Attachment F

Economic Impact Report

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FROM: Paul Coomes

RE: Estimated economic impact of Graves County solar project

Executive Summary

GreenGo Energy US, Inc. (GreenGo) is developing a 120MWac photovoltaic solar powerplant facility with 30MWac battery energy storage system (BESS), known as Banjo Creek Solar LLC (Banjo Creek or the Project) on about 1,200 acres of farmland south of Farmington, in Graves County KY. The company plans to invest approximately $248 million to develop the Project, including both hard and soft costs, both on the ground in Kentucky and outside the state. 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 to one and a half years. Using estimates of the construction payroll, I estimate that there will be a total (direct and spinoff) of 323 new jobs in the County in year one, with new labor compensation of $23.1 million.

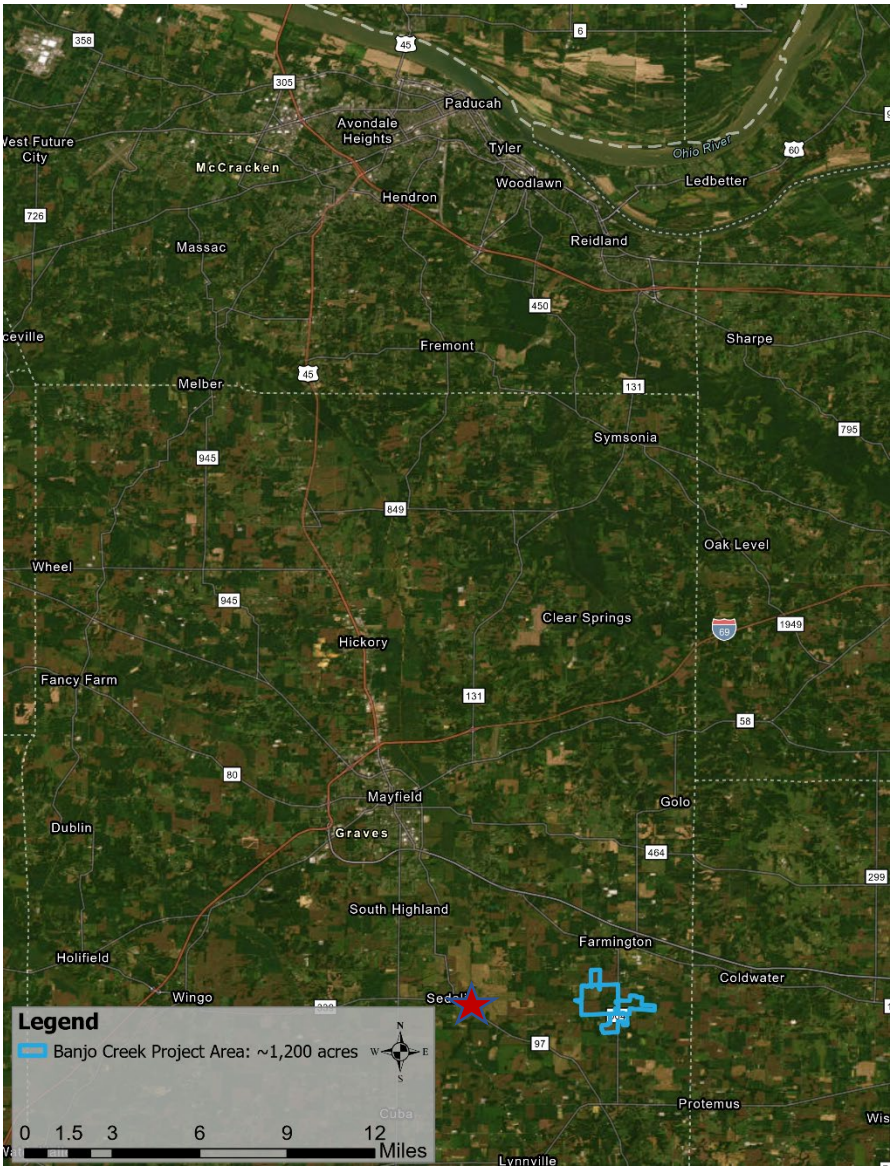
The Graves County Fiscal Court levies an occupational tax of one percent on employees' wages, salaries and other compensation. If all the construction-related compensation were taxed, this would yield a one-time increase of $231,000 in new tax revenue. The company has provided me with tax projections related to their capital expenditures. Over the first forty years, Kentucky state government is projected to receive $4.7 million over the subsequent four decades. Local jurisdictions would receive $3.2 million, of which $2.1 million would go to the County school system. The thirteen land parcels generated about $7,000 in property tax revenues for local jurisdictions in 2022. The

Project is projected to generate an average of $80,000 in property tax revenues locally per year for over forty years. This is approximately eleven and a half times larger than current property tax payments from the farmland.

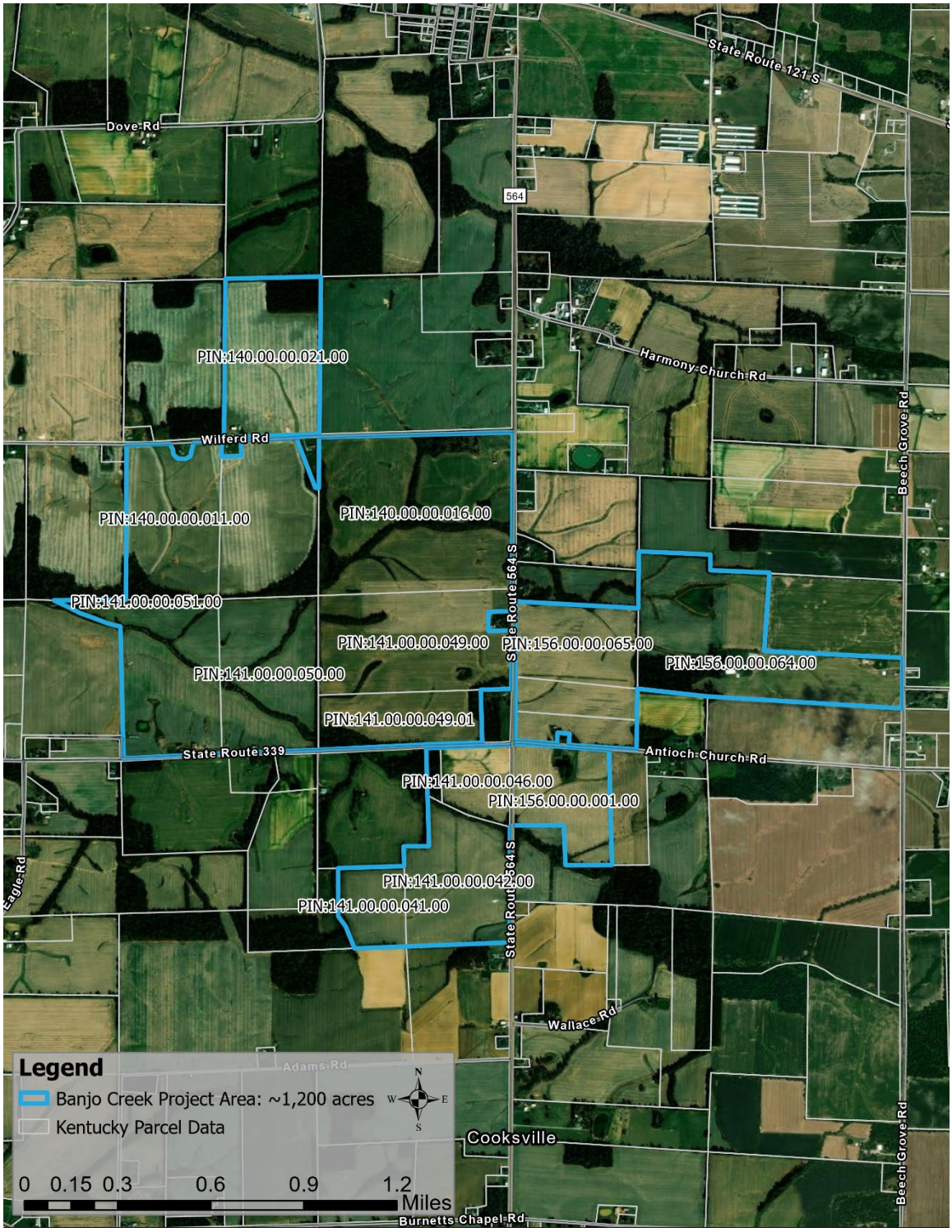
Demographic and Economic Characteristics of Graves County

Graves County is located in far western Kentucky, just south of Paducah. The solar site is near Farmington, which is about ten miles southeast of the Graves County seat of Mayfield. One can see the basic geography in Map 1. The red star indicates the approximate location of the proposed Banjo Creek solar farm.

Map 1:



Map 2:



The company also provided me with a site map, shown above (Map 2). One can see that the site is rural, mainly rolling farmland.

Newly released results from the 2021 American Community Survey provide a nice summary of demographic and economic characteristics of Graves County. Some details are provided in Table 7 at the end of this report. For many of the measures, the County is similar to the State, for example median age, persons per household, and commute times. However, the County differs from the state average in a few areas:

- Compared to the Kentucky state average, the County population is whiter, less likely to be foreign-born, and less likely to have moved recently.
- Fewer adults have a four-year college degree, and a larger percentage of adults are not in the labor force.
- Residents tend to work disproportionately in construction and manufacturing industries around the region, and in construction, production and transportation occupations.
- Median household income was $48,200, compared to a state average of $55,500.

Graves County's population has been flat over the past several decades, and there are now around 36,600 residents. It has grown 19 percent over the period shown below in Chart 1 (1969 to 2021), with some slippage in the 1980s. Interestingly, this demographic pattern is not very correlated with the number of jobs in the County, as is evident in Chart 2.

The County gained 1,600 jobs in the 1980s while losing about 500 residents. And the County then began losing jobs after they peaked around 2000, but then gained about 200 residents. The County added on net 3,200 jobs in the 1970 to 2000 period, driven particularly by growth in manufacturing employment in the 1980s. However, since then the County has lost about half of its manufacturing jobs, and growth in other sectors has not been sufficient to prevent an overall net loss of jobs (Chart 3). The only sector that added significant employment over the past two decades was accommodations and food services (hotels and restaurants). But their combined growth was only 640 jobs, not enough to offset the loss of 1,100 manufacturing jobs. Moreover, average pay in the growing hospitality sector is much less than that in manufacturing.

Chart 1:

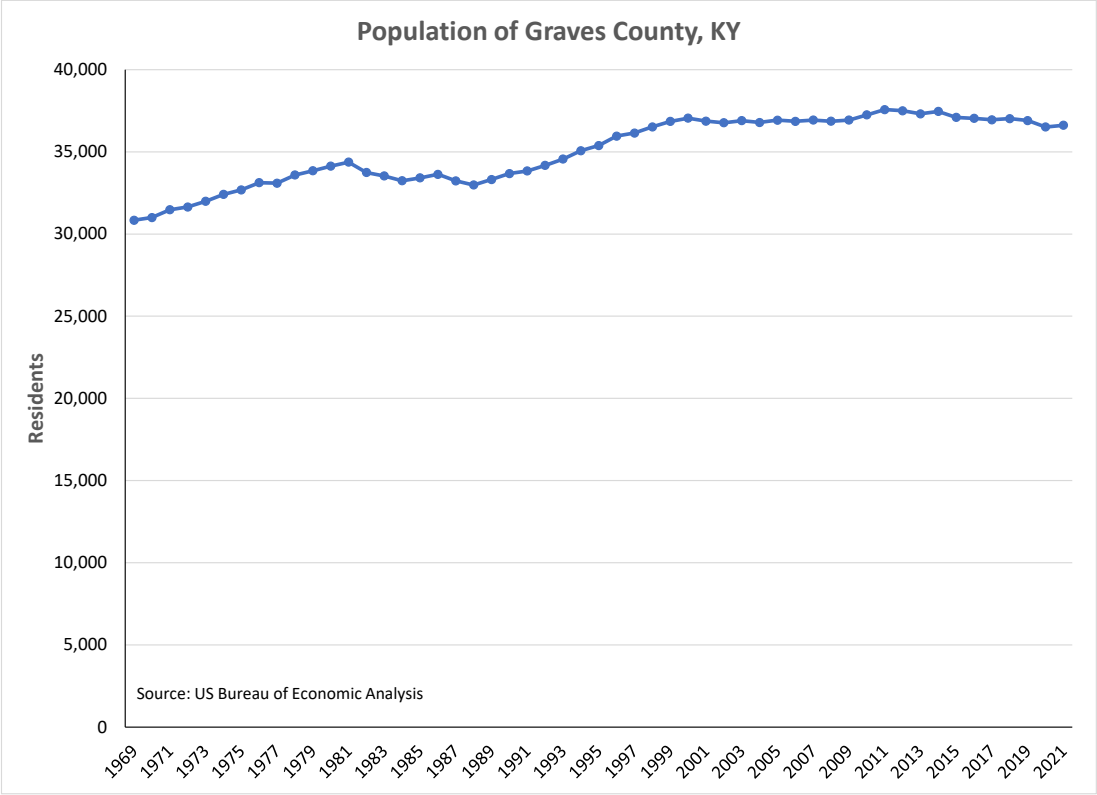


Chart 2:

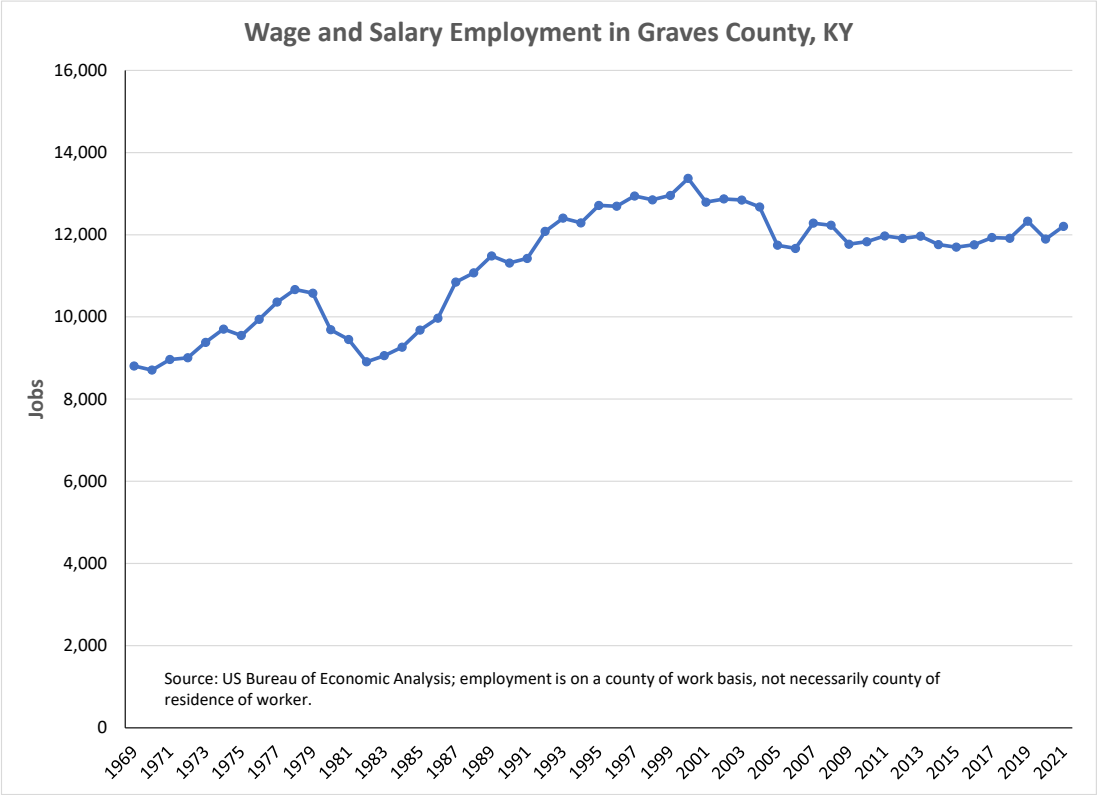
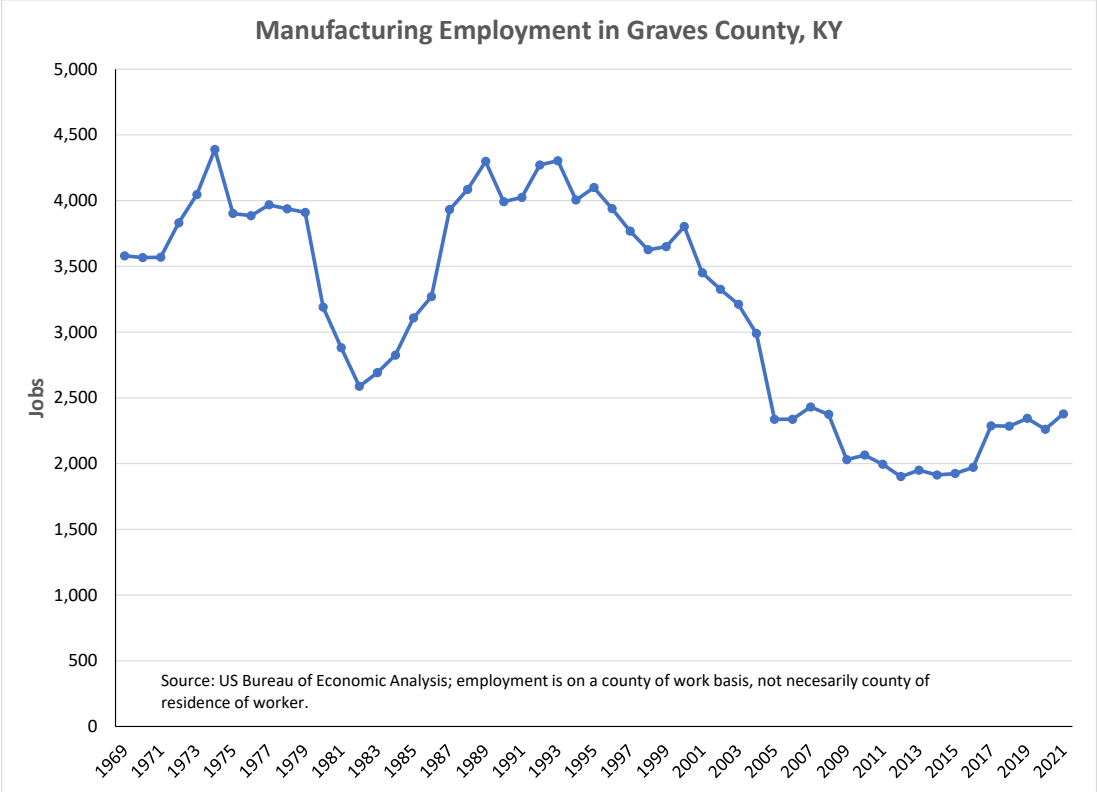


Chart 3:



The loss of manufacturing jobs in Graves County evidently did not cause much of a change in commuting patterns. Graves is adjacent to McCracken County, home of Paducah –the largest city in far western Kentucky. Personal income data reveal that historically, between 7 and 11 percent of personal income of Graves County residents is derived from the net inflow of dollars from residents working outside the county. In 2021, $129 million more was earned by county residents working outside the county than by nonresidents working in the county. This commuting out to Paducah and other nearby places of work has helped stabilize the income and population of Graves County.

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 Graves County. The share of residents' personal income from government transfer payments rose from 14 to 37 percent over the last five decades. The value of those transfer payments to residents, such as Social Security, Medicare, and Medicaid was $647 million in 2021. By contrast, wages and salaries paid to workers in the County were only $519 million.

Data on commuting patterns are only published with a long lag, but reveal the historical interchange of workers to and from Graves County. We see that there is a net outflow of workers to surrounding counties (Table 1). Local residents fill 81 percent of the 12,300 jobs in the County, with a significant flow of nonresidents commuting into work from McCracken, Calloway, Carlisle, Hickman, Marshall, and Fulton counties.

Consider now the opposite flow, where Graves County residents work. In this survey, there were 15,540 working Graves County residents, of which 64 percent worked in their home county. One can see the primary work locations in Table 2. McCracken, Calloway, Marshall, and Fulton counties are the primary destinations. McCracken County (Paducah) is by far the most developed area in the region, with diversified industries, many more high-paying jobs, and a full complement of retail and services. It is only 27 miles between Mayfield and Paducah.

Table 1:

County of Residence of Workers in Graves County, KY		
Graves County	9,901	80.5%
McCracken County	637	5.2%
Calloway County	397	3.2%
Carlisle County	312	2.5%
Hickman County	217	1.8%
Marshall County	210	1.7%
Fulton County	148	1.2%
Weakley County, TN	113	0.9%
all other	366	3.0%
Total	12,301	100.0%

Source: US Census Bureau, American Community Survey, Residence County to Workplace County Commuting Flows, 5-Year ACS, 2011-2015.

Table 2:

County of Work for Residents of Graves County		
Graves County	9,901	63.7%
McCracken County	2,699	17.4%
Calloway County	985	6.3%
Marshall County	590	3.8%
Fulton County	290	1.9%
Obion County, TN	182	1.2%
Hickman County	138	0.9%
Ballard County	113	0.7%
All other	642	4.1%
Total	15,540	100.0%

Source: US Census Bureau, American Community Survey, Residence County to Workplace County Commuting Flows, 5-Year ACS, 2011-2015.

Modeling the Economic Impacts

I take a conventional approach to modeling the regional economic impacts, using a customized input-output model of Graves 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 Graves County is 1.322. 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. Moreover, the County is not developed enough to supply all the goods and services demanded by households, and thus the predicted impact of the new construction wages is also relatively small as would be the impact of new wages from any development until Graves County is developed enough to supply all goods and services demanded by households.

There will also be some modest spin-off impacts from ongoing operations. Unfortunately, for the operations phase, the relevant IMPLAN sector, number 42,

[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.

"Electric Power Generation – Solar", is empty of data and results for Graves County. This is because there is no history of solar electricity generation and therefore no basic economic data to construct industry relationships. The sector is also empty of data for the statewide model.

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 and a half years, 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 expects to invest approximately $248 million in the solar project. This includes both hard and soft costs, and a mixture of spending in Kentucky and outside the state. The investment involves land acquisition, site preparation, solar panel and electrical equipment installation, plus landscaping and security fencing. GreenGo 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 and a half years construction phase. The results of a recent California study of six large photovoltaic projects suggests that there will be an average of 288 direct jobs over a twelve to eighteen-month construction period for this project[3].

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			

[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 the Graves County project's 120 MW one gets 288 direct construction jobs. He shows the permanent operations jobs per MW, and applied to this project one gets 3.8 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

The California study also provides a range of results for construction wages and benefits. The lowest average annual construction wage reported was $52,736, and the average wage across the six projects was $78,002, as shown in Table 3. 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]

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 2021 was $50,710[5].

Table 4:

	Kentucky Wages for Related Occupations, 2021			
SOC code	Occupation	Employment	Hourly mean wage	Annual mean wage
11-9021	Construction Managers	980	$46.54	$96,800
47-2073	Operating Engineers and Other Construction Equipment Operators	5,930	$24.80	$51,580
47-2111	Electricians	9,260	$25.66	$53,370
47-4031	Fence Erectors	60	$16.77	$34,880
17-2112	Industrial Engineers	320	$41.01	$85,300
17-2131	Materials Engineers	2,370	$45.47	$94,570
17-2141	Mechanical Engineers	1,210	$39.23	$81,600
49-9021	Heating, Air Conditioning, and Refrigeration Mechanics and Installers	5,790	$24.27	$50,470
49-9051	Electrical Power-Line Installers and Repairers	2,930	$32.41	$67,410
49-9052	Telecommunications Line Installers and Repairers	1,170	$23.25	$48,350
	Source: US Bureau of Labor Statistics, Occupational Employment Survey, www.bls.gov/oes/current/oes_ky.htm			

Good inferences about other relevant occupations can be gleaned from Table 4. The construction managers are likely to earn over $90,000, heavy equipment operators and installers over $50,000, electricians around $53,000, and fencers $35,000. The average annual wages and salaries for all such jobs in Graves County in 2021 was $42,520[6].

[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

[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.

[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.

Based on this information, I assume the average annual pay across the construction occupations will be $50,000, excluding fringe benefits.

Multiplying the expected number of jobs times the assumed average pay per job yields a direct construction payroll of $14.4 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 assumed for these jobs is $17.5 million, or $60,700 per job.

Total impacts in Graves County from construction

The construction phase will have spin-off effects in Graves 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 Graves County multipliers for the relevant construction sector, and the direct construction budget, I project there will be a total of 381 new jobs in the County, and new labor compensation of $23.1 million.

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	$4,310,146	$6,773,085	$12,951,479
Indirect Effect	14.9	$725,852	$1,234,329	$2,442,246
Induced Effect	17.3	$663,587	$1,308,630	$2,463,201
Total Effect	132.2	$5,699,585	$9,316,044	$17,856,925
implied multiplier	*1.322*	*1.322*	*1.375*	*1.379*

Source: IMPLAN model of Graves County, using 2019 economic data.

Table 5 illustrates the various impact components across several standard economic measures. These are stated in terms of 100 direct jobs, but can be scaled up or down to

[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.

fit any assumed number of construction jobs[8]. Note that both the indirect and induced effects are small. The indirect effect is small due to the lack of local suppliers of solar farm materials. The 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. Both of these constraints may indicate opportunity for further economic growth in Graves County.

Wider regional impacts from construction

Some readers may wonder why I have focused on impacts in Graves 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 Graves 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 in the region.

To investigate possible broader regional impacts, I built another IMPLAN model, this time of Graves plus Calloway, Carlisle, Hickman, McCracken and Marshall counties. The results are slightly larger than that of the Graves-only simulation.

The job multipliers for the solar farm construction phase are 1.322 for Graves alone, and 1.450 for the six-county region, for a net change of 37 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 1.564, slightly higher than that for the six-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[9]. In this case, the economic multipliers are relatively small whether one models one county, seven, or 120. This is due primarily to the lack of industrial linkages in the region to the solar industry. Expanded solar and energy storage manufacturing in Kentucky, such as the Enervenue battery manufacturing facility in Shelbyville, would

[8] 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.

[9] 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.

potentially enable the region to capitalize on a larger multiplier for renewable energy projects such as this one[10].

Impact of Ongoing Operations

As mentioned in the above discussion of modeling methods, the IMPLAN sector for solar farm operations is empty of data. A reasonable recourse is to tap the literature on solar project impacts, find comparable places, and use other studies to estimate the likely operational impacts on local economies in Kentucky. The California PV study cited above found that a ratio of 31.3 MW per permanent operations job. Applied to the Graves County project, this results in an estimate of 3.8 permanent operational jobs at the site. Thus, ongoing annual economic impacts are expected to be small relative to the one-time impacts of construction.

[10] See https://enervenue.com/enervenue-opening-gigafactory-in-shelby-county-kentucky-to-scale-production-of-its-differentiated-energy-storage-solutions/

Local Tax Revenues

Graves 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 countywide. They total substantially less than one percent of the assessed value of property, with about two-thirds of the revenue going to the County public school system. There are two municipal taxing jurisdictions in Graves County – Mayfield and Wingo - but the project is outside their city boundaries and thus would not be subject to those property taxes.

Table 6:

Graves County Property Tax Rates, 2022

in cents per $100 valuation

Jurisdiction	Real Estate	Tangible Personal
Extension Service	3.9000	5.0400
General Fiscal Court	9.9000	10.5000
Health	3.5000	3.5000
J U Kevile Memorial Foundation	2.1000	2.1000
Library	5.5000	9.0500
County Public Schools	45.5000	46.1000
Total, County-wide	70.4000	76.2900

Source: Kentucky Department of Revenue

https://revenue.ky.gov/News/Publications/Property%20Tax%20Rate%20Books/Property%20Tax%20Rate%20Book%202022.pdf

Graves County levies a countywide occupational tax of one percent on wages, salaries and other compensation, as well as on the net profits of businesses[11]. If construction worker compensation is fully captured by the tax, the County would receive a one-time increase of $231,000 in occupational tax revenues.

The company has provided me with a property tax projection for their intended investment. Much of the capital expenditures will be for equipment classified as manufacturing machinery, which is taxed at the state level, but not locally. The value of the real estate is enhanced by two factors. The Project will add fencing and other

[11] See www.gravescountyky.gov/finance-and-tax-department/

improvements that increase the land value; and the lease payments to the landowners greatly increase the valuation as compared to its former agricultural use. Kentucky state government is projected to receive $4.7 million over the subsequent four decades. Local jurisdictions would receive $3.2 million, of which $2.1 would go to the County school system[12]. So, local jurisdictions would receive an average of $80,000 per year under this projection.

The company may pursue an Industrial Revenue Bond (IRB) for the project through Graves County Fiscal Court. Under an IRB, the County would actually own the property for the likely 30-40 year life of the bond, and thus the investment 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 make Payments in Lieu of Taxes (PILOT) each year to partially replace the tax revenues that the County would have received.

The company also provided me with the parcel numbers of the land for the site, and I downloaded the 2022 property valuations and tax bills from the Graves County PVA site. There are thirteen land parcels, currently leased at the site, covering about 1,200 acres, and total taxes paid in 2022 of $7,000. The Project is projected to generate an average of $80,000 in property tax revenues per year for over forty years. This is approximately eleven and a half times larger than current property tax payments from the farmland. 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.

[12] The ultimate net financial benefit to the schools is more complicated than this. Extra property tax revenues to the County school system would trigger a reduction in state SEEK funding to the district.

Table 7:

Demographic and Economic Characteristics of Graves County		
	Graves County	**State of Kentucky**
Number of residents	*36,796*	*4,494,141*
Median age	39.6	39.0
Percent white	88.5%	85.5%
Percent of noninstitutionalized population w disability	19.3%	17.4%
Percent foreign-born	2.10%	4.00%
Percent 18 and older veteran	6.1%	7.2%
Percent living in same house as a year ago	89.1%	86.0%
High school attainment rate, population aged 25+	89.5%	87.7%
College attainment rate, population aged 25+	18.0%	25.7%
Number of Households	14,214	1,748,475
Median household income	$48,187	$55,454
Persons per household	2.59	2.57
With broadband internet subscription	79.8%	83.6%
Population 16+	*28,978*	*3,588,209*
In the labor force	56.6%	59.5%
Employed civilian	53.9%	56.0%
Unemployed	2.7%	3.1%
Armed forces	0.0%	0.4%
Not in labor force	43.4%	40.5%
Median travel time to work (minutes)	20.1	23.7
Civilian employed population 16 years and over	*15,622*	*2,009,185*
Management, business, science, and arts occupations	30.8%	35.7%
Service occupations	14.6%	15.8%
Sales and office occupations	18.1%	21.0%
Natural resources, construction, and maintenance occupations	14.6%	8.9%
Production, transportation, and material moving occupations	22.0%	18.5%
Industry		
Agriculture, forestry, fishing and hunting, and mining	5.5%	1.9%
Construction	8.2%	6.1%
Manufacturing	16.3%	14.3%
Wholesale trade	3.0%	2.4%
Retail trade	13.0%	11.9%
Transportation and warehousing, and utilities	6.2%	6.6%
Information	2.4%	1.4%
Finance and insurance, and real estate and rental and leasing	3.5%	5.6%
Professional, scientific, and mgmt, and admin and waste mgmt services	6.5%	8.7%
Educational services, and health care and social assistance	21.2%	24.1%
Arts, entertainment, and recreation, and accommodation and food services	5.0%	8.3%
Other services, except public administration	5.2%	4.5%
Public administration	4.0%	4.3%
Source: US Census Bureau, American Community Survey, 5-year profiles, 2017-21,		

Conclusion

The Banjo Creek Solar Project in Graves County represents a $248 million investment in both hard and soft costs. Graves County has seen little job-creating economic activity over the past two decades apart from accommodations and food services. Graves County residents are increasingly dependent on government transfer payments. Increased tax revenue, even if small, will be welcome. The County is not developed enough to supply all the goods and services demanded by households, which will dampen economic multiplier effects for any local investment until more goods and services are provided within the county.

The total new labor compensation arising from constructing the Banjo Creek Solar Project is projected to be $23.1 million and new jobs in the county to reach 381. It will bring a spike in construction linked jobs and up to $231,000 in one-time new tax revenue for the Graves County Fiscal Court. Over the next four decades, the project is projected to pay the Kentucky state government $4.7 million and the Graves County School system $2.1 million. It will increase the real property taxes from the project parcels elevenfold. At the same time, it will require almost no public services from local government.

Investments such as the Banjo Creek Solar Project provide additional tax revenue that would otherwise not be available to the local jurisdictions, including the local school board. The project may create opportunities for capturing the effects of economic multipliers within the county and region, boosting economic growth. The economic effect of the Banjo Creek Solar Project on Graves County is projected to be positive.