Attachment G

ECONOMIC ANALYSIS

Lost City Renewables LLC

Muhlenberg County, Kentucky

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January 21, 2025

TO: Marty Marchaterre
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FROM: Paul Coomes

RE: Estimated economic and fiscal impacts of Lost City solar project

Lost City Renewables LLC, a subsidiary of Copenhagen Infrastructure Partners, is developing a solar farm with 250 MW generating capacity on about 1,400 acres of hilly farm and timber land in Muhlenberg County, Kentucky. The solar site is named Lost City (Project). The developer is expecting to invest nearly $300 million in the Project. This note provides estimates of the new local economic and fiscal activity expected from the development.

There are two primary impacts expected from the project. First, there will be a spike in construction and linked jobs as the site is built out over approximately one year. Using estimates of the construction payroll, I estimate that there will be a total (direct and spinoff) of approximately 739 new jobs in the county in year one, with new labor income around $41.0 million.

The ongoing annual economic impacts from operating the solar farm involve the positive effects of several operational and maintenance jobs plus the effects of the new lease payments to owners of the land. In Appendix 2, these are compared to the negative effects of lost agribusiness activity, revealing a small net annual gain in jobs and labor income over the operating period. Looking out over four decades, and including the impacts of construction, I estimate there is a net gain of approximately 839 job-years and $44.9 million in labor income to Muhlenberg County.

Second, Lost City is pursuing an Industrial Revenue Bond (IRB) with the County Fiscal Court. According to the 2023 property tax bills for the five land parcels at the site, the

total real estate property tax payments were $14,500. Lost City anticipates that the IRB and Payment in Lieu of Taxes (PILOT) agreement would generate payments to the County of approximately $250,000 - $300,000 annually over the life of the Project.

Location, Regional Economy

The Project site is in western Kentucky, south of Drakesboro, and near the town of Penrod, in southern Muhlenberg County. The approximate location of the Project is shown by the red star in Figure 1. It is just east of US Highway 431.

Figure 1

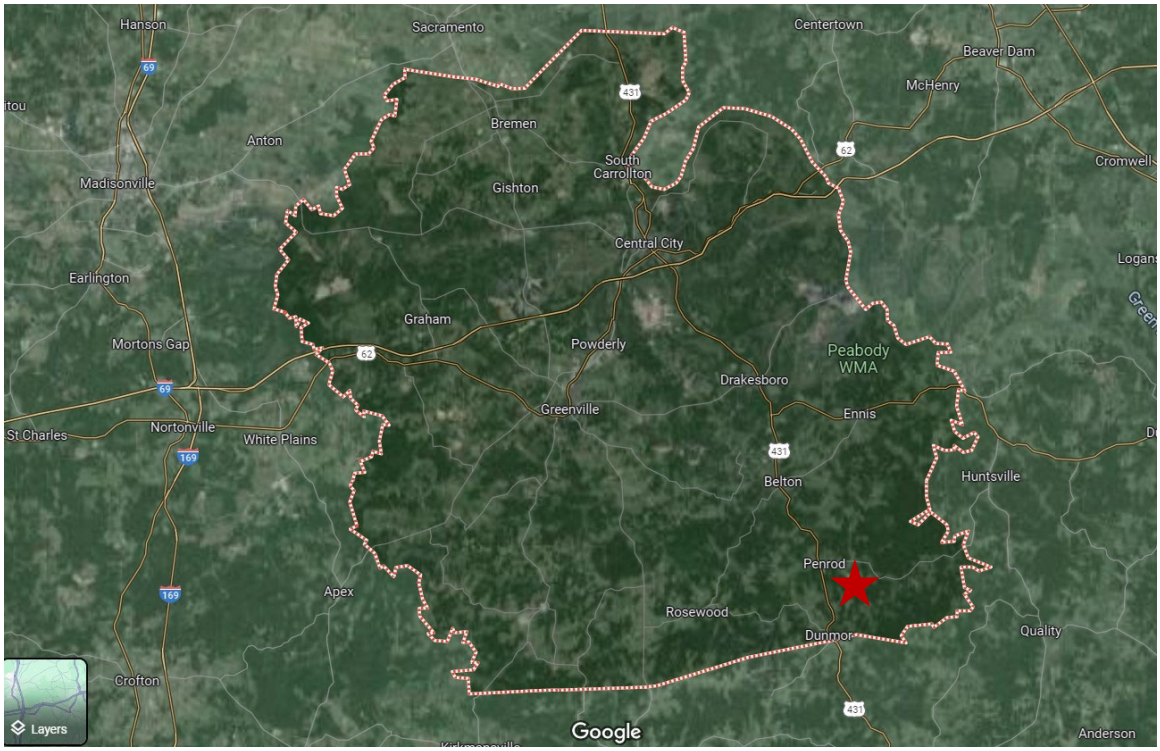
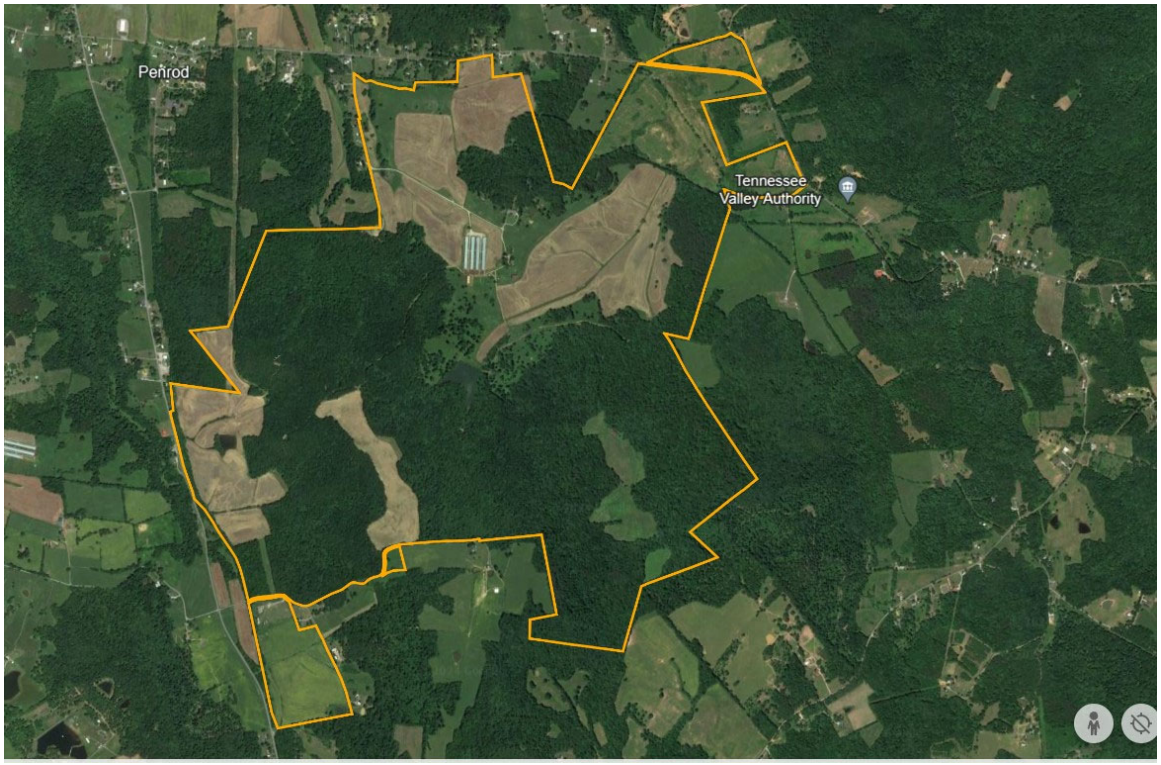


Figure 2 is a site map provided by the developer. The Project will be inside the boundary indicated by the yellow line. see the aerial imagery shows that the site is partially wooded, with some cropland. The building near the northwest corner is a poultry operation that will remain. The developer has estimated that the land use is 59 percent woods, 21 percent soybeans, 14.6 percent grass/pasture, 0.4 percent corn, and 5 percent other (cattle, sheep, goats). And only about 350 acres of current agricultural activity is expected to be displaced.

Figure 2



Newly released results from the U.S. Census Bureau's 2023 American Community Survey (ACS) provide a nice summary of demographic and economic characteristics of Muhlenberg County. Some details are provided in Appendix 1. For many of the measures, the county is similar to the State of Kentucky, for example high school attainment rates, persons per household, and average commute times. However, several things stand out:

- Compared to the Kentucky state average, Muhlenberg County's population is older, more likely to be categorized as white/Caucasian, and has a higher percentage of residents with a disability.
- Few Muhlenberg County adults hold a four-year college degree: 13 percent in the county, compared to 27 percent statewide.
- Median household income in Muhlenberg County was $52,700, significantly lower than the state average of $62,400.
- Over 48 percent of Muhlenberg County adults are not in the labor force, compared to 40 percent statewide.

Muhlenberg County's population has fluctuated around 31,000 for the past three decades (Figure 3). The county had a surge in population in the 1970s as the local coal industry boomed, reaching a peak of 33,000 residents before falling to its current level. As is

evident in Figure 4, population growth is highly correlated with job growth, particularly in mining. Strong employment growth in the 1970s was accompanied by significant population growth.

Figure 3

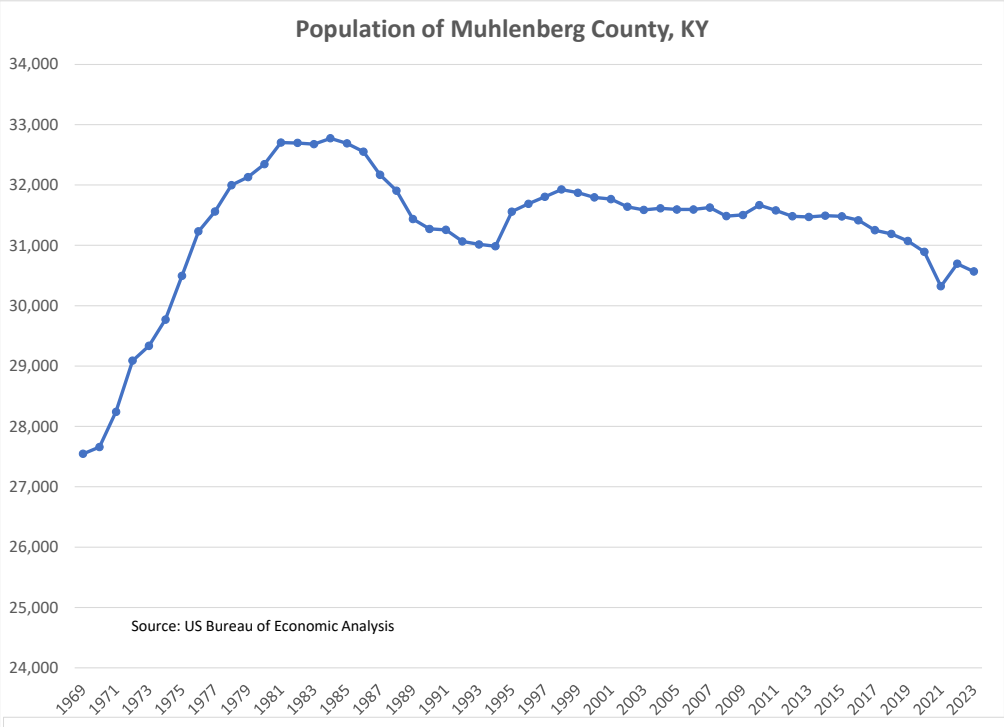


Figure 4

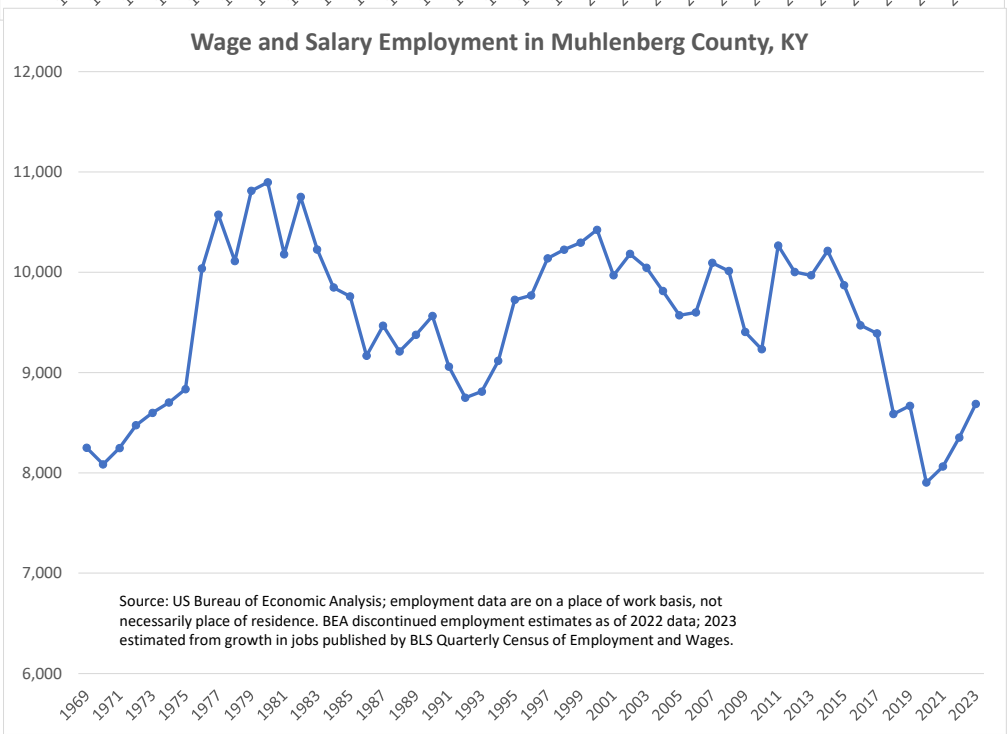


Table 1

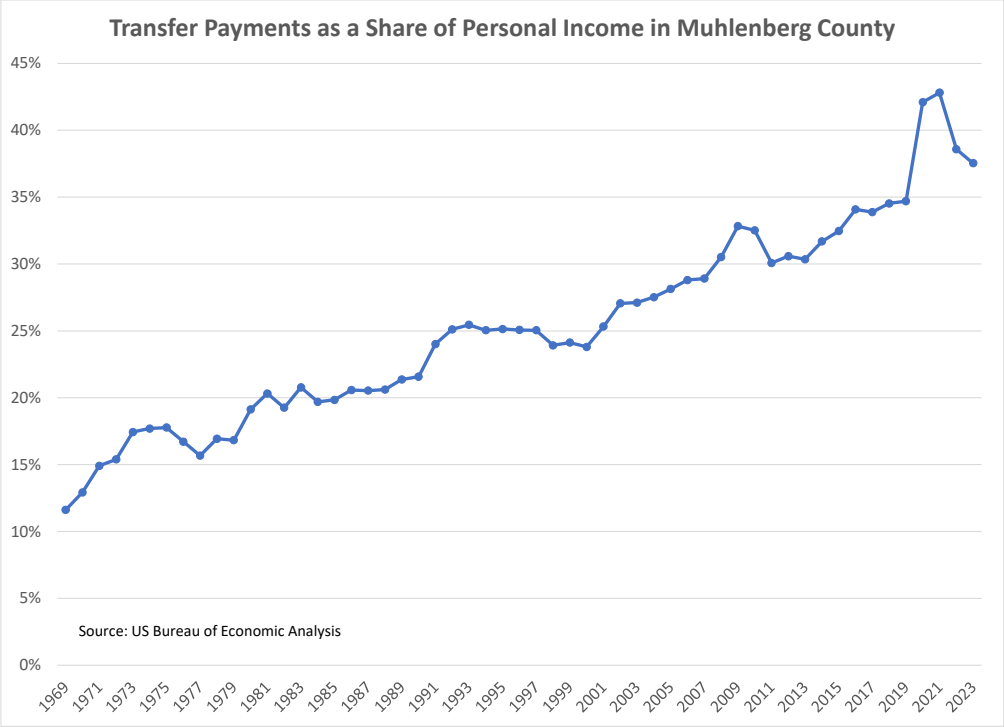
Coal mining was the economic engine of Muhlenberg County in the past, but as of 2024 supports no employment[1]. The mining jobs paid very well, and the modest growth in some other local industries has not been sufficient to replace that payroll. Indeed in 1975, mining accounted for 54 percent of all labor and proprietors' earnings in Muhlenberg County. That share fell to around 6 percent in 2022, and is now presumably zero.

Mining Employment in Muhlenberg County	
1970	1,957
1975	3,075
1980	2,984
1985	2,054
1990	1,131
1995	425
2000	417
2005	614
2010	582
2015	1,014
2020	397

Source: US Bureau of Economic Analysis. Employment data are on a county of work basis, not necessarily county of residence. Estimate for 2015 no disclosed; estimated from other years by author.

The lack of job growth and the aging of the resident population has led to an increased reliance on government transfer payments. In Muhlenberg County, residents received $468 million in payments in 2022. These accounted for 38 percent of total personal income, well above the Kentucky state (26 percent) and United States (18 percent) averages. In 1970, transfer payments accounted for only 13 percent of the county's personal income. Social Security, Medicare and Medicaid are the primary sources of the transfers. Figure 5 reveals the steady upward trend, as well as the spike in payments (across the country) during the onset of the COVID-19 pandemic (2020-21).

Figure 5



Not all working

[1] The last coal mine in Muhlenberg County closed in 2024, with a loss of 200 jobs: www.14news.com/2024/02/29/pride-mine-closing-muhlenberg-co/ ..

residents of Muhlenberg County work in Muhlenberg County, and not all workers in the county are residents. The U.S. Census Bureau publishes estimates of county-to-county commuting patterns, and these reveal regional economic linkages. The estimates below, from the 2016-2020 ACS 5-year estimates, are the latest available.

First consider where the workers in Muhlenberg County live. Table 2 shows that there were 9,617 workers in the county. While 78 percent of the workers were residents of Muhlenberg County, there is significant commuting from surrounding counties, including Hopkins, Daviess, Ohio, Warren, McLean, Christian and Logan counties.

Table 2

County of Residence of Workers in Muhlenberg County, KY		
Muhlenberg County	7,494	77.9%
Hopkins County	621	6.5%
Daviess County	304	3.2%
Ohio County	216	2.2%
Warren County	137	1.4%
McLean County	129	1.3%
Christian County	112	1.2%
Logan County	108	1.1%
all other	496	5.2%
Total	9,617	100.0%

Source: US Census Bureau, American Community Survey, Residence County to Workplace County Commuting Flows, 5-Year ACS, 2016-2020

Table 3

County of Work for Residents of Muhlenberg County		
Muhlenberg County	7,494	64.5%
Hopkins County	1,076	9.3%
Logan County	970	8.4%
Ohio County	560	4.8%
Daviess County	292	2.5%
Warren County	215	1.9%
Christian County	211	1.8%
Butler County	201	1.7%
All other	593	5.1%
Total	11,612	100.0%

Source: US Census Bureau, American Community Survey, Residence County to Workplace County Commuting Flows, 5-Year ACS, 2016-2020

Next, consider where residents of Muhlenberg County work (Table 3). Note that there are significantly more working Muhlenberg County residents than there are people working in the Muhlenberg County. In other words, there is a net flow out of the county to work. The destination counties are generally the same as the origin counties in Table 2. We will use these findings to model the impact of the solar farm construction phase on the wider regional economy.

This net outflow of residents to work in surrounding counties shows up in personal income statistics for Muhlenberg County. For 2023, $131 million of residents' total

personal income of $1,302 million was due to the net effect of more residents working outside the county than nonresidents working inside the county.

Modeling the Economic Impacts

I take a conventional approach to modeling the regional economic impacts, using a customized input-output model of Muhlenberg County[2]. I have purchased annual economic data for all 120 Kentucky counties and use these as needed to construct regional models – of a county, a group of counties, or the whole state. The model has detailed information about the linkages among 500+ potential industries in each regional economy, as well as the relationship between household spending and demand for local retail goods and services due to the employee compensation or other forms of income. When there is new industrial activity in a region, the model can predict how much of the supply chain can be met by local businesses and how much the new payroll will result in additional sales (and jobs) by local businesses.

The ratio of the change in total regional economic activity to a change in activity by a regional industry is called a multiplier. For example, if a new manufacturing company adds 100 jobs and the County were to ultimately see another 80 jobs due to related spinoff activity, the employment multiplier would be 1.8 (180 total jobs divided by 100 direct jobs). Similar multiplier effects are generated for business output, employee compensation, and value-added[3].

The relevant sector for the construction phase is number 52, "Construction of new power and communication structures", which is used to model the initial investment. The employment multiplier for that sector in Muhlenberg County model is 1.243, per the latest release (2023 data). This is a very modest multiplier, due to the fact that almost all the materials used to assemble a solar farm are made outside the county; thus, there are few inter-industry impacts locally.

There will also be some spin-off impacts from ongoing operations. Unfortunately, for the operations phase, the relevant IMPLAN sector, number 42, "Electric Power Generation – Solar", is empty of data and results for Muhlenberg County. This is because there is no history of solar electricity generation and therefore no basic economic data to construct

[2] For documentation of IMPLAN modeling, see www.implan.com/history/ .

[3] Value-added is a measure of how much economic activity actually 'sticks' to a region. For example, if one purchases a new vehicle for $40,000 from a local dealership, only a few thousand dollars actually is captured in the county. Business revenues rise by $40,000, but most of it flows right out to the place where the vehicle was made. Local value-added measures the fraction of the sale that ends up paying workers and owners at the dealership, as well as any local taxes captured as a result of the sale.

industry relationships. However, beginning with its release of 2022 data, IMPLAN does provide activity measures for that sector statewide, and we use that below to model the operations phase.

Construction Payroll and Local Economic Impacts

From an economic perspective, the solar project has two phases, construction and operations. The construction phase is expected to last about one year, while the operations phase will last several decades. Almost all the employment occurs in the construction phase. The regional economic impacts consist of the direct effects of spending by the developer, and any spinoff impacts due to local purchases of supplies and new spending by households as a result of the increased incomes.

Direct effects

The company is likely to invest around $300 million in the solar project. The investment involves land acquisition, site preparation, solar panel and electrical equipment purchase and installation, plus landscaping and security fencing. The company will hire construction companies for this project, so it is not possible to know precisely how many workers will be employed nor their total compensation. For modeling purposes, I use an estimate of average employment over a one-year construction phase. Using the results of a California study of six large photovoltaic projects suggests that there will be an average of 600 direct jobs over a twelve- to eighteen month construction period for this project[4].

Table 4

Construction wages and benefits from 2014 Berkeley study			
	Average annual wage	Average annual benefits	Total compensation
CA Valley & Topaz Combined, Low Wage	$52,736	$24,104	$76,840
Average Across Six Solar Projects	$78,002	$36,880	$114,882

Source: https://laborcenter.berkeley.edu/pdf/2014/building-solar-ca14.pdf

The California study also provides a range of results for construction wages and benefits, as shown in Table 4. The lowest average annual construction wage reported was $52,736, and the average wage across the six projects was $78,002, as shown in the table.

[4] A University of California-Berkeley study looked at six large PV projects in California, and summarized the economics. The author finds a ratio of 2.4 FTE construction jobs per MW. Applied to Lost City's 250 MW you get 600 direct construction jobs. He also shows the permanent operations jobs per MW, and applied to this project you get about 8 FTEs. See page 28 of *Economic and Environmental Benefits of Building Solar in California*, by Peter Philips, November 10, 2014, https://laborcenter.berkeley.edu/pdf/2014/building-solar-ca14.pdf .

California is, of course, a high wage state, with a much higher cost of living than Kentucky. On the other hand, the wage results are from projects developed a decade ago, and there have been large increases in average wages across the US since.[5]

Occupations include construction managers, earth grader operators, panel installers, electricians, and fencers. I searched the federal database on hundreds of occupations to learn how much these workers are likely to earn on the project (Table 5). The U.S. Bureau of Labor Statistics publishes estimates of employment and wages by occupations for states and metropolitan statistical areas, but not for counties.

Table 5

Kentucky Wages for Related Occupations, 2022			
Occupation (SOC code)	**Employment**	**Hourly mean wage**	**Annual mean wage**
Construction Managers(119021)	-	$45.07	$93,740
Operating Engineers and Other Construction Equipment Operators(472073)	6,230	$26.20	$54,490
Electricians(472111)	9,210	$26.85	$55,840
Fence Erectors(474031)	280	$18.91	$39,320
Industrial Engineers(172112)	5,500	$42.29	$87,960
Materials Engineers(172131)	330	$47.57	$98,940
Mechanical Engineers(172141)	2,730	$40.87	$85,010
Heating, Air Conditioning, and Refrigeration Mechanics and Installers(499021)	5,240	$24.43	$50,810
Electrical Power-Line Installers and Repairers(499051)	2,590	$34.63	$72,020
Telecommunications Line Installers and Repairers(499052)	1,090	$26.10	$54,290

Source: US Bureau of Labor Statistics, Occupational Employment Survey, https://data.bls.gov/oes/#/geoOcc/Multiple%20occupations%20for%20one%20geographical%20area

There is no listing in the Kentucky data for "Solar Photovoltaic Installer", but the national average annual wage in 2022 was $47,970,710[6]. Based on these published wages, the construction managers are likely to earn over $90,000, heavy equipment operators and installers over $50,000, electricians around $56,000, and fencers $39,000.

[5] By contrast, a recent union-oriented report on Ohio solar projects claims temp workers there are only making $18 to $20 per hour, implying average annual pay of around $40,000; See https://columbusfreepress.com/article/ohio-solar-panel-farms-are-booming-construction-workers-are-being-exploited-make-it-happen

[6] Source: US Bureau of Labor Statistics, Occupational Employment Survey. For national data on solar photovoltaic installer, see www.bls.gov/oes/current/oes_nat.htm#47-2231 . For Kentucky and MSA data, see www.bls.gov/oes/current/oes_ky.htm County-level estimates are not available.

Assuming an average of $50,000 per construction job over a year leads to a direct payroll of $30 million in the county. The average annual pay for all jobs in Muhlenberg County in 2023 was $51,200[7]. The average fringe benefits, such as employer payments for health insurance, in Kentucky for the construction industry is 18 percent[8]; so, total labor compensation for these jobs is around $35.4 million, or $59,100 per job.

Spin-off impacts in Muhlenberg County

The construction phase will have some spin-off effects in Muhlenberg County. I model this using a custom IMPLAN model of the county. The relevant sector for the construction phase is number 52, "Construction of new power and communication structures", and this can be used to model the initial investment. The direct effect in the County is around 600 jobs over one year, with labor compensation of approximately $35.4 million.

The model has detailed information about the inter-industry linkages in each regional economy, as well as the expected household spending on retail goods and services due to the enhanced employee compensation. When there is new industrial activity in a region, the model can predict how much of the supply chain can be met by local businesses and how much the new payroll will result in additional sales (and jobs) by local businesses. Adding these two effects to the direct effect yields the total effect of a development, and dividing the total effect by the direct effect yields a multiplier. Using the Muhlenberg County multiplier for the relevant construction sector, and the direct construction budget, I project there will be a total of approximately 739 new jobs in the County, and new labor compensation of around $41.0 million[9].

Table 6 illustrates the various impact components across several standard economic measures. The results can be scaled up or down to fit any assumed number of construction jobs[10]. Note that both the indirect and induced effects are quite small. The indirect effect is small due to the lack of local suppliers of solar farm materials. The

[7] Source: US Bureau of Economic Analysis, https://www.bea.gov/data/by-place-county-metro-local , Table CAINC30, average annual wages and salaries in county.

[8] BEA provides estimates of both total compensation and total wages by industry for the state. Dividing total construction industry compensation by wages in 2023 yields 1.18.

[9] IMPLAN estimates a much higher average labor income per employee for this sector than I am assuming. So, I apply the labor income multiplier (1.156) to the assumed employee compensation ($35.4 million) instead of using the IMPLAN total labor income prediction ($51.5 million).

[10] This linear scaling is a feature of IMPLAN and other regional input-output modeling systems. It is reasonable in the case of a solar farm construction project. The feature becomes a problem in cases where an industrial development dramatically changes a local economy, for example, in the case of a large manufacturing plant in rural county. In that case, one could expect complicated and nonlinear effects, such as growth in the local population, much higher wage rates, and growth in support industries.

induced effect is somewhat bigger, though still small due to the lack of retail and service businesses in the county to absorb the new household income linked to the construction jobs.

Table 6

600 Jobs in Sector 47, Construction of new power and communication structures

Impact Type	Employ-ment	Labor Income	Value Added	Output
Direct	600.0	$44,554,116	$70,376,899	$102,530,229
Indirect	37.4	$2,214,087	$4,015,440	$7,425,074
Induced	101.7	$4,726,476	$9,855,086	$16,636,270
Total	739.1	$51,494,678	$84,247,425	$126,591,573
implied multiplier	1.232	1.156	1.197	1.235

Source: IMPLAN model of Muhlenberg County, using 2023 economic data.

Regional impacts from construction

Some readers may wonder why I have focused on impacts in Muhlenberg County as opposed to more widespread regional impacts. Keep in mind that most federal-state statistical agencies and models measure employment on a place of work basis, as opposed to a place of residence basis. So, all construction workers at the site are counted as Muhlenberg County jobs. Nevertheless, clearly there will be some spinoff economic activity in surrounding counties, as supplies are purchased and workers spend their paychecks at retail establishments.

To investigate possible broader regional impacts in Kentucky, I built another IMPLAN model consisting of Muhlenberg County plus the seven other Kentucky counties that supply workers – Hopkins, Daviess, Ohio, Warren, McLean, Christian and Logan. The results are slightly larger that of the Muhlenberg County-only simulation.

The job multipliers for the solar farm construction phase are 1.232 for Muhlenberg County alone, and 1.299 for the eight-county region, for a net change of only 40 total predicted jobs. Other economic multipliers, such as labor income and business output, are also consistently in that range. I also performed a comparable simulation using a

model covering the whole state of Kentucky. The statewide job multiplier for the solar farm is 1.440, larger than that for the eight-county region, due to the inclusion of so many more potential suppliers and retail outlets for household spending. Based on our impact analysis tools, there are not large differences in the predicted regional impacts when zooming out to nearby counties or statewide[11]. In this case, the economic multipliers are relatively small whether one county, two, eight, or 120 counties are modeled. This is primarily due to the lack of industrial linkages in the region to the solar industry.

Ongoing operations

There will also be some spin-off impacts from ongoing operations. The company expects operations to support several jobs. The California PV study cited above found that a ratio of 31.3 MW per permanent operations job. Applied to the Muhlenberg County project, this results in an estimate of 8 permanent operational jobs at the site. The California study also revealed that the operations jobs on average paid $78,000 in wages and salaries, plus $37,000 in fringe benefits. The relevant IMPLAN sector 42, "Electric Power Generation – Solar", is empty of data for the county, but we do have results for the state of Kentucky as a whole. The model predicts an employment multiplier of 2.708 and a labor income multiplier of 1.636. Applying these to the Lost City site results in approximately 22 jobs and $1.34 million in labor income annually.

There are also positive local economic impacts from the annual lease payments to the owners of the land. On the negative side is the annual loss of local economic activity due to taking the land out of agricultural use. This is examined in detail in Appendix 2. I estimate that, beyond the one-time impacts of construction, the annual economic benefits from the solar farm operation more than offset the annual economic losses from reduced agricultural activity in the county.

Local Tax Revenues

Local Tax Rates

Muhlenberg County and the Commonwealth of Kentucky levy property taxes on real estate and tangible property (and the Commonwealth taxes the value of manufacturing machinery). Table 7 provides the latest published tax rates that are applied county-wide, which total about one percent of the assessed value of real property and one and one-third percent of the value of tangible property. The County school systems is by far the largest recipient of property tax revenues. There are several municipal taxing jurisdictions

[11] For other industrial developments around Kentucky it is common for our models to predict job multipliers of 3, 4, or 5, particularly for complicated manufacturing operations such as motor vehicles and parts.

in the county, but the project is outside their city boundaries and thus would not be subject to those property taxes.

Table 7

Muhlenberg County Property Tax Rates, 2023			
in cents per $100 valuation			
Jurisdiction	**Real Estate**	**Tangible Personal**	**Manufacturers' Machinery**
Airport	1.00	1.00	
Extension Service	2.20	2.57	
Fiscal Court	11.10	10.60	
Health	4.00	4.00	
Library	11.50	18.38	
Soil Conservation	0.52	0.00	
County Public Schools	53.40	53.40	
State of Kentucky	11.40	45.00	15.00
Total, County-wide	95.12	134.95	15.00
Source: Kentucky Department of Revenue			
https://revenue.ky.gov/News/Publications/Pages/Property-Tax-Rate-			

In addition, the Commonwealth of Kentucky levies rates of 11.5 cents per $100 on real estate, 45 cents on tangible personal property, and 15 cents on manufacturing machinery[12].

Unlike most Kentucky counties, Muhlenberg County does not levy an occupational tax on wages, salaries, and other compensation paid to those working in the County.

Expected Property Tax Revenues

The land purchased and leased for the site, as well as all the equipment installed, would generate much more in property taxes than under its current use. The latest estimate of the taxable value of the investment is $290.1 million, primarily in installed equipment. Most of the real estate is currently valued at its discounted farm value rather than its market value. The conversion to commercial use results in a much higher tax assessment and tax revenues. Similarly, the land that is leased gets re-assessed at its new commercial value. An analysis by Stoll, Keen, Ogden PLLC projects that over 40 years the state of Kentucky would receive $10.2 million, and local jurisdictions would receive $11.7 million in new property tax revenues.

[12] To convert these tax rates to percentages, simply multiply by 0.0001.

The developer may pursue an Industrial Revenue Bond (IRB). An IRB is a type of economic incentive that would provide a temporary state and local tax abatement for the Project. IRBs have been used across the Commonwealth for distilleries and warehouses, distribution centers, hotels, greenhouses, steel mills, racetrack upgrades, power plants, and solar projects. The Project would make a Payment in Lieu of Taxes (PILOT) to offset the tax loss to Muhlenberg County. Lost City anticipates that the IRB and PILOT agreement would generate payments to the County of approximately $250,000 - $300,000 annually over the life of the Project.

I looked up the 2023 tax bills for the five land parcels at the site, using the service provided by the Muhlenberg County Sheriff's office[13]. Total real estate property tax payments were $14,500 last year. A majority of those revenues went to local county school system. With an IRB, funding for schools following the state school funding formula would be included in the PILOT. It should be pointed out that solar projects like this require almost no public services from local government. And, because they require so few people to operate, do not add students and expenses to the county public school system.

[13] www.muhlenbergcountysheriffky.com/taxes

Appendix 1

Demographic and Economic Characteristics of Muhlenberg County, KY		
	Muhlenberg County	**State of Kentucky**
Number of residents	*30,712*	*4,510,725*
Median age	42.8	39.1
Percent white	92.5%	83.7%
Percent of noninstitutionalized population w disability	23.0%	17.7%
Percent foreign-born	2.00%	4.40%
Percent 18 and older veteran	7.3%	6.8%
Percent living in same house as a year ago	88.7%	87.1%
High school attainment rate, population aged 25+	84.6%	88.5%
College attainment rate, population aged 25+	13.0%	27.0%
Number of Households	11,937	1,791,991
Median household income	$52,672	$62,417
Persons per household	2.57	2.52
With broadband internet subscription	83.7%	87.2%
Population 16+	*25,021*	*3,605,426*
In the labor force	51.5%	59.6%
Employed civilian	49.4%	56.4%
Unemployed	2.1%	2.9%
Armed forces	0.1%	0.4%
Not in labor force	48.5%	40.4%
Median travel time to work (minutes)	25.9	24.0
Civilian employed population 16 years and over	*12,349*	*2,032,890*
Management, business, science, and arts occupations	31.7%	37.1%
Service occupations	16.1%	15.4%
Sales and office occupations	18.8%	20.3%
Natural resources, construction, and maintenance occupations	11.2%	8.8%
Production, transportation, and material moving occupations	22.1%	18.4%
Industry		
Agriculture, forestry, fishing and hunting, and mining	4.0%	1.8%
Construction	6.9%	6.3%
Manufacturing	15.1%	14.3%
Wholesale trade	1.0%	2.2%
Retail trade	10.4%	11.8%
Transportation and warehousing, and utilities	6.7%	6.9%
Information	0.9%	1.3%
Finance and insurance, and real estate and rental and leasing	4.8%	5.6%
Professional, scientific, and mgmt, and admin and waste mgmt services	7.9%	9.0%
Educational services, and health care and social assistance	28.2%	24.2%
Arts, entertainment, and recreation, and accommodation and food services	4.7%	8.0%
Other services, except public administration	4.3%	4.5%
Public administration	5.1%	4.2%

Source: US Census Bureau, American Community Survey, 5-year profiles, 2019-23, www.census.gov/acs/www/data/data-tables-and-tools/data-profiles/

Appendix 2
Measuring the Net Economic Impact of the Change in Land Use

The conversion of agricultural land to a solar farm involves both positive and negative economic effects on the regional economy. The negative effects involve the reduction in farming activity, and the linkages that has on local suppliers of seed, feed, fertilizer, equipment and labor, summarized by a reduction in business activity employment and personal income. Many of the positive effects are described in the body of the report, including the one-time construction impacts, the several operations and maintenance jobs at the site, plus the increase in property tax payments to local jurisdictions. But there is also another important positive effect to consider – the impact of the annual lease payments to the farmland owners. This involves not only the actual new income, but also the regional spinoff impacts as the income is spent on goods and services in the local economy.

In this appendix, I attempt to account for all these factors and put them together to measure the net economic impact of the change in land use. No direct accounting-type information is available on actual farm operations at the solar site, but rich data are available on farmland activity at the county level. Using county data on crop yields, livestock production and prices provide a reasonable basis to estimate farm output at the solar site. Annual lease payments to the farmland owners, as provided by the solar developer, provides a fairly precise measure of the new income to the owners. If the lease information is not available, national studies can be used to approximate the rate per acres. Then I use a custom IMPLAN model of the county to predict the linkages of both farm output and new lease income to the local economy.

As context, it is useful to remember that many if not most farmers hold a nonfarm job in a nearby city or industrial site, as often do their spouses. The income from nonfarm work is generally much greater than what they can earn from actual farming, and is how the family is able to pay its bills. Because farming is a seasonal activity, farmers of midsize plots can work extra hours during the growing season and hopefully supplement their household incomes. I say hopefully because historical data reveal that net farm income is negative in many years.

Lost Economic Activity From Farming

1. Determine the solar site's share of county farmland. In most Kentucky contexts, the relevant components are acres harvested of corn for grain, acres harvested for soybeans, and inventory of cattle and other livestock. The county totals are published every five years in the Census of Agriculture, with 2022 the latest

available[14]. Farmland use at the solar site is estimated based on visual inspection, as it is not feasible to do an actual acre by acre survey. The distribution of farmland use at the site will be similar to the county distribution, to the extent the topography and soil quality is similar throughout the county.

2. Obtain the yield per acre and the value per bushel for corn and soybeans from the county tables in the Census of Agriculture. Multiply the site acreage by the yield and value to obtain farm revenues (Output) for the site. A similar calculation can be made for any livestock activity.

3. Use IMPLAN to simulate the Output loss in the county from the loss of farm activity. IMPLAN has three sectors that usually apply: Oilseed Farming (#1), Grain Farming (#2), and Beef Cattle Ranching and Farming (#11). If needed, there are also sectors for Dairy Cattle (#12), Poultry and Egg (#13), Other Animal Production (pigs and hogs) (#14). IMPLAN will return a statement of the direct, indirect and induced economic impacts in the county from the loss of the farm activity. It also provides a detailed listing of the impacted sectors in the county, such as farm supplies.

4. Care should be taken at this point to distinguish between Output and Value Added. Output is the total sales, while Value Added measures only the dollars that stick to the county. For example, if farmers purchase $50,000 of fuel most of those dollars go to the refinery in another county or state. Only the portion used to compensate the local distributor results in lost income in the county. Employment and Labor Income impacts are the most useful for our purposes.

New Income from Leasing Land to Solar Company

1. The solar farm developer will have confidential data on the contracted amount they will pay landowners for the use of their land each year. If the company will not release the lease payments, the only recourse is to estimate them based on studies of other places. According to a recent paper, “More rural areas with high land prices and high solar demand may be in the ballpark of $1,000 an acre near a substation with capacity. Areas where land price is much lower, and the land doesn’t offer much in the way of agriculture, may drop rent rates to around $500

[14] The 2022 Census of Agriculture statistics for Kentucky were released in February 2024. See www.nass.usda.gov/Publications/AgCensus/2022/Full_Report/Volume_1,_Chapter_2_County_Level/Kentucky/

per acre"[15]. Below, I use a midpoint estimate of $750 per acre for the solar site. The lease payments rise over time, but I do not have access to the details of the contracts.

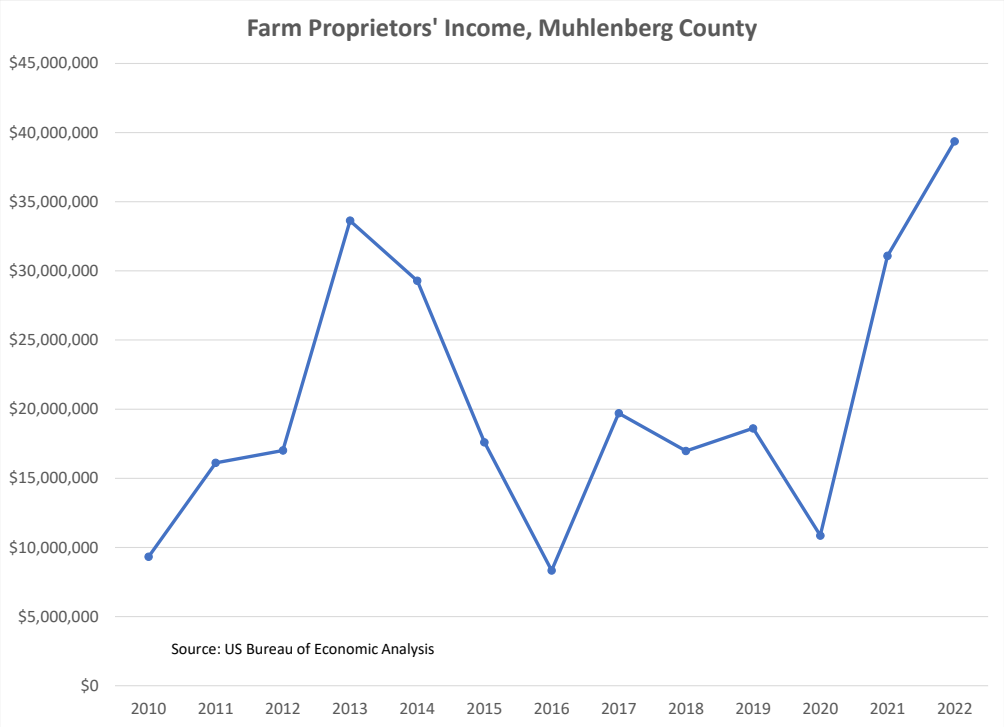
2. To estimate the economic impact of this new income, IMPLAN can be used again. This involves a simulation of new household income and spending, resulting in estimates of the impact on other sectors in the county. Changes to household income have predictable impacts on residential construction, retail sales, health care, insurance, banking, restaurants, entertainment, education and a large range of activities covered by the IMPLAN modeling system. We follow the methods employed in a recent Minnesota study, which allocates one-half the lease payments to net household income and the other half to payments on their real estate mortgage and other debts[16]. The more urbanized the county, the greater the portion of household spending that is captured in the county versus imported from other regions. Again, one should distinguish between Output and Value Added, so the focus is on the new dollars that stick to the county.

[15] These sites have good overviews of the factors involved: https://uslightenergy.com/news/solar-land-lease-rates-how-much-do-solar-companies-pay-to-lease-land/ and www.solarlandlease.com/lease-rates-for-solar-farms-how-valuable-is-my-land

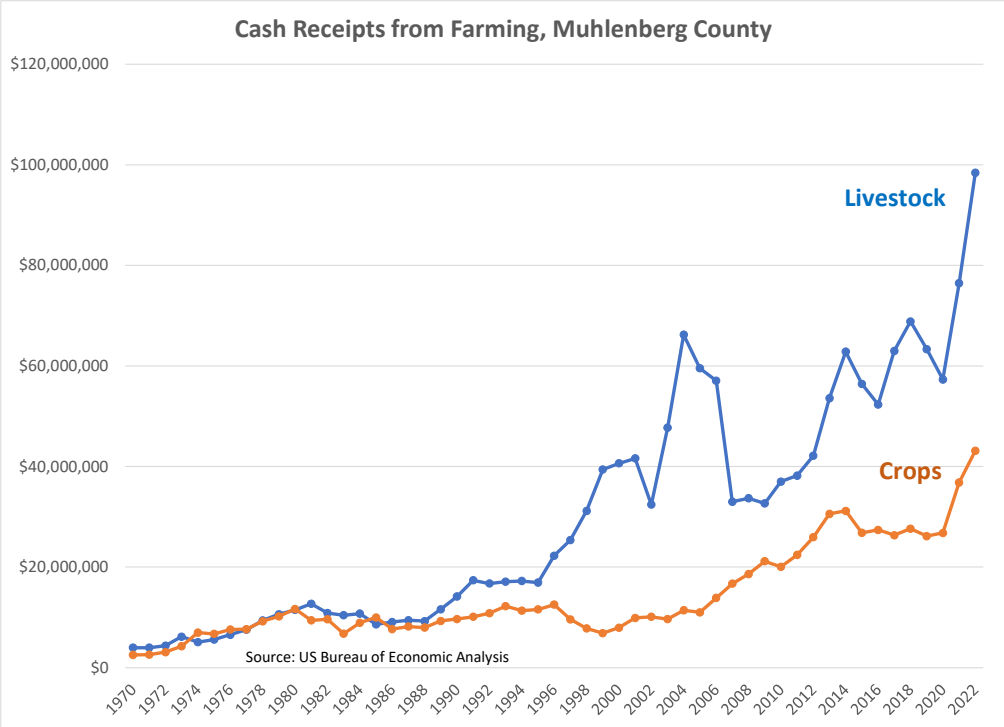
[16] See Economic Impacts of a Proposed Solar Energy Project in Freeborn County, Minnesota, by Brigid Tuck, University of Minnesota Extension, April 2021: https://conservancy.umn.edu/handle/11299/223053

Muhlenberg County

I now apply the method to the Lost City solar site, which is located in Muhlenberg County. Before estimating farm income at the site, it is worth looking briefly at agricultural conditions at the county level. The next chart shows net farm income over the past dozen years. Note the volatility of farm income due to changes in product prices and costs of production. The average over the period shown was about $20 million per year.



In the next chart, we see that livestock revenues are about twice that of crop revenues. The last Census of Agriculture, to be discussed in more detail next, revealed that poultry operations are the greatest source of livestock revenues in Muhlenberg County, followed by hogs and pigs, then cattle and calves. Soybeans are the principal crop, followed by corn and then hay.



A summary of 2022 Census of Agriculture results is provided in the next table. The solar site accounts for one percent of the farmland in Muhlenberg County. Soybeans accounted for about twice as much acreage as corn. Dividing bushels by acreage, we see that Muhlenberg County had an average soybean yield of 52 bushels per acre, For corn, Muhlenberg had a yield of 173 bushels per acre. Hay production averaged 2.1 tons per acre. Soybean revenue per bushel was $14.25, corn revenue per bushel was $7.01, and hay revenue was $59.41 per ton. Cattle sold for $673 per head.

A majority of the 1,400 acres leased for the project is forested, and only about 350 acres is expected to be removed from agricultural activity (with the possibility of adding sheep herds). Using estimated current land use provided by the developer, I am assuming 210 acres of soybeans, and 149 acres of pasture. I have estimated the number of cattle grazing, using the results of a study by the University of Kentucky[17]. They find that beef cows need two to four acres of pasture per head, depending on the soil quality and the amount of hay used as feed. Taking the midpoint value of three acres, this implies that the acreage would support about 47 head of cattle.

[17] https://agecon.ca.uky.edu/sacred-cows-and-stocking-rates

Summary Agricultural Statistics, Muhlenberg County	
Farms	583
Land in farms, acres	129,431
Corn for grain, acres	14,214
Corn for grain, bushels	2,453,120
Soybeans, acres	25,821
Soybeans, bushels	1,344,418
Hay, acres	15,263
Hay, tons dry equivalent	31,544
Broilers and other meat-type chickens sold, farms	11
number sold	7,620,400
Hogs and pigs sold, farms	7
number	140,024
Cattel and calve inventory	12,461
Cattle and calves sold	7,119
Corn, value sold (000)	$17,186
Soybeans, value sold (000)	$19,162
Hay, value (000)	$1,874
Poultry and eggs, value (000)	$66,081
Hogs and pigs, value (000)	$33,602
Cattle and calves sold, market value (000)	$4,788
Farm production expenses (000)	$107,213
Net cash farm income from operations (000)	$46,392
Farms with net gains	221
Farms with net losses	362
Government paymens received (000)	$1,518
Hired farm labor, workers	536
Hired farm labor (000), payroll	$9,706
Source: 2022 Census of Agriculture, Kentucky Sate and County Data, Volume 1, Geographic Area Series, Par 17, February 2024.	
www.nass.usda.gov/Publications/AgCensus/2022/Full_Report/Volume_1,_Chapter_2_County_Level/Kentucky/	

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Applying the countywide yields and prices, results in annual agricultural revenues of $174,000. I simulated this using the Muhlenberg County IMPLAN model, and the results are shown in the next table. The relevant sectors here are #1 Oilseed farming and #12 Cattle and calves. One can see that this method generates an estimate of less than one total job in the county, with labor income of $62,000. This reflects both the direct income from farming plus the income of those in the local supply chain (indirect) and those selling goods and services to households (induced).

Solar Site Agribusiness, Estimated County Impacts

Impact	Employment	Labor Income	Value Added	Output
Direct	0.39	$47,398	$117,913	$173,774
Indirect	0.11	$7,196	$10,007	$19,588
Induced	0.15	$7,142	$14,970	$25,215
Total	0.65	$61,736	$142,890	$218,577

Source: IMPLAN model of Muhlenberg County, using 2023 economic data.

The developer has indicated that they plan to deploy sheep to graze around the solar panels, and any associated income from paying shepherds or selling sheep products would mitigate some of the lost agricultural activity just discussed. However, the sheep grazing would reduce the need for mechanical mowing, which is implicitly included in my estimate of operations and maintenance jobs. I do not have enough information to net these offsetting factors out. Ideally, I would know the size of the sheep herd, as well as the reduction in maintenance budget for mechanical mowing.

These negative farm-related jobs and labor income need to be compared to the positive economic impacts related to the solar farm. Beyond the one-time construction impacts, the solar operation generates two new annual revenue streams – the operation of the solar site and the lease payments to farmland owners.

In the body of the report, I estimated that the operation of the solar farm will support about 22 jobs, with labor income of $1,341,000 annually. I assume the lease payments are $750 per acre, implying new household income of $1,059,750. This can be simulated in two ways, shown in Tables A and B. In Table A, I assume that all the lease income is available for household spending, using the income bracket $70,000 to $100,000 annually. This results in 4.0 jobs and $195,000 in new labor income in the county. The reader may wonder where the rest of the lease dollars went. Taxes and savings reduce

the amount available for spending. More importantly, in a rural county there are fewer goods and services available locally than in an urban county, and thus the dollars leak out of the county in the form of imports[18]. The most impacted sectors in Muhlenberg County are child day care services, hospitals, educational services, offices of dentists, home health care, and offices of physicians.

A. Estimated Annual Impact of Lease Payments

Impact	Employment	Labor Income	Value Added	Output
Direct	0.00	$0	$0	$0
Indirect	0.00	$0	$0	$0
Induced	3.97	$194,863	$379,800	$647,278
Total	3.97	$194,863	$379,800	$647,278

Source: IMPLAN model of Muhlenberg County, using 2023 economic data. All lease income simulated as increase in household income.

In Table B, the results are based on the assumption that one-half of lease income goes unrestricted to households in the income bracket $70,000 to $100,000. The other half is simulated as going to the banking system to pay down real estate mortgage and other debts[19]. The results are shown in the accompanying table. I estimate that the lease payments will support 4.8 jobs in Muhlenberg County, with labor income of $280,000. One can see that the estimated impacts are quite low in both cases. I will use the more conservative one, in Table A, in the net calculations below.

B. Estimated Annual Impact of Lease Payments

Impact	Employment	Labor Income	Value Added	Output
Direct	1.74	$134,652	$270,179	$529,875
Indirect	0.72	$32,334	$49,118	$114,014
Induced	2.33	$113,430	$223,249	$379,943
Total	4.79	$280,417	$542,546	$1,023,831

Source: IMPLAN model of Muhlenberg County, using 2023 economic data. Half the lease income treated as new household income; half as new expenditures in the banking system to pay down debts.

[18] By comparison, the same simulation in Jefferson County (Louisville) results in a total of 7.1 jobs, $455.000 in labor income, value added of $765,000, and total output of $1,294,000.
[19] IMPLAN sector 423 "Monetary authorities and depository credit intermediation".

In the body of the report, I estimated that the operation of the solar farm will support about 22 jobs, with labor income of $1.34 million annually. A quick comparison of the negative agricultural impacts with the positive impacts from operating the solar site reveals a small annual net gain in jobs and labor income, primarily due to the operations and maintenance jobs.

Estimated Net Annual Muhlenberg County Impacts

	Employment	Labor Income
Farming	-0.7	-$61,736
Solar operations	21.7	$1,340,816
Lease payments to landowners	4.0	$194,863
Net	25.0	$1,473,943

Looking out over three decades, and including the impacts of construction, there is a net gain of 839 job -years and $44.9 million in labor income to the county.

Estimated Net Economic Impact Over Three Decades

	Year 1 Construction	Years 2 through 29, annual average	Cumulative 30 years
Solar-related employment	743.1	4.0	858.2
Solar-related labor income	$41,146,553	$194,863	$46,797,575
Agricultural-related employment	-0.7	-0.7	-19.5
Agricultural-related labor income	-$61,736	-$61,736	-$123,472
Net employment	742.5	3.3	**838.7**
Net labor income	$41,084,817	$133,127	**$44,945,496**