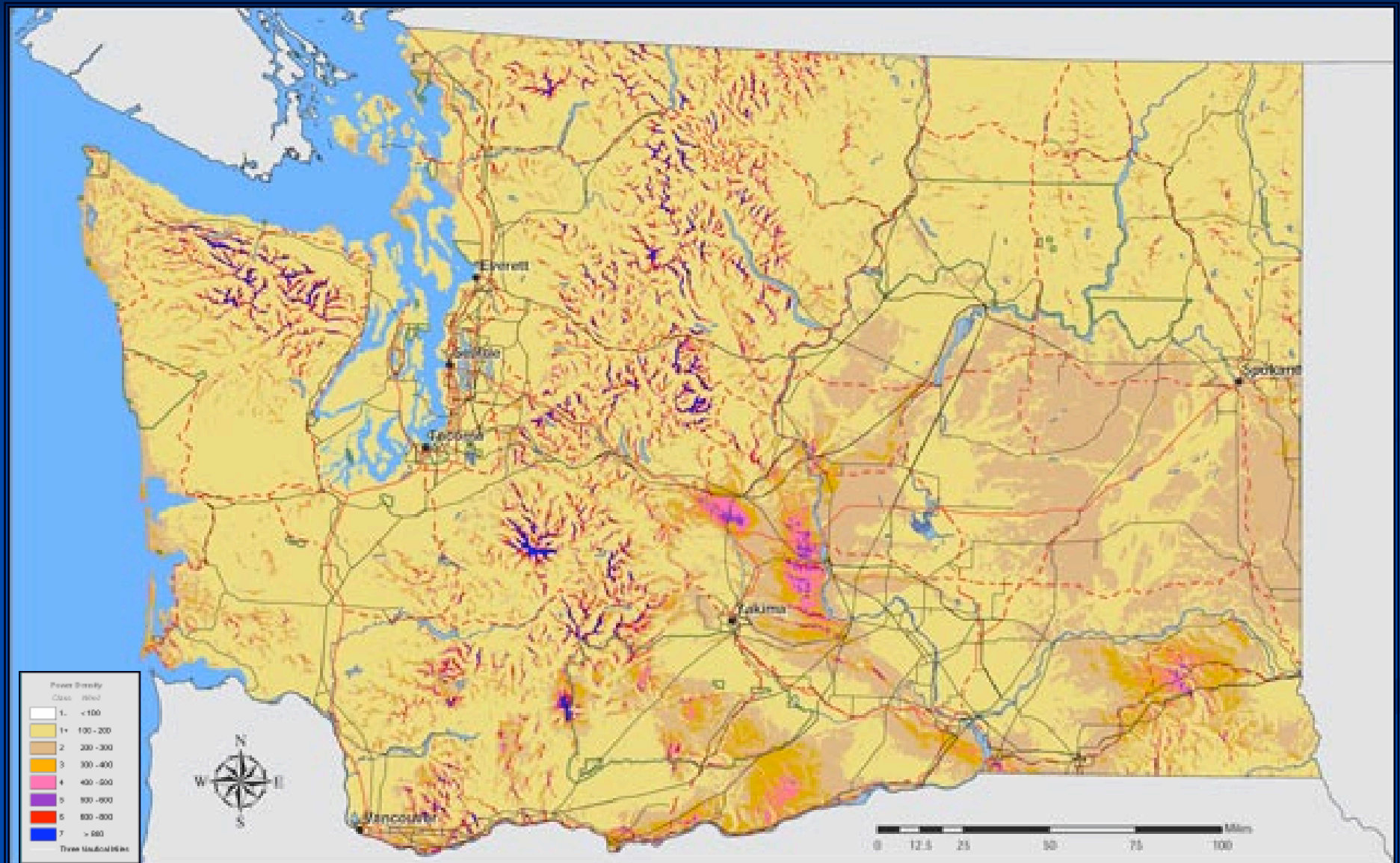
Source: EIA



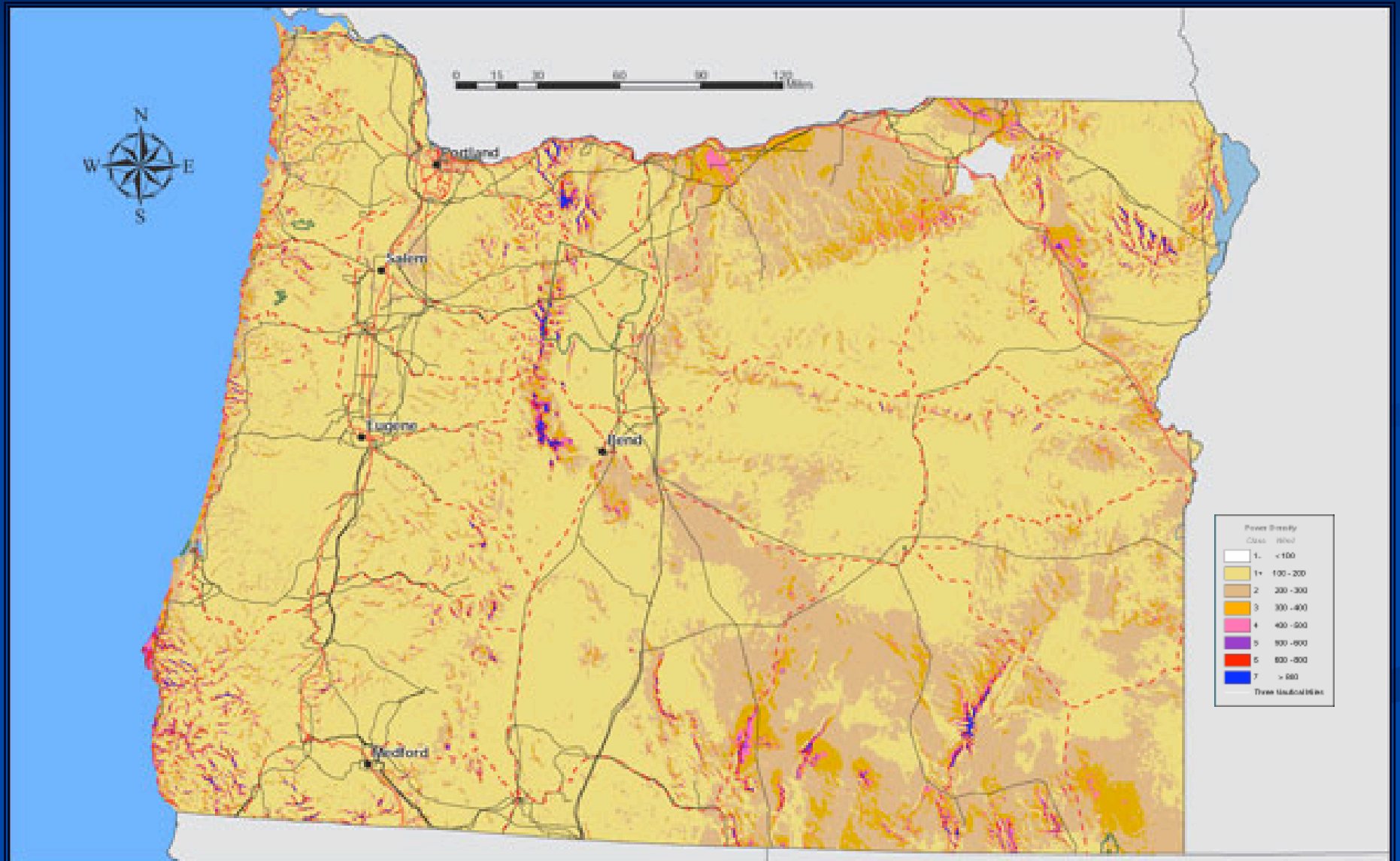
Washington & Oregon

Source: EIA

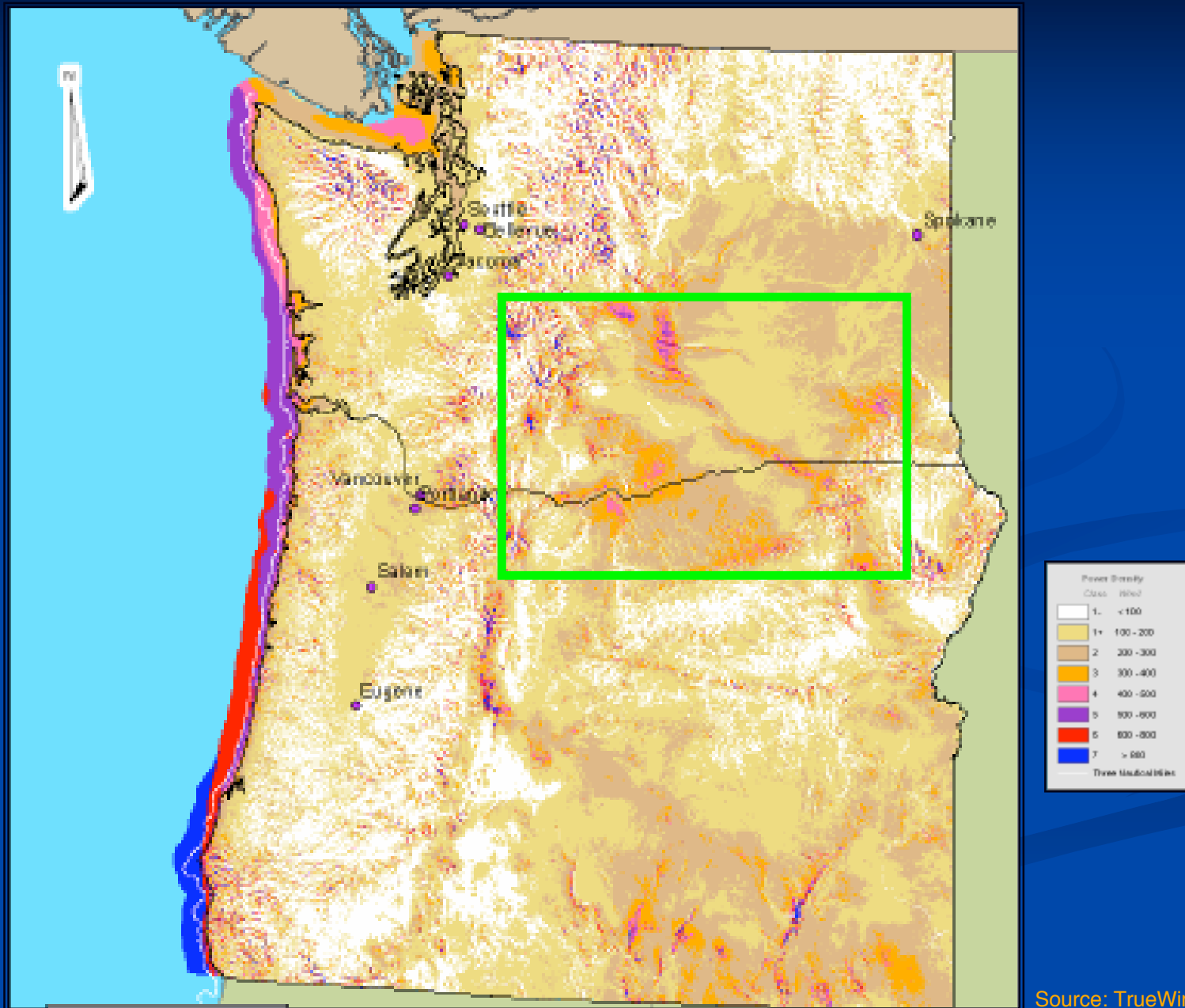
Wind Resource Washington



Wind Resource Oregon

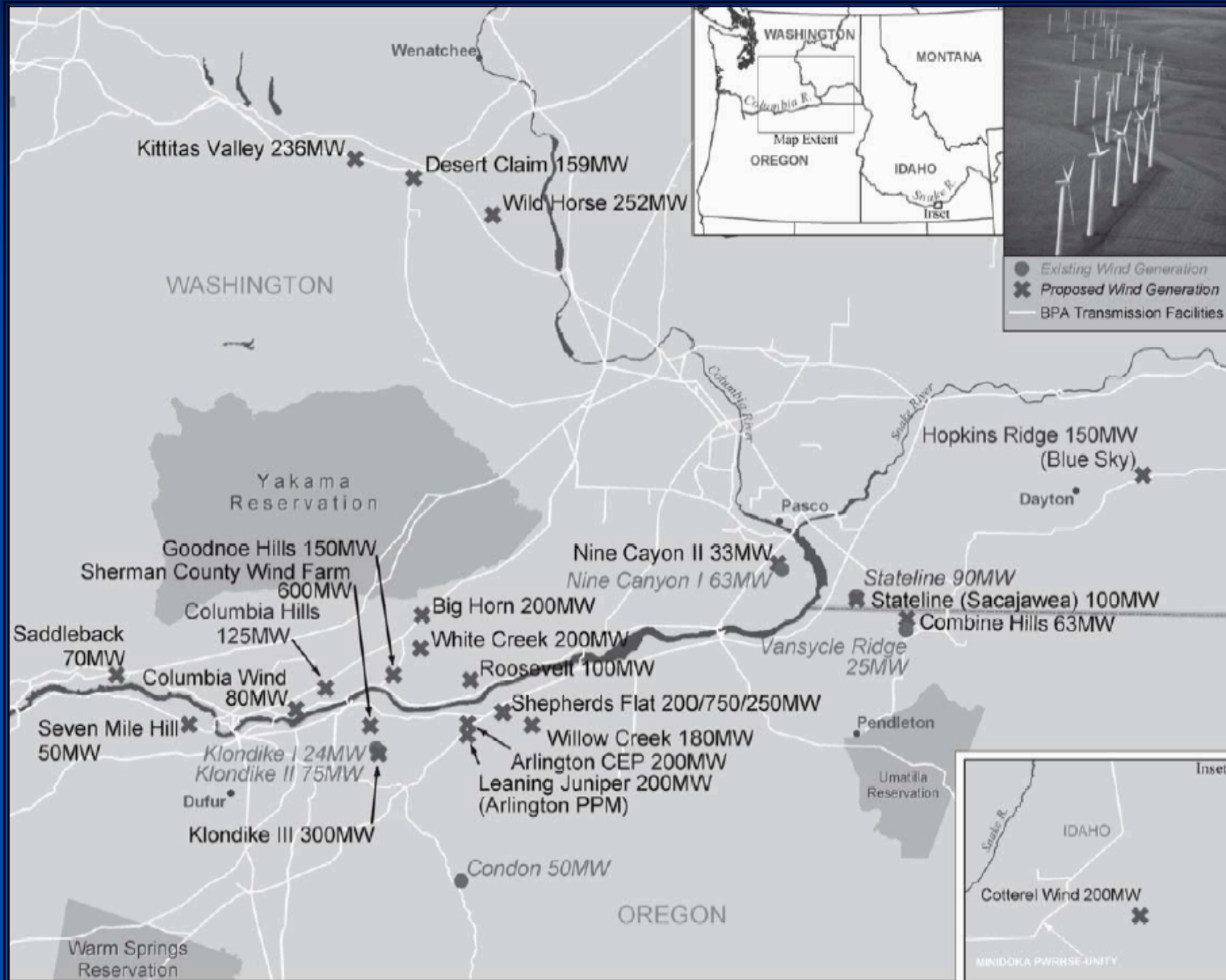


Offshore and Onshore



Source: TrueWind Solutions

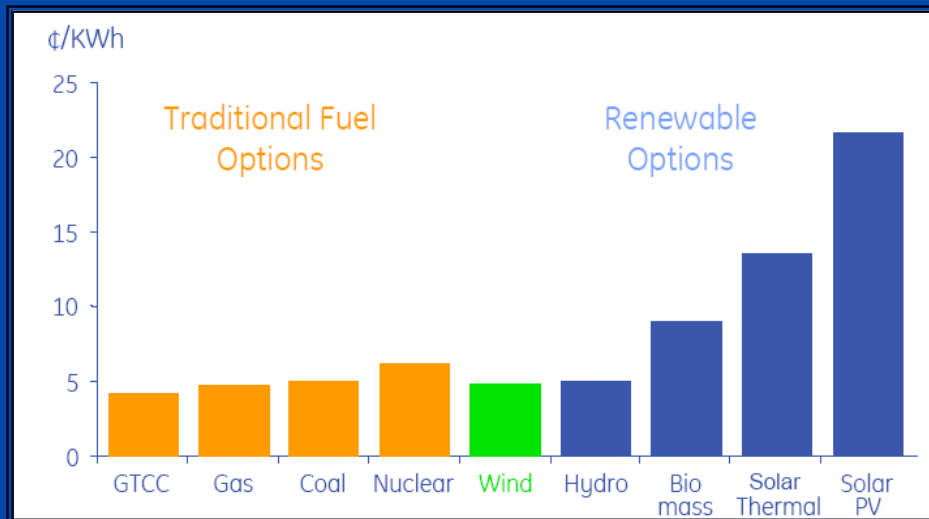
Existing and Proposed Wind Generation Facilities



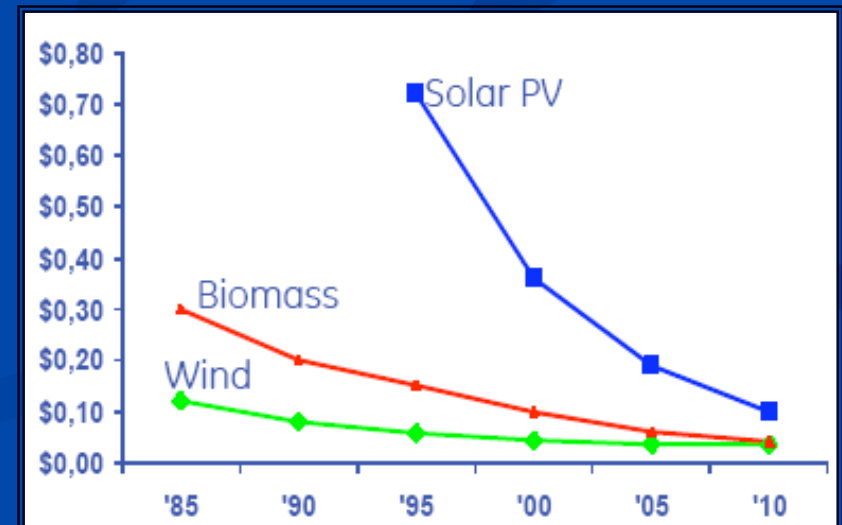
Source: Bonneville Power Authority

Advantages of Wind Power

- Clean Energy
- No fuel costs, a hedge against price volatility
- Security of Supply – avoids reliance on imported fuels
- Modular and rapid to install
- Utility scale bulk power source



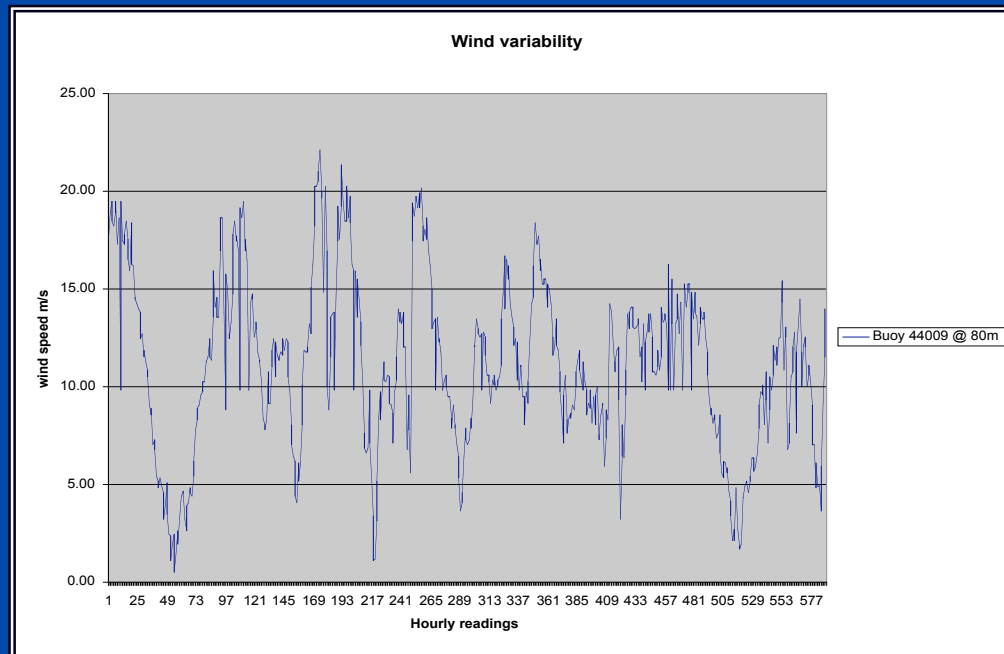
Source: Lawrence Livermore Lab



Source: GE Power

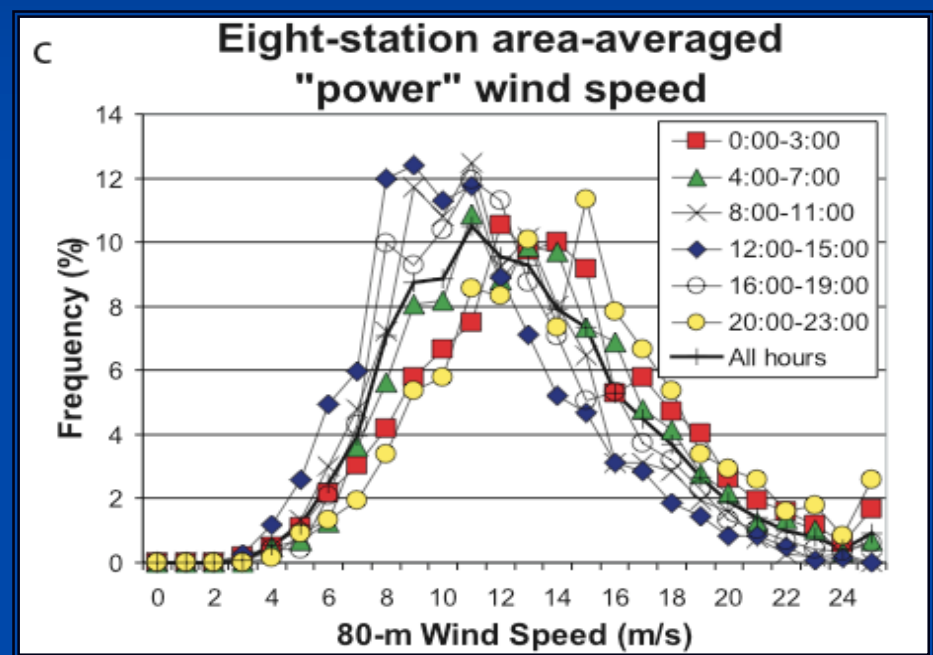
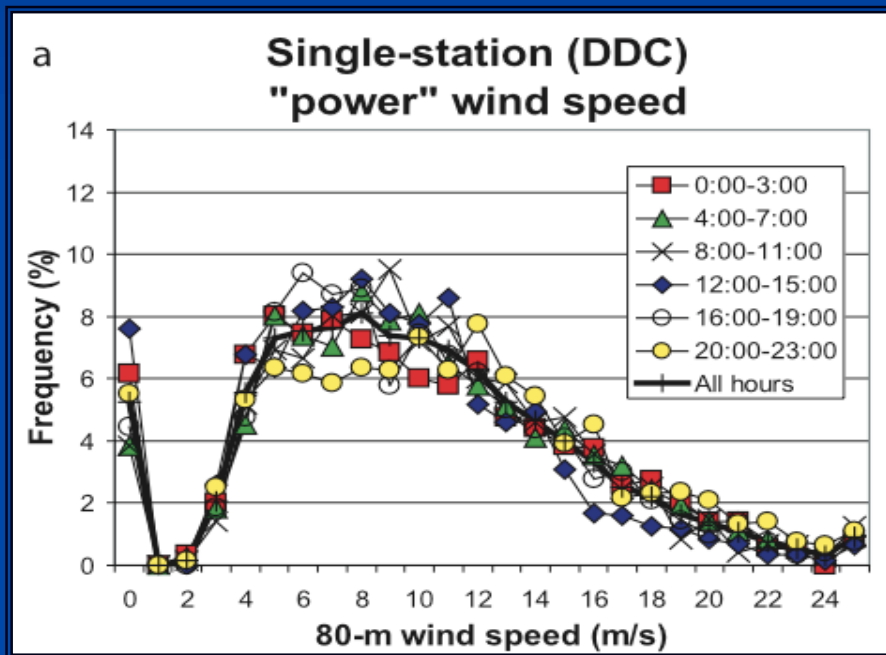
Disadvantages of Wind Power

- Variable resource: Wind Power is an intermittent resource with daily and seasonal variations
- Capital Intensive: The upfront cost of setting up a wind farm is greater than conventional power plant
- Aesthetics
- Not a Portable Resource



Data Source: NOAA Data Buoy Center

Multiple Sites



Source: Archer and Jacobson, 2003

Wind Energy with Storage

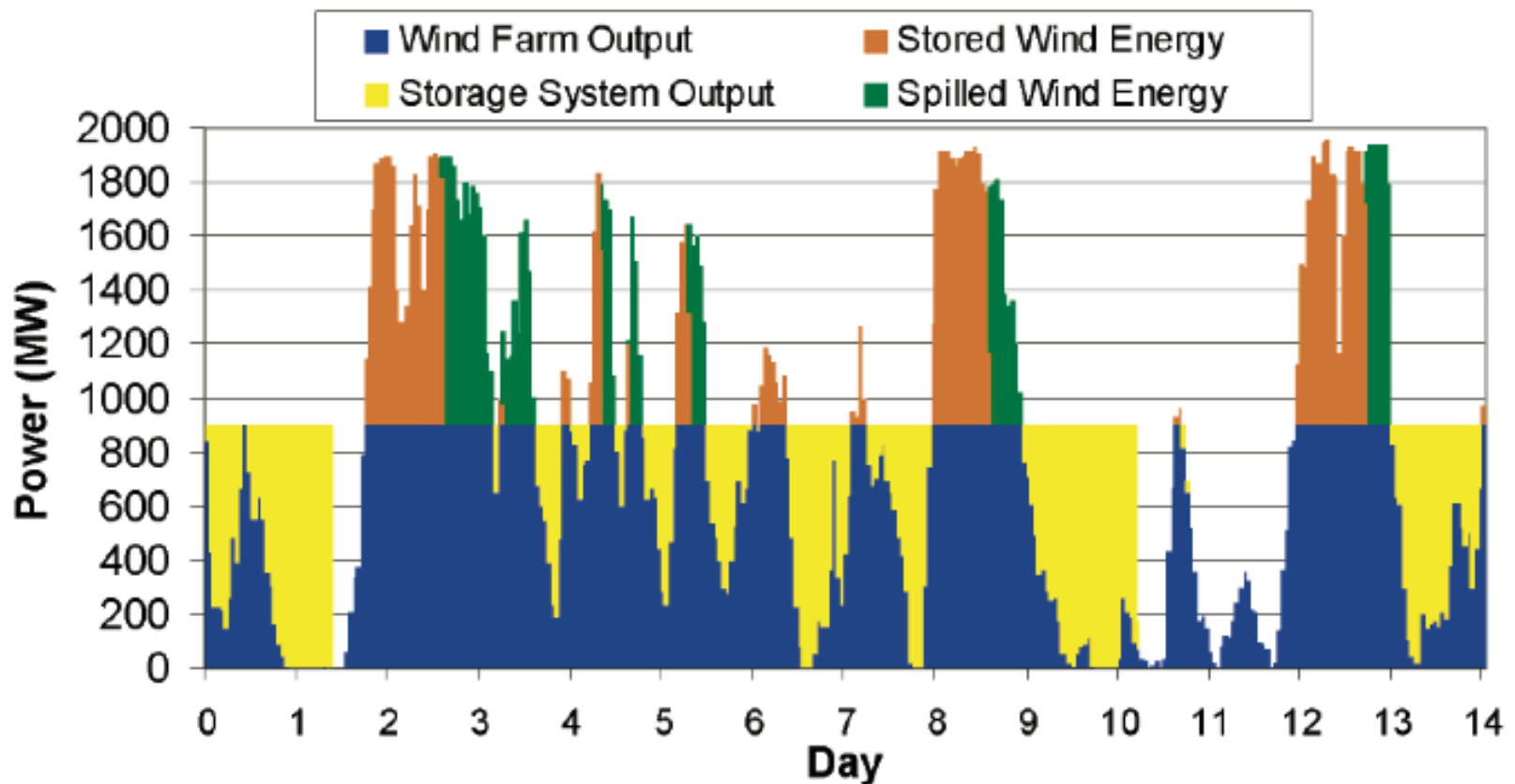
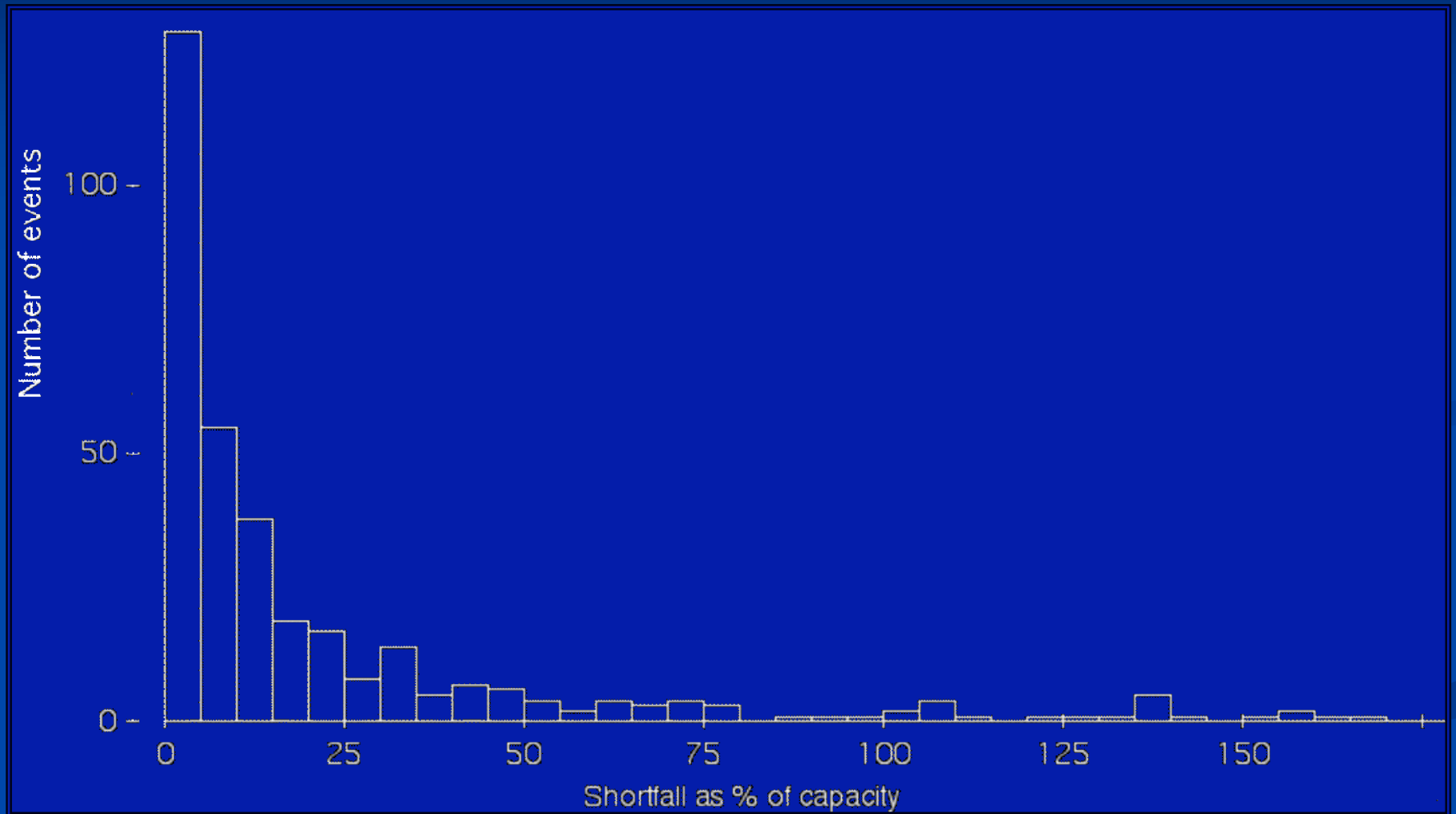


FIGURE 1. Sample baseload wind generator output (target output = 900 MW).

V2G



Source: Kempton and Tomic " Vehicle to grid implementation : From stabilizing the grid to supporting large scale renewable energy

Conclusion

- **Hydro is the major energy source in Pacific NW. Natural Gas is the favored new energy source.**
- **Carbon emissions and price volatility associated with the use of Natural Gas.**
- **On shore and Offshore Wind resources available in the region.**
- **Intermittency and storage are the main drawbacks associated with large scale use of Wind energy.**
- **Wind energy is a clean power source for EDV.**
- **V2G can effectively and affordably provide an essential component of a base load Wind energy system.**