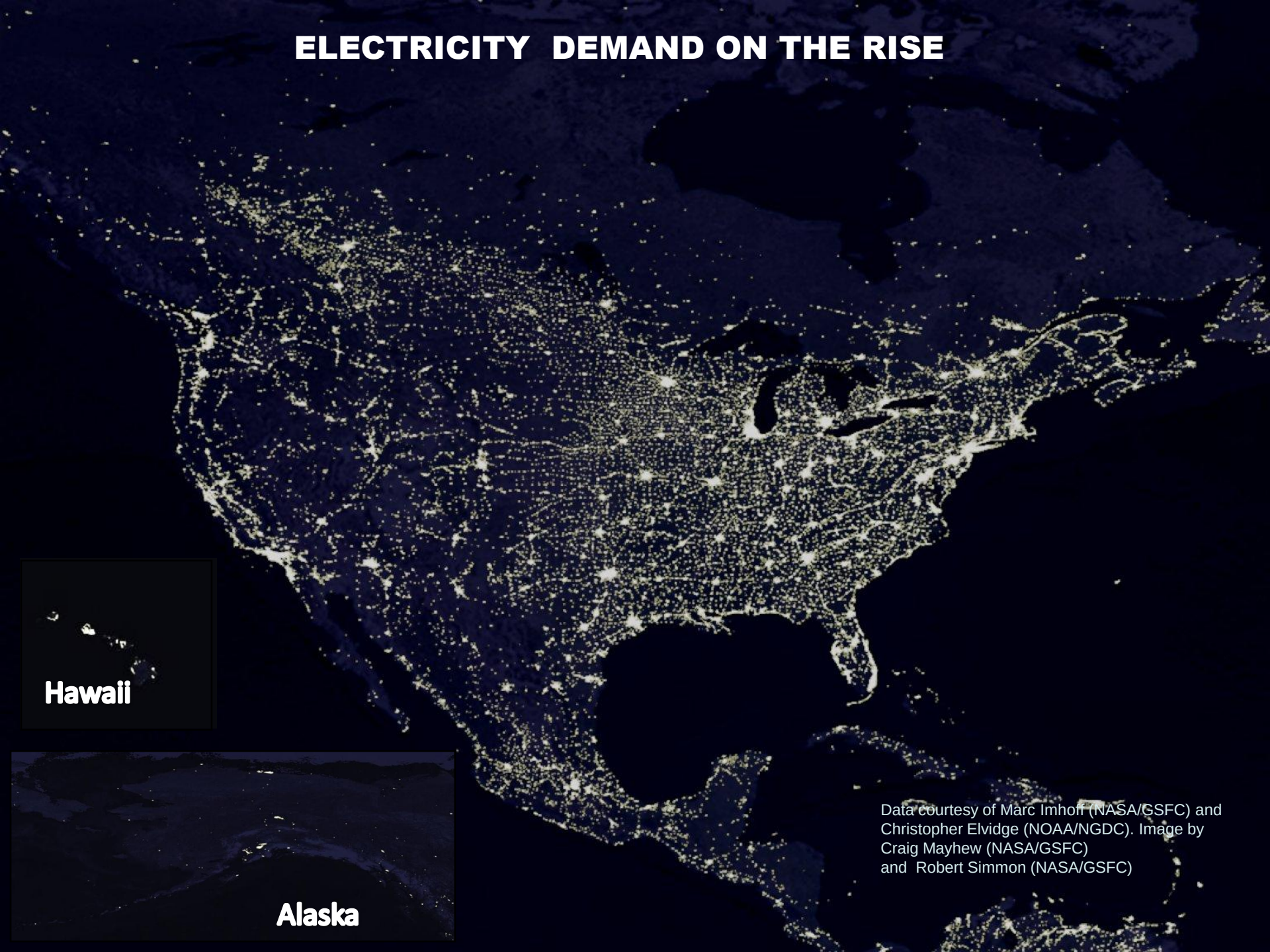
Examples of Offshore Renewable Energy

Wind Energy

Wave Energy

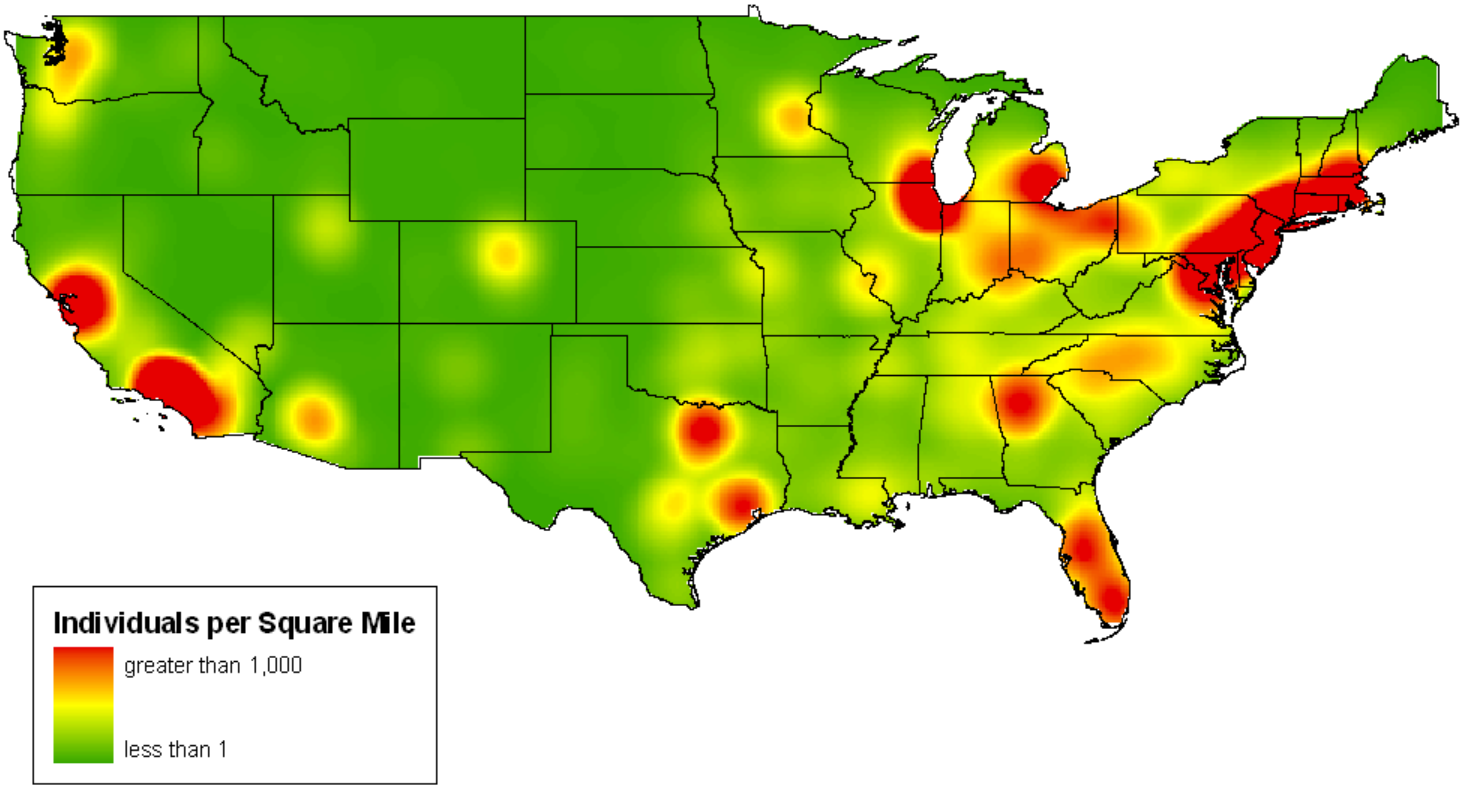
Ocean Current Energy

ELECTRICITY DEMAND ON THE RISE



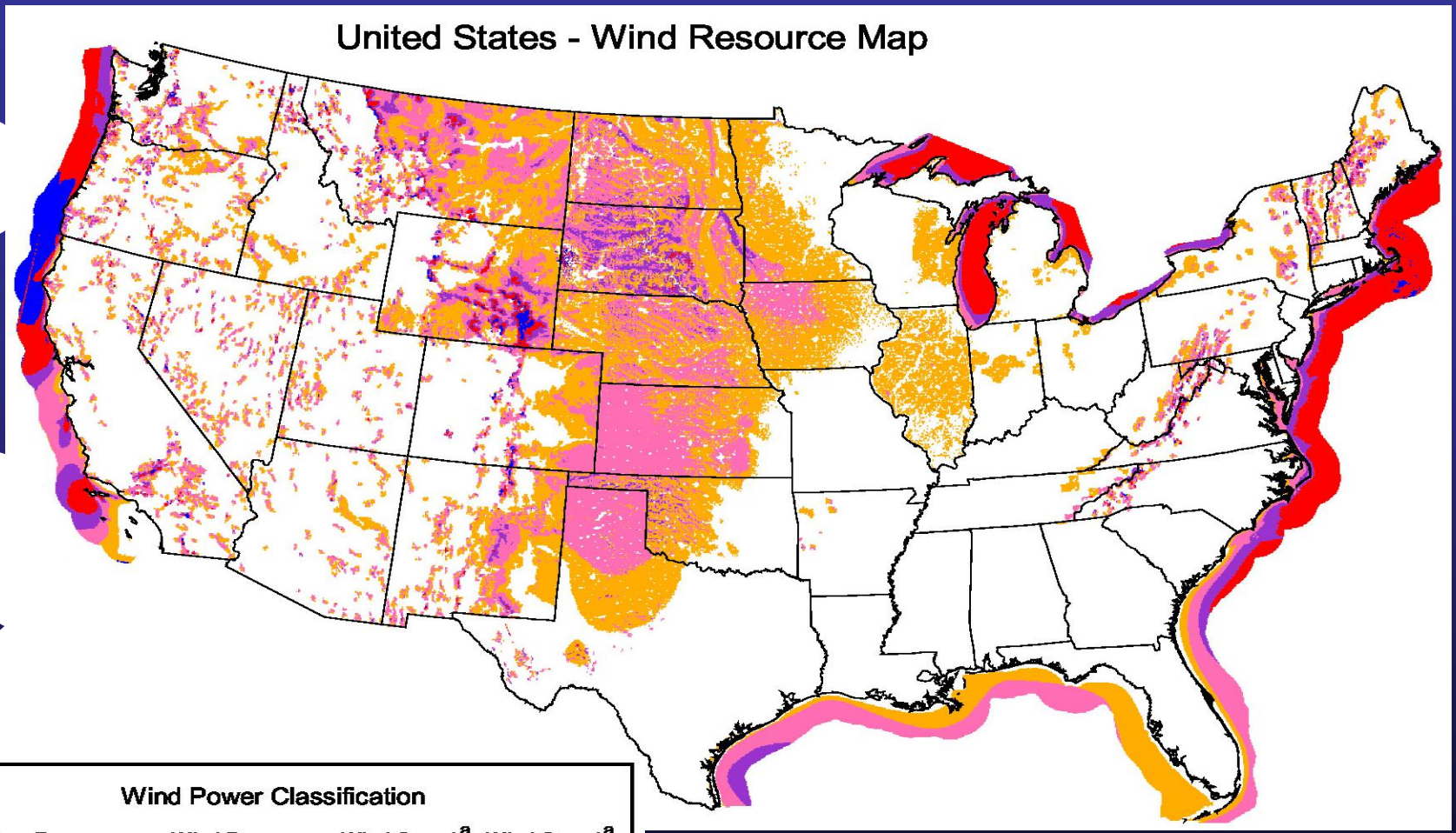
Data courtesy of Marc Imhoff (NASA/GSFC) and Christopher Elvidge (NOAA/NGDC). Image by Craig Mayhew (NASA/GSFC) and Robert Simmon (NASA/GSFC)

Population Density of the Contiguous United States



U.S. Wind Speed Data

Substantial Offshore Resources Located Near Coastal Areas



Wind Power Classification

Wind Power Class	Resource Potential	Wind Power Density at 50 m W/m^2	Wind Speed[a] at 50 m m/s	Wind Speed[a] at 50 m mph
3	Fair	300 - 400	6.4 - 7.0	14.3 - 15.7
4	Good	400 - 500	7.0 - 7.5	15.7 - 16.8
5	Excellent	500 - 600	7.5 - 8.0	16.8 - 17.9
6	Outstanding	600 - 800	8.0 - 8.8	17.9 - 19.7
7	Superb	800 - 1600	8.8 - 11.1	19.7 - 24.8

[a] Wind speeds are based on a Weibull k value of 2.0

What About Watts?

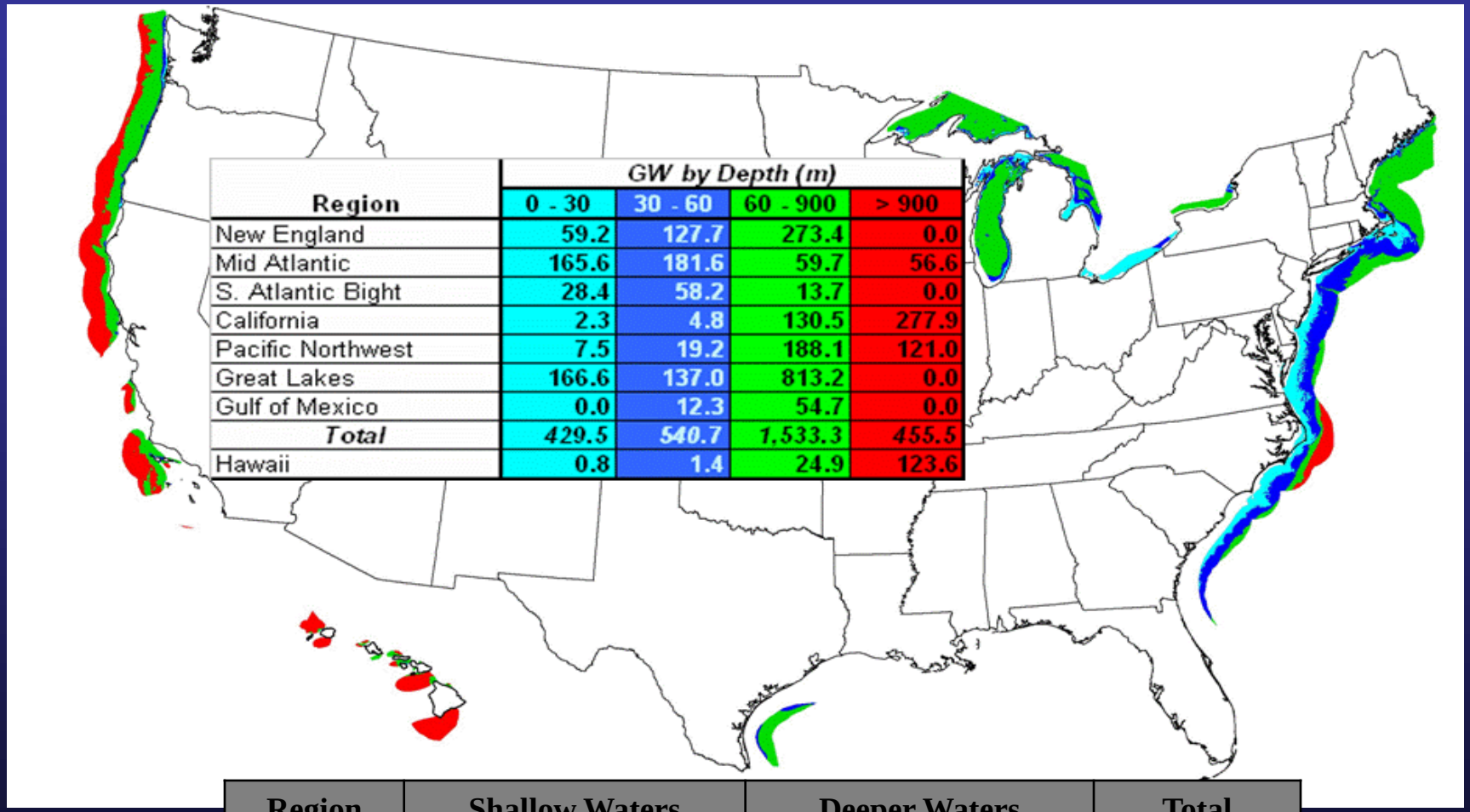
- **Household power is measured in KW (kilowatts)**
- **1,000 KW = 1 MW (megawatt)**
- **1,000 MW = 1 GW (gigawatt)**
- **A mid-size coal-fired electrical plant produces ~350 MW; so 1 GW = output from 3 typical coal plants**

Energy Consumption

- The average American household uses about 10,655 kilowatt-hours per year (kWh/y)

- 1 GW of wind power will supply between 225,000 to 300,000 average U.S. homes with power annually.

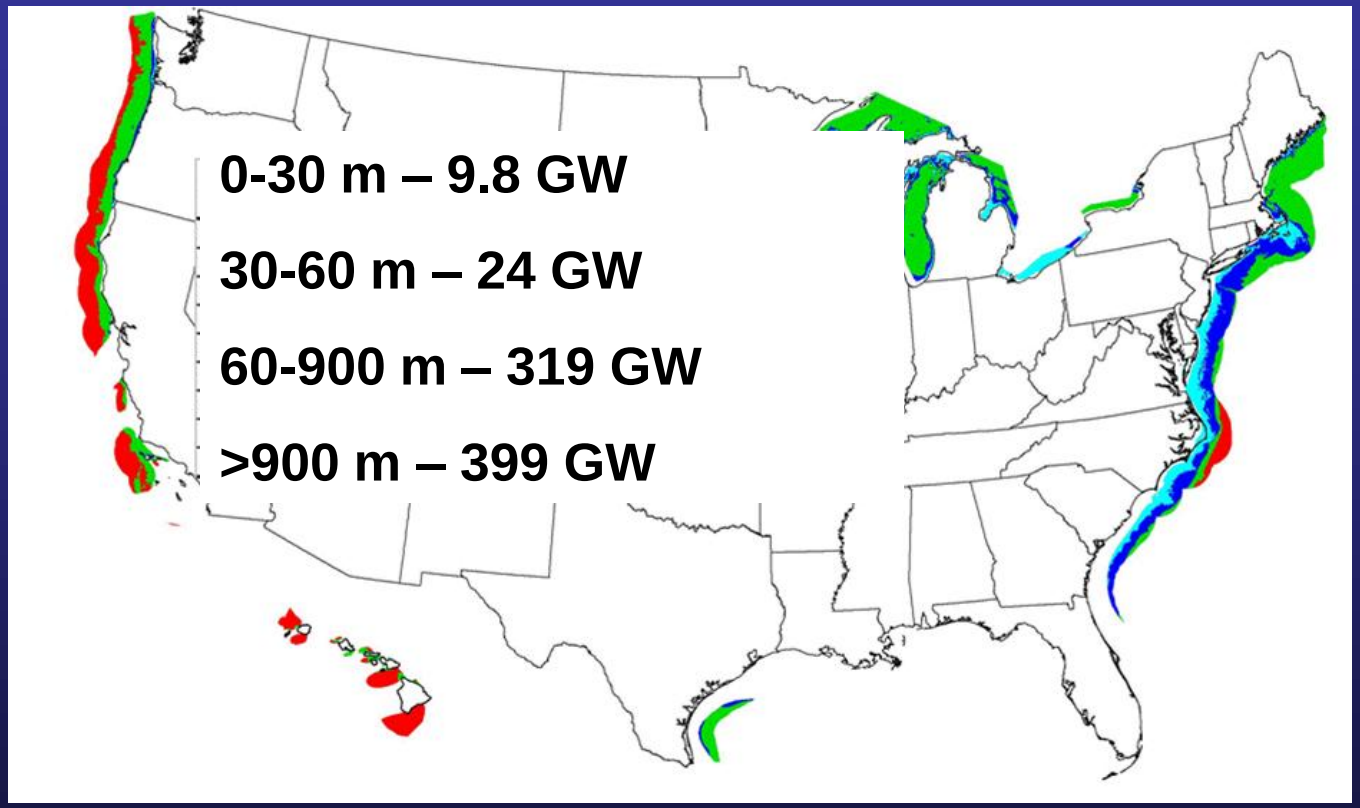
Regional Offshore Wind Energy Potential Capacity



Region	GW by Depth (m)			
	0 - 30	30 - 60	60 - 900	> 900
New England	59.2	127.7	273.4	0.0
Mid Atlantic	165.6	181.6	59.7	56.6
S. Atlantic Bight	28.4	58.2	13.7	0.0
California	2.3	4.8	130.5	277.9
Pacific Northwest	7.5	19.2	188.1	121.0
Great Lakes	166.6	137.0	813.2	0.0
Gulf of Mexico	0.0	12.3	54.7	0.0
Total	*429.5*	*540.7*	*1,533.3*	*455.5*
Hawaii	0.8	1.4	24.9	123.6

Region	Shallow Waters	Deeper Waters	Total
Atlantic	**253.2 GW**	**770.9 GW**	**1024 GW**
Pacific	**9.8 GW**	**741.5 GW**	**751 GW**
Gulf	**0 GW**	**67 GW**	**67 GW**

California and Pacific NW Resource

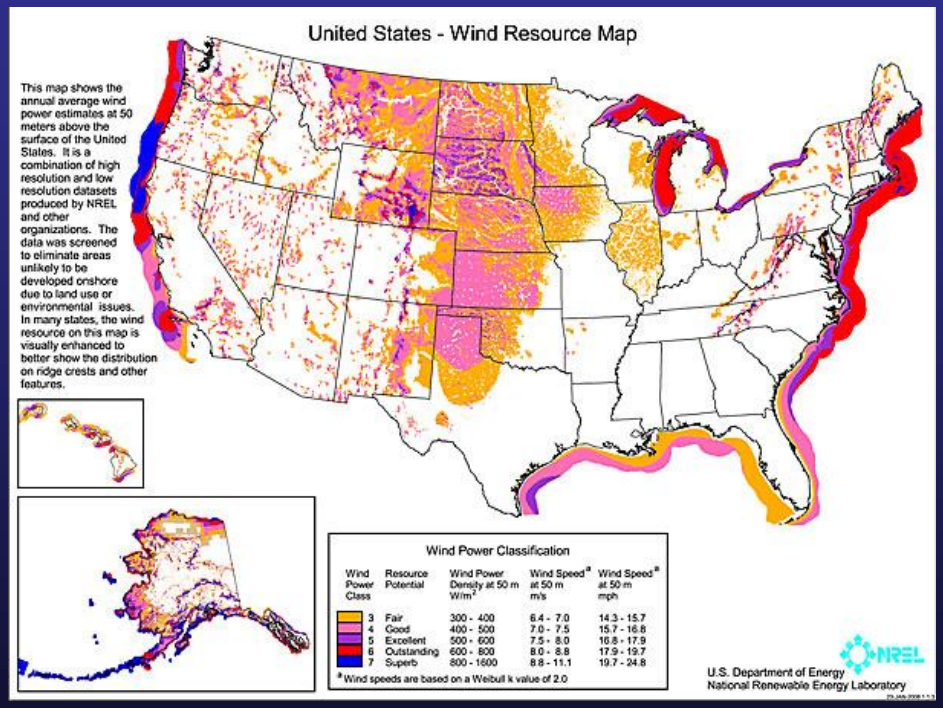


NREL

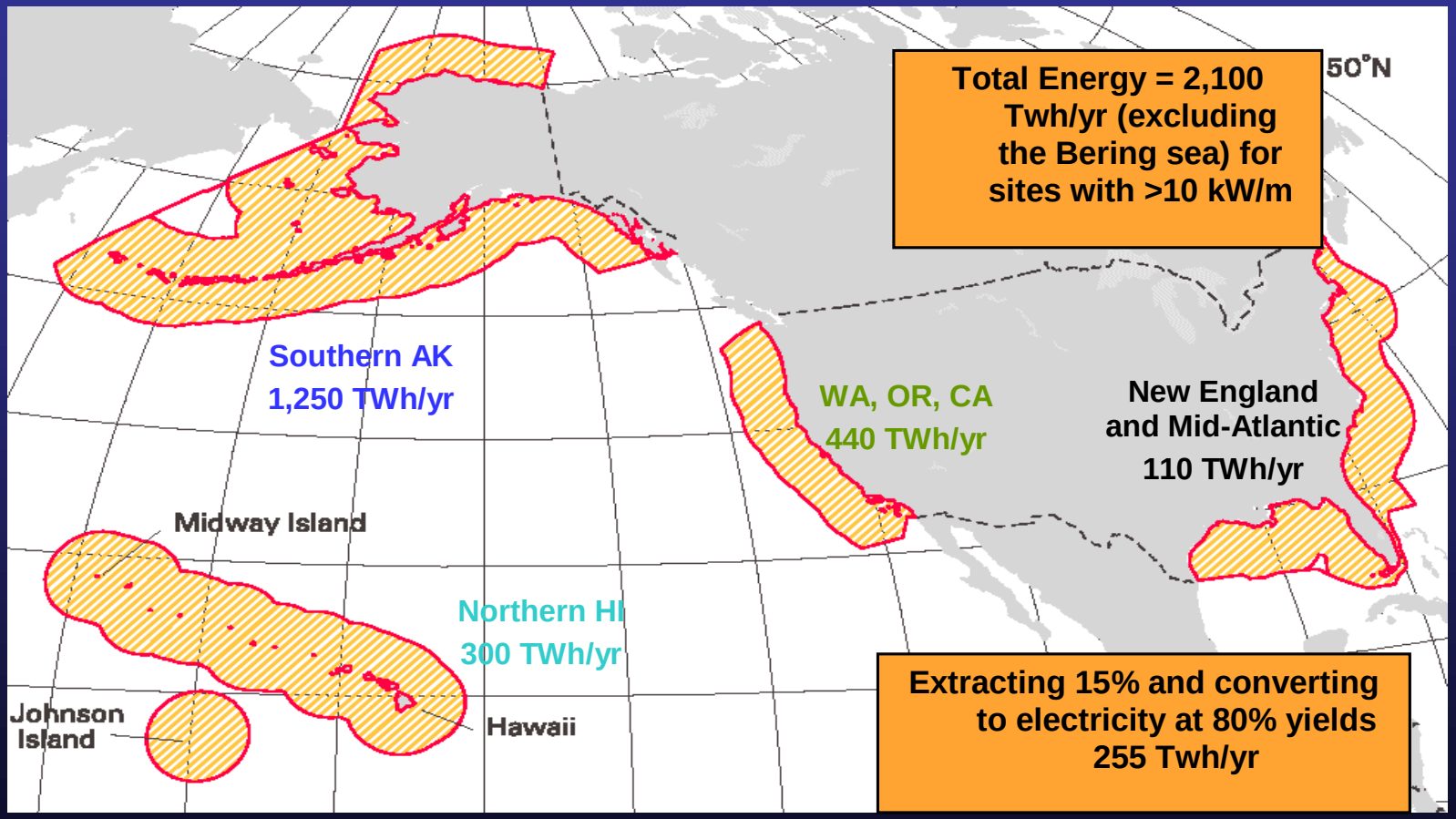
Potential Offshore Wind
California and Pacific NW OCS

- **California (Dvorak et. Al, 2007)**
  - **Northern California shows greatest resource**
  - **estimate overall potential of 25-108 GW, but mostly in deep waters**

- **Entire West Coast, (NREL)**
  - **estimate a gross resource of 750 GW**
  - **Assume about 40%—300 GW would be developed. That could power about 90 million average U.S. homes.**



U.S. Offshore Wave Energy Resources



Greatest resource potential occurs in the Pacific, especially Alaska

Potential Offshore Wave Energy
Pacific OCS

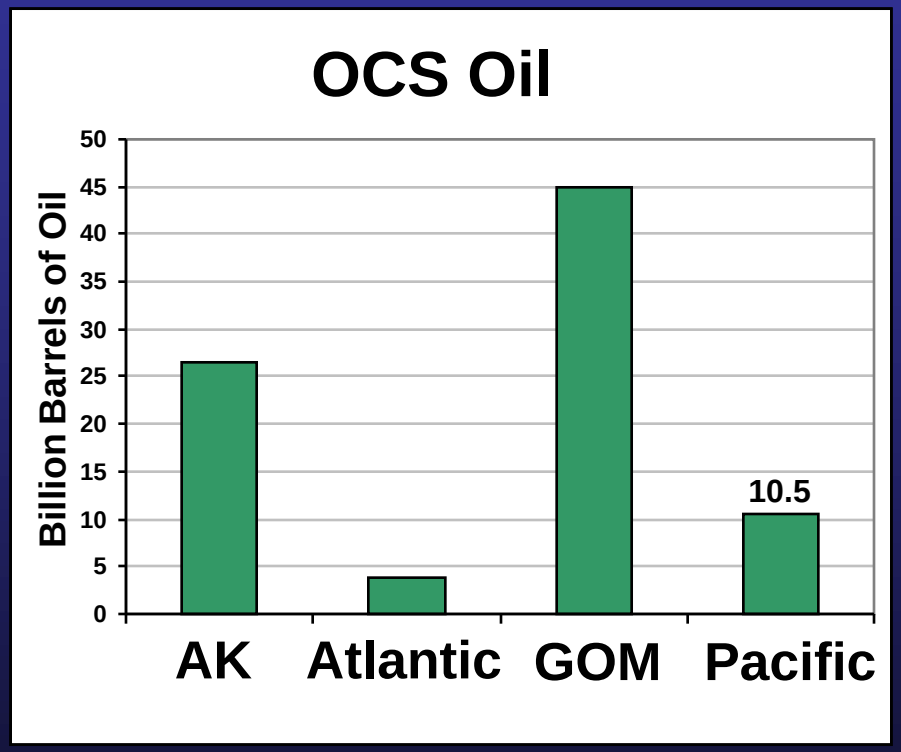
- Wave resources along the Pacific coast are consistently strong.
- Developers have shown interest offshore Washington and Oregon. U.S. Navy has been experimenting offshore Hawaii.
- **Pacific Northwest: EPRI estimates the wave resource to be 440 TWh/y. Assuming 15-percent of that would be developed results in a potential of 66 TWh/y or 20 GW—enough to power about 6 million average U.S. homes.**

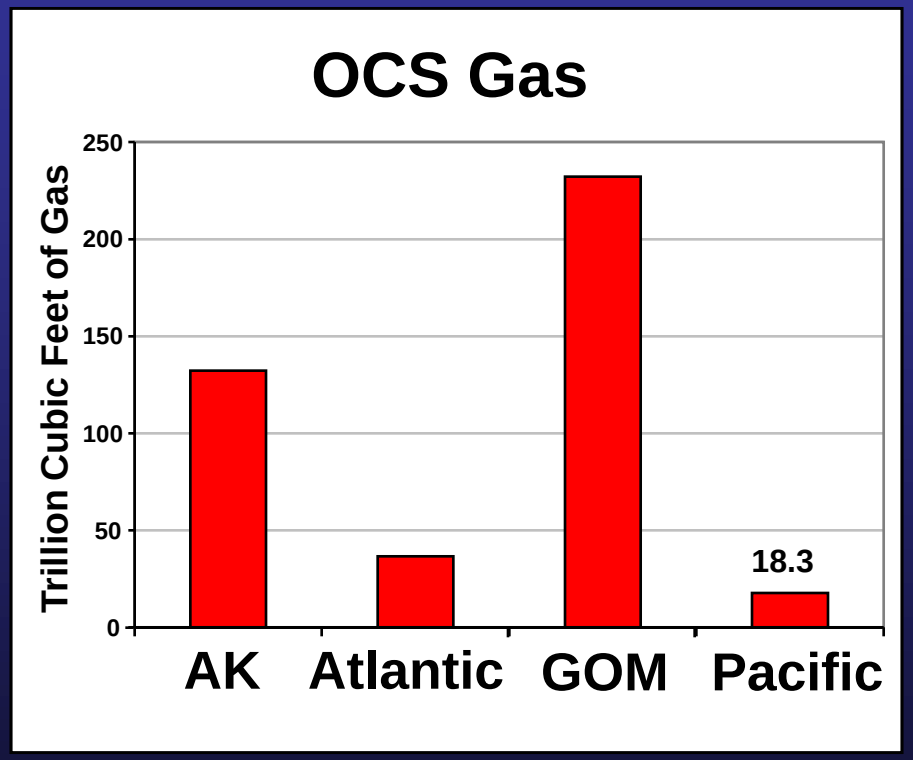
Oil and Gas Resources

After more than 50 years of exploration and development, 70% of total resources are yet to be discovered.

Undiscovered Technically Recoverable Oil and Gas Resources

2006 National Assessment Results





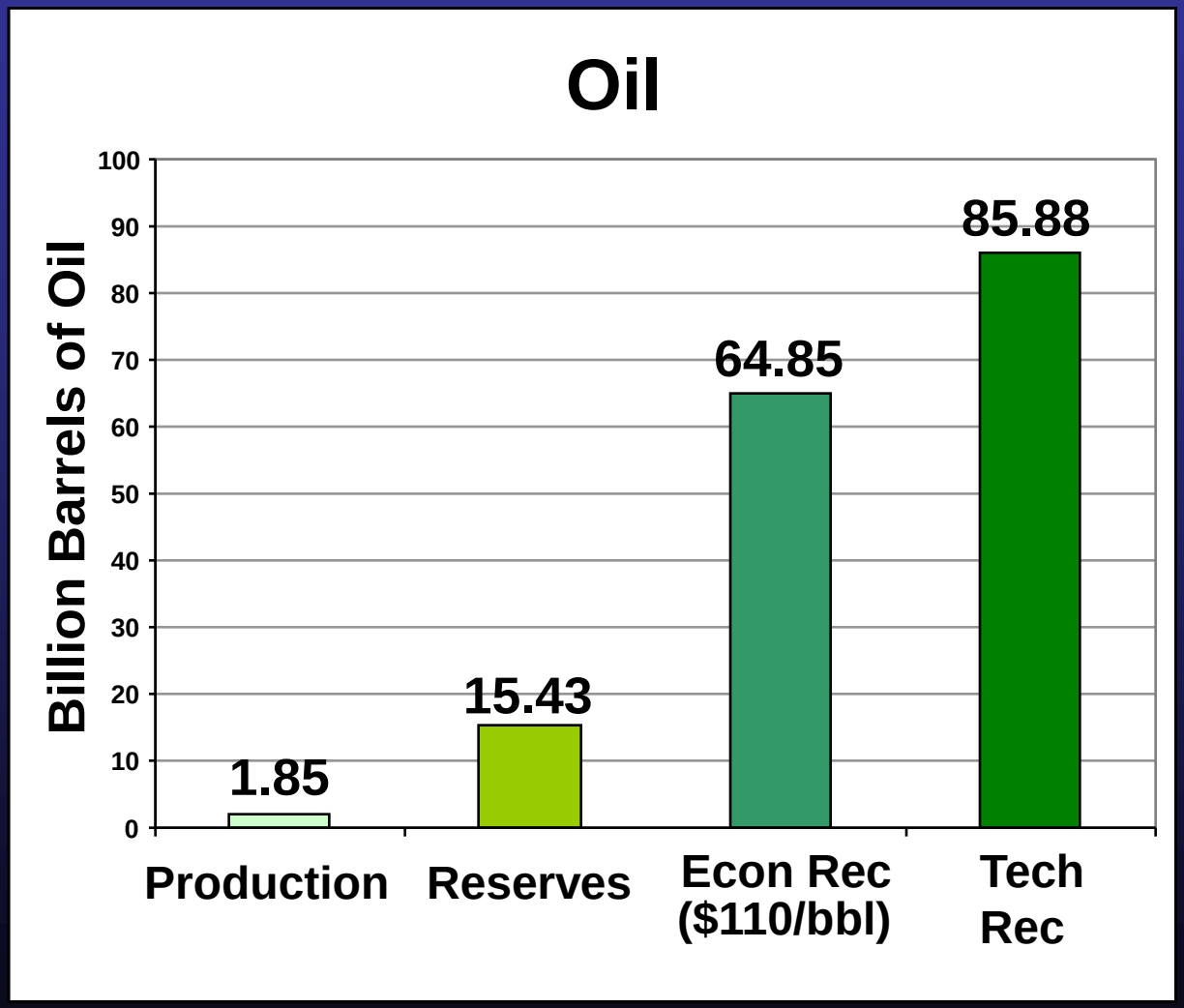
Pacific OCS Oil Resources:

7.6 – 13.9 billion barrels

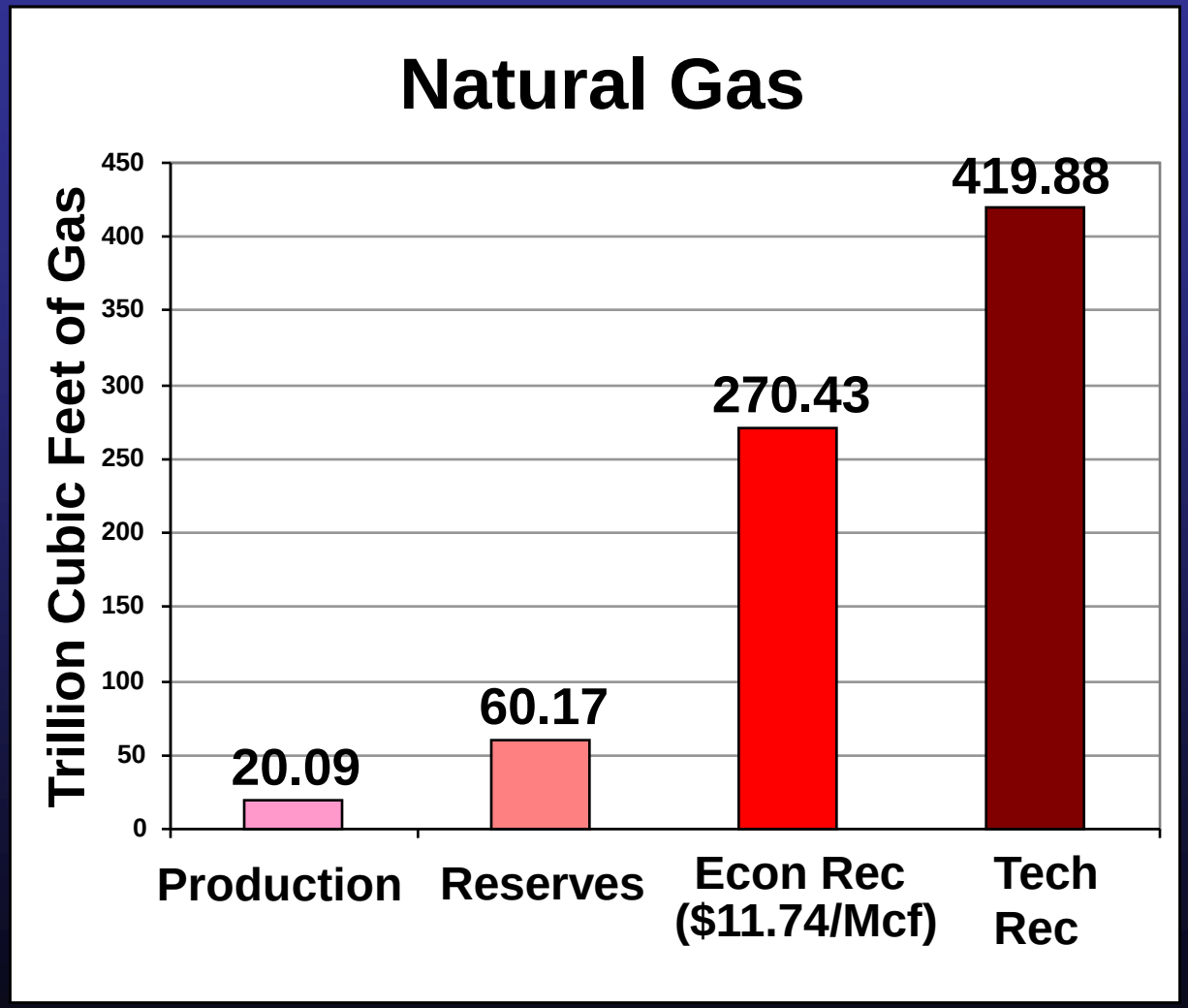
Pacific OCS Gas Resources:

13.2 – 24.1 Trillion Cubic Feet

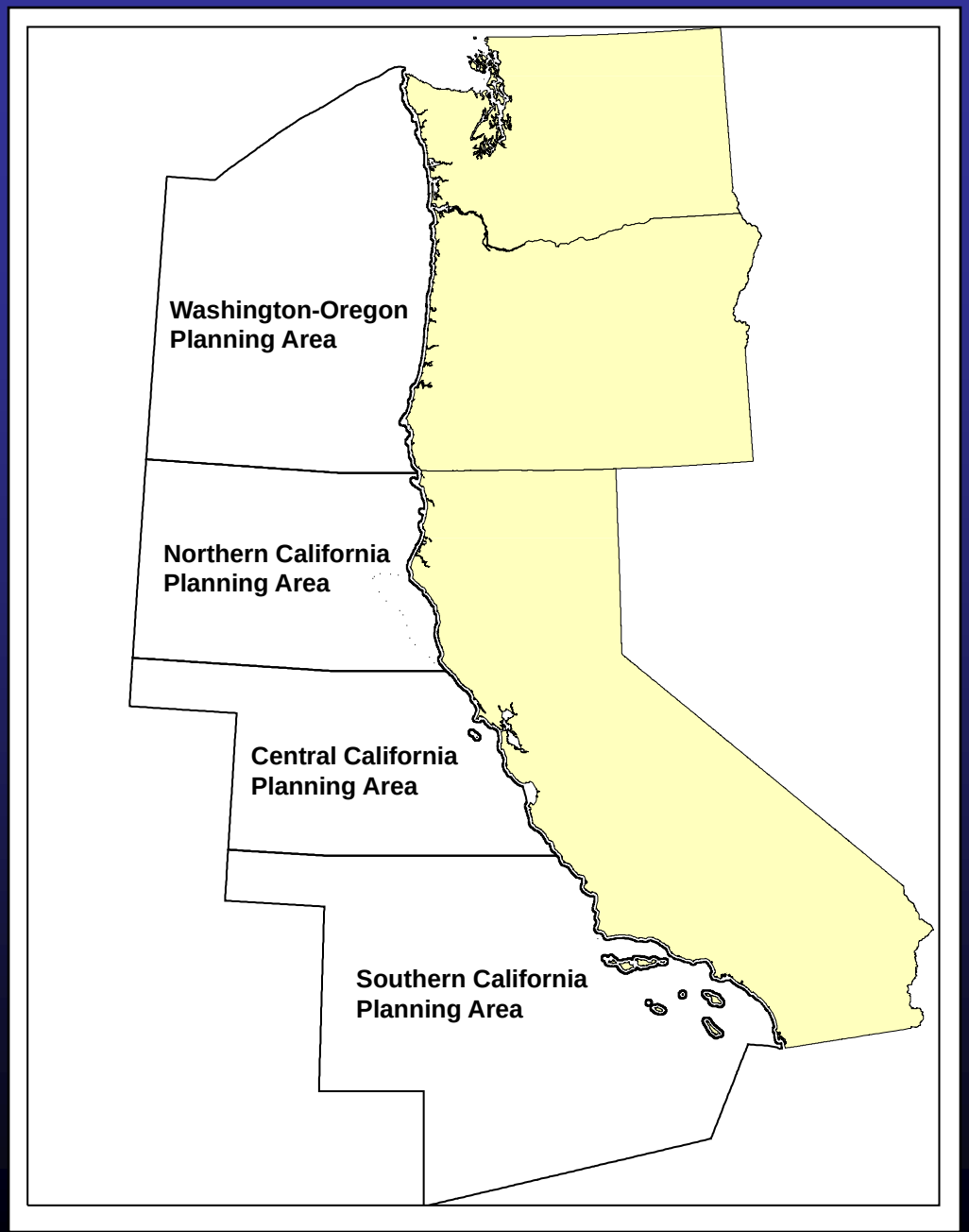
U.S. Annual Oil Production, OCS Reserves, and Resources



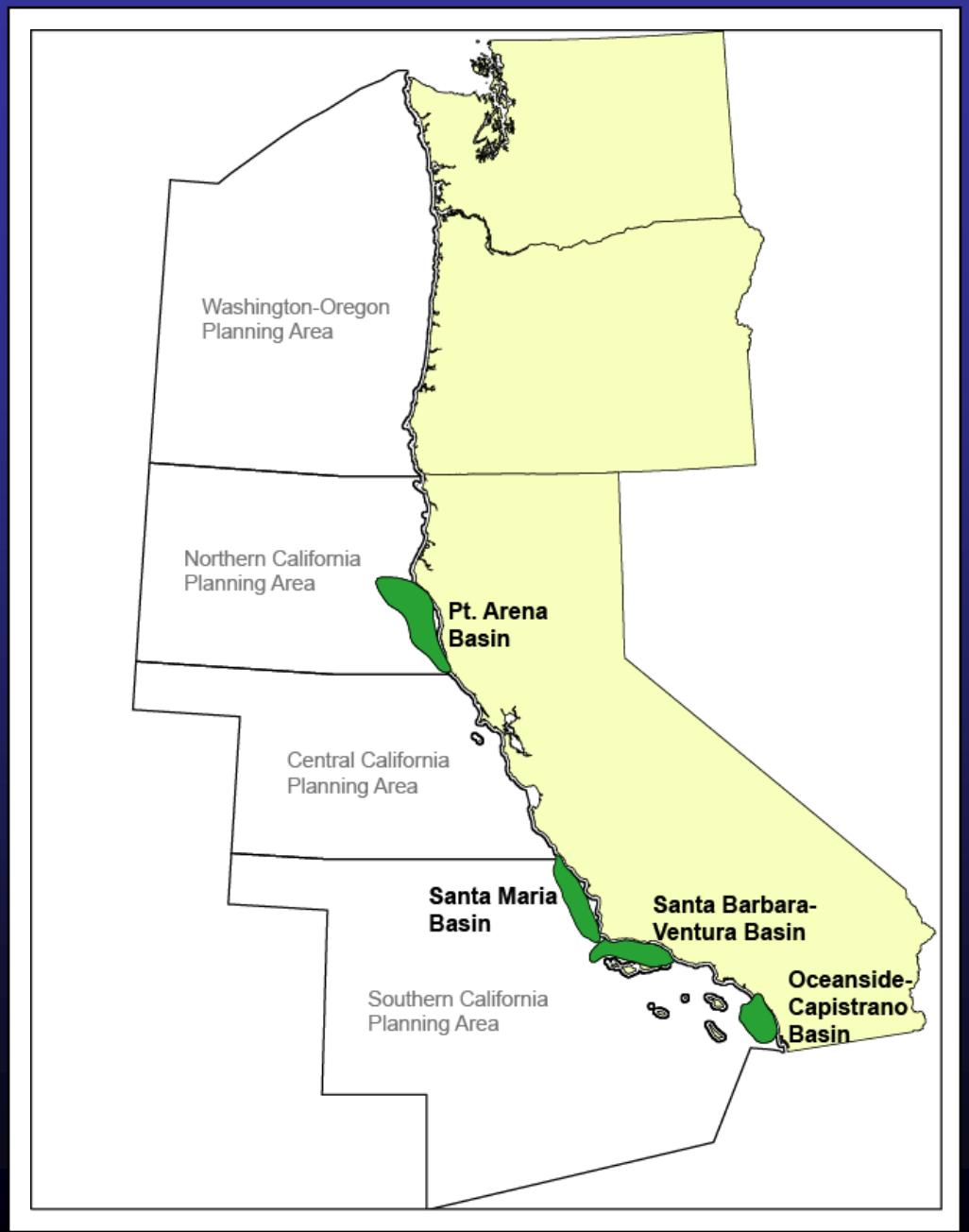
U.S. Annual Gas Production, OCS Reserves, and Resources



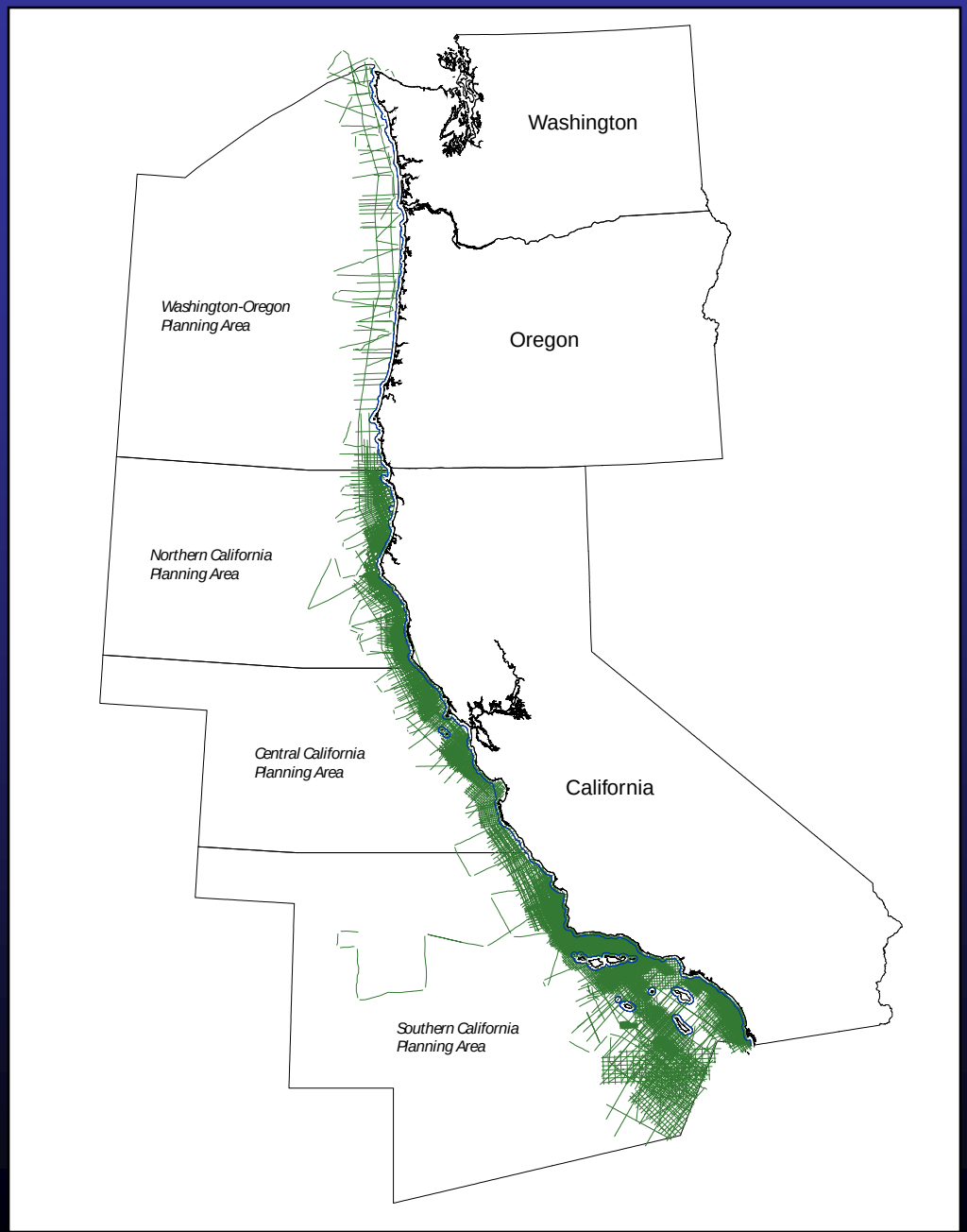
Pacific OCS Region Planning Areas



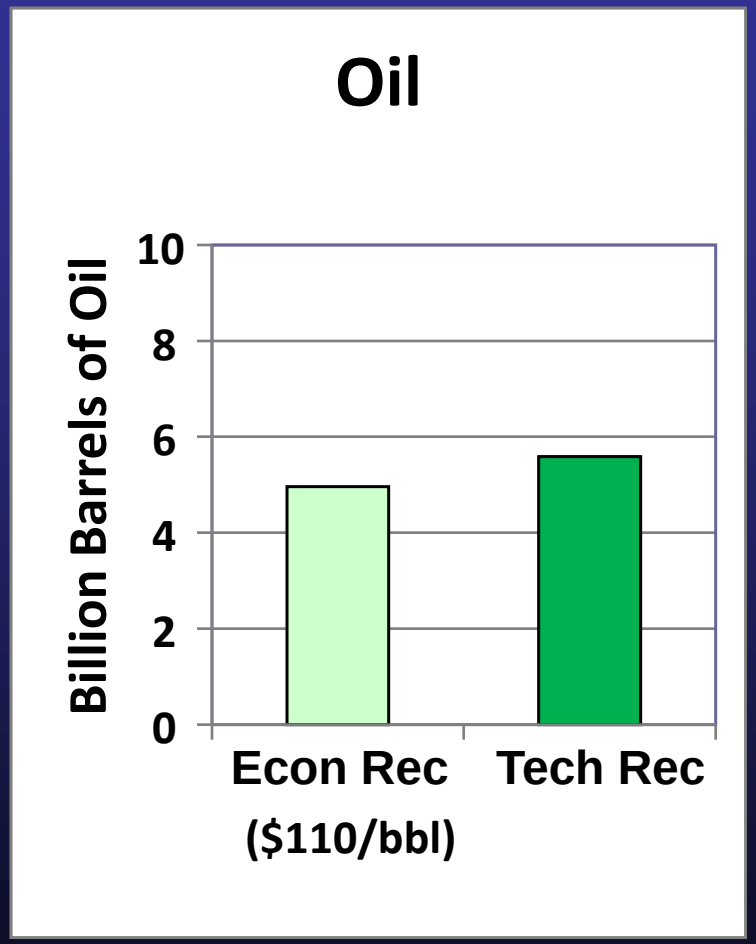
Four Pacific OCS Region Basins

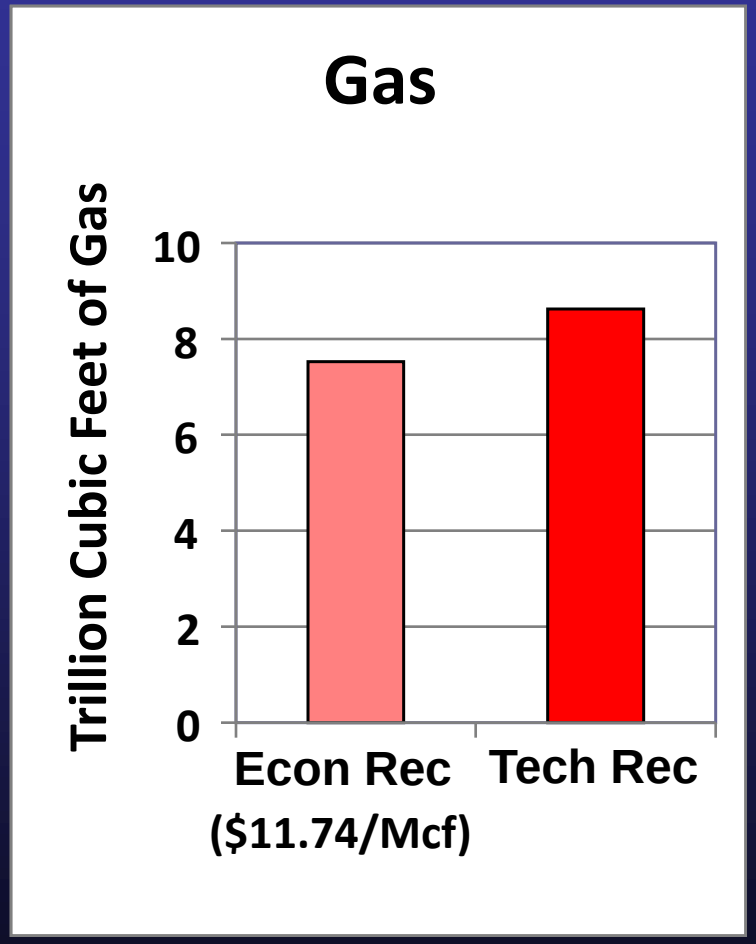


Pacific OCS Region Seismic Data



Four Pacific OCS Basins Undiscovered Oil and Gas Resources





Pacific OCS Region Oil and Gas Resource Data Gaps

- **Most Seismic data were acquired in the 1970's and 1980's.**
- **New seismic and related data may be desired for some areas in the Pacific OCS Region by the oil and gas industry as part of their pre-leasing evaluation.**
- **Prior to acquisition of seismic data, National Environmental Policy Act (NEPA) and other environmental analyses will be required.**

Key Environmental Issues

Stewardship

Our Overriding Consideration

BALANCING:

- **the Nation's energy needs**
- **Environmental sensitivity and marine productivity**
- **Multiple use of the sea and seabed**

The Challenge of Climate Change

Forecasting, planning for and mitigating:

- **Long-term Ecosystem Changes**
  - **(and effects on species and habitats)**
- **Changes in Renewable Energy Resources**
  - **e.g. Wind and Wave frequency, persistence, etc.**
- **Changes in Environmental Conditions and Impacts to Energy Infrastructure**
  - **(storms, sea level, wave heights, etc.)**

Pacific OCS
Key Challenges & Information Gaps

- Lack of Existing Onshore Infrastructure to support Renewable or Oil & Gas Activities (outside of Southern California)
- Risk of Oil Spills
- Noise in the Sea – potential effects on Marine Mammals, Fish
- Fisheries - Multiple-use of OCS
- Tourism, other socio-economic issues