

Government Perspective and Kickoff

Wind Energy Systems Engineering

Ben Hallissy

Technology Manager, Wind Energy Technologies Office (WETO)

August 30, 2022

Boulder CO

Wind Energy Technologies Office | What We Do

FY22 Enacted: \$114M | FY23 Request: \$345M



Offshore Wind



Land-Based Wind



Distributed Wind



Materials & Systems RDT&E



Environmental & Siting R&D



Grid Integration and Analysis:



Education & Workforce Development

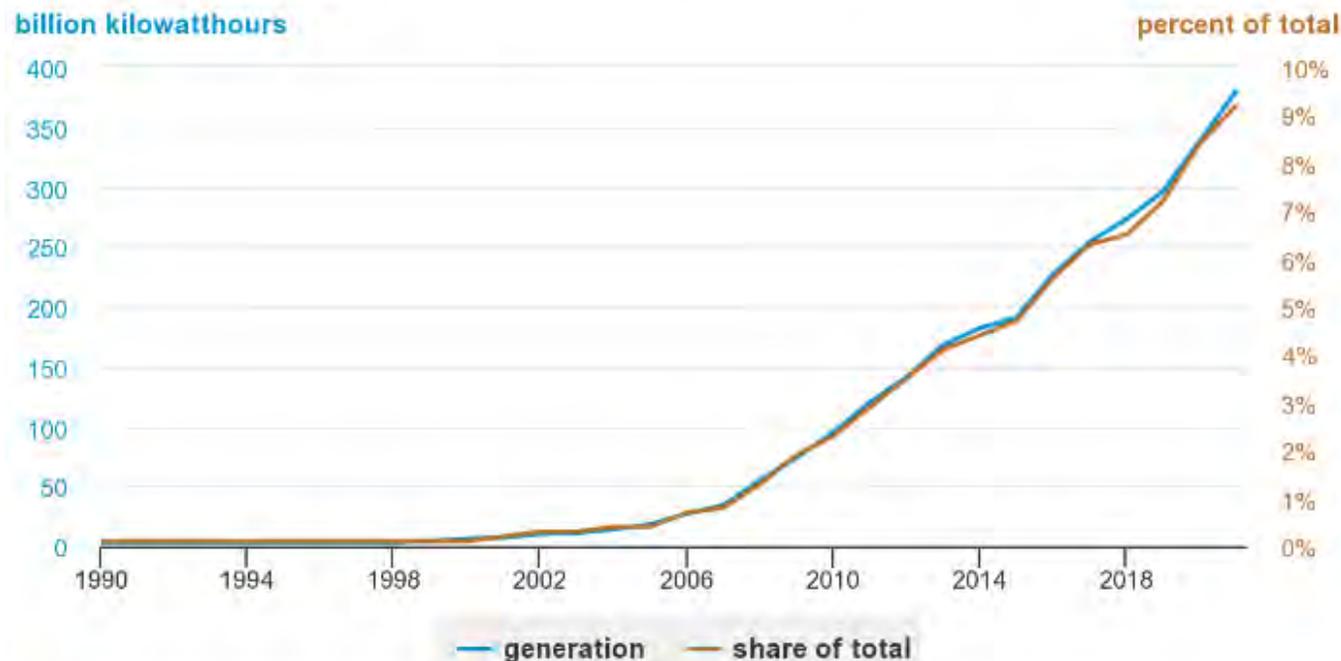
Wind is a cornerstone of achieving the Administration's goals of 100% clean electricity by 2035 and a net-zero emissions economy by 2050.

New U.S. Wind Market Reports

<http://energy.gov/windreport>



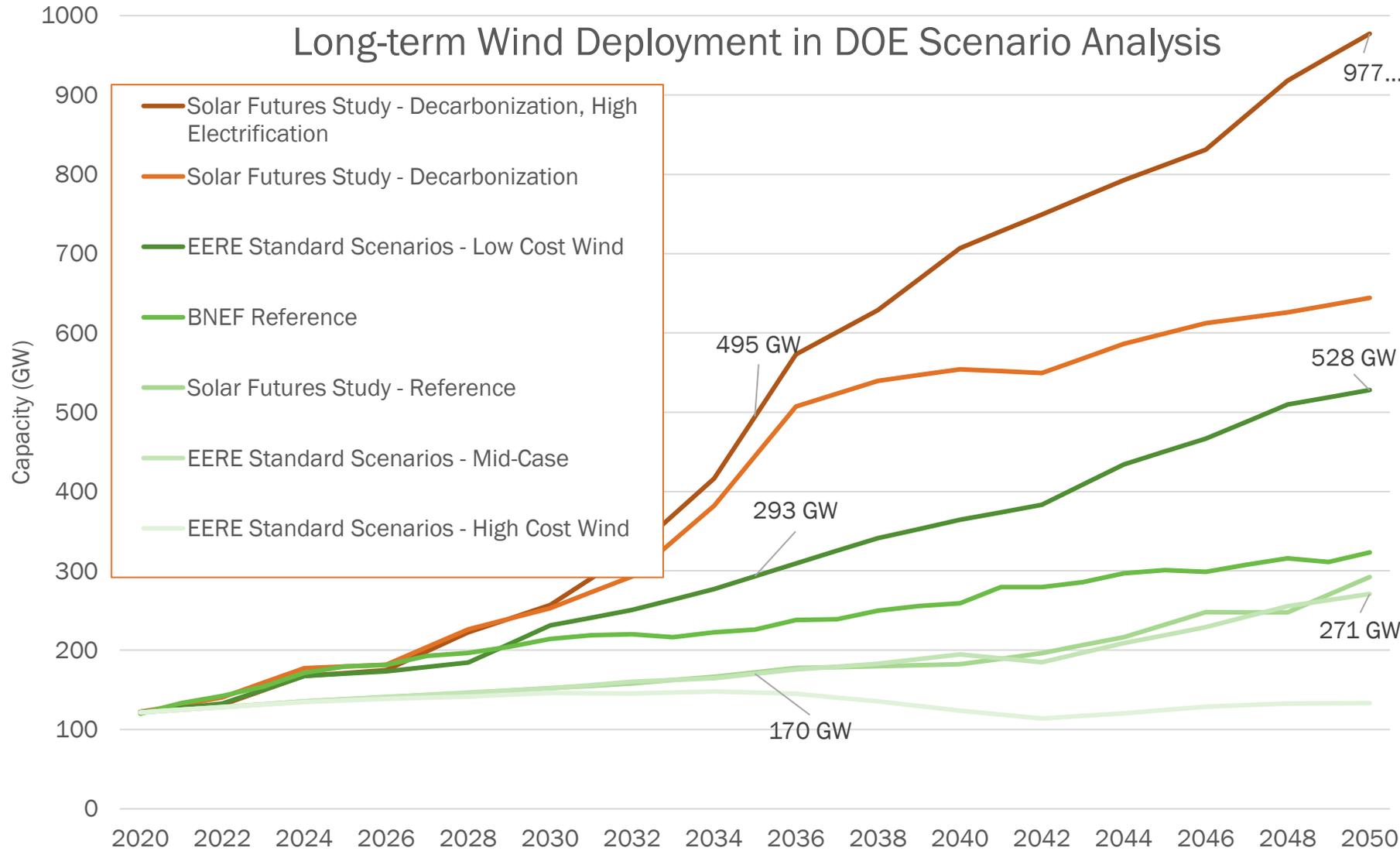
Wind electricity generation and share of total U.S. electricity generation, 1990-2021



Data source: U.S. Energy Information Administration, *Electric Power Monthly*, February 2022, preliminary data for 2021
Note: Utility-scale electricity generation

2035: Up to ~300 GW wind if no policy; 500+ GW to meet climate goals

Long-term Wind Deployment in DOE Scenario Analysis



- Achieving a carbon-free grid by 2035 could require:
 - 60-80% wind + solar (up from ~10% now)
 - > 500 GW wind
 - Average install rates of 35 GW/year, peak > 50 GW/yr
 - Significant expansion into new areas
- Achieving a net-zero carbon economy by 2050 could require more than 1 TW wind
- Cost reductions alone could drive up to ~300 GW wind by 2035
- But...extremely high uncertainty

Solar Futures Study, EERE Standard Scenarios, Bloomberg

U.S. Policy Update

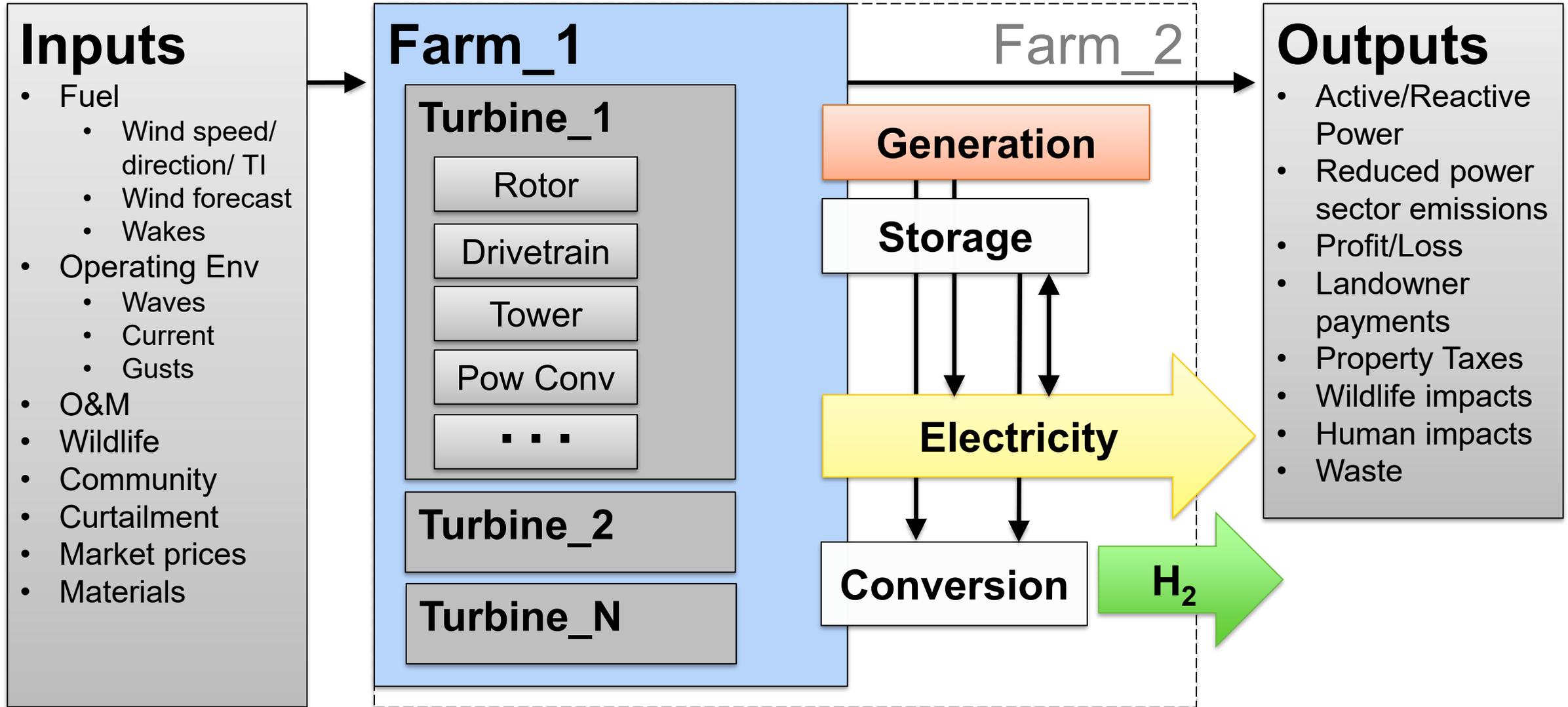
- **Bipartisan Infrastructure Law (BIL)**
 - \$60M to WETO for all authorizations
 - \$40M to WETO for recycling R&D (EA2020)
- **Inflation Reduction Act (IRA)**
 - PTC extension for wind 2023-2024
 - PTC becomes tech-neutral 2025-2032 or until CO₂ targets met (can also choose ITC)
 - Introduces advanced manufacturing tax credits
 - \$100M for OSW transmission planning

Advanced Manufacturing Production Tax Credits

Blade	2c/watt
Nacelle assembly	5c/watt
Tower	3c/watt
Offshore wind foundation	Fixed 2c/watt and floating 4c/watt
Offshore wind vessel	10% of sales price

Source: ACP

Wind Energy Systems – The Farm



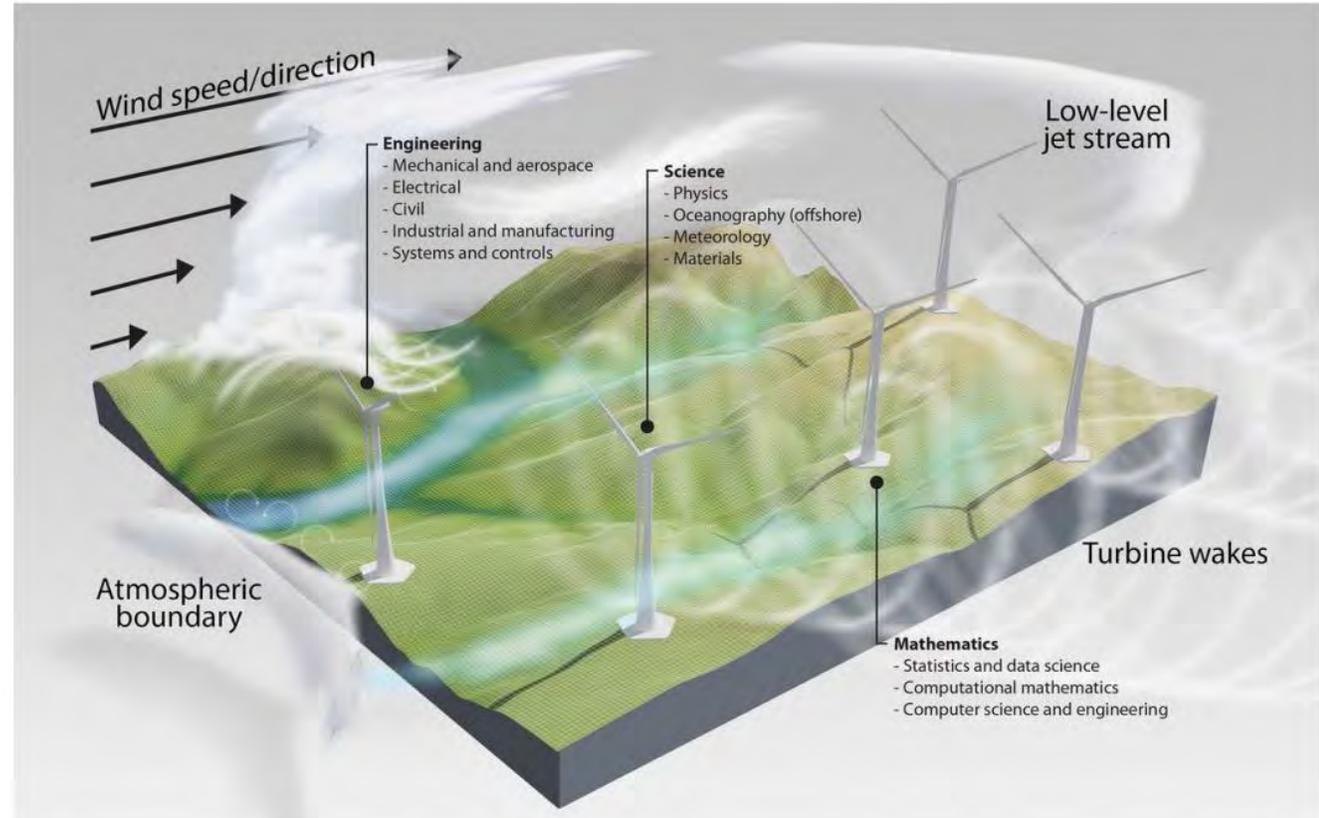
Next-Gen Turbine Systems

- Tall tower technologies w/ lower cost and material requirements
- Novel transport or on-site assembly
- Extreme weather (Lightning, Tropical Cyclones)
- O&M
 - Long life turbines
 - Think of the techs (stay ashore and on the ground)
 - Share data and failure modes (IEA Wind Task 43 – Digitalization)
- Wide variety of floating platform architectures and OEMs
- Continue innovation in turbine and platform architecture



Next-Gen Wind Farms

- Pre-construction estimates of losses and production
- Wind farm flow control (IEA Wind Task 44)
- Intra-array and inter-array wakes (AWAKEN)
- Design of floating arrays (IEA Wind Task 49)
- Grid services and cyber security

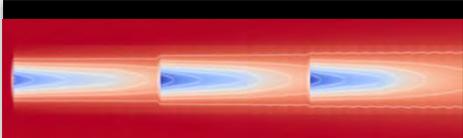
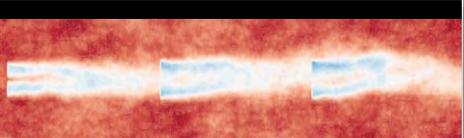
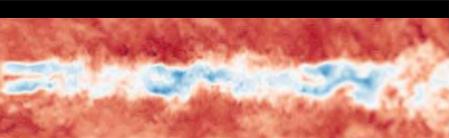


Veers et al, 2019. Grand challenges in the science of wind energy

Multi-fidelity Modeling – Enabling Confident Scaling

- Designing and deploying the largest rotating machines ever built by humankind
- First principles understanding of atmospheric flow and wind turbine system response

Model Fidelity / Computational Intensity

Application	Design Exploration	Detailed Design	Highly Resolving
Single Turbine Performance and Loads	WISDEM, RAFT Multidisciplinary design optimization and cost modeling	OpenFAST Turbine loads analysis, detailed turbine design, IEC standards	ExaWind/SOWFA Understand physics, final turbine design check, calibrate / validate lower fidelity
	WEIS		
Full Wind-Plant Performance and Loads	FLORIS Wind-plant controls and siting optimization	FAST.Farm, WindSE Turbine siting within plant, wind-plant controls, plant loads analysis, detailed plant design	ExaWind/ERF/SOWFA Understand physics, final plant design check, calibrate / validate lower fidelity
	 Other Tools: WAsP, WindFarmer, Fuga	 Other Tools: openWind, MeteoDyn WT, DWM	 Other Tools: EllipSys3D, PALM, WRF-LES, W2A2KE3D, VFS-Wind

* Other Tools are other widely-used tools with similar capabilities

Extending the System / Design-for-X

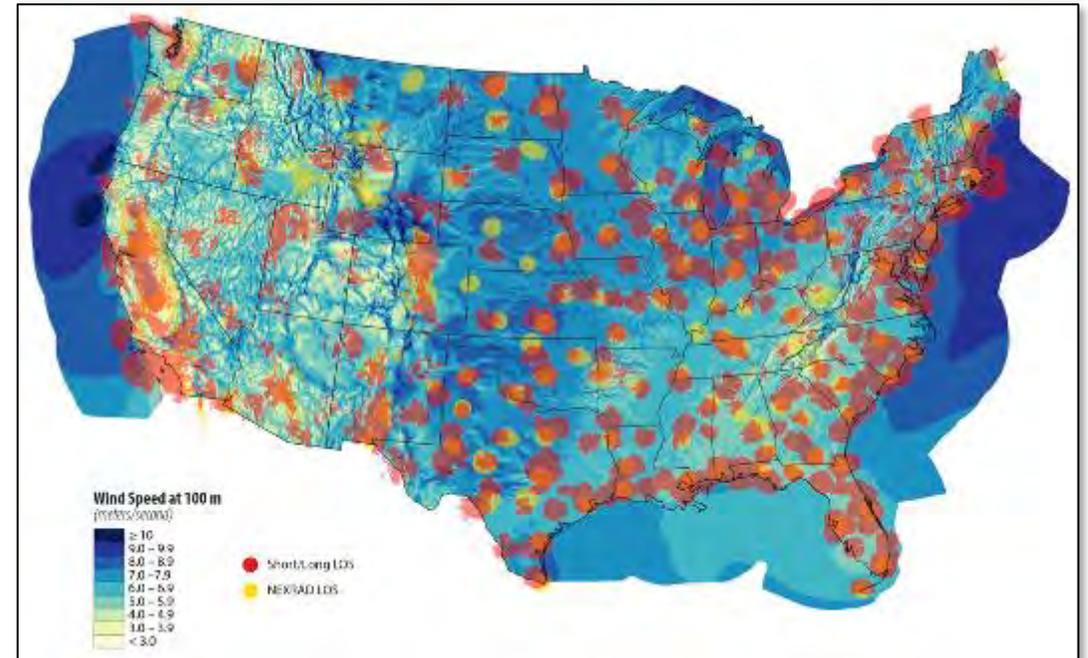
- Wind/wildlife co-design and operation
- Hybrids and/or performance guarantees, “clean firm wind”
- Turbine/radar interference
- Adoption
 - Who will use the tech or ideas, are they aware? Are they here?
- Community
 - Where turbines will be deployed
 - Of researchers, OEMs, funding bodies that may help along the way – many in the room!

U.S. Department of Energy Releases Request for Information to Improve Bat Deterrent Technology

AUGUST 23, 2022

Dominion Energy mulls appeal of ‘untenable’ performance standard for \$9.8B offshore wind project

Published Aug. 8, 2022



Pace of progress



Photo by The Oregonian



ABC News 9 via Twitter

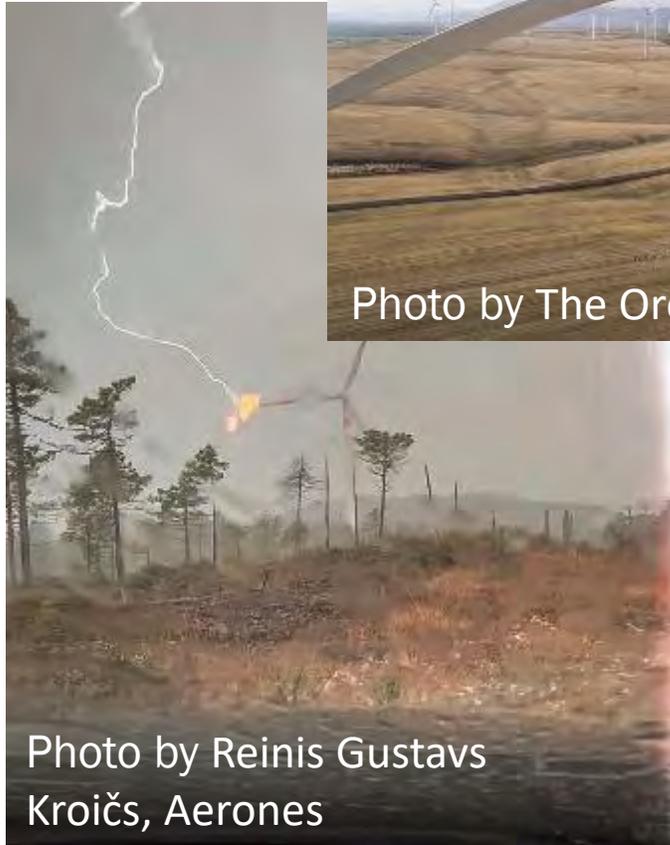
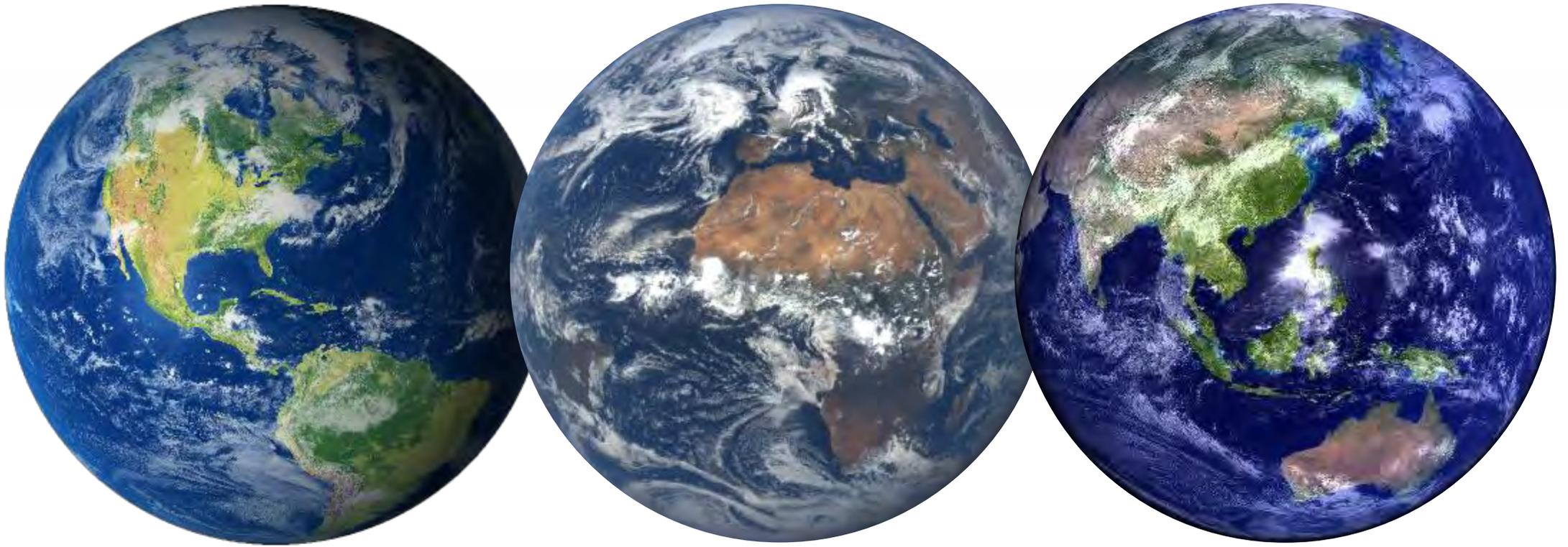


Photo by Reinis Gustavs
Kroičs, Aeronas



Video by Brent Havins



There are no passengers on spaceship Earth, we are all crew.

– Marshall McLuhan

Questions or follow-up: benjamin.hallissy@ee.doe.gov