Cuyahoga County Council

Steve Dever

LEEDCo Board of Directors Member representing Cuyahoga County

Tuesday, September 27, 2016

Great Lakes Energy Task Force

A public/private/philanthropic/academic collaboration between:

County of Cuyahoga Ohio

City of Cleveland Ohio

Port of Cleveland
Cleveland - Cuyahoga County Port Authority

Cleveland Foundation

Case Western Reserve University
Est. 1826

Fund for Our Economic Future

NorTech
Shaping Northeast Ohio's Technology Future

GenerationFoundation
Northeast Ohio's Collaborative Philanthropy

Great Lakes Energy Task Force

…with extensive private sector participation and interest, including

GE

LINCOLN ELECTRIC

FirstEnergy

Parker

EATON

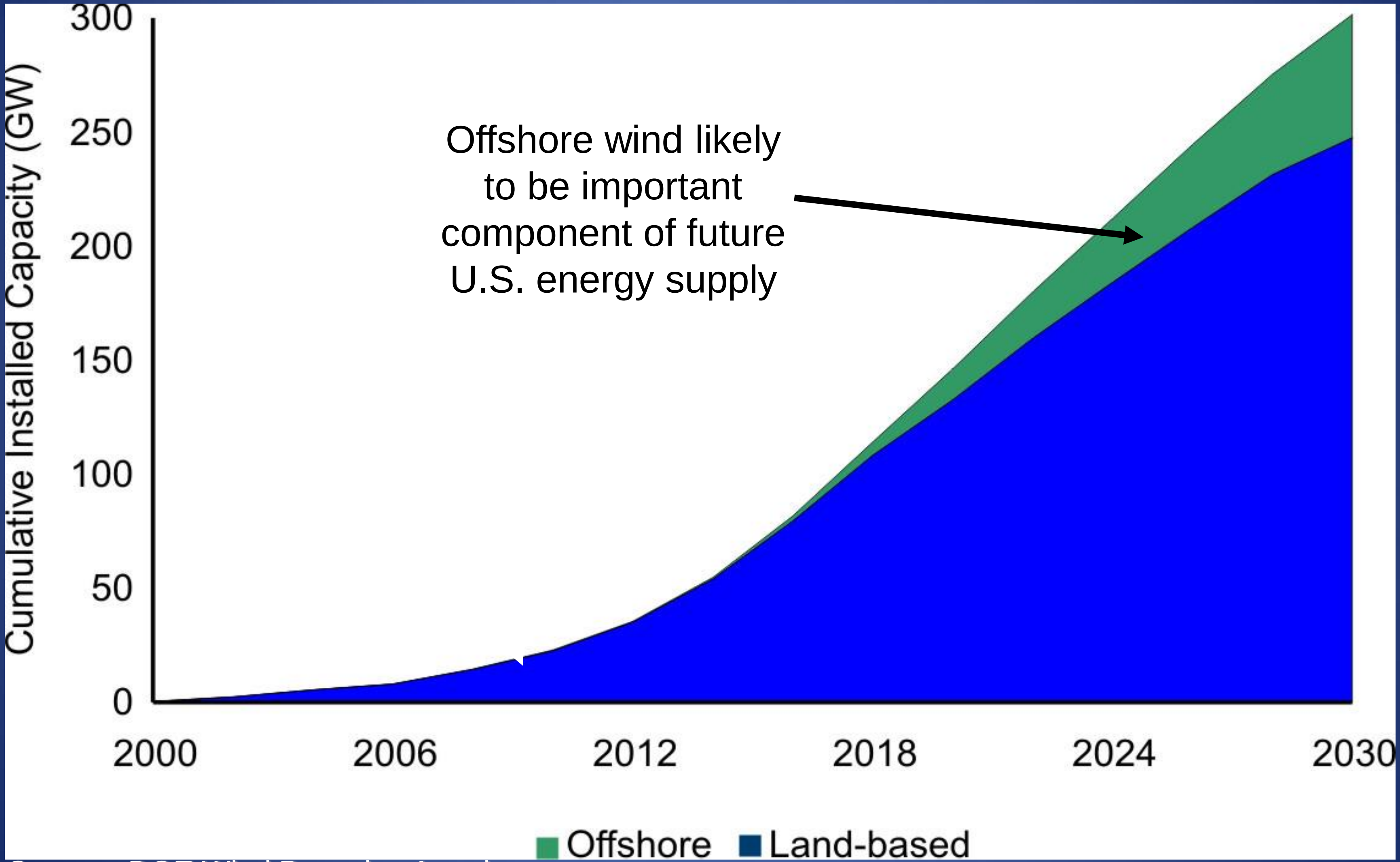
KeyBank

LUBRIZOL
Fluid technologies for a better world

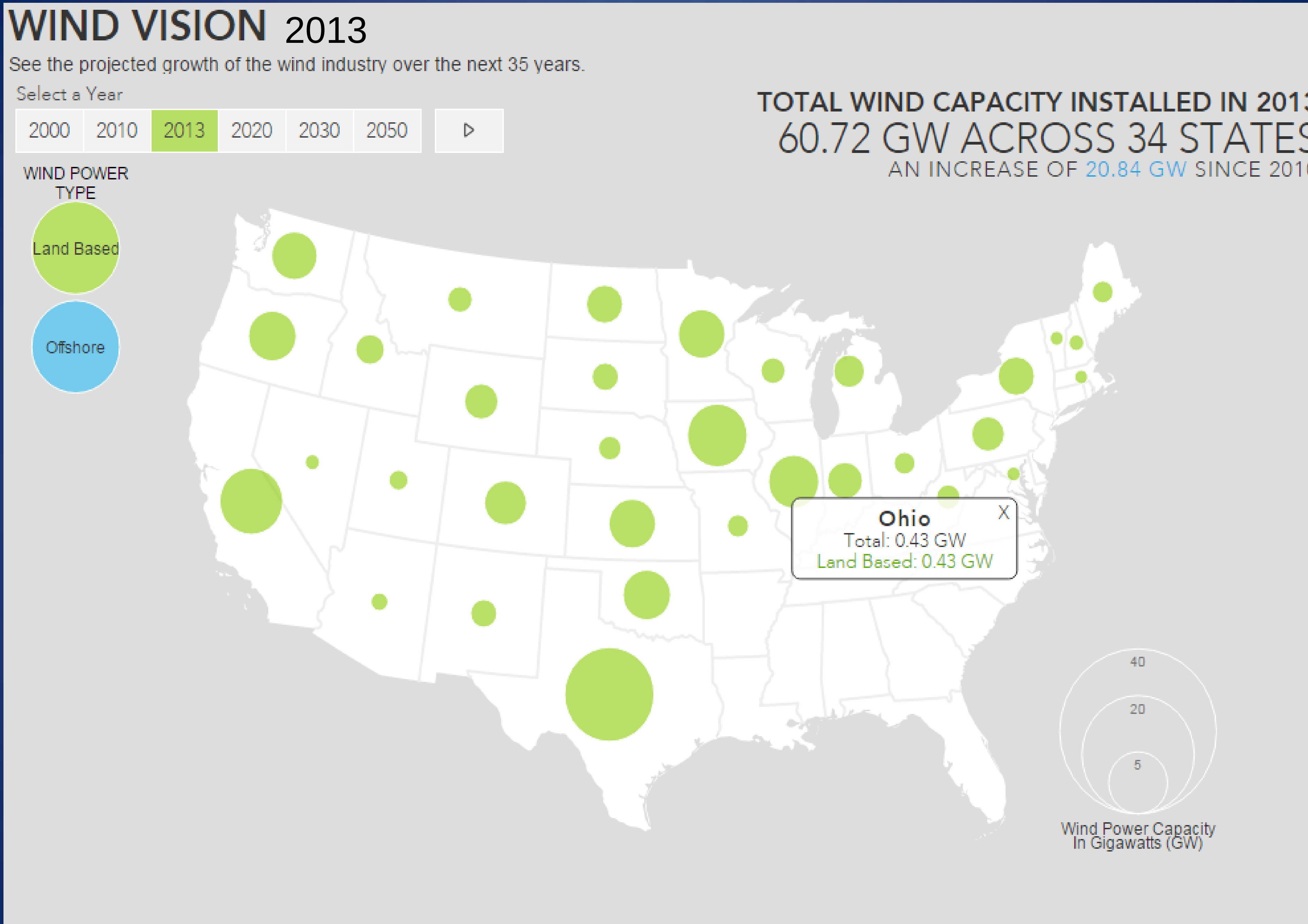
Feasibility Study

- Several areas of work including:
  - Environmental impact (e.g., avian studies)
  - Legal/regulatory permitting processes
  - Preliminary engineering and interconnection
  - Community acceptance (e.g., aesthetics)
  - Optimal project configuration
  - Preferred ownership/governance structure
  - Economic analysis and finance ability
  - Wind industry interest and willingness to participate
- Key findings:
  - Substantial data compiled on wind, ice, avian and geotechnical factors
  - No technical or environmental "deal-breakers" identified
  - Pilot project would require financial and policy support from public sector
- Available at http://development.cuyahogacounty.us/en-US/energy-task-force.aspx

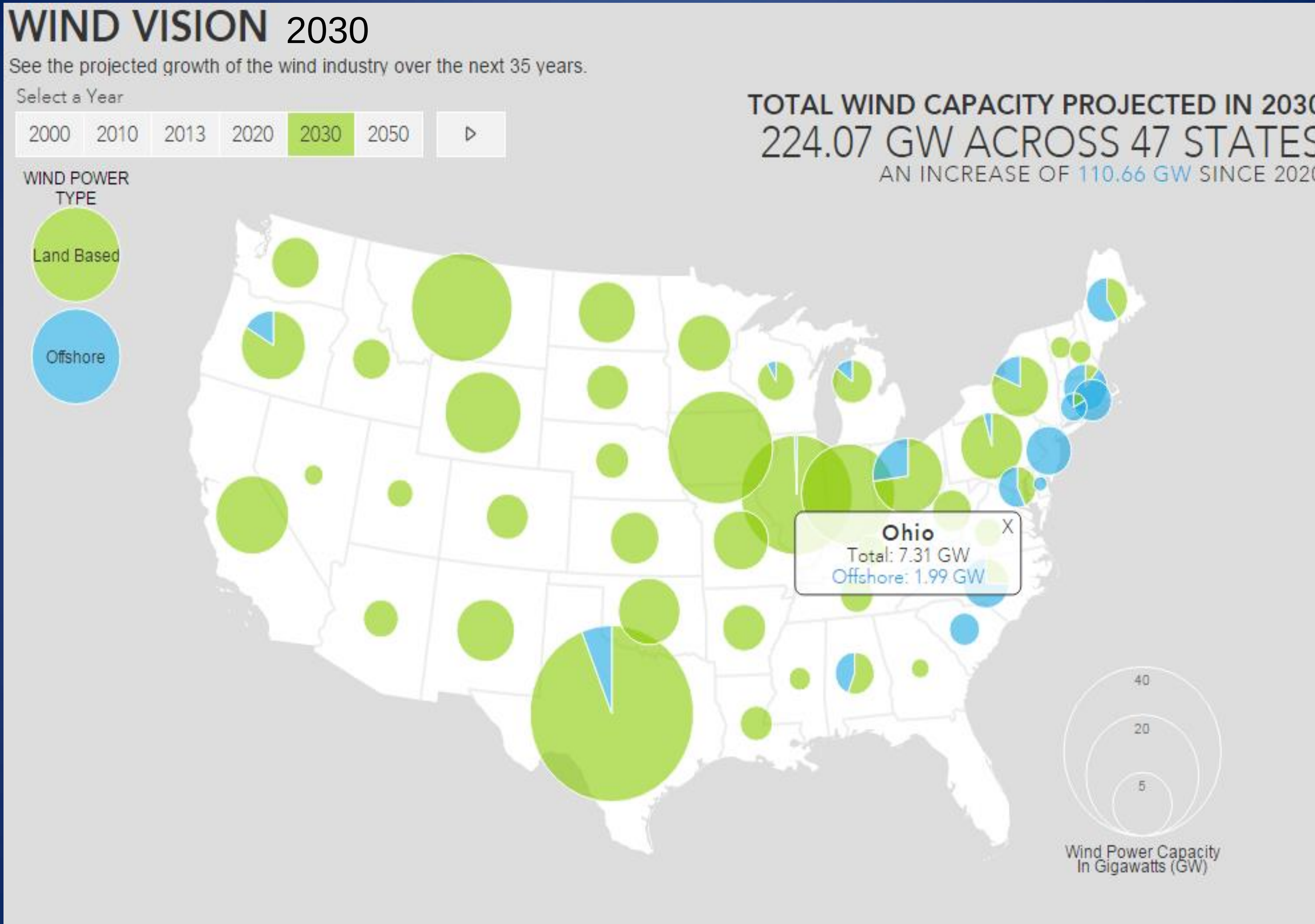
20% Wind Scenario by 2030



Source: DOE Wind Powering America



Lawrence Berkeley National Laboratory
http://energy.gov/maps/map-projected-growth-wind-industry-now-until-2050#.V-VMoamDswQ.email



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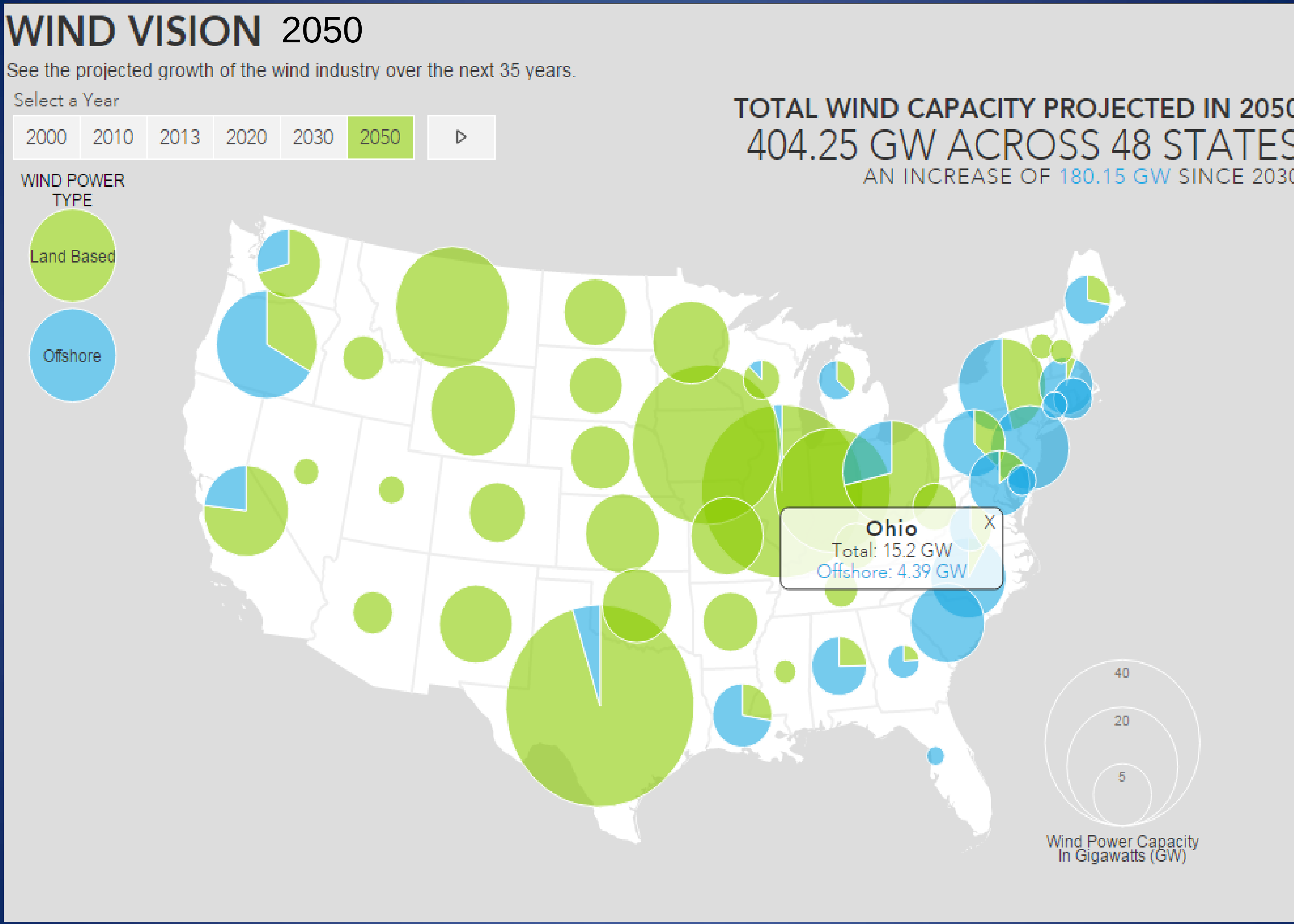

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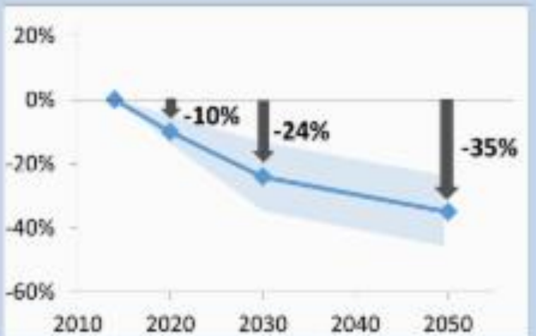
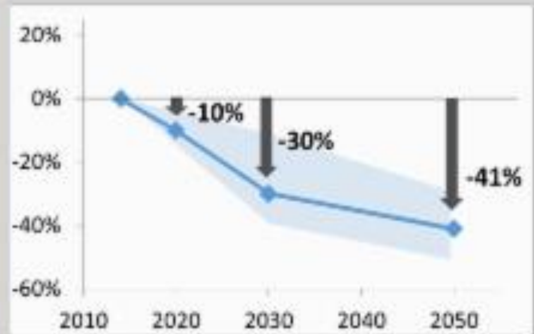
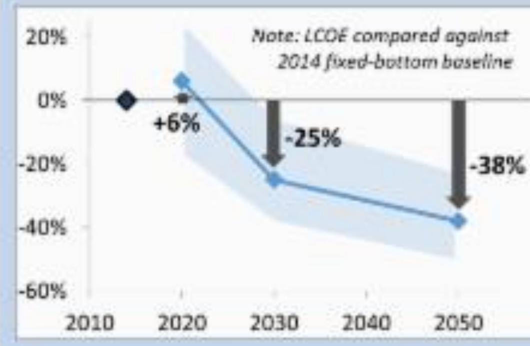
	ONSHORE (LAND-BASED)	FIXED-BOTTOM OFFSHORE	FLOATING OFFSHORE

LEVELIZED COST OF ENERGY
(median estimates for median scenario & 1st-3rd quartile range)







DRIVERS FOR COST REDUCTION IN 2030
(median estimates; median scenario)

	ONSHORE (LAND-BASED)	FIXED-BOTTOM OFFSHORE	FLOATING OFFSHORE
Capacity factor	+10%	+4%	+9%
Project life	+10%	+15%	+25%
CapEx	-12%	-14%	-5%
OpEx	-9%	-9%	-8%
WACC	no Δ	-10%	-5%

TURBINE SIZE IN 2030
(typical projects)

Onshore (land-based): 3.25 MW, 115 m hub height, 135 m rotor diameter

Fixed-bottom offshore: 11 MW, 125 m hub height, 190 m rotor diameter

Floating offshore: 9 MW, 125 m hub height, 190 m rotor diameter

TOP-FIVE IMPACT CATEGORIES

Onshore (land-based):
- Larger rotors, reduced specific power
- Rotor design advancements
- Taller towers
- Reduced financing costs
- Component durability / reliability

Fixed-bottom offshore:
- Larger turbine capacity
- Foundation / support structure design
- Reduced financing costs
- Economies of scale via project size
- Component durability / reliability

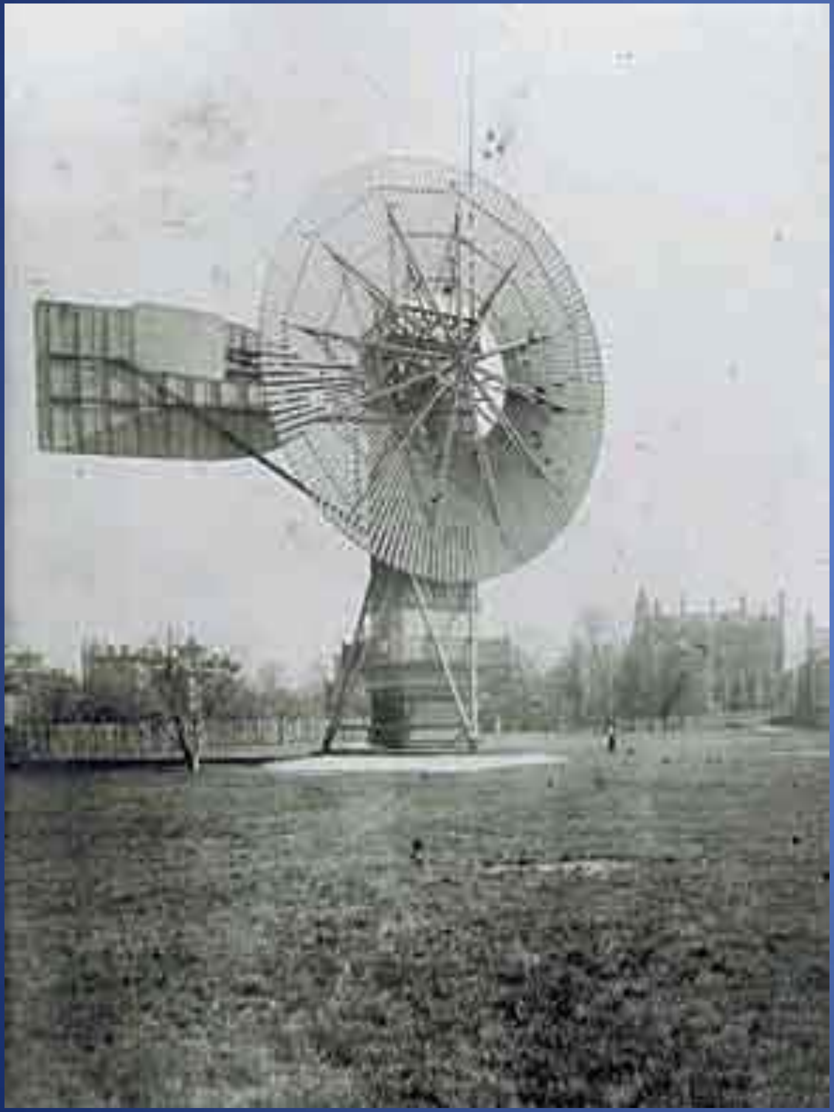
Floating offshore:
- Foundation / support structure design
- Installation process efficiencies
- Foundation / support manufacturing
- Economies of scale via project size
- Installation / transport equipment

Cost Reduction Potential for Solar and Wind Power, 2015-2025

	Global weighted average data									
	Investment costs (2015 USD/kW)		Percent change	Capacity factor		Percent change[2]	LCOE (2015 USD/kWh)		Percent change
	2015	2025		2015	2025		2015	2025	
Solar PV	1 810	790	-57%	18%	19%	8%	0.13	0.06	-59%
Onshore wind	1 560	1 370	-12%	27%	30%	11%	0.07	0.05	-26%
Offshore wind	4 650	3 950	-15%	43%	45%	4%	0.18	0.12	-35%

Source: International Renewable Energy Agency 2016bhttp://www.irena.org/menu/index.aspx?mnu=Subcat&PriMenuID=36&CatID=141&SubcatID=2733

Cleveland: First in Wind



First wind-powered electricity generator, 1888

Charles Brush
Euclid Avenue
Cleveland

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