Offshore Renewable Energy Catapult
Wind Wakes: Briefing Webinar
Friday, 1 December, 2023

Are Governments Waking Up to Wind Wakes— U.S. Perspective

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I. Background—Onshore and Offshore Wind Development in the U.S.

II. Lessons from U.S. Wind Development on Private Lands

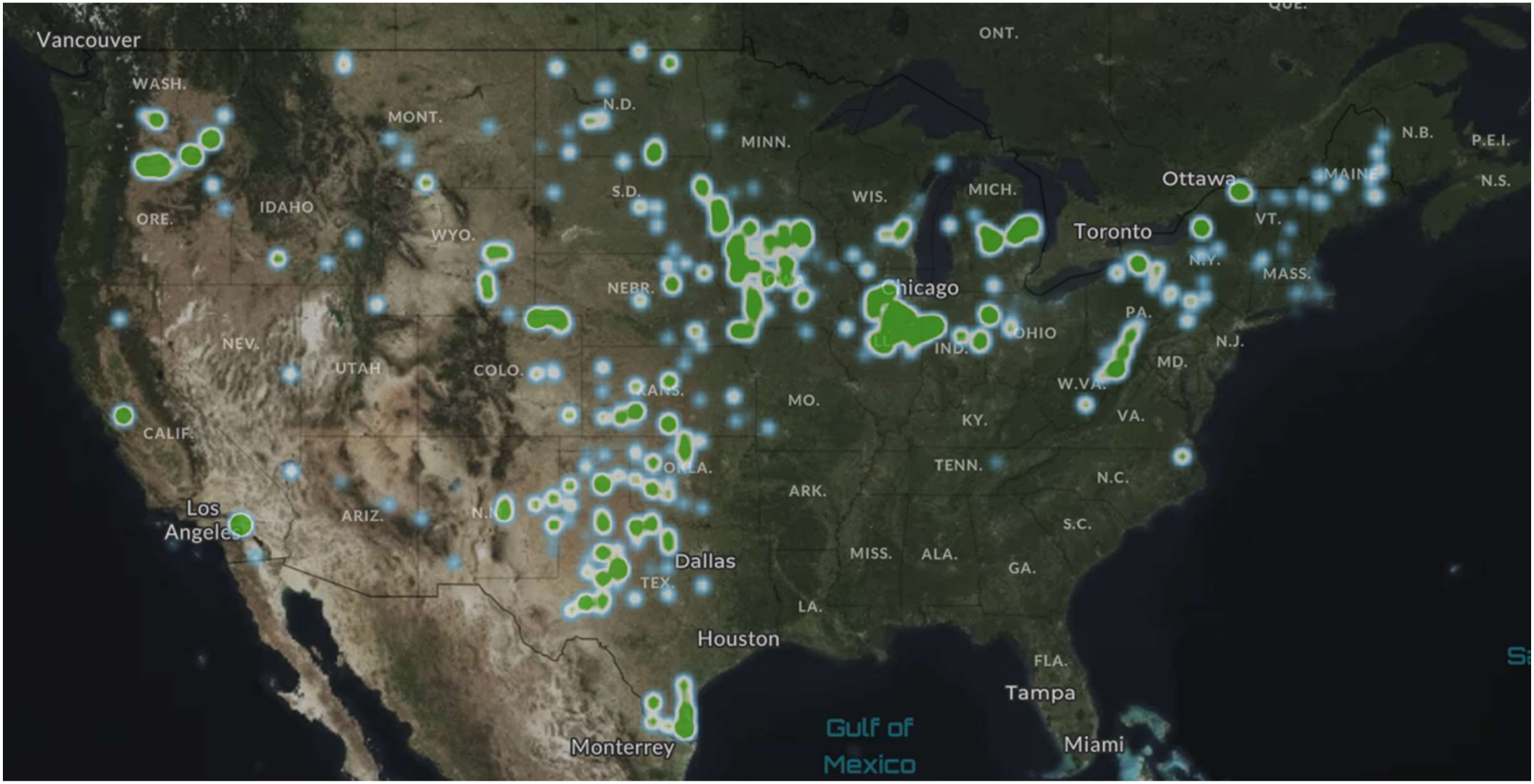
III. Current U.S. strategies to deal with offshore wind wakes

I. Background

144,173 MW =

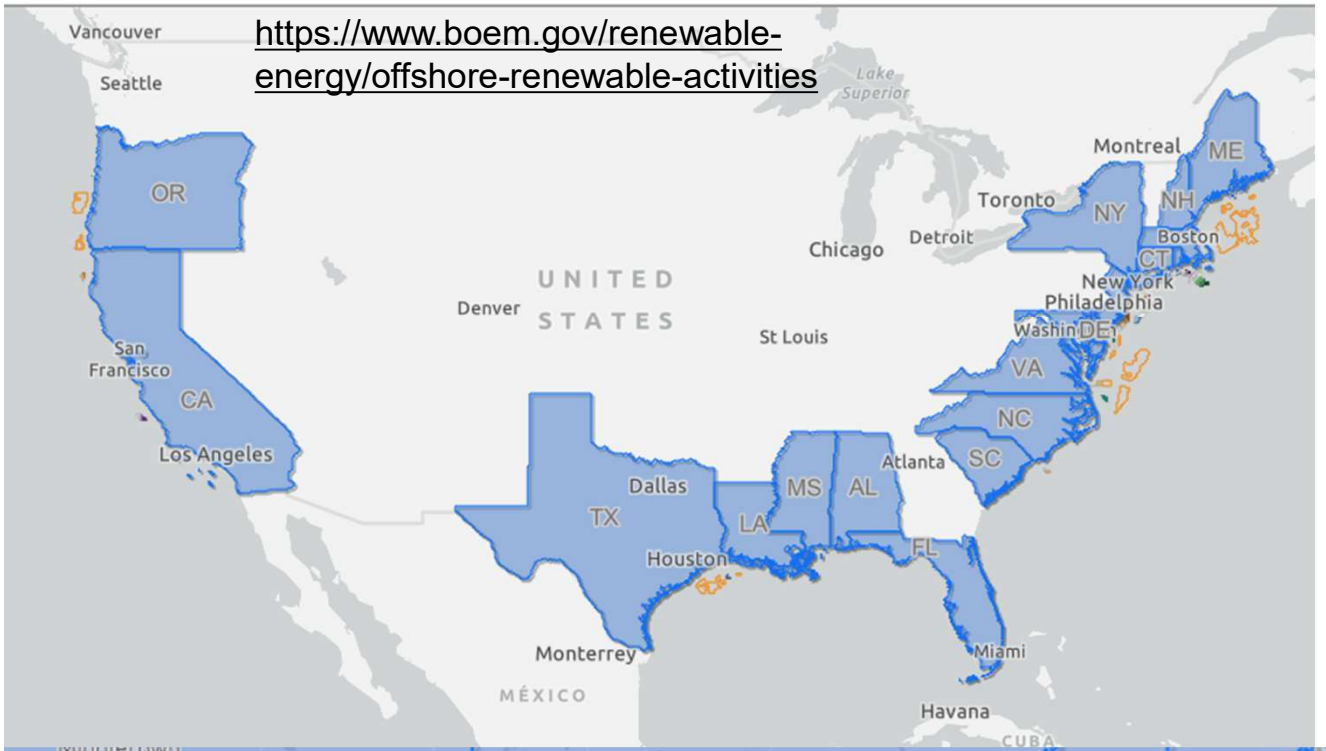
U.S. land-based capacity *installed* by the end of 2022.

https://www.energy.gov/eere/wind/wind-market-reports-2023-edition



https://eerscmap.usgs.gov/uswtdb/viewer/

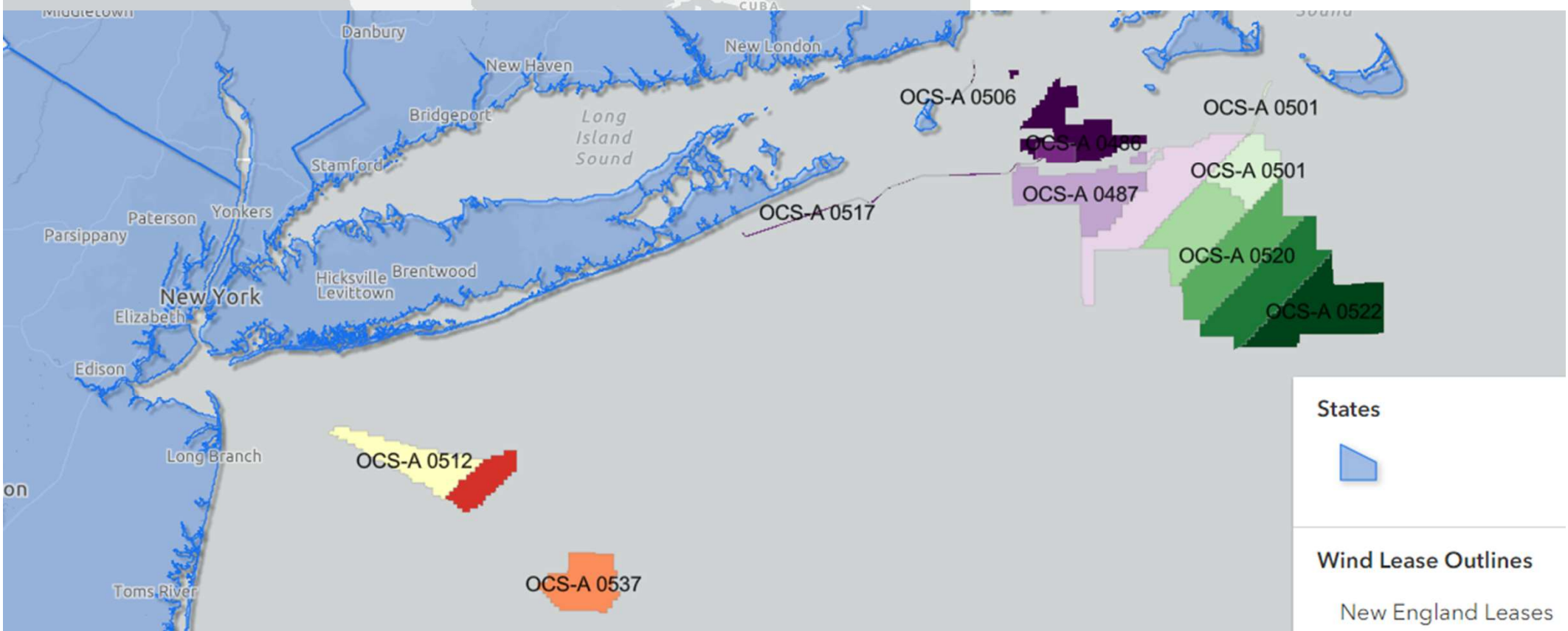
https://www.boem.gov/renewable-energy/offshore-renewable-activities

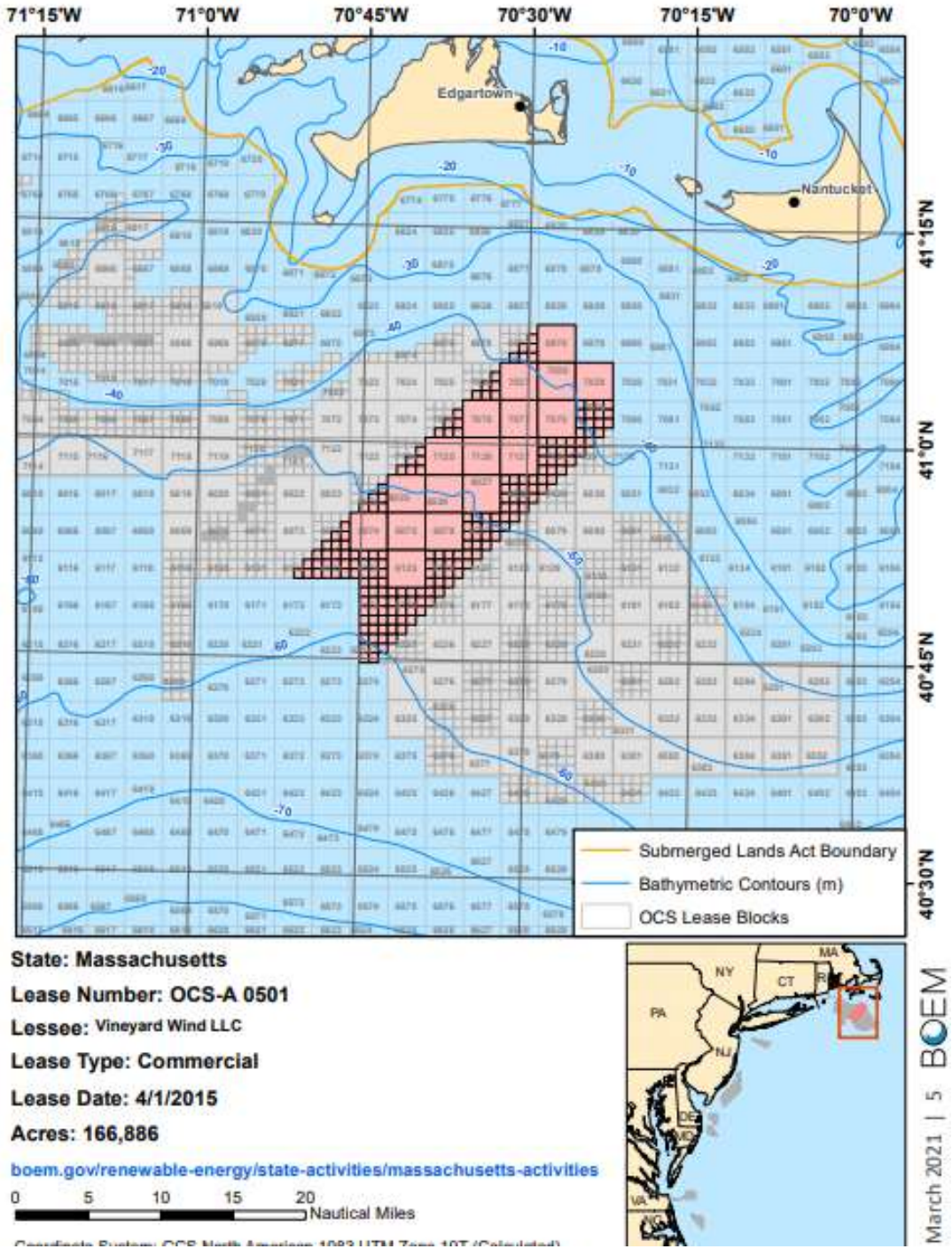


52,687 MW=

potential generating capacity of the U.S. offshore wind energy project development and operational pipeline by the end of 2022.

https://www.energy.gov/eere/wind/wind-market-reports-2023-edition



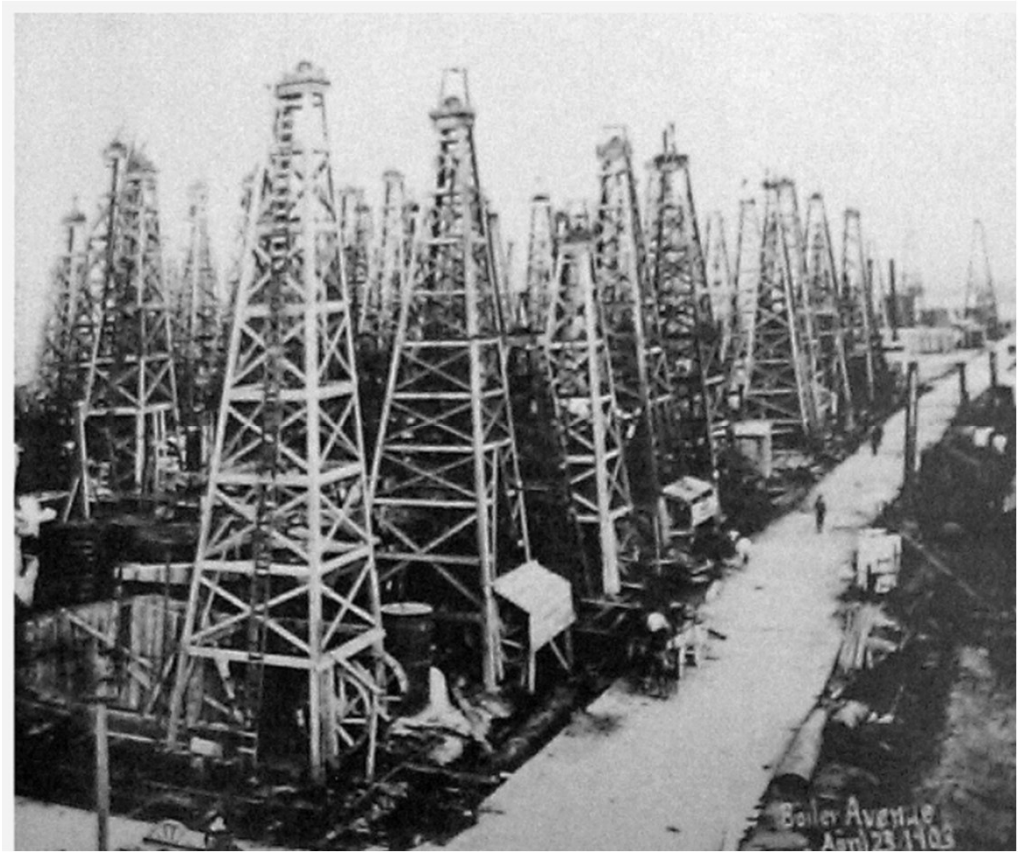


Block Island **(30 MW)**— U.S.'s first commercial offshore wind farm in RI state waters (Dec. 2016).

Vineyard Wind—U.S.'s first commercial wind farm placed its first **13 MW** capacity turbine into operation (Oct. 2023) (Final project=62 turbines).

President Biden's goal is **30,000 MW by 2030**.

https://www.boem.gov/sites/default/files/documents/oil-gas-energy/Renewable_Energy_Leases_Map_Book_March_2021_v2.pdf



Boiler Ave., Spindletop, TX
https://aoghs.org/old-oil-stocks/beaumont-confederated-oil-pipe-line-company/

II. Lessons from U.S. Wind Development on Private Lands

San Gorgonio, CA
© 2011 K.K. DuVivier

In oil and gas development, competitive leases and the "rule of capture" created "waste" until governments intervened with forced spacing, "pooling," and "unitization."

Preventing Wind Waste
71 Am. U. L. Rev. 1 (2021)
https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3873006

Moat Mentality: Onshore and Offshore Approaches to Wind Waking
1 Notre Dame J. of Emerging Tech. (2020)
https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3531043

ARTICLES
https://doi.org/10.1038/s41560-018-0281-2
nature energy

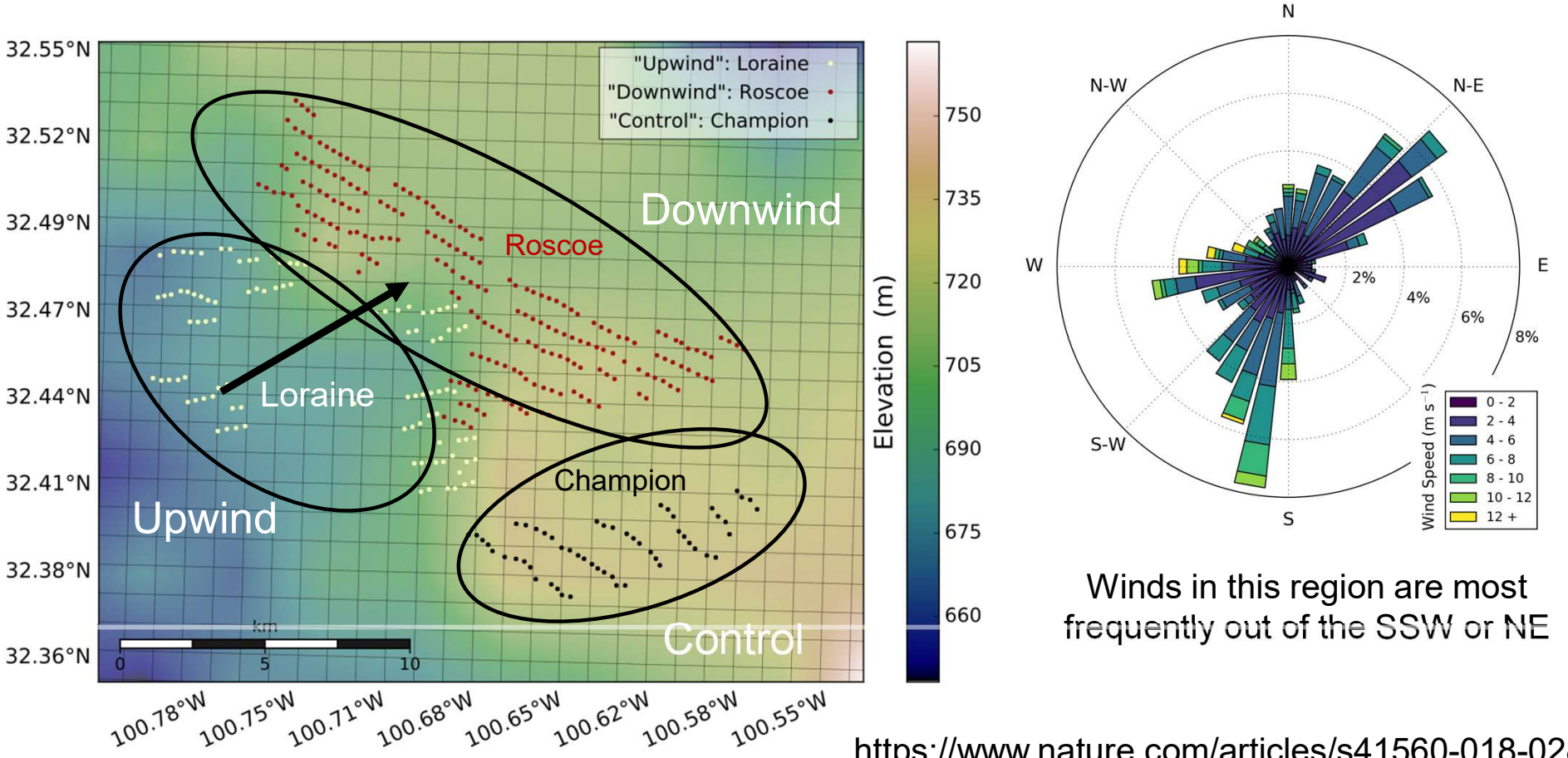
Costs and consequences of wind turbine wake effects arising from uncoordinated wind energy development

J. K. Lundquist[1,2*], K. K. DuVivier[3], D. Kaffine[4] and J. M. Tomaszewski[1]

Optimal wind farm locations require a strong and reliable wind resource and access to transmission lines. As onshore and offshore wind energy grows, preferred locations become saturated with numerous wind farms. An upwind wind farm generates 'wake effects' (decreases in downwind wind speeds) that undermine a downwind wind farm's power generation and revenues. Here we use a diverse set of analysis tools from the atmospheric science, economic and legal communities to assess costs and consequences of these wake effects, focusing on a West Texas case study. We show that although wake effects vary with atmospheric conditions, they are discernible in monthly power production. In stably stratified atmospheric conditions, wakes can extend 50+ km downwind, resulting in economic losses of several million dollars over six years for our case study. However, our investigation of the legal literature shows no legal guidance for protecting existing wind farms from such significant impacts.

https://www.nature.com/articles/s41560-018-0281-2

Part of work sponsored by the National Science Foundation under grant BCS-1413980



Winds in this region are most frequently out of the SSW or NE

https://www.nature.com/articles/s41560-018-0281-2

Results of Econometric modeling (2009-2015)

Private costs: (1) Project's *capacity factor* **(productivity) decreased** by nearly **6;** (2) Wakes caused downwind project to generate roughly **185,000 fewer MWh**; (3) Project lost ≈**$1 million per year** in power sales from 2011-2015 (based on wholesale prices) & **≈$2 million/year** when accounting for the PTC.

Social Costs: Based on a 0.6 *CO_2 offset ratio*, wakes resulted in ≈111,000 more tons of CO_2 emissions. At a social cost of $39/ton [current U.S. EPA recommendation is $190/ton]= **$4.3 million** in losses.

Legal considerations

Plaintiff (downwind farm) must hire a lawyer and bring a **lawsuit=$$.**

Litigation takes time, and the **outcome is uncertain**.

In order to win the lawsuit, plaintiff has the **burden of proof**.

Two types of **financial injury**:

(1) **Close turbulence** (3-10RD)causes wear & tear and premature retirement of capital investment—**perhaps some liability** and

(2) **Longer distance lost power**—can't sue for taking or "theft" because the downwind farm has **no enforceable property interest** in the wind.

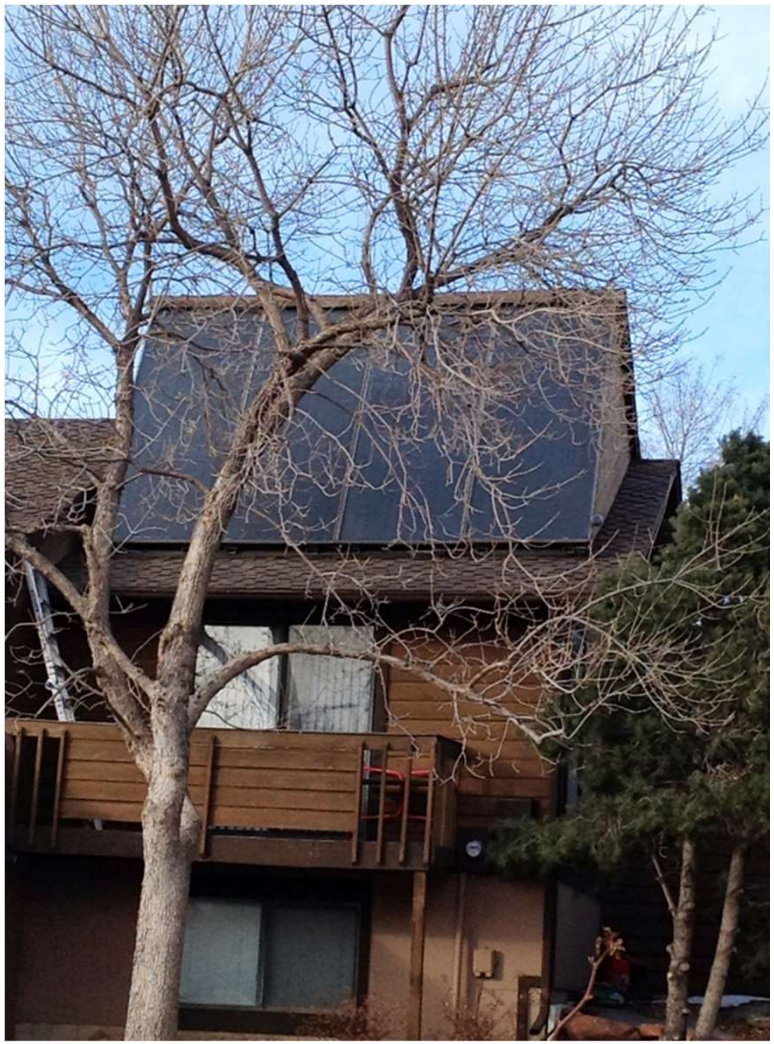
Can't sue for **common law nuisance** because the downwind farm does not need to show trespass but would have to show "unreasonable or unlawful use that substantially interferes with their property."

Possibly governments could create a "**modified nuisance** standard."

Modified Nuisance Rule—e.g., California Solar Shade Control Act

Private nuisance if tree or shrub "cast[s] a shadow greater than **10 percent** of the collector absorption area upon that solar collector surface at any one time **between the hours of 10 a.m. and 2 p.m.**, local standard time."

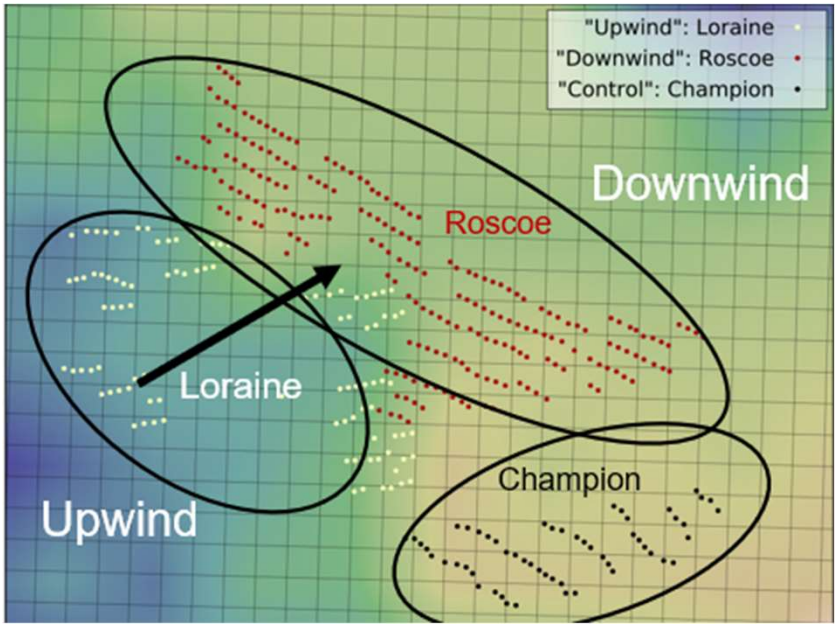
25982:Chapter 12 added by Stats. 1978, Ch. 1366, Amended by Stats. 2008, Ch. 176, Sec. 2. Effective January 1, 2009.



Similarly, the costs of disputes could be significantly reduced by **federal or state legislation** that establishes a **definition of "undue interference" or nuisance within a set space or time period.**

Wake effects smaller than that level would be ignored.

Prior appropriation (protection of status quo for first in time, first in right) recognized in some U.S. water law, but not for wind.



Competitive leases & the absence of a protective legal regime or government regulation can foster **predatory behaviors** & maximization of recovery from individual leases by extracting wind from neighbors v. maximization of the entire resource.

There is a tension between developers (who want to maximize their production projections to get better funding) and 3rd party reviewers for financiers (who want conservative estimates to avoid liability to banks for a project's underperformance). As a **defensive strategy**, some financiers can require large buffer zones.

Buffer zones or setbacks

Problem: Trying to create buffers for longer distance wakes is much like creating fortress moats and takes valuable acreage out of production.

III. Current U.S. strategies to deal with offshore wind wakes

1) DOE/NREL comprehensive wake study: https://www.nrel.gov/wind/awaken.html

2) Layout of leases (oriented to minimize lease-to-lease wakes) & disclosure of possible waking at lease sales.

(3) Renewable Energy Modernization Rules:

The draft rules only would require disclosure of wake data in the Construction & Operations Plans (COP). Final rules, due in early 2024, may also include language about "prevention of waste."

(4) Clauses in leases to encourage lessees to work with each other by mandating a setback of 1.5 nm if they don't.
E.g.,https://www.boem.gov/sites/default/files/documents/renewable-energy/state-activities/Lease OCS-A 0542.pdf (sec. 8.1, p. C-13)

(5) Cooperation with shared resources to bring electricity to shore—use as a model for turbine layout cooperation?

(6) No consideration yet of "unitization" similar to O &G development.

Questions?

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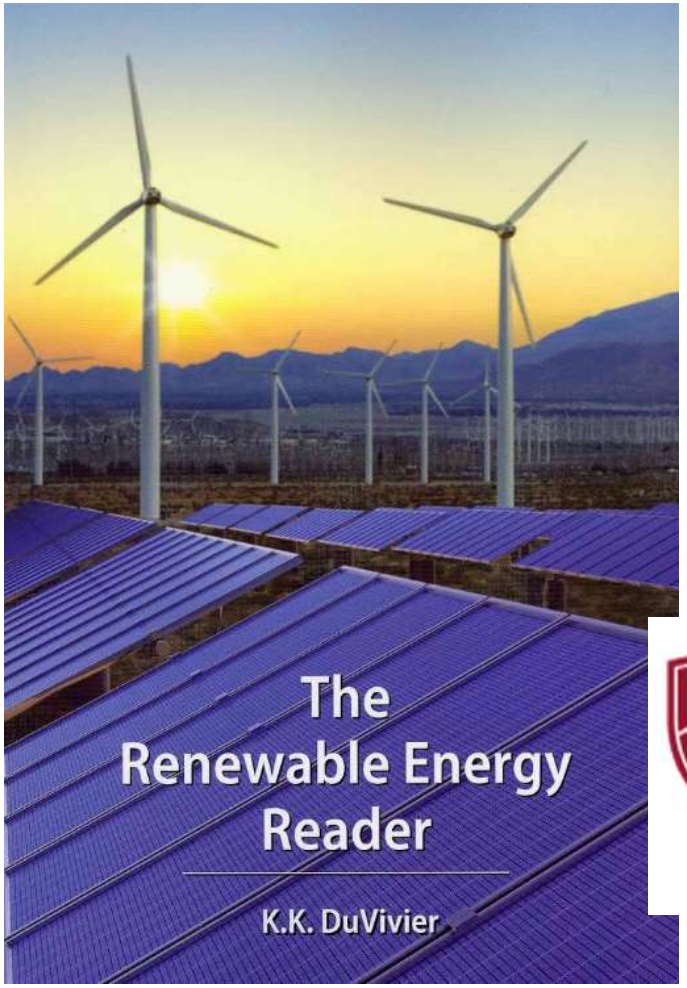

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SSRN:
http://ssrn.com/author=725005

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