Revisiting Community Wind Through the Lens of Community Solar

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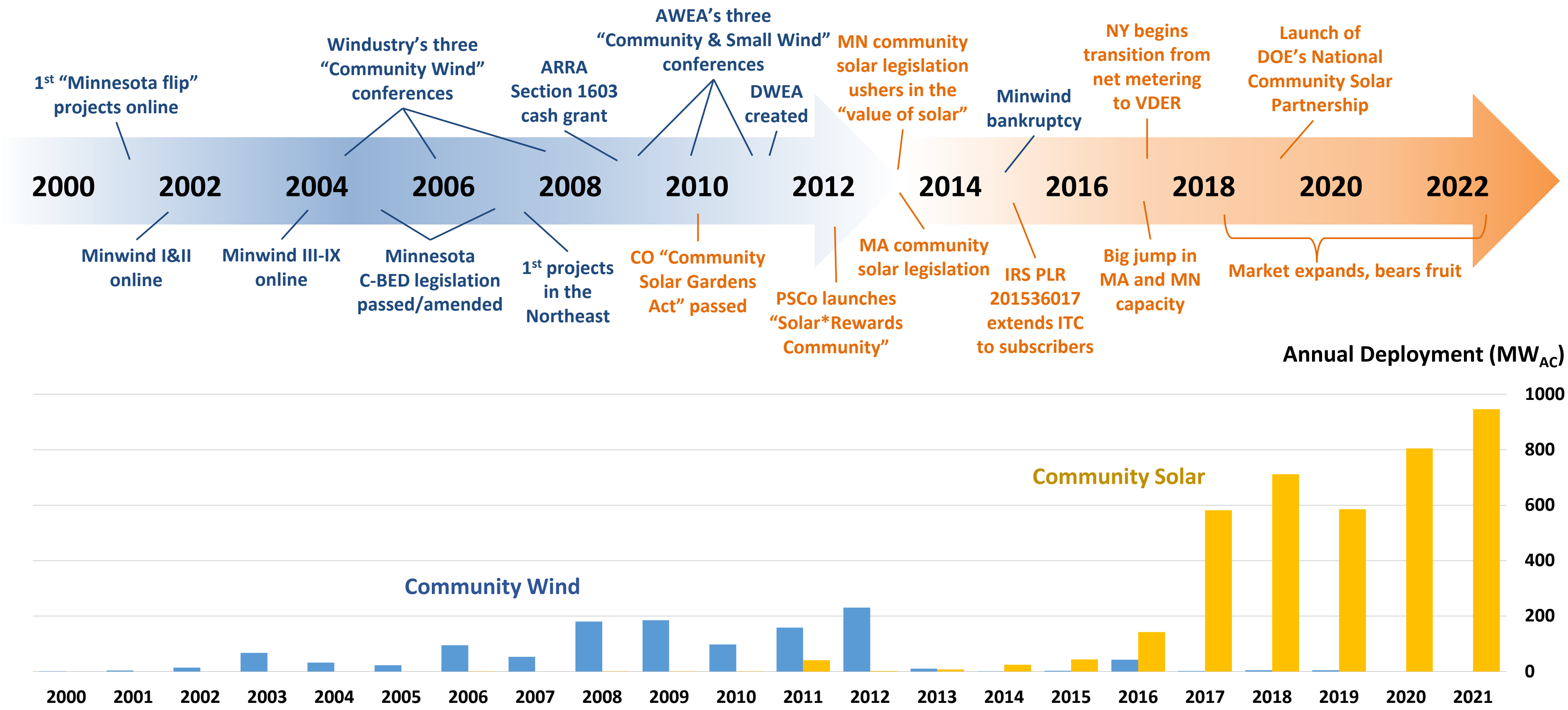
A very brief history of community wind (and community solar) in the U.S.

- In the early 2000s, community wind was an up-and-coming, promising sector of the U.S. wind industry
  - Early U.S. community wind development efforts (mostly centered in the Midwest) aimed to replicate the European wind cooperative model that was popular in Denmark, Sweden, Germany, and the UK
  - The focus was primarily on community ownership, and there were several different ownership structures in use, including the "Minnesota-Style Flip" and the "Multiple Local Owner" (i.e., Minwind) structures
  - A number of states enacted policies and incentives to encourage and support "community wind" (e.g., Minnesota's 10-year, 1.5 cent/kWh cash production incentive and C-BED offtake agreements; Massachusetts' "Community Wind Collaborative" program)
  - There was even a community wind "conference circuit," initiated by a Minnesota advocacy group ("Windustry") and later—as the sector picked up steam—sponsored by the American Wind Energy Association
- But by the early 2010s, community wind in the U.S. had largely faded away—*for a variety of reasons explored in this deck*
- Around the same time as community wind was fading, the solar industry picked up the "community" concept and has since had much success with "community solar"—*again, for a variety of reasons explored in this deck*

Community Wind and Community Solar timelines



This research project seeks to answer three main questions

1) Why did “community wind” fade in the US, while “community solar” has thrived?

2) What can distributed/community wind learn from community solar?

3) Are there opportunities for distributed/community wind to participate in “community solar” programs, and if so, what do the economics look like?

We focus on "MW-class" wind turbines connected to the distribution system

Why focus on big (2-5 MW) turbines rather than smaller (≤100 kW) distributed wind turbines?

- Project capacity limits for state DER programs vary, but 5 MW is fairly typical and is large enough to accommodate today's name-brand "Tier 1" turbines (e.g., GE 2.8 MW/3.4 MW, Vestas 4 MW, Nordex 4.8 MW, SGRE 5.0 MW)
- These Tier 1 vendors offer (at a cost) long-term service contracts and availability guarantees—reduces technology risk
- These taller/larger turbines often have better capacity factors than smaller turbines, opening up more developable sites
- Larger turbines can capture economies of scale, particularly on the "balance of plant" portion of construction costs (e.g., 1 x 4.5 MW versus 3 x 1.5 MW, or even 1 x 4.5 MW versus 1 x 2.8 MW)

Why deploy 2-5 MW turbines in a distributed application rather than in a larger wind farm?

- Avoid clogged transmission interconnection queues: connecting to distribution can be simpler, faster, cheaper
- Develop sites that aren't necessarily suitable for larger wind farms, but can accommodate 1-3 large turbines
- Access greater (above-wholesale/near-retail) revenue through state-sanctioned DER programs
- More broadly: We need all of the renewable energy we can get, which calls for multiple development approaches

Methodology

- **Literature review:** Reviewed past literature related to community wind, as well as more recent reports and trade press articles on community solar
- **Interviews:** Talked with 15 distributed/community wind and community solar veterans and current practitioners to hear their perspectives and tap into their expertise
- **Primary research:** Reviewed enabling legislation, regulatory decisions, program documents and web platforms for community solar programs across the U.S., with a focus on determining whether wind is eligible, relevant program constraints (e.g., limits on plant capacity, program-wide caps), how the programs work (mechanics), and the type and level of compensation provided
- **Financial modeling:** Adapted a cash flow pro forma model to estimate the revenue requirements (i.e., the required levelized PPA price) for a typical distributed wind project

Why "community wind" faded while "community solar" has thrived: Timing

Community Wind (~2000 to ~2012)	Community Solar (~2010 to present)
• **Early 2000s:** Still early days for wind; financing and ownership structures (e.g., tax equity flips) were still being worked out; steep learning curve. • **2005-2009:** Growing wind deployment and rising turbine prices made sourcing turbines more difficult and deploying them more capital-intensive. • **2008-2012:** The "great recession" and ensuing credit crisis hit the market hard as PPA prices plunged with the cost of natural gas and reduced demand, and utilities no longer needed new power.	• Community solar has been able to learn from community wind's earlier experience. • By the 2010s, ownership structures were well-oiled and investors were comfortable with financing wind and solar projects. • Until recently, solar has only ever known declining costs and a favorable market environment: low interest rates, a "wall of money" chasing projects, the rise of corporate climate goals and renewable power procurement, ESG investing, and increasing concerns around equity/justice/resilience.

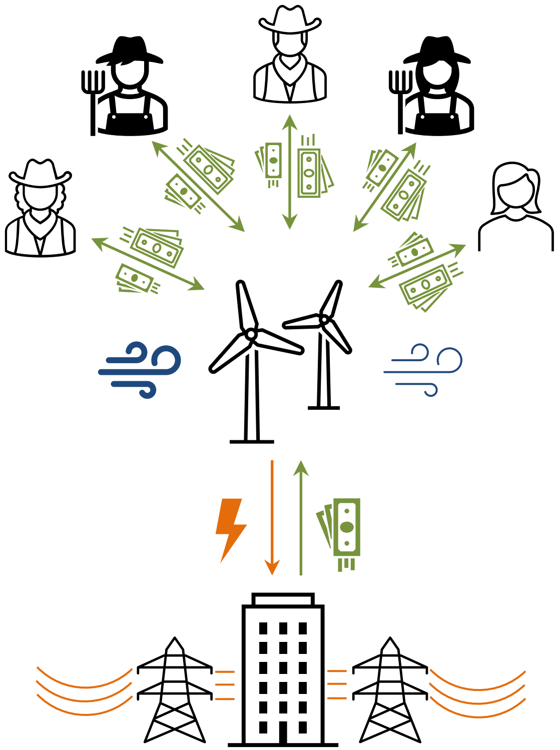
Why "community wind" faded while "community solar" has thrived: Technology-related differences

	Community Wind	Community Solar
Wind / Solar Resource:	Localized (great in some areas, limited in others)	Widespread (more viable sites; broadens public support)
Permitting:	Harder (FAA, radar, viewshed, road weight)	Easier and faster
Construction:	Harder (creative transport, need a crane)	Relatively simple
Operating Cost and Risk:	Higher (rotating equipment, cranes, spare parts)	Lower (no/few moving parts)
Depth of Manufacturing:	Very few wind turbine OEMs, yet relatively high product differentiation	Many PV module OEMs, yet relatively low product differentiation (commoditized)
Unit Size / Modularity:	MW-level (and rising) modularity: resi and utility-scale sectors use very different turbines	kW-level modularity: resi and utility-scale sectors use essentially the same modules
Economies of Scale:	Community wind sacrifices more: $/W CapEx at 1-5 MW is ~100% higher than at >20 MW*	$/W CapEx at 1-5 MW is only ~60% higher than at >20 MW (and is ~60% lower than at <10 kW)*
Market Evolution:	Community wind "downscales" utility-scale wind to enhance local benefits and acceptance	Community solar "upscales" resi solar towards utility-scale to broaden access and reduce costs
Broader Industry Support:	Low (viewed as less competitive than commercial wind; small potatoes)	Lower costs and expanded access drive significant support from both industry *and* government

*CapEx data are from LBNL's *Tracking the Sun* and *Utility-Scale Solar* reports, as well as the *Land-Based Wind Market Report*

Why "community wind" faded while "community solar" has thrived: Wind focused on ownership, while solar has pivoted to "community offtake"

Community Ownership



Community members (farmers, ranchers, others) pool their capital to develop and own a project.

The project secures a PPA with the local utility and sells its output at (most likely) wholesale prices.

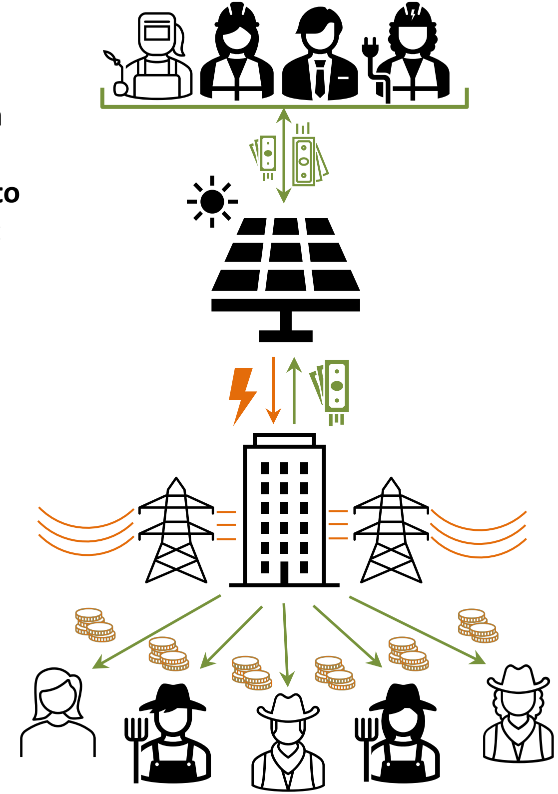
The community-based owners earn a return on investment over time…but also take on the risks associated with ownership.

Community Offtake

A professional developer or sponsor builds/owns a project and invites the community to subscribe to its output via "virtual net metering" (the backbone of most "community offtake" programs).

Subscribers provide the developer/sponsor with access to the market at near-retail prices.

Subscribers earn bill credits (often with no investment or risk) for serving as virtual offtakers.



Research suggests that community offtake could be as good as, or possibly even better than, community ownership at fostering public acceptance

Local financial compensation can promote local acceptance, but not all forms of compensation are created equal…

- The default model has been community ownership…but because ownership is risky and not affordable for everyone, it can be seen as unfair[2,3,4]—which can actually erode, rather than promote, local acceptance[2,3]
- It is not necessarily ownership per se, but rather the non-financial aspects of ownership—such as greater local engagement and involvement in the decision-making process—that promote acceptance[1,3]
- Financial compensation that is more equitable and broadly distributed across the community—e.g., a wind production tax, or funds to build a community center—is often favored over "private compensation" to a smaller number of local investors/owners[2,4,5]

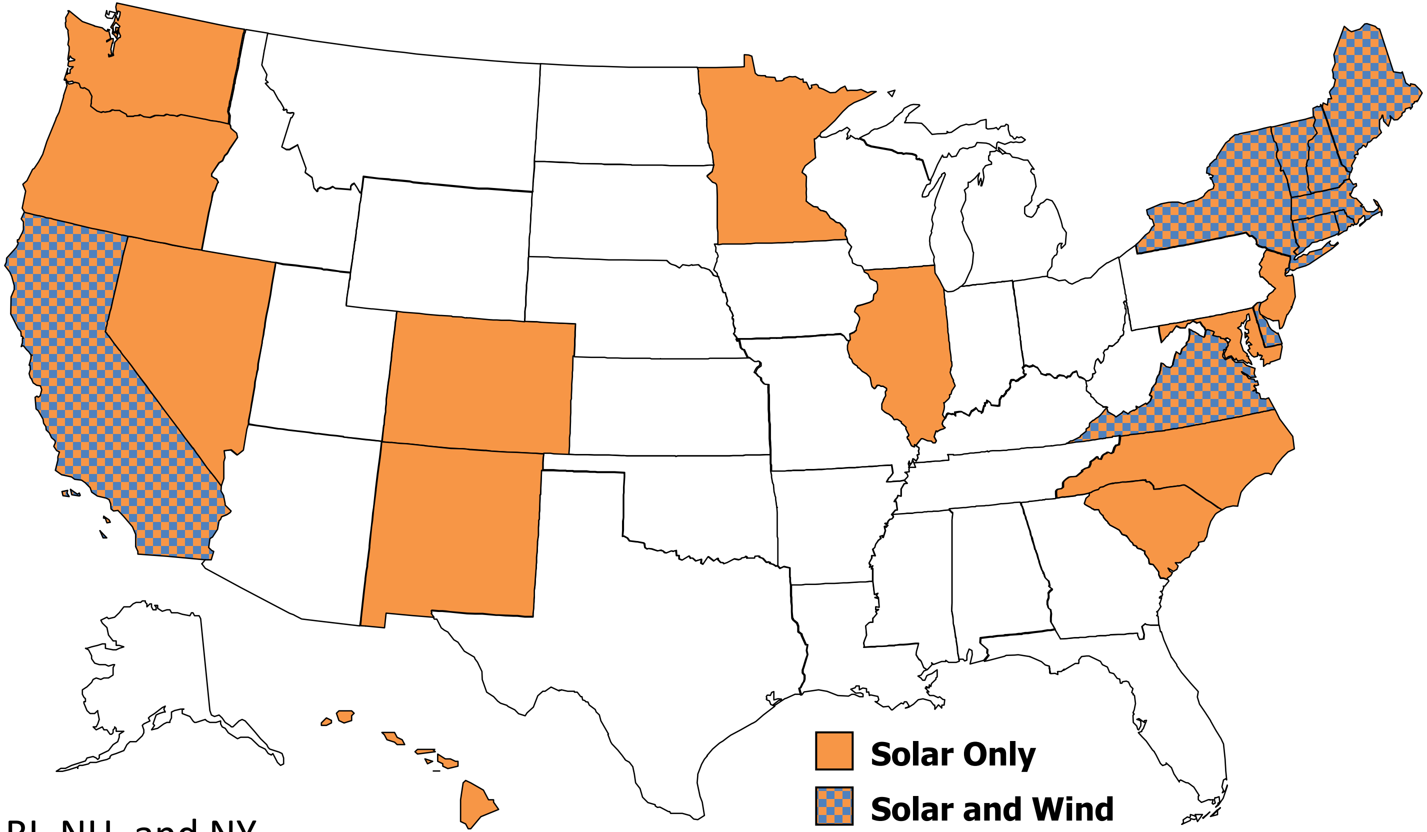
"Community offtake" fits within these themes: no risky up-front investment, and the benefits are broadly available to all

- Perhaps not coincidentally, community solar—which is based on community offtake—has enjoyed broad public acceptance in the US

1) "What makes local energy projects acceptable? Probing the connection between ownership structures and community acceptance"
   - *Energy Policy*; 2022; Michael Simpson and Darren McCauley; https://doi.org/10.1016/j.enpol.2022.113257
2) "Individual or collective? Community investment, local taxes, and the social acceptance of wind energy in Switzerland"
   - *Energy Research & Social Science*; 2019; Pascal Vuichard, Alexander Stauch, Nathalie Dällenbach; https://doi.org/10.1016/j.erss.2019.101275
3) "Acceptance of wind energy and the role of financial and procedural participation: An investigation with focus groups and choice experiments"
   - *Energy Policy*; 2018; Nele Lienhoop; https://doi.org/10.1016/j.enpol.2018.03.063
4) "Wind farm acceptance for sale? Evidence from the Danish wind farm co-ownership scheme"
   - *Energy Policy*; 2018; K. Johansen and J. Emborg; https://doi.org/10.1016/j.enpol.2018.01.038
5) "Willingness to accept local wind energy development: Does the compensation mechanism matter?"
   - *Energy Policy*; 2016; Jorge H. García, Todd L. Cherry, Steffen Kallbekken, Asbjørn Torvanger; https://doi.org/10.1016/j.enpol.2016.09.046

At least 22 states have "community offtake" (aka "community solar") programs

- Solar is eligible in all 22 states; **wind is eligible in at least 10 of those states**
- Even in states where wind is eligible, these programs are often called "community solar" programs, and/or the marketing materials only refer to solar
- The following slides take a closer look at 4 of the 10 states where wind is eligible and may be able to compete: DE, RI, NH, and NY



A closer look at 4 (of 10) states where wind is eligible for community offtake: Delaware

Delaware's "community-owned energy generating facility" program

Plant capacity ≤4 MW is eligible, must be interconnected to the distribution system in Delmarva territory

Plants can be either standalone or behind-the-meter

Revenue = default supply rate (currently ~8¢/kWh) + distribution rate (currently ~4¢/kWh) + RECs (currently ~3¢/kWh) = **~15 ¢/kWh at present (though varies over time)**

Host provides subscriber info to utility, utility credits subscribers' bills accordingly, subscribers pay host a subscription fee (that is presumably less than their bill credit, providing net savings)

Other requirements:

- Subscribers can't subscribe to >110% of their historical annual consumption
- Subscriptions >200 kW cannot exceed 60% of plant capacity (except for any self-consumption by host)
- At least 15% of subscribers must qualify as low-income

No programmatic capacity limit!

A closer look at 4 (of 10) states where wind is eligible for community offtake: Rhode Island

Rhode Island's RE Growth (REG) program: **Plants ≤5 MW are eligible**…but targeting just 3 MW/yr for wind

This is a "sell all" program: energy, capacity, RECs are all sold to utility

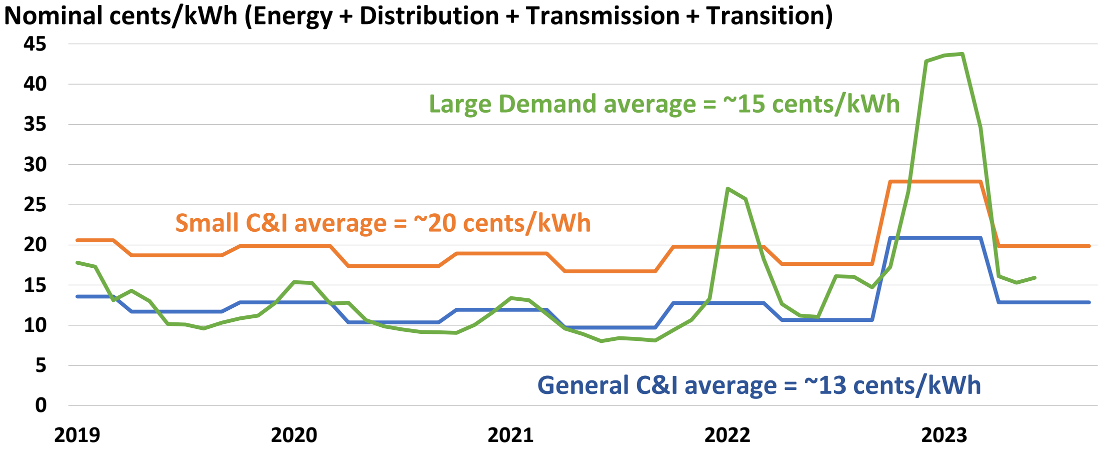
Revenue is fixed for 20 years and reflects a successful competitive offer price that must be below an administratively set price cap (**cap is currently ~21 cents/kWh for community wind**)

Rhode Island's Virtual Net Metering (VNM) program: **Plants ≤10 MW are eligible**…but program capacity limit has been reached ***except for*** projects serving "public" loads, which are exempt from the program cap

VNM revenue = Energy + Distribution + Transmission + Transition charges for applicable rate class (see graph for history)

RECs are an additional source of revenue, and have ranged from 2.9-4.4 cents/kWh (3.9 cents on average) from 1/20-12/22

Virtual net metering and REC revenue is variable over time (not fixed like REG)



A closer look at 4 (of 10) states where wind is eligible for community offtake: New Hampshire

New Hampshire's "group net metering" program

Plants ≤5 MW are eligible if the "group" consists solely of municipal loads; otherwise, the limit is ≤1 MW

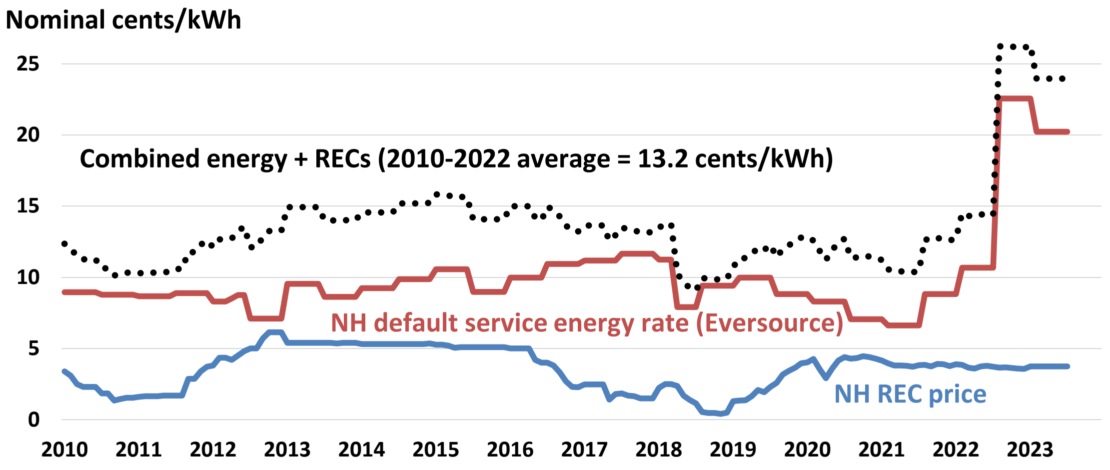
Plants can be either standalone or behind-the-meter; municipal- or third-party-owned

Revenue is the default service energy rate plus RECs (see graph—**average of 13.2 ¢/kWh from 2010-2022**)

Two revenue sharing possibilities:

1) **Traditional:** Utility pays the host and the host pays the group members their share (based on pre-agreed contract)
2) **On-bill crediting:** Host provides group member info to utility, utility credits group members' bills accordingly, group members pay host a subscription fee

No programmatic capacity limit!



A closer look at 4 (of 10) states where wind is eligible for community offtake: New York

New York's "community distributed generation" program

Standalone or behind-the-meter **plants ≤5 MW are eligible**; effectively no program-wide capacity limit

Subscribers receive monthly bill credits based on the project's "Value Stack" (see table below), and pay the host ~90% of that credit (i.e., subscribers typically get a ~10% discount)

	Wind	Solar	
Energy Value:	3.6	4.1	Changes hourly, based on day-ahead prices
Capacity Value:	1.0	1.1	Changes monthly, based on NYISO's ICAP market
Environmental Value:	3.1	3.1	Fixed for 25 years, based on cost of carbon abatement
Demand Reduction Value:	0.5	1.5	Fixed for 10 years, based on distribution system savings
Locational System Relief Value:	0.0	0.0	Fixed for 25 years BUT only available to plants sited in specific load pockets
Total Value Stack:	**8.2**	**9.8**	**cents/kWh (estimated using Value Stack Calculator, will vary over time)**
Subscriber Savings:	**1.0** (12%)	**1.0** (10%)	**cents/kWh (assuming 10-12% subscriber bill savings)**
Host Revenue:	**7.2**	**8.8**	**cents/kWh (estimated, will vary over time)**

Estimated values in table above are outputs from NYSERDA's online "Value Stack Calculator" based on:

- **Wind:** Hourly wind profile from upstate New York (near Watertown, National Grid, NYISO Zone E)
- **Solar:** Calculator-generated profile for fixed bifacial plant (near Syracuse, National Grid, NYISO Zone E)

How do community wind's costs stack up versus this revenue? The IRA helps…

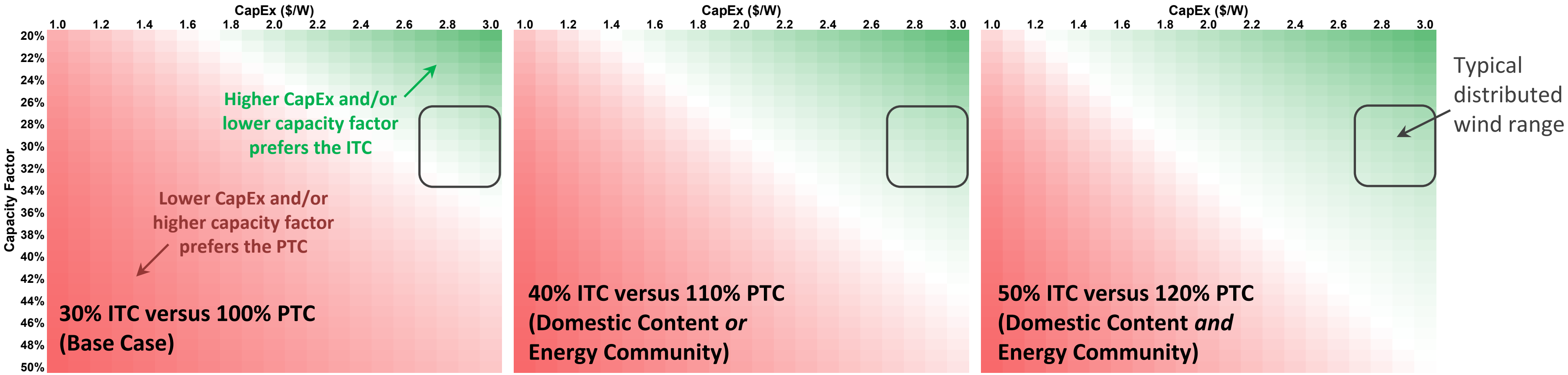
The IRA's enhanced ITC will be particularly valuable to distributed/community wind:

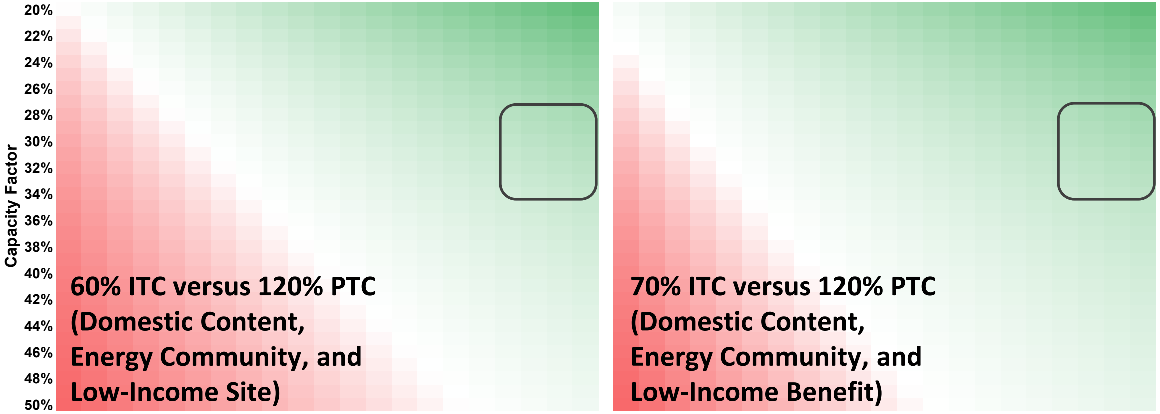
- Even at the "base case" 30% level, distributed/community wind will likely prefer the ITC over the PTC, due to its relatively high CapEx and lower capacity factor (see next slide), as well as ease of use and less performance risk
- The new tax credit adders also favor the ITC and smaller distributed/community projects
  - The "10 percentage point" ITC adders for domestic content and energy communities are worth more than the corresponding "10%" PTC adders (see next slide)
  - The two allocated "low income" adders are ONLY available to projects <5 MW that elect the ITC (the PTC is not eligible)
  - Projects ≤5 MW can now apply the ITC to interconnection costs even beyond the point of interconnection (again, PTC not eligible)
- Easier monetization under the IRA:
  - Taxable owners can sell the ITC (but not the benefit of accelerated depreciation), though presumably at a discount
  - Tax-exempt owners can receive the cash value of the ITC (but not accelerated depreciation) via "direct pay"

USDA REAP grants—the IRA provides a big step up in funding over the next decade:

- USDA has doubled the maximum grant size, from the lesser of $500k or 25% of costs to $1M or 40-50% of costs
- A lot of money to get out the door: program had recently been oversubscribed by ~20%, but now has ~5x the money
- Open to plants owned by agricultural producers and rural small businesses—i.e., natural community wind audience

For most distributed wind, the ITC will provide more value than the PTC (particularly with the “bonus credits” or “adders”)





- X-axis: CapEx ranging from $1/W-$3/W
- Y-axis: Capacity factor from 20%-50%
- **Green-shaded combinations prefer the ITC**
- **Red-shaded combinations prefer the PTC**
- ITC adders are worth more than PTC adders
  - A “10 percentage point” ITC adder is more than a “10%” PTC adder (moving from 30% to 40% ITC is a 33% increase)
  - The PTC caps out at 120%—the two low-income adders are ITC-only (and <5 MW, and must be allocated)

Distributed wind modeling assumptions for revenue requirements

- **CapEx: $3000/kW**, based on a combination of data from the most recent *Land-Based Wind Market Report* and *Distributed Wind Market Report*, as well as input from interviewees
- **OpEx: $40/kW-year**, based on a combination of data from the most recent *Land-Based Wind Market Report*, as well as input from interviewees
- **Capacity Factor: 30%**, based on capacity factor data from the most recent *Land-Based Wind Market Report* and *Distributed Wind Market Report*, the 2-5 MW size range of interest, and the targeted Northeast region
- **Equity IRR: 10% (after-tax, levered)** – roughly based on "market-rate" return requirements
- **Debt: 20-yr, 6% interest, DSCR=1.35** – roughly based on current interest rate environment
- **Tax: 21% federal, 5% state** – generic tax assumptions
- **Plants elect the ITC rather than the PTC** – based on the analysis from the previous slide

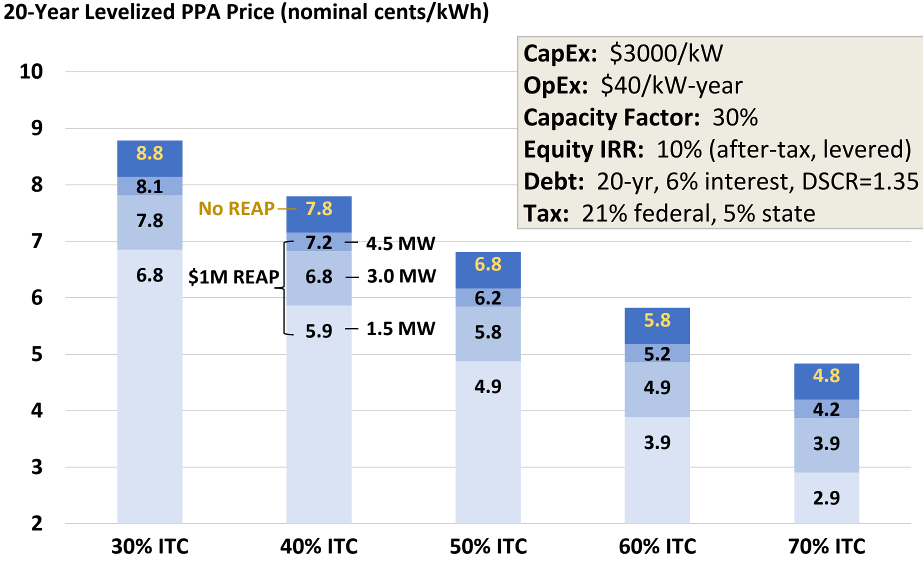
Bookending the best- and worst-case revenue requirements

Best Case: Taxable sponsor has full tax appetite

- ITC taken as a tax credit for full value
- 5-year MACRS depreciation used in the year that it accrues
- Impact of a $1M REAP grant varies by plant capacity: 7.4% grant at 4.5 MW, 11.1% at 3.0 MW, 22.2% at 1.5 MW

Worst Case: Taxable sponsor has no tax appetite

- ITC sold for cash at a 20% discount (e.g., 30% ITC sold for 24%)
- Depreciation carried forward as needed, offsetting the plant's taxable income until it is fully used up
- Impact of a $1M REAP grant varies by plant capacity



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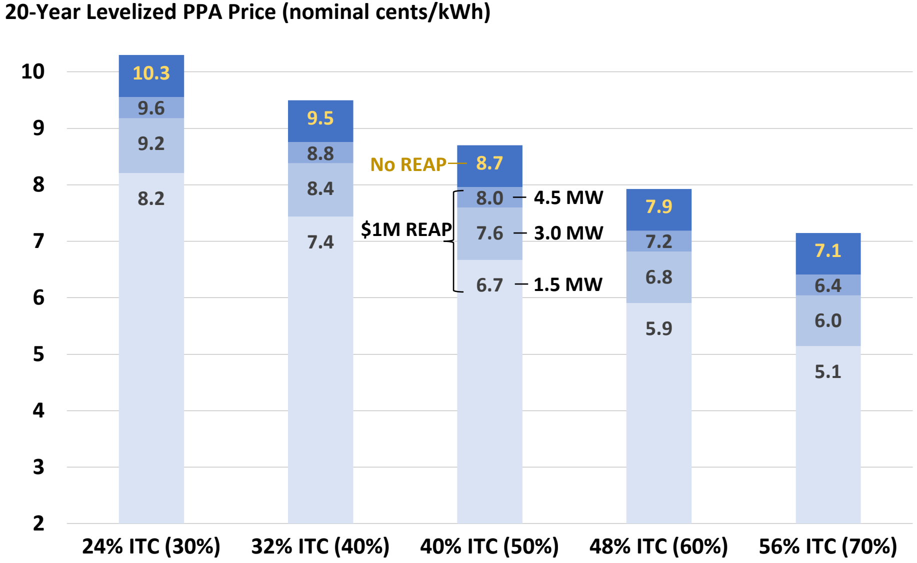
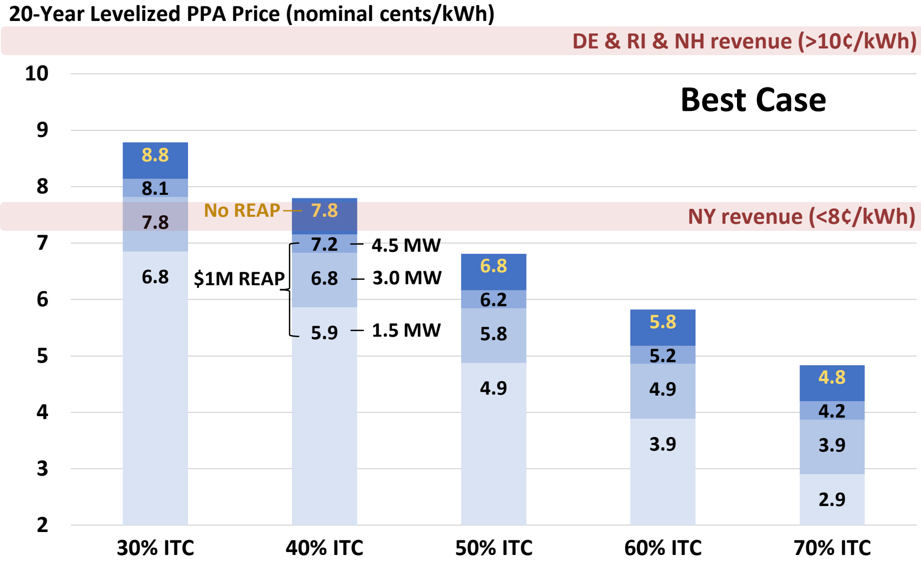
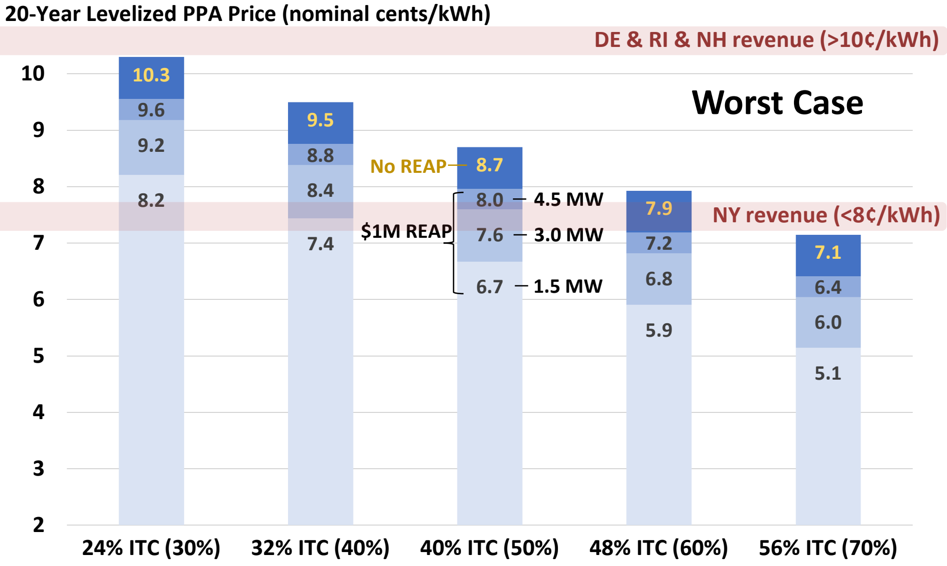


Comparing revenue requirements to revenue availability

- Delaware, Rhode Island, and New Hampshire all currently offer revenue above (and in some cases *well* above) 10 cents/kWh, which suggests that distributed wind should have no problems meeting revenue requirements and target returns—***even in the worst-case modeling scenario*** (i.e., no tax appetite and 24% ITC)
- But to pencil out in New York, where the Value Stack compensates wind at ~7-8 cents/kWh, distributed wind would likely need to secure one or more ITC adders and/or a REAP grant





Summary and key takeaways

1) One important reason why community solar has had more success than community wind in the US relates to choice of business model: **solar has focused mostly on *community offtake* instead of *community ownership***

2) There are **at least 10 states where distributed wind could participate in “community offtake”** (aka “community solar”) programs and be compensated at near-retail (or at least above-wholesale) prices

3) Particularly with expanded and well-funded IRA incentives in hand (e.g., 30% ITC plus adders, REAP grants), ***distributed wind pursuing a community offtake model could very well be profitable in a number of these states***

But there are a few “reality checks” to keep in mind:

- In many cases, available revenue will vary over time and is unpredictable—i.e., participating in virtual net metering and/or these community offtake programs most often will NOT provide the same revenue stability as a fixed-price PPA
- Political/regulatory risk—e.g., traditional net metering is under fire across the US, so why not also virtual net metering (the backbone of many of these “community offtake” programs), particularly given that virtual net metering often has little or no linkage to on-site load?
  - On the other hand, VNM is increasingly viewed as an effective way to support low-income ratepayers, thereby bolstering its “social license to operate”
- More generally, state and utility DER program rules/regs seem to be constantly evolving and in flux, so one must pay close attention
- There is likely to be stiff competition from solar

Three program design considerations to enhance wind's opportunities

1) **Consider making "community offtake" (aka "community solar") programs more technology-neutral by expanding access to wind (and other DER technologies)**
   - Currently, wind is only eligible in 10 of the 22 states that have so far enacted statewide "community offtake" programs—why?
2) **Consider limits on individual plant capacity that are large enough to accommodate at least a single modern utility-scale wind turbine**
   - 5 MW is probably sufficient (at least for now), and also matches the capacity limit for the Section 48 ITC "low-income" adders
3) **Consider eliminating any caps on overall programmatic capacity (or at least make any such caps sufficiently large and transparent)**
   - This could be particularly important for wind, given that it has a longer development cycle than solar and so needs greater visibility into the long-term viability of the market

Thank you! Questions?

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