Critical Lessons for Future Installers to Reduce End-Of-Life Costs

Saxon Metzger

Do This, Not That!

Eighth Generation Consulting

- Goals
  - Identify the issues that we're facing from our current market and how it's developed.
  - Demonstrate the importance of early planning and decision-making to reduce future costs.
  - Clarify the key strategies and practices for installers, financiers, product manufacturing firms, and crew looking to improve project performance.

- We need an industry wide incorporation of decommissioning
  - How we're selling and developing new solar
  - How we're investing in solar infrastructure
  - How we're committing to various products and tech

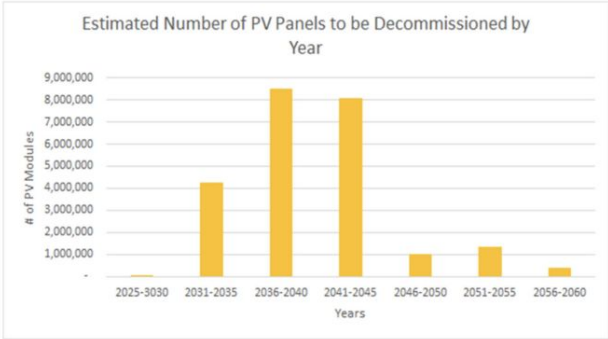


Figure 5-2. Estimated Number of PV Panels Decommissioned by Year

Here's the Reality:

Eighth Generation Consulting

- Solar decommissioning will be discussed at the 10-15 year mark
- Everyone thinks their solar is a gold mine
- Everyone thinks they can easily perform and estimate decom work
- I don't see many solar installers discussing the details of decom. It's a losing sales conversation, but there's a reality
- I've lost numerous bids to theoretical pricing. You have to understand the market to beat quotes that aren't real
- Rooftop systems will need to be removed and replaced eventually
    - For roof repairs or new roofing
    - Begs the question, swap while it's already off the roof?

Understanding End-Of-Life Costs

- Decommissioning steps and estimates is more than just installation in reverse.
  - Take New York's example of a 2 mW site.
  - At 200-400w per panel, that's 5,000-10,000 panels
  - Approximately 1-10 acres per site

- These costs are delusionally inaccurate and highly optimistic. You'll go broke with this
  - This assumes a break even on all components. After 20 years, that's not reality
    - Recycling: $18 per panel
    - Ballast at $80/ton concrete
    - Pallets for transportation and removal
  - Trucks to recycling center: Only 500-800 panels per 53' flat bed
  - Seed Disturbed Areas…. $250?
  - Panel removal at 50 cents per panel for labor?

New York state offers a more detailed set of requirements.

According to New York state's decommissioning guideline handbook, a 2 MWdc solar facility might cost $98,900 to dismantle. Facilities on third-party-owned land must include a guarantee or security agreement.

Table 1: Sample list of decommissioning tasks and estimated costs

Tasks	Estimated Cost ($)
Remove Rack Wiring	$2,459
Remove Panels	$2,450
Dismantle Racks	$12,350
Remove Electrical Equipment	$1,850
Breakup and Remove Concrete Pads or Ballasts	$1,500
Remove Racks	$7,800
Remove Cable	$6,500
Remove Ground Screws and Power Poles	$13,850
Remove Fence	$4,950
Grading	$4,000
Seed Disturbed Areas	$250
Truck to Recycling Center	$2,250
Current Total	**$60,200**
Total After 20 Years (2.5% inflation rate)	**$98,900**

I'm Not Done

Eighth Generation Consulting

- Other Cost Issues
  - Far more labor, equipment etc.
    - Concrete
      - A skid and breaker costs more than $1,500 for concrete
    - Removing electrical equipment
      - Electrician?
    - Dismantling racks
    - Remove rack wiring
    - Removing cable
    - Removing Ground Screws and Power Poles
    - Remove Fencing
    - Grading
- These numbers create downward pressure
  - Don't go broke competing against these prices

New York state offers a more detailed set of requirements.

According to New York state's decommissioning guideline handbook, a 2 MWdc solar facility might cost $98,900 to dismantle. Facilities on third-party-owned land must include a guarantee or security agreement.

Table 1: Sample list of decommissioning tasks and estimated costs

Tasks	Estimated Cost ($)
Remove Rack Wiring	$2,459
Remove Panels	$2,450
Dismantle Racks	$12,350
Remove Electrical Equipment	$1,850
Breakup and Remove Concrete Pads or Ballasts	$1,500
Remove Racks	$7,800
Remove Cable	$6,500
Remove Ground Screws and Power Poles	$13,850
Remove Fence	$4,950
Grading	$4,000
Seed Disturbed Areas	$250
Truck to Recycling Center	$2,250
Current Total	**$60,200**
Total After 20 Years (2.5% inflation rate)	**$98,900**

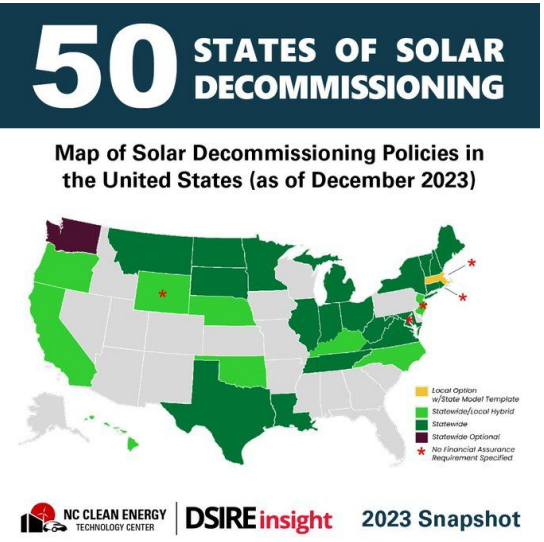
The Impact of This

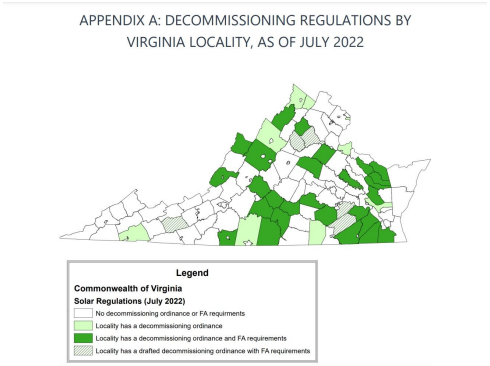
Eighth Generation Consulting

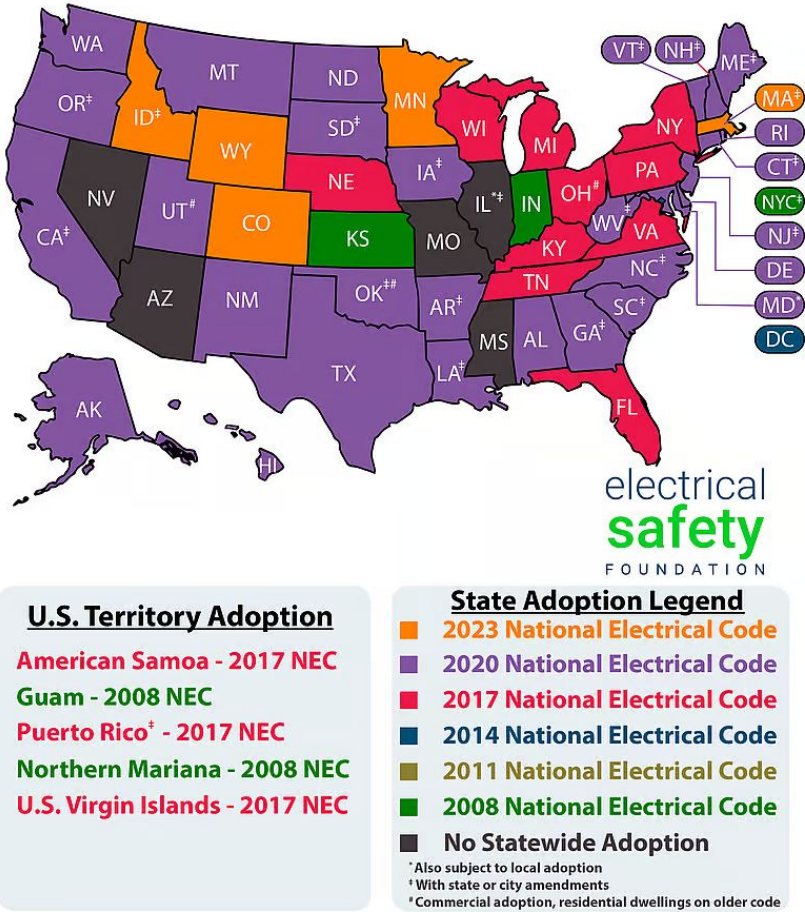
- Horrible press for our industry
  - We just became mainstream!
  - Can we survive breaking our promises?
- Unethical for us to abandon the legacy assets that built our solar future.
  - This is the same thing that orphaned oil wells have done
- Legal and financial costs
  - Did our workers tell clients wrong information?
  - Will the government step in to solve acres of abandoned solar fields?

Current Challenges: Regulations

- There's local, state, federal, and international rules!
- Research is a huge cost
- Permits: Anecdote







Best Practices in Design and Installation: Panels

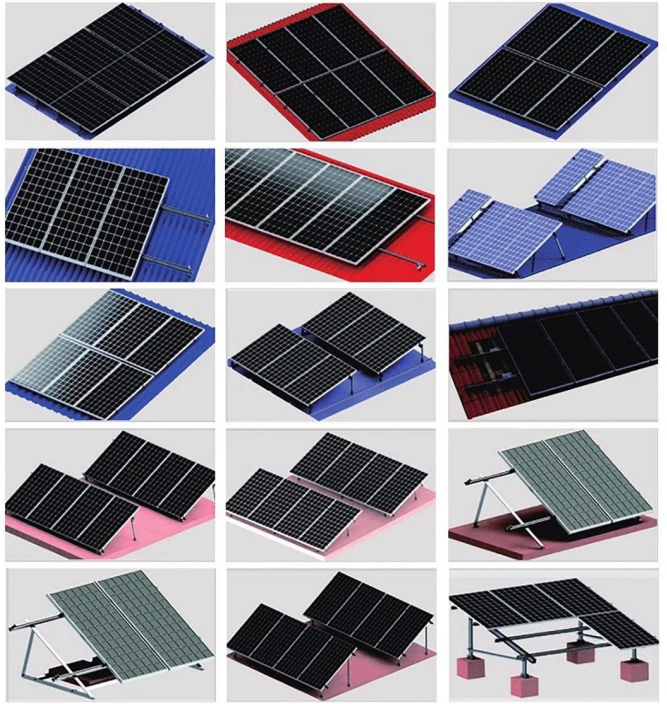
Eighth Generation Consulting

- Design and Engineering
  - Voltage
  - Sizing
  - Connector type
  - High quality
  - High wattage
  - Selection of materials for ease of recycling or reuse.
  - Incorporating modularity to extend the lifecycle.

- Installation
  - Waterproof seals
  - Correct connectors, proper wiring
  - Be gentle up front
  - Create a decommissioning plan before you install. Encountered an issue or cost? Good!
  - Create solutions while you install for the problems that would be faced at the end.

Best Practices in Design and Installation: Racking

- Designing with disassembly in mind.
  - Warranties?
- Selection of materials for ease of recycling or reuse.
  - This will help your project economics at decommissioning
- Incorporating modularity to extend the lifecycle
  - Can you replace sections?
  - Rewire easily?



Best Practices in Design and Installation: Ballast/Attachments

- Attachment points = roofer cost, less waste
- Ballast = Labor, equipment, and recycling
- Self-ballasting options
- Selection of material for longevity, reuse, and ability to be added and removed regularly

Eighth Generation Consulting

Best Practices in Design and Installation: EBOS

- Aim to minimize risk of structural repairs needed
- Accessible location?
- Properly installed to keep equipment at peak operation?
- How efficient is your EBOS setup?

Do's of Installation to Reduce End-Of-Life Costs

- Prioritize accessibility for maintenance and repair.
- Use standardized parts to facilitate efficient repowering.
- Implement traceability and documentation of materials for future recovery.
    - Personal Anecdote: As-Builts

Don'ts of Installation to Avoid High End-Of-Life Costs

- Avoiding non-recyclable materials and composites.
    - That includes materials that are challenging to remove
        - Gravel
        - Concrete
- Utilizing products that are difficult to disassemble.
- Ignoring the potential for future technology upgrades.

Eighth Generation Consulting

Solutions: Incentives for Reducing End-Of-Life Costs

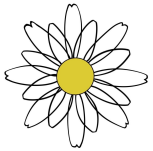
- Tax incentives and rebates for sustainable practices
- Owning the costs of decommissioning or recycling up front
- Ongoing work on decommissioning to help create value while offering the service
- Enhancing brand value and customer loyalty through sustainability

Technology and Innovation in Product Life Extension

- Advances in materials science for longer-lasting products.
  - Doesn’t resolve roofing issues
  - Doesn’t resolve structural or ground issues like erosion
- Better O&M solutions
- Improved Repowering Options
- More Modular Solutions

Engaging Stakeholders in the Lifecycle Approach

- Role of consumers in driving demand for sustainable products.
- Partnering with recyclers and waste management firms.
- Collaborating with regulatory bodies for effective standards.

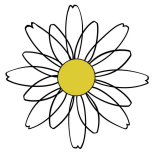


Eighth Generation Consulting

Future Trends and Predictions in End-Of-Life Management

- Better and better recycling, upcycling, reuse, and reduction strategies
  - Cheaper
  - More efficient and sustainable

- More established-industry benefits
  - Affordability
  - Ease of navigation
  - Options
  - Manufacturer improvements



Eighth Generation Consulting

Strategies for Installers

- Develop a full life cycle perspective for new installations
  - What is our plan to build, fix, and remove this?
- Training and educate teams on installation and design best practices.
- Building a network of partners for material recovery and recycling.
- Begin working on these projects.
- Find ways to market yourself based on these services.

Challenges and Barriers to Change

- Too few options
  - Inexperienced contractors
  - Locality dependent
  - Material recycling/upcycling solutions haven’t all scaled

- Resistance within our industry
  - Who profits from these costs?
  - Who loses from these costs?

- The importance of leadership and culture change in adopting new practices.

Conclusion

- Important takeaways:
  - Early planning
  - Best practices
  - Engaging with stakeholders often
- Future outlook:
  - Role of innovation
  - Regulatory compliance.
- Call to Action: Are we creating positive or negative headwinds for our industry?

Eighth Generation Consulting

Thoughts? Questions?

Table 1: Sample list of decommissioning tasks and estimated costs

Tasks	Estimated Cost ($)
Remove Rack Wiring	$2,459
Remove Panels	$2,450
Dismantle Racks	$12,350
Remove Electrical Equipment	$1,850
Breakup and Remove Concrete Pads or Ballasts	$1,500
Remove Racks	$7,800
Remove Cable	$6,500
Remove Ground Screws and Power Poles	$13,850
Remove Fence	$4,950
Grading	$4,000
Seed Disturbed Areas	$250
Truck to Recycling Center	$2,250
Current Total	**$60,200**
Total After 20 Years (2.5% inflation rate)	**$98,900**