

3443 E. Lee Street
Tucson, AZ 85716
Sent by U.S. Mail and electronically January 3, 2012

Mr. Adrian García
Bureau of Land Management
SunZia Transmission Line Project
P.O. Box 27115
Santa Fe, NM 87502-0115

Dear Mr. García:

In late 2011 the SunZia Southwest Transmission Project released two economic studies entitled “SunZia Southwest Transmission Project Economic Impact Assessment” and “Impacts of Potential Alternative Generation Facilities.” The job numbers from these reports that SunZia has provided in press releases and published articles are greatly misleading because job-years of work are reported as jobs. As I understand, these reports will be incorporated into the SunZia environmental impact statement (EIS), and I thus request that the correction I provide in the accompanying report be included in the EIS.

SunZia claims that its transmission project will create 6,200 jobs when the maximum number of jobs supported is only 2,459, reached in year 3 of construction. Of these 2,459 jobs, only 780 are actual construction jobs, and only 234 of these will actually go to workers in Arizona and New Mexico. In addition, SunZia claims that the project would create 36,700 renewable energy-related jobs when a more realistic number would be between 13,000 and 14,000. This adjusted jobs number yet depends upon an unrealistic assessment of the actual number of renewable energy projects that would be constructed and remains questionable in itself.

Although the main economic report on the project contains certain deficiencies, my report does not question the numbers it contains. It merely explains them. However, I strongly question the numbers that the renewable energy jobs supplement contains because the mix of renewable energy projects is unrealistic and the jobs associated with photovoltaic projects are a factor of 3–4.5 too high when compared with other projects currently being built.

If the draft EIS will include these SunZia reports, I request that the enclosed report accompany them if at all possible to give the public, elected representatives and government officials a clearer understanding of the numbers they contain. I realize that it may be too late to incorporate it at this point.

Sincerely,



Norm “Mick” Meader
Cascabel Working Group
(520) 323-0092
nmeader@cox.net

Enclosure

cc: Mr. Jesse Juen, Acting Director, New Mexico Office of the BLM
Mr. Tim Meeks, Administrator, Western Area Power Administration
Ms. Lisa Meiman, Corporate Communications Team, Western Area Power Administration

Review of the SunZia Southwest Transmission Project Economic Report
By Norm “Mick” Meader, Cascabel Working Group
January 3, 2012

Introduction

SunZia has released two reports, “SunZia Southwest Transmission Project Economic Impact Assessment” and “Impacts of Potential Alternative Generation Facilities” that it now includes on its website and which the November 23, 2011 edition of the *Albuquerque Journal* summarized in a front-page article entitled “SunZia Project Promises Jobs.” The numbers published are misleading because the units on the data tables in these reports are in error. What are called “jobs” in most of these tables are actually “job-years of work,” or FTEs. This error affects both the jobs supported by building the transmission project and alternative (renewable) generation facilities. While job-years of work is an important economic parameter to calculate, what is most important is how many people can actually get a job, what kind of job that is, and how long it will last.

This review has been delayed because the main report contained a major error in Table 6.1, which summarized jobs by year for Arizona. I alerted Dr. Alberta Cherney, the principal author of the study, to this error, and she has now provided a corrected version, which allows me to discuss the report’s numbers accurately.

Jobs Created by the Transmission Project Itself

These numbers include four types of jobs: (1) construction labor jobs, (2) construction materials jobs (jobs associated with the manufacturing materials required to build the project), (3) indirect jobs created in industries doing business with materials manufacturers, and (4) induced jobs, or jobs created in the general economy by the spending of direct job wages and salaries.

Numbers released by SunZia state that building SunZia itself will create a total of 6,200 jobs; however, these are actually the job-years of work summed together over the project’s four-year construction period. Thus the average number of jobs that SunZia supports is 1,550/year; the maximum employment associated by SunZia occurs in year 3, when a total of 2,459 jobs are supported (Figure 1).

As a further example of this confusion, Senator Jeff Bingham stated in a press release dated October 5, 2011 regarding the fast-tracking of permitting of SunZia that the project would create 3,408 direct jobs during the construction period. Again, these are job-years of work, not jobs. The average number of direct jobs supported during the four-year construction period is 842/year; the maximum number of direct jobs supported is 1,353, reached in 2015 (Figure 2).

The number of actual construction jobs supported by SunZia (workers hired by SunZia) averages 491/year, reaching a maximum of 780 in 2015 (Figure 3). Seventy percent of these jobs will go to people outside the states of New Mexico and Arizona. This is to say, the average number of people employed by SunZia in Arizona and New Mexico will be 147/year. In addition, only

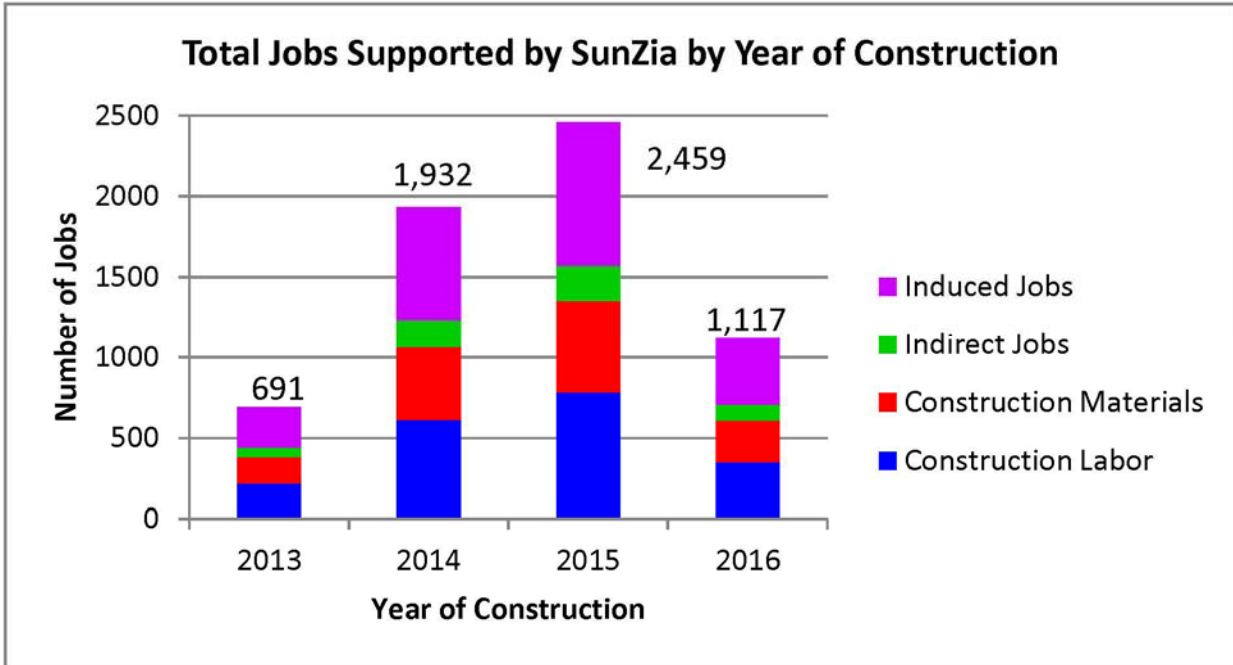


Figure 1. Total jobs supported by SunZia by year of construction. Induced jobs, those created by spending direct salaries and wages, represent the largest category. These would include department store and restaurant jobs, for example.

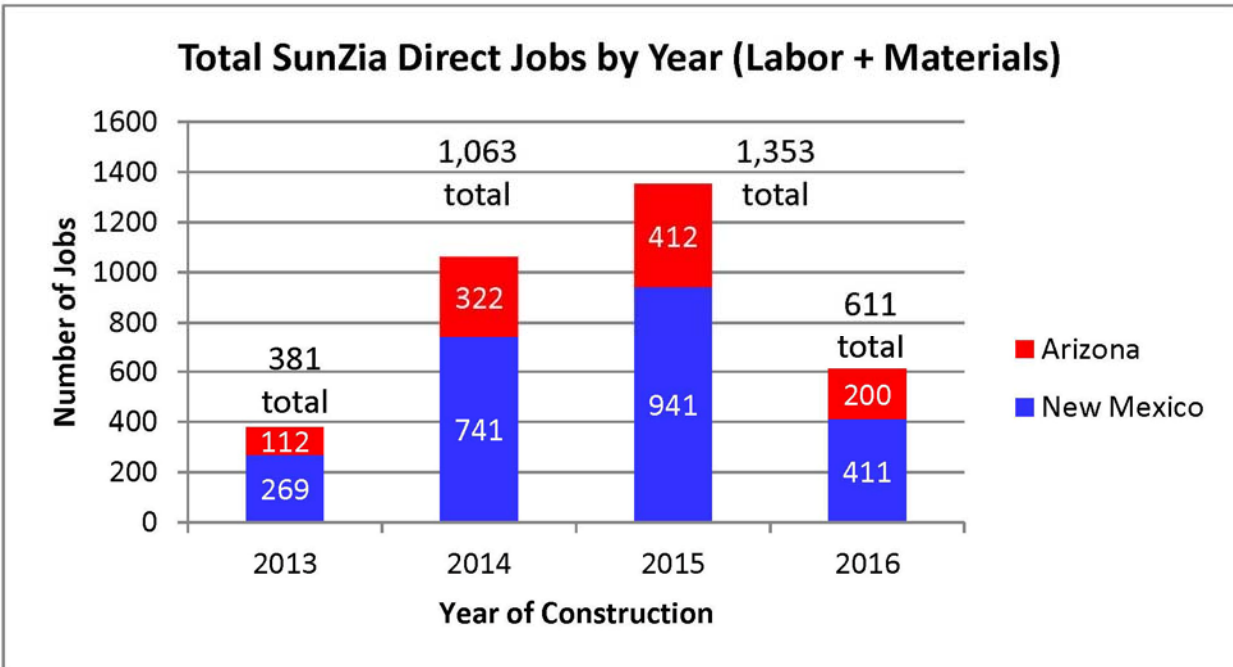


Figure 2. Direct jobs supported by SunZia by construction year. Direct jobs average 842/year for the four years of the project, reaching a peak of 1,353 in 2015.

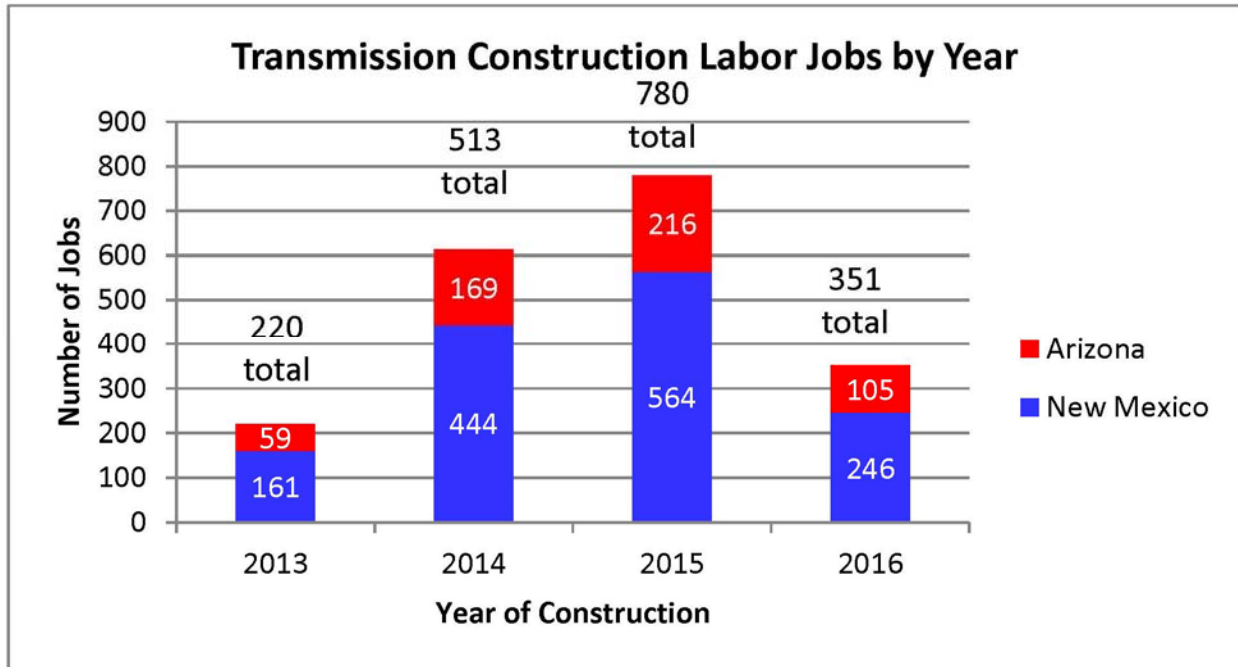


Figure 3. Total construction labor jobs – the number of people hired by SunZia – for New Mexico and Arizona for the four-year construction period. Note that 70% of these jobs will go to workers from outside these states.

10% of those people hired will be from those counties that the project crosses. In the six counties in New Mexico affected, an average of 35 people/year will be employed; in the three counties in Arizona, an average of 14 people/year will be employed. These numbers are averages for all counties *combined*, not individual counties.

Jobs Associated with Potential Alternative Generation (Renewable) Facilities

Job projections associated with alternative generation (renewable) facilities are inflated by three factors: (1) the 36,700 jobs given are again job-years of work, not jobs, (2) the mix of renewable technology projects is unrealistically biased toward solar projects, photovoltaic projects in particular, which require more job-years of work to complete, and (3) the number of job-years of construction labor given for a 100-MW photovoltaic installation is a factor of 3-4.5 greater than that calculated from current photovoltaic projects. The latter two factors are input model parameters furnished to the economic modelers by SunZia and were not chosen by the modelers themselves.

First, using job-years to represent jobs does not inflate job numbers as seriously as for the transmission project because construction times are shorter, but it is still a significant factor. While photovoltaic projects are completed in 1 year, solar thermal projects require 2 years, wind projects 1.5 years, and geothermal projects 1.5 years. Correcting the job-years of work to jobs using these factors reduces the total number of jobs to 31,090. (This assumes that all workers will be hired at the beginning of these projects and will work the full time required to complete them.)

Second, the mix of technologies is not realistic. The original mix includes 10 solar projects (8 photovoltaic and 2 solar thermal) totaling 1,120 MW of capacity compared with 12 wind projects totaling 1,200 MW of capacity. Wind generation is far more economic than solar generation and is the reason given for building this project. New Mexico wind-energy producers are unquestionably expecting to use far more than 1,200 MW of this transmission capacity. To be more realistic, changing the mix of technologies to 2 photovoltaic plants, 2 solar thermal plants, 1 geothermal plant, and 19.5 100-MW wind farms further reduces job numbers to 17,547. (The odd number of wind projects is needed to match the original 2,420 MW of renewable generation.)

Third, what inflates job numbers most significantly is the high number of construction labor job-years used for photovoltaic plants. The model uses 890 job-years (890 people working one year) to complete a 100-MW plant, whereas a survey of current photovoltaic plants indicates a range of 200 to 300 job-years/100 MW of installed capacity. Thus the modeled number is a factor of 3–4.5 too high. While comparable data for other photovoltaic job categories are much harder to determine, if SunZia photovoltaic numbers are decreased by a factor of 3.0 (using the smallest number to be most conservative), then the total Arizona photovoltaic job-years would be 1,045 rather than 3,135 and New Mexico job-years would be 789 instead of 2,368, further reducing the number of renewable-generation jobs by 3,689 to 13,878. This compares with the total of 36,700 given in the article.

One last critical factor to mention here is that 80% of the construction jobs for wind-generation installations – what seems most realistic to emphasize in this modeling – will go to workers from outside New Mexico. Crews will be brought in for much of the work. Although this would still leave 236 construction jobs for New Mexicans, it is a sobering fact.

A Missing Model Component: Nonrenewable Generation

An essential component missing from these job projections is new nonrenewable generation. SunZia was originally proposed to provide transmission capacity for the SouthWestern Power Group's yet-to-be-built 1,000-MW Bowie, Arizona, natural gas generating plant, and SunZia will provide connections for 1,000+ MW of existing natural gas generating capacity in southwestern New Mexico, although this capacity currently uses other transmission facilities. SunZia follows El Paso Natural Gas Company's pipeline corridor across southern New Mexico and Arizona, which would facilitate easy expansion of natural gas generating capacity in the area, something that is highly likely to occur.

Natural gas is currently the most economic form of electrical generation, especially compared with renewable generation, and realistic modeling would include this capacity. Integrating 800-1000 MW of new natural gas generation into the SunZia model is very reasonable – it could easily be more – and is required to produce a fuller and more robust economic assessment. The amount of renewable generation included in the model would need to be reduced to accommodate this, which would reduce the number of renewable energy-related jobs. As a basic reference, the SouthWestern Power Group states that building its 1,000-MW Bowie power plant would create 500-600 construction (labor) jobs.

Summary

This analysis shows that the number of jobs associated with SunZia is far less than that reported by SunZia. While job-years of work is an important parameter to calculate in assessing economic impact, what is most important is how many people can actually get jobs. This analysis does not question any of the job numbers calculated for the transmission project itself but merely explains them. The modeling of renewable generation jobs is, however, based upon highly unrealistic model parameters and is not credible.

Benefits seem overstated for SunZia project

■ Study questions job projections for transmission system

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Albuquerque Journal

BY MICHAEL HARTRANFT
Journal Staff Writer

The initial rosy economy benefits projected for the two-state SunZia high-voltage transmission project were too rosy.

So asserts Arizona resident Norm Meader, who has been monitoring the project's development as a member of the Cascabel Working Group, a watchdog of the San Pedro River Valley in southeastern Arizona.

To be sure, Cascabel's group is trying to prevent the route of the project — a 500-mile-long transmission system linking New Mexico and Arizona to deliver electricity principally generated by renewable sources — from intruding into the valley because of its environmental uniqueness.

But Meader, a retired University of Arizona geoscience department staff member, says SunZia's widely reported claim — including in the *Journal* — that the project would

create 6,200 construction jobs and spin off 36,700 renewable-energy jobs is badly overstated, which he attributes to labeling errors on data tables in the report and misinterpretations of what the label actually means.

One of the report's authors concedes Meader is right.

"Of course, there's an economic upside to it," said Meader of the project. "It just isn't nearly as big as it's been portrayed — maybe a third."

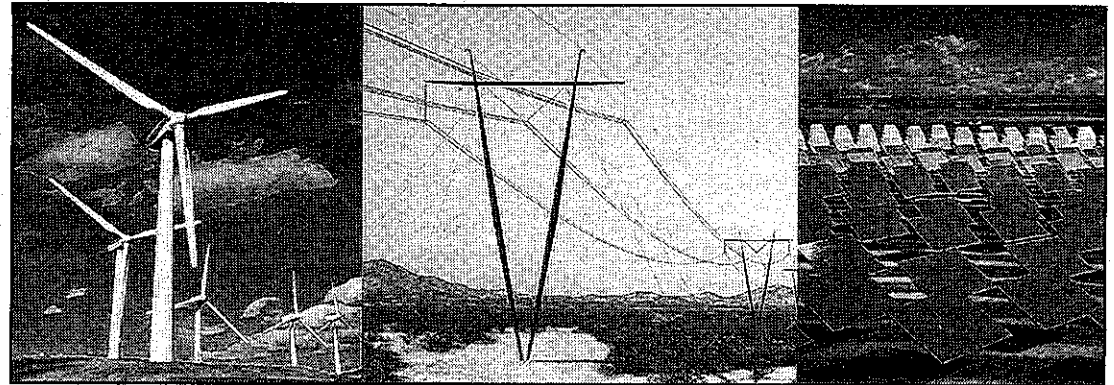
Jobs vs. FTEs

Meader also provided a copy of the critique to report co-author Alberta Charney of the University of Arizona, who confirmed the report intended jobs to mean job-or-man-years. She said "jobs" is commonly used in economic reports, but could see how it might be confusing.

"Sometimes people misinterpret jobs to mean, oh, it's going to be 6,000 people working for the full duration of this project," she said. "That is the common usage, so I sympathize with you."

She said man-years are used in economic studies because of uncertainties about the actual jobs.

"If you have three jobs, you don't know for sure whether that's three guys working for



These are renewable energy components that would be in play in SunZia's proposed, 500-mile-long transmission project linking New Mexico and Arizona.



SunZia's logo suggests New Mexico-Arizona linkage.

one year, or one guy working for three years," she said.

Meader said the projection of 36,700 "jobs" related to renewable generation development is also inflated, though not as dramatically because construction times are shorter, one to two years. Converting the figure to actual jobs would reduce the number to 31,090, he said.

An unrealistic mix?

He contends the study, however, relies on an

unrealistic mix of renewable projects — 10 solar and 12 wind projects, though wind is far more economical and wind-energy producers are likely expecting to use far more than the projected 1,200-megawatt capacity used in the SunZia study. A more realistic mix of four solar, one geothermal and 19½ wind farms to match the amount of renewable generation in the economic study would reduce the job numbers to 17,547, Meader

said.

But the number shrinks even more because of the high number of job-years projected to complete solar PV projects. While the model said it would take 890 job-years to complete a 100-megawatt plant, Meader said a survey showed it would actually be in the range of 200 to 300 job-years, making the SunZia number a factor of three to 4.5 too high. Decreasing the photovoltaic numbers by a factor of three would reduce the number of renewable-generation jobs to 13,878, he said.

A draft of the environmental impact statement identifying the preferred route is due out in April.

Subject: Additional SunZia Economic Impact Report

From: Norm Meader <nmeader@cox.net>

Date: 1/19/2012 7:17 AM

To: Adrian Garcia <agarcia@blm.gov>

BCC: Dave Shreeve <daveshreeve@gmail.com>

Dear Mr. Garcia,

I have written a second, more extensive review of the SunZia Economic Impact Assessment that I am attaching for inclusion in the SunZia DEIS or EIS. I have submitted this to Michael Hartranft of the *Albuquerque Journal*, Tom Wray of SunZia, and Alberta Charney, who was the lead researcher on the report. I document very serious oversights and errors in the two parts of the report that were issued (transmission and renewable generation).

Thank you for considering this.

Sincerely,

Norm "Mick" Meader

Member, Cascabel Working Group

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(520) 323-0092

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— Attachments: —

SunZia_Economic_Impact-01-17-12.pdf

44.9 KB

Summary of Jobs Analysis

The Main Report

SunZia employment will average ~482 people/year over the project's four-year construction period, with a peak employment of 780 in year 3. For all categories of employment combined, employment will average 1,550 people/year with a peak employment of 2,459. Lastly, the total number of job-years of work will be 6,200. SunZia itself will employ an average of 41 Arizona residents and 106 New Mexico residents, with peak employment being 65 and 169, respectively.

An additional problem with the study is determining how many Arizona and New Mexico residents will have jobs. The study states that only 30% of the people hired for construction will be from these states (job numbers given above), and the locations of jobs associated with the manufacture of materials are not given. Most of these materials are likely to be manufactured outside these two states, and thus the jobs associated with them will be elsewhere.

A general adjustment for these factors indicates that the average number of people employed in Arizona for all categories will be ~180 with a peak employment of ~285, and the average number of people employed in New Mexico will be ~320 with a peak employment of ~510.

Average employment in these states will be somewhat less than 10% of the number that SunZia promotional brochures suggest (2,200 and 3,900, respectively). These new numbers are derived by (1) converting job-years of work to jobs, (2) removing people hired from out of state, (3) adjusting for jobs associated with materials manufactured out of state, and (4) reducing the number of induced jobs somewhat to compensate for the saving of wages and payment of debts.

Renewable Generation Projects

A major revision of the jobs and revenue associated with photovoltaic (PV) projects is required for renewable generation modeling to be valid. The error in jobs for solar-thermal projects is also significant, requiring additional recalculations. Actual PV jobs are approximately 17% of that of the number given in the current study, and the number of solar-thermal construction jobs should be approximately twice that in the current study.

Using 150 construction jobs/solar PV project gives 1,200 construction jobs rather than 7,120, as derived in the study. *Total solar PV job-years of work would be ~5,500 rather than 22,016.* It is uncertain how material supply, indirect, and induced jobs should scale. If the other jobs scale in the same way that construction jobs do, then total *average employment/year for all photovoltaic projects combined would be ~3,700.* This underscores the magnitude of the error in model input parameters, which translates into gross miscalculations of job numbers and tax revenues.

For solar-thermal projects, total construction employment for both states combined should be ~1,000 rather than 500. Total job-years of construction work should be ~2,000 rather than 1,000. It is unclear whether the other employment categories should be similarly scaled, and modelers must research this before redoing job and revenue projections.

A problem, again, with total renewable job projections for Arizona and New Mexico is the hiring of workers from out of state and the location of manufacturing facilities for needed materials. Fifty percent of construction jobs for solar PV, solar-thermal, and geothermal projects will go to outside workers. For New Mexico wind projects, 80% of workers will be hired from out of state, and nearly all materials for the installations will be manufactured out of state. Thus of the 5,632 jobs (derived from 8,448 job-years of work) projected for wind installations in New Mexico, approximately 1,100 of them would go to New Mexico workers if 90% of the materials are manufactured elsewhere. Manufacturing location would sharply reduce jobs related to solar-PV projects in at least New Mexico.

Lastly, a variety of factors make the mix of renewable generation projects used in modeling unrealistic. A more reasonable mix would include a higher number of wind projects and significant natural gas generation. Solar installations would need to be rather sharply reduced in number. And again, all generation projects in the supplemental study are hypothetical, and the jobs projected from them are thus very uncertain. Because of the time needed to permit and construct these projects and because of the great uncertainty in whether they will actually be built, investors must be very cautious about committing to SunZia and overbuilding the project at the beginning.

SunZia Economic Impact Analysis Review
Norm “Mick” Meader, Cascabel Working Group
January 17, 2012

Introduction

This report addresses the economic impacts calculated by the University of Arizona and New Mexico State University for the two-line 500-kV AC configuration of the SunZia Southwest Transmission Project. As mentioned in my previous analysis (December 11, 2011), the fundamental problem with the job numbers released by SunZia is equating job-years of work with jobs, which greatly inflates SunZia’s job potential. Dr. Charney and her associates consistently refer to job-years as jobs throughout their main report, and SunZia apparently accepted this without questioning it. In other economic impact studies that I have examined, all researchers explicitly differentiate between job-years and jobs, discussing them separately. Not doing this is a major oversight in this study.

The error that I note in the job numbers calculated for photovoltaic projects rests with SunZia and not with the modelers. A consultant presumably supplied the basic input for this study. The starting job numbers are so greatly in error that I suspect a typographical error is to blame. Because of this error, the job numbers and associated revenues are invalid, and this portion of the study must be completely redone to have any merit.

The following addresses additional weakness of the report. I intend this discussion to be taken as a peer review designed to make the report better and more worthy of public presentation, not an attack on the work that was done. It is something to use in revising the report, if this is done.

Additional Shortcomings of the Main Report

The Relative Importance of Job Numbers

I have two significant criticisms of the transmission project report itself. Most importantly, while projecting supply-related, indirect and induced job numbers helps assess the broader impact of a project, the single most important economic indicator for any project is how many people it will hire. When DOE references job numbers in project summaries, it is this number that is always given as a baseline measurement of economic potential. Nowhere in Dr. Charney and her associates’ report or on SunZia’s website is this number given. While one can derive it from the data provided, one cannot determine it without doing a series of computations. This, again, is a fundamental oversight.

The most important job figures to give, in the proper order, are (1) how many people the company will hire (both average and peak employment, or 482 and 780, respectively), (2) how many total jobs will be supported (again, both average and peak employment, or 1,550 and 2,459, respectively), and lastly, (3) how many job-years of work will result (6,200). Because only 30% of SunZia hires will be from Arizona and New Mexico, SunZia will employ an average of 41 Arizona residents and 106 New Mexico residents. Peak employment will occur in

year 3 of construction, when SunZia will employ 65 Arizona residents and 169 New Mexico residents.

While SunZia, like any company, wants to make its job potential appear as large as possible, legislators and policy makers need an honest portrayal of actual jobs and their locations to make sound decisions. SunZia will generate some good jobs, but the misuse of the study's results makes it difficult to correct misconceptions now without embarrassing SunZia and harming the company's credibility.

Out-of-State Hirees and Induced Jobs

A major problem with these employment numbers is that published summaries do not make clear that not all construction jobs will go to workers in Arizona and New Mexico. The states where SunZia workers are hired and the location of spin-off jobs is critical information for policy makers and legislators, especially those in these states. Seventy percent of direct construction jobs would go to individuals from other states. In addition, while the report assumes that these people would spend 80% of their income in Arizona and New Mexico, this seems too high. This also applied to in-state hirees, who will supposedly spend 100% of their wages in state. These are high-quality jobs with food and lodging paid, and modelers assume that no one will save money or pay down existing debts, a rather unrealistic assumption given the nature of the jobs. Induced jobs, which rely on the spending of wages, could be significantly overestimated by assuming this, and these jobs represent the largest job category.

In addition, many people hired from outside Arizona and New Mexico will have families to support and mortgages to pay in their home states. Single individuals without these concerns are likely to save a higher proportion of their incomes as well. I thus expect the number of induced jobs resulting from the spending of wages in Arizona and New Mexico by non-residents to be less than 80% and by residents to be less than 100%. Both of these factors – the employment of outside individuals and the inclusion of savings and debt reduction in calculating induced jobs – diminish the job potential in these states.

Also, the number of induced jobs depends heavily on how concentrated the spending of wages is. Such spending must be concentrated in a fairly limited number of businesses or otherwise revenues will be insufficient to justify hiring additional workers. If such spending is very diffuse, it will not create jobs. Economic modeling calculations need to include a spending diffusivity index to more accurately predict job potential. Because SunZia employees will come from a widely dispersed area and because a significant portion of their income will likely be spent with more businesses, this should reduce induced job creation. I make no adjustment of this, however, in any of the job numbers that I calculate.

Assessment Problems Arising from the Location of Material Supply Jobs

A second very serious shortcoming of the main report is that nowhere does it give a breakdown of the primary materials needed to build the project, where these materials will be manufactured, and the number of jobs associated with each material. This is critical because many of the materials will be manufactured overseas or in other states, and the jobs associated with them will

not be in Arizona or New Mexico. The manner in which SunZia references job numbers on its website and in its brochures makes it appear that all of these jobs will occur within these two states.

As an example of this problem, Tom Wray of SunZia has stated that all of the steel for the transmission towers will be manufactured in India or China¹. In addition, the transmission cable may be manufactured overseas, or at least in other states. These are the two main materials needed for the project, and many of the direct material-supply jobs given in the study are presumably associated with them. Lesser amounts of additional materials are undoubtedly needed also, some of which may be procured in Arizona and New Mexico.

This lack of clarification of job location and associated spending accentuates the difficulty in assessing the economic impact on Arizona and New Mexico because the additional indirect and induced jobs associated with these jobs will be elsewhere also. SunZia's summary of the reports suggests that all of these jobs would be created in Arizona and New Mexico when they will not be.

Adjusting for Jobs Created Elsewhere

Nowhere does the report state that these jobs may be created throughout the country or in foreign countries. The brochures on the SunZia give the impression that the project will create 3,900 jobs in New Mexico and 2,200 jobs in Arizona, although they contain a rather obscure footnote at the end that mentions that these are man-years of work. When one converts job-years to jobs, adjusts for people hired from other states, removes jobs associated with materials manufactured elsewhere (direct, indirect, and induced), and reduces induced jobs to accommodate savings and debt reduction, the average jobs/year summed together for all categories in New Mexico will be ~320 with peak employment of ~510; the average jobs/year summed together for all categories in Arizona will be ~180 with peak employment of ~285.

These numbers are derived by (1) reducing direct labor jobs by 70% to adjust for out-of-state hiring, (2) reducing the number of direct, indirect, and induced jobs associated with manufacturing of materials by 80%, (3) reducing the number of construction-related induced jobs created by in-state worker spending from 100% to 80%, and (4) reducing the number of construction-related induced jobs created by out-of-state worker spending from 80% to 60%. The reduction of jobs associated with materials is not based on known information, however, and the locations of the manufacture of needed materials are required to accurately derive this. Neither do I have a sound basis for reducing induced jobs. Thus the job numbers that I have calculated are only a rough approximation.

This required adjustment significantly affects the collection of local and state sales taxes, corporate taxes, and personal taxes in Arizona and New Mexico. Not adjusting for the location of material supply jobs and associated indirect and induced jobs produces revenue estimates that would be much too high for these states. Presumably modelers have compensated for this, but nowhere is this stated in the report.

¹ Tom Wray, public presentation, Cascabel, Arizona, January 13, 2010.

To fully assess the economic impact of SunZia on Arizona and New Mexico, it is essential to know where employees will be hired, where ancillary jobs will be created, and thus where money will be spent. How the report portrays job numbers does not make this possible.

Adjusting Photovoltaic Jobs Numbers

Review of Other Photovoltaic Projects

What initially alerted me that something was seriously wrong with the SunZia photovoltaic job numbers was the great imbalance between them and those for the Topaz and Desert Sunlight photovoltaic projects in California. These two projects total 1,100 MW in capacity compared with 800 MW for SunZia jobs projects. The total number of job-years of work, including indirect and induced jobs, for these two California projects was 3,619, yet for the SunZia projects, which had nearly one-third less capacity, the total job-years of work was 22,016. Part of the mismatch results from the lack of full inclusion of material supply jobs for the California projects, but this cannot explain such a large difference. When the California projects are proportionally sized to match the SunZia projects, the number of SunZia job-years is nearly an order of magnitude greater.

I compiled a list of the number of construction jobs associated with these and four other projects on the DOE website, and I give these in the table below. Excluding the number of jobs associated with the Mesquite Project, which gave peak employment rather than average employment, the number of construction jobs/100 MW of capacity averages ~120. Had the 890 jobs/100 MW of capacity given in the SunZia study been merely 89, the job numbers would have been more accurate. This suggests that this initial number is a typographical error.

Photovoltaic Projects

Project	Location	Capacity (Megawatts)	Construction Jobs	Jobs per 100 MW
Agua Caliente	Yuma Co., AZ	290	up to 400	up to 138
Antelope Valley Solar Ranch	Los Angeles Co., CA	230	350	152
California Valley Solar Ranch	San Luis Obispo Co. CA	250	350	140
Desert Sunlight	Riverside Co., CA	550	550	80
Mesquite Solar 1	Phoenix, AZ	150	up to 300	up to 200
Topaz Solar Project	San Luis Obispo Co., CA	550	400	73

I obtained three economic impact studies that calculated actual construction (labor) job-years of work associated with photovoltaic projects (California Valley², Desert Sunlight³, and Topaz⁴), and scaling them proportionally to 100 MW of capacity gives 272, 173, and 218 job-years of work, respectively, again far below the 890 figure given in the SunZia report. While it is

² Available from http://www.californiavalleysolarranch.com/pdfs/Economic_Impact_to_SLO_Final.pdf. Accessed January 15, 2012.

³ Available from http://www.desertsunlight.com/~media/WWW/Files/Microsites/Desert-Sunlight/Report_EconomicImpactReport.ashx. Accessed January 15, 2012.

⁴ Available from <http://www.topazsolar.com/~media/WWW/Files/Microsites/Topaz/TopazEconomicStudy.ashx>. Accessed January 15, 2012.

somewhat difficult to determine an appropriate number for recalculating all photovoltaic job and revenue numbers, this must be done for the study to have any validity. These other reports suggest that a reasonable number for construction jobs would be ~150 with a construction time of 1.5 years, which gives 225 job-years of work/100 MW. The number of years required to build these other projects suggests that 1 year is too short to construct a 100-MW facility. I cannot determine whether the direct jobs associated with material supplies should be adjusted by the same amount. I did so in my original analysis.

When these adjustments are made, the total number of job-years associated with the eight photovoltaic projects is approximately 5,500, with actual employment being about 3,700. This compares with the 22,016 job-years (equivalent to jobs in this case) given in the report.

Problem with the Location of Photovoltaic Material Supply Manufacturers

Again, a major problem with assessing the actual economic impact of these projects on Arizona and New Mexico is the lack of locations for manufactured materials. SunZia's presentation of these job numbers gives the impression that all of these jobs and any associated indirect and induced jobs will occur in Arizona or New Mexico. No solar panel manufacturers are located in New Mexico, although First Solar is a major manufacturer in Arizona. The largest manufacturers of solar panels reside in China and Taiwan.

The principal components of a PV system include the solar modules, mounts, electrical wiring and AC/DC inverters. While mounts can be manufactured locally and wiring can be purchased locally, the modules and inverters will be built outside New Mexico. Thus the majority of associated supply, indirect, and induced jobs will occur outside New Mexico. Whether this situation accrues to Arizona's advantage depends upon whether PV installers use First Solar for their panels or whether they use one of the larger standard PV manufacturers located elsewhere in the country or world.

Additional Ramifications of Photovoltaic Job Errors

Because the jobs numbers for photovoltaic projects are so greatly in error, this affects all of the revenue calculations derived from them for county and state income. Thus all of these revenues must be recalculated. In addition, because the mix of possible projects proposed for all 18 counties contain photovoltaic projects, all of the potential economic impacts of renewable generation on these counties must be recalculated. Some attempt must be made to determine the manufacturing location of the PV components in order to adjust material supply jobs and associated indirect and induced jobs. This is likely to sharply reduce employment numbers for at least New Mexico.

Other Renewable Generation Projects

Error in Solar-Thermal Job Numbers

While I have not found actual construction job numbers for other geothermal and wind-energy projects, I did find numbers for several solar-thermal projects on the Department of Energy's

website. Project summaries listed there indicate that the numbers used in the SunZia study are too low. Construction job numbers for the Genesis Solar Project, Ivanpah Solar Complex, and Mojave Solar Project suggest that a 160-MW solar thermal plant should support ~500 jobs for 2 years, resulting in 1,000 job-years of work. Tables 2.1.2 and 2.1.3 in the SunZia study list 500 job-years of work for this amount of capacity, suggesting that construction jobs were not converted to job-years in computing economic impacts.

It is unclear whether the associated supply, indirect, and induced jobs need adjustment also. Comparing the relative abundances of job numbers in all job categories for other project types does provide solid guidance in determining this. It is possible that merely the construction job-years are in error, which could partially affect the number of induced jobs calculated. SunZia and the modelers need to further examine this to determine if additional corrections are needed.

Hiring Location and Material Supply Problems for Other Project Types

Again, hiring location and the location of material supplies greatly affects job numbers and related revenue streams for Arizona and New Mexico. As mentioned in my original analysis, 80% of the construction jobs associated with New Mexico wind turbine installation will go to workers outside New Mexico. Because no manufacturers of wind turbine components are located in New Mexico, most of the associated material supply jobs will be located outside New Mexico, as will most of the related indirect and induced jobs.

Again, SunZia's manner of referencing these numbers makes it appear that these jobs will be in New Mexico, which significantly inflates job expectations. The total number of jobs associated with wind installations was given as 5,632 (derived from 8,448 job-years). After adjusting for out-of-state workers and out-of-state material supply jobs, the number of jobs available to New Mexico workers would be ~1,100. If wind project size were 200 MW instead of 100 MW, this would reduce employment to 550, but workers would work twice as long to complete all projects, conserving job years of work.

This problem of manufacturer location affects solar-thermal and undoubtedly geothermal projects also. For the Mojave Solar Project, 20% of the materials will come from overseas, while the remaining supply manufacturers are located in six states. Again, this affects the location of indirect and induced jobs and tax revenues associated with them. While I did not research geothermal installations, I assume that components will be widely distributed as well.

Comments on Renewable Project Mix

The mix of renewable generation projects given in the SunZia study is hypothetical and as such is unrealistic in light of what is feasible. SunZia references these job numbers as though they are concrete and that all of these jobs will materialize if SunZia is built. This will not occur and is misleading. Several factors make construction of the proposed mix of renewable generation unlikely. The SunZia project itself is extremely vulnerable economically because these projects cannot be built with certainty. While other companies may have expressed interest in building renewable generation to use SunZia, obtaining the hundreds of millions of dollars in loans to build that generation and committing the money to these projects is difficult and risky. The

following lists several factors that make the full build-out of the proposed renewable generation mix unlikely.

- *Low Capacity Factors and Inefficient System Utilization.* A major problem with this mix is the low capacity factors of solar PV and wind, which are ~20% and ~33%, respectively. This means that for 800 MW of installed PV capacity, only 160 MW of power is generated on average, and for 1,200 MW of wind generation capacity, only 400 MW of power is generated on average. This translates to an average capacity factor of 28%, which translates to a system utilization of the same percentage. Solar thermal, geothermal, and natural gas have capacity factors of ~65%, which would raise the overall system utilization to between 30% and 40%, but this would still be very low for a system of this regional significance. The less power that a system carries, the less economically viable it is. A system utilization of 75% for a large-scale transmission project would be optimum both physically and financially and requires a different energy mix.
- *The Need for Large Amounts of Nonrenewable Energy to Stabilize Power Output.* The use of highly variable generation such as solar and wind requires that such generation be coupled to an equivalent amount of nonrenewable generation. The system cannot function effectively without this. Conceiving of SunZia without taking this into account leaves an important component out of the system, although nonrenewable generation located outside the system will partially compensate for this. This nonrenewable generation is needed to support the system physically and financially.
- *The Time Required to Build Generation Facilities.* The modeled scenario assumes that most of this renewable generation will be built quickly during or following construction of SunZia, when it will most likely be built over time if the project is built. It would not be unrealistic to expect a construction period of 20 years for this much generation. If this capacity is not built quickly, however, SunZia will fail financially, and investors cannot justify building the project. A 500-kV line costing up to \$1 billion cannot sit unused for 10-15 years. This is the prospect that SunZia faces, which makes a full, initial build-out of the project extremely risky financially.
- *The Lack of a Need for the Power.* This project is predicated on the basis that states such as Arizona and California will require additional renewable power to meet their renewable portfolio standards (RPSs), yet Arizona is well on its way to meeting its RPS with its own solar energy⁵, and California has warned the Western Electricity Coordinating Council against building long interstate lines to deliver renewable energy to the state because it believes that it can meet its RPS with its own renewable sources⁶. This weakens the need for New Mexico power and the justification for SunZia.
- *The Need for Federal Loan Guarantees and Subsidies.* While wind facilities can be built profitably by private investors without federal support, both solar PV and solar thermal facilities require hundreds of millions of dollars in federal aid to be built. The proposed 800 MW of solar PV capacity would require \$2–3 billion in federal loan guarantees, and the 320 MW of solar thermal capacity would require ~\$1.5 billion in federal loan guarantees. The

⁵ Susan Whittington, “Arizona Solar: Victim of Success?”, *Energy Prospects West*, December 6, 2011. Available at <http://www.roselawgroup.com/blog/wordpress/?p=40326>. Accessed January 16, 2012.

⁶ John Farrell, “California Governor Tells Western Grid: No Renewable Energy Imports Needed,” *Renewable Energy World.com*, November 3, 2011, <http://www.renewableenergyworld.com/rea/blog/post/2011/11/california-governor-tells-western-grid-no-renewable-energy-imports-needed>. Accessed January 12, 2012.

federal government has already spent enormous sums on such facilities. It is uncertain whether the federal government allocate additional funds for these new projects.

- *System Use by Natural Gas Generation.* SunZia has no control over what type of generation will use its system. The transmission system must be open to all operators. SunZia traverses prime natural gas generation territory, and owners of existing natural gas generation will unquestionably expand it at some time and request use of SunZia. While SunZia's transmission capacity is rated at 3,000 MW, approximately 10% of this capacity cannot be sold in order to maintain system reliability in case of grid failure elsewhere. Thus only 2,700 MW of capacity is available for sale, leaving just 280 MW of system capacity for nonrenewable generation in the modeled scenario. This is unrealistically small. In addition, the SouthWestern Power Group initially proposed SunZia to serve its 1,000-MW Bowie, Arizona, natural gas-fired power plant. SWPG needs 500 MW or more of this capacity to fully build its plant, and the magnitude of renewable energy generation in this scenario is insufficient for SWPG's own needs.
- *Utilities Need Reliable Power.* While public utilities are legally mandated to increase their usage of renewable energy, they must have enough nonrenewable generation online to meet their full power needs in case solar and wind facilities are not producing power. These utilities *must* provide power when it is needed, and they will always be seeking additional nonrenewable generation to maintain full system reliability. Not using SunZia to meet some of these additional power requirements greatly limits the system's usefulness and robustness.
- *Transmission Capacity Dependent Upon Generation Capacity.* Lastly, while renewable generation needs transmission capacity to be utilized, a transmission system needs generation capacity in order to be built. If that generation capacity does not materialize, the project will fail. While some companies have expressed interest in building generation facilities near SunZia, the magnitude of generation required to support the system will accrue only in small increments. The generation proposed to support this system is nothing like that of a 2,000-MW coal-fired power plant. This uncertainty places SunZia at great financial risk.

All of these factors indicate the need for a more realistic generation mix for SunZia. Such a mix would need to include far more wind and natural gas generation. These factors also suggest the need to be very cautious in building this system and not to overbuild it to start with.

Summary

This discussion highlights several problems with the presentation of results from the SunZia economic impact study and with assumptions used in calculating jobs associated with renewable generation facilities. Equating job-years of work with jobs has greatly exaggerated the job potential of the project and created confusion. While the number of job-years of work is an important economic indicator, what is most important is how many people can have jobs.

SunZia employment will average ~482 people/year over the project's four-year construction period, with a peak employment of 780 in year 3. For all categories of employment combined, employment will average 1,550 people/year with a peak employment of 2,459. Lastly, the total number of job-years of work will be 6,200. SunZia itself will employ an average of 41 Arizona residents and 106 New Mexico residents, with peak employment being 65 and 169, respectively.

An additional problem with the study is determining how many Arizona and New Mexico residents will have jobs. The study states that only 30% of the people hired for construction will be from these states (job numbers given above), and the locations of jobs associated with the manufacture of materials are not given. Most of these materials are likely to be manufactured outside these two states, and thus the jobs associated with them will be elsewhere.

A general adjustment for these factors indicates that the average number of people employed in Arizona for all categories will be ~180 with a peak employment of ~285, and the average number of people employed in New Mexico will be ~320 with a peak employment of ~510. Average employment in these states will be somewhat less than 10% of the number that SunZia promotional brochures suggest (2,200 and 3,900, respectively). These new numbers are derived by (1) converting job-years of work to jobs, (2) removing people hired from out of state, (3) adjusting for jobs associated with materials manufactured out of state, and (4) reducing the number of induced jobs somewhat to compensate for the saving of wages and payment of debts.

A major revision of the jobs and revenue associated with photovoltaic (PV) projects is required for renewable generation modeling to be valid. The error in jobs for solar-thermal projects is also significant, requiring additional recalculations. Actual PV jobs are approximately 17% of that of the number given in the current study, and the number of solar-thermal construction jobs should be approximately twice that in the current study.

Using 150 construction jobs/solar PV project gives 1,200 construction jobs rather than 7,120, as derived in the study. Total solar PV job-years of work would be ~5,500 rather than 22,016. It is uncertain how material supply, indirect, and induced jobs should scale. If the other jobs scale in the same way that construction jobs do, then total average employment/year for all photovoltaic projects combined would be ~3,700. This underscores the magnitude of the error in model input parameters, which translates into gross miscalculations of job numbers and tax revenues.

For solar-thermal projects, total construction employment for both states combined should be ~1,000 rather than 500. Total job-years of construction work should be 2,000 rather than 1,000. It is unclear whether the other employment categories should be similarly scaled, and modelers must research this before redoing job and revenue projections.

A problem, again, with total renewable job projections for Arizona and New Mexico is the hiring of workers from out of state and the location of manufacturing facilities for needed materials. Fifty percent of construction jobs for solar PV, solar-thermal, and geothermal projects will go to outside workers. For New Mexico wind projects, 80% of workers will be hired from out of state, and nearly all materials for the installations will be manufactured out of state. Thus of the 5,632 jobs (derived from 8,448 job-years of work) projected for wind installations in New Mexico, approximately 1,100 of them would go to New Mexico workers if 90% of the materials are manufactured elsewhere. Manufacturing location would sharply reduce jobs related to solar-PV projects in at least New Mexico.

Lastly, a variety of factors make the mix of renewable generation projects used in modeling unrealistic. A more reasonable mix would include a higher number of wind projects and significant natural gas generation. Solar installations would need to be rather sharply reduced in

number. And again, all generation projects in the supplemental study are hypothetical, and the jobs projected from them are thus very uncertain. Because of the time needed to permit and construct these projects and because of the great uncertainty in whether they will actually be built, investors must be very cautious about committing to SunZia and overbuilding the project at the beginning.