Building an Offshore Wind Industry with the Atlantic Wind Connection

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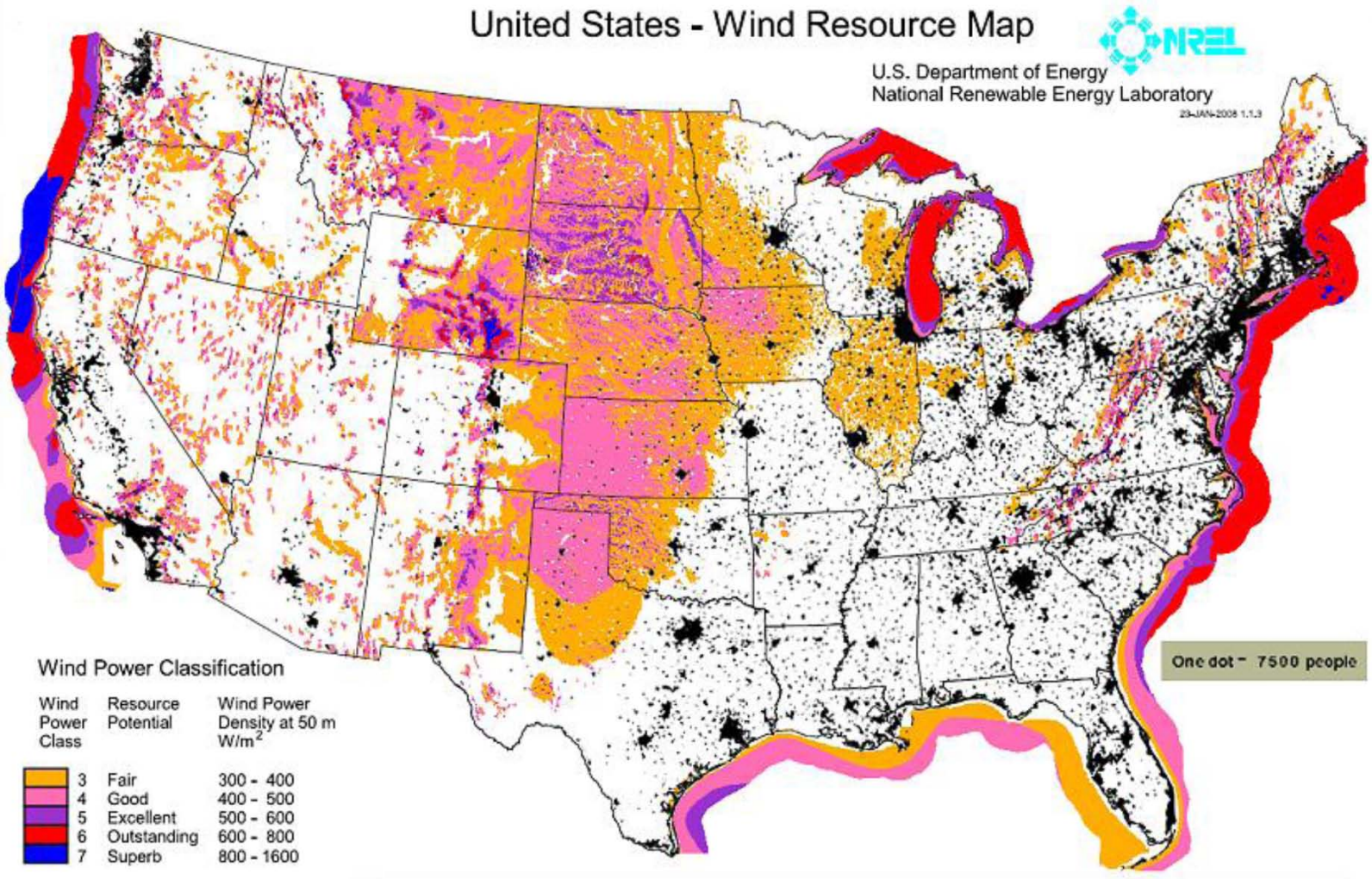
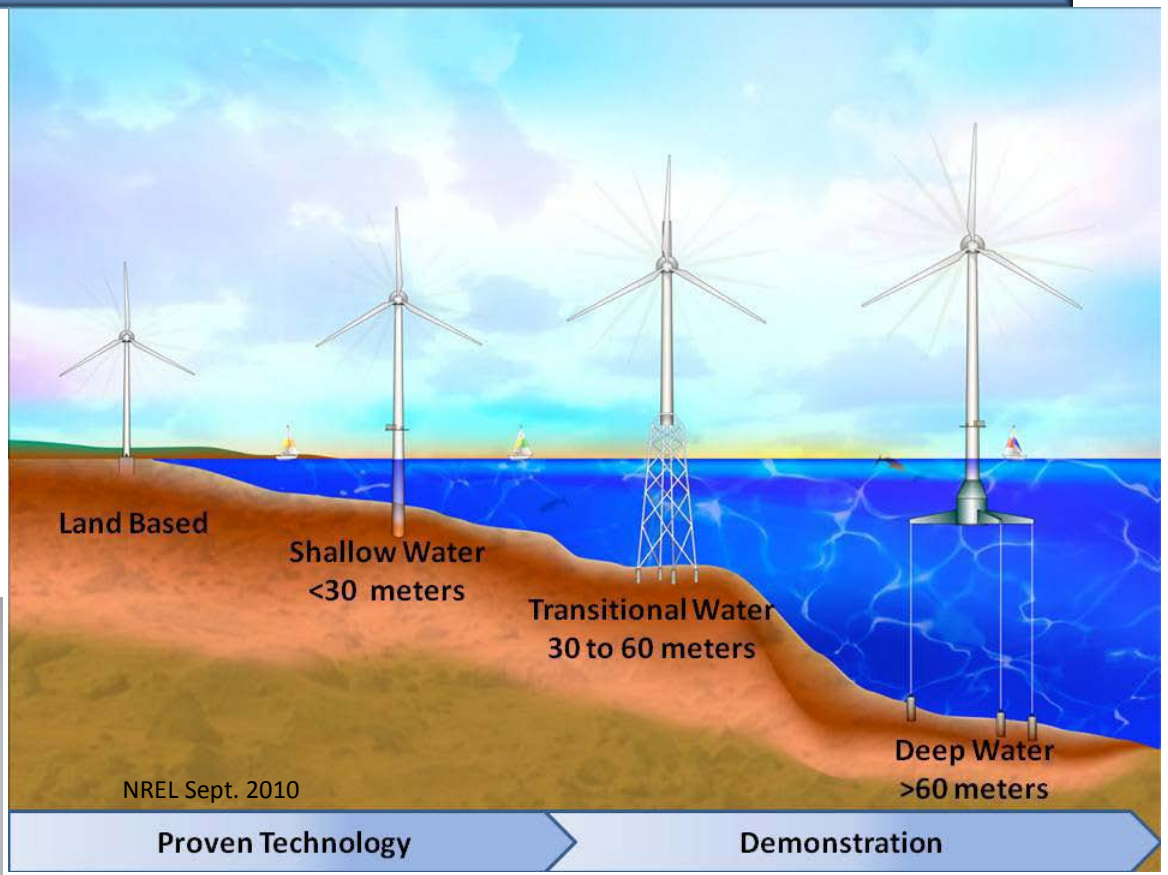
Strong offshore winds close to population centers



Offshore wind technology

- Offshore turbines initially followed terrestrial example
  - Now scaling up and becoming specialized – e.g. Vestas V164 7MW

Courtesy: Vestas



Starting with shallow, fixed foundations, moving to floating foundations.

Cost of Energy

DOE goal: 54 GW at $0.07/kWh by 2030
COE = ((DRF x ICC) + O&M + LRC + Fees)/AEP

Potential Path to Reduce Cost of Offshore Wind Energy in Class 6 Wind ($2009 USD) (NREL 2010)

Component	2010	2020	2030	2010 -Land
Installed Capital Cost ($/kW)	$ 4,259	$ 2,900	$ 2,600	$ 2,120
Discount Rate Factor (DRF)	20%	14%	8%	12%
Turbine Rating (MW)	**3.6**	**8.0**	**10.0**	**1.5**
Rotor Diameter (m)	**107**	**156**	**175**	**77**
Annual Energy Production / Turbine (MWh)	**12,276**	**31,040**	**39,381**	**4,684**
Capacity Factor	39%	44%	45%	36%
Array Losses	10%	7%	7%	15%
Availability	95%	97%	97%	98%
Rotor Coefficient of Power	0.45	0.49	0.49	.47
Drivetrain Efficiency	0.9	0.95	0.95	0.9
Rated Windspeed (m/s)	12.03	12.03	12.03	10.97
Average Wind Speed at Hub Heights (m/s)	8.8	9.09	9.17	7.75
Wind Shear	0.1	0.1	0.1	.143
Hub Height (m)	80	110	120	80
Cost of Energy ($/kWh)	0.27	0.10	0.07	0.09
Cost of Energy ($/kWh) at constant 7% DR	0.12	0.08	0.07	0.08

Many opportunities for efficiency through technology and policy

Permitting

Outreach

Vessel Fabrication & Operations

Foundation Installation

Submarine Cable Supply & Installation

Electric Interconnection

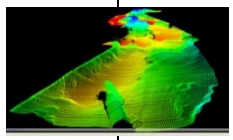
Turbine Supply & Installation

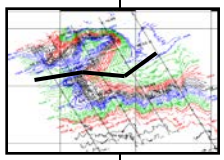
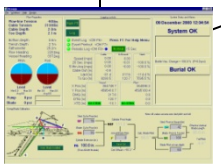
Foundation Design & Fabrication

Site Surveys

System Engineering









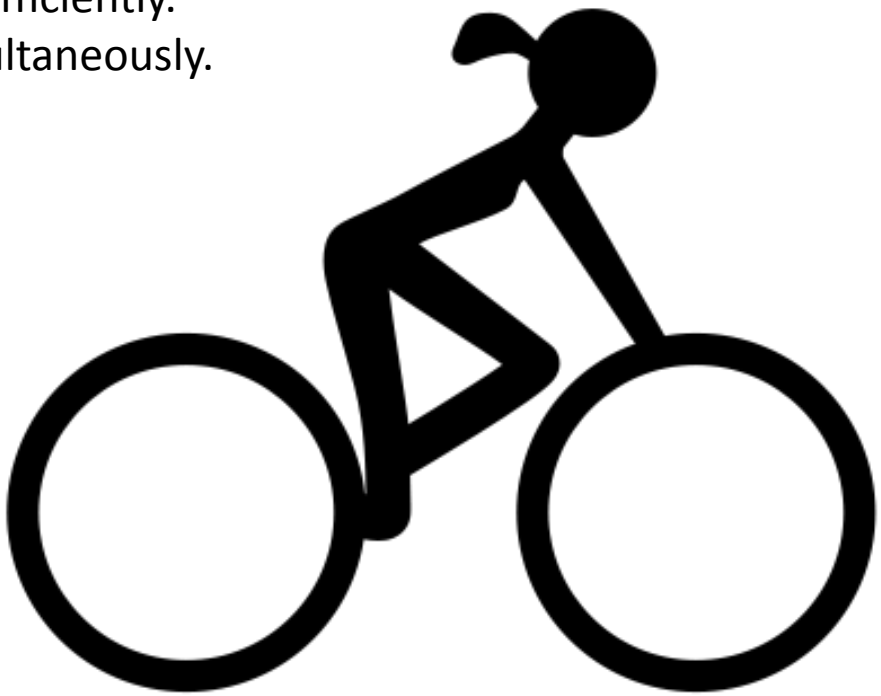




AWC: a unique solution for a unique commodity

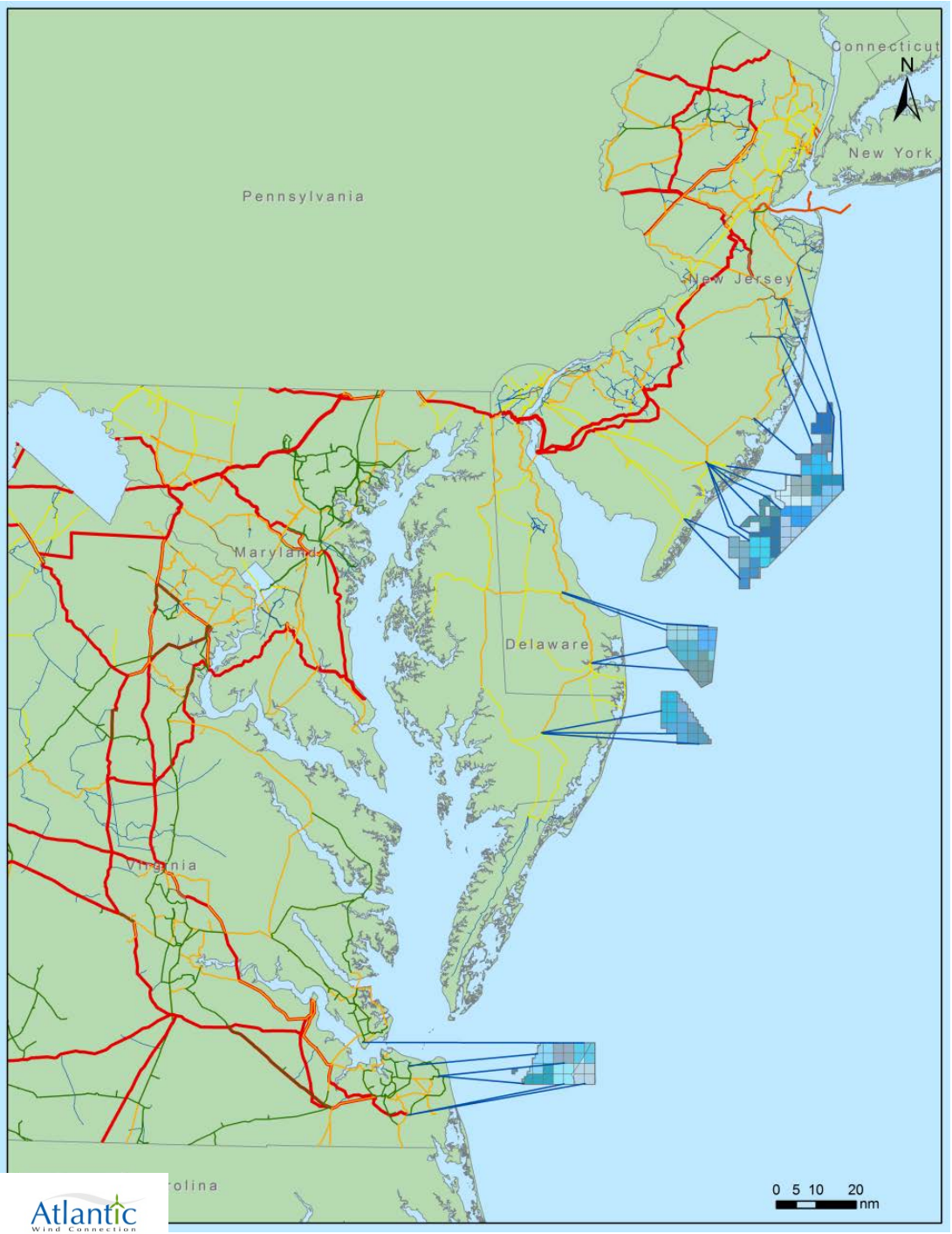
- We can't store electricity efficiently.
- We make it and use it simultaneously.

Balance is essential.



AWC is the best way to balance a variable load and a variable supply, while making the grid stronger and more efficient.

Harvesting offshore wind the old way



Radial ties using alternating current (AC) technology connect along the coast where the grid is generally weak.

The "superhighway" for offshore wind energy

The AWC offshore network uses HVDC to provide efficient transmission at scale, plus additional benefits:

1. **balances variability**
2. **strengthens the grid**
3. **improves efficiency**

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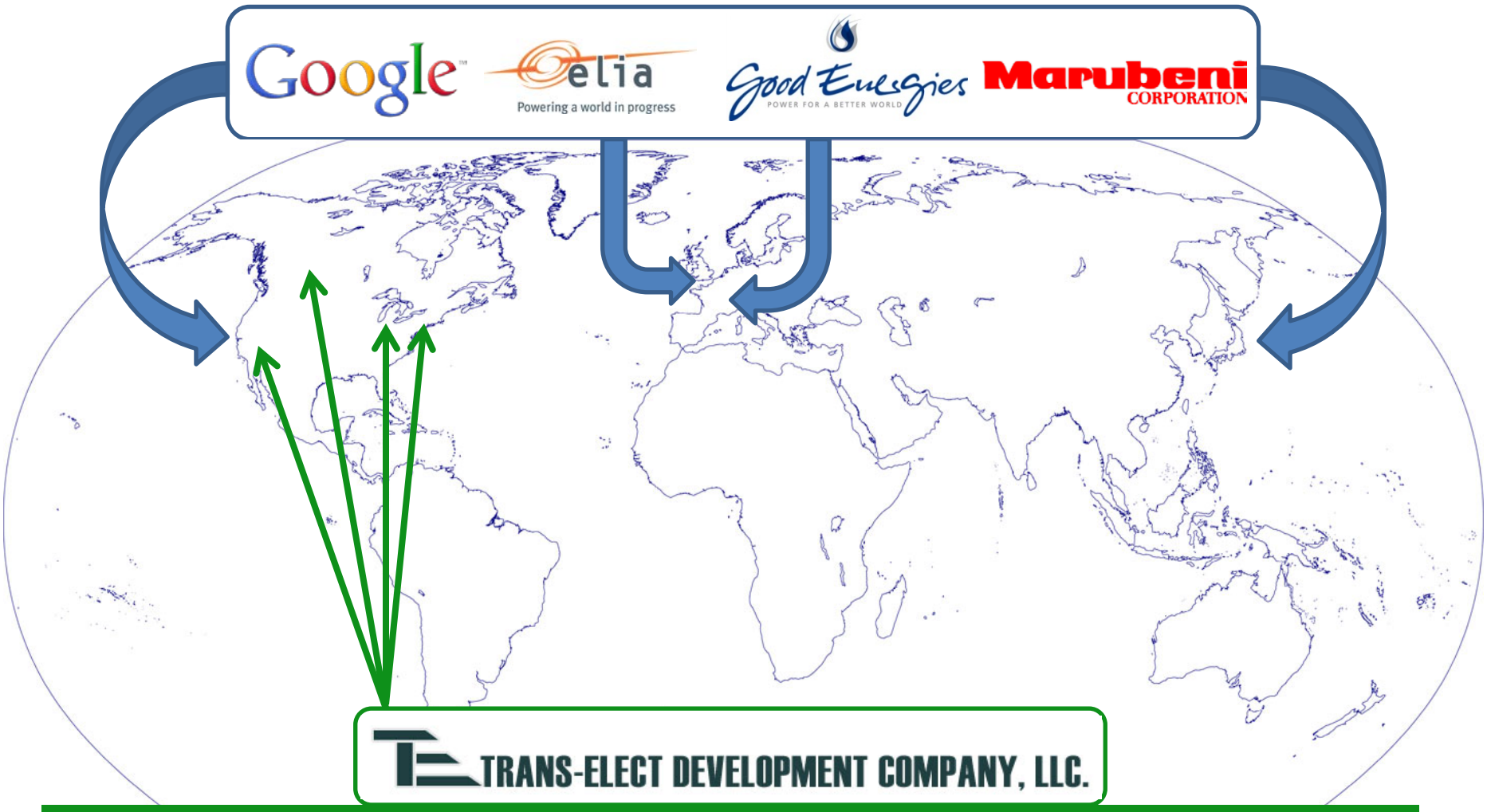
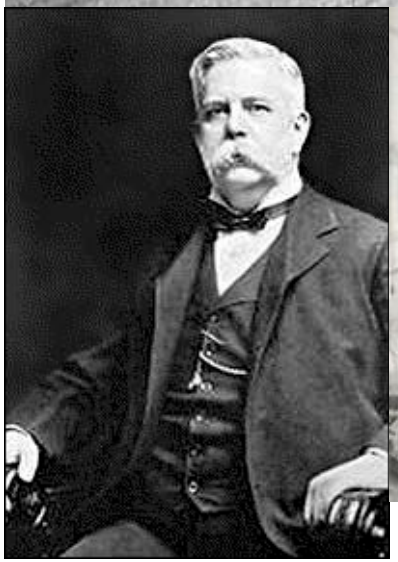
AWC is funded by a team of global investors

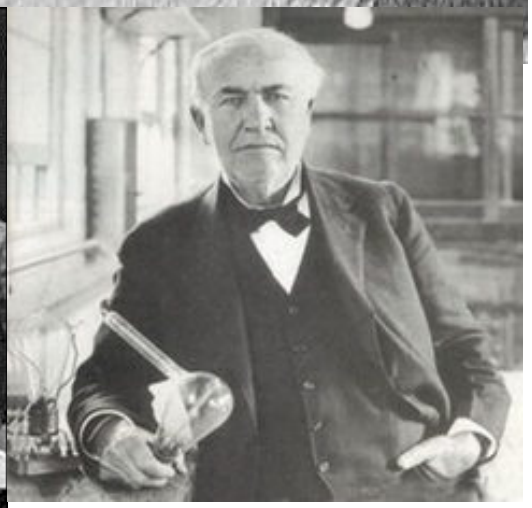


Development Led by Experienced Independent Transmission Company

History repeats

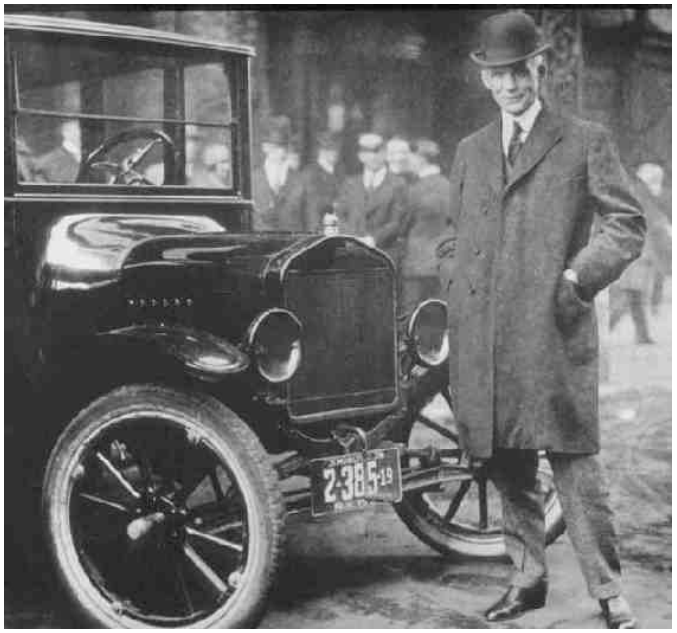
- Edison argues advantages of direct current
  - Safety
  - Consistent with battery technology (allows for backup and storage)
  - Worked with existing lights, meters and motors
- Westinghouse advances with alternating current
  - Transformers allow for multiple voltage levels
  - Higher voltage, less copper, remote generation, less expensive
  - Used in new, reliable induction motors
- Standards war ensues
  - Then: Topsy and the electric chair
  - **Today: insulated gate bipolar transistors (IGBTs) make HVDC a smart grid solution**





Offshore wind makes sense and it is affordable!

- **The goals are:**
  - **Jobs**
  - **Energy Independence**
  - **Economic Stability**
- **Creative approaches to the technical, financial and policy challenges we face will bring success.**



Henry Ford lived by the maxim: ***"Everything can always be done better than it is being done."*** *The Model T was introduced at a price of $825 in 1908. Over 15 million units later the last Model T rolled off the assembly line priced at $380.* Like other manufactured goods, land-based wind energy has experienced dramatic cost reductions over time, and offshore wind can achieve the same success.

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