

STOOP LAW

A COMMUNITY JUSTICE PROJECT

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July 29, 2019

Re: Comments Notice of Proposed Rulemaking ZC-19-04

Dear Zoning Commissioners,

Stoop Law is an administrative law and civil rights law firm located in the District of Columbia. Since 2014 we have regularly appeared before the Zoning Commission representing community members and community organizations seeking the opportunity to influence development in their neighborhoods. Stoop Law represented clients at McMillan Park I and Barry Farm successfully overturning legally insufficient zoning orders. Stoop Law has an interest in ZC 19- 's rulemaking as the proposed rules make it more difficult for Stoop Law's clients and prospective clients to influence development in their neighborhoods. Furthermore, Stoop Law has an interest in the Zoning Commission's adherence to the Zoning Regulations, Zoning Act, and Comprehensive Plan since Stoop Law's main practice area is predicated on the predictable administration of the Zoning Regulations and the Zoning Act. In that vein, the foregoing rulemaking is invalid and should never have been set down. Please consider the following:

The Zoning Commission's Rulemaking Authority is Limited by Common Law.

When the Zoning Commission endeavors to utilize its rulemaking authority, according to the District of Columbia Administrative Procedures Act (hereinafter DCAPA), the notice whereby the rulemaking is made public "shall also contain a citation to the legal authority under which the rule is being proposed." DC Code §2-505(a). In other words, the Zoning Commission is limited in its rulemaking ability. The Commission can only rule-make in as much as existing regulations and statutes can reasonably be construed to grant "legal authority" for the Commission to rule-make on any given matter.

The District of Columbia Court of Appeals (hereinafter COA) has provided extensive guidance for agencies to determine whether they are within their ambit to rule-make. In reviewing an agency interpretation of a statute, the COA follows the two-part test set out by the Supreme Court in *Chevron, U.S.A., Inc. v. Natural Res. Def. Council. Pannell-Pringle v. District of Columbia Dep't of Emp't Servs.*, 806 A.2d 209, 211 (D.C.2002) (citing *Chevron, U.S.A., Inc. v. Natural Res. Def. Council*, 467 U.S. 837, 104 S.Ct. 2778, 81 L.Ed.2d 694 (1984)).

In assessing the validity of an agency's interpretation of regulation or statute, the court "must first determine whether the meaning of the statute is clear and, if so..." the court "must give effect to the unambiguously expressed intent of [the legislature]." *Colbert v. District of Columbia Dep't of Emp't Servs.*, 933 A.2d 817, 819 (D.C.2007). If the statute is ambiguous, the COA "will defer to an agency's reasonable interpretation of the statute it administers." See *Coumaris v. District of Columbia Alcoholic Beverage Control Bd.*, 660 A.2d 896, 899 (D.C.1995). In such a case, "[t]he agency's interpretation... is controlling unless it is plainly erroneous or inconsistent with the statute." In *re D.K.*, 26 A.3d 731, 734 (D.C. 2011) (quoting *Taggart-Wilson v. District of Columbia*, 675 A.2d 28, 29 (D.C.1996)). However, "[n]o deference is appropriate ... where the agency has failed to identify the question of statutory construction to be addressed." *Coumaris*, 660 A.2d at 899. Likewise, the COA "will not affirm an administrative determination that reflects a misconception of the relevant law or a faulty application of the law." *Georgetown Univ. v. District of Columbia Dep't of Emp't Servs.*, 971 A.2d 909, 915 (D.C. 2009))."

The COA's doctrine of substantial deference to agency interpretations of the laws they administer and the regulations they have promulgated is based on *Chevron*. See, e.g., *Reichley v. District of Columbia Dep't of Employment Servs.*, 531 A.2d 244, 248 n. 4 (D.C.1987) Indeed, the COA's "standard of review of an adjudicative rule...is the same as the standard applicable when an agency uses the rule-making mechanism to construe a statute..." *Mallof V. Bd. Of Elections And Ethics*, 1 A. 3d 383 - DC: Court of Appeals 2010. See also *Chevron U.S.A., Inc. v. Natural Resources Defense Council*, 467 U.S. 837, 843-45, 104 S.Ct. 2778, 2781-83, 81 L.Ed.2d 694 (1984)("arbitrary, capricious, or manifestly contrary to statute"); *Hughes v. District of Columbia Dept. of Employment Services*, 498 A.2d 567, 570 (D.C.1985) ("reasonable...given plain language"). Although the COA accords great weight to the Commission's interpretation of the statute it is charged with administering, "the judiciary is the final authority on issues of statutory construction," *Howard Univ. Hosp. v. District of Columbia Dep't of Emp't Servs.*, 952 A.2d 168, 173 (D.C. 2008), and the COA will not defer to the Commission's interpretation if it is inconsistent with the "unambiguously expressed intent of [the legislature]." *Chevron U.S.A., Inc. v. Natural Res. Def. Council, Inc.*, 467 U.S. 837, 843 (1984). The COA accords "less weight to an agency's interpretation where the attributes of long standing and consistency are lacking." *J. Parreco & Son V. Rental Housing Com'n*, 567 A. 2d 43, 48 - DC Court of Appeals (1989). The COA likewise "decline[s] to defer to an administrative construction where it is inconsistent with the statutory language or purpose." *Guerra v. District of Columbia Rental Hous. Comm'n*, 501 A.2d 786, 790 (D.C. 1985).

The Office of Planning Cites to Specious Authority thus the Zoning Commission has no Jurisdiction to Rule-make for the Matters at Hand.

The Office of Planning (OP) admits the Zoning Regulations do not specifically apply to Solar Arrays. In their submission to the Zoning Commission, OP states, "The Zoning Regulations do not specifically regulate solar arrays". Undeterred, OP maintains that roof mounted solar arrays "must comply with penthouse regulations" and that since solar arrays are "permanently affixed" to the ground and "greater than four feet in height" that they *would* be considered structures. In other words, OP maintains 1.) that since the Zoning Commission can regulate the height of buildings and structures erected on the top of them, that they can independently regulate solar arrays whether or not they have to do with a building's height or appearance, 2.) that solar arrays are "Structures" as defined by 11-B DCMR 101.2, and 3.) that

the Zoning Commission may regulate solar arrays because they are basic utility.

Addressing OP's contention's one by one, it is clear the Zoning Regulations, indeed, do not regulate solar arrays. First, the Zoning Act explicitly grants the authority for the zoning commission to regulate height. DC Code §6-641.01. The Zoning Regulations construe height regulations to include, "anything attached to something having a permanent location on the ground and including, among other things, radio or television towers, reviewing stands, platforms, flag poles, tanks, bins, gas holders, chimneys, bridges, and retaining walls." Structures. The Zoning Act and the Zoning Regulations explicitly grant the Zoning Commission the ability to regulate the height of buildings, and in doing so, allows the Zoning Commission to consider "anything" attached to them so long as it qualifies as a "Structure" under 11-B DCMR 101.2. Thus, the statutory interpretation set forth by OP is inapposite to ZC 19-04 because solar arrays are not attached to any building and rather are attached directly to the ground thus there is no explicit authority for the Zoning Commission's regulation of solar arrays. In fact, OP's reading here seems to suggest that because radio towers or television towers may be regulated because of height, that now it is within the Zoning Commission's purview to regulate radio and television *transmissions*. An absurd outcome that the FCC would likely contest. However, more importantly, and also germane to OP's second contention, solar arrays do not fit within the 11-B DCMR 101.2's definition of a structure.

The Zoning Regulations define a Structure as:

"Structure - Anything constructed, including a building, the use of which requires permanent location on the ground, or anything attached to something having a permanent location on the ground and including, among other things, radio or television towers, reviewing stands, platforms, flag poles, tanks, bins, gas holders, chimneys, bridges, and retaining walls. *The term structure shall not include mechanical equipment, but shall include the supports for mechanical equipment. Any combination of commercial occupancies separated in their entirety, erected, or maintained in a single ownership shall be considered as one (1) structure.*"

11-B DCMR 101.2.

The zoning regulations shall *not* include mechanical equipment. Webster's Dictionary defines mechanical as something, "of or produced by a machine" and further defines a machine as "an assemblage of parts that transmit forces, motion, and energy one to another in a predetermined manner". The only plain language interpretation for the relevant statutes provides that solar arrays are mechanical equipment that cannot be considered structures under 11-B DCMR 101.2. *Coumaris v. District of Columbia Alcoholic Beverage Control Bd.*, 660 A.2d 896, 899 (D.C.1995). (The agency's interpretation... is controlling unless it is plainly erroneous or inconsistent with the statute.) *See also, Hughes v. District of Columbia Dept. of Employment Services*, 498 A.2d 567, 570 (D.C.1985) (must be reasonable given plain language.)

The Basic Utility definition of solar arrays poses just as many problems. First, the Zoning Regulations explicitly forbid electronic facilities from being placed in residential neighborhoods. 11-U DCMR 203.1(p)(1). Webster's Dictionary defines a facility as "something

that is built, installed, or established to serve a particular purpose” and defines “electronic” as “of or relating to electrons”.¹ A solar array field is clearly a facility that produces electricity, thus relates to electrons. The only plain language interpretation for the relevant statutes provides that solar arrays are an electronic facility that cannot be placed in a residential neighborhood pursuant to 11 DCMR 203.1(p)(1). Thus a proposed rulemaking which claims authority to build solar arrays by-right in residential neighborhoods pursuant to an interpretation of the “Basic Utility” regulations is plainly erroneous. *Coumaris, Bd.*, 660 A.2d 896, 899 (D.C.1995). (The agency's interpretation... is controlling unless it is plainly erroneous or inconsistent with the statute.) *See also, Hughes*, 498 A.2d 567, 570 (D.C.1985) (must be reasonable given plain language.)

Moreover, any “Basic Utility” requires going through the BZA for a special exception which could take into account the orderly development of the neighborhood where the “Basic Utility” was proposed, and, in any event, the examples listed within the Basic Utilities definition: “electrical sub-station, telephone exchange, optical transmission node, electronic equipment facility, sewer plant, water treatment plant, methods and facilities for renewable energy generation, or utility pumping station. . .” suggest facilities of fixed and predictable size. On the contrary, the proposed rulemaking for ZC 19-06 whereby the Zoning Commission grants by-right ability to build any-sized solar array fields in residential neighborhoods amounts to inappropriate incursion into District of Columbia energy policy outside the jurisdiction of the Zoning Commission and concomitantly undershoots the regulatory regimes undoubtedly within the Commission’s ambit.

The Office of Planning’s Interpretation of a “Basic Utility” is Very New Wine Being Poured into Old Bottles.

11 DCMR 203.1 provides that “Basic Utilities” The following uses shall be permitted as a special exception in R-Use Groups A, B, and C, if approved by the Board of Zoning Adjustment under Subtitle X, Chapter 9. For years, the Zoning Commission has abided by this protocol. In fact, there is a BZA case currently underway where a solar array field is being proposed in a residential district. BZA Case No. 19927. This has been the longstanding policy of the BZA for handling a “Basic Utility”. Thus, at the COA, the Zoning Commission would not be given any deference for this reverse course. *Superior Beverages V. Alcoholic Bev. Cont.*, 567 A. 2d 1319 - DC: Court of Appeals 1989 (Overturned where agency interpretation overturns longstanding interpretation) *See also, Winchester Van Buren Tenants Ass’n v. District of Columbia Rental Hous. Comm’n*, 550 A.2d 51, 55 (D.C. 1988) (quoting from *Norwegian Nitrogen Co. v. United States*, 288 U.S. 294, 315, 53 S.Ct. 350, 358, 77 L.Ed. 796 (1933), *See also J. Parreco & Son V. Rental Housing Com’n*, 567 A. 2d 43, 48 - DC Court of Appeals (1989) (Less weight to an agency's interpretation where the attributes of long standing and consistency are lacking.)

The proposed Rulemaking is Inconsistent with Statutory Language and Purpose

The Zoning Act requires the Zoning Commission to prevent the “overcrowding of land...” DC Code §6-641.02. Regulations shall be made with “reasonable consideration, among other things, of the character of the respective districts.” *Id.* The Zoning Act requires the Zoning

¹ Webster’s Dictionary defines electron as “an elementary particle consisting of a charge of negative electricity equal to about 1.602×10^{-19} coulomb and having a mass when at rest of about 9.109×10^{-31} kilogram or about $1/1836$ that of a proton”

Commission to “To promote...order...and...orderly development” All of these precepts to Zoning are undermined by ZC 19-04 which permits by-right development of limitless scope. ZC 19-04 does not provide “reasonable consideration” to the “character of neighborhoods” when it allows blanket approvals for fields of “structures”² that are measured by acres and have no height limits. Further, there is no “order” to how and why the solar array fields are built when they are allowed by-right. ZC 19-04, in fact, is a regulation written to allow chaos in residential neighborhoods. There are absolutely no checks for anything pertaining to solar array fields within ZC 19-04, neither in their construction, density, height, environmental impact, or breadth.

In fact, ZC 19-04 is completely inconsistent with the Comprehensive Plan. The Comprehensive Plan is a document, where taken on the whole, accounts for the unique character of neighborhoods (*See generally* Small Area Plans). Solar array fields have, by their very nature, have the potential to be so large that by-right approval for them undermines any notion of “orderly development.” The 5 largest solar array fields range from 10 to 50 square kilometers.³ Theoretically, under ZC 19-04, a solar array field could be built covering an entire quadrant. The scale of by-right development for solar array fields necessarily at odds with the statutory construction and the purpose of the Zoning Act and the Comprehensive Plan, respectively. *Howard Univ. Hosp. v. District of Columbia Dep't of Emp't Servs.*, 952 A.2d 168, 173 (D.C. 2008) (The judiciary is the final authority on issues of statutory construction.), *See also Chevron U.S.A., Inc. v. Natural Res. Def. Council, Inc.*, 467 U.S. 837, 843 (1984) (The court will not defer to the Commission's interpretation if it is inconsistent with the unambiguously expressed intent of the legislature). *Guerra v. District of Columbia Rental Hous. Comm'n*, 501 A.2d 786, 790 (D.C. 1985). (Court declines to defer to an administrative construction where it is inconsistent with the statutory language or purpose.

ZC 19-04 Has an Unrealistically Rosy Picture of the Environmental Impacts of Solar Array Fields

Using BZA Case No. 19927 as a case study for environmental impact to the allowance of by-right construction of solar array fields in residential neighborhoods is illuminating. WJLA reported that “glyphosate” or the herbicide “Roundup” was used to clear the site of vegetation in order to construct the solar array fields.⁴ Indeed, the developer even admits to this. *Id.* Roundup has been known to cause cancer and is outright banned in many jurisdictions around the world.⁵ The Zoning Act calls upon the Zoning Commission to “protect the health...” of DC residents. DC Code §6-641.01.

Also, it has been observed that the solar panels themselves are not always entirely environmentally sound.⁶ Within them toxic materials such as, “lead and carcinogenic cadmium” and may be washed out by rainwater, leaching into the soil. *Id.* “Broken Modules”, “Edge Delamination”, “Animal Bites”, Backsheet Burn, *inter-alia*, can further exposes toxic materials to the environment⁷ and surrounding neighborhood if placed in a residentially zoned area.

² Structures in quotation marks acknowledges that solar array fields are not “Structures” according to the Zoning Regulations.

³ <https://www.originenergy.com.au/blog/lifestyle/5-largest-solar-farms-in-the-world.html>

⁴ <https://wjla.com/news/local/dc-neighborhood-not-happy-new-solar-farm>

⁵ <https://www.baumhedlundlaw.com/toxic-tort-law/monsanto-roundup-lawsuit/where-is-glyphosate-banned/>

⁶ <https://www.forbes.com/sites/michaelshellenberger/2018/05/23/if-solar-panels-are-so-clean-why-do-they-produce-so-much-toxic-waste/#405e4fd4121c>

⁷ See Exhibit A, page 7.

Should the solar array field fail, or the owner become insolvent, the city could be responsible for millions in clean-up costs.⁸

Blanket by-right approval of solar array fields will in many instances require deforestation of vast swaths of land and without any mechanism to assess the means of clearing vegetation from a site, it is dangerous policy that counter-indicates one of the most fundamental purposes of zoning – safety and health. *Id.* Moreover, the type of solar panels used matters⁹ and blanket approval for any-sized solar array field with any-kind of solar panels goes towards the chaos that will be caused by ZC 19-04 and the complete deregulation of *energy* in the District of Columbia through an agency not even authorized to regulate energy, that is the Zoning Commission.

Legislative Pretense: This Rulemaking is a part of a Disturbing Pattern and Practice of the Zoning Commission Conducting Rulemakings in Order to Work-Around Problematic Adjudicative Hearings.

Should this rulemaking requested by the Office of Planning apply to *any* ongoing BZA exception it would be evident that this rulemaking was nothing more than a scheme to wrap adjudicative facts into legislative garb. The DC's own court of appeals has held, "the Zoning Commission may not adjudicate. . . under the pretense of legislative action" *Dupont Circle Citizens Ass'n*, 343 A.2d 296, 300. To the extent finalizing of this Proposed Rulemaking facilitates movement forward on BZA Case No 19927¹⁰, for example, Stoop Law objects to this undermining of due process.

In the past, courts have held, "[i]t is a principle which has always been held sacred in the United States, that laws by which human action is to be regulated, look forwards, not backwards." *Reynolds v. McArthur*, 27 U.S. (2 Pet.) 417, 434, 7 L.Ed. 470 (1829); *see also Landgraf v. USI Film Prods.*, 511 U.S. 244, 265. ([T]he presumption against retroactive legislation is deeply rooted in our jurisprudence). The law applies a presumption that new legislation applies *only* prospectively. *Id.* at 270. Prospective application of new legislation goes towards protecting "due process interests" by providing "fair notice, reasonable reliance, and settled expectations" *De Niz Robles v Lynch*, 803 F.3d. 1165, 1169. A "fundamental unfairness would inevitably result" if new regulations were applied to "parties who had previously established their legal positions in reliance upon the former regulations." *1880 Columbia Road, N.W., Tenants' Ass'n v. District of Columbia Rental Accommodations Comm'n*, 400 A.2d 333, 338 (D.C. 1979); *accord, Anderson, Clayton*, 562 F.2d at 984.

Conclusion

Through these comments Stoop Law seeks explanation from the Zoning Commission on 3 primary matters, 1.) How is the Office of Planning's interpretation of 11-U DCMR 203.1 and 11-B DCMR 101.2 consistent with plain language interpretations of the same? 2.) How is the Proposed Rulemaking in ZC 19-04 consistent with Zoning Act mandates for safety, health, and orderly development, 3.) Will this rule apply to the land parcels and application at issue in BZA 19927, and, if

⁸ <https://www.forbes.com/sites/michaelshellenberger/2018/05/23/if-solar-panels-are-so-clean-why-do-they-produce-so-much-toxic-waste/#405e4fd4121c>

⁹ Exhibit A (*See generally*)

¹⁰ Or in some other way facilitates eventual approval of the relief being granted by 16-23 for the land owner on the lots at issue.

so, why is this not considered impermissible retroactive rulemaking by the Zoning Commission, and 4.) Though not explicitly addressed within the comment, have all of the ANC's been served and are they aware of such massive changes to the zoning laws and energy regulation?

s/Aristotle Theresa

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EXHIBIT A

PV Life Cycle Analysis Managing PV Assets over an Uncertain Lifetime

Nadav Enbar
Principal Project Manager

Solar Power International
14 September 2016



Agenda

- Background
 - Industry needs
 - Overview of EPRI project
- Research Findings
 - PV site surveys
 - Repowering and decommissioning guidance
- Conclusions and Next Steps



Background

Industry Needs

The Issue

- PV project lifetimes are not well-understood
- Factors that influence lifetimes have not been quantified
- Underperforming assets can be a burden to project owners
- Options and steps to restore power or decommission systems need to be defined



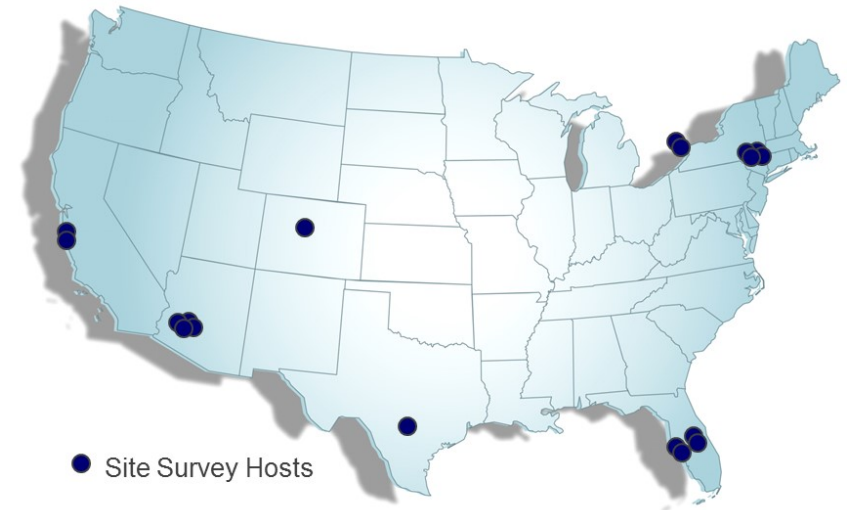
Background

Overview of EPRI Project

The project provides guidance to PV system owners around assessing plant health—performance and safety issues—and determining best options for repowering and decommissioning.

Scope

1. Develop detailed methodology for PV site condition surveys
2. Conduct surveys of 30 PV systems
3. Develop processes for a) re-powering PV systems and b) decommissioning PV systems
4. Develop generic economic model to allow plant owners to compare repowering options
5. Research options for recycling and disposing of modules and other plant components



EPRI Supplemental Project Stats:

- Schedule: 2013-2017
- \$660k study funded by 6 utilities
- EPRI Report (3002008832) to be published late-Sept. 2016

Results were packaged into a PV Life Cycle Analysis Manual, which provides guidance for owners and operators of PV systems.

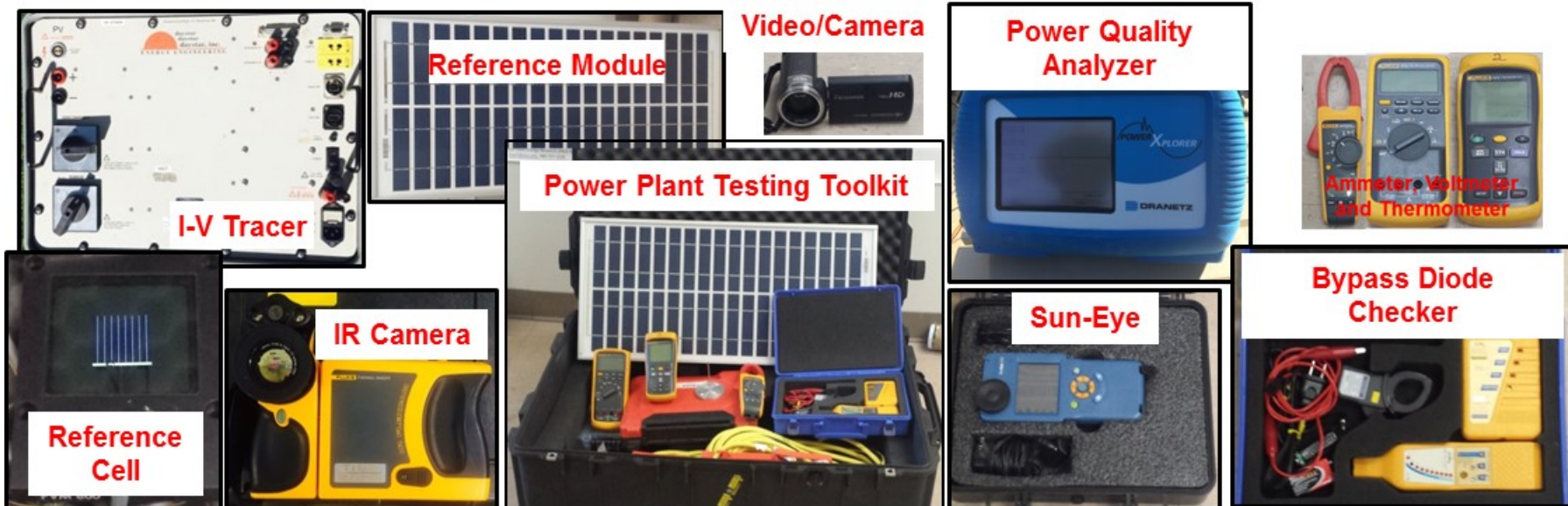
Research Findings

PV Site Surveys

Background

Site Survey Methodology

- Visual Inspection
- Measurements
 - I-V curves
 - Bypass diode check
 - Infrared scanning
 - Power quality analysis
 - Shading analysis



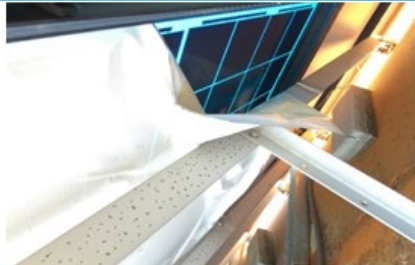
Research Findings

Examples of Safety Failures

Broken Module



Backsheet Delamination



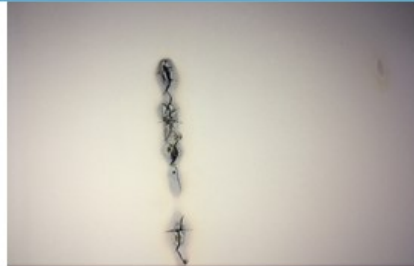
Damaged Rack



Missing Lid



Backsheet Burns



Backsheet Cuts



Edge Delamination



Burnt Wire

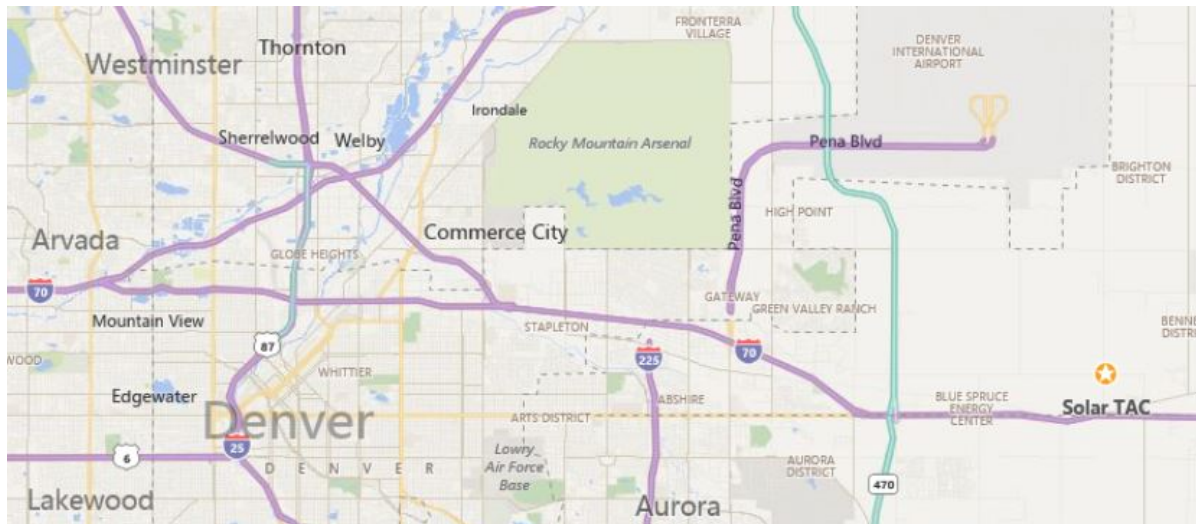


Animal Bites



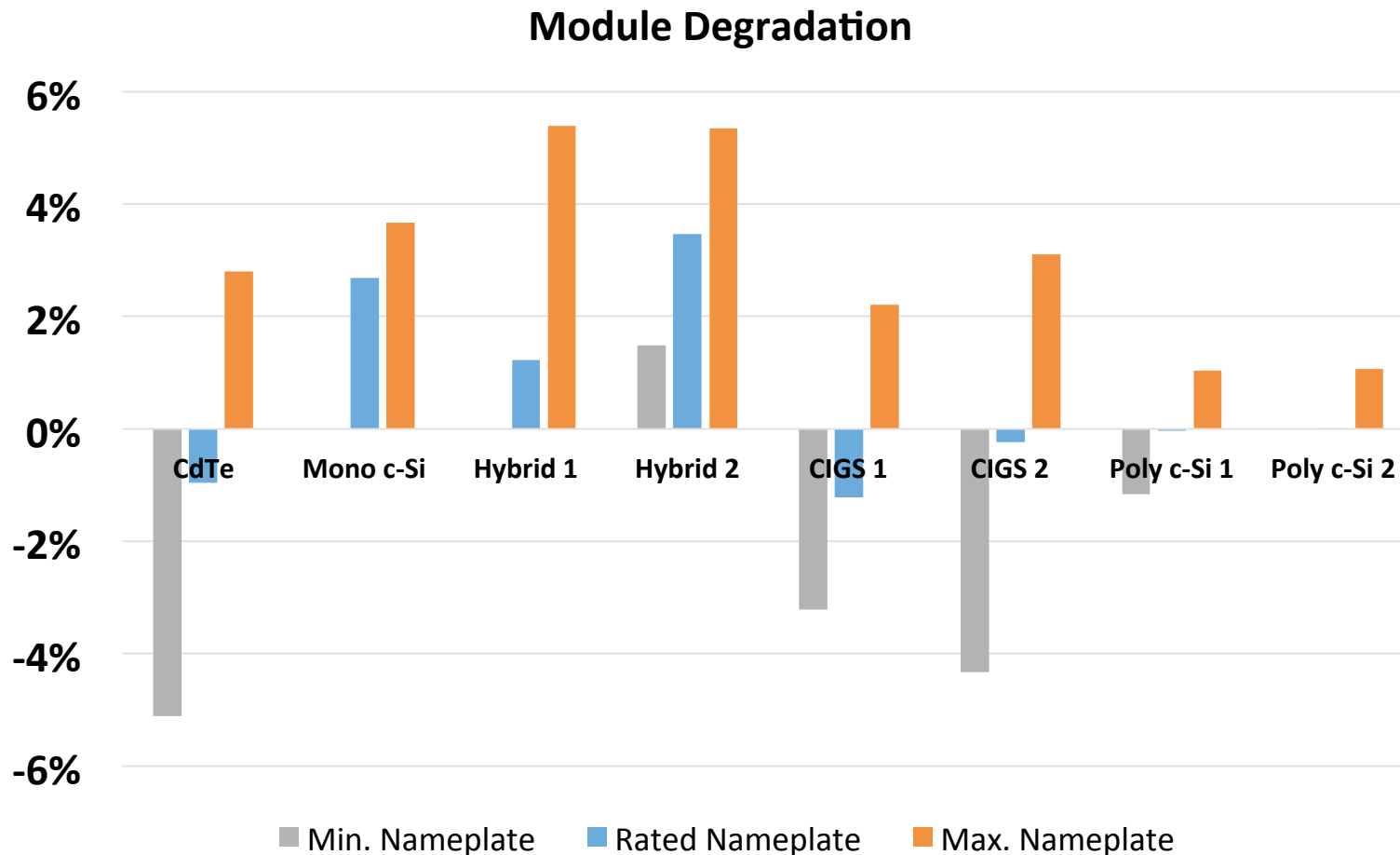
Research Findings

Example Site Survey Results: SolarTAC



Research Findings

Example Site Survey Results: SolarTAC



Negative degradation rates, or performance gains, may be due to manufacturer underrating of modules, whereas positive values may indicate underrating.

Research Findings

Example Site Survey Results: SolarTAC Poly c-Si 1 System

String 1											String 3											
String 2																						

System

- Size: 9.4 kWdc
- Modules: 33 (3 strings)
- Tilt: Latitude (20°)
- Installation: November 2010
- Status: Operational

Inverter

- Size: 10 kWac
- Quantity: 1
- Status: Operational

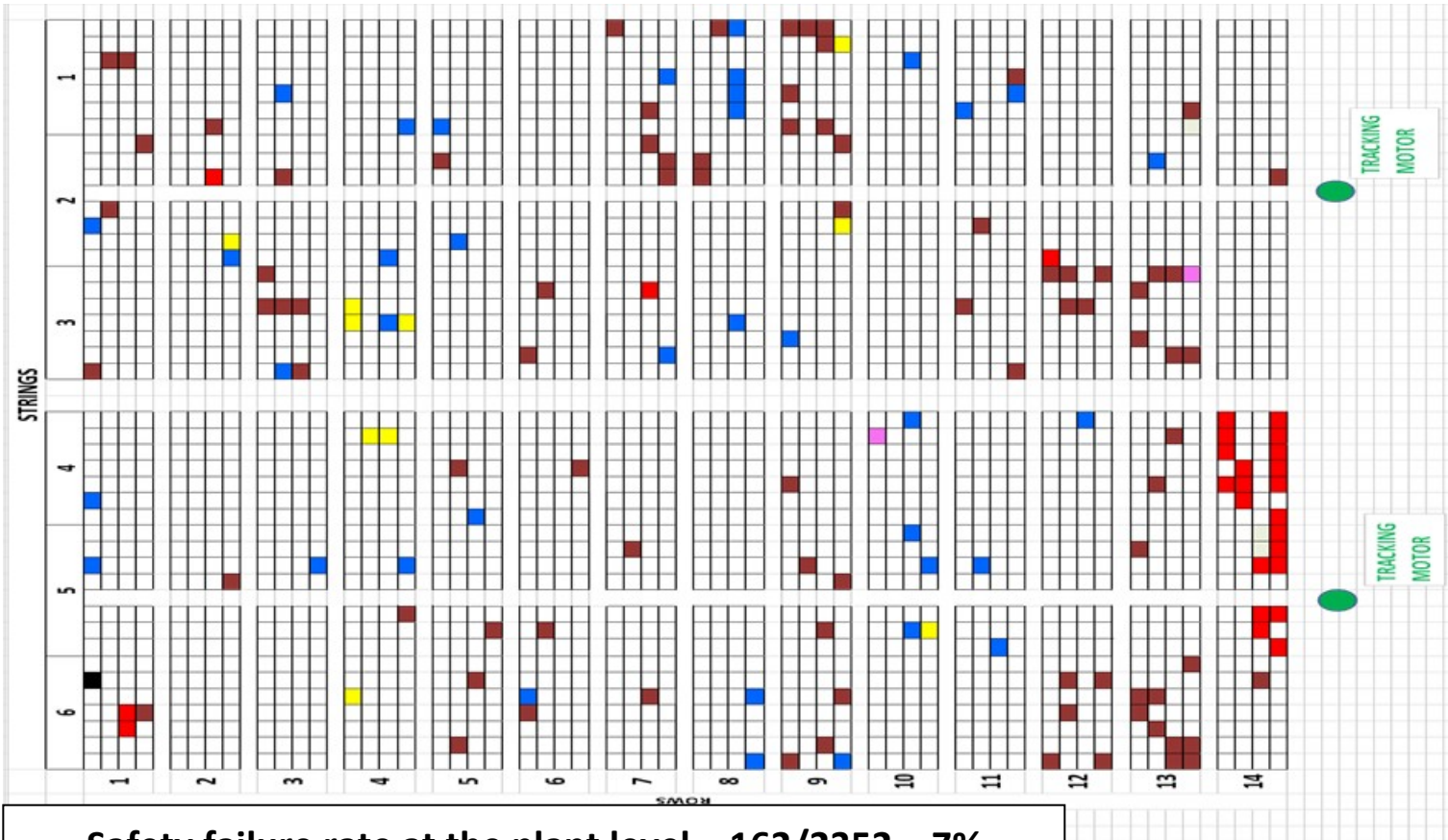


Example Results

One safety failure: failed diode
Average String Degradation: **0.31%/yr**
Average Module Degradation: **0.03%/yr**

Research Findings

Example Safety Failure Mapping for a Older, Larger Site



Safety failure rate at the plant level = $162/2352 = 7\%$

Blue: Hotspot issues leading to backsheet burn (37/2352)

Brown: Ribbon-ribbon solder bond failure with backsheet burn (86/2352)

Red: Failed diode with no backsheet burn (26/2352)

Black: Hotspot issues with backsheet burn + Ribbon-ribbon solder bond with backsheet burn (1/2352)

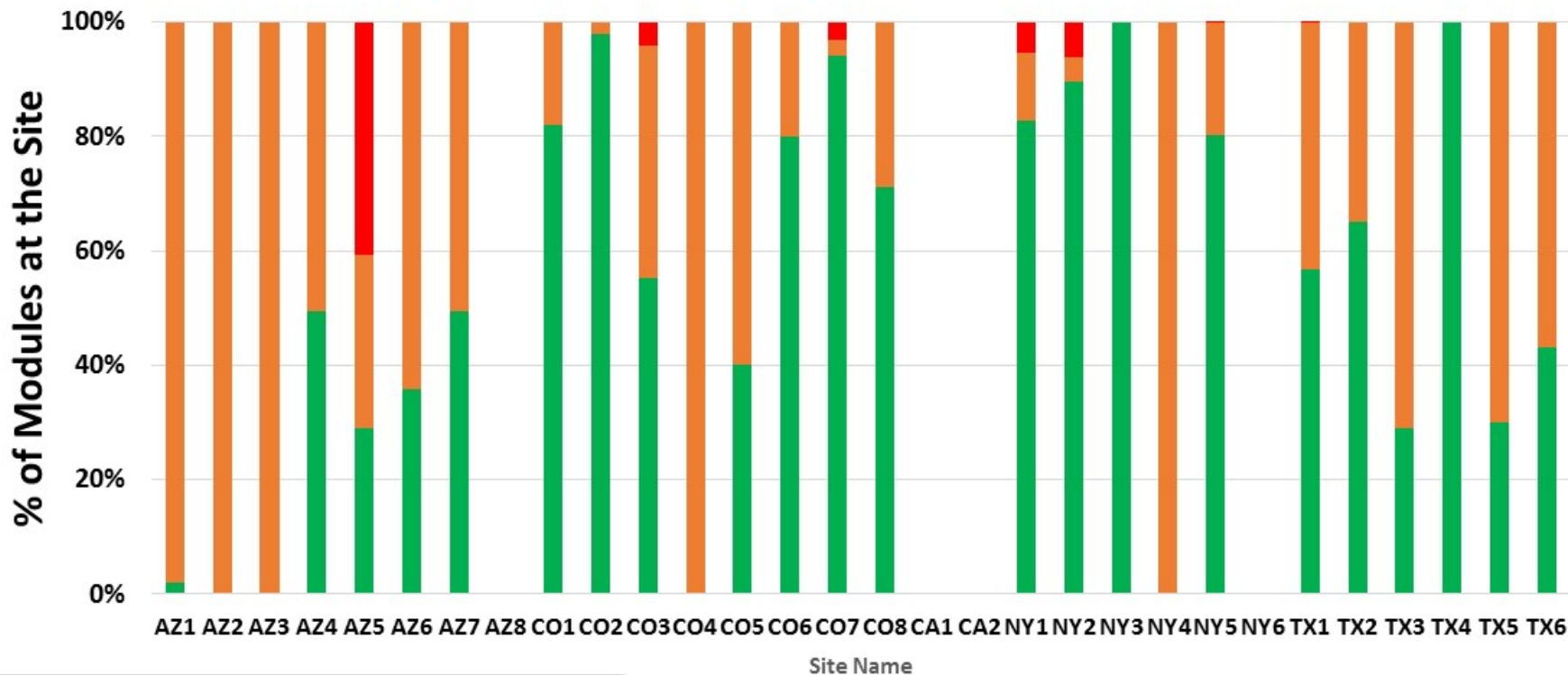
Yellow: Backsheet Delamination (10/2352)

Pink: Backsheet Delamination + Ribbon-ribbon solder bond failure (2/2352)

Research Findings

Summary of Module Distribution (all sites)

Degradation Rate and Safety Failure Distribution for 30 Photovoltaic Power Plants in Different Environmental Regions in the United States



Site Technology
 Crystalline Si: AZ1-8; CO4-8; CA1-2; NY1-6; TX5-6
 Amorphous Si: TX4
 CdTe: CO1; TX1-2
 CIGS: CO2-3; TX1

■ Degradation < 1%/Yr ■ Degradation > 1%/Yr ■ Safety Failures

Degradation generally seems higher in the hotter climates (AZ and TX)
 Cool climates (NY) tend to have lower degradation, and CO systems fall in between.

Research Findings

Repowering and Decommissioning

Repowering and Decommissioning Guidance

Process for Determining Best Path

Steps for PV System Owners and Utilities

1. Conduct site survey
2. Identify issues to be fixed
 - Safety
 - Performance
 - May include non-PV assets like roof repairs, infrastructure upgrades
3. Develop scope of work (perhaps for multiple options)
 - May include re-design
 - Can be reduced to time & materials (or sub-contracts)
 - Meet latest code for safety and performance
 - Authority Having Jurisdiction (AHJ) dependent
 - Grandfathering may apply
 - PV specific code changes: 2014 NEC for PV
4. Perform cost-benefit analysis

Repowering Guidance

2014 NEC Code With Legacy PV Plants

- The 2011 and 2014 NEC code cycles made significant changes to Article 690
 - Improved safety
 - Improved performance
- Allow ungrounded DC systems
- Require use of PV Wire not USE-2 for ungrounded systems
- Improved ground fault detection
- Require arc fault detection
- Rapid disconnects required for rooftop systems

The above changes significantly affect repowering legacy PV plants

Repowering Guidance

Implications of Inverter Replacement for Legacy PV Plant

- For some legacy systems, to replace the inverter means:
 - Switch to a transformerless inverter due to limited availability of isolated inverters and lack of manufacturer support/warranties
 - Unground the PV system, as required by the transformerless inverter
 - Replace all modules with products that have PV wire
 - Replace home runs and combined wires (no white wire)
 - Restring to 1000 V to match inverter specifications
 - Replace combiner boxes to support positive and negative fusing
 - Replace disconnects to support positive and negative disconnecting means
 - Relabel entire system



Replacing the inverter may cost almost as much as a new installation.

PV Plant Decommissioning

- Reasons for decommissioning include:
 - End of project life
 - Economic viability
 - Safety
- Decommissioning plans include steps to restore sites to their intended use:
 - Land and water use restoration
 - Salvage, recycling, and disposal of plant equipment
 - “Safe” disposal of all materials (although plans often don’t specify what to do or how to do it)



Decommissioning PV Plants

Balance of System

- Equipment removal, disposal, and recycling
 - Inverters and other electronic components – e-waste recycling
 - Module mounting structures – steel recycle, resale
 - Concrete – recycle
 - Electrical equipment – reuse or recycle
 - Wiring – copper recycling
- Equipment abandon in place
 - Underground conduit
 - Certain structures
- Equipment reuse
 - Infrastructure improvements – roads, fences, etc.
 - Substations, communication towers
 - Maintenance buildings



Decommissioning PV Plants

Modules

Recycling

- No federal, state, or local regulations require PV module recycling in the U.S.
- No 3rd party or public module recycling programs in the U.S., with the exception of limited manufacturer take-back programs
- Recycling technologies exist to extract/reuse ~80% of module material

Disposal

- PV modules are not classified as hazardous waste, but they contain hazardous materials
- Disposal options in U.S.
 - Modules that fail the Toxicity Characteristic Leaching Procedure (TCLP) must be disposed of in hazardous waste landfills
 - Long-term storage in storage containers may be best option until recycling becomes available

Module waste volumes are 0.1-0.6% of total e-waste today, but by 2050 panel waste may surge to over 10% of 2014 global e-waste levels*

Conclusions

- Interest in PV plant repowering and decommissioning is growing as PV plants age and experience performance and safety issues
- Module disposal is potentially a major issue
 - Some modules contain hazardous waste, but limited data available to verify which modules fail the Toxicity Characteristic Leaching Procedure (TCLP)
 - Some deployment estimates show that PV waste could equal 10% of today's e-waste by 2050
 - Disposal in regular landfills not recommended in case modules break and toxic materials leach into the soil
- Regulatory environment
 - Europe regulates panel recycling, and Japan and Korea are establishing recycling programs
 - Currently no regulatory framework in U.S. and no public PV recycling facilities

EPRI | ELECTRIC POWER
RESEARCH INSTITUTE

Solar Photovoltaic Life Cycle Analysis

A Practical Handbook for Solar Photovoltaic Power Plant Owners and Operators

3002008832

Next Steps

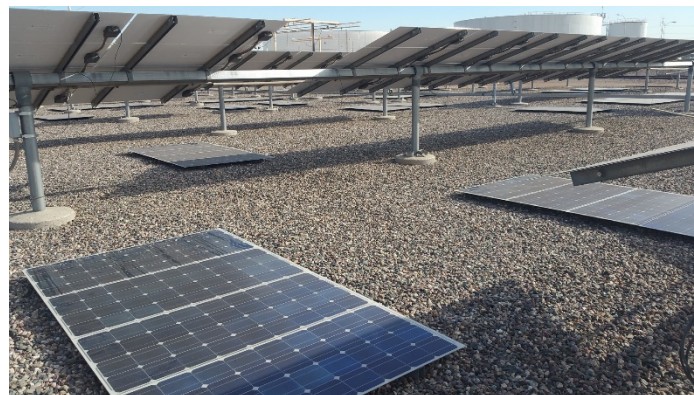
Planned Work

- Deeper dive study on PV recycling feasibility in the U.S.
 - Regulatory environment
 - Feasibility of developing a comprehensive collection system
 - State of the art in PV recycling technology
 - Limited TCLP testing to determine module toxicity in landfill environment



Proposed Projects

- Comprehensive test and evaluation program to assess various factors that may influence TCLP outcomes
- Technical and cost considerations for the decommissioning and disposal of PV plants



More data is needed to clarify the extent to which module toxicity is a pervasive issue.



Together...Shaping the Future of Electricity

Questions for potential discussion

- Who budgets for PV **end-of-life costs**?
 - Method and considerations in your cost calculation?
 - Is PV salvage value positive or negative? Anecdotal data?

- Has anyone **repowered or decommissioned** a plant?
 - Challenges and/or key questions during the process?
 - Chosen method of module and/or balance of plant disposal?
 - Compatibility of new vs. old equipment?

- **Hazardous waste** associated with PV plant disposal?
 - Aware of Toxicity Characteristic Leaching Procedure?
 - Usefulness to include on module or BOS spec sheet?

- Do you think the U.S. needs to regulate PV **recycling**?
 - What are the biggest challenges, e.g., economics / value of materials, collection?
 - Percentage of project developers opting to include recycling in the upfront purchase contract?