Western Mass Solar Forum – September 12, 2023
Presentation Notes – Josh Hilsdon, PV Squared
Challenges of Solar Development in the Built Environment

1. What are the types of solar in the built environment?
    a. Often small-scale, residential and small-commercial (~3kW to 250KW)
        i. Typically interconnected Behind-the-Meter of existing electrical service, and primarily serve on-site electricity loads
    b. Some larger-scale, commercial & industrial (~250kW to >1MW)
        i. Typically, still behind the meter serving onsite electrical loads, but some larger projects may require a new dedicated utility service, and export 100% of generation to the grid.
    c. Rooftop Solar
        i. Flush mounted system on a pitched roof
        ii. Tilt up system on a flat roof
    d. Ground Mounted Solar
        i. Back yards
    e. Solar Parking Canopies
        i. Elevated solar mounting structures on parking lots
2. What are the unique challenges of developing and installing each solar project type?
    a. Rooftop Solar
        i. Finding a viable site:
            1. Newer roof, with good orientation, that's not too shaded, and can handle the added load from solar arrays
            2. Owner-occupied, with a credit-worthy owner, who plans to stay in the building for awhile
        ii. Physically difficult to install
            1. Working outdoors, exposed to the elements, in hot or cold, rainy or snowy weather conditions
            2. Working at height, often a pitched roof, carrying large/heavy solar panels
            3. Hard on the bodies of installers
                a. Joint pain in knees and ankles, people's bodies can get worn down
                b. Injuries can and will occur, hopefully minor, and some installers will require extended periods of time off or light-duty work to recover
        iii. The good news about rooftop solar:

1. lowest cost installation (at least for residential and small-commercial solar), zoning approval is typically by right, not competing with other uses for ground space, generally accepted as positive by the community, lots of interest from the general population

b. Ground Mounts
    i. Requires open, mostly unshaded space, that is reasonably accessible
        1. More suited to rural areas than denser urban/sub-urban areas with smaller lot sizes
        2. Can allow for greater solar production vs. rooftop because you can choose a sunny site, point it south, with a decent tilt angle
    ii. More costly than rooftop solar, with added racking costs, and specialty machinery required to install foundations, and excavate trenches for underground conduit runs
    iii. Permitting is generally more time consuming and costly, with many communities requiring special permits, zoning board of appeals hearings, and restrictive bylaws with significant property line setback requirements, not to mention stream & wetland setbacks
c. Solar Parking Canopies
    i. Parking lots provide open space, with good solar exposure, no issues with roof age/loading capacity, generally well accepted by community
    ii. Disadvantages: much more expensive vs rooftop and ground mount, complexities abound, additional incentives do not fully offset cost increase of canopy installation
    iii. Either clients have to value the covered parking (shade, snow protection) and be willing to fund the canopy construction for its own merits, or they have to be deeply committed to going solar, regardless of the higher price, and not have an better alternative site.
    iv. Cost prohibitive for many smaller scale installations. Some canopy providers have minimum size thresholds that exclude a lot of small-commercial sites
    v. Good news, is when you do build them, people tend to really like them, and be inspired by them.

3. What are challenges that exist across all project types?

    a. Local & State Regulations
    b. Utility Interconnection & Service Upgrades
    c. Licensed Electrician Shortages
4. Regulatory Challenges
    a. State Regulations
        i. Net Metering Caps
            1. Lifted in 2021 and 2022 clean energy laws, but yet to be implemented through DPU rulemaking process, the lag between policy and implementation is painfully long
            2. Still installing 10kWac inverters as "standard" residential solar project, despite increasing household electrical usage driven by adoption of heat pumps and EVs
            3. Solar project sizes are routinely limited to net metering cap thresholds, despite not taking full advantage of the available roof space at a site, or meeting long term energy needs of the clients. Incredibly frustrating as a solar designer.
        ii. Single Parcel Rule
            1. Can restrict access to net metering for condos, townhouses, co-housing, farms, and any site with multiple utility services on a single tax parcel.
            2. SPR restrictions were rolled back in 2022 clean energy law, but yet to be implemented (DPU says soon...)
        iii. 1:1 Ratio of Licensed Electricians to unlicensed Apprentices on a jobsite
            1. High demand and limited supply of licensed electricians makes hiring difficult and drives up wages, physically challenging work on roofs is not well suited to ageing bodies
            2. Installation crews generally need to be dispatched in pairs of licensed and unlicensed installers, makes scheduling logistics hard, and limits ability to bring younger, less experienced installers into the workforce
            3. Apprenticeship programs are needed to bring up new electricians, who need 4-5 years of code classes and supervisory hours before they can site for licensing exam
            4. PV Squared has an apprenticeship program, and is now minting our own new licensed electricians, who have

gotten their supervisory hours on the job, and had their code classes paid for by the company. We ask they stay on for at least a year after earning their license, or refund the company for the cost of their code classes.

iv. Module Level Rapid Shutdown
    1. Dramatically reduced inverter product options. Residential rooftop solar now dominated by only two companies, SolarEdge which makes DC power optimizers and Enphase which makes micro-inverters), for 3-Phase 208V utility services (i.e. nearly all multifamily housing, and lots of small commercial), SolarEdge 17.3kW inverter is now the only option with native module level rapid shutdown. Other options, Tigo, APS, Generac have either proven to have issues with reliability and communications, or are too new to evaluate their long-term performance.

b. Municipal Permitting
    i. Building & Electrical Permitting & Inspections
        1. Multiple plan reviews and multiple inspections
        2. Rough and final inspections, scheduling and inspector availability can be a challenge, some inspectors will only meet with licensed electricians, sometimes requiring 3 separate inspections (building rough / final + electrical final)
        3. Variation in processes across municipalities (PV Squared installs solar in >50 municipalities, each with their own rules and permitting processes
        4. Installation routines interrupted to wait for rough building inspection. Crew leaves site, finishes early or starts another job, then returns to complete. Way too common for projects to face delays due to scheduling rough building inspections.
    ii. Fire setbacks (New for 2023!)
        1. Requires fire department review of plans (added cost and time)
        2. Typical residential roof setbacks: 18" to 36" from ridge, 36" access pathway to ridge on each roof plane. 36” ridge setback kicks in if solar covers more than 1/3 of overall roof area, which is an easy threshold to exceed.

3. ~25% reduction in average residential solar array size, with smaller projects more dramatically impacted.
4. Roll out was messy, and lacked any centralized coordination or telegraphing of timeline for onset of setback requirements
5. Enforcement varies by municipality, with some towns not requiring any setbacks, and others requiring most strict interpretation of code, with least room for common sense exceptions and accommodations
6. For PV Squared that meant that approximately 50 projects that were sold and in process had to be re-designed, causing huge strain on our staff, or clients, and the permitting officials themselves - a truly awful experience that was entirely avoidable. A number of projects canceled post-sale, determining that the project had gotten too small to be viable.
7. Legitimate competing interests here, and reasonable to ask for some amount of roof access to be preserved for firefighting activities, but also is this a problem that actually needs to be solved? What is the greater good?

iii. Zoning Bylaws
1. Overly restrictive setback requirements for ground mounts (i.e. 100ft frontage setback in Deerfield for even small scale ground mounts)
2. Onerous Large-Scale Solar permitting requirements, and threshold between Small-scale and Large-scale ground mount is not appropriately defined (i.e. Shelburne 1 acre)

5. Utilities
   a. Interconnection
      i. timelines for approval to interconnect and approval to operate can be drawn out, larger projects can require costly engineering studies (supplemental review or impact study), and may trigger system upgrade costs, which can be cost-prohibitive
      ii. Significant parts of the grid in Western Mass are considered “saturated” with solar, and interconnection may be cost-prohibitive (i.e. requires circuit / sub-station upgrades).
   b. Service Upgrades
      i. Solar does not typically require a larger electrical service, so while upgrading from 100A to 200A would be a common need

for whole home electrification (i.e. adding Heat pumps, EV charging), it's not usually necessary for solar interconnection.
    ii. However, interconnecting solar is considered by the utility to be a service upgrade, which triggers compliance with current utility service design guidelines.
    iii. Existing electrical services, that work just fine, but have fallen out of compliance with current utility service configuration guidelines, are required to be upgraded to meet current codes, as part of a solar installation.
    iv. This can be costly, and in some cases prevents solar installation from moving forward, and at a minimum adds significant timeline delays and added cost.
    v. Examples: utility meters located indoors, meters located on backside of building, meters that have been encroached upon by additions.
  c. Transformer Upgrades
    i. Always required when solar inverter capacity > transformer capacity, but also required when aggregate solar interconnect capacity > transformer capacity on a shared transformer
    ii. Hard to predict, especially with shared transformers where it's not clear how much solar is already interconnected or approved for interconnection
    iii. Increasingly common in dense neighborhoods, with lots of solar adoption
    iv. Cost of transformer upgrades born entirely by interconnecting customer. Costs not distributed across all interconnecting customers, all utility customers, or all tax payers.
    v. Example: My street, 5 solar projects, one transformer, next person who tries to go solar very likely to face cost of new transformer. May prevent further solar development on the street, especially if project size is small.
6. Conclusion
  a. Developing solar in the built environment can be challenging. There are many complexities have to be navigated, and the cost/Watt is generally much higher than MW utility scale ground mounts. But, people are generally very accepting of solar in the build environment, and view rooftops and parking canopies as the most preferred locations for solar installation.