Think Small for Nascent Alternative Energy Technologies*

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Abstract

Alternative energy sources are needed in the long run, but have obstacles to implementation in today's financial and political climate. With dropping oil prices and a Congress less inclined to fund expensive and often untested technologies, we need to consider ways to reduce costs, and get the most for our tax dollars. Big corporations prefer big power plants, often in remote locations. They have been counting on the government to subsidize them, for land, for building the plants, and for building transmission lines to where power is needed. Distributed production has several advantages. It can be produced near to where it is needed, as is being done with rooftop solar collectors. New transmission lines are not needed; the electricity goes directly into the distribution network. A similar system can work with small-scale wind turbines and certain geothermal technologies in rural areas. Distributed production is less susceptible to variations in wind or sun that can affect large localized power plants. In addition, distributed networks are far less susceptible to power disruption due to environmental catastrophes or sabotage. They are a viable alternative energy source for rural areas and a valuable supplement in metropolitan areas. In the future, ocean-based wind and wave power generation will be important in the U.S., as most populated areas are near the coast. However, there are many technical and regulatory hurdles to be overcome before it can become a major contributor to our power mix. The ocean can be a hostile environment. Waves have enormous power, and salt water is corrosive. Most proposed sites are in areas with large waves with the aim of maximizing produced energy per installed extraction device. Most wave energy devices fail because they have moving parts that cannot withstand such an environment. Most proposed sites are far from where energy is needed, and require extensive transmission networks. An alternative approach to these problems is to start smaller, in less stormy seas, and close to where the energy is needed. Devices with few or no external moving parts, and encased in non-corrosive enclosures will be less prone to damage. Devices below the surface or on the ocean floor may be preferable; they would be invisible from shore, and less affected by the surface waves. They would not extract the maximum energy of the waves, but starting with such a network could prove the technology, and be improved in successive iterations.

Think small for nascent alternative energy technologies

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Goal – Clean source of energy for the Nation

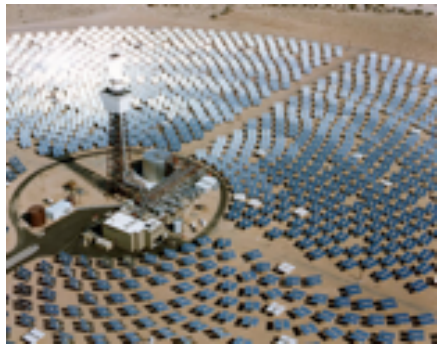
Possible Sources

- Offshore/Coastal installations – Wind, Wave, Current



- Onshore installations – Wind, Solar, Geothermal, Current

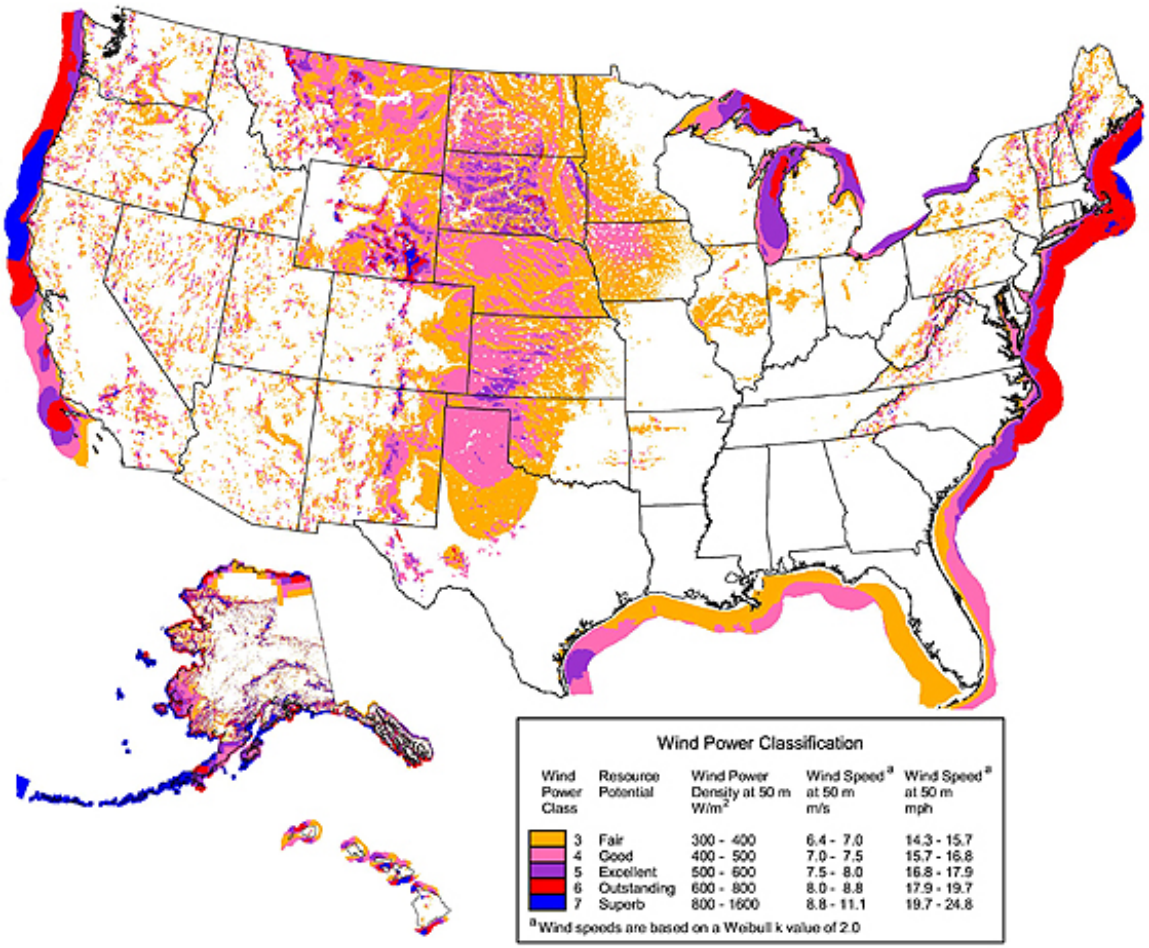




Offshore wind and wave power generation

Advantages

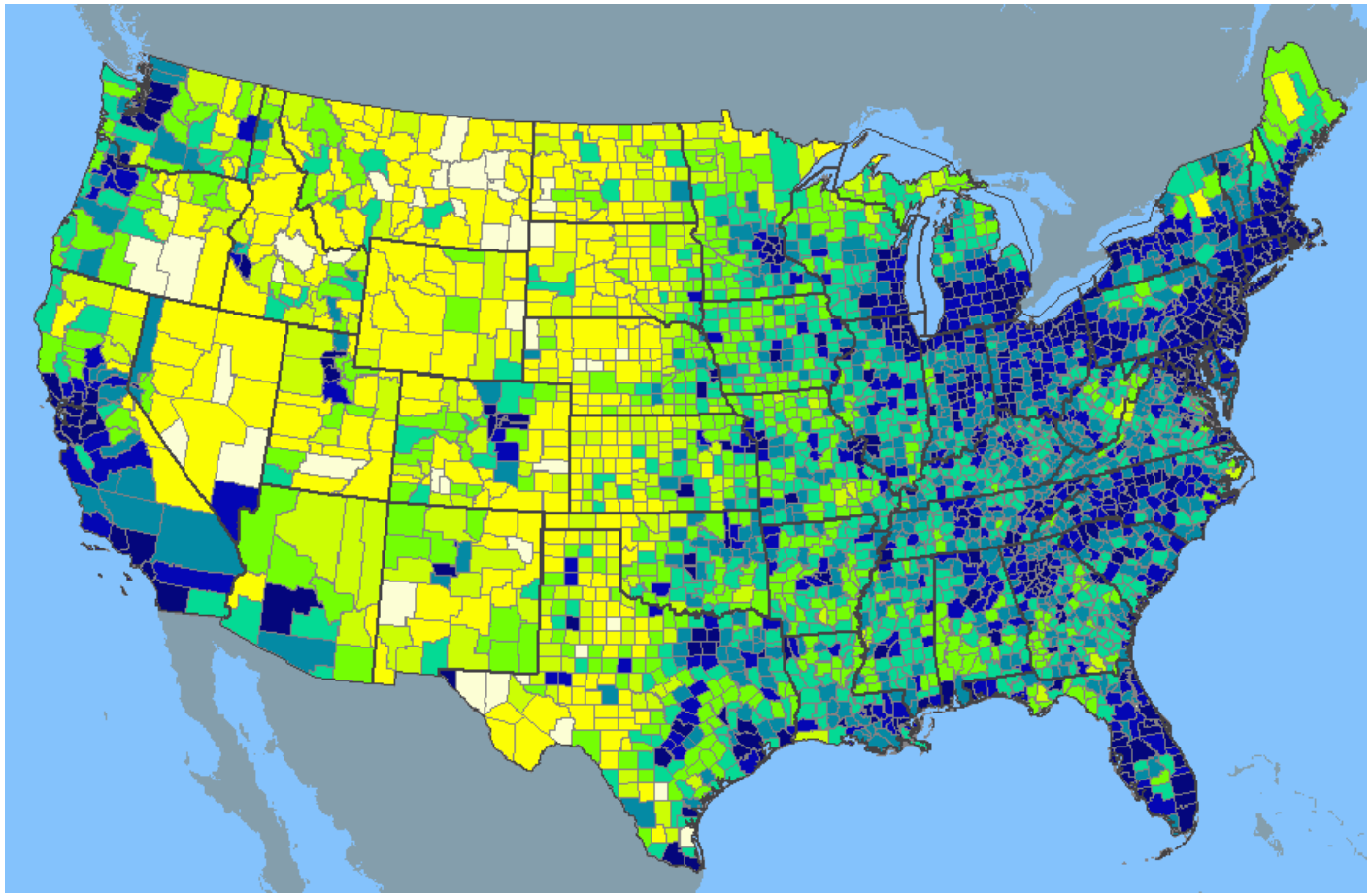
- Wind and wave resources are abundant and nearly continuous.



Offshore wind and wave power generation

Advantages

- Sources are nearer to population centers.



Offshore wind and wave power generation

Advantages

- Generation can be far enough offshore to avoid most conflicts.

Offshore wind and wave power generation

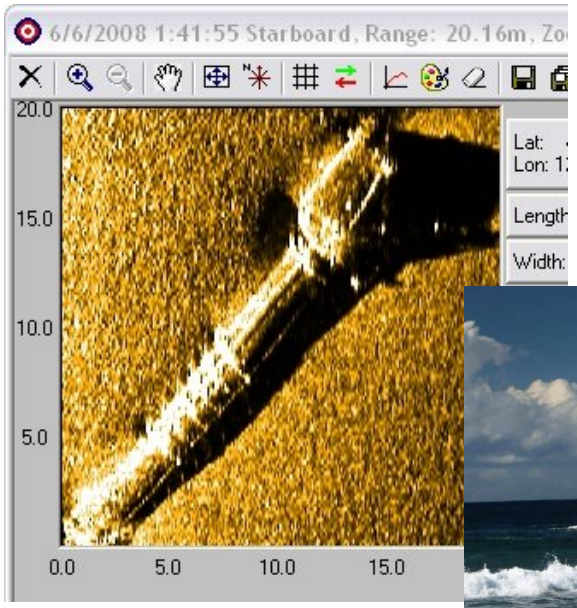
Advantages

- There is the potential to link multiple projects along the coast to even out surges and lapses of power that may occur locally.
  - Atlantic Wind Connection would link multiple wind farms along the East Coast.

Offshore wind and wave power generation

Problems

- Wave powered devices are prone to failure.
  - After spending millions of dollars in development, wave generation devices tend to fail – miserably.
- High winds and waves are too much for the present technology.
- And, there is the problem of external moving parts in salt water.



Offshore wind and wave power generation

Problems

- And wind turbines are not immune to problems, including altering local weather patterns.
- Deep-water installations require either a floating platform or a floating pylon. Either of these is subject to the destructive power of waves.

Offshore wind and wave power generation

Problems and more problems

- Because of bureaucracy and perceived environmental hurdles (and now, economic issues), commercial development is years off.
  - After 14 years of troubles, Cape Wind has lost its two major power purchase agreements, and its future is in doubt.
  - In addition to local opposition, they and others have to pass scrutiny of perhaps two dozen governmental and environmental groups. Each major change requires signoff by most or all of these groups.

Outlook

- Offshore wind and wave power generation is likely to be an important source of U.S. electrical power in the future, but not for 20 or more years.

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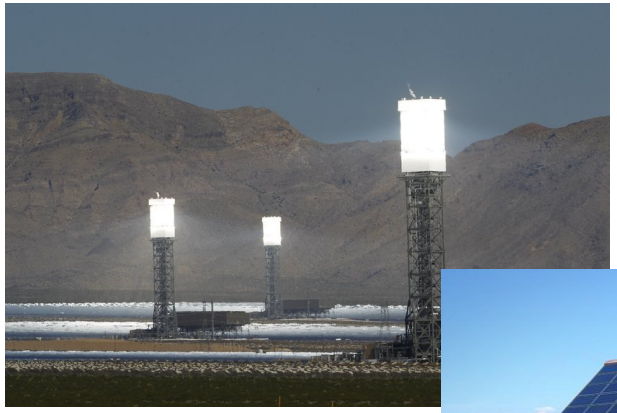
So, what about onshore installations?

Onshore Installations

Advantages

- The technology is proven – large and small onshore commercial installations of solar, wind, and geothermal electrical generation exist. Small-scale installations of water current electrical generation have been around for more than 100 years.



Onshore Installations

Problems

- Remote installations in areas of abundant solar or wind resources require more grid capacity than is available. Electrical transmission utilities do not want to spend the capital on construction of transmission lines without a source in place. Conversely, prospective electrical generating companies do not want to develop capacity without transmission capacity.

Onshore Installations

Problems

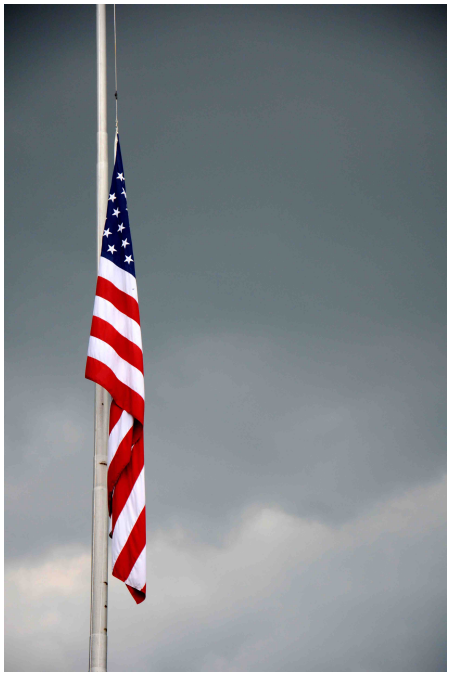
- Large installations are a blight in populated or scenic areas and may be a major environmental problem in other areas.

- Even in farming areas, large generation facilities may not be the best use of the land.

Onshore Installations

And, the obvious problems

- Wind does not always blow in any given location.



- No solar at night. Not always sunny even in the daytime.

Onshore Installations

A Possible solution: Distributed generation of electricity, primarily wind and solar, over large areas.

Onshore Installations

Distributed generation

- Distributed power generation is more constant.
  - Wind may not be blowing at a given time in an area occupied by a large localized wind farm, but it will be blowing over a substantial portion of a distributed wind network.
  - Solar power is, of course limited to daytime hours, but cloud cover will be a less important factor. Daytime hours are extended because of the greater total uptime of an extensive east-west network.
- Distributed power generation does not require an extensive new transmission grid. It can connect to the existing distribution network.
  - Many electric utility customers have connections that can "run the meter backwards."
  - Transmission lines can be built later as needed to connect local networks.

Onshore Installations

Distributed generation

- Distributed power generation is less prone to sabotage, or local environmental phenomenon that might jeopardize a centralized power generation facility.
  - A localized wind farm may be severely damaged by tornadoes or an ice storm.
  - A localized solar facility may be severely damaged by strong winds or hail.
  - A localized power facility of any kind, or its connection to the electrical grid may be an attractive target for sabotage by terrorists or others that may hope to gain something.

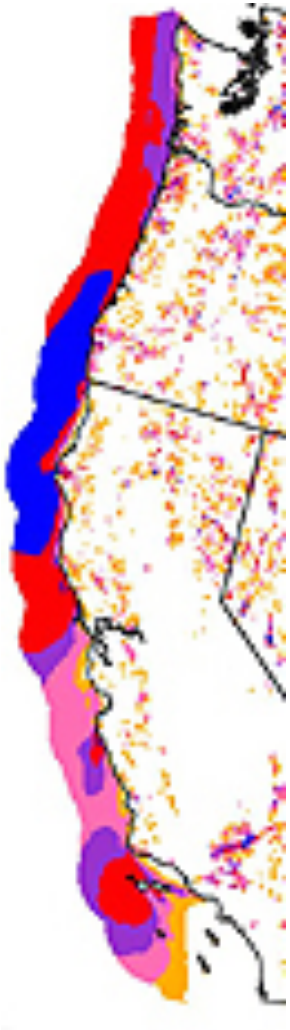
So, what about Offshore?

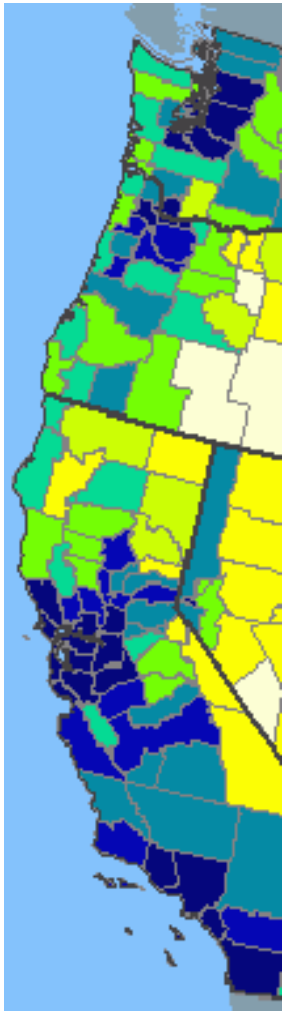
What can we do now, that is a less expensive way to “get up to speed” and develop the best offshore technologies for the long-term?

Offshore wind and wave power generation

Start *small* and *close.*

Proposed projects have been here, where wind is strong and waves are big.





But the population is down here…

Offshore wind and wave power generation

Start *small* and *close.*

- Costs are lower for prototype devices.
  - Less severe weather (wind and waves) mean smaller, less expensive devices. Size and power can be scaled up gradually.
- Costs are lower for transmission lines.
  - Generation close to where the power is needed will not need extensive, and expensive, power cables, or onshore transmission lines.
- Smaller devices will mean less environmental disruption, and fewer bureaucratic hurdles.
  - Follow the European example: Figure out the problems, and make changes as needed.

As technology is developed, devices or installations can be scaled up.

Offshore wind and wave power generation

We need to toss the old paradigms

- Most wave devices still convert mechanical energy to driving a fluid pump that then moves the fluid to turn a turbine connected to a generator. There is energy loss at each conversion.
- Most wave devices also have external moving parts, and are made of corrosive materials.

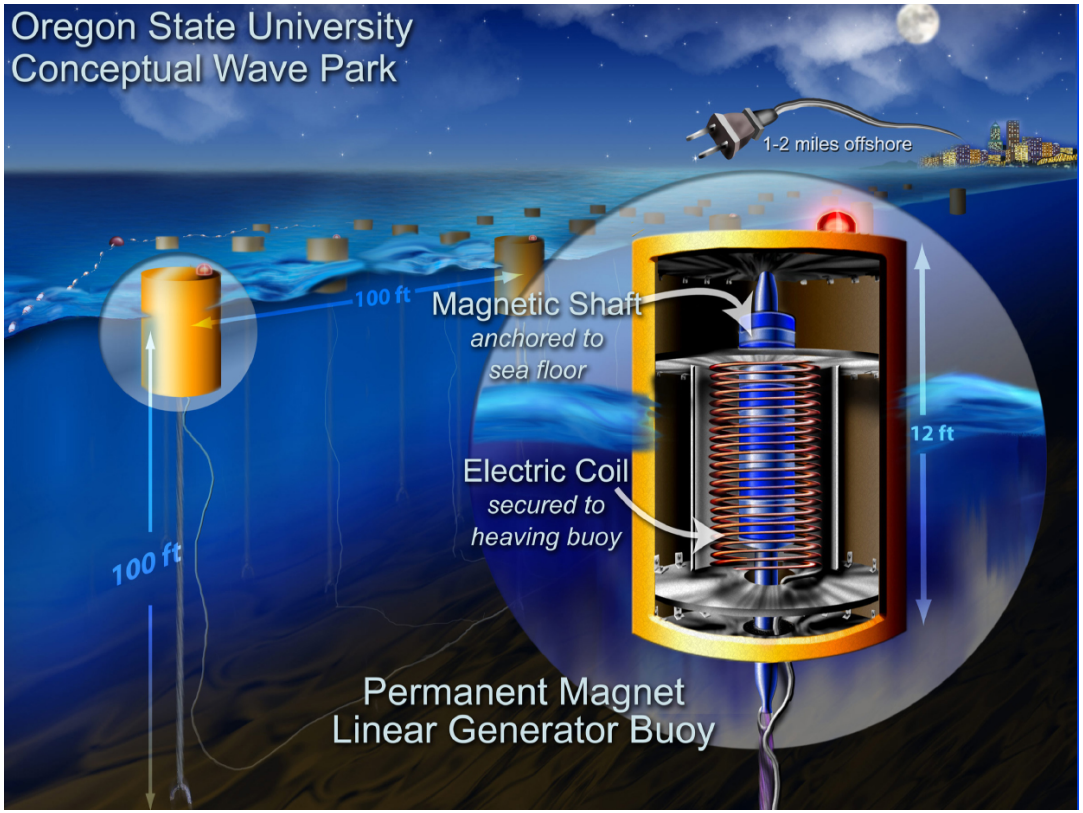
Make survivability the primary driver for design

- Keep all moving parts enclosed.
- Encase the entire mechanism in a non-corrosive material.
- If possible, move wave generators below the surface, where wave action is less severe.

Offshore wind and wave power generation

We need to toss the old paradigms

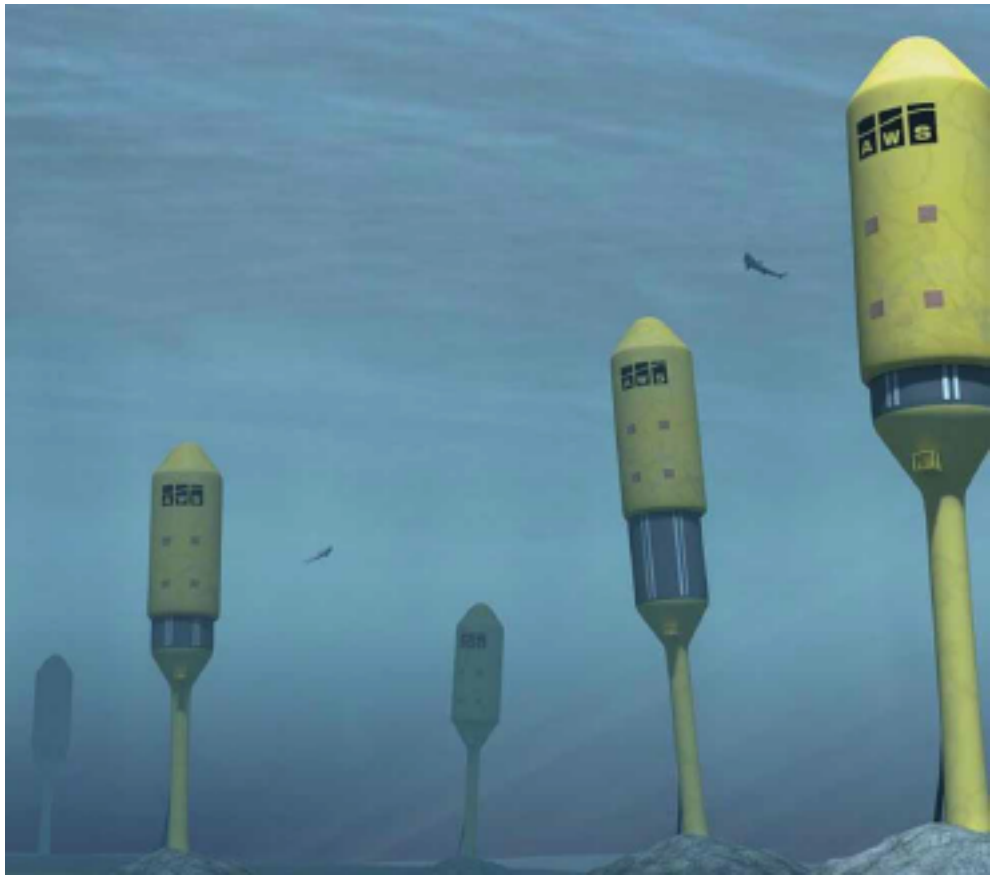
- About 10 years ago, Oregon State University began working on devices that convert linear motion directly into electrical energy. Although this device requires external seals, the design could be modified to work using inertia, without any external moving parts, much as seismometers do.



Offshore wind and wave power generation

We need to toss the old paradigms

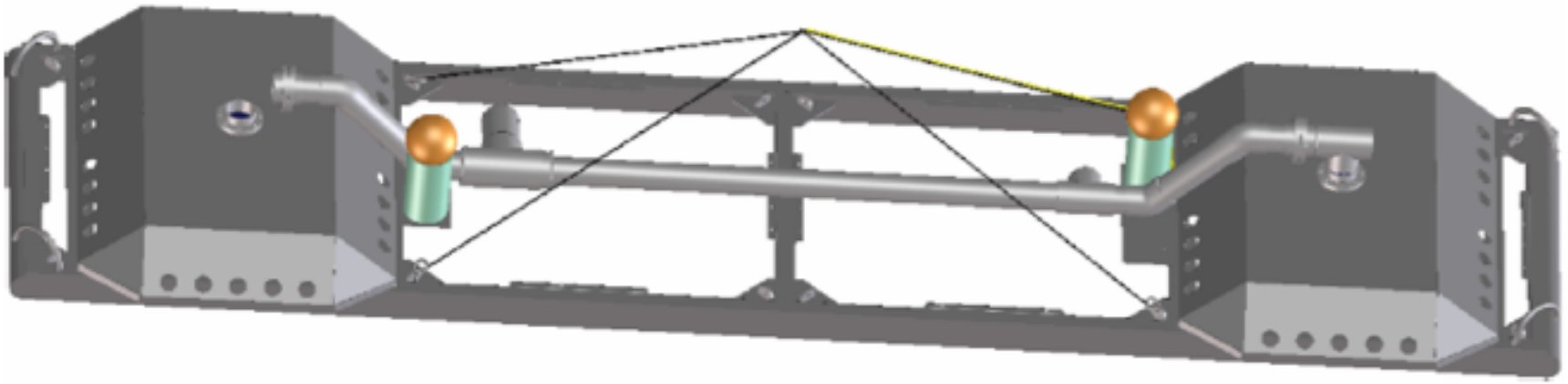
- This design uses pressure differential. It has the advantage of being below the surface, so it doesn't get exposed to the destructive waves experienced at the surface. It also has no visual impact from shore.



Offshore wind and wave power generation

We need to toss the old paradigms

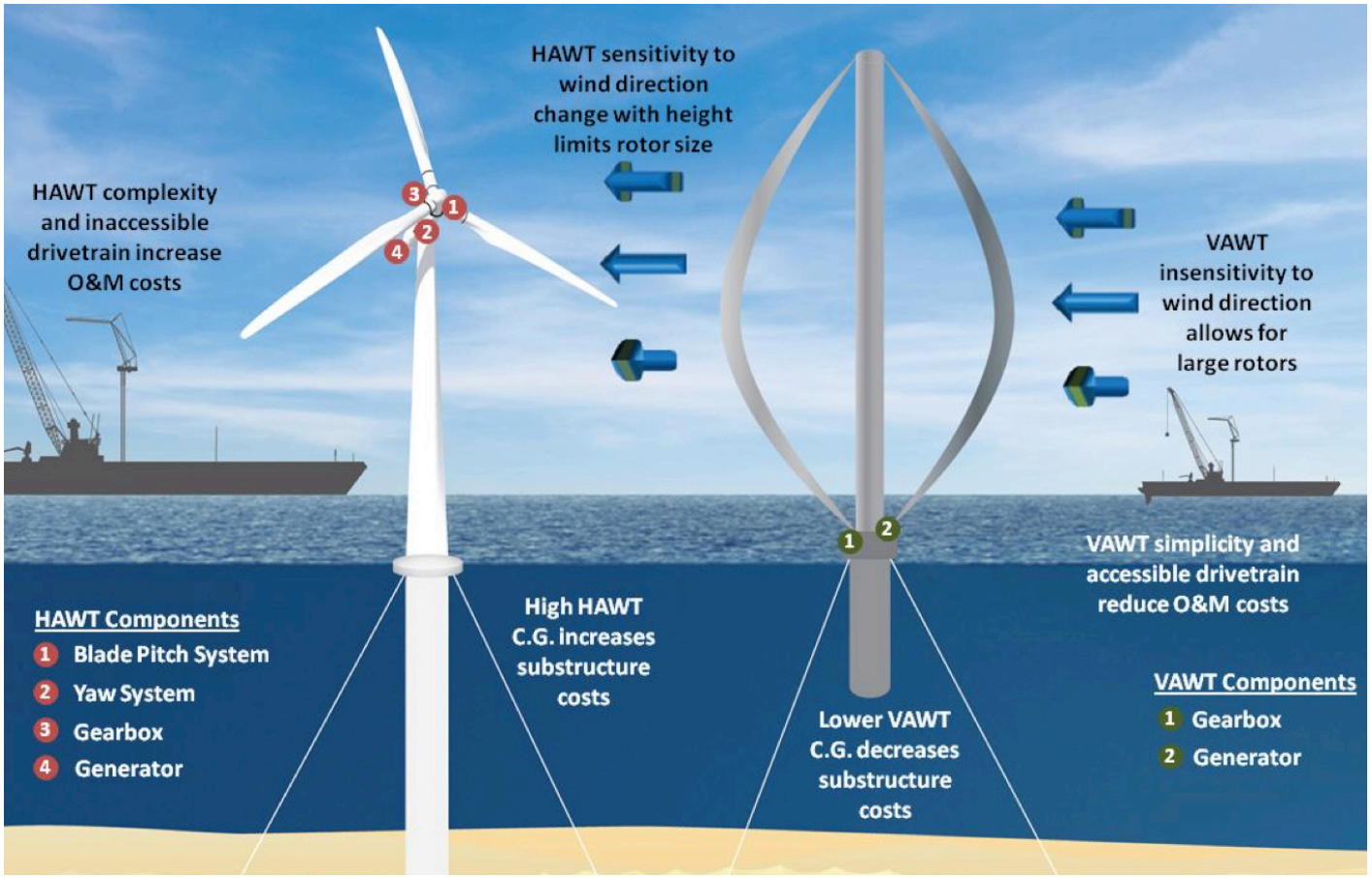
- In 2014 Oregon State University successfully deployed a test device that uses pressure differential to move fluid to drive a turbine generator. Although it does involve an extra conversion step, it has no external moving parts.
- This device sits on the ocean floor, isolated from the destructive environment at the surface.



Offshore wind and wave power generation

We need to toss the old paradigms

- The current paradigm for wind favors large propeller turbines with horizontal shafts because they maximize power generation. It may be that survivability is more important in the offshore environment, and that may favor vertical axis rotors, such as the familiar "eggbeater" design from about 40 years ago.



Offshore wind and wave power generation

The ideal pilot project site?

For more information

For a copy of this presentation, contact Ken at:
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More on both conventional and alternative energy can be found at:

www.kineticpotentialenergy.com