Wind Energy Center

Challenges of Large Scale Deployment of Wind Power

Session Introduction

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University of Massachusetts

Is it possible to supply a large fraction of the continent's energy from wind?

- History shows that a large fraction of the world's mechanical and transportation energy once came from the wind, so it is clearly possible!

Naval battle of Trafalgar, 1805

Water pumper , US, c. 1870

The Industrial Revolution…

- Coal/oil convenient than wind →
- Use of wind energy dropped precipitously with the rise of fossil fuels
  - But: fossil fuels are finite, difficult to extract, are often found in inhospitable places, and release CO_2 !

Strip mining for coal

Burning oil pipeline, Iraq

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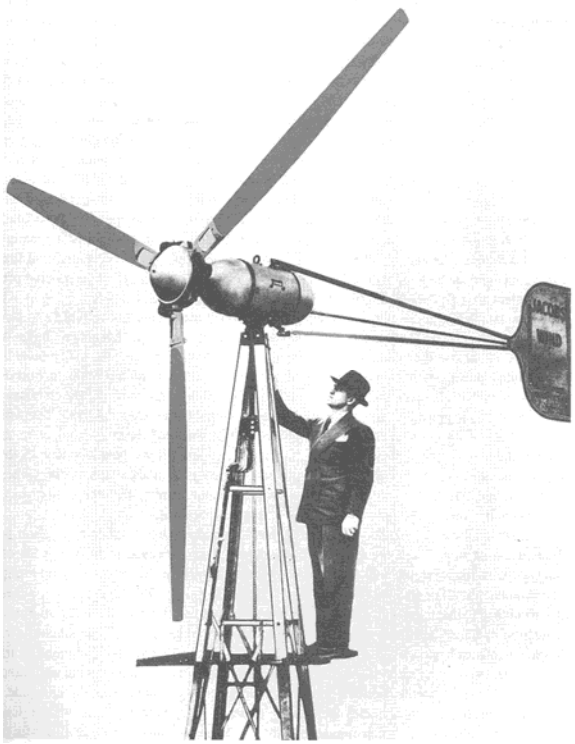
Age of Electrification

- Dominant energy for prime movers was coal, etc.
- Wind turbines emerged but % contribution small

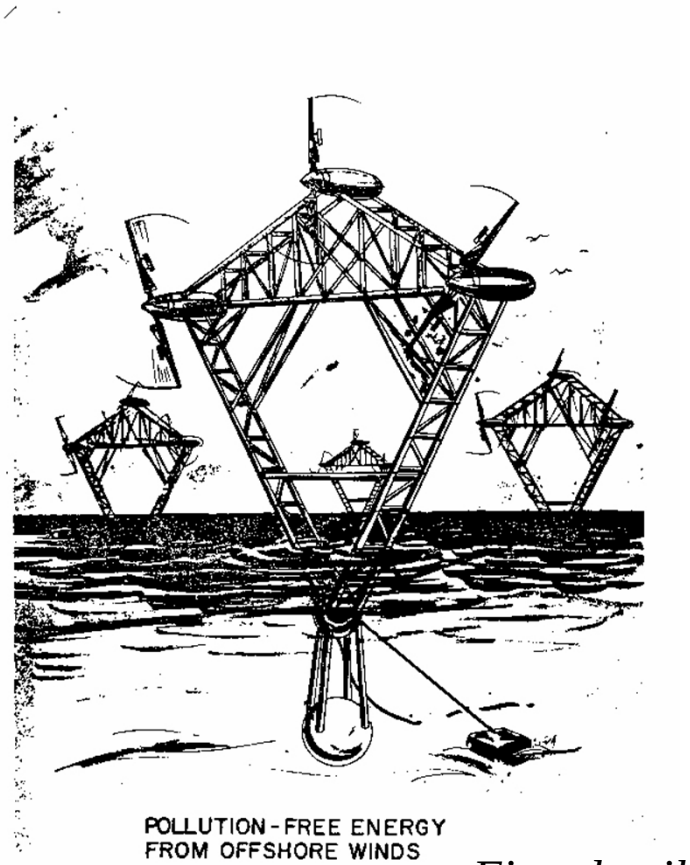


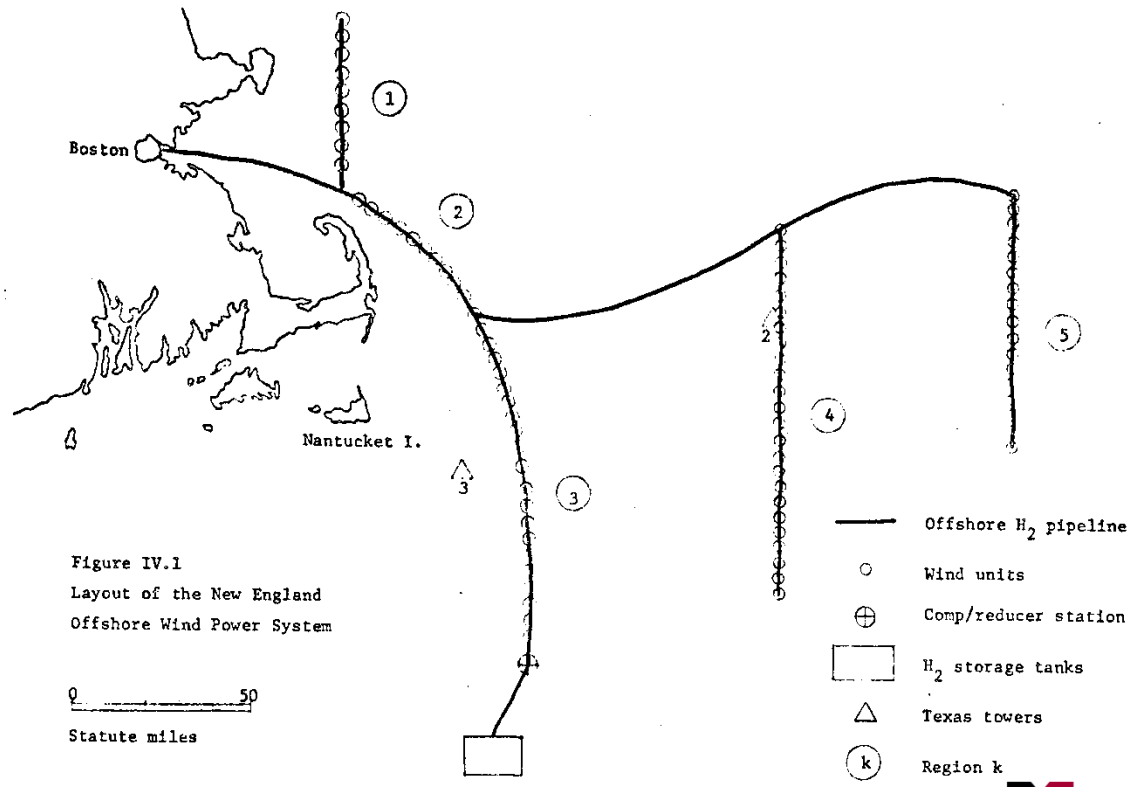
Jacobs windcharger, 1930s

Smith-Putnam turbine, 1940s

An Early Vision of Large Scale Utilization of Wind Energy

- Offshore wind and the hydrogen economy





First detailed offshore wind concepts, UMass, 1972

Wind Electricity Reborn

- Technical advances on many fronts facilitate new types of wind turbines

UMass WF-1, 1976

US Windpower, c. 1980

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Wind Energy Today

- Turbines are commercial: much larger, more sophisticated, more reliable
- They generate significant amounts of electricity, but still small compared to continent's total energy
- Mostly operate as "fuel savers"
- How much more can wind do?

Hull (MA) Wind I, 2002

Wind/Diesel Systems: Precedent for High Penetration Wind Energy

- Diesel generators, wind turbines, load management, intelligent supervisory control, short term energy storage, thermal energy
- 50% of fuel savings is good target!

Selawik, AK wind/diesel system, 2009

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Even Higher Penetration Levels?

- How high can we go? What would it take?
- Wide-spread deployment of turbines
- Wind turbines for wide range of applications
- Resolution of interconnection/load matching issues on large scale
- Integration with solar electric?
- Storage?
- Fuel production? (H_2, NH_3, hydrogenated biomass…)

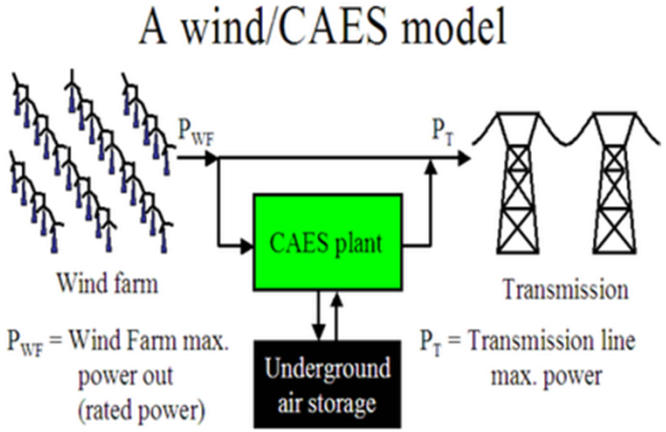
Questions Remain in Many Areas…

- Wind energy system science and engineering
- Grid integration and management
- Atmospheric sciences
- Environmental issues
- Market barriers
- Social acceptance
- Policy research
- Business and financial
- Interdisciplinary topics
- New topics: storage? fuels?

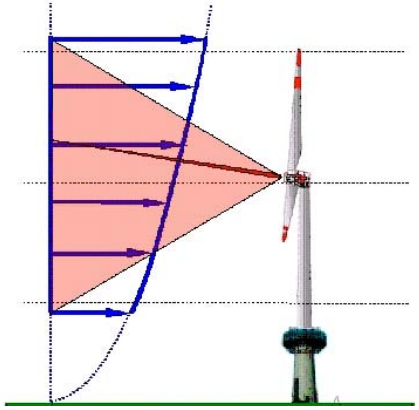
Some Technology Options

Floating Offshore Wind

Hydrogen Powered Bus



Compressed Air Energy Storage



LIDAR integrated control

UMASS

Can We Answer the Questions?

- Why not?
- It is the intent of NAWEA to make it happen!
- This session→
  - Need for NAWEA
  - DOE's vision for R&D and education
  - Industry perspective
  - Offshore wind power challenges
  - Grid integration
  - Policy, integration and transmission