

Economic Impacts of the Cherrywood Solar Farm on Caroline County and the State of Maryland

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Introduction and Summary

The proposed Cherrywood Solar I project proposed for Caroline County is a solar photovoltaic project of up to 202 megawatts (AC) under development in Caroline County, MD. This report seeks to estimate the economic impact of a 150 megawatt (AC) version of the project on the local and state economy. Development of the project will involve the purchase and leasing of a total of 1000 acres of land currently devoted to crop production. The conversion to a utility scale 150 megawatt (AC) photovoltaic solar farm requires large investments in equipment, site preparation and a myriad of other construction and installation expenditures needed to produce solar electricity. After the planned one year construction phase, the solar farm will continue to produce electricity for 35 years. Each of these two phases will have significant economic impacts on Maryland and Caroline County in terms of jobs, income and fiscal consequences. The operating phase impacts, although smaller than the construction phase impacts, are annually repeating, so ultimately, a large multiple of the annual operating effects estimated in this study.

The goals of this analysis are to:

- Analyze the state and county economic impacts of the construction phase of the solar farm;
- Analyze the state and county economic impacts of the operating phase of the farm; and
- Analyze the net fiscal and other economic gains for the Caroline County economy resulting from the conversion of the 1000 acre Cherrywood site from crop production to solar.

To estimate these effects, we employed MIG IMPLAN models of the State of Maryland and Caroline County economies. The key findings of these analyses are as follows:

- Additional Maryland jobs, labor income and output from the construction phase:
 - Total of 777 jobs = Direct employment of 460 + 73 indirect + 244 induced¹ jobs
 - Labor income of \$52.4 million = Direct labor income of \$35.1M + \$5.1M indirect + \$12.2M induced labor income
 - Total gain in output of \$104.6 million = \$55.5M direct + \$13.5M indirect + \$35.6M induced
- Additional Caroline County jobs, labor income and output from the construction phase:
 - Total of 479 jobs = 348 direct + 37 indirect + 94 induced
 - Labor income of \$27.9 million = \$23.5 million direct + \$1.4 million indirect + \$3.0 million induced
 - \$51.6 million gain in output = \$35.4M direct + \$5.0M indirect + \$11.2M induced.
- Fiscal benefits from the construction phase:
 - Total state and local government revenues of \$5.5 million², of which the revenue shares are:
 - Maryland state government revenues \$3.3 million
 - All local governments in MD combined \$2.2 million
 - Caroline County (local) government share \$1.2 million
- Additional jobs, labor income and output from the operating and maintenance phase: Every year of operation, Maryland gains the benefits of:

¹ Explanations of the terms, direct, indirect and induced are provided in the appendix to this report.

² MIG IMPLAN models combine state and local revenue estimates. The state and local government revenues were separated from the total of state and local taxes using US Census data to estimate the state and local shares of each tax and fee item from Implan. The county specific estimates were calculated in the same manner, from the Caroline County IMPLAN model.

- Total of 47 more jobs = 12 direct employees + 19 indirect + 16 induced
- \$3.0 million/year in labor income = \$1.0M direct + \$1.1M indirect + \$0.8M induced
- \$21.1 million/year in output = \$15.9M direct + \$2.9M indirect + \$2.3M induced.
- Additional Caroline County jobs, labor income and output from the operating phase: Every year of operation, Caroline County gains the benefits of:
 - Total of 35 jobs = 10 direct jobs + 18 indirect + 7 induced
 - Additional \$1.6 million in labor income = \$550k direct + \$872k indirect + \$216k induced
 - \$19.3 million in output = \$15.9M direct + \$2.6M indirect + \$0.8M induced
- Annual fiscal benefits from the operating and maintenance phase:
 - Total Maryland state and local government revenues of \$2.9 million/year of operation, of which, the estimated revenue shares are:
 - State government of Maryland \$617 thousand
 - All Maryland local governments \$2.3 million
 - Caroline County (local) government \$2.2 million

Subtracting the economic contributions to the Caroline County economy which currently originate from using the 1000 acre site to produce crops, the *net benefit* of the operating and maintenance phase was estimated to add an additional 29.6 jobs, \$1.5 million per year in labor income and \$2.2 million per year in county tax revenues—over and above the effects originating from crop production. The net increase in output was estimated to be \$18.5 million per year.

Cherrywood Solar I

The proposed solar farm as studied for the purpose of this report has a generating capacity of 195 megawatts (DC) which will yield 150 megawatts (AC). This is a utility scale project and will carry with it, substantial expenditures for site preparation, equipment installation and construction. At the end of its planned 35 year lifespan, it will be decommissioned and the site returned to agricultural use. In this report, we present analyses of the economic impact of the construction, and operating and maintenance phases of the solar farm.

As proposed, Cherrywood Solar I, LLC, will purchase 300 acres and lease the remaining 700 acres of farmland needed. The purchase price of the land will be \$3.9 million and the annual lease payments will be \$700,000.

Modern solar farms involve several construction steps, each of which present economic opportunities for local businesses and labor. Once delivered to the site, the solar modules must be mounted on racks which are attached to pilings driven into the ground. The modules are connected to buried cables which carry the current to the inverters and eventually to substations and into the transmission grid.

Pavement, concrete and other impervious surfaces are minimal, and the site is almost entirely devoted to low growing grasses and other cover vegetation among the modules. For aesthetic reasons, views of the site from the perimeter will be screened with plantings of shrubs and trees. Since the skillsets required for large portions of this work are readily available in the region, the construction and installation phase of the project will create a large number of job opportunities within Caroline County and the State of Maryland.

A summary of the Year 0 construction phase expenditures used as inputs in the estimation models is shown in Table 1. The total anticipated installed cost is projected to be close to \$195 million which is in keeping with current utility scale solar installation costs of \$1000 per kilowatt. Most of the \$128 million in equipment will be purchased outside of Maryland, but some of the components will be locally sourced. Approximately \$4.3 million in buried cable and other electrical components is required to bring the electricity from the modules to the inverters and eventually to the transmission lines. In state suppliers are likely to provide much of those requirements.

The most significant line item for Maryland and Caroline County is the labor component of the construction and installation. Close to 100 percent of the \$37 million construction and installation labor component will be Maryland sourced, mostly from within the local region. Estimates for the purchase and planting of trees and other horticultural and landscaping needs will approach \$3 million.

Table 1: Year 0 Construction Phase Expenditures

Installation Costs	Cost	Cost Per kW	Percent of Total Cost
Materials & Equipment			
Mounting (rails, clamps, fittings, etc.)	\$23,595,000	\$121	12%
Modules	\$79,950,000	\$410	41%
Electrical (cables, connectors, breakers, etc.)	\$4,324,466	\$22	2%
Inverters	<u>\$20,475,000</u>	<u>\$105</u>	<u>10%</u>
Subtotal	\$128,344,466	\$658	66%
Labor			
Installation	<u>\$37,050,000</u>	<u>\$190</u>	<u>19%</u>
Total labor, materials and equipment	\$165,394,466	\$848	85%
Other Costs			
Permitting, overhead and miscellaneous	<u>\$29,640,000</u>	<u>\$152</u>	<u>15%</u>
Total installed cost	\$195,034,466	\$1,000	100%

Source: NREL, Cherrywood Solar I and JFI.

Once built, the Year 1 operation and maintenance phase begins. During its operation, Cherrywood Solar will directly employ an estimated 10 to 12 people to monitor and repair the equipment and to maintain the site. The overall number of jobs generated will be much larger, given not only the purchases of third party goods and services by Cherrywood Solar itself, but the ripple effects that arise as each of those individuals and businesses in turn, make further expenditures.

After construction is finished, the operating phase of Cherrywood Solar will have the following direct economic effects:

- Payments to employees
- Purchases of goods and services such as equipment, materials and groundskeeping services
- Lease payments to landowners
- Property and other tax payments

A summary of the expected Year 1 operating expenditures appears in Table 2. Onsite workers will include technicians as well as other support personnel, required to monitor, maintain and repair the

equipment and to manage the general care and upkeep of the property. The annual labor expenditure is projected to be \$975,000. Materials and services add another \$585,000 per year to the basic operating costs. The labor and a large share of the materials and services requirements will be locally sourced. Other annually recurring expenditures not directly included in the operating expenditures in the table, include lease payments to local landowners and more than \$2 million in property taxes—in all, adding \$2.75 million over and above the \$1.56 million basic operating and maintenance expenditures. The lease payments will begin in Year 0, whereas it is assumed that the property tax payments will begin in Year 1, after the construction phase has been completed.

Table 2: Annual Operating Phase Expenditures

Expenditures	Cost	Cost Per kW	Percent of Total Cost
Basic operating expenditures			
Labor			
Technicians and other personnel	\$975,000	\$5	63%
Materials and Services			
Materials, equipment and services	<u>\$585,000</u>	<u>\$3</u>	<u>38%</u>
Total	\$1,560,000	\$8	100%
Other annually recurring expenditures not included above			
Lease payments to landowners	\$700,000		
Property taxes (personal)	\$1,950,000		
Property taxes (real estate)	\$98,000		

Source: NREL, Cherrywood Solar and JFI

The expenditures presented for the construction and operating phases above provide a baseline for the immediate impact of Cherrywood Solar on the local and regional economy, but the effects do not end there. The initial inflow of additional money, once spent by the recipients, generates further rounds of spending, all of which can be estimated.

Economic Contributions of Cherrywood Solar I to Caroline County and the State of Maryland

In order to estimate the complete effects of the construction and operating phases of the solar farm on the economy, MIG IMPLAN models were used to determine the effects on jobs, labor income and economic output. Estimates for Maryland and the county require separate IMPLAN models. Caroline County effects appear in sections following the discussion of the effects of the construction and operating phases on the State of Maryland.

Construction Phase Economic Effects of Cherrywood Solar on Maryland

Table 3 summarizes the economic effects on the State of Maryland. The model indicates that a solar construction and installation project of this scale is likely to directly provide 460 jobs. This represents the labor required for site preparation, installation of the equipment and landscaping services, business managers and support staff, as well as the professional service jobs provided to engineers, lawyers and others needed in the site development and construction process. Initial estimates by Cherrywood Solar I indicated that the onsite direct construction and installer labor force will be approximately 400 workers. Although they are presented with some caveats in terms of the appropriateness of doing so, each of the average labor income per job values is shown as a simple division of the estimated labor income values by the corresponding projected number of jobs. Simple explanations and meanings of the direct, indirect and induced economic effects are provided in the final section of this report.

The state IMPLAN model estimates indicate that once the expenditures have cycled through the economy of Maryland, the total effects of the construction phase on employment and labor income include 777 jobs and \$52.4 million respectively. The output measure of \$104.6 million is the dollar value of all the goods and services produced by Maryland based resources as a result of the construction project. That is, the total impact on output includes not only the value of the solar construction itself, but the total output produced by property, plant, equipment and labor in Maryland as a consequence of the original construction expenditures.

The construction phase has a sizeable fiscal impact. Total state and local taxes of \$5.5 million are predicted by the State of Maryland model. Local governments are expected to collect \$2.2 million of that total with \$3.3 million going to the state. From a separate IMPLAN model of Caroline County, estimates indicate \$2.2 million will enter the county revenue stream. As previously stated, it is assumed that the additional taxes on real estate and personal property will not arise until the year following completion of the construction, so ultimately Caroline County will see not only the short run boost of \$1.2 million from the construction phase, but annual taxes of \$2.2 million in the first year of operation. It is noted that the personal property tax portion will decline by 3.33 percent per year, if there are no further capital investment additions. Undiscounted, the total personal property tax revenues over the 35 year project life will exceed \$40 million which is more than \$20 million in present value terms. Furthermore, any increases to the assessed value of the real property will offset the 3.33 percent annual decrement to the personal property tax.

Table 3: Impact of the Construction Phase on and within the State of Maryland

Item	Direct Impact	Indirect Impact	Induced Impact	Total Impact
Output (\$s)	\$55,520,216	\$13,545,654	\$35,572,491	\$104,638,361
Employment (# of Jobs)	459.7	73.4	244.2	777.3
Labor Income (\$s)	\$35,132,422	\$5,112,522	\$12,169,033	\$52,413,977
Average Labor Income/Job (\$s)	\$76,425	\$69,653	\$49,832	\$67,431
Fiscal Impact (\$s)	--	--	--	\$5,537,763
Comprised of:	Estimated State Government Revenues			\$3,310,253
	Estimated Local Government Revenues			\$2,227,510
	Caroline County Share of Local Government Revenues			\$1,239,870

Source: IMPLAN and JFI

The Maryland IMPLAN model also sheds light on the economic sectors that will gain the most from the construction phase of Cherrywood Solar I. Table 4 shows the ten sectors with the largest increase in jobs and Table 5 shows those gaining the most in labor income. Not surprisingly, the largest gains occur in the construction sector since the largest Maryland expenditures will be the labor needed to install the equipment and associated wiring. There will be 379.8 construction jobs created and 43.4 more in the landscape and horticultural services sector. Wholesale trade also sees a substantial job gain with 29 jobs created. Other sectors see gains of less than 15 jobs. Most obvious is the impact on restaurants, hospitals and food and beverage stores which will presumably see large portions of those gains arising from the construction and installation labor force itself.

Table 5 shows similar results, but ranked on labor income rather than the number of jobs. Not surprisingly, the construction sector leads, with more than \$30 million in labor income. Wholesale trade follows with \$2.5 million. The management sector and landscaping and horticultural services sector will gain \$1.8 million and \$1.6 million respectively, in labor income. Smaller effects of less than \$1 million can be expected in sectors such as hospitals and the professional sector of architects, engineering and related services.

Table 4: Sectors in Maryland with the Largest Construction Phase Gains in Employment

Description	Employment	Labor Income	Output
Construction	379.8	\$30,016,502	\$43,367,839
Landscape & horticultural services	43.4	\$1,581,299	\$2,857,027
Wholesale trade	29.0	\$2,488,795	\$7,033,181
Management of companies & enterprises	14.8	\$1,776,999	\$3,620,842
Real estate	14.4	\$507,221	\$3,550,724
Hospitals	13.0	\$996,857	\$2,064,371
Limited-service restaurants	12.9	\$279,240	\$1,179,972
Full-service restaurants	12.6	\$318,917	\$677,355
Architectural, engineering, & related	9.0	\$910,952	\$1,615,002
Retail - Food & beverage stores	8.0	\$283,669	\$603,853

Source:IMPLAN

Table 5: Sectors in Maryland with the Largest Construction Phase Gains in Labor Income

Description	Employment	Labor Income	Output
Construction	379.8	\$30,016,502	\$43,367,839
Wholesale trade	29.0	\$2,488,795	\$7,033,181
Management of companies & enterprises	14.8	\$1,776,999	\$3,620,842
Landscape & horticultural services	43.4	\$1,581,299	\$2,857,027
Hospitals	13.0	\$996,857	\$2,064,371
Architectural, engineering, & related services	9.0	\$910,952	\$1,615,002
Offices of physicians	7.8	\$762,246	\$1,119,151
Real estate	14.4	\$507,221	\$3,550,724
All other misc. Electr. equip. & components	6.4	\$499,713	\$1,669,732
Comm. & indust. machinery & equip. leasing	2.1	\$339,440	\$932,077

Source: IMPLAN

The third measure of economic impact, presented in Table 6, is output. In the present case, output is the dollar value of all of the goods and services produced as a result of the activity infused into the Maryland economy by the construction of Cherrywood Solar. As before, the construction and wholesale trade sectors see the largest gains—\$43 million and \$7 million respectively. Owner occupied dwellings is a sector within the IMPLAN model which captures the imputed income from owner occupied housing, which experiences a gain of \$5 million in output. The next largest contributions to output arise from the management and real estate sectors with gains of \$3.6 million each. The landscape and horticultural services sector gains \$2.9 million and hospitals contribute over \$2 million to output. The remaining sectors see output increases of less than \$2 million each.

Table 6: Sectors in Maryland with the Largest Construction Phase Gains in Output

Description	Employment	Labor Income	Output
Construction	379.8	\$30,016,502	\$43,367,839
Wholesale trade	29.0	\$2,488,795	\$7,033,181
Owner-occupied dwellings	0.0	\$0	\$5,006,875
Management of companies & enterprises	14.8	\$1,776,999	\$3,620,842
Real estate	14.4	\$507,221	\$3,550,724
Landscape & horticultural services	43.4	\$1,581,299	\$2,857,027
Hospitals	13.0	\$996,857	\$2,064,371
All other misc. electr. equip. & components	6.4	\$499,713	\$1,669,732
Architectural, engineering, & related services	9.0	\$910,952	\$1,615,002
Limited-service restaurants	12.9	\$279,240	\$1,179,972

Source: IMPLAN

Operating Phase Economic Effects of Cherrywood Solar on Maryland

Although the scale of the economic effects from the operating phase are nearly all far smaller than those of the construction phase, these annual effects repeat throughout the planned 35 year operational life of Cherrywood Solar. A summary of the estimated effects on the Maryland economy appears in Table 7.

The direct employment impact is expected to be approximately 12 workers. However, the ripple effects of purchases by Cherrywood Solar, its employees, and the ensuing subsequent rounds of activity add total impact measures of 46.8 jobs and labor income of almost \$3 million per year. The total impact on output, of more than \$21 million is the sum of the dollar values of all of the goods and services added by Cherrywood's operations and maintenance and all of the subsequent transactions that result from its addition to the economy. A large part of that new activity is accounted for by the value of the electricity generated. Since those revenues from electricity sales will be paid to a public company which is likely to be owned primarily by investors who are outside of the local economy, it is important to acknowledge that the economic measures of jobs and labor income may in this case be more relevant than the output measure. However, this does tell us the value of the additional goods and services produced by Maryland labor and other resources that result because of Cherrywood's activities.

Caution in interpreting the entries of average labor income per job is advised, especially when it is applied to a smaller number of jobs. An estimate of one or two more jobs would significantly change the average for example, all else equal. Similarly, the inclusion of one or two professionals' salaries in the total would push the average above the more representative salary of a technician or groundskeeper.

The annual fiscal effects on the state are much smaller in the operational phase than the short run benefit we found in the construction phase, with revenues of just over \$617 thousand per year. However, it is to be emphasized that these are annually recurring, not just a one year boost. Because of

the scale of property taxes, the local tax component is much larger. The estimates of local taxes and fees are \$2.3 million per year. With the benefit of the estimates from a separate Caroline County specific model, which is discussed in later sections of this report, the Caroline County portion of the state and local tax impact is estimated to be \$2.2 million per year.

As with the construction phase estimates, we can also predict which sectors of the economy will see the largest gains in jobs, labor income and output. Table 8 outlines the ten largest gains as measured by employment. The largest job gain is in the solar electricity generating sector, with 12 jobs and more than \$1 million in labor income. Next in line, IMPLAN predicts a gain of 2.9 jobs in the miscellaneous professional, scientific and technical services sector, accompanied by a labor income gain of almost \$138,000. Other sectors such as hospitals, construction and repair services, wholesale trade and restaurants will see increases of 1 or 2 jobs per sector. The sector, charter transportation and transportation support services is predicted to gain 1.8 jobs and just under \$121 thousand in labor income. Note that this sector includes charter bus operators, which in Caroline County is a substitute for the major bus lines that one would find more prominent in other regions of Maryland. In a rural area which does not have multiple public transit options or thick schedules, charter bus companies will not only see an uptick in tours to Baltimore and elsewhere, but also in custom bookings, airport service and other regional transportation services.

When ranked by labor income, in Table 9, the leading gain arises in the solar generating sector itself with an increase of over \$1 million. Sectors gaining more between \$106 thousand and more than \$137 thousand include as with the job rankings, miscellaneous professional, scientific and technical services, charter transportation and related support activities and the maintenance and repair nonresidential construction services sectors. The remaining sectors in the top ten list gain between \$50 thousand and \$90 thousand in labor income and include hospitals, legal services, employment services and restaurants. Monetary authorities and depository credit intermediaries are also among the top ten with just under \$54 thousand in additional labor income arising through 0.6 more jobs.

Table7: Impact of the Operation and Maintenance Phase of Cherrywood Solar I on the State of Maryland

Item	Direct Impact	Indirect Impact	Induced Impact	Total Impact
Output (\$s)	\$15,898,465	\$2,877,300	\$2,344,536	\$21,120,301
Employment (# of Jobs)	12.0	18.7	16.1	46.8
Labor Income (\$s)	\$1,042,026	\$1,126,049	\$804,078	\$2,972,153
Average Labor Income/Job (\$s)	\$86,836	\$60,217	\$49,943	\$63,508
Fiscal Impact (\$s)	--	--	--	\$2,902,754
Comprised of:	Estimated State Government Revenues			\$617,253
	Estimated Local Government Revenues			\$2,285,501
	Estimated Caroline County Government Revenues			\$2,214,542

Source: IMPLAN and JFI

Table 8: Maryland Sectors with the Largest Operating Phase Gains in Employment

Description	Employment	Labor Income	Output
Electric power generation – Solar	12.0	\$1,042,297	\$15,899,600
Misc. professional, scientific, & tech. services	2.9	\$137,898	\$213,523
Full-service restaurants	2.1	\$53,398	\$113,413
Charter transportation & support activities	1.8	\$120,898	\$306,349
Employment services	1.7	\$84,743	\$164,989
Maint. & repair construction (nonresidential)	1.7	\$106,102	\$272,081
Real estate	1.3	\$47,439	\$332,090
Wholesale trade	1.0	\$88,338	\$249,636
Limited-service restaurants	1.0	\$20,928	\$88,433
Hospitals	0.9	\$67,213	\$139,190

Source: IMPLAN

Table 9: Maryland Sectors with the Largest Operating Phase Gains in Labor Income

Description	Employment	Labor Income	Output
Electric power generation – Solar	12.0	\$1,042,297	\$15,899,600
Misc. professional, scientific, & tech. services	2.9	\$137,898	\$213,523
Charter transportation & support activities	1.8	\$120,898	\$306,349
Maintenance & repair construction (nonresidential)	1.7	\$106,102	\$272,081
Wholesale trade	1.0	\$88,338	\$249,636
Employment services	1.7	\$84,743	\$164,989
Legal services	0.8	\$67,958	\$157,318
Hospitals	0.9	\$67,213	\$139,190
Monetary authorities & dep. credit intermed.	0.6	\$53,735	\$148,919
Full-service restaurants	2.1	\$53,398	\$113,413

Source: IMPLAN

With the exception of the solar generating sector itself, which adds \$15.9 million to output, the top ten ranked by output, in Table 10, experience output gains between \$148 thousand and \$333 thousand. The sector which reflects the imputed income from owner occupied housing follows the solar generating sector with a gain of \$332,501 in output. The other sectors ranked by this measure were all present in either Table 8 or Table 9, although there may be some variation in their rankings. The most significant results from the Maryland IMPLAN estimates of the operating phase of Cherrywood Solar are the 46.8 additional jobs, the annual gain of \$2.9 million in labor income and the \$2.9 million per year increase in local government revenues.

Table 10: Maryland Sectors with the Largest Operating Phase Gains in Output

Description	Employment	Labor Income	Output
Electric power generation - Solar	12.0	\$1,042,297	\$15,899,600
Owner-occupied dwellings	0.0	\$0	\$332,501
Real estate	1.3	\$47,439	\$332,090
Charter transportation and trans. Services	1.8	\$120,898	\$306,349
Maint. & repair constr. nonres. structures	1.7	\$106,102	\$272,081
Wholesale trade	1.0	\$88,338	\$249,636
All other misc. prof., scientific, & tech svcs.	2.9	\$137,898	\$213,523
Employment services	1.7	\$84,743	\$164,989
Legal services	0.8	\$67,958	\$157,318
Monetary authorities & dep. credit intermed.	0.6	\$53,735	\$148,919

Source: IMPLAN

The Construction Phase Effects of Cherrywood Solar on Caroline County

From an IMPLAN model of Caroline County, we constructed estimates of the economic impacts of the construction phase and the operating phase of Cherrywood Solar on the economy of the county, just as we did at the state level. As shown in Table 11, the model predicts that the direct effect of the construction project on county employment will be 348.3 jobs, which grows to a total of 478.6 jobs after including the indirect and induced effects of the construction and installation expenditures. In total, labor income will increase by \$27.9 million and economic output by \$51.6 million within the county. Average labor income is presented with some cautionary caveats but represents the outcome of simply dividing the labor income by the number of jobs within each column. One important note is that within IMPLAN, labor income includes the dollar amount of salaries plus all employer paid benefits.

The estimate of an increase of 348.3 via direct employment is in keeping with the initial projections of approximately 400 onsite construction and installation workers and consistent with the results from the Maryland model. The direct impact at the county level is likely to include more construction workers and installers and fewer professional service personnel—lawyers and technical services, for example—which helps to explain the lower estimate of average labor income per job. It is to be expected that many of the construction phase workers will commute to the county, although a significant number are predicted to be residents.

After accounting for indirect and induced economic activities, the total job increase rises to a gain of 478.6 workers and a \$27.9 million increase in labor income. The total impact on output from the construction project will be \$51.6 million, which includes the dollar value of all of the additional goods and services produced by Caroline County labor and other resources that results from the Cherrywood Solar construction phase. As noted in the State of Maryland discussion in earlier sections, the fiscal impact of the construction phase on the county will be \$1.2 million. This amount will increase as a result of local personal property taxes in subsequent years.

Table 11: Impact of the Construction Phase on Caroline County

Item	Direct Impact	Indirect Impact	Induced Impact	Total Impact
Output (\$s)	\$35,400,791	\$4,978,740	\$11,220,573	\$51,600,103
Employment (# of Jobs)	348.3	36.8	93.5	478.6
Labor Income (\$s)	\$23,548,261	\$1,371,678	\$2,952,016	\$27,871,956
Average Labor Income/Job (\$s)	\$67,609	\$37,274	\$31,572	\$58,236
Caroline County Fiscal Impact (\$s)	--	--	--	\$1,239,870

Source: IMPLAN and JFI

Table 12: Caroline County Sectors with the Largest Construction Phase Effects on Employment

Description	Employment	Labor Income	Output
Construction	292.5	\$21,537,278	\$30,132,532
Landscape and horticultural services	42.9	\$1,516,160	\$2,770,645
Wholesale trade	24.8	\$886,504	\$4,211,698
Limited-service restaurants	6.1	\$97,757	\$487,555
Retail - General merchandise stores	5.5	\$139,161	\$377,530
Services to buildings	5.1	\$51,062	\$137,986
Retail - Food and beverage stores	4.3	\$115,841	\$275,815
Other educational services	3.9	\$16,541	\$73,812
Hospitals	3.9	\$243,227	\$551,764
Auto repair & maintenance, except car washes	3.6	\$54,961	\$122,939

Source: IMPLAN

In Table 12, the ten industrial sectors which will see the largest increases in employment are shown. The first three, replicate the results from the Maryland model, with construction, landscape and horticultural services, and wholesale trade gaining 292.5, 42.9 and 24.8 jobs respectively. If we combine the results from the limited service restaurants (6.1 jobs) and retail food and beverage sectors (4.3 jobs), the total impact on this food sector is 10.4 jobs. The impact of the construction phase is also evident in the 5.5 additional jobs in the general merchandise sector, the 3.9 additional jobs in the hospital and educational services sectors and the addition of 3.6 jobs in automobile repair. A significant portion of these gains is very likely generated directly by the activities of the construction and installation workforce itself.

Table 13 ranks the gaining sectors by labor income. The rankings of the first 3 are identical to the rankings obtained in Table 12. The top gain is seen in the construction sector, with a labor income of \$21.5 million while the landscape sector and wholesale trade sector gain \$1.5 million and more than \$886 thousand, respectively. Medical sectors and the trucking sector will see labor income benefits within the \$200 thousand to \$243 thousand range. Combining the two automotive sectors in the table, the total labor income is over \$328 thousand. Finishing out the top ten list, the accounting, tax preparation, bookkeeping and payroll services sector is projected to generate more than \$120 thousand in labor income benefits.

Table 13: Caroline County Sectors with the Largest Construction Phase Effects on Labor Income

Description	Employment	Labor Income	Output
Construction	292.5	\$21,537,278	\$30,132,532
Landscape and horticultural services	42.9	\$1,516,160	\$2,770,645
Wholesale trade	24.8	\$886,504	\$4,211,698
Hospitals	3.9	\$243,227	\$551,764
Truck transportation	3.2	\$237,699	\$594,013
Offices of physicians	3.4	\$205,253	\$364,354
Auto repair & maintenance, except car washes	3.5	\$181,656	\$338,358
Retail - Motor vehicle and parts dealers	2.9	\$146,650	\$337,825
Retail - General merchandise stores	5.5	\$139,161	\$377,530
Accounting, tax prep. & payroll services	2.1	\$120,825	\$213,736

Source: IMPLAN

Ranking the sectors by output in Table 14, the dollar value of the construction sector activity resulting from the construction phase of Cherrywood is projected to be more than \$30 million. The value going to the wholesale trade sector adds another \$4.2 million. The third spot is claimed by the imputed income from owner occupied dwellings. This is a special sector in Implan, intended to value the revenues that would otherwise be paid as rent—in this case, \$2.8 million. This is nearly equal to the output attributed to the landscape and horticultural services sector. The remaining sectors in the list will experience output gains between \$377 thousand and \$595 thousand each. The electric power transmission and distribution sector itself, will see relatively small benefits in jobs and labor income, but add \$383 thousand to Caroline County output.

Table 14: Caroline County Sectors with the Largest Construction Phase Effects on Output

Description	Employment	Labor Income	Output
Construction	292.5	\$21,537,278	\$30,132,532
Wholesale trade	24.8	\$886,504	\$4,211,698
Owner-occupied dwellings	0.0	\$0	\$2,812,770
Landscape and horticultural services	42.9	\$1,516,160	\$2,770,645
Truck transportation	3.2	\$237,699	\$594,013
Hospitals	3.9	\$243,227	\$551,764
Retail - nonstore retailers	3.2	\$88,981	\$512,436
Limited-service restaurants	6.1	\$97,757	\$487,555
Electric power transmission and distribution	0.3	\$43,124	\$483,237
Retail - General merchandise stores	5.5	\$139,161	\$377,530

Source: IMPLAN

Operating and Maintenance Phase Effects of Cherrywood Solar on Caroline County

After the completion of the construction and installation phase, the operations and maintenance of Cherrywood Solar remains as an ongoing contributor to the Caroline County economy. Table 15 summarizes the impact of the Year 1 effects. These are annual figures, which continue over the 35 year life of the project, as stated previously. It is projected that Cherrywood will directly involve 10 jobs, labor income of \$550 thousand and output of \$15.9 million within the Caroline County economy. Once all of the indirect and induced effects are added in, these figures increase to 34.6 jobs, with a corresponding \$1.6 million in labor income and \$19.3 million in economic output. From the perspective of Caroline County residents, the benefits are most likely best measured by the number of jobs and the labor income attributable to Cherrywood Solar. This table provides a clear demonstration of how the effects of an initial addition to the economy such as that provided by the 10 jobs and \$550 thousand in labor income that is directly provided by Cherrywood, ultimately grows into much larger numbers as the spending works its way through successive rounds of purchases and related job additions. It is also noteworthy that in the operating phase, the property taxes paid by Cherrywood Solar introduce a substantial addition to the Caroline County revenues. Taking all of the tax impacts together, the county fiscal impact is predicted to exceed \$2.2 million per year. As points of comparison and to emphasize that this is a significant annual contribution, the Caroline County FY2018 budget proposed the following expenditures:

- Sheriff \$3.3 million
- Fire companies \$1.2 million
- Emergency Services: Medical services \$2.9 million

Table 15: Impact of the Operations and Maintenance Phase of Cherrywood Solar on Caroline County

Item	Direct Impact	Indirect Impact	Induced Impact	Total Impact
Output (\$s)	\$15,898,465	\$2,618,646	\$820,888	\$19,337,999
Employment (# of Jobs)	10.0	17.8	6.8	34.6
Labor Income (\$s)	\$550,603	\$871,663	\$215,617	\$1,637,883
Average Labor Income/Job (\$s)	\$55,060	\$48,970	\$31,708	\$47,338
Caroline County Fiscal Impact (\$s)	--	--	--	\$2,214,542

Source: IMPLAN and JFI

As can be seen in Table 16, the largest sectoral benefits in terms of jobs, arise in the solar electricity generating sector itself, with 10 direct jobs projected. Charter transportation and transportation support services gains 3.4 jobs and the maintenance and repair construction sector receives an addition of 3.2

jobs. Another 1.2 jobs will be created within the wholesale trade sector. The remaining sectors in the top ten will experience job gains of between 0.7 and 1.0 job. Among the sectors filling out the rest of the list are various professional and business services such as accounting and legal services as well as the monetary authorities and depository credit intermediation sector.

Ranked by labor income, the top three sectors shown in Table 17 duplicate the Table 16 results. The solar power sector adds more than \$550 thousand in labor income, which is almost twice the benefit generated by the number two charter transport sector's \$269 thousand addition. The maintenance and repair sector receives a \$134 thousand benefit while the remaining sectors on the list gain less than \$50 thousand per sector. Completing the top ten list, the final two spots are rail transportation and the postal services sectors, each of which are expected to receive approximately \$26 thousand in labor income.

Table 16: Caroline County Sectors with the Largest Operating Phase Impacts on Employment

Description	Employment	Labor Income	Output
Electric power generation - Solar	10.0	\$550,603	\$15,898,465
Charter transport and support activities	3.4	\$268,594	\$628,672
Maintenance & repair construction (nonresidential)	3.2	\$134,314	\$414,141
Wholesale trade	1.2	\$43,957	\$208,836
Accounting, tax prep. and payroll services	0.9	\$49,399	\$87,385
Services to buildings	0.9	\$8,474	\$22,900
Monetary authorities and dep. credit intermed.	0.8	\$45,827	\$156,954
Legal services	0.8	\$14,352	\$77,003
Warehousing and storage	0.7	\$24,422	\$58,066
Business support services	0.7	\$33,591	\$46,529

Source: IMPLAN

Table 17: Caroline County Sectors with the Largest Operating Phase Impacts on Labor Income

Description	Employment	Labor Income	Output
Electric power generation - Solar	10.0	\$550,603	\$15,898,465
Charter transport and support activities	3.4	\$268,594	\$628,672
Maintenance & repair construction (nonresidential)	3.2	\$134,314	\$414,141
Accounting, tax preparation and payroll services	0.9	\$49,399	\$87,385
Water, sewage and other systems	0.4	\$46,887	\$101,494
Monetary authorities and dep. credit intermed.	0.8	\$45,827	\$156,954
Wholesale trade	1.2	\$43,957	\$208,836
Business support services	0.7	\$33,591	\$46,529
Rail transportation	0.2	\$26,281	\$68,115
Postal service	0.3	\$25,893	\$31,249

Source: IMPLAN

Table 18: Caroline County Sectors with the Largest Operating Phase Impacts on Output

Description	Employment	Labor Income	Output
Electric power generation - Solar	10.0	\$550,603	\$15,898,465
Charter transport and support activities	3.4	\$268,594	\$628,672
Maintenance and repair construction (nonresidential)	3.2	\$134,314	\$414,141
Owner-occupied dwellings	0.0	\$0	\$209,285
Wholesale trade	1.2	\$43,957	\$208,836
Electric power transmission and distribution	0.1	\$16,419	\$183,984
Monetary authorities and dep. credit intermed.	0.8	\$45,827	\$156,954
Water, sewage and other systems	0.4	\$46,887	\$101,494
Petroleum refineries	0.0	\$19	\$96,310
Accounting, tax prep. and payroll services	0.9	\$49,399	\$87,385

Source: IMPLAN

Table 18 lists the impacts ranked by the dollar value of output generated as a consequence of the operations of Cherrywood Solar. The solar power sector is predicted to add \$15.9 million to Caroline County's economic output as the largest sectoral impact. The remaining output effects are far more modest, with the second leading sector—charter transportation—giving rise to a \$629 thousand contribution to output. The remaining sectors on the top ten list fall in line between \$87 thousand and just over \$414 thousand. The imputed income from owner occupied housing, explained in prior sections, is attributed \$209 thousand in economic output, which is nearly equal to the contribution expected from the wholesale trade sector. The water, sewage and other systems sector will provide an output contribution gain of \$101 thousand, accompanied by a labor income boost of almost \$47 thousand. Petroleum refineries add \$96 thousand in output, although this sector's contribution to jobs and labor income within Caroline County are very small. The accounting and tax preparation sector fills the tenth spot, contributing \$87 thousand in output accompanied by job and labor income gains of 0.9 jobs and \$49 thousand, respectively.

Contributions of Cherrywood Solar Operating Phase Net of Agricultural Use

Highlights of the impact of the operating and maintenance phase of Cherrywood Solar on Caroline County discussed above include 34.6 jobs added, \$2.2 million in county revenues, \$1.6 million in labor income and an overall addition to economic output of \$19.3 million each year of operation. Utilizing 1000 acres of farmland does however displace its current use growing primarily corn and soybeans. With that in mind, we conducted an IMPLAN estimate of the economic impact of the current agricultural land use on Caroline County and then subtracted those economic effects from the operating and maintenance phase effects of Cherrywood Solar to obtain the net contributions. The total impact of the agricultural usage as shown in Table 19, is summarized as \$829 thousand, 5.0 jobs and labor income of less than \$159 thousand. Largely because agricultural land receives favorable tax treatment, the

Caroline County fiscal benefit generated from all of the activities related to the 1000 acres of farmland is estimated as just over \$5 thousand.

Table 20 presents the net effects of Cherrywood Solar, obtained by subtracting the amounts in Table 19 from the operating and maintenance summary effects in Table 15. The highlights of the net benefits listed in Table 20 include:

- Additional employment 29.6 jobs
- Additional labor income \$1.5 million per year of operation
- Additional Caroline County revenues \$2.2 million per year of operation
- Additional Caroline County output \$18.5 million per year of operation.

As noted previously, this phase of the solar farm is planned to continue for 35 years. The job gains are not temporary and it is emphasized that the other measures of net additions to the economy are annually recurring.

Table 19: Impact of Agricultural Use of the 1000 Acre Cherrywood Site on Caroline County

Item	Direct Impact	Indirect Impact	Induced Impact	Total Impact
Output (\$s)	\$566,288	\$208,107	\$54,803	\$829,198
Employment (# of Jobs)	2.9	1.6	0.5	5.0
Labor Income (\$s)	\$81,324	\$63,165	\$14,380	\$158,869
Average Labor Income/Job (\$s)	\$28,043	\$39,478	\$28,760	\$31,774
Caroline County Fiscal Impact (\$s)	--	--	--	\$5,103

Source: USDA, IMPLAN and JFI

Table 20: Annual Net Gains from the Conversion of the Cherrywood Site from Agriculture to Solar
(Table 20 equals Table 15 *minus* Table 19)

Item	Direct Impact	Indirect Impact	Induced Impact	Total Impact
Net Changes in:				
Output (\$s)	\$15,332,177	\$2,410,539	\$766,085	\$18,508,801
Employment (# of Jobs)	7.1	16.2	6.3	29.6
Labor Income (\$s)	\$469,279	\$808,498	\$201,237	\$1,479,014
Average Labor Income/Job (\$s)	\$27,018	\$9,492	\$2,948	\$15,564
Caroline County Fiscal Impact (\$s)	--	--	--	\$2,209,438

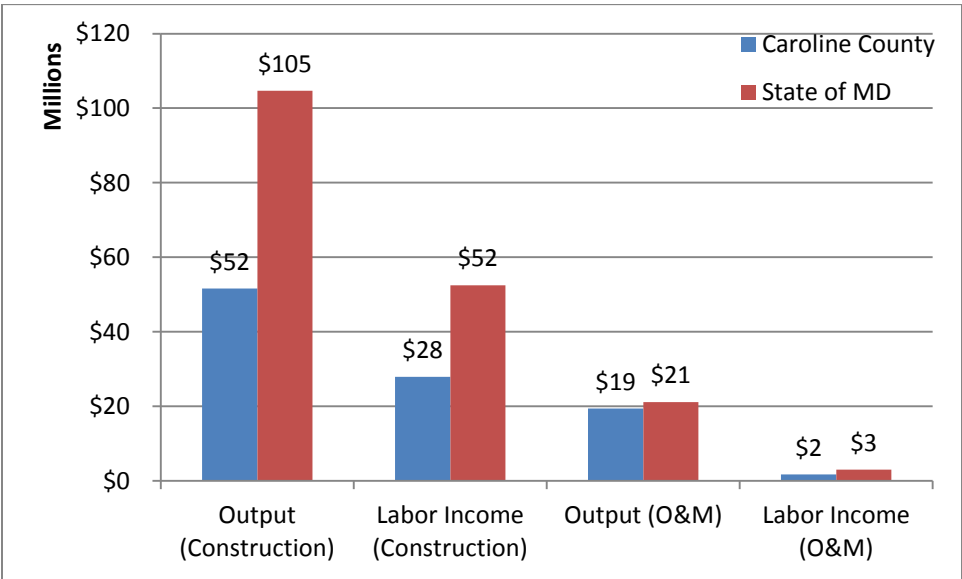
Source: USDA, IMPLAN and JFI

Summary of Economic Impacts of Cherrywood Solar on the Economies of Caroline County and the State of Maryland

In order to more readily visualize the county and state level impacts of Cherrywood Solar on the state and county, Figure 1 shows the labor income and economic output effects which were discussed separately in the Maryland and Caroline County sections above. Figure 2 shows the same side by side comparison for the job gains. The figures show that in the construction phase, the impacts on the state are almost twice those of the county. This is not surprising given that the county economy is small and a major share of the resources needed for the comparatively large construction and installation phase will necessarily come from beyond the county itself. Still, the county gains 478.6 of the state level estimates of the 777.3 construction phase job gain and \$27.9 million of the state level \$52.4 million labor income effect. In the operating phase, the county projections of \$1.6 million per year in labor income and 34.6 job gains compare to the state’s \$3 million per year addition to labor income and 46.8 added jobs.

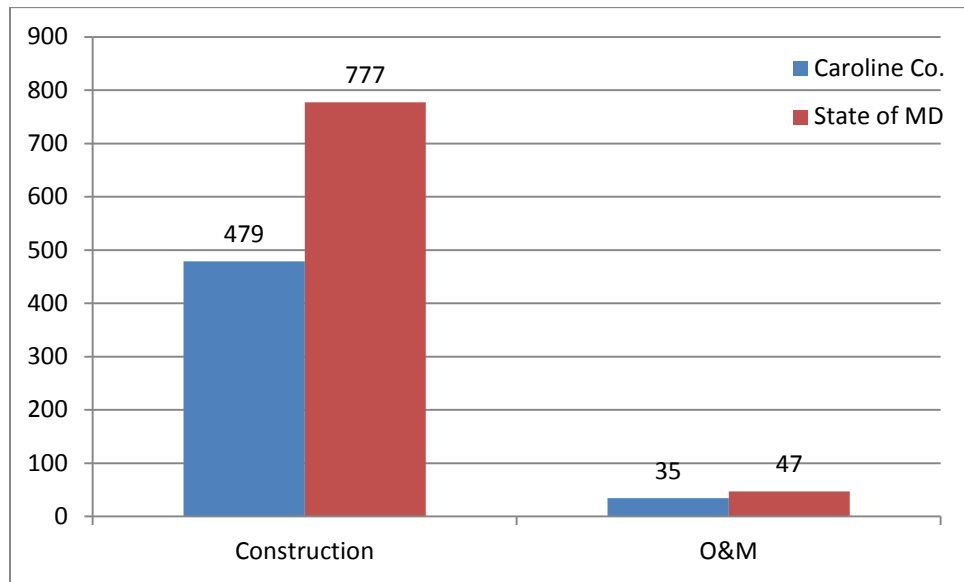
Figure 3 and Figure 4 show the distributions of the government revenues from taxes and fees that arise due to the construction phase and the operating phase, respectively. These are taxes and fees that result from all of the direct, indirect and induced activities.

Figure 1: Caroline County and State of Maryland Output and Labor Income Impacts



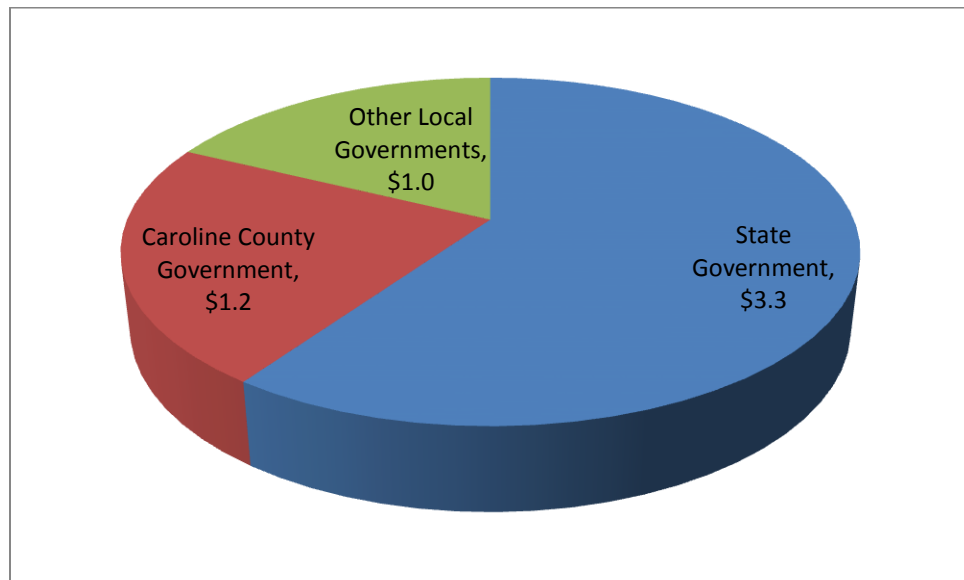
Source: IMPLAN

Figure 2: Caroline County and State of Maryland Construction Phase and Operating Phase Job Impacts.



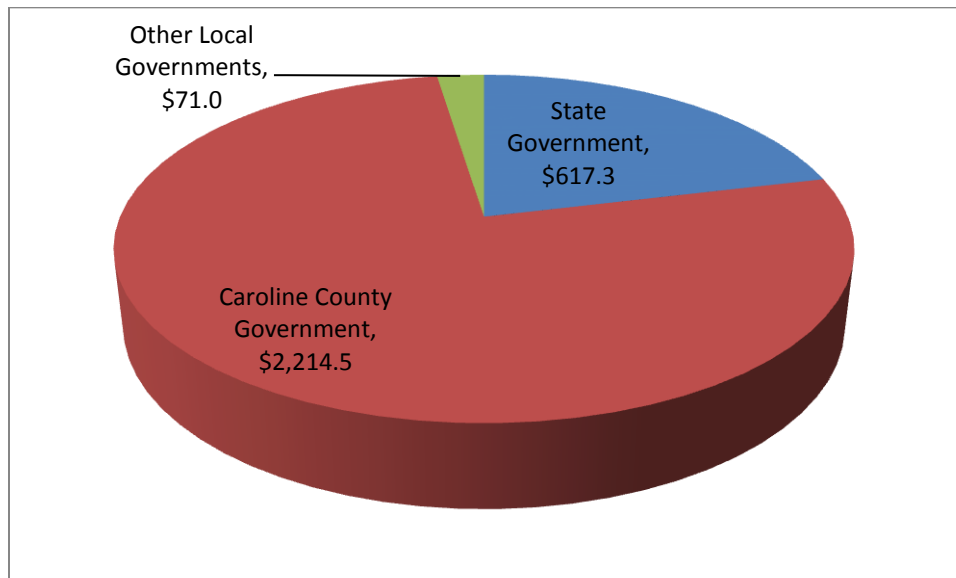
Source: IMPLAN

Figure 3: Distribution of Government Revenues within Maryland from the Construction Phase (\$ millions)



Source: IMPLAN and JFI

Figure 4: Distribution of Government Revenues within Maryland from the Operating and Maintenance Phase (\$ thousands per year)



Source: IMPLAN and JFI

Economic Impact Methodology and Terms

The JFI prepared this analysis of the economic contributions of the Cherrywood Solar I project on the Maryland and Caroline County economies using the IMPLAN input-output models for the State of Maryland and Caroline County. IMPLAN is one of the most widely used models in the nation, and can be used to analyze the impacts of companies, projects, or of entire industries. An input-output analysis examines the relationships among businesses and among businesses and final consumers. Input-output analysis is based on the use of multipliers, which describe the response of an economy to a change in demand or production. Multipliers measure the effects on an economy from a source of economic activity, in this case the jobs and revenues associated with the construction and subsequent operation of the Cherrywood Solar farm.

The economic activity generated in a city, county, region or state is greater than the simple total of spending associated with the event or activity being studied. This is because as this money is earned it is, in turn, spent, earned and re-spent by other businesses and workers in the local economy through successive cycles of spending, earning and spending. However, the spending in each successive cycle is less than in the preceding cycle because a certain portion of spending “leaks” out of the economy in each round of spending. Leakages occur through purchases of goods or services from outside of the region and via federal taxation. The IMPLAN multipliers used in this analysis capture the effects of these multiple rounds of spending based on observed spending patterns within the region of study. This analysis focuses on three measures of economic impact:

- **Output.** The total value of production or sales in all industries.
- **Employment.** The total number of full and part time jobs in all industries.
- **Labor Income.** The wages and salaries, including benefits, and other labor income earned by the workers holding the jobs created.

Four measures of the economic activity and impact of the construction spending and operating expenditures of the solar farm are included in this report:

- **Direct effects.** The change in economic activity being analyzed—in this case the jobs and revenues directly associated with the solar farm.
- **Indirect effects.** The changes in inter-industry purchases, for example the purchase of goods or services to support the construction and production activities, in response to the change in demand from the directly affected industry.
- **Induced effects.** The changes in spending from households as income and population increase due to changes in production.
- **Total effects.** The combined total of direct, indirect and induced effects.