What's So Risky About Alternative Energies?

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This Presentation Will

Key Areas of Understanding

- Look at the most popular alternative energy generation facilities used in the public sector,
- Examine the associated risks and exposures
- Explore methods to effectively manage alternative energy risks.

Solar and Biogas Power Generation Overview

February 13, 2017

PARMA Conference and Expo
Disneyland Hotel
Anaheim, CA

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Solar Power Generation Statistics

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According to the Solar Energy Industries Association (SEIA), as of the Q3 of 2016:

- There are now over 33,800 MW of cumulative solar electric capacity operating in the U.S., enough to power more than 6.8 million average American homes.
- By 2020, solar will provide more than 3.5% of all U.S. electricity, up from just 0.1% in 2010, an increase of well over 3000% in just a decade.
- More than 75% of the Q3 2016 installation total came from the utility PV segment
- Since the implementation of the Investment Tax Credit (ITC) in 2006, the cost to install solar is dropped by more than 73%.

Solar Power Generation Statistics (Continued)

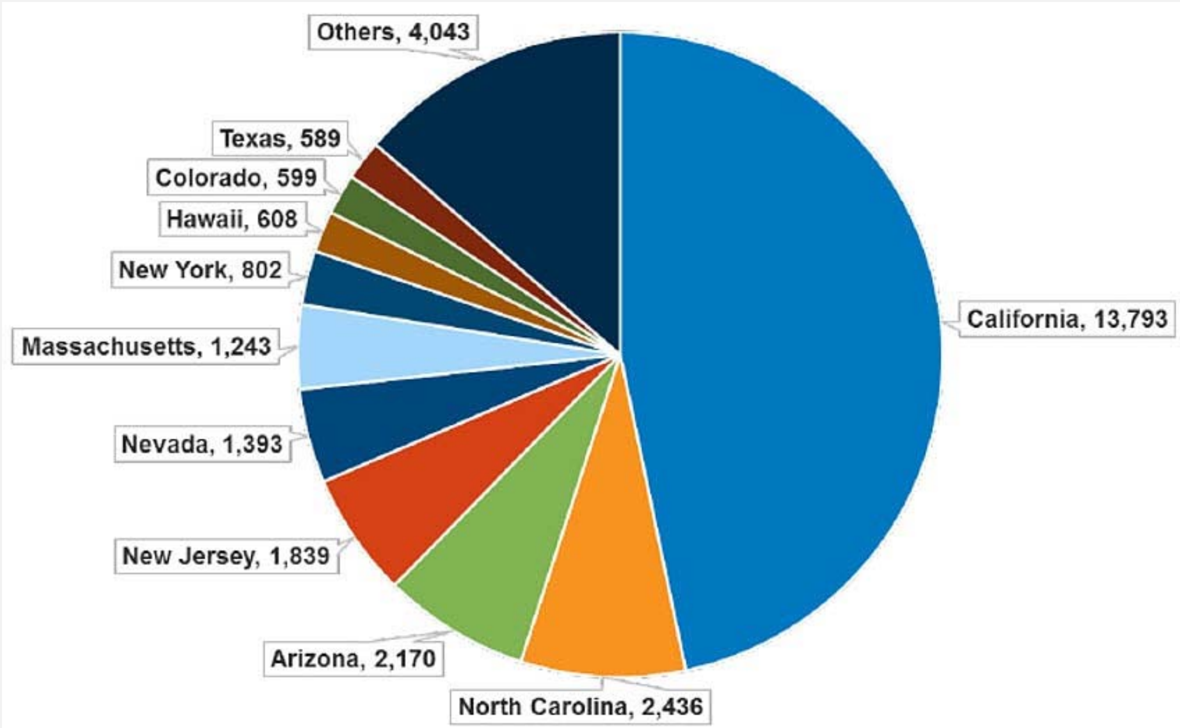
2014 Figures (most recent published information)

- The 3,727 PV systems at U.S. schools have a combined electric capacity of 490 MW, and generate roughly 642,000 megawatt-hours (MWh) of electricity every year.
- Projections:
  - Roughly 20,000 MW of solar capacity is forecasted to come online over the next two years, doubling the country's existing solar capacity.
  - 450 individual school districts could each save more than $1,000,000 over 30 years by installing a solar PV system.
  - Of the 125,000 schools in the country, between 40,000 and 72,000 can "go solar" cost-effectively.

Solar Power Generation Statistics (Continued)

Cumulative Installed Solar Capacity (as of Q2 2016)

- According to SEIA, California leads the nation in total solar power generation.
- Growth is expected to be broad-based, with more than 16 states expected to top the 100 MW mark in 2016, up from 9 states in 2014.



Total Installed Capacity (MW)

Solar Power Generation
Critical Components

Photovoltaic Solar Panels

- Convert solar energy into direct current electricity.
- Majority of modules use wafer-based crystalline silicon cells or thin-film cells based on cadmium telluride or silicon.
- Cells must also be protected from mechanical damage and moisture.
- Most solar modules are rigid, but semi-flexible thin film cells are available.

Solar Power Generation
Critical Components

Inverters

- May be set up as a string inverter or as a central inverter.
- Convert direct current (DC) into alternating current (AC).
- Needs to be converted so it can be distributed through an electrical grid.
- Current can be back-fed through a service transformer, or may use a dedicated step up transformer.

Solar Power Generation
Critical Components

Transformer

- Size of array will dictate type and arrangement of transformers.
- Needed so that electricity can be distributed through an electrical grid.
- Transformers typically insulated with mineral oil.
- “Less than Flammable” transformers use environmentally friendly biodegradable fluids.
- Smaller transformers may be dry type.

Biogas Electrical Generation Information

Biogas

- Mixture gases produced by the breakdown of organic matter in the absence of oxygen (anaerobic).
- Can be produced from a number of organic based materials.
    - Agricultural waste.
    - Food waste.
    - Municipal waste.
    - Sewage.

Biogas Electrical Generation Information

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Biogas

- Biogas is primarily methane (~ 50%) and carbon dioxide (~ 25%).
- Gases can be combusted or oxidized and the resulting heat used to generate electricity.
- Biogas can be compressed, just like natural gas is compressed to CNG.
- Can be cleaned and upgraded to natural gas standards (bio methane).

Municipal Uses

Two common methods of municipal biogas generation.

- Sewage.
- Landfill.

Although biogas can be used for a variety of applications, the most common municipal use is to use as a fuel in for electrical generation.

Biogas Electrical Generation
Critical Components

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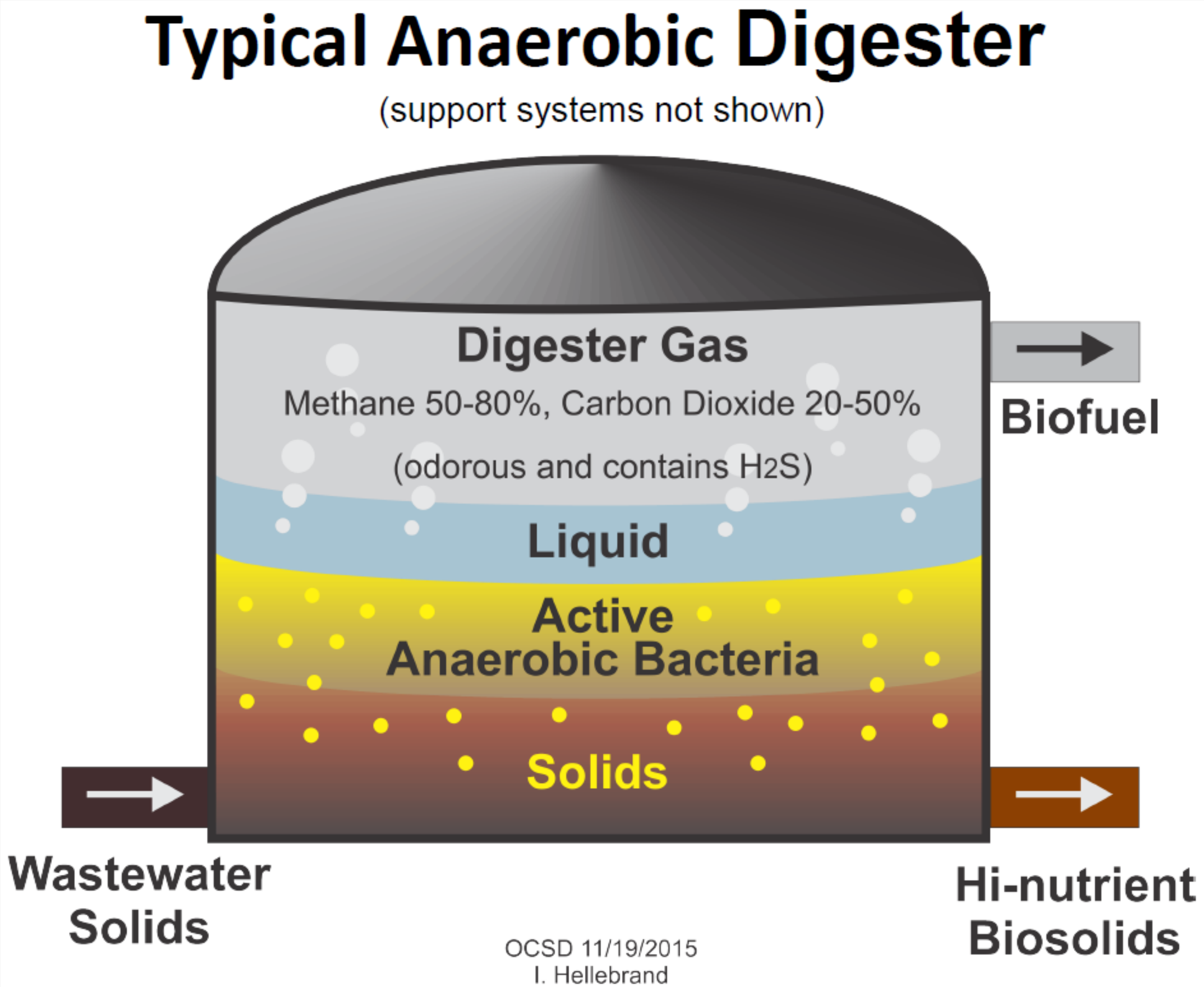
Anaerobic Digester

- Needed for digestion of organic matter in absence of oxygen.
- Wide variety of construction types.
  - Aboveground tank.
  - Pond or lagoon.
- Must have method of keeping out oxygen and collecting gas.
  - Rigid Roof.
  - Flexible bladder.

Biogas Electrical Generation
Critical Components



Biogas Electrical Generation
Critical Components

Driver and Generator

- Two types of common drivers
  - Internal Combustion Engine.
  - Micro Turbine.
- Typically connected to generator with solid shaft and installed as a set.
- Waste heat may be used to generate steam using a heat exchanger.

Combustibility of Panels

The 2012 International Building Code includes the following requirement: "1509.6.2 Fire Classification. Rooftop mounted photovoltaic systems shall have the same fire classification as the roof assembly as defined required by Section 1505."

Rigid Panels

Three spread of flame experiments were conducted on a PV module only in accordance with the revised UL 1703 test procedure in January 2014. All experiments resulted in Class A fire performance, Spread of Flame (SOF) < 6 feet.

- Class A – Less than 6 feet.
- Class B - Less than 8 feet.
- Class C – Less than 13 feet.
- Also reference the FM 4478 Approval Standard for Rigid Photovoltaic Modules.
- Check for flame spread ratings.
- With influx of cheap panels, make sure you are actually getting a UL listed and/or FM approved panel.

Source: Report on Spread of Flame and Burning Brand Performance of Generic Installations, Underwriters Laboratories

Dietz and Watson Factory in Delanco, NJ (cont.)

- First reported as being caused by a solar array fault.
- Fire fighters were hesitant to maneuver on roof due to electrocution concerns.
- Officials first reported that the array prevented the fire from being extinguished.
- No evidence that the solar array caused the fire or contributed to the fire load.
- Sprinkler system was not effective and the fire penetrated the roof structure.
- Water supply was inadequate:
  - Reported that nearby industrial sites provided water trucks.
  - Dispatched a fire boat on the Delaware River, planned to use water from a nearby creek for fire fighting. Go to web browser.

Apple Facility, Mesa, AZ

- No information found on exactly how it started.
- Speculation that roof covering is combustible.

Go to web browser.

Solar Power Generation Hazards (some, not all!)

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- Fire related concerns.
  - FD may not work on roof.
  - Venting may not be possible.
  - Panels will shield roof fire from water.
  - Worse if roof covering is combustible.
- Increased Roof Loads.
  - Weight.
  - Wind.
  - Snow.
- May block access for maintenance and inspection.

Solar Power Generation Hazards (cont.)

- The National Electrical Code now requires that all rooftop solar arrays be equipped with rapid shutdown devices.
  - Meant to provide some protection for fire fighting personnel.
  - May not be effective for large rooftop systems.
  - Consider use of microinverters.

    A microinverter (MI) works a little differently from the large inverter in that every solar panel will be outfitted with its own MI, most of which are approximately the size of handbook. This means that the DC current produced by the panel will be converted to AC current right at the panel before it is added to the string transmission line.

    The single greatest advantage to using microinverters is that each is controlled by a computer module that is programmed to monitor every panel in the entire solar array, including the transmission of power. Each MI is individually addressable so that if a condition occurs that may be indicative of a line fault, the computer has the ability to control each and every individual MI and effect a complete shut down of power transmission.

Biogas Power Generation Hazards

Methane is a flammable gas. Biogas is approximately 50% to 60% methane. If diluted with air between 10% to 30%, will form an explosive mixture.

Hydrogen sulfide is a highly toxic gas that is heavier than air. At very low levels, it smells like rotten eggs and can produce eye irritation. When mixed with water, forms sulfuric acid.

Ammonia is a gas that is lighter than air, has a pungent odor, and can irritate the eyes and respiratory tract. Under specific conditions, may form explosive mixture with air.

Biogas Power Generation Hazards (Cont.)

- Engines and Generators.
  - Hydrogen Sulfide.
  - Siloxanes.
  - Old generation equipment.

- Buildings and Equipment.
  - Gas explosion.
  - Fire.
    - Lube Oil Systems.
    - Electrical Equipment (transformers, battery rooms, switchgear, etc.)

Typical Scenarios

In the Municipal and Scholastic Spaces

1. Municipality/University owns and operates a large power plant that provides electricity for entire city/campus and sells excess electricity to utility.
2. Municipality/University owns and operates power plant that partially powers city/campus and then buys remainder of power from utility.
3. Municipality/University owns power plant but a third party operates it.

Policy Implications

Things to Consider

- Business Interruption and Time Element can be tricky:
  - Business Income limits include income from sale of electricity?
  - Business Income excludes loss of income from lost or damaged power generating assets?
  - Extra Expense includes Replacement Power Extra Expense?
- Separate Boiler & Machinery policy can be problematic:
  - Time element include power generating assets? At sufficient limits? With Replacement Power Extra Expense?
  - Joint loss agreement?
- Wear and Tear Exclusion and Defects Exclusion

Scenario 1

Owning and Selling Power

Situation: Municipality owns solar array that provides power to its campus. It sells electricity to a local utility through a Power Purchase Agreement (PPA) that requires the municipality to provide replacement power in the event there is a total loss to the generating assets.

Problem: Municipality's property policy includes business income/extra expense but time element is excluded for hydro plants. In the event of a covered loss, municipality would have to self-insure the lost income, the extra expense to purchase replacement power, and the extra expense to purchase replacement power for its customer—or be in breach of contract.

Scenario 2

Owning and Selling Power

Situation: Same municipality as above has a separate boiler & machinery policy that includes business income and extra expense but with a combined limit that is $500k lower than the revenue generated from the sale of electricity.

Problem: In the event of a covered loss, municipality would be able to recover most of its lost income but would have no remaining limits to cover the extra costs necessary to purchase replacement power for itself and its customer. The choice is self-insurance or breach of contract.

Scenario 3

University

Situation: A university has separate boiler & machinery and property policies. The two policies have different “joint loss” and “other insurance” provisions.

Problem: A fire destroys one of the power plants but it is unclear whether the fire was caused by a breakdown of the combustion turbine or if the combustion turbine was destroyed by the fire. The property insurer and B&M insurer undertake a lengthy, expensive, and ultimately unsuccessful root cause analysis. The carriers disagree on who should bear the brunt of the loss.

Scenario 4

University

Situation: Same university as above has separate boiler & machinery and property policies. B&M limits are 1/10 of limits on the property policy.

Problem: In the event of a breakdown of "covered equipment" that damages other "covered property," the limits could be insufficient to cover the extent of the loss…and the university can't turn to the property policy to cover the remainder because it excludes the peril of equipment breakdown. This problem negates the savings brought by the favorable B&M rate.

Solar and Biogas Power Generation Conclusion

Always Conduct a Formal and Complete Hazard Analysis.

- SCOPE (surveillance, construction, occupancy, protection, exposure).
- Hazard analysis should include components and electrical system as well.
- Should be conducted by a qualified professional.
- Include the Fire Department and Insurance Company in the planning and review.
- If dependent on electrical generation for operations and/or revenue, should develop appropriate Business Contingency Plans.

Solar and Biogas Power Generation Conclusion

Implement Predictive Maintenance Program for Solar and Biogas Installations.

- Need to include as part of the general maintenance budget.
- Needs to be managed by qualified and competent professionals.
- Include IR thermography, DGA, breaker testing, etc.
- Use of computerized maintenance management program (CMMS).

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Exposure Checklist

- Has a HAZOP been performed, including after changes to the design or installation?
- Is the installer a licensed contractor and specializes in the installations of residential and/or commercial solar photovoltaic systems?
- Does the installer have the proper insurance coverages, and has contractual risk control been practiced?
- Have the solar panels, during construction as well as spares, been installed and stored in an area where they will not be susceptible to damage?
- Is the equipment properly designed and installed for the location's climate?
- Is adequate theft protection been provided (perimeter fencing, cameras, motion detection, etc.)
- Has a preventative maintenance agreement been signed with a qualified contractor?
- Has the entire system been thoroughly approved and inspected by a licensed, qualified engineer?
- If your property is being leased to a third party, involve your legal counsel to contractually identify parties responsible for maintenance, liability, and other associated exposures.

Thank you very much for your attention

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