Attachment G

ECONOMIC ANALYSIS

Mantle Rock Solar LLC

Livingston County, Kentucky

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FROM: Paul Coomes

RE: Estimated economic impact of Livingston County solar project

Executive Summary

Enerfin is developing a solar farm with 65 MW generating capacity on about 560 acres of rolling farmland in Livingston County KY. The company plans to invest approximately $70 million to develop the site, named *Mantle Rock*. 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 185 new jobs in the County in year one, with new labor income of $10.3 million. Livingston County levies a one percent occupational tax on wages, salaries and other compensation. Thus, assuming this construction projection materializes, the County would receive about $103,000 in one-time tax revenues.

Second, there will be three or four decades of new property-related tax payments to state and local jurisdictions in Livingston County due to the increased value of real, personal, and manufacturing property. The company projects a total of $2.7 million in property tax payments to local jurisdictions over the first thirty years, of which $1.8 million would flow to the County school system. The three land parcels currently generated about $2,250 in property tax revenues for local jurisdictions in 2023. This can be compared to an average of $89,000 likely to be generated per year by the solar project over the first thirty years of the project.

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 B, these are compared to the negative effects of lost agribusiness activity, revealing net annual gain in jobs and labor income over the operating period. Looking out over three decades, and including the impacts of construction, I estimate there is a net gain of 462 job-years and $22.8 million in labor income to Livingston County.

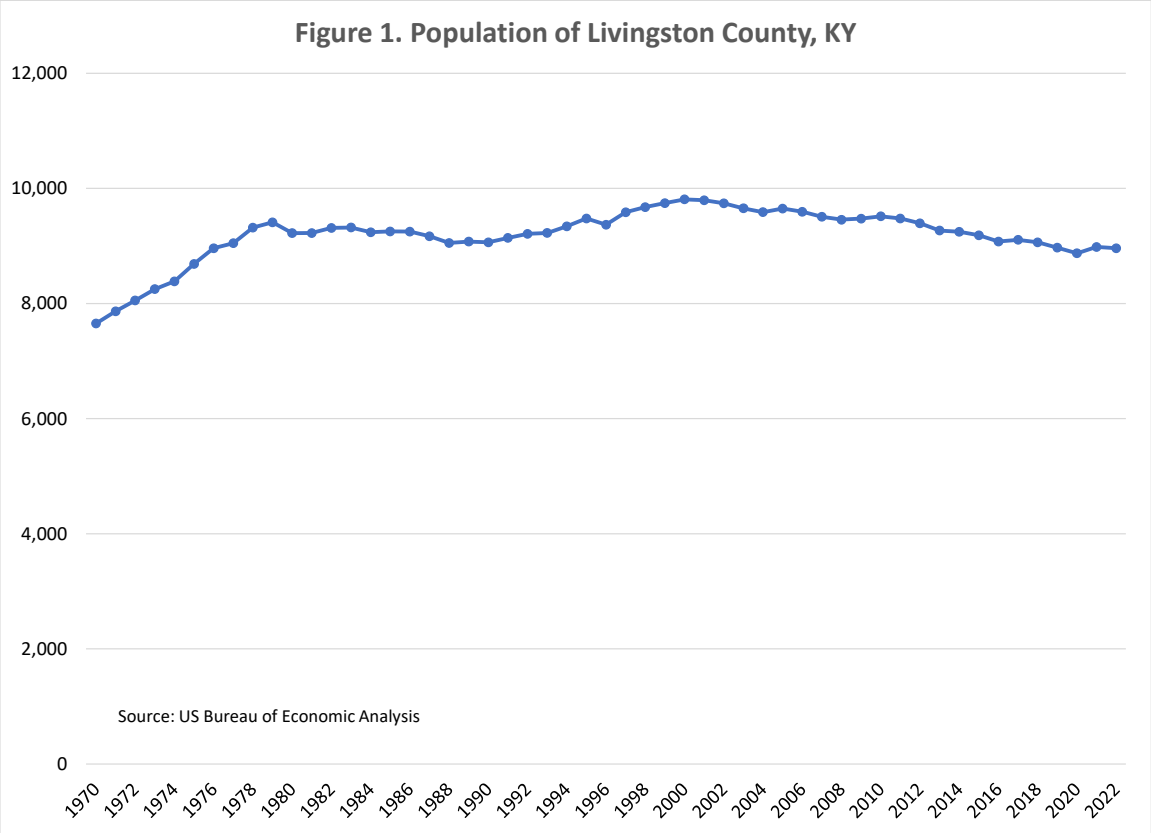
Demographic and Economic Characteristics of Livingston County

Livingston County is located in western Kentucky, along the Ohio River. The Google Earth Map screenshot below shows the approximate location of the solar farm. One can see that the site is very rural, far from any urban areas.

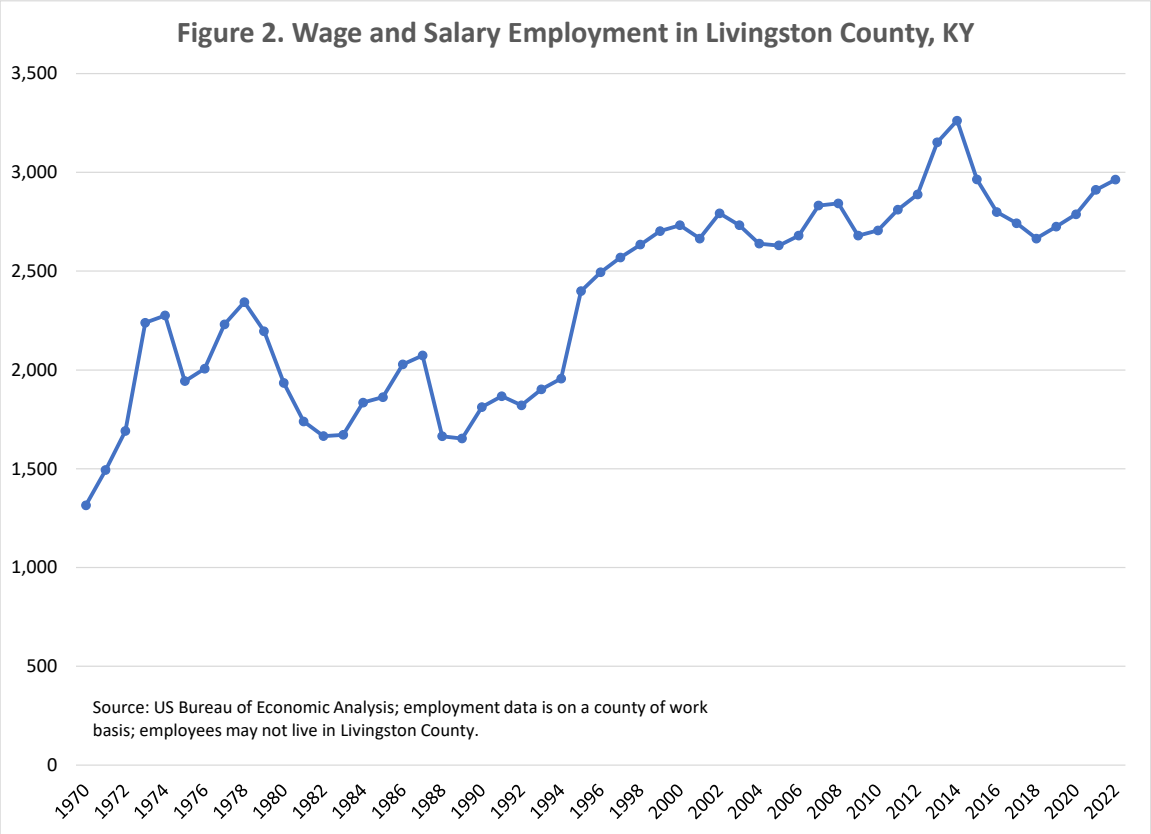
Newly released results from the 2022 American Community Survey provide a nice summary of demographic and economic characteristics of Livingston County. Some details are provided in Appendix A. A few things stand out:

- Compared to the Kentucky state average, the county population is older, whiter, native-born, and less likely to move.
- Few adults have a four-year college degree, and a large percentage of adults are not in the labor force.
- Residents tend to work disproportionately in construction industries around the region.
- Median household income was $56,100, compared to a state average of $60,200.

Livingston County's population has hovered around 9,000 over the past several decades (Figure 1). This demographic pattern is correlated with the number of jobs in the county, as is evident in Figure 2. The county gained about 800 jobs in the 1990 to 2000 decade, but has essentially had no net growth since, and had only about 3,000 wage and salary jobs in 2022. Without job growth, the population has fallen slightly over the past two decades. The county added about 1,000 jobs in the 1990s, and reached a peak of 3,300 wage and salary jobs in 2014, but has since given up several hundred of those job gains. I examined the employment history (by place of work) by major industry over the last two decades, and see a net decline in every major industry except construction.



It appears from historical data on personal income that the county residents are increasingly dependent on income from government transfer payments. It is the fastest growing component of personal income in Livingston County. The share of residents' personal income from government transfer payments rose from 20 to 36 percent over the last four decades. The value of those transfer payments, such as Social Security, Medicare, and Medicaid was $149.8 million in 2022 (out of a total of $410.4 million in personal income).



Data on commuting patterns are only published with a long lag, but reveal the historical interchange of workers to and from Livingston County. As is evident from Table 1, local residents fill 59 percent of the 2,500 jobs in the county, and a significant flow of nonresidents commute in to work in from Crittenden, McCracken and Marshall counties.

Consider now the opposite flow in Table 2, where Livingston County residents work. In this survey there were 3,793 working Livingston County residents, of which only 1,471 work in their home county. Where do the rest of the residents work? One can see the primary work locations in the next table.

Table 1. County of Residence of Workers in Livingston County, KY

Livingston County	1,471	58.8%
Crittenden County	361	14.4%
McCracken County	193	7.7%
Marshall County	143	5.7%
Trigg County	58	2.3%
Jefferson County	55	2.2%
Graves County	53	2.1%
Lyon County	36	1.4%
Christian County	25	1.0%
all other	105	4.2%
Total	2,500	100.0%

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

McCracken County (Paducah) clearly dominates the destinations, employing almost as many Livingston County residents as Livingston County itself. Paducah is by far the largest city in the region, and therefore has the most job opportunties in its industries. Nearby Marshall County is the second most imporatnat work destination.

The net outflow of workers from Livingston County shows up in the official estimates of personal income of residents. There was a $26 million positive 'residence adjustment' to earnings in the county for 2022, reflecting the fact that residents earned more from working outside the county than nonresidents earned working in the county.

Table 2. County of Work for Residents of Livingston County

Livingston County	1,471	38.8%
McCracken County	1,153	30.4%
Marshall County	726	19.1%
Crittenden County	123	3.2%
Lyon County	60	1.6%
Graves County	48	1.3%
Hardin County	41	1.1%
Massac County	36	0.9%
Weakley County	35	0.9%
All other	100	2.6%
Total	3,793	100.0%

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

Modeling the Economic Impacts

I take a conventional approach to modeling the regional economic impacts, using a customized input-output model of Livingston County[1]. 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 total regional economic activity to a change in activity by a local 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[2].

The relevant sector for the construction phase is number 52, "Construction of new power and communication structures", and I use this to model the initial investment. The employment multiplier for that sector in Livingston County is 1.182. 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 modest 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 Livingston County. This is because there is no history of solar electricity generation and therefore no basic economic data to construct industry relationships. However, there are supporting data at the statewide level, and I use those results to model the operations phase.

[1] For documentation of IMPLAN modeling, see www.implan.com/history/ . For this project I use economic data for 2019. While data for 2020 and 2021 are available now, they reflect abnormal pandemic conditions, and I do not believe they are representative of typical economic linkages.

[2] 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.

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 their increased incomes.

Direct effects

The company expects to invest approximately $70 million in the solar project. The investment involves land acquisition, site preparation, solar panel and electrical equipment installation, plus landscaping and security fencing. Enerfin plans to enter into an Engineering, Procurement, and Construction (EPC) contract 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 am using an estimate of average employment over a one-year construction phase. The results of a recent California study of six large photovoltaic projects suggests that there will be an average of 156 direct jobs over a twelve-month construction period for this project[3].

The California study also provides a range of results for construction wages and benefits, as shown in Table 3. 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. 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 then.[4]

[3] 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 Mantle Rock's 65 MW one gets 156 direct construction jobs. He shows the permanent operations jobs per MW, and applied to this project one gets 2.1 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

[4] 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

Table 3

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 company will pay local 'prevailing wages' by occupation for the construction. Prevailing wages are determined by federal surveys of employers, and are shown on the web site of the US Bureau of Labor Statistics (BLS). BLS publishes detailed wage estimates for hundreds of occupations at the state and metropolitan area level, but not at the county level.

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. There is no listing in the Kentucky data for "Solar Photovoltaic Installer", but the national average annual wage in 2023 was $53,140[5].

Table 4

Kentucky Wages for Related Occupations, 2023			
Occupation (SOC code)	Employment	Hourly Mean Wage	Annual Mean Wage
Construction Managers(119021)	1,280	$50.36	$104,750
Operating Engineers and Other Construction Equipment Operators(472073)	6,530	$27.45	$57,100
Electricians(472111)	9,620	$28.18	$58,610
Fence Erectors(474031)	260	$20.19	$41,980
Industrial Engineers(172112)	6,020	$43.76	$91,010
Materials Engineers(172131)	500	$46.99	$97,740
Mechanical Engineers(172141)	2,970	$47.55	$98,900
Heating, Air Conditioning, and Refrigeration Mechanics and Installers(499021)	6,500	$25.90	$53,870
Electrical Power-Line Installers and Repairers(499051)	2,870	$35.72	$74,300
Telecommunications Line Installers and Repairers(499052)	900	$27.19	$56,560

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

Good inferences about other relevant occupations can be gleaned from the Kentucky state estimates in Table 4. The construction managers are likely to earn over $100,000,

[5] 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 data, see www.bls.gov/oes/current/oes_ky.htm County-level data are not available.

heavy equipment operators and installers over $53,000, electricians around $58,000, and fencers $42,000. The average annual pay for all wage and salary jobs in Livingston County in 2022 was $54,295[6]. Based on this information, I assume the average annual pay across the construction occupations will be $50,000.

Multiplying the expected jobs times the assumed average pay per job yields a direct construction payroll of $7.8 million. The average fringe benefits, such as employer payments for health insurance, in Kentucky for the construction industry is 21 percent[7]; so, total labor compensation for these jobs is $9.5 million, or $60,700 per job.

Total impacts in Livingston County from construction

The construction phase will have some spin-off effects in Livingston County, due to materials and labor purchased locally. The economic impact of local supplies purchased is called the indirect effect, and the impact of new local household spending is called the induced effect. 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 Livingston County multipliers for the relevant construction sector, and the direct construction budget, I project there will be a total of 185 new jobs in the county, and new labor compensation of $10.3 million.

Table 5 illustrates the various impact components across several standard economic measures. It is stated in terms of 100 direct jobs, but can be scaled up to fit any assumed number of construction jobs. 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 induced effect is small due to the lack of retail and service businesses in the county to absorb the new household income linked to the construction jobs.

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

[7] BEA provides estimates of both total compensation and total wages by industry for the state. Dividing total construction industry compensation by wages in 2021 yields 1.21.

Table 5

100 Jobs in Sector 52, Construction of new power and communication structures				
Impact Type	**Employment**	**Labor Income**	**Value Added**	**Output**
Direct Effect	100.0	$8,852,143	$14,088,398	$20,477,690
Indirect Effect	6.9	$337,164	$661,487	$1,469,282
Induced Effect	11.4	$422,512	$1,018,447	$1,868,004
Total Effect	118.2	$9,611,818	$15,768,332	$23,814,976
implied multiplier	*1.182*	*1.086*	*1.119*	*1.163*

Source: IMPLAN model of Livingston County, using 2022 economic data.

Wider regional impacts from construction

Some readers may wonder why I have focused on impacts in Livingston 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 Livingston 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, I built another IMPLAN model, this time of Crittenden, Livingston, McCracken and Marshall counties. McCracken (Paducah) is by far the most populous county in the region, and will no doubt supply many workers to the project, as well as absorb a lot of the new household spending. The results are a bit larger than that of the Livingston-only simulation, primarily because of the inclusion of the more urbanized and adjacent McCracken County.

The job multipliers for the solar farm construction phase are 1.182 for Livingston County alone, and 1.392 for the four-county region, for a net change of 33 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. That job multiplier for the solar farm is 1.539, a bit higher than that for the four-county region. Based on our impact analysis tools, there are not significant differences in the predicted regional impacts when zooming out to

adjacent counties or statewide[8]. In this case, the economic multipliers are relatively small whether one models one county, four, or 120. This is due to the lack of industrial linkages in the region to the solar industry.

Impact of Ongoing Operations

As mentioned in the above discussion of modeling methods, the IMPLAN sector for solar farm operations is empty of data for Livingston County. However, state-level results became available with the 2022 IMPLAN data release, and I apply those here. The California PV study cited above found that a ratio of 31.3 MW per permanent operations job. Applied to the Livingston County project, this results in an estimate of 2.1 direct permanent operational jobs at the site. Applying the Kentucky state model results yields a prediction of 6.2 total jobs and $399,000 in annual labor income in the county.

[8] 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.

Local Tax Revenues

Livingston 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 6 provides the latest published tax rates that are applied County-wide. They total less than one percent of the assessed value of real property, with about 54 percent of the revenue going to the County public school system. There are four municipal taxing jurisdictions in Livingston County – Carrsville, Grand Rivers, Salem and Smithland - but the project is outside their city boundaries and thus would not be subject to those property taxes.

Table 6

Livingston County Property Tax Rates, 2023

in cents per $100 valuation

Jurisdiction	Real Estate	Tangible Personal	Manufacturers' Machinery
Ambulance	5.00	5.00	
Extension Service	5.10	6.63	
Fiscal Court	11.90	16.70	
Health	3.00	3.00	
Soil Conservation	1.56	0.00	
County Public Schools	45.50	45.50	
State of Kentucky	11.40	45.00	15.00
Total, County-wide	83.46	121.83	15.00

Source: Kentucky Department of Revenue

https://revenue.ky.gov/News/Publications/Pages/Property-Tax-Rate-Books.aspx

Livingston County also levies a one percent occupational tax on wages, salaries and "other compensation".[9] Thus, if the construction phase generates a payroll in the County of $10.3 million, the County Fiscal Court would receive a one-time increase in tax revenues of about $103,000. The County also levies a similar tax on net profits – as do most jurisdictions that levy an occupational tax. However, I have no basis to project taxable profits from the development.

[9] See http://livingstoncountyky.org/tax.php

The company may pursue an Industrial Revenue Bond (IRB) for the project through Livingston County Fiscal Court. Under an IRB, the County actually owns the property for the likely 30-40 year life of the bond, and thus is exempt from property taxes. Under the IRB the company makes the debt service payments and the County incurs no financial risk. Moreover, the company would likely agree to make Payments in Lieu of Taxes (PILOT) each year to replace the tax revenues that the IRB exempts.

The company has provided me with a property tax projection for their intended investment. Without an IRB, the company expects over the subsequent thirty years to pay $2.7 million in property taxes to local jurisdictions, of which $1.8 million would be to the County school system. If an IRB were used here, the local property taxes paid would be much less, though typically a PILOT is made by the developer to offset any resulting reduction in tax revenues.

The company also provided me with the parcel numbers of the land for the site, and I looked up recent property tax assessments through the website of the Livingston County Property Valuation Assessor's offices. There are three land parcels currently leased at the site, and PVA data show the land in 2023 had certified cash value of $1,240,500. However, because of farm exemptions, the taxable value was only $269,000, with total taxes paid in 2023 of $2,250. This can be compared to an average of $89,000 generated by the solar project per year over the first three decades of the project. 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.

Appendix A

Demographic and Economic Characteristics of Livingston County		
	Livingston County	**State of Kentucky**
Number of residents	*8,980*	*4,502,935*
Median age	46.0	39.1
Percent white	96.0%	84.8%
Percent of noninstitutionalized population w disability	31.2%	17.6%
Percent foreign-born	0.50%	4.10%
Percent 18 and older veteran	7.3%	7.0%
Percent living in same house as a year ago	93.1%	86.6%
High school attainment rate, population aged 25+	87.0%	88.2%
College attainment rate, population aged 25+	13.2%	26.5%
Number of Households	3,537	1,769,102
Median household income	$56,125	$60,183
Persons per household	2.54	2.55
With broadband internet subscription	83.0%	85.6%
Population 16+	*7,432*	*3,607,440*
In the labor force	55.0%	59.5%
Employed civilian	51.6%	56.1%
Unemployed	3.4%	3.0%
Armed forces	0.0%	0.4%
Not in labor force	45.0%	40.5%
Median travel time to work (minutes)	26.9	23.9
Civilian employed population 16 years and over	*3,837*	*2,025,396*
Management, business, science, and arts occupations	27.0%	36.4%
Service occupations	16.3%	15.7%
Sales and office occupations	16.9%	20.6%
Natural resources, construction, and maintenance occupations	16.4%	8.8%
Production, transportation, and material moving occupations	23.4%	18.6%
Industry		
Agriculture, forestry, fishing and hunting, and mining	4.1%	1.8%
Construction	12.6%	6.2%
Manufacturing	10.2%	14.2%
Wholesale trade	5.5%	2.3%
Retail trade	11.5%	11.8%
Transportation and warehousing, and utilities	5.6%	6.8%
Information	2.5%	1.4%
Finance and insurance, and real estate and rental and leasing	1.6%	5.6%
Professional, scientific, and mgmt, and admin and waste mgmt services	8.8%	9.0%
Educational services, and health care and social assistance	20.9%	24.0%
Arts, entertainment, and recreation, and accommodation and food services	9.4%	8.1%
Other services, except public administration	4.7%	4.5%
Public administration	2.4%	4.3%

Source: US Census Bureau, American Community Survey, 5-year profiles, 2018-22, https://www.census.gov/acs/www/data/data-tables-and-tools/data-profiles/

Appendix B

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[10]. 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

[10] 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"[11]. 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.

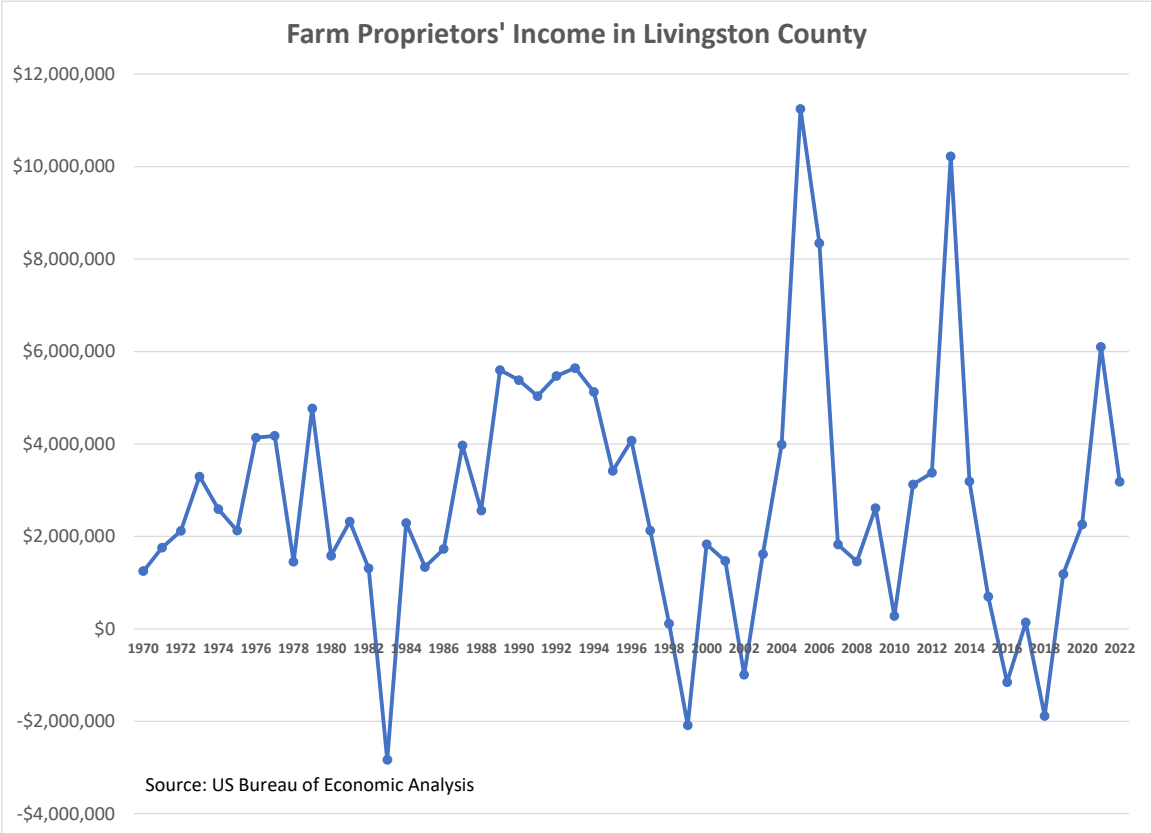
2. To estimate the economic impact of this new income, IMPLAN can be used again. This involves a simulation of new household income and spending, resulting in estimates of the impact on other sectors in the county. Changes to household income have predictable impacts on residential construction, retail 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[12]. 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.

[11] 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

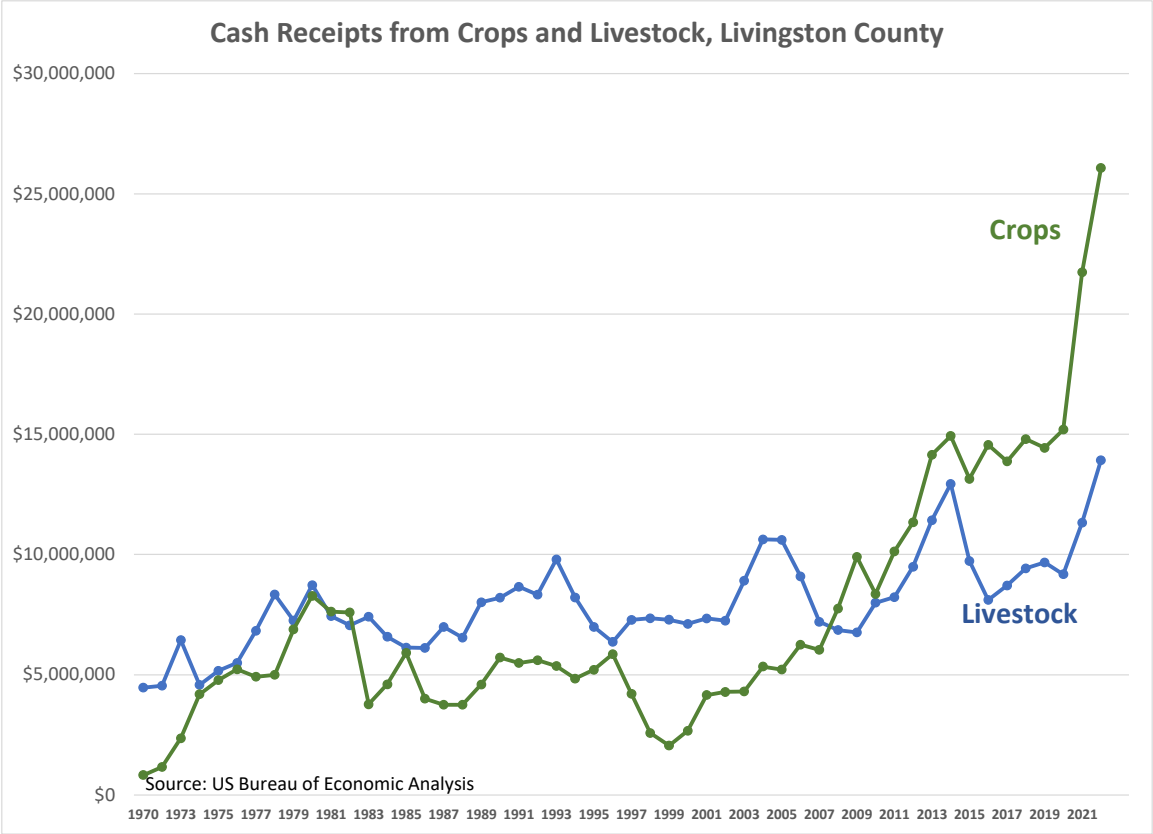
[12] See Economic Impacts of a Proposed Solar Energy Project in Freeborn County, Minnesota, by Brigid Tuck, University of Minnesota Extension, April 2021: https://conservancy.umn.edu/handle/11299/223053

Livingston County

I now apply the method to the Mantle Rock solar site, which is located Livingston 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 five decades. Note the volatility of farm income due to changes in product prices and costs of production. The average over the period shown was $2.8 million per year.



In the next chart, we see that crop revenues are now twice that of livestock revenues, reversing the pattern of two decades earlier. The last Census of Agriculture, to be discussed in more detail next, revealed that poultry operations are the greatest source of livestock revenues in Livingston County, followed by hogs and pigs, then cattle and calves. Soybeans are the principal crop, followed by corn and then hay/pasture.



A summary of 2022 Census of Agriculture results is provided in the next table. The solar site accounts for about four-tenths of one percent of the farmland in Livingston County. Soybeans accounted for about 35 percent more acreage as corn. Dividing bushels by acreage, we see that Livingston County had an average soybean yield of 35 bushels per acre, For corn, Livingston County had a yield of 148 bushels per acre. Winter wheat averaged 86 bushels per acre. Hay production averaged 2.3 tons per acre. And 42 percent of cattle inventory were sold that year. Soybean revenue per bushel was $14.14, corn revenue per bushel was $6.84, winter wheat revenue was $7.44 per bushel, and hay revenue was $56.17 per ton. The average price per cow sold was $866.

According to the developer, the 560-acre site currently supports several agricultural activities. The largest land use is pasture and hay, accounting for just over one-half the acreage. Soybeans account for 17 percent, corn 9 percent, and winter wheat 3 percent of the acreage. The remaining land is forested or nonfarm acreage. I have estimated the number of cattle grazing, using the results of a study by the University of Kentucky[13]. They find that beef cows need two to four acres of pasture per head, depending on the soil

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

quality and the amount of hay used as feed. Taking the midpoint value of three acres per head, this implies that the acreage would support about 100 head of cattle.

Summary Agricultural Statistics, Livingston County, 2022	
Farms	360
Land in farms, acres	144,892
Corn for grain, acres	20,618
Corn for grain, bushels	3,058,207
Soybeans, acres	27,882
Soybeans, bushels	963,375
Winter wheat for grain, acres	2,422
Winter wheat for grain, bushels	208,160
Hogs and pigs sold, farms	6
number	2,431
Cattel and calve inventory	13,864
Cattle and calves sold	5,850
Corn, value sold (000)	$20,910
Soybeans, value sold (000)	$13,618
Winter wheat for grain, value (000)	$1,549
Hogs and pigs, value (000)	D
Cattle and calves sold, market value (000)	$5,064
Farm production expenses (000)	$33,314
Net cash farm income from operations (000)	$17,013
Farms with net gains	187
Farms with net losses	173
Government paymens received (000)	$1,115
Hired farm labor, workers	142
Hired farm labor (000), payroll	$1,918
Geographic Area Series, Part 17, February 2024.	
www.nass.usda.gov/Publications/AgCensus/2022/Full_Report/Volume_1,_Chapter_2_County_Level/Kentucky/	

Applying county-wide yields and prices to the agricultural activity at the site gives us an estimate of the total annual agricultural revenue, as shown in the next table. Total estimated cash receipts are $147,000.

Estimate of Annual Agricultural Revenues at Solar Site	
Corn	$53,375
Soybeans	$46,780
Winter wheat for grain	$10,361
Cattle	$36,064
Total farm revenues	$146,580

Next, I use IMPLAN to simulate the full economic impact of these revenues on the county. One can see that this agricultural activity is predicted to support almost two jobs in the county and $40,000 in labor income.

Solar Site Agribusiness, Estimated Negative County Impacts

Impact	Employment	Labor Income	Value Added	Output
Direct	1.21	$27,318	$78,846	$146,580
Indirect	0.43	$10,568	$17,268	$33,073
Induced	0.07	$2,597	$6,278	$11,470
Total	1.72	$40,483	$102,391	$191,122

Source: IMPLAN model of Livingston County, using 2022 economic data.

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 6 jobs, with labor income of $399,000 annually. I assume the lease payments are $750 per acre, implying new household income of $420,000. I simulate that one-half goes unrestricted to households in the income bracket $70,000 to $100,000. The other half is simulated at going to the banking system to pay down real estate mortgage and other debts. The results are shown in the accompanying table. I estimate that the lease payments will support 1.5 jobs in Livingston County, with labor income of $72,000.

Estimated Annual Impact of Lease Payments				
Impact	Employment	Labor Income	Value Added	Output
Direct	0.71	$41,538	$77,903	$210,000
Indirect	0.20	$6,778	$10,417	$28,586
Induced	0.61	$23,206	$54,044	$99,390
Total	1.53	$71,522	$142,365	$337,976

Source: IMPLAN model of Livingston County, using 2022 economic data.

Summarizing, one can see that the negative agricultural impacts are more than offset by the positive impacts from operating the solar site, revealing an annual net gain in jobs and labor income.

Estimated Net Annual Livingston County Impacts		
	Employment	Labor Income
Farming	-1.2	-$27,318
Solar operations	6.2	$ 398,642
Lease payments to landowners	1.5	$71,522
Net	6.5	$442,845

Looking out over three decades, and including the impacts of construction, there is a net gain of 462 job -years and $22.8 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	186.0	7.8	410.8
Solar-related labor income	$10,351,237	$470,164	$23,985,982
Agricultural-related employment	1.7	1.7	51.5
Agricultural-related labor income	-$40,483	-$40,483	-$80,966
Net employment	187.7	9.5	**462.3**
Net labor income	$10,310,754	$429,681	**$22,771,491**