

Worldwide demand for and production of photovoltaic energy systems has been growing at a compound annual growth rate of more than 30% over the last decade. This growth has taken place in response to cost and efficiency improvements and to government support programs in Germany, Spain, and other countries outside the United States. Demand for PV products has the potential to also grow in the United States due to new and emerging Federal and State support programs and favorable solar conditions, as well as declining system costs.

Although it is difficult to predict the cost of energy that far into the future, it is projected that by 2015 retail electricity (residential and commercial rates) will range from \$0.06 to \$0.15/kWh, and wholesale electricity will be \$0.04 to \$0.08/kWh. Solar energy must be at or below these costs if it is going to play a major role in the market. If PV goals are met, industry projects that installed PV capacity could reach 10 GW in the United States by 2015. The on-going Department of Energy (DOE) approach coordinates and funds applied research and development; emphasizing the development, performance, cost, and durability of materials and components, or process improvements for increased efficiency. The overall focus continues to be proof of technology concepts, scale-up research and demonstrations, cost reductions in the various technologies and processes, and system deployment support.

Increasing the overall PV system efficiency and lowering the total manufacturing costs are essential for the success. Program activities are currently bringing emerging technologies and manufacturing processes to market. The program focus is primarily on accelerating product and process development at the product level, whether cell, module or system. For example, current DOE programs such as the Technology Pathway Partnerships and PV Incubator programs target manufacturing processes and module/system product developments and preliminary system deployment. These programs are successfully developing technologies, implementing economies of scale, and vertically integrating the business structure to drive down costs.

Presume the existence of a wealth of applicable technologies from industries and companies outside the PV industry that could be optimized for domestic PV-specific manufacturing methods and products. Examples of future high-impact technologies may include processing steps to improve throughput, yield or diagnostics; material solutions to improve reliability or enhance optical, thermal, or electrical performance; or non-module system components that streamline installation.

Past examples of such cross-cutting technologies demonstrating a broad impact on the industry include wire saws, screen printing, laser scribing, in-situ analysis, and automated handling. On the materials side, the emergence of improved pastes, films, and coatings have had cost, performance, and reliability impacts on the industry. Each of these examples has had significant impact, not only because they improved upon the industry's existing best practices, but also because they were broadly applicable across several PV products or processes at that time.

Promising technologies can be quantified in terms of their cost or Levelized Cost of Energy (LCOE) reduction potential. Additionally, it is important to quantify the market potential of this promising technology in terms of sales volume or breadth of application. Taken together, the cost reduction and market volume of a technology defines the total impact.

Total Annual Impact Table: This data quantifies both the current and anticipated out-year annual impact of technology.

ITEM	UNITS	Present *	FY 2012 *	FY 2015 *
Baseline cost:	\$/Wp ¹ or ¢/kWh			
Improved cost²:	\$/Wp or ¢/kWh			
Total Addressable Market:	MW/yr or MWhr/yr ³			
Serviceable Addressable Market:	MW/yr or MWhr/yr			
Total Annual Impact⁴:	\$(Millions)/yr			

*All values calculated and reported in FY2010 dollars. See corresponding footnotes below.

Total Annual Impact Table entries.

Discuss each of the items presented in the Section 1 Table, example above. The discussion must include the assumptions and explain the calculations in a transparent and straightforward manner. Claims or assertions that are unclear, appear overly optimistic, or are without supporting information, may be interpreted negatively. Each of the terms in the Section 1 Table is described more fully below.

1. Baseline costs: These are the current and future costs of traditional technology which is directly comparable to the proposed technology and represents current best practices in industry. It is expected that baseline costs will decline and performance will improve over time as the baseline technology undergoes

¹ Peak watts measured under standard testing conditions

² All cost assumptions that are unrelated to the specific impact of the proposed technology must remain the same in both baseline and improved cost calculations.

³ For MWhr/yr calculations assume the solar resource of Phoenix AZ as provided in SAM <https://www.nrel.gov/analysis/sam/>.

⁴ Calculate by multiplying the difference between the Baseline Costs and Improved Costs by the Serviceable Addressable Market annual market potential. Be sure to use correct units.

evolutionary improvements. Fully describe the assumptions for the baseline cost calculation in this section.

2. Improved Costs: These are the current and future costs of the proposed technology. If these costs are captured at the system level, the “improved system” should be identical to the baseline case technology except for the incorporation of the applicant’s proposed technology. In the likely event that this improved technology doesn’t presently exist or is not commercially viable, the “present improved cost” can be equal to or even higher than the “present baseline costs”. Discuss how the proposed improved technology will remain ahead of the improving baseline process or component, and describe the sustainable market for the proposed technology as the industry evolves. Address how the proposed technology would improve upon the baseline technology in both quantitative (cost, power, energy) and qualitative or indirect (components or process enhancement or substitution, equipment cost reduction etc.) terms. For the analysis, all cost assumptions that are unrelated to the specific advantages of the proposed technology must remain the same in both baseline and improved cost calculations.
3. Total Addressable Market: This is defined as the current and projected annual global PV market size which is technically addressable by the proposed technology. For example, if the proposed technology is applicable only to traditional silicon wafers, then the Total Addressable Market would be the annual global production of traditional silicon wafers and not include other technologies such as thin films, concentrating PV, or differentiated crystalline silicon processes which are not compatible with the proposed technology. Specifically quoted information with supporting references may be included. While this number is not used in the calculation, it will be evaluated by reviewers to assess the reasonableness of an applicant’s market assumptions.
4. Serviceable Addressable Market: This is the sub-set of the Total Addressable Market the applicant anticipates will realistically be its actual annual production (NOT production capacity). Describe how this annual production will be achieved, including such possible factors as a direct materials supplier, process licensing, equipment sales, etc. Describe how the necessary resources will be secured to scale up to a level of manufacturing capacity which exceeds projected annual production for the same year. Citations for these forecasts may also be included.
5. Total Annual Impact: This value is calculated by multiplying the difference between the baseline and improved costs by the Serviceable Addressable Market and ensuring the use of correct units. Discuss uncertainty in this total number and where appropriate include how the estimate changes under various assumptions. If this Total Annual Impact is contingent upon certain market conditions, define the conditions.

HOW TO CALCULATE BASELINE AND IMPROVED COSTS

There are 2 options for calculating the baseline costs. The same approach should be used for both baseline and improved costs.

Option 1: This is the preferred approach for technologies that allow a straightforward estimate in terms of \$/W cost reductions. If the technology decreases manufacturing costs and/or increases efficiency, then a \$/W savings can be quantified by estimating the reduced processing costs (\$) and/or projected increased efficiency (watts). Secondary effects such as the increased value of the module (premium pricing for a higher efficiency module) may be included but must be justified. In this case, it may be preferable to quantify the “total system installed cost” to show how this improved performance translates into lower \$/W_p at the system level. Describe the assumptions in the baseline discussion.

Option 2: When Option 1 does not highlight all the cost reductions of the proposed technology (e.g. technologies affecting the kWh/kW_p performance or reliability or maintenance of a system), the second option is to quantify a technology in terms of its Levelized Cost of Energy (LCOE) advantage over a directly comparable PV system (i.e. the difference in LCOE values between the conventional and improved systems). If the technology provides a different LCOE reduction for various target markets (e.g. ground mount versus commercial rooftop), an average LCOE, weighted by the proportionate size of each target market, may be used. Describe the assumptions in the baseline discussion.

LCOE improvement may be calculated using the Solar Advisor Model (SAM) which can be downloaded at: <https://www.nrel.gov/analysis/sam/>. For more information about SAM, download the latest version of the Solar Advisor Model User Guide (under the Help menu, or via the download page of the SAM website).

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3.003 Principles of Engineering Practice
Spring 2010

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