Frankfort 100 Solar Feasibility Study
Allison Smith and Karlynn Cory

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Suggested Citation
Executive Summary

In 2021, the city of Frankfort—the capital of Kentucky—set ambitious 100% clean energy goals. Through a partnership with the National Renewable Energy Laboratory (NREL), utility-scale solar was identified as the most cost-effective method of achieving the goal of clean electricity for government operations by the end of 2023 and communitywide clean energy by 2030. Procuring energy from a utility-scale solar facility would ensure fixed energy costs and could potentially be revenue-neutral.

This report identifies key considerations for the city of Frankfort as it explores utility-scale solar.¹ Those considerations include the availability of land, the solar resource, access to the transmission network, and market opportunities. Although NREL found these factors to be advantageous to the project, there are other factors that bring risk, such as the potential cost of interconnection with the existing transmission network, the value of solar determined by the Frankfort Plant Board (FPB) (the local utility), the issues raised by FPB around the city’s legal standing to build utility-scale solar, the possible need for siting board approval, and the effects of added energy generation on FPB’s current All Requirements Power Sales Contract (AR Contract) with Kentucky Municipal Energy Agency (KYMEA).

Although there are still outstanding issues to resolve, the current incentives for municipalities to invest in clean energy generation are significant (up to 70% of the project cost) if the community submits a tax credit form that is accepted by the IRS. This could provide justification for pursuing the development of a utility-scale solar facility based on economic incentives available. A cooperative effort with FPB could further resolve the outstanding issues and help the city meet its clean energy goals.

¹ This was a narrowly scoped project that did not consider other energy options, such as rooftop solar or community solar options. Rooftop solar and renewable energy certificates were screened in Phase I of the project.
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1 Project Background

This section describes the overall objectives of the city of Frankfort and describes the two main options to meet the goals: purchasing unbundled renewable energy certificates or building one or more utility-scale solar plants.

1.1 Objectives

In 2021, The city of Frankfort, Kentucky (“Frankfort,” or “the City”) committed to ambitious climate target.

1. City Clean Electricity: 100% net clean electricity for city government operations by the end of 2023
2. City Clean Energy: 100% carbon free energy for city operations by 2030
3. Community Clean Electricity: 100% clean electricity community-wide by the end of 2030.

In 2022, Frankfort partnered with the National Renewable Energy Laboratory (NREL) for a Phase I study to identify pathways to achieve the City’s first two goals of City Clean Electricity by 2023 and City Clean Energy by 2030 (Phase I).

As recommended in the final Phase I report (described next), NREL was asked to perform an initial feasibility study for a photovoltaics (PV) project to offset the electricity used by city government operations. This report evaluates the feasibility of utility-scale solar and identifies potential barriers.

1.2 Phase I Project Analysis

To conduct the Phase I analysis, NREL received city facility electricity bills from Frankfort Plant Board (FPB), the City’s municipally owned electric utility, for the period of May 2020–May 2022, which reflects peculiarities in energy usage because of the COVID pandemic.

At the time of the Phase I work, the city of Frankfort paid a flat rate of 8.9 cents/kWh with a monthly charge of $18.50 for each electric meter. Annual consumption for all city operations averaged 12,000 megawatt hours (MWh), the equivalent of about 1,200 typical homes in a year. The City Hall building itself consumes 100 MWh annually, while Frankfort’s wastewater treatment plant accounts for more than 40% (4,800 MWh/yr) of city electricity consumption. In 2021, the City spent $3,421,478.11 on electricity. In addition, NREL’s analysis found that city operations consumed 5% more energy in the last 12 months of these data compared to the first year of data. However, this increase may be because of increased consumption in the second year of the pandemic.

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2 A new schedule of rates went into effect July 1, 2023. The municipal rate previously applied to city operations was eliminated. The City now pays the standard commercial and large power rates. (T. McCullar, personal communication, February 5, 2024)
1.2.1 Energy Efficiency First
NREL identified a potential energy efficiency level using the NREL SLOPE tool. SLOPE suggests 12% energy savings is possible for the entire commercial building stock in KY. Assuming that Frankfort’s city-owned facilities could achieve a similar level of savings as a rough approximation, Frankfort could save about 10% off its annual electric bills.

1.2.2 Phase I – Option 1: Renewable Energy Certificates
In addition to exploring potential ECMs, as part of the Phase I analysis, NREL evaluated two pathways to “green” the City’s energy portfolio: 1) procurement of “unbundled” renewable energy certificates (RECs) either on the open market or from local utility-scale solar projects and 2) development of utility-scale solar PV generation. The purchase of unbundled RECs ranged from $1/MWh to $6.60/MWh nationally between 2015 and 2021. At that price, RECs would cost Frankfort approximately $11,400 to $75,000 annually on the open market to “green” its operations once 10% energy efficiency has been realized.

1.3 Phase II – Option 2: Utility-Scale Solar Feasibility: Strengths and Weaknesses
NREL’s feasibility study initially evaluated the prospects of a Frankfort PV array based on the following four criteria that are key to project success: available land, solar resources, interconnection and transmission, and potential market.

- **Available land**: The city of Frankfort and Franklin County have ample available land in parcels greater than 50 acres that are relatively clear, flat, and inside the county and FPB service area. Theoretically there is sufficient land to deploy as much as 1,187 to 2,375 MW (based on 5 or 10 acres/MW, respectively).
- **Solar resources**: The area has solar resource of 4.0–4.5 kWh/m²/day, as determined through NREL’s National Solar Radiation Database (NSRDB).
- **Access to distribution**: Multiple FPB transmission lines and substations span Franklin County that could allow for interconnection. In this analysis, FPB lines’ carrying capacity was not evaluated.
- **Market opportunities**: Recent provisions in the Inflation Reduction Act (IRA) provide significant incentives for solar construction, now including entities that do not pay taxes through direct pay, dramatically increasing the prospects for a PV project’s cost effectiveness. The base investment tax credit is 30% of qualifying costs. In addition, the City is located in a 2023 energy community area that can receive an additional 10% tax credit, for 40% total. Frankfort might be able to document its domestic content for another 10% tax credit. Finally, the City is interested in taking advantage of economies of scale and building out up to 5 MW of community solar to benefit low-income communities.

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3 NREL does not conduct energy audits.
4 In 2021, the U.S. average for RECs was $6.60 per MWh, up from $1.50/MWh in December 2020 and up from $1/MWh from 2015–early 2020: [https://www.nrel.gov/docs/fy22osti/81141.pdf](https://www.nrel.gov/docs/fy22osti/81141.pdf)
5 [https://nsrdb.nrel.gov/](https://nsrdb.nrel.gov/)
households, which could qualify that portion of the project for an additional 20% tax credit on the community solar portion, subject to availability.\(^7\)

Thus, all the above-mentioned dynamics are favorable indicators for the prospects of a PV project for Frankfort. However, potential challenges include the following:

- The cost required for interconnection to the FPB transmission system may make the project financially impractical.
- The developer (or City) may not be able to negotiate a financially viable “value-of-solar” with FPB, rendering a PV project financially infeasible.
- FPB questions the City’s standing to authorize the project. In a letter dated June 13, 2023, FPB raised several issues regarding the proposed project:
  - FPB questions the City’s legal authority to authorize retail sale of electricity in FPB’s service area
  - Whether the project could begin without preapproval from the Kentucky State Board on Electric Generation and Transmission Siting (“Siting Board”)
  - Whether it is possible for the City to structure the project in compliance with KYMEA’s (Kentucky Municipal Energy Agency) All Requirements Power Sales Contract (“AR Contract”).

Although NREL has not, and will not, conduct a legal/regulatory/policy analysis, the following represents the City’s understanding of the issues raised, as communicated to NREL:

- The City does not intend to “authorize a retail sale of electricity by a third-party” but for the power to be routed to the FPB transmission system
- According to KRS 278.700,\(^8\) the following are the criteria for requiring Siting Board approval: (2) “Merchant electric generating facility” means, except for a qualifying facility as defined in subsection (7) of this section, an electricity generating facility or facilities that, together with all associated structures and facilities:
  - Are capable of operating at an aggregate capacity of 10 MW or more
  - Sell the electricity they produce in the wholesale market, at rates and charges not regulated by the Public Service Commission.
- The AR Contract states that KYMEA will not oppose any demand response, net metering, or energy efficiency programs and allows FPB to negotiate net-metering.\(^9\) In addition, FPB has recently given a 5-year notice to withdraw from participation with KYMEA. This will require FPB to identify new generation sources by 2029.\(^10\) (See Section 4.2 for a full discussion of effects on KYMEA and the local distribution network.)

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\(^7\) Even if Frankfort is eligible, it does not mean that an allocation will be available. More is found in Section 3.1.2..


\(^9\) Kentucky Municipal Energy Agency All Requirements Power Sales Contract

\(^10\) [FPB Special Board Meeting Minutes](https://www.fpbg.com/meetings), Aug. 25, 2023
2 Site and Permitting Analysis

This section explores the impact of the largest potential site considerations, including zoning, permitting, solar resources, and land use; it also briefly touches upon other site considerations, such as proximity to interconnection, site accessibility, insurability, and soil geology and vegetation. This analysis does not include an estimate of FPB transmission system upgrades that could be required for interconnection.

2.1 Potential Site Considerations

The first question for any ground-mounted solar PV project is whether there is enough of the right kind of land, with gentle slopes, minimal shading, and that is contiguous in nature. To answer this question, first an estimate about the number of acres is required. Estimating approximately 5–10 acres/MW, the project would require 40–80 acres for an 8.2 MWdc (or approximately 6 MWac) system or, if the community solar is included, 65–130 acres for a 13 MWdc system (or approximately 11.54 MWac system). There is land available within the FPB system and Franklin County specifically that would provide adequate space for either size system, and both systems could be developed. The FPB has identified sites that would accommodate a project of this size within its transmission network.

2.1.1 Zoning and Permitting

The city is exempt from zoning regulations and is allowed to build as needed regardless of zoning type. (City of Frankfort 1983) Article 4.420 Special Government District states, “The purpose of this zone is to identify property owned by federal, state, county, or municipal governments or by government owned public corporations or agencies, for the purpose of putting the public on notice that the areas so zoned are outside the jurisdiction of the administrators of this zoning regulation and the development thereon is at the discretion of the government owning the property.”

Should a private developer own the project and own or lease the property from an entity other than the city, approval would have to be obtained from the zoning commission. There are currently no zoning regulations on large community-scale solar. The City Planning Department could interpret its current zoning or add a text amendment to address this land use. This amendment would require approval by the Planning Commission and City Commission (E. Cockley, personal communication, November 16, 2023).

2.1.2 Solar Resources

NREL has delivered solar resource data for the United States for three decades through the National Solar Radiation Database (NSRDB). Currently, the NSRDB provides multiyear, half-hourly values of meteorological and solar data. NSRDB’s physics-based modeling approach uses geostationary satellite data to accurately represent regional climates both temporally and spatially in gridded segments (4 km by 4 km). Using long-term median conditions represented as a typical meteorological year (TMY), potential future availability of solar energy at a given location can be predicted reliably. Solar irradiation is measured and expressed in terms of the solar energy received on a unit area, typically expressed in kWh/m². This captures the total daily solar resource available in a given area.
According to the NSRDB data shown in Figure 1, Franklin County has a solar resource between 4.0 and 4.5 kWh/m²/day. These data are used to estimate the size of installation needed for desired output.

![Figure 1. According to the NSRDB, the solar resource for Franklin County is approximately 4.0–4.5 kWh/m²/day](image)

**NREL’s PV Watts** estimates the energy production of grid-connected PV energy systems. It allows building owners, installers, and manufacturers to easily develop estimates of the performance of potential PV installations based on geography and potential system design.

As shown in Table 1, NREL’s PV Watts analysis indicates that an 8.2 MWdc array sited in the presumed location could be expected to produce over 10,858 MWh in its first year, which would offset 100% of the City’s energy use after potential ECMs are taken.
### Table 1. PV Watts projected monthly generation

Source: [https://pvwatts.nrel.gov/](https://pvwatts.nrel.gov/)

<table>
<thead>
<tr>
<th>Month</th>
<th>Solar Radiation (kWh / m² / day)</th>
<th>AC Energy (MWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>2.93</td>
<td>635</td>
</tr>
<tr>
<td>February</td>
<td>3.58</td>
<td>683</td>
</tr>
<tr>
<td>March</td>
<td>4.23</td>
<td>867</td>
</tr>
<tr>
<td>April</td>
<td>5.23</td>
<td>995</td>
</tr>
<tr>
<td>May</td>
<td>5.83</td>
<td>1,126</td>
</tr>
<tr>
<td>June</td>
<td>6.45</td>
<td>1,172</td>
</tr>
<tr>
<td>July</td>
<td>6.16</td>
<td>1,145</td>
</tr>
<tr>
<td>August</td>
<td>5.94</td>
<td>1,121</td>
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<tr>
<td>September</td>
<td>5.42</td>
<td>1,001</td>
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<tr>
<td>October</td>
<td>4.41</td>
<td>875</td>
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<tr>
<td>November</td>
<td>3.4</td>
<td>688</td>
</tr>
<tr>
<td>December</td>
<td>2.54</td>
<td>546</td>
</tr>
<tr>
<td>Annual</td>
<td>4.68</td>
<td>10,858</td>
</tr>
</tbody>
</table>

#### 2.1.3 Land Use

Land use is a key consideration given the significant percentage of agricultural land within Frankfort city limits. Although agricultural land has the advantage of being relatively flat and without tree cover, there may be local cultural and economic concerns around the conversion of this land use or around the transfer of property from long-time owners. However, these concerns can be mitigated. NREL’s scientists have partnered on many agrivoltaics projects that combine PV with other uses such as farming or grazing. Although this may limit the type of crops that can be grown, land used for PV does not have to be exclusively reserved for PV. Land for PV projects can also be leased instead of purchased. Solar arrays have a life span of 30–50 years, and long-term leases can allow for use of the property while maintaining long-term ownership. Lease terms can address the conditions for decommissioning at the end of project life and might include returning the site to its prior state.

#### 2.1.4 Additional Site Considerations

Several site and permitting factors must be weighed before committing to develop a particular site, including proximity to interconnection, site accessibility for construction and maintenance, insurability, and soil and vegetation characteristics. Each of these factors is discussed in greater detail next.

##### 2.1.4.1 Proximity to Interconnection

A key factor in the success of any solar project is its proximity to existing utility infrastructure into which the project could connect to deliver power to the FPB system. Limiting the need for significant infrastructure upgrades will help the project retain a competitive advantage, reduce
the impact on the environment, and limit the need for permitting for linear corridors. FPB has provided a system map showing the locations of transmission lines and substations. These substations are located across the county, and several occur within “energy communities,” which could qualify the project for additional tax incentives. In addition, there must be sufficient capacity on the distribution lines to accommodate the project.

2.1.4.2 Site Accessibility
Potential sites will need to be evaluated to determine where egress may occur and any rights-of-way that need to be addressed. The site must allow access for construction of the facility as well as ongoing maintenance.

2.1.4.3 Insurability
Potential sites should be evaluated for flood risk to determine if special flood insurance is necessary.

2.1.4.4 Grading, Soil, Geology, and Vegetation Considerations
In general, solar sites are most frequently built on sites with fewer than 3 degrees of slope—although with more steel and longer post lengths or land grading, some racking can accommodate 10 degrees or more. (Ludt 2019) Sites should be examined for slope and vegetation cover. A geotechnical and soil analysis may be conducted by a developer once a site has been selected.

2.2 Local Examples
Any utility-scale solar in Frankfort would not be the first in Kentucky—there are several examples of large-scale PV sites that are already completed or under development.

In 2017, the East Kentucky Power Cooperative (EKPC) built 8.5 MW of solar in Clark County, Kentucky, at a cost of $17.7 million. The project consisted of 32,000 solar panels on 60 acres of land near EKPC’s headquarters. Customers can buy a license for $460 per 260 W dc panel, which entitles them to a credit for the energy produced by their share (Petke 2017).

The Unbridled Solar LLC project in Henderson County, Kentucky, has recently received its building permit and will be in operation by May 31, 2024. The 160 MW of electricity, generated on almost 1700 acres of land south of the city of Robards, will be sold to Big Rivers Electric Corp., the power provider to the three rural electric cooperatives that own it: Kenergy Corp., Jackson Purchase Energy Corp. of Paducah, and Meade County Rural Electric Cooperative Corporation (RECC). Through a 20-year power purchase agreement (PPA), Big Rivers will acquire 100% of the power generated. The project will pay approximately $160,000 in local taxes each year, in addition to the $500,000 fee for the building permit (Stinnett 2023).

An additional 400 MW solar array is planned for Henderson County, Kentucky. The Sebree Solar project by NextEra Energy Resources, LLC, would install 250 MW on approximately 1200 acres in Phase I and an additional 150 MW on 900 acres in Phase II. Subject to local and state approvals, Phase I is scheduled to begin operations by the end of 2024, and Phase II is scheduled to begin operations by the end of 2025. This project is expected to bring in approximately $32 million in tax revenue over 30 years (NextEra Energy).
3 Market Evaluation

This section explores Frankfort’s electricity payments and potential opportunities available through the Inflation Reduction Act of 2022.

3.1 Inflation Reduction Act

The Inflation Reduction Act of 2022 includes significant incentives for the development of solar through the Investment Tax Credit (ITC) and provisions to allow nontax-paying entities, such as municipalities, to receive these credits via direct pay. Table 2 describes the tax credits and bonuses that could be available to support development of solar PV in Frankfort, Kentucky. Specifically, Frankfort is eligible for the base ITC value of 30% of qualifying costs and is eligible for the 10% energy community bonus. Frankfort will have to take action to be eligible for the domestic content credit (to prove the required amount of domestically manufactured content) and will have to apply for and receive a successful allocation for the low-income/disadvantaged community credit bonus of 20%. While the low-income/disadvantaged community credit bonus was oversubscribed in 2023, it is determined by an annual lottery.

<table>
<thead>
<tr>
<th>Table 2. Cumulative Investment Tax Credits Available for Solar Through the IRA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td>Base credit of qualifying costs</td>
</tr>
<tr>
<td>Energy community bonus</td>
</tr>
<tr>
<td>Domestic content credit*</td>
</tr>
<tr>
<td>Economic benefit to disadvantaged community, if available*</td>
</tr>
<tr>
<td><strong>Total possible investment tax credit</strong></td>
</tr>
</tbody>
</table>

The following sections describe the tax credits that Frankfort, Kentucky is clearly eligible for and those that Frankfort could be eligible for if specific actions are taken and requirements are met.

3.1.1 Tax Credit Benefits: Frankfort Eligibility

One of the biggest changes to tax policy from the IRA is that nontax-paying entities—such as municipalities, tribes, states, and nonprofits—can use “elective pay” or “direct-pay” so that the tax credit is “effectively refundable.”11 An eligible entity that qualifies can notify the IRS of its intent to claim the credit after the project is placed in service and file an annual tax return for the full value of the credit (no later than May 15 of the next year). After the tax credit is submitted and the U.S. Internal Revenue Service (IRS) processes it, the eligible entity can be paid the value of the credit from the IRS (Solar Energy Technologies Office 2023). Developers already get a 30% base incentive for paying prevailing wages and employing apprentices. After the IRA bill, this is also applicable to state, local, tribal, and nonprofit organizations using direct pay.

11 [https://www.whitehouse.gov/cleanenergy/directpay/](https://www.whitehouse.gov/cleanenergy/directpay/)
The U.S. Department of Energy’s (DOE’s) IRA Energy Community Tax Credit Bonus map, shown in Figure 2, indicates that Frankfort is also considered an “energy community”—meaning that it meets both the fossil fuel employment (FFE) threshold and the unemployment rate requirement. There is an additional 10% for siting projects in “energy communities,” that is, places with brownfield sites or coal plant closures. There is no cap on the number of projects that can happen inside of energy communities; however, this map will be updated each year based on changing U.S. unemployment and potentially other factors.

![Figure 2. Image from DOE’s IRA Energy Community Tax Credit Bonus map that shows energy communities that qualify for additional incentives for solar.](https://arcgis.netl.doe.gov/portal/apps/experiencebuilder/experience/?id=a2ce47d4721a477a8701bd0e08495e1d)

### 3.1.2 Potential Community Benefits

There are two main community benefits for which Frankfort, Kentucky may also be eligible, but these will require taking specific actions and might depend on overall demand for the tax credits.

First, it might be possible to secure an additional 10% incentive for meeting domestic content standards—meaning that a certain percentage of any manufactured product is made in the United States. However, this may not be easy to prove; according to DOE, “all structural steel or iron products must be produced in the United States and a ‘required percentage’ of the total costs of manufactured products (including components) of the facility need to be mined, produced, or manufactured in the United States.” Moreover “the required percentage of manufactured...
products starts at 40% for all projects beginning construction before 2025, increases to 45% for project beginning construction in 2025, 50% for projects beginning construction in 2026, and 55% for projects beginning construction after 2026.” The specific IRS Domestic Content Bonus Credit Guidance has more details (Office of Associate Chief Counsel 2023). However, solar PV components do not include labels or ways to easily identify which country’s steel and iron were used or the origins of component mining, production, or manufacturing.

Although the IRS Notice includes a list of products and product components that must be included in the calculation, it is not exhaustive. The clean energy industry is asking the U.S. Treasury for a final list of products and components that must be considered to clarify what must be included and what should not be. In addition, to claim the domestic content credit, a statement must be submitted for each relevant project, certifying U.S. manufacturing or production (Cooper 2023). Thus, it could be challenging to identify domestic content, and the components required to prove that a project meets the Domestic Content Bonus Credit are still unclear.

Second, Frankfort is potentially interested in community solar projects that benefit low-income households, which might result in an additional 20% bonus tax credit benefits called the Low-Income Communities Bonus credit. For the IRA, these Low-Income Communities Bonus credits have several requirements: 1) the project must be less than 5 MW in size, 2) at least 50% of the total capacity has to benefit low-income, residential customers, 3) qualifying households must get a 20% bill credit discount benefit, and 4) low-income tax credit bonus allocations must still be available up to the 1.8 GW annual cap (each year, for 10 years). If these requirements are met, it is possible to secure another 20% bonus tax credit—however, the allocations for which Frankfort is eligible are oversubscribed in 2023 as described below.

There are two main subcategories of eligibility for community solar: community solar projects that meet the above requirements and a separate one that meets the stated requirements as well as being in a geographic area identified as “additional selection criteria.” To meet the additional selection criteria, the project must either meet the “Energy Criteria”12 of the White House Climate and Economic Justice Screening Tool (CJEST) or be identified as a “Persistent Poverty County.” Importantly, Frankfort does not currently meet these additional selection criteria and thus could be eligible only as a “qualifying community solar project,” according to the DOE Low-Income Communities Bonus Credit mapping tool shown in Figure 3.13 In 2023, each of these two subcategories was allocated 350 MW of the total 1.8 GW of eligible tax credit (three other main categories received the rest of the 1.8 GW allocation). According to the DOE Program Capacity Dashboard,14 most 2023 allocations have been distributed; the only ones that

12 The CJEST tool (https://screeningtool.geoplatform.gov/en/#11.5/38.1942/-84.9084) has eight total criteria that are considered low-income; energy is only one of these criteria and is the only one that is important for the Low-Income Community Bonus credit. To meet the energy criteria, 1) the community must be “low income” and 2) it must meet one of the other energy criteria of a) energy cost must be at or above the 90th percentile or b) PM2.5 in the air must be at or above the 90th percentile. Although Frankfort meets 1) “low-income,” it does not meet either 2a or 2b, which is required.
13 https://experience.arcgis.com/experience/12227d891a4d471497ac13f60fff822/page/Page/
14 https://eco.energy.gov/ejbonus/s/
remain are projects on Tribal Land and residential and multifamily housing on “additional selection criteria” areas.

![Low-Income Communities Bonus Credit Program](image)

**Figure 3.** Frankfort does not meet the “Additional Selection Criteria” for the Low-Income Community Bonus tax credit.

Source: [https://experience.arcgis.com/experience/12227d891a4d471497ac13f60fff8d22/page/Page/](https://experience.arcgis.com/experience/12227d891a4d471497ac13f60fff8d22/page/Page/)

Finally, it is true that a new 1.8 GW allocation is available each year for up to 10 years. However, all community solar tax credits were allocated in the first lottery for 2023 and were oversubscribed by 9 times in the category for which Frankfort is eligible (3,113 MW applied for 350 MW of allocations as of December 2023). It is an annual lottery, which means that Frankfort could be allocated the bonus tax credit in 1 of the 9 remaining future years, but if the number of applicants remains the same every year, the odds of receiving a community solar allocation could be challenging.

Another potential option is that Frankfort could apply for the Category 1c: Nonresidential project that is third-party owned or owned by the site/building owner. However, in 2023, this subcategory was oversubscribed by 29 times (3,052 MW applied for 105 MW total allocation). The IRS could choose to reallocate the total capacity from other categories to either Category 1c or Category 4/community solar either for the 2023 allocations or in future years; any future redirections of tax credit allocations to these categories should be monitored closely.

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15 [https://eco.energy.gov/ejbonus/s/](https://eco.energy.gov/ejbonus/s/)
4 Interconnection

This section discusses interconnection opportunities, risks, and mitigation strategies.

4.1 Opportunities

Any solar array would need to interconnect with the FPB transmission system. The carrying capacity (i.e., availability of excess space) of this system was not evaluated.

However, based on Figure 4., existing FPB substations are scattered throughout the City—meaning that there could be ample locations to interconnect solar PV to the FPB system. Data on these locations was shared with NREL and the City but are considered confidential and thus not provided in this report.

4.2 Interconnection Risks and Mitigation Strategies

Separate from the Phase II work, NREL staff conducted an analysis using Engage™, a capacity expansion modeling tool, to investigate how development of a distribution-tied PV power system in Frankfort could financially impact KYMEA, FPB, and the city of Frankfort. Specifically, the analysis was designed to determine how Frankfort’s reduced demand as a result of the city’s distributed energy resource (DER) impact KYMEA’s all-requirements sales contract if power sales for KYMEA and FPB decreased. By simulating KYMEA’s generation and transmission (G&T) system in Engage, the study found that Frankfort could pursue DER development without negatively impacting the revenue streams for both KYMEA and FPB. Frankfort could do this by compensating KYMEA and FPB for the changes they would experience to their operating revenues with the potential to improve the grid’s regional resilience and reduce future capacity requirements for KYMEA. NREL researchers also determined that Frankfort could meet the city’s renewable energy targets while lowering electricity costs if the costs of operating and maintaining the PV facilities fall below $1.17 million or $53.33/MWh produced. (Harris et al. 2023).
5 Business Model and Financial Analysis

This section describes the solar PV ownership model possibilities and provides a high-level financial analysis for third-party ownership compared to self-ownership.

5.1 Ownership Model

To implement a utility-scale solar generation facility sufficient to cover the City’s operational consumption, the City would engage independently or through FPB with a third-party private developer. Although either FPB or the City could now benefit from direct payment provisions of the IRA to self-build, not every solar facility is profitable—and private developers hold portfolios to diversify risk and realize marginal profits in doing so. Therefore, there would be less risk for either FPB (through KYMEA) or the City to engage with a developer to establish a PPA, though at a potentially higher cost. Such developers will own, operate, and maintain the facilities and will carry their own tax liability or identify a tax equity partner to benefit from tax credits.

Another potential benefit is that large-scale solar PV independent power producers would be more likely to understand, contract for, and able to prove adherence to the domestic content requirements.

5.2 Financial Analysis for a Power Purchase Agreement

In Phase I, an NREL System Advisor Model (SAM) analysis based on a 30% or 50% tax credit estimated that the cost of electricity is 6.57 cents/kWh and 5.36 cents/kWh, respectively (NREL 2023). This should be compared to the current price of electricity, which is assumed to increase with inflation estimated at 2%. The PPA price is assumed to have a 1% escalation. The City or FPB may realize savings over 25 years by engaging a solar developer in a PPA.

Table 3 shows the results of the Phase I SAM analysis of electricity costs to purchase power from an 8.2 MW solar facility. This analysis assumes a $1.02/Wdc national median cost of solar and a 6.5% internal rate of return for the developer.

<table>
<thead>
<tr>
<th>Tax Credit</th>
<th>Estimated PPA Price</th>
<th>Cost to Developer (not the city)</th>
</tr>
</thead>
<tbody>
<tr>
<td>30%</td>
<td>6.57 cents/kWh</td>
<td>$8.71 million</td>
</tr>
<tr>
<td>50%</td>
<td>5.36 cents/kWh</td>
<td></td>
</tr>
</tbody>
</table>

It is critical to note what is and is not included in the analysis. The costs included in the analysis are for equipment, balance of system, installation labor, installer margin, permitting and

16 SAM analysis of electricity costs to purchase power from an 8.2 MW solar facility. This analysis assumes a $1.02/W_dC national median cost of solar and a 6.5% internal rate of return for the developer.
environmental studies, engineering and developer overhead, grid interconnection, land use, and operations and maintenance (O&M). Importantly, not all equipment, development, financing, and other balance-of-system costs are included as part of the “eligible basis” for the ITC (Sullivan 2017), but generally the majority are. In addition, the analysis above is agnostic regarding who is purchasing the power from whom or what else might still need to be purchased to keep the FPB system operational. This is not an islanded approach to city operations and does not include any costs of storage. Therefore, the City will still need to pay customer charges for electricity service and when the sun has set, providing for transmission and distribution and other fundamental services necessary for grid operations. Those costs are not reflected in the PPA price.

5.3 Financial Analysis Self-Ownership

Another alternative is for the City to contract with an engineering, procurement, and construction (EPC) consultant to create a model for development of the solar facility, which would then be the property of the City. Upfront capital costs would be the responsibility of the City as would ongoing maintenance. This option would result in lower overall costs and produce a better rate of return for the City but would require upfront capital to finance the project. The IRA now allows for nontaxed entities such as local municipalities to take advantage of the tax incentives through a direct-pay option. However, the project must be placed in service, and tax credits must be applied for, so there would likely be several months—or perhaps up to a year—before the tax credit portion of upfront capital would be paid back, depending on the time of year the project becomes operational. The City has the authority to issue municipal bonds for the upfront cost of the project which could potentially be structured so that annual debt maintenance is at or below the City’s current energy costs.

<table>
<thead>
<tr>
<th></th>
<th>PPA</th>
<th>EPC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upfront cost</td>
<td>$8.7 million (paid by developer)</td>
<td>Paid by City</td>
</tr>
<tr>
<td>O&amp;M</td>
<td>Covered by developer</td>
<td>Would require a contract (possibly with FPB)</td>
</tr>
<tr>
<td>Levelized cost of energy (LCOE) with 30% tax credit</td>
<td>$0.0657/kWh</td>
<td>Unknown</td>
</tr>
<tr>
<td>Levelized cost of energy (LCOE) with 50% tax credit</td>
<td>$0.0536/kWh</td>
<td>Unknown</td>
</tr>
<tr>
<td>Tax incentives available</td>
<td>Goes to developer</td>
<td>30% direct pay, with possible additional credits up to 70% of project costs</td>
</tr>
<tr>
<td>Risk</td>
<td>Developer insures project</td>
<td>City accepts risk</td>
</tr>
</tbody>
</table>
6 Other Considerations

The Phase I report also identified the possibility of procuring energy generation from the Ashwood project, an anticipated 86 MW facility planned by KYMEA that had a ribbon-cutting on July 26, 2023, in Lyon County. Pricing for this project was not yet available.

The FPB recently opened its first community solar project, which allows subscribers to purchase shares and get a utility bill credit for the energy generated by their share; a ribbon-cutting was held on Monday, July 24, 2023, for Phase I. (State Journal 2023). The subscription cost for this project is $1049.70 per 250 Wdc panel\(^{17}\) (compared to EKPC’s cost of $460/260 W panel mentioned in Section 2.2). A personal communication from FPB (G. Zheng, May 30, 2023) stated that were the City to purchase the next three phases of FPB’s community solar project which would produce an estimated 687 MWh/year, it would cost an additional $66,000/year above current costs and only offset a fraction of city operations, which total about 12,000 MWh/year.

Thus, because of costs, both these options were tabled in favor of further exploring utility-scale solar. In addition, these projects were already planned when the city began evaluating options and so would not result in any new, additional solar on the grid.

\(^{17}\) Frankfort Plant Board Subscription Agreement
https://static1.squarespace.com/static/509ac5d5e4b011ec8327ecea/t/64c7fd043e48870e94681039/1690828036997/Community+Solar+Agreement+7-31-23.pdf
7 Summary

Key considerations for utility-scale solar—including available land, the ability to site and permit a project, the solar resource, ease and access to the transmission network, and market opportunities—are all favorable for such a project. The current provisions in the IRA allow for direct pay of tax incentives to nontax-paying entities such as municipalities. Frankfort could qualify for at least 30% tax incentives, and potentially more, which would significantly offset project costs.
8 Possible Next Steps

This analysis was based on a projected 10% energy reduction in City facilities. As stated in the Phase I report, the City can reduce its energy use by around 10% with cost-effective energy efficiency measures. Energy audits of all buildings will identify how to prioritize those investments and allow the City to save money and reduce emissions. Savings from projects could be invested in a fund that could be used to make further cost-saving investments. The City could also consider an energy savings performance contract, a financing technique that does not require upfront investment but is paid for over time with the realized energy cost savings.

The City could issue an RFP/RFQ to identify a partner in the development of a utility-scale solar array who can help address the identified issues, identify potential sites, and inform site design. Partnering with FPB on an RFP for a solar facility could resolve the issues raised by FPB and provide energy generation for FPB after leaving KYMEA while helping the city meet its goals. Draft language for an RFP/RFQ was provided to the City as part of the Phase II work by NREL. After issuing an RFP, the City could then establish a partnership with a developer to provide the necessary in-depth, site-specific economic analysis needed to move the project forward.

Continued discussion with FPB could result in a cooperative effort that is beneficial to both parties. Such a collaboration was identified in the Phase I report and is still possible. FPB has identified sites that would accommodate a development of this size. Based on the described Engage analysis, this option could allow FPB to meet its obligations, achieve the City’s clean energy goals, and save the City money, without passing on any costs to other ratepayers. This would also provide an energy generation source, which FPB will require after leaving KYMEA in 2028.
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