MUNICIPAL OFFICIALS’ GUIDE TO GRID-SCALE SOLAR DEVELOPMENT IN PENNSYLVANIA

Section 6: Localized Economic Impacts of Grid-Scale Solar Development
Goals of This Publication

Our primary goal with this guide is to explain the emerging solar energy development trends occurring in the Commonwealth and what might be expected in the next few years. The guide is intended to inform municipal and county officials about grid-scale solar development so they can potentially add clear, regionally consistent language addressing the specific issues around solar energy development to their zoning ordinances and other regulations.

A resources list at the end of this publication provides sources of further information. A glossary defines unfamiliar terms. A notes section provides sources for statistics and additional information. Over time as new information becomes available to further inform this discussion, it will be added to this guide, including information about new legislation affecting solar development and the evolution of new solar technologies.

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Introduction

Every energy source has both positive and negative impacts. We need to understand them so we can make informed decisions. Communities typically host grid-scale solar developments (GSSD) for economic reasons. People’s views about GSSD may be influenced by whether the community sees GSSD being foisted on them, or if they see it as an economic development opportunity.

Impacts to Property Value

There is currently a lack of decisive unbiased research on whether the presence of grid-scale solar (GSS) affects nearby property values. Studies funded by solar developers tend to find little or no impact. A study from the University of Rhode Island in 2020 found house prices reduced by an average of 1.7% ($5,751) within one mile of a GSS array in Massachusetts or Rhode Island. Within one-tenth of a mile, the reduction was 7%. The greatest losses were seen when GSS replaced farm or forest land. This research suggests the value of placing GSSD away from residential properties, where possible.

GSS developers are now commonly taking into consideration the distance to potential residential housing, if possible. In other cases, the use of vegetative screening and fencing to buffer the view of the facilities from neighboring properties or a public roadway has become an industrywide best management practice and a common goal of most township and county solar ordinances dealing with viewshed impacts.

Land Lease Revenues for Property Owners

GSS lease income is expected to be a significant economic impact, with total payments potentially exceeding $80 million per year spread among landowners in about 54 Pennsylvania counties. Lease rates in October 2021 were typically between $1,000 and $1,200 per acre per year but can range between $800 and $2,000 per acre per year, depending on a number of factors, including proximity to existing electrical infrastructure, contracted downstream power sales, and size.
of project. Most lease offers include a rent escalator, which is an annual increase in rent, typically between 1.5 and 2.5%.

The lease price per acre is likely to be greater than what farmers could earn growing common crops, especially if lower productivity lands are converted to GSS. A lease provides a stable source of diversified income to the landowner, giving some insurance against difficult weather years and other difficulties that can come with farming. It is not uncommon to hear of farmers considering this new income stream as a way to help fund a secure retirement.

The lease for GSSD affects heirs and any subsequent owners of the land for the lease period. The lease and its payments pass to the land’s next owners. The terms of the lease can affect the future property value because the right to construct a solar facility or the actual solar equipment, if installed, will carry forward for the life of the lease. A potential buyer may or may not see the same value in the solar facility being on the land as the selling landowner.

With Midwest wind energy development, research showed that many landowners used the lease payments to invest in other areas of their farm and improve its overall productivity. So GSS might bring about greater farm efficiency for the acres remaining in agriculture. This pattern was also seen in areas where farm owners leased land for shale energy production. So we might expect that landowners hosting GSSD could use this new income stream to follow a similar pattern.

Other landowners might invest in the community with their supplemental earnings from a GSS lease, producing a feedback effect that results in greater capital availability for the community. This outcome is the ideal, where investment in GSS is mutually beneficial for the broader community. Pending research at Penn State University is going to explore this potential outcome in greater detail in early 2023.

In a 2022 University of Michigan study, researchers are interviewing Midwest GSS leaseholders to learn about the effects of the lease payments on their lives and farming operations. Initial interviews have found that some farmers are using GSS leasing as a farm diversification strategy, choosing to lease less productive land to a solar developer and using lease revenue on it to reinvest in their farming operation. However, interviews and preliminary results also indicate that solar developers are purchasing, rather than leasing, land much more than expected: over one-third of the land in these Midwestern solar developments is now owned by a solar developer, and many farmers with solar leases have indicated that the solar developer first offered to buy the land, rather than lease it. Preliminary results also show that nonresident leaseholders (i.e., those living out of county or even out of state) are more numerous. Of all of the acreage in these midwestern GSSDs, roughly 40% are held by an in-county taxpayer, 20% are held by an in-state but out-of-county taxpayer, and nearly 40% are held by an out-of-state taxpayer. Furthermore, there are many fewer individual leaseholders than expected, even

Dennis Schroeder, NREL, USDOE
for very large projects. If the final findings confirm these trends, the positive impacts of GSSD to rural economies could be different than some communities are anticipating in the near- and long-term. Nonresident leaseholders tend to spend the proceeds from the lease payments in locations other than where GSSD is being constructed and operated.

Land purchase offers for GSSD are more difficult to track because there have been very few in Pennsylvania, but those Penn State Extension is aware of have sold above local fair market value due to the increased potential as an energy production location. We’re starting to see increased activity in purchase offers for potential landholdings to site GSSD in neighboring states.

Effects of GSSD on Regional/State Economics

Many unknowns remain about the economic effects of GSSD. We don’t yet have sufficient data to know what happens to surrounding farms and farm-based businesses if, for example, 2,000 acres are taken out of production in an area. This is an issue that is becoming more common in the dialogue between municipalities and nearby farmers as GSSD facilities are proposed.

It is unknown in Pennsylvania how GSS affects nearby farmland lease rates, but logically if a landowner can make several times as much from a GSS lease as from a farming lease, we would expect ag lease rates to go up nearby. The biggest challenge in this situation will most likely rest with the farmers who depend on leased land, because they’ll have to pay more or it won’t be accessible. They won’t get any direct benefit from the new solar development, but they have an associated increase in indirect crop production costs.

Some governing bodies may decide to establish an overlay zoning district encompassing land within, say, 3 miles of an electrical substation, because these areas are most attractive to solar developers given the lower cost to hook into the electricity distribution grid if capacity to do so is available at those locations. An overlay district

<table>
<thead>
<tr>
<th>Estimated construction costs of $1.13M per MW across the following categories:</th>
<th>Single 20 MW Project</th>
<th>9.9 GW Statewide</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land Acquisition &amp; Taxes</td>
<td>$0.8 M</td>
<td>$0.8 B</td>
</tr>
<tr>
<td>Installation Labor</td>
<td>$2.2 M</td>
<td>$1.0 B</td>
</tr>
<tr>
<td>Structural Equipment</td>
<td>$1.9 M</td>
<td>$1.0 B</td>
</tr>
<tr>
<td>Developer Costs</td>
<td>$2.1 M</td>
<td>$1.1 B</td>
</tr>
<tr>
<td>Interconnection Costs</td>
<td>$0.6 M</td>
<td>$1.1 B</td>
</tr>
<tr>
<td>Panels, Inverters &amp; Electrical Equipment</td>
<td>$10.4 M</td>
<td>$6.1 B</td>
</tr>
<tr>
<td>Total:</td>
<td>$22.6 M</td>
<td>$11.2 B</td>
</tr>
</tbody>
</table>
may have unique development requirements given the needs of the proposed land use and the lands in the district.

GSS companies often make philanthropic commitments to local organizations where they’re building or operating a site. They may also invest in habitat conservation projects in the area as part of their corporate sustainability commitment or the power purchase agreement for the site, or to encourage local buy-in to the development.

Construction of GSS facilities will have a local economic impact, but it will likely be short-lived and associated with the construction and installation process, because panels are generally manufactured elsewhere.

**The Economics Behind GSSD**

Several economic and regulatory factors influence the costs and benefits of GSSD.

**Power Purchase Agreements**

A 10-megawatt (MW) solar array is capable of producing 10 MW of electricity per hour to the grid, assuming the sun is shining. This facility might actually average 2–5 megawatt-hours (MWh) per day for 365 days per year. PJM Interconnect, LLC, the regional electric grid operator in Pennsylvania, much of the Mid-Atlantic, and parts of Midwest, paid roughly $18–20/MW in May 2021. This is the wholesale power price (also called the spot price).

Negotiating a power purchase agreement (PPA) is a necessary step in the development of a GSSD. Through a PPA, a GSS developer consents to build a solar array if the electricity buyer agrees to purchase the electricity produced there. This is a long-term agreement, typically 10–25 years, with most PPAs averaging 20 years. The agreement may include a price ceiling and/or floor, or there may be a set price. Toward the end of the contract, the purchaser may be able to extend the agreement. A PPA could have a lot of variability depending on the needs and wants of the developer, financer, broker, and end user.

**The Alternative Energy Portfolio Standard**

Pennsylvania’s alternative energy portfolio standard (AEPS) requires the grid operator to produce a certain percentage of total electricity from renewable energy sources. The AEPS is the benchmark regulated utilities in Pennsylvania have to meet. The AEPS currently says that 0.5% of a grid operator’s total in-state energy production must come from solar. This is referred to as a “solar carve-out.” The state’s AEPS sunset at 0.5% in 2021. Bills that would raise this percentage to between 5.5 and 10% have been introduced in the state legislature. If one of these bills should pass, that would significantly expand the demand for solar energy production.

**Solar Renewable Energy Credits**

Solar renewable energy credits (SRECs) are a market instrument that utilities and electricity suppliers use to measure compliance with Pennsylvania’s AEPS. Corporations and institutions also use SRECs to increase their support for alternative energy. One SREC equals 1 MWh of solar energy generated from a qualifying facility. SRECs must be generated in Pennsylvania to count for compliance.

Developers and brokers can sell SRECs to utilities and electricity suppliers through the state SREC program. For example, an

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https://unsplash.com/photos/m5nbvV8sX00
Governments can encourage or discourage different kinds of economic development, including different kinds of energy infrastructure, through various policies and regulations. Different government policymakers may not align on which kinds of investment should be encouraged. In general, policymakers want to find the sweet spot where taxes on a new venture aren’t prohibitive to new investment, but aren’t so low that there’s nothing in it for the community. This dynamic is at play in GSSD.

There are numerous kinds of tax-based incentives for solar development that drive the appeal for GSSD developers.

**Solar Investment Tax Credit**

The federal investment tax credit (ITC) has been an important factor in the growth of solar energy throughout the country. This is a tax credit available to energy project installers, developers, or financers who install designated renewable energy generation equipment (see Section 48 of the Internal Revenue Code of 2006 (as amended)). As currently written (June 2022), these groups can apply a percentage of the project’s engineering, procurement, and construction costs as a credit toward their income taxes in a one-time dollar-for-dollar reduction. If a business doesn’t have enough tax liability to claim the entire credit in a single year, they can carry the remainder over the following 20 years. The ITC does not cover interconnection costs.

Based on these rates, a GSS operator would be eager to sell SRECs into the Washington, D.C., market and get $380 or more per SREC. There are limits in some states as to whether the SREC has to be from power produced in-state or if it can come from an out-of-state generator.

GSS developers make money from the sale of electricity and from the sale of SRECs that allow other entities to meet environmental requirements for supporting green power.

Pennsylvania is the number one net electricity exporter in the United States, primarily to New York and New Jersey.

**Public Tax Subsidies**

GSSD benefits the local community by creating jobs, diversifying energy options, increasing the tax base, and providing supplemental income for landowners.

<table>
<thead>
<tr>
<th>State</th>
<th>SREC price $/MWh (in June 2022)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maryland</td>
<td>59</td>
</tr>
<tr>
<td>Massachusetts</td>
<td>292</td>
</tr>
<tr>
<td>New Jersey</td>
<td>235</td>
</tr>
<tr>
<td>Ohio</td>
<td>5.75</td>
</tr>
<tr>
<td>Pennsylvania</td>
<td>41</td>
</tr>
<tr>
<td>Washington, D.C.</td>
<td>380-435</td>
</tr>
</tbody>
</table>

Credit: Penn State MCOR
or some other related “soft” development and financing costs.

The ITC rate for commercial installations that begin construction in 2022 is 26%, and for those starting in 2023, it’s 22%. The credit for GSS installations drops to a permanent 10% for projects starting construction in 2024 and later unless Congress renews it. The ITC has changed as energy policies change, and it may be modified or extended.

Because solar companies often don’t have much profit to tax, the ITC has become an investment vehicle. Investors using it are often large entities, such as banks and hedge funds, with a lot of profit that they want to offset with a deduction on their taxes. The solar developer develops the array, but an investor finances the project and takes the ITC. This can serve as an incentive for companies to finance GSSD.

**Payment in Lieu of Taxes (PILOT)**

Pennsylvania does not currently allow payment in lieu of taxes (PILOT) for GSS, but some states, such as New York and Ohio, do. PILOTs exist to reduce the tax burden on the land and/or GSS owner, while preserving some of the revenue that would have been paid in property taxes. Where PILOT is part of the current tax code, a taxing jurisdiction can notify a GSS developer within a certain time after the developer states their plan to construct a GSS facility that the developer must make an annual payment to offset part of the property tax revenue the facility would have generated. A PILOT must be equal to or less than what would have been paid in property taxes.

PILOTs have the advantage that they create a more stable revenue stream versus standard property tax, which tends to be heavily front-loaded in the early years after development. These payments can be especially consequential in less populous rural communities.

Work at the University of Michigan calculated a reasonable range of PILOTs between $3,000 and $10,000 per megawatt AC (MW<sub>AC</sub>). A megawatt AC is a measure of solar energy output after inverters convert the direct current (DC) produced by PV panels to alternating current (AC) for use by end users. The researchers calculated that $7,500 per MW<sub>AC</sub> “would closely match the total lifetime equivalent ad valorem property tax payments.” Ad valorem taxes reflect the value of the asset. In Ohio, PILOTs range from $6,000 to $9,000 per MW<sub>AC</sub>. Where a community wants to encourage GSSD, they will commonly set a PILOT rate that is beneficial to the taxing jurisdiction but doesn’t hinder GSSD.

**Host Community Agreements**

New York allows host community agreements (HCAs) in GSSD, but they are not yet practiced in Pennsylvania. PILOT payments are sometimes paired with HCAs. HCAs allow greater flexibility than PILOTs in providing certain benefits directly to the municipality where the GSS project lies. HCAs can be adapted to meet the municipality’s needs and allocated as the host community prefers. A bill proposing to allow HCAs between municipalities and owners of certain power plants was introduced in the 2019–2020 Pennsylvania legislative session.

**Solar Viability in Pennsylvania**

Given these economic factors, how viable is GSSD in Pennsylvania? Will it really take off? What are the main driving factors?

**Corporate and Governmental Sustainability Pledges**

Many corporations are choosing to set corporate sustainability goals to meet their customers’ expectations. In Pennsylvania, many electricity producers are under state mandate—the AEPS—to produce at least some of their total power from solar sources. They will pursue the least expensive projects to achieve these mandates.

United Nations Climate Action reports that more than 1,200 companies, 1,000 cities, 1,000 educational institutions, and 400 financial institutions have pledged to take action to cut global carbon emissions by half by 2030.
These pledges are important drivers of the alternative energy economy, including solar. Companies such as Google, Microsoft, and Amazon have made pledges. They may not be concerned with developing only the least expensive form of alternative energy.

As an example, Pennsylvania’s PULSE program aims for the state government to source nearly 50% of its annual energy consumption from renewables. This investment was the largest solar commitment by any government in the United States when it was announced in June 2021.

There is a trend now toward larger arrays, which tend to be more economical on a per MW basis because of fixed costs like connection to the grid, access roads, and shared equipment. Variable costs such as labor, equipment, and maintenance may also decrease with larger arrays.

Unpredictable Economic and Political Forces

A number of factors could influence the demand for and the actual building of new GSS facilities:

• New federal or state climate policies and mandates
• Price of solar panels and the components needed for other forms of alternative energy
• Demand for electric vehicles and other new demands
• The shape of the economic recovery from the COVID-19 pandemic

International Relations and Tariffs

International human rights may play a role in the availability of solar panels. The U.S. Congress passed and President Biden signed the Uyghur Forced Labor Protection Act in December 2021 to address concerns about slavery and forced labor in the Xinjiang region of China. It took effect in June 2022. It bans the U.S. import of goods made in that region unless the importer can show that the goods were not made with forced labor. This region provides 45% of the world’s polysilicon, a critical component of solar panels.

In 2018 President Trump placed tariffs up to 30% on most solar equipment from Southeast Asia, which was supplying 80% of all such equipment used in the U.S. The intent was to help U.S. manufacturers of solar panels. The tariffs slowed and stalled many project installations. In June 2022, President Biden declared a two-year pause for tariffs on these solar imports.

The prices of solar panel components, including polysilicon, steel, copper, and aluminum, have risen 10–25% since the beginning of 2021, along with the cost to transport materials. These increases represent a reversal of about a decade of declining prices for solar panels, and how much these increases will affect the demand for solar energy is unclear.
Lessons for GSSD from Recent Marcellus Shale Development

Parts of Pennsylvania saw tremendous investment in Marcellus shale natural gas development in the 2000s and 2010s. Several lessons learned from that industry could be valuable to the GSS industry.

Workforce Implications

There is a misconception that solar jobs are only temporary. The U.S. solar industry employed more than 230,000 people in 2020. Installers must be willing to travel to different sites.

GSSD is occurring in Pennsylvania now. The state does not currently have the trained workforce in local communities in the numbers that will potentially be needed. It takes time, effort, and planning to build the institutional capacity to train the right number of people with the right skills at the right time.

GSSD installation capacity is expanding in the United States. A number of skills can be repurposed from programs already in place, but new skills are also needed. The industry is organizing training for employees regionally.

However, regulators don’t want to be trained by the industry. The TOPCORP training program may serve as a useful model for GSS regulator training. TOPCORP is a unique national collaboration among industry, universities, and nongovernmental organizations created to train environmental regulatory agency personnel to inspect oil and gas facilities. The Penn State Marcellus Center for Outreach and Research is a partner. Many more GSS projects are in the planning/exploration phase now than in the construction phase, so training efforts may need to scale up quickly.

Direct, Indirect, and Induced Economic Development

Direct economic development from GSS comes from the dollars spent to build a facility and keep it operational once it’s built.

Indirect economic development comes as local businesses sell goods or services to the industry. This may involve customizing local businesses to the needs of the industry. Those business owners will need to determine how to optimize this opportunity. GSSD is also an opportunity for new entrepreneurs. It presents a somewhat different challenge to local businesses than Marcellus development did because GSSD is more spread out across the state, whereas Marcellus development was concentrated in certain regions. The salaries of people working with these businesses, where the indirect economic effects of GSSD are generated, are not paid directly by the company building or operating the solar facility.

Induced economic development from GSSD comes as industry employees spend their wages in the local economy. This can produce additional business opportunities beyond what the solar industry generates directly. Because there are few workers after the construction phase, this type of economic development from GSSD is likely to be minimal.

Marcellus shale natural gas development in Pennsylvania occurred in somewhat of a boom-bust cycle. The greatest workforce
needs came during initial construction of wells. Once the wells were installed, companies needed only a handful of people to maintain them over time. This pattern will be similar for GSSD.

There is some evidence of land rent inflation in areas near electrical substations or GSS arrays, but we lack hard data as of yet (June 2022). As GSSD concentrates, this is more of a concern. It’s also possible that GSSD lease rates may increase as more facilities are built. This happened with Marcellus development as competition for land resources increased and the market for natural gas was strong.

Landowners should keep in mind that some companies approaching owners about lease options are start-ups. They may have limited experience in the field and a limited track record of success in seeing lease options exercised to project build-out. These companies aim to lock up the land through option agreements and sell those to a larger company. Landowners should also be aware that the company holding an interest in their land may change several times throughout the life of the project. This also happened with Marcellus development. It is the leaseholder’s responsibility to be fully informed throughout the lease term.

Decommissioning

Most companies say the life of their solar panels is 20–25 years. Typically, the lease terms include language allowing for extension of the lease timeframe, under like conditions, possibly with an escalator clause to adjust pricing. At some point in the future when the lease expires, the panels and all the equipment will be removed and the land could potentially go back to its prior use, or it might be redeveloped for other commercially viable uses at that time. This process is referred to as decommissioning and should be addressed in a GSS lease and/or in a zoning ordinance. Property-specific decommissioning details need to be worked out and included in the lease, although the actual decommissioning won’t happen for many years.

Some municipalities have requirements for decommissioning in their solar ordinances. Typically, all equipment aboveground would be removed other than components such as electrical poles on the road, interior roadways on the site, or other constructed features that the current landowner prefers to maintain. Cable conduit buried below 3–4 feet might not be removed because the cost of removal would be greater than the value of the materials, although the cables themselves would likely be pulled out and recycled for their valuable metal content. Cables are typically placed in plastic conduit well below plow depth, so this alone shouldn’t stop the reversion of the land to farming. Concrete pads below transformers and battery storage would typically be broken up and removed.

Decommissioning requirements in a zoning ordinance should protect the landowner in case the solar developer or operator goes out of business or abandons the property. Requirements should place the risk on the company, while not creating undue roadblocks to GSSD if a community is interested in pursuing this option.

Decommissioning terms should:

- Address project dismantling, removal, and restoration as separate phases
- Require removal of any aboveground equipment, wiring, and structural components, and possibly the removal of belowground equipment
- Require restoration, grading, and reseeding of any disturbed soil after the removal of equipment, or immediate return of the land to another allowed use. Soil compaction should be remediated as part of this process as well.
- Specify a deadline for equipment removal and restoration of the land to preconstruction conditions
- Mandate the posting and maintenance of financial security in the form of trust funds, escrow accounts, bonding, or letters of credit to equal the true cost of
decommissioning minus salvage value, as determined by a qualified third-party. Adjust the value of the bond to account for inflation over the 20+ year life of the project’s operation.

- Grandfather projects permitted prior to the effective date of legislation

**Challenges to Return to Farming**

If the desire is to return the land to ag use, municipalities should consider whether anything in their solar ordinance would make this difficult. Stormwater management practices, movement of topsoil, tree planting, and the use of earth berms for screening could hinder the return to agricultural use. It may be advisable to limit access roads because they lead to soil compaction.

Even if the land under GSS panels is planted in forages or pollinators plants, it’s possible that the process of decommissioning could negate the 2–3 decades of good stewardship of the soil with severe compaction if the work is done at the wrong time or with improper machinery.

Bills were proposed in the 2021–2022 session of the Pennsylvania legislature that would require bonding to restore the land to certain conditions upon removal of GSS panels.

**Financial Assurance**

Most of the costs of GSSD occur during construction and right after start-up. Maintenance costs during site operation are relatively low. So that probably lessens the likelihood of a company abandoning an operating project. But a GSS array can be sold during the life of the lease, so a decommissioning bond is important.

One of the challenges with a solar decommissioning bond is determining 20+ years into the future the cost to remove the panels and all the related infrastructure, and offsetting that cost against the recaptured potential value of the recycled materials, particularly the more valuable metals. Most landowners and municipalities don’t have the market savvy to assess that outcome.

Various approaches are being used to place a value on a decommissioning bond. A bond should include an inflation escalator to account for the growth of costs over time. Active research at Penn State Law indicates that most Pennsylvania solar ordinances that mention decommissioning also have a bonding requirement. Similar methods are being used in other states as well.

Some decommissioning legislation introduced in the Pennsylvania legislature names the state as the authority with jurisdiction over decommissioning and would require bonding to the state to complete decommissioning if the owner/
operator defaults. With the current legal framework (as of June 2022), a decommissioning bond or other financial assurance is typically payable to the municipality, county, and/or landowner until such time as pending legislation might be passed to create a state requirement for a decommissioning bond.

Ohio has a new law that requires such a bond to the state, with the amount updated every 5 years. This is similar to the pending legislation in Pennsylvania. The Ohio law also specifies 12 months to complete decommissioning and that the state will complete decommissioning if the owner/operator defaults.

**Need for Focus on Panel Recycling**

Solar energy is commonly viewed as an environmentally friendly alternative energy source. For the industry to maintain its “green” image, it must develop a viable plan to recycle and reuse valuable materials in solar panels and to safely dispose of the materials that can’t be reused.

The International Renewable Energy Agency estimated in 2016 that by 2050 about 78 million metric tons of solar panels will have reached the end of their useful life. This number will be even larger if panels are replaced before the end of their life as panel technology advances. The same study estimated that by 2050 the total value of recoverable materials from outdated solar panels could be more than $15 billion. Some panels may be refurbished at or near the end of their life and sold for lower-end uses. The cost of transporting used panels is another factor.

The solar industry currently estimates that one ton of solar panels has approximately $550 in potential value if separated into individual components and resold. Most of the value comes from the silver, aluminum, silicon, and copper in the panel. Recycling the useful parts of panels is currently labor-intensive. It must be cost-effective if it is become common practice. In the end, only 10–15% of the original panel volume is waste needing final disposal.

Other countries are much further ahead of the U.S. in panel recycling efforts. The European Union requires solar manufacturers to recycle. Japan requires that solar developers and owners pay into a decommissioning fund. First Solar is the only U.S. solar panel manufacturer with an active recycling program. It covers only their own products—up to two million panels per year. Through this program, it costs $20–$30 to recycle one panel, but the same panel can be sent to a landfill for only $1–$2.

Pennsylvania does not currently require panels to be recycled, but future legislation may change this. Pennsylvania has expertise in the
mining and metal refining industries, and in extracting, processing, and marketing metals. Panel recycling may become a growth sector in Pennsylvania.

**Repowering**

Although not currently done, there is some thought being given to the technical and financial benefits to not decommissioning GSS facilities, but instead to replacing panels every 10–15 years to optimize productivity. This is called “repowering.” This practice would help get the maximum value from the project for the community. It is assumed that much of the racking and site infrastructure such as roads and fencing would still be useful.

What type of energy might we be using in 30 or 40 years? Many times, the most difficult aspect of developing a new facility is finding the right place for it. If the goal is to repower a site perhaps with the next form of energy production, it may not be unreasonable to assume that with different technology, the property currently hosting a GSS array is still the right place.

**Conclusion**

GSSD has the potential to affect property values; landowners’ bottom lines; and regional, state, and federal economics and politics. Some effects may be positive and others negative. Many unpredictable factors are influencing the potential buildout: the fate of regulatory requirements for alternative energy use, the existence and size of public tax subsidies for GSSD, the costs of solar versus other forms of alternative energy, and international relations and tariffs. Pennsylvania officials can look to lessons learned from the Marcellus shale natural gas boom in preparing for GSSD.

Decommissioning of solar panels at the end of their life and/or lease period remains a speculative topic because GSSD typically has not yet reached this point in the U.S. There’s a lot of opportunity to develop and optimize panel recycling and materials reuse programs. More exploration and fine-tuning of requirements for financial assurance for decommissioning will be required going forward. The same is true in knowing whether repowering a GSS site is a viable option.

**For More Information**


TOP energy training. TOPCORP. https://topenergytraining.com/


Notes

p. 3: University of Rhode Island study on house prices near GSSD.
Source: URI researcher: Housing prices decline within mile of solar energy arrays. URI News. https://www.uri.edu/news/2020/09/uri-researcher-housing-prices-decline-within-mile-of-solar-energy-arrays/?fbclid=IwAR30VrYqR8FyEmsfrwE84WLbi7VWD-CSvs0YHWg6YaBlVJCKwO1jwZFc1AM

p. 3: GSSD land purchase offers in Pennsylvania.

p. 4: Farm owner responses to wind energy development in the Midwest.

p. 4: Preliminary results of 2022 University of Michigan study about Midwest GSS leaseholders.

p. 6: Power purchase agreements.

p. 6: Pennsylvania’s alternative energy portfolio standard.


p. 6-7: SRECs.


p. 7: Solar investment tax credit.


p. 8: Payment in lieu of taxes.
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