The Influence of Solar Photovoltaics Patents Funded by the U.S. Department of Energy's Solar Energy Technologies Office and Other DOE Offices

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Executive Summary

This report describes the results of an analysis tracing the technological influence of photovoltaics (PV) research funded by the U.S. Department of Energy (DOE)'s Solar Energy Technologies Office (SETO) and its precursor programs, as well as PV research funded by other offices in DOE. The tracing is carried out both backwards and forwards in time, and focuses on patents filed in three systems: the U.S. Patent & Trademark Office (U.S. patents); the European Patent Office (EPO patents); and the World Intellectual Property Organization (WIPO patents). The primary period covered in this analysis is 1976 to 2018.

The main purpose of the backward tracing is to determine the extent to which SETO-funded PV research has formed a foundation for innovations patented by leading PV organizations. Meanwhile, the primary purpose of the forward tracing is to examine the broader influence of SETO-funded PV research upon subsequent technological developments, both within and outside PV technology. In addition to these SETO-based analyses, we also extend many elements of the analysis to other DOE-funded PV patents, in order to gain insights into their influence.

The main finding of this report is:

- Photovoltaics research funded by SETO, and by DOE in general, has had a significant influence on subsequent developments, both within and beyond PV technology. This influence can be seen on innovations associated with the leading PV organizations. It can also be seen on innovations associated with large companies across a range of other technologies, including semiconductors, nanomaterials, optics and displays.

More detailed findings from this report include:

- In PV technology, in the period 1976-2018, we identified a total of 63,172 patents (22,162 U.S. patents, 16,837 EPO patents and 24,173 WIPO patents). We grouped these patents into 42,295 patent families, with each family containing all patents resulting from the same initial application (named the 'priority application').

- 860 PV patents are confirmed to be associated with SETO funding (483 U.S. patents, 158 EPO patents, and 219 WIPO patents). We grouped these SETO-funded PV patents into 361 patent families.

- In addition, we identified a further 773 PV patents (513 U.S. patents, 107 EPO patents and 153 WIPO patents) that are associated with DOE funding. These "Other DOE-funded" patents are grouped into 424 patent families.

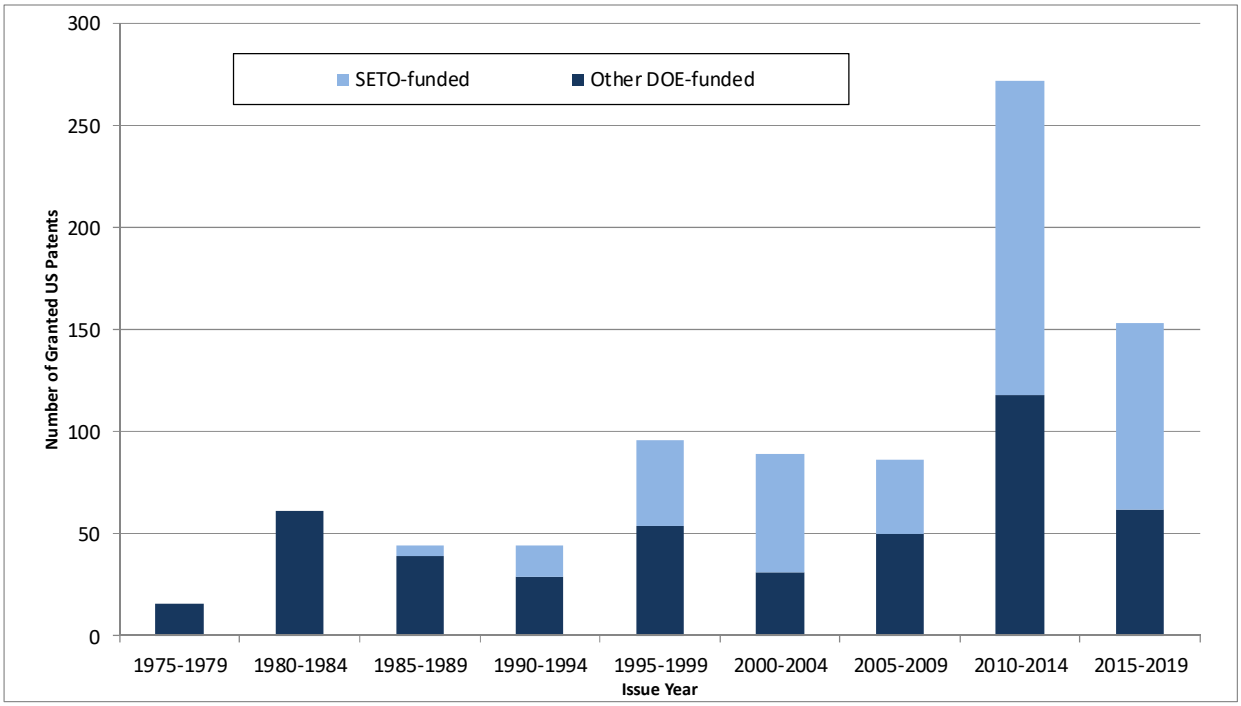
- Out of these 424 Other DOE-funded patent families, 216 are definitely not SETO-funded. These patent families were either funded by a different DOE office, or were marked as being not SETO-funded by inventors or SETO technology managers, but without specifying funding from another DOE source.

- The remaining 208 Other DOE-funded PV patent families could not be linked definitively to a specific DOE funding source. Many of these patent families are older, and may in fact have been SETO-funded, since they correspond with a particularly active period of PV funding by SETO. Hence, up to 49% (208 out of 424) of the Other DOE-funded PV patent families in this analysis may be SETO-funded. As such, the results presented in this report may understate the influence of SETO-funded PV research, relative to the influence of PV research funded by DOE in general.

- The total number of DOE-funded PV patents (SETO-funded plus Other DOE-funded) is 1,633, corresponding to 785 patent families. This represents 1.9% of the total number of PV patent families in the period 1976-2018.

- The earliest time period in the analysis, from 1976-85, saw a gradual increase in DOE-funded PV patenting (see Figure E-1). Almost all the patents in this period are defined as Other DOE-funded, since a definitive link to SETO funding could not be made. However, given that this was the peak in SETO funding of PV research, it may be that many of these Other DOE-funded patents were in fact funded by SETO. There was then a relatively consistent period in DOE-funded PV patenting, before a sharp increase in 2010-2014, with a higher proportion of SETO-funded PV patents in this time period. In recent years, the number of DOE-funded PV patents has declined. This is part of a broader decrease in PV patenting overall.

Figure E-1 - Number of PV Granted U.S. Patents Funded by SETO and Other DOE Sources by Issue Year (5-Year Totals)



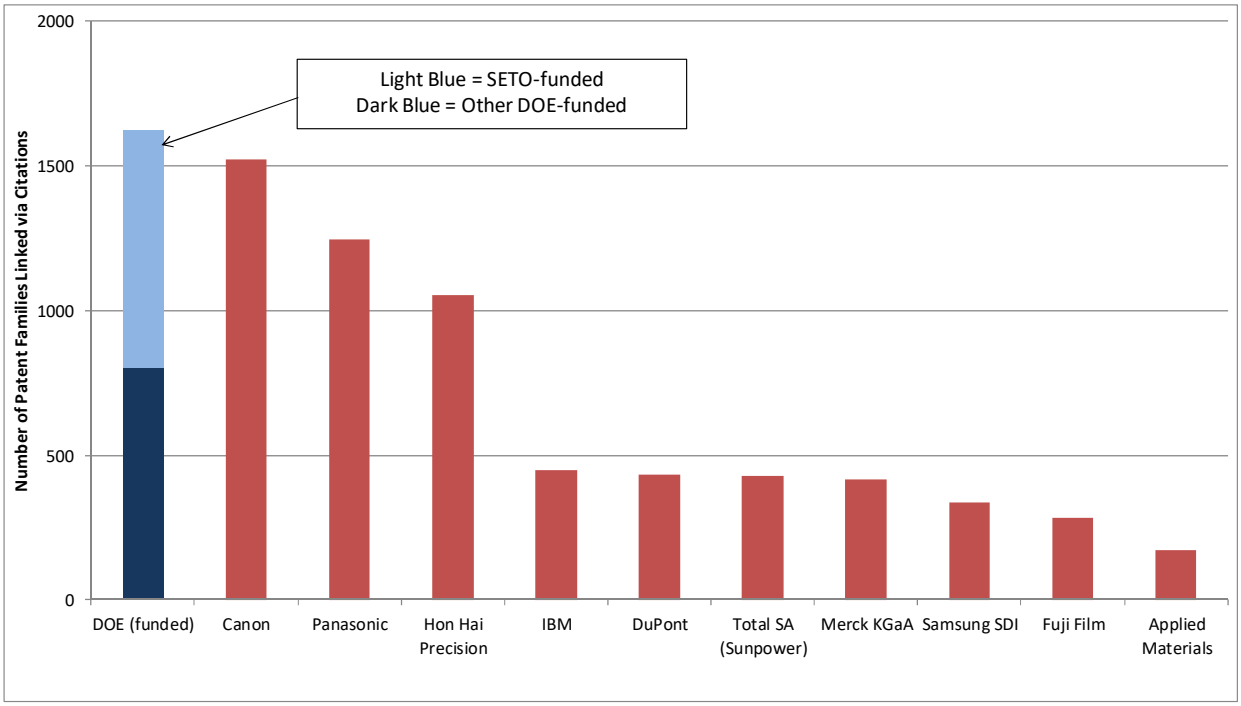
Note: The data collection period for this analysis ended with 2018. Any 2019 patents in the 2015-2019 column are additional patents that have been included because they are members of the same patent families as pre-2019 patents. No new patent search for 2019 was carried out.

- Based on U.S, EPO and WIPO patent data, the 785 DOE-funded PV patent families represent the third largest PV patent portfolio, behind only Panasonic (1,201 families) and Hon Hai Precision (commonly known as Foxconn - 915 families). The remaining organizations in the top ten in terms of number of patent families are: Samsung SDI (630); Total SA (largely due its acquisition of SunPower - 603); DuPont (595); Canon (587); Merck KGaA (562); Fuji Film (517); Applied Materials (473); and IBM (460).

- There is a great deal of overlap between the technology focus of patents associated with SETO funding and those funded by Other DOE, those assigned to the ten leading PV organizations, plus PV patents overall. However, there are some differences. SETO-funded patents have a greater focus on back-junction PV cells and applications of PV in buildings. Hence, these are areas where SETO may have provided important funding where other organizations were less focused. Meanwhile, the other portfolios have a greater focus on organic PV cells.

- More PV patent families owned by leading organizations are linked via citations to DOE-funded (i.e. SETO-funded plus Other DOE-funded) PV patents than are linked to the PV patents assigned to any other leading organization (see Figure E-2). This is an impressive result, since DOE-funded patents represent only the third largest portfolio among the leading organizations. It suggests that DOE-funded research has formed an important part of the foundation for PV research carried out by leading organizations.

Figure E-2 - Number of Leading Organization PV Patent Families Linked via Citations to Earlier PV Patents Assigned to Each Leading Organization
e.g. 1621 leading organization PV families are linked to earlier SETO/Other DOE-funded families

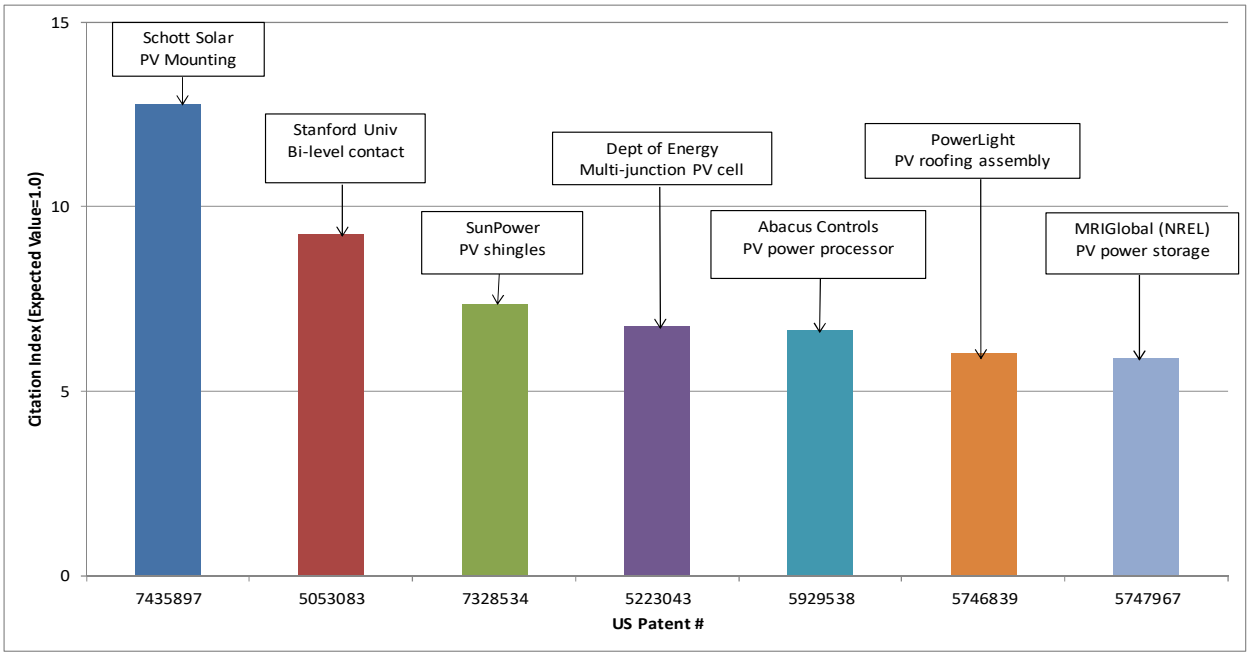


- Among the leading organizations, PV patent families owned by Total SA (SunPower), IBM, Applied Materials and DuPont are linked particularly extensively via citations to earlier SETO-funded PV patents. This suggests that SETO-funded PV research has had an especially strong influence on innovations developed by these companies. Meanwhile, PV patent families assigned to Canon are linked particularly extensively via citations to Other DOE-funded patents.

- Both SETO-funded and Other DOE-funded PV patents have average Citation Index values above two (the Citation Index is a normalized citation metric with an expected value of 1.0; a value over two shows that, based on their age and technology, SETO-funded and Other DOE-funded PV patents have been cited as prior art more than twice as frequently as expected by subsequent patents). The influence of SETO-funded and Other DOE-funded PV patents can be seen on innovations associated with the leading PV organizations, plus large companies across a range of other technologies.

- There are a number of individual high-impact SETO-funded PV patents, examples of which are shown in Figure E-3. These patents all have Citation Index values above six (i.e. based on their age and technology, they have been cited at least six times as frequently as expected by subsequent patents). They include Schott Solar, SunPower and PowerLight patents for PV mountings and shingles, a Stanford patent describing a bi-level contact PV cell, a DOE patent for multi-junction PV cells, and Abacus Controls and MRIGlobal (National Renewable Energy Laboratory) patents for PV power management and storage.

Figure E-3 – Examples of Highly-Cited SETO-funded PV Patents



1.0 Introduction

This report focuses on photovoltaics (PV) technology. Its objective is to trace the influence of PV research funded by the Solar Energy Technologies Office (SETO) in the Department of Energy's (DOE) Office of Energy Efficiency and Renewable Energy (EERE) – as well as PV research funded by DOE as a whole – upon subsequent developments both within and outside PV technology. The purpose of the report is to:

(i) Locate patents awarded for key SETO-funded (and Other DOE-funded) innovations in PV technology; and
(ii) Determine the extent to which SETO-funded (and Other DOE-funded) PV research has influenced subsequent technological developments both within and beyond PV.

The primary focus of the report is on the influence of SETO-funded PV patents. That said, we also extend many elements of the analysis to DOE-funded PV patents that could not be definitively linked to SETO funding. There are both evaluative and practical reasons for extending the analysis in this way. From an evaluation perspective, it is interesting to examine the influence of SETO itself upon the development of PV technology, while also tracing the influence of DOE more generally. Meanwhile, in practical terms, determining which patents were funded by SETO, versus other offices within DOE, is often very difficult.

In the U.S. patent system, applicants are required to acknowledge any government funding they have received related to the invention described in their patent application. Typically, this government support is listed at the level of the agency (e.g. Department of Energy, Department of Defense, etc.). Hence, the only way to determine which office within DOE funded a given patent is via other data resources (e.g. iEdison), or through direct input from offices, program managers and individual inventors. Such information is often unavailable, especially for older patents where records may be less comprehensive, and there is less access to the inventors and program managers involved.

Rather than discard patents confirmed as DOE-funded, but that could not be definitively categorized as SETO-funded, we instead included these patents in the analysis under a separate "Other DOE-funded" category. Some of these Other DOE-funded patents are confirmed as being linked to funding from other DOE offices, while for others the source of funding within DOE is unknown. Many of these "unknown" patents are from the earliest period of the analysis (1976-1984) and may in fact have been funded by SETO, although a definitive link could not be established. Hence, the results reported here may underestimate the influence of SETO-funded PV research, relative to the influence of PV research funded by the rest of DOE.

This report contains three main sections. The first of these sections describes the project design. This section includes a brief overview of patent citation analysis, and outlines its use in the multi-generation tracing employed in this project. The second section outlines the methodology, and includes a description of the various data sets used in the analysis, and the processes through which these data sets were constructed and linked.

The third section presents the results of our analysis. Results are presented at the organizational level for both SETO-funded and Other DOE-funded patents. These results show the distribution

of SETO-funded (and Other DOE-funded) patents across PV technologies (as defined by Cooperative Patent Classifications). They also evaluate the extent of SETO's influence (and DOE's influence in general) on subsequent developments in PV and other technologies. Patent level results are then presented to highlight individual SETO-funded PV patents that have been particularly influential, as well as to reveal key patents from other organizations that build extensively on SETO-funded PV research.[1]

2.0 Project Design

This section of the report outlines the project design. It begins with a brief overview of patent citation analysis, which forms the basis for much of the evaluation presented in this report. This overview is followed by a description of the techniques used to link the various patent sets in the analysis, plus a listing and description of the metrics employed in the study.

The analysis described in this report is based largely upon tracing citation links between successive generations of patents. This tracing is carried out both backwards and forwards in time. The primary purpose of the backward tracing is to determine the extent to which technologies developed by leading organizations in the PV industry used SETO-funded research as a foundation. Meanwhile, the primary purpose of the forward tracing is to examine how SETO-funded PV patents influenced subsequent technological developments more broadly, both within and outside PV technology. Many elements of both the backward and forward tracing are also extended to the Other DOE-funded patents, in order to trace their influence, both overall and upon the leading PV organizations.[2]

Our analysis covers patents filed in three systems: the U.S. Patent & Trademark Office (U.S. patents); the European Patent Office (EPO patents); and the World Intellectual Property Organization (WIPO patents). By covering multiple generations of citations across patent systems, our analysis allows for a wide variety of possible linkages between DOE-funded PV research and subsequent technological developments. Examining all of these linkage types at the level of an entire technology involves a significant data processing effort, and requires access to specialist citation databases, such as those maintained at 1790 Analytics. As a result, this project is more ambitious than many previous attempts to trace through multiple generations of research, which have often been based on studying very specific technologies or individual products.

Patent Citation Analysis

In many patent systems, patent documents contain a list of references to prior art. The purpose of these prior art references is to detail the state of the art at the time of the patent application, and to demonstrate how the new invention is original over and above this prior art. Prior art

[1] This is one of a series of similar reports examining research portfolios across a range of DOE offices. Note that the results are not designed to be compared across portfolios, for example in terms of numbers of patents granted, number of citations received etc. The portfolios have very different profiles with respect to research risks, funding levels and time periods covered, plus there are wide variations in the propensity to patent across technologies. Hence, the results reported in the various reports should not be used for comparative analyses across portfolios.

[2] The analyses described in this report were carried out separately for SETO-funded PV patents and Other DOE-funded PV patents. However, referring repeatedly to "SETO-funded/Other DOE-funded patents" or "SETO-funded/Other DOE-funded research" in describing the analyses is lengthy, so we instead use the collective terms "DOE-funded patents" and "DOE-funded research" in the Project Design and Methodology sections of the report.

references may include many different types of public documents. A large number of the references are to earlier patents, and these references form the basis for this study. Other references (not covered in this study) may be to scientific papers and other types of documents, such as technical reports, magazines and newspapers.

The responsibility for adding prior art references differs across patent systems. In the U.S. patent system, it is the duty of patent applicants to reference (or "cite") all prior art of which they are aware that may affect the patentability of their invention. Patent examiners may then reference additional prior art that limits the claims of the patent for which an application is being filed. In contrast to this, in patents filed at the European Patent Office (EPO) and World Intellectual Property Organization (WIPO), prior art references are added solely by the examiner, rather than by both the applicant and examiner. The number of prior art references on EPO and WIPO patents thus tends to be much lower than the number on U.S. patents.[3]

Patent citation analysis focuses on the links between generations of patents that are made by these prior art references. In simple terms, this type of analysis is based upon the idea that the prior art referenced by patents has had some influence, however slight, upon the development of these patents. The prior art is thus regarded as part of the foundation for the later inventions. In assessing the influence of individual patents, citation analysis centers on the idea that highly cited patents (i.e. those cited by many later patents) tend to contain technological information of particular interest or importance. As such, they form the basis for many new innovations and research efforts, and so are cited frequently by later patents. While it is not true to say that every highly cited patent is important, or that every infrequently cited patent is necessarily trivial, many research studies have shown a correlation between patent citations and measures of technological and economic importance. For background on the use of patent citation analysis, including a summary of validation studies supporting its use, see: Breitzman A. & Mogee M. "The many applications of patent analysis", *Journal of Information Science*, 28(3), 2002, 187-205; and Jaffe A. & de Rassenfosse G. "Patent Citation Data in Social Science Research: Overview and Best Practices", NBER Working Paper No. 21868, January 2016.

Patent citation analysis has also been used extensively to trace technological developments over time. For example, in the analysis presented in this report, we use citations from patents to earlier patents to trace the influence of DOE-funded PV research. Specifically, we identify cases where patents cite DOE-funded PV patents as prior art. These represent first-generation links between DOE-funded patents and subsequent technological developments. We also identify cases where patents cite patents that in turn cite DOE-funded PV patents. These represent second-generation links between technological developments and DOE-funded research.

The idea behind this analysis is that the later patents have built in some way on the earlier DOE-funded PV research. By determining how frequently DOE-funded PV patents have been cited by

[3] Note that this analysis does not cover patents from other systems, notably patents from the Chinese, Japanese and Korean patent offices. This is because patents from these systems do not typically list any prior art. Hence, it is not possible to use citation links to trace the influence of DOE research on patents from these systems. Having said this, Chinese, Japanese and Korean organizations are among the most prolific applicants in the WIPO system. Our analysis thus picks up the role of organizations from these countries via their WIPO filings.

subsequent patents, it is thus possible to evaluate the extent to which DOE-funded research forms a foundation for various technologies both within and beyond PV.

Forward and Backward Tracing

As noted above, the purpose of this analysis is to trace the influence of DOE-funded PV research upon subsequent developments both within and beyond PV technology. There are two approaches to such a tracing study – backward tracing and forward tracing – each of which has a slightly different objective.

Backward tracing, as the name suggests, looks backwards over time. The idea of backward tracing is to take a particular technology, product, or industry, and to trace back to identify the earlier technologies upon which it has built. In the context of this project, we first identify the leading PV organizations in terms of patent portfolio size. We then trace backwards from the patents owned by these organizations. This makes it possible to determine the extent to which innovations associated with these leading PV organizations build on earlier SETO-funded and Other DOE-funded research.

The idea of forward tracing is to take a given body of research, and to trace the influence of this research upon subsequent technological developments. In the context of the current analysis, forward tracing involves identifying all PV patents resulting from research funded by DOE (i.e. SETO plus Other DOE). The influence of these patents on later generations of technology is then evaluated. This tracing is not restricted to subsequent PV patents, since the influence of a body of research may extend beyond its immediate technology. Hence, the purpose of the forward tracing element of this project is to determine the influence of DOE-funded PV patents upon developments both inside and outside this technology.

Tracing Multiple Generations of Citation Links

The simplest form of tracing study is one based on a single generation of citation links between patents. Such a study identifies patents that cite, or are cited by, a given set of patents as prior art. The analysis described in this report extends the tracing by adding a second generation of citation links.[4]

The backward tracing starts with patents assigned to the leading patenting organizations in PV technology. The first generation contains the patents that are cited as prior art by these starting patents. The second generation contains patents that are in turn cited as prior art by these first generation patents. In other words, the backward tracing starts with PV patents owned by leading organizations in this technology, and traces back through two generations of earlier patents to identify the technologies upon which they were built, including those funded by DOE.

The forward tracing starts with DOE-funded patents in PV technology. The first generation contains the patents that cite these DOE-funded patents as prior art. The second generation

[4] As noted above, the forward and backward tracing were carried out separately for SETO-funded and Other DOE-funded PV patents. The references in this section to "DOE patents" are shorthand, and do not mean that the tracing was carried out for all DOE-funded PV patents as a single portfolio.

contains the patents that in turn cite these first-generation patents. In other words, the analysis starts with DOE-funded PV patents and traces forward for two generations of subsequent patents.

This means that we trace forward through two generations of citations starting from DOE-funded PV patents; and backward through two generations starting from the patents owned by leading PV organizations. Hence there are two types of links between DOE-funded patents and subsequent generations of patents:

1. **Direct Links**: where a patent cites a DOE-funded PV patent as prior art.
2. **Indirect Links**: where a patent cites an earlier patent, which in turn cites a DOE-funded PV patent. The DOE patent is thus linked indirectly to the subsequent patent.

The idea behind adding the second generation of citations is that agencies such as DOE often support basic scientific research. It may take time, and numerous generations of research, for this basic research to be used in an applied technology, for example that described in a patent owned by a leading company. Introducing a second generation of citations provides greater access to these indirect links between basic research and applied technology.

One potential problem with adding generations of citations must be acknowledged. Specifically, if one uses enough generations of links, eventually almost every node in the network will be linked. This is a problem common to many networks, whether these networks consist of people, institutions, or scientific documents, as in this case. The most famous example of this is the idea that every person is within six links of any other person in the world. By the same logic, if one takes a starting set of patents, and extends the network of citations far enough, almost all patents will be linked to this starting set. Hence, while including a second generation of citations provides insights into indirect links between basic research and applied technologies, adding further generations may bring in too many patents with little connection to the starting patent set.

Constructing Patent Families

The coverage of a patent is limited to the jurisdiction of its issuing authority. For example, a patent granted by the U.S. Patent & Trademark Office (a 'U.S. patent') provides protection only within the United States. If an organization wishes to protect an invention in multiple countries, it must file patents in each of those countries' systems. For example, a company may file to protect a given invention in the U.S., China, Germany, Japan and many other countries. This would result in multiple patents for the same invention.[5] In addition, in some systems – notably the U.S. – inventors may apply for a series of patents based on the same underlying invention.

In the case of this study, one or more U.S., EPO and WIPO patents may result from a single invention. To avoid counting the same inventions multiple times, it is necessary to construct "patent families". A patent family contains all of the patents and patent applications that result from the same original patent application (named the "priority application"). A family may include patents from multiple countries, and also multiple patents from the same country. In this project, we constructed patent families for DOE-funded PV patents, and also for the patents owned by leading PV organizations. We also assembled families for all patents linked via citations to DOE-funded PV patents.

[5] It also means that patents from a given country's system are not synonymous with inventions made in that country. Indeed, roughly half of all U.S. patent applications are from overseas inventors.

To construct these patent families, we matched the priority documents of the U.S., EPO and WIPO patents, in order to group them into the appropriate families. It should be noted that the priority document need not necessarily be a U.S., EPO or WIPO application. For example, a Japanese patent application may result in U.S., EPO and WIPO patents, which are grouped in the same patent family because they share the same Japanese priority document.

Metrics Used in the Analysis

Table 1 contains a list of the metrics used in the analysis.

Table 1 – List of Metrics Used in the Analysis

Metric
Trends
• Number of SETO/Other DOE-funded PV patent families by year of priority application
• Number of SETO/Other DOE-funded granted U.S. PV patents by issue year
• Overall number of PV patent families by priority year
• Percentage of PV patents families funded by SETO/Other DOE by priority year
Assignee Metrics
• Number of PV patent families for leading patenting organizations
• Assignees with largest number of PV patent families funded by SETO/Other DOE
Technology Metrics
• Patent classification (CPC) distribution for SETO-funded PV patent families (vs Other DOE-funded, leading PV companies, all PV)
Backward Tracing Metrics
• Total number of leading company PV patent families linked via citations to earlier patent families from SETO/Other DOE and other leading companies
• Number of PV patent families for each leading company linked via citations to earlier SETO/Other DOE-funded patent families
• Total citation links from each leading company to SETO/Other DOE-funded patent families
• Percentage of leading company PV patent families linked via citations to earlier SETO/Other DOE-funded patent families
• SETO/Other DOE-funded PV patent families linked via citations to largest number of leading company PV patent families
• Leading company PV patent families linked via citations to most SETO-funded PV patent families
• Highly cited leading company PV patent families linked via citations to earlier SETO-funded PV patent families
Forward Tracing Metrics
• Citation Index for PV patent portfolios owned by leading companies, plus portfolios of SETO/Other DOE funded PV patents
• Number of patent families linked via citations to SETO/Other DOE-funded PV patents by patent classification
• Organizations (beyond leading PV companies) linked via citations to largest number of SETO/Other DOE funded PV patent families
• Highly cited SETO-funded PV U.S. patents
• SETO/Other DOE funded PV patent families linked via citations to largest number of subsequent PV/non-PV patent families
• Highly cited patents (not owned by leading companies) linked via citations to earlier SETO-funded PV patents families

The metrics in Table 1 are divided into three main groups – technology landscape metrics (trends, assignees, and technology distributions), backward tracing metrics, and forward tracing metrics. Findings for each of these three groups of metrics can be found in the Results section of the report.

3.0 Methodology

The previous section of the report outlines the objective of our analysis – that is, to determine the influence of SETO-funded (and Other DOE-funded) PV research on subsequent developments both within and outside PV technology. This section of the report describes the methodology used to implement the analysis. Particular emphasis is placed on the processes employed to construct the various data sets required for the analysis. Specifically, the forward tracing starts from the sets of PV patents funded by SETO and Other DOE. Meanwhile, the backward tracing starts from the set of all PV patents owned by leading patenting organizations in PV technology. We therefore had to define these various data sets – SETO-funded PV patents; Other DOE-funded PV patents; and PV patents assigned to the leading organizations in this technology.

Identifying SETO-funded and Other DOE-funded PV Patents

The objective of this analysis is to trace the influence of PV research funded by SETO (plus PV research funded by the remainder of DOE) upon subsequent developments both within and outside PV technology. Outlined below are the three steps used to identify SETO-funded and Other DOE-funded PV patents. These three steps are:

(i) Defining the universe of DOE-funded patents;

(ii) Determining which of these DOE-funded patents are relevant to PV; and

(iii) Categorizing these DOE-funded PV patents according to whether or not they can be linked definitively to SETO funding.

Defining the Universe of DOE-Funded Patents

Identifying patents funded by government agencies is often more difficult than locating patents funded by companies. When a company funds internal research, any patented inventions emerging from this research are likely to be assigned to the company itself. In order to construct a patent set for a company, one simply has to identify all patents assigned to the company, along with all of its subsidiaries, acquisitions, etc.

Constructing a patent list for a government agency is more complicated, because the agency may fund research carried out at many different organizations. For example, DOE operates seventeen national laboratories. Patents emerging from these laboratories may be assigned to DOE. However, they may also be assigned to the organization that manages a given laboratory. For example, many patents from Sandia National Laboratory are assigned to Lockheed Martin (Sandia's former lab manager), while many Lawrence Livermore National Laboratory patents are assigned to the University of California. Lockheed Martin and the University of California

are large organizations with many interests beyond managing DOE labs, so one cannot simply take all of their patents and define them as DOE-funded.

A further complication is that DOE does not only fund research in its own labs and research centers, it also funds extramural research carried out by other organizations. If this research results in patented inventions, these patents are likely to be assigned to the organizations carrying out the research, rather than to DOE.

We therefore constructed a database containing all DOE-funded patents. These include patents assigned to DOE itself, and also patents assigned to individual labs, lab managers, and other organizations and companies funded by DOE. This "All DOE" patent database was constructed using a number of sources:

1. ***DOEPatents Database*** – The first source is a database of DOE-funded patents put together by DOE's Office of Scientific & Technical Information (OSTI), and available on the web at www.osti.gov/doepatents/. This database contains information on research grants provided by DOE. It also links these grants to the organizations or DOE labs that carried out the research, the sponsor organization within DOE, and the patents that resulted from these DOE grants.

2. ***iEdison Database*** – EERE staff provided us with an output from the iEdison database, which is used by government grantees and contractors to report government-funded subject inventions, patents, and utilization data to the government agency that issued the funding award.

3. ***Visual Patent Finder Database*** – EERE also provided us with an output from its Visual Patent Finder tool. This tool takes DOE-funded patents and clusters them based on word occurrence patterns. In our case, the output was a file containing DOE-funded patents.

4. ***Patents assigned to DOE*** – in the USPTO database, we identified a small number of U.S. patents assigned to DOE itself that were not in the any of the sources above. These patents were added to the list of DOE patents.

5. ***Patents with DOE Government Interest*** – A U.S. patent has on its front page a section entitled 'Government Interest', which details the rights that the government has in a particular invention. For example, if a government agency funds research at a private company, the government may have certain rights to patents granted based on this research. We identified all patents that refer to 'Department of Energy' or 'DOE' in their Government Interest field, including different variants of these strings. We also identified patents that refer to government contracts beginning with 'DE-' or containing the string '-ENG-'. The former string typically denotes DOE contracts and financial assistance projects, while the latter is a legacy DOE lab code listed on numerous older DOE-funded patents. We manually checked all of the patents containing these strings that were not already in any of the sources above, to make sure that they are indeed DOE-funded (e.g. '-ENG-' is a string that typically denotes a DOE contract, but it is also used in a small number of NSF contracts). We then added the DOE-funded patents to the database.

The "All DOE" patent database constructed from these five sources contains more than 31,000 U.S. patents issued between January 1976 and December 2018 (the end-point of the primary data collection for this analysis).

Identifying DOE-Funded PV Patents

Having defined the universe of DOE-funded patents, the next step was to determine which of these patents are relevant to PV technology. We designed a custom patent filter to identify PV patents, consisting of different combinations of Cooperative Patent Classifications (CPCs) and keywords. Details of the patent filter are shown in Table 2.

Table 2 – Filters used to Identify DOE-funded PV Patents

Filter A
Cooperative Patent Classification
F03G 6/001 (Producing mechanical power from PV)
H01L 31/022425-022458 (PV electrodes)
H01L 31/042-0516 (PV modules or arrays)
Y02B 10/10-14 (Integrating PV into buildings)
Y02E 10/50-58 (Photovoltaic energy)
Y02E 10/60 (Thermal-PV hybrids)
Y02P 70/521 (Photovoltaic generators)
Y02P 80/25 (Photovoltaic energy)
OR
Filter B
Cooperative Patent Classification
H01L 31 (Semiconductors sensitive to light)
AND
Title/Abstract
PV OR photo(-)voltaic*
OR
Filter C
Title/Abstract
amorphous(-)si* OR crystalline(-)si* OR CIGS OR cu(-)in(-)ga(-)se OR Copper(-)indium(-)gallium(-)selenide OR CD(-)TE OR cadmium(-)telluride OR GaAs* OR gallium(-)arsenide
AND
Title/Abstract
Solar* OR PV OR photo(-)voltaic*

The form of the filter is (Filter A OR Filter B OR Filter C), so patents that qualify under any of the three filters in Table 2 were included in the initial patent set. In addition to this patent filter, we also searched a number of specific technical terms provided to us by SETO (e.g. single(-)crystal* or multi(-)crystal* or poly(-)crystal* or czochralski* or wafer(-)si* or multiple(-)exciton* or MEG).

We then manually checked the resulting list of patents to determine which of them appear relevant to PV. For example, there are a number of patents that were defined as PV and also solar thermal technology. We read these patents individually in order to define them as PV, solar thermal, or both.

Having constructed the PV draft patent list, we then sent it to SETO for review. Following this review, and based on feedback from SETO, the initial list of PV patents funded by DOE contained a total of 940 granted U.S. patents.

Defining SETO-funded vs. Other DOE-funded PV Patents

As noted above, linking DOE-funded patents to individual offices is often a difficult task. For this analysis, EERE staff undertook an exhaustive process to determine which of the 940 DOE-funded PV patents in the initial list could be linked definitively to SETO funding. This process involved a number of steps, which are listed below:

(i) Linking contract numbers listed in patents to EERE project contract numbers, for financial assistance projects,
(ii) Linking contract numbers listed in patents to EERE SBIR project agreement numbers,
(iii) Asking SETO technology managers to verify individual patents,
(iv) Asking SETO technology managers to send lab patents to lab POCs to get direct verification of these patents,
(v) Contacting individual inventors listed on patents to ask them to confirm whether individual patents were funded by SETO, and
(vi) Locating references to patents in available office annual project progress reports or patent disclosure documents with accomplishments reported by PIs.

Final List of SETO-funded and Other DOE-funded PV Patents

Based on the process described above, we divided the initial list of 940 DOE-funded PV U.S. patents into two categories – SETO-funded and Other DOE-funded. We then searched for equivalents of each of these patents in the EPO and WIPO systems. An equivalent is a patent filed in a different patent system covering essentially the same invention. We also searched for U.S. patents that are continuations, continuations-in-part, or divisional applications of each of the patents in the final set. We then grouped the patents into families by matching priority documents (see earlier discussion of patent families). Table 3 contains a summary of the final number of SETO-funded and Other DOE-funded PV patents and patent families.

Table 3 – Number of SETO-funded and Other DOE-funded PV Patents and Patent Families

	# Patent Families	# U.S. Patents	# EPO Patents	# WIPO Patents
SETO-funded	361	483	158	219
Other DOE-funded	424	513	107	153
Total DOE-funded	785	996	265	372

Table 3 shows that we identified a total of 361 SETO-funded PV patent families, containing 483 U.S. patents, 158 EPO patents, and 219 WIPO patents (see Appendix A for patent list). We also identified 424 Other DOE-funded PV patent families, containing 513 U.S. patents, 107 EPO patents, and 153 WIPO patents (see Appendix B for patent list).

As noted throughout this report, the approach used to define patents as SETO-funded was very stringent. Hence, a number of the 424 Other DOE-funded patent families may in fact have been funded by SETO, but are not categorized as such because a definite link could not be established. To get a better sense of how many of these Other DOE-funded patents (and patent families) may in fact be SETO-funded, we divided them into two groups.

The first group contains DOE-funded patent families that are definitely not funded by SETO. These include families linked specifically to funding from an office other than SETO, or that the inventor or SETO technology manager said were not funded by SETO (but without specifying funding from a different office). There are 216 such patent families.

The second group contains DOE-funded patent families where the funding source within DOE could not be established, and inventors and SETO technology managers could not state categorically whether or not they were funded by SETO. There are 208 such patent families. Many of them are from the earliest time periods in the analysis, between 1976 and 1984, so institutional knowledge associated with them is relatively scarce. Hence, up to 49% (208 out of 424) of the Other DOE-funded patent families included in this analysis may in fact be SETO-funded. As a result, the findings in this analysis may understate the influence of SETO funded PV patents, relative to the influence of the remainder of DOE patents.

Identifying PV Patents Assigned to Leading Organizations

The purpose of the backward tracing element of our analysis is to evaluate the influence of SETO-funded (and Other DOE-funded) research upon PV innovations produced by leading organizations in this technology. To identify such organizations, we first defined the universe of PV patents in the period 1976-2018 using the patent filter detailed earlier in Table 2. Based on this filter, we identified a total of 63,172 PV patents (22,162 U.S. patents; 24,173 WIPO patents; and 16,837 EPO patents). We grouped these patents into 42,295 patent families by matching priority documents.

We then located the most prolific patenting organizations in this overall PV patent universe, based on number of patent families.[6] The ten organizations with the largest number of PV patent families are shown in Table 4. This includes patent families associated with all variant names under which the organizations have patents, including all subsidiaries and acquisitions. The PV patent families of the ten organizations in this table form the starting point for the backward tracing element of the analysis.

[6] These companies are sometimes referred to hereafter as the leading PV organizations. This is based on patent portfolio size, and is not a reflection of number of units sold or revenues, profits etc. A fuller description would be the leading patenting PV organizations, but this is a cumbersome description to use throughout the results section of the report.

Table 4 – Top 10 Patenting PV Organizations

Organization	# PV Patent Families
Panasonic	1201
Hon Hai Precision	915
Samsung SDI	630
Total SA (SunPower)	603
DuPont	595
Canon	587
Merck KGaA	562
Fuji Film	517
Applied Materials	473
IBM	460

The organizations in Table 4 are generally large companies for which PV technology forms only one element of their operations, for example Panasonic, Canon and DuPont. There are also companies with a greater focus on energy solutions, such as Samsung SDI and Total SA (which is included in the list largely due to its majority stake in SunPower).

Constructing Citation Links

Through the processes described above, we constructed starting patent sets for both the backward forward tracing elements of the analysis. The patent set for the backward tracing consisted of patent families assigned to the leading patenting organizations in PV technology. The patent sets for the forward tracing consisted of SETO-funded (and, separately, Other DOE-funded) PV patent families.

Having defined these patent sets, we then traced backward through two generations of citations from the leading organizations' PV patents, and forward through two generations of citations from the SETO/Other DOE-funded PV patents. These included citations listed on U.S., EPO and WIPO patents, and required extensive data cleaning to account for differences in referencing formats across these systems. The citation linkages identified, along with characteristics of the starting patent sets, form the basis for the results described in the next section of this report.

4.0 Results

This section of the report outlines the results of our analysis tracing the influence of SETO-funded and Other DOE-funded PV research on subsequent developments both within and beyond PV technology. The results are divided into three main sections. In the first section, we examine trends in patenting over time in PV technology, and assess the distribution of SETO-funded and Other DOE-funded patents across PV technologies. The second section then reports the results of an analysis tracing backwards from PV patents owned by the leading organizations in this technology. The purpose of this analysis is to determine the extent to which PV innovations developed by leading organizations build upon earlier PV research funded by SETO (plus PV research funded by the remainder of DOE). In the third section, we report the results of an analysis tracing forwards from SETO-funded (and Other DOE-funded) PV patents. The purpose

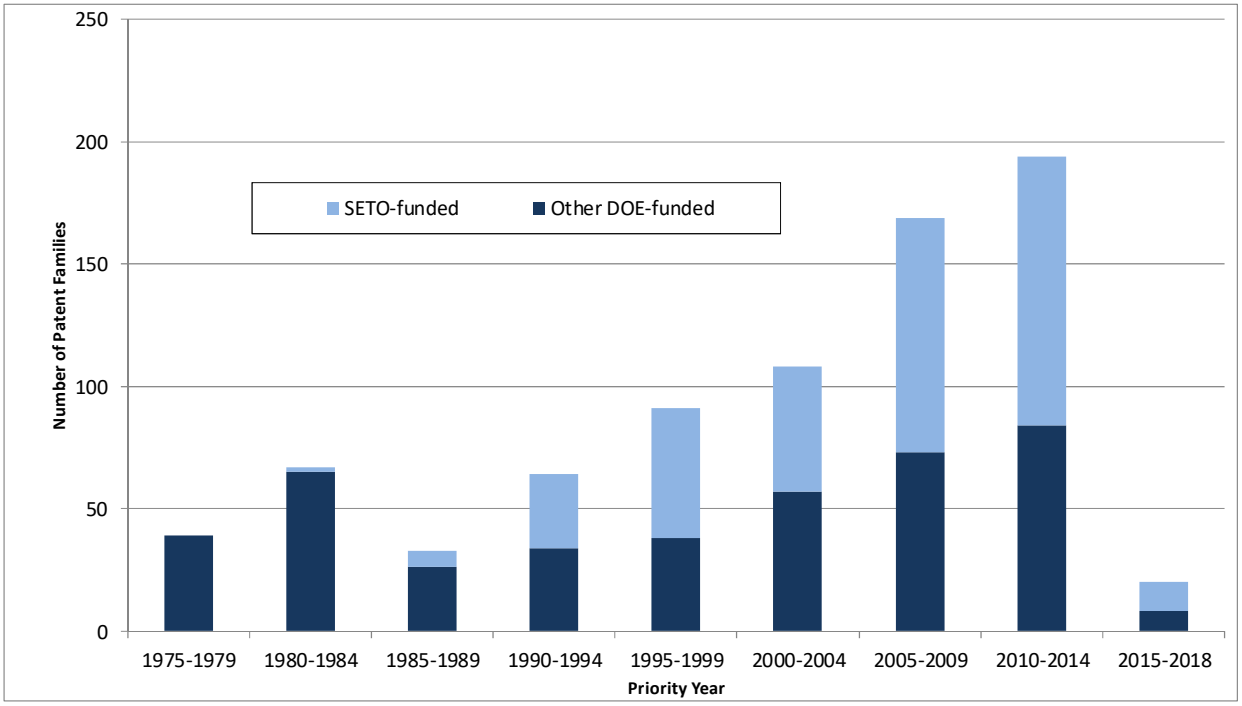
of this analysis is to assess the broader influence of DOE-funded research upon subsequent developments within and beyond PV technology.

Overall Trends in PV Patenting

Trends in PV Patenting over Time

Figure 1 shows the number of DOE-funded PV patent families by priority year – that is, the year of the first application in each patent family. This figure separates SETO-funded and Other DOE-funded patent families, and reveals an interesting pattern in terms of DOE-funded patent activity in PV technology.

Figure 1 - Number of PV Patent Families funded by SETO/Other DOE by Priority Year (5-Year Totals)



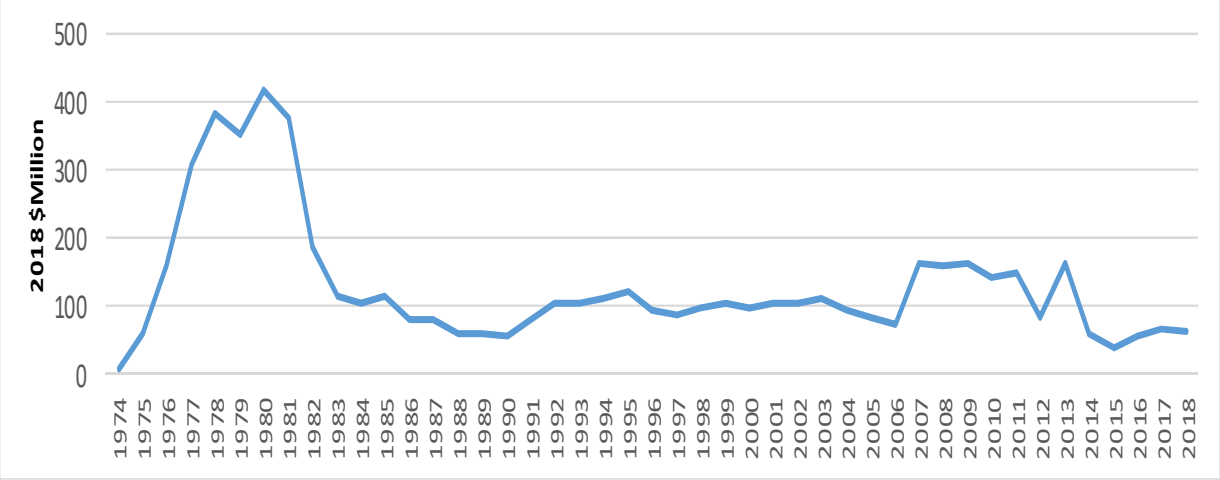
Note: The final time period in this figure is 2015-2018, and is shown for completeness, although data for this time period are incomplete. Due to time lags associated with the patenting process, only a fraction of the patent families from this time period will be included.

The earliest years in the study saw a steady increase in PV patenting by recipients of DOE funding, with 39 patent families filed in 1975-1979 followed by 67 in 1980-84. Out of all these early PV patent families, only two were confirmed as being funded by SETO. However, this may be largely due to the age of these patent families, which reduces the amount of institutional knowledge associated with them (for example program managers and inventors connected to these research efforts). Many of the patent families from these time periods were marked as "unknown" in terms of whether they were funded by SETO (rather than being marked specifically as being funded by a DOE office other than SETO).

Following the initial period of increasing DOE-funded PV patenting, there was then a lull in 1985-1989. Since that time, the number of DOE-funded PV patent families has increased steadily, peaking at 194 in 2010-2014. The role of SETO funding also became much more pronounced over time. Over half of the DOE-funded PV patent families in both 2005-2009 and 2010-2014 are confirmed as being connected to SETO funding. Data for the most recent time period are incomplete, but the very low number of patent families from this period suggests there has been a decline in DOE-funded PV patenting in recent years.

Figure 2 shows the pattern of SETO funding of PV research from 1974 through 2018. This figure reveals that SETO PV funding was at its peak in the late 1970s and early 1980s. Hence, a number of the early DOE-funded PV patents marked as "unknown" for funding source may in fact have been funded by SETO, although we could not conclude this definitively. This should be kept in mind in assessing the results presented below, especially in terms of evaluating the balance of SETO's influence in PV versus the influence of the remainder of DOE.[7]

Figure 2 - SETO PV Funding (in $Million, 2018 inflation adjusted)



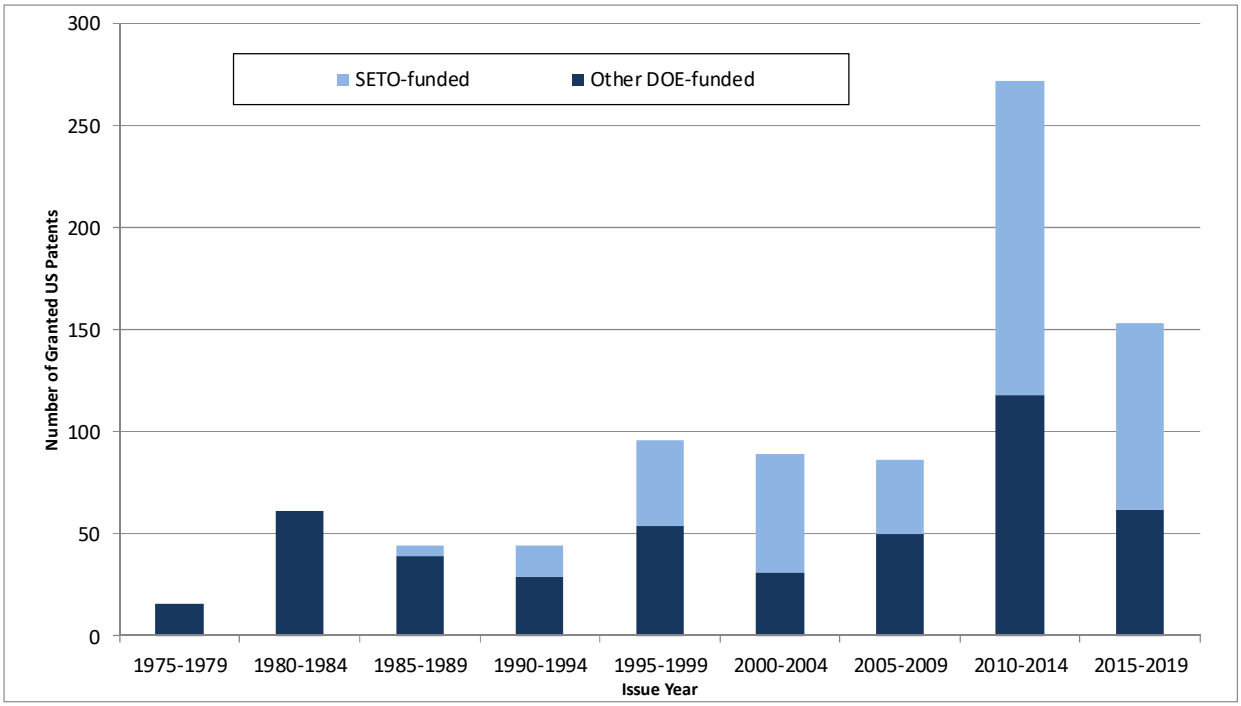
Source: Funding data is EERE historical appropriations provided by DOE that was obtained from Congressional Budgets. A secondary source for historical data is "History of Solar Energy at DOE", a 2011 presentation by Frank (Tex) Wilkins. Funding data in nominal dollars is inflation-adjusted using the GDP deflator from U.S. Department of Commerce, Bureau of Economic Analysis.

The patenting trend in Figure 1 is also reflected in Figure 3, which shows the number of PV granted U.S. patents funded by DOE by issue year. Again, the early period is characterized by a steady increase in the number of patents, none of which are defined as being associated with SETO funding. However, as noted above, many of them may in fact be SETO-funded, but we were not able to confirm this. The number of PV patents then entered a period of decline from 1985-94, before increasing again to an average of approximately 20 per year between 1995 and 2009. There then followed a rapid increase in DOE-funded U.S. patents, with 272 issued in 2010-2014, 154 of which are connected to SETO funding. The number of patents in 2015-2019

[7] Note that this funding chart is not included in order to facilitate a longitudinal analysis of funding vs. patenting, which is a highly complex relationship beyond the scope of this study. The chart is merely an additional data point showing how SETO was active in PV in the early years of the analysis, thus adding credence to the suggestion that SETO may have funded many of the "unknown" DOE-funded PV patents .

is lower at 153, although this focuses primarily on patents issued through 2018. Even though data for this final period are incomplete, there does appear to be a downward trend in DOE-funded PV patenting in recent years.

Figure 3 - Number of DOE-Funded PV Granted U.S. Patents by Issue Year (5-Year Totals)



Note: The data collection period for this analysis ended with 2018. Any 2019 patents in the 2015-2019 column are additional patents that have been included because they are members of the same patent families as pre-2019 patents. No new patent search for 2019 was carried out.

Comparing Figures 1 and 3 shows the effect of time lags in the patenting process, with many of the patent families with priority dates in 2005-09 and 2010-14 (Figure 1) resulting in granted U.S. patents in 2010-14 and 2015-19 (Figure 3). These time lags can also be seen in Figure 4, which shows PV patent family priority years alongside issue years for granted U.S. PV patents (in this figure, SETO and Other DOE are combined, in order to simplify the presentation). This figures reveals how the peak in DOE-funded PV patent family priority dates came in 2009-11, with the peak in U.S. patent issue dates occurring later in 2014-15. Also, referring back to Figure 3, it shows that many of the DOE-funded PV U.S. patents issued in 2015-19 were from the early part of that time period.

Figure 5 shows the overall number of PV patent families by priority year (based on USPTO, EPO, and WIPO filings). This figure reveals that the number of PV patent families remained relatively consistent throughout the period from 1975 through 1999. The number of patent families then started to increase at the start of the new century, followed by a sharp increase in both 2005-09 and 2010-14. PV patenting peaked in the latter time period, with a total of 18,765 patent families. Data for the most recent time period are again incomplete, but once again there is evidence of an overall decline in PV patenting.

Figure 4 - Number DOE-funded PV Patent Families (by Priority Year) and Granted U.S. Patents (by Issue Year)

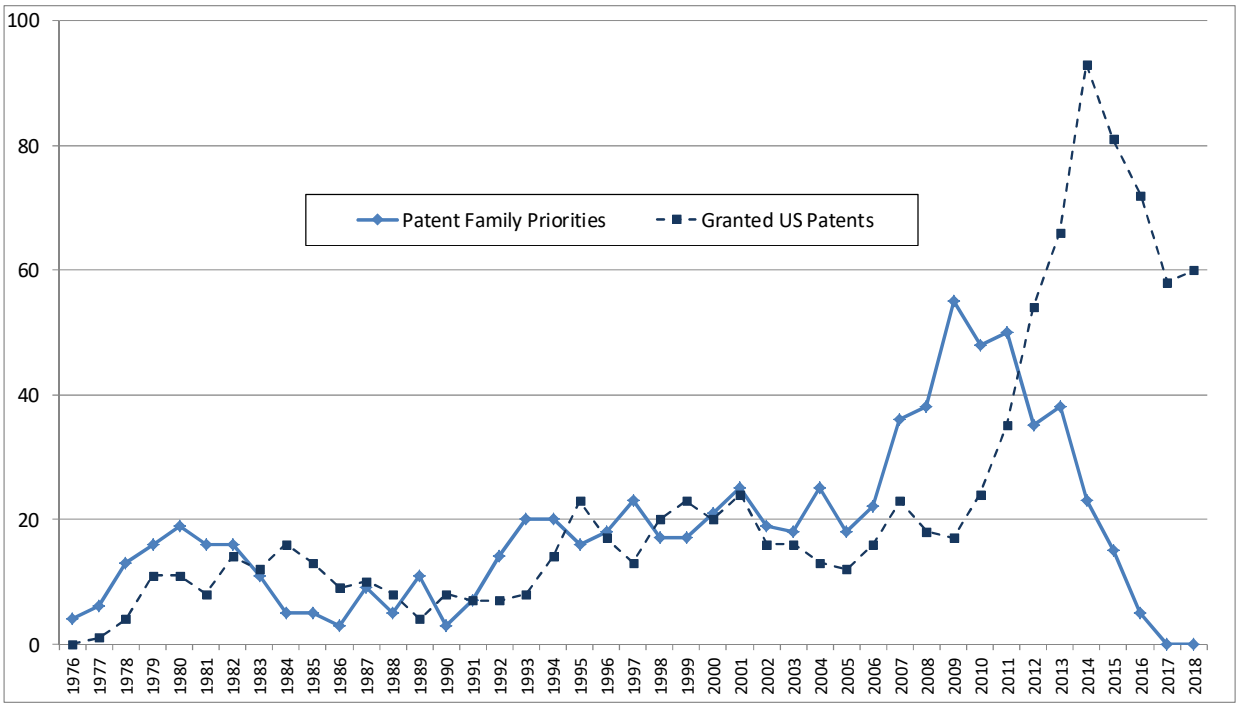
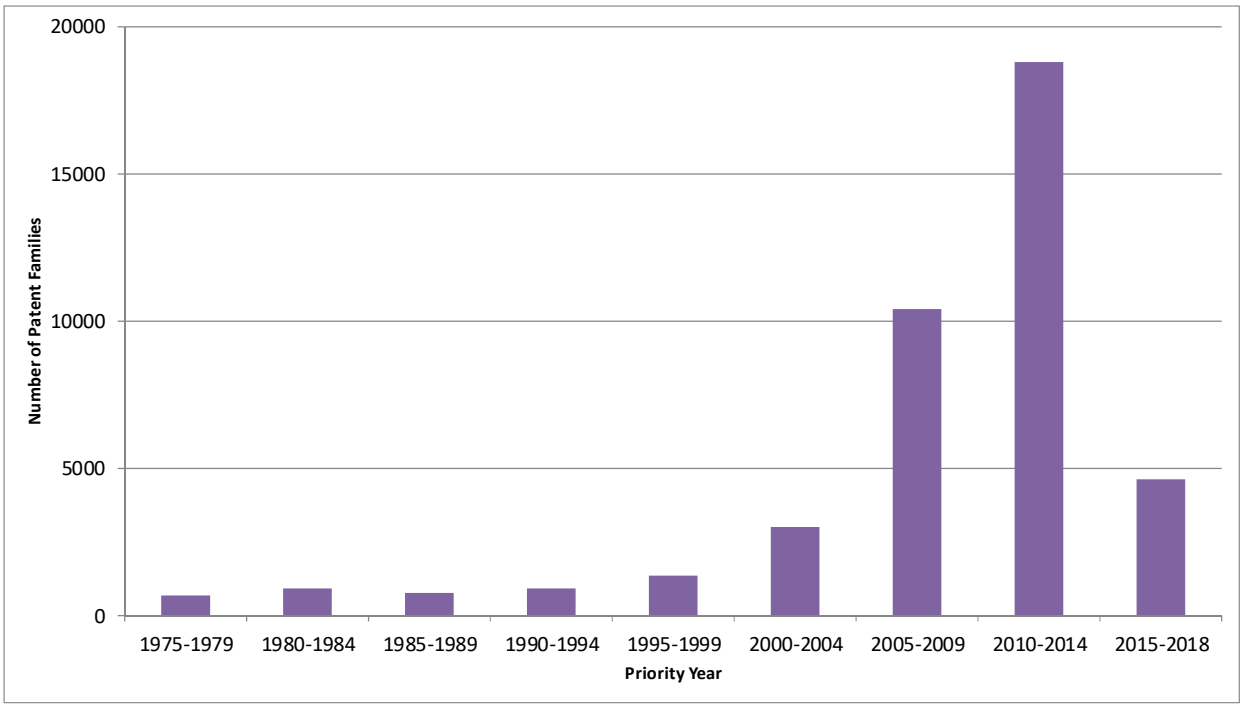


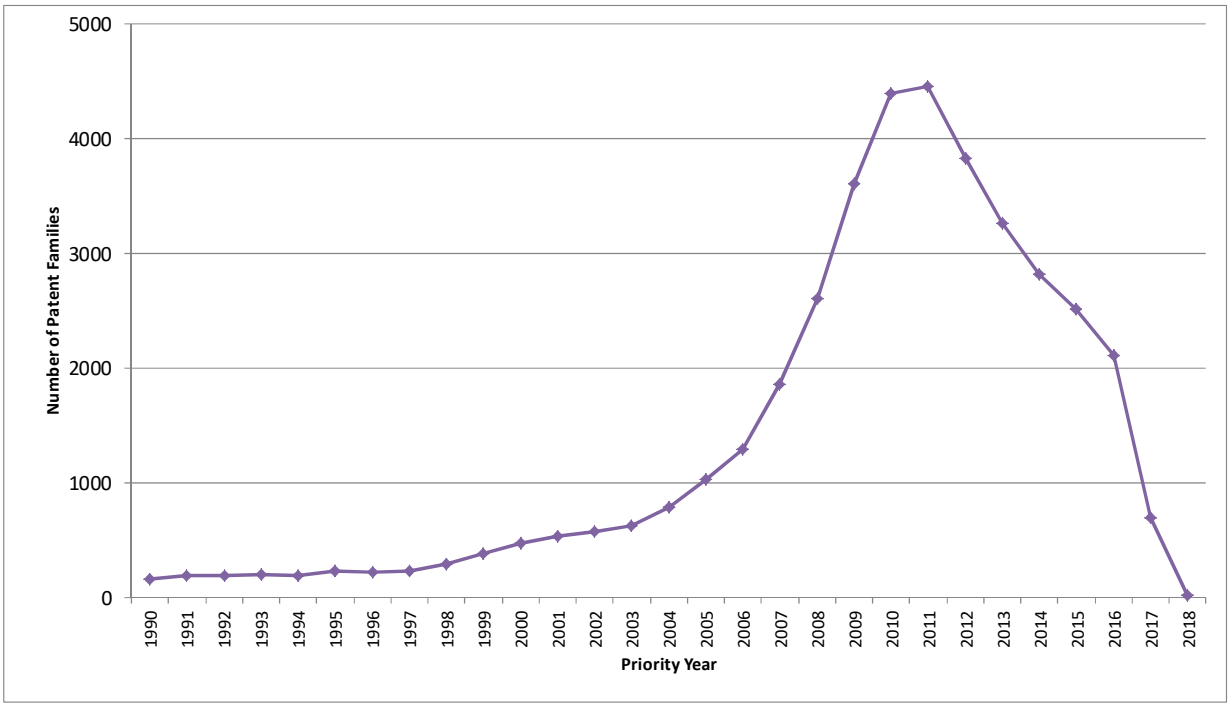
Figure 5 - Total Number of PV Patent Families by Priority Year (5-Year Periods)



Note: The final time period in this figure is 2015-2018, and is shown for completeness, although data for this time period are incomplete. Due to time lags associated with the patenting process, only a fraction of the patent families from this time period will be included.

To examine this recent decline in overall PV patenting in more detail, Figure 6 shows the number of patent families by year, rather than in five-year periods. This figure reveals that PV patenting increased rapidly in the first decade of this century, and peaked in 2011 at 4,457 families. There was then an almost equally rapid decline, with fewer than 3,000 patent families every year since 2014. This suggests that the rapid increase followed by recent decline in DOE-funded PV patenting is part of a broader trend in PV patenting in general.

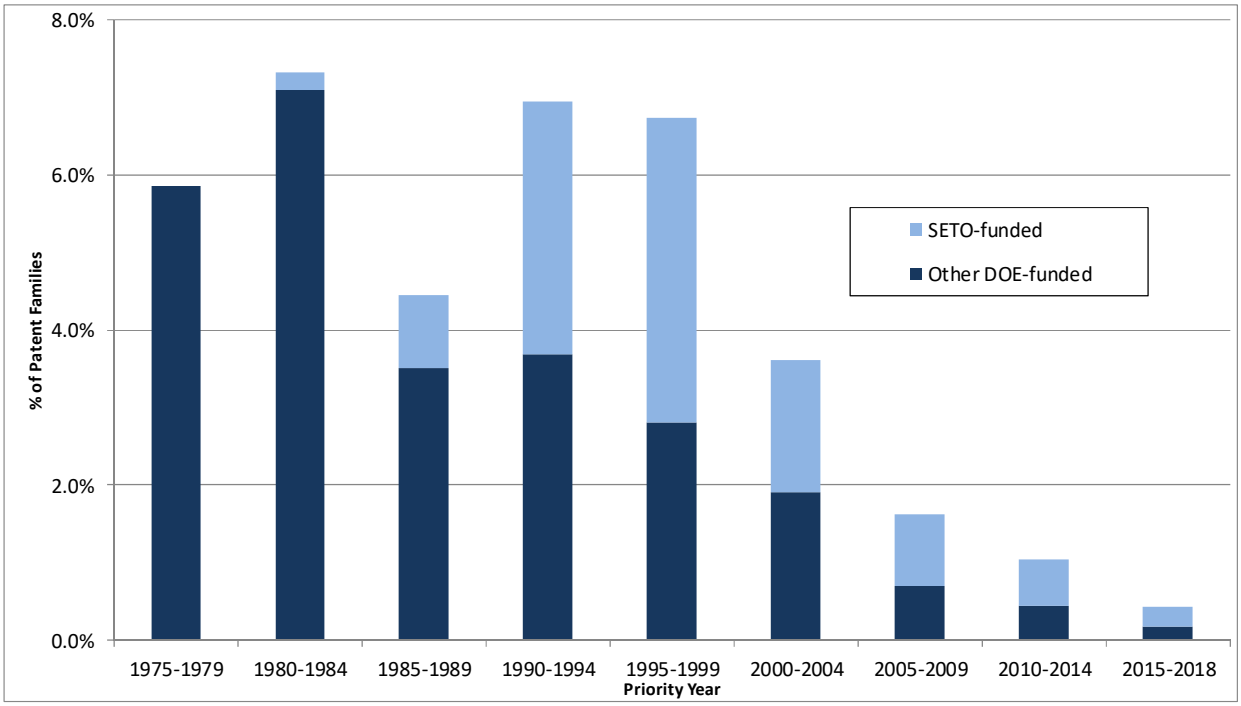
Figure 6 - Total Number of PV Patent Families by Priority Year



Note: The most recent years in this figure (i.e. 2017 and 2018) are shown for completeness, although data for these years are incomplete. Due to time lags associated with the patenting process, only a fraction of the patent families from these years will be included.

Figure 7 shows the percentage of PV patent families filed in each time period that were funded by DOE (SETO plus Other DOE). Throughout the first 25 years of the analysis, DOE funding was connected to a sizeable percentage of PV patent families, peaking at over 7% in 1980-84. SETO funding became increasingly prominent over these time periods, with almost 4% of PV patent families linked to SETO funding in 1995-99. Since 2000, the percentage of PV patent families connected to DOE funding has dropped sharply, with less than 1% of PV patent families in both 2005-09 and 2010-14 being connected to DOE. That said, the decline in this percentage should be assessed in the context of the rapid increase in overall PV patenting. There was a ten-fold increase in PV patenting between 2000 and 2011, making it much more difficult for DOE to maintain the percentage of PV patents to which it was linked. Overall, in the period 1976-2018, 1.9% of PV patent families were funded by DOE.

Figure 7 - Percentage of PV Patent Families Funded by DOE by Priority Year



Leading PV Assignees

The ten leading patenting organizations in PV technology are listed above in Table 4. The PV patent families assigned to these ten organizations form the starting point for the backward tracing element of the analysis, as outlined below. Figure 8 shows the same information in graphical form, while also including DOE-funded patent families.

Figure 8 - Leading PV Organizations (Based on Number of Patent Families)

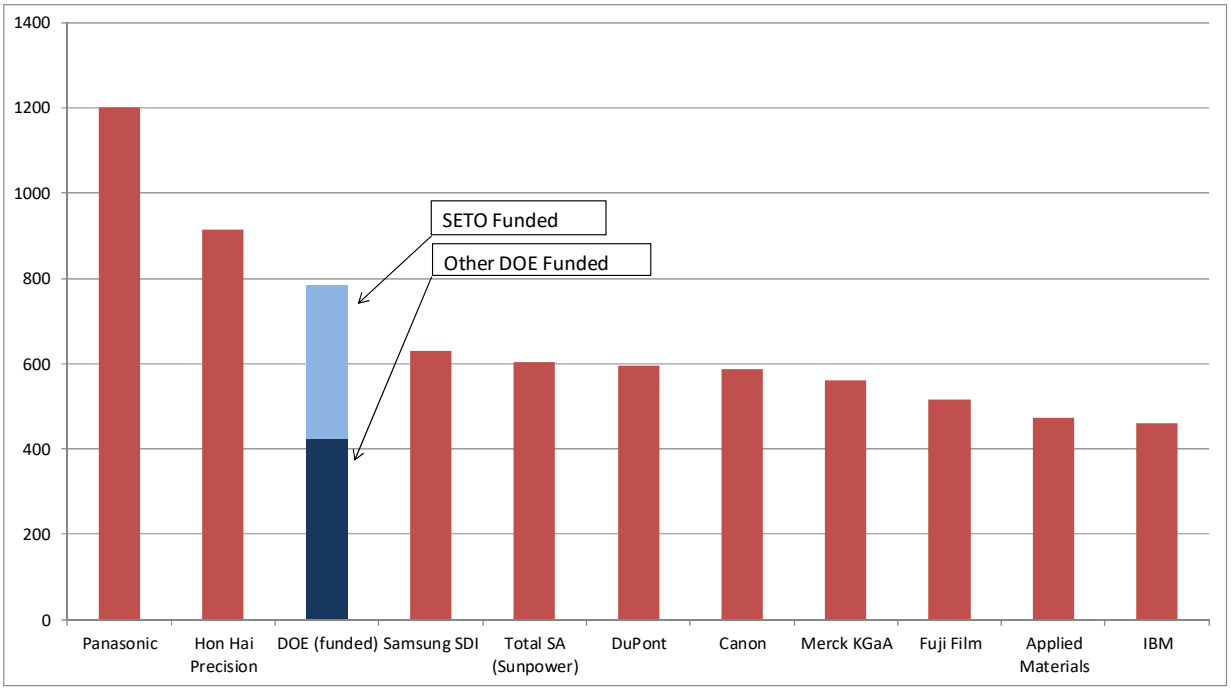


Figure 8 reveals that DOE-funded PV patents represent one of the most significant portfolios in PV technology. DOE (SETO plus Other DOE) funded families rank third in this figure, behind only Panasonic and Hon Hai Precision (often known by its trading name, Foxconn). The remaining top ten companies are very large entities with interests well beyond PV technology. They include chemical companies, electronics companies and semiconductor companies, reflecting the different aspects of PV technology. There are also companies that qualify for the top ten based in part on their acquisition of other companies, notably Total SA (largely through its majority stake in SunPower) and, to a lesser extent, Applied Materials (through its acquisition of Advent Solar and Varian Semiconductor).

It should be noted that there is some double-counting of patent families in Figure 8. For example, there are 58 patent families assigned to Total SA (SunPower) that were partially or fully funded by SETO. In Figure 8, these patent families are thus counted in both the SETO segment of the DOE column and in the Total SA column. This double-counting is appropriate, since these patent families are both funded by SETO and assigned to Total SA.

Assignees of SETO/Other DOE PV Patents

The DOE-funded PV patent portfolios are constructed somewhat differently from the portfolios of the top ten organizations listed in Figure 8. Specifically, DOE's 785 PV patent families are those funded by DOE, but are not necessarily assigned to the agency. They may instead be assigned to the company or DOE lab manager where the research was carried out.

Figure 9 - Assignees with Largest Number of SETO-Funded PV Patent Families

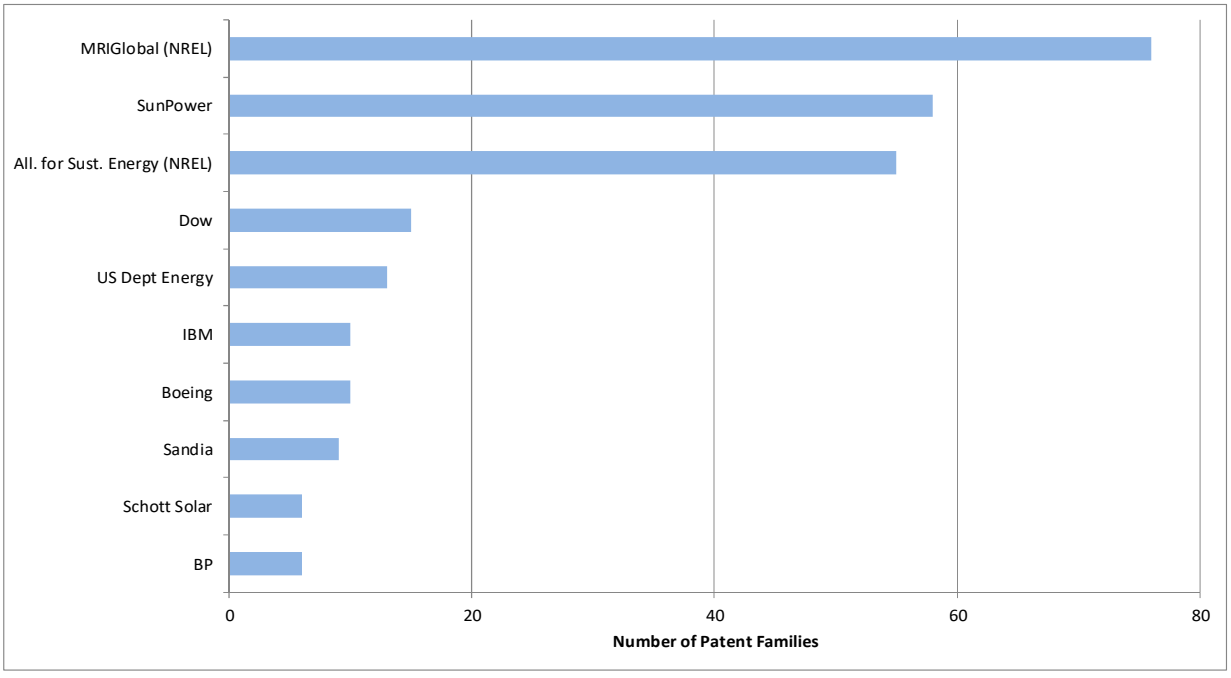
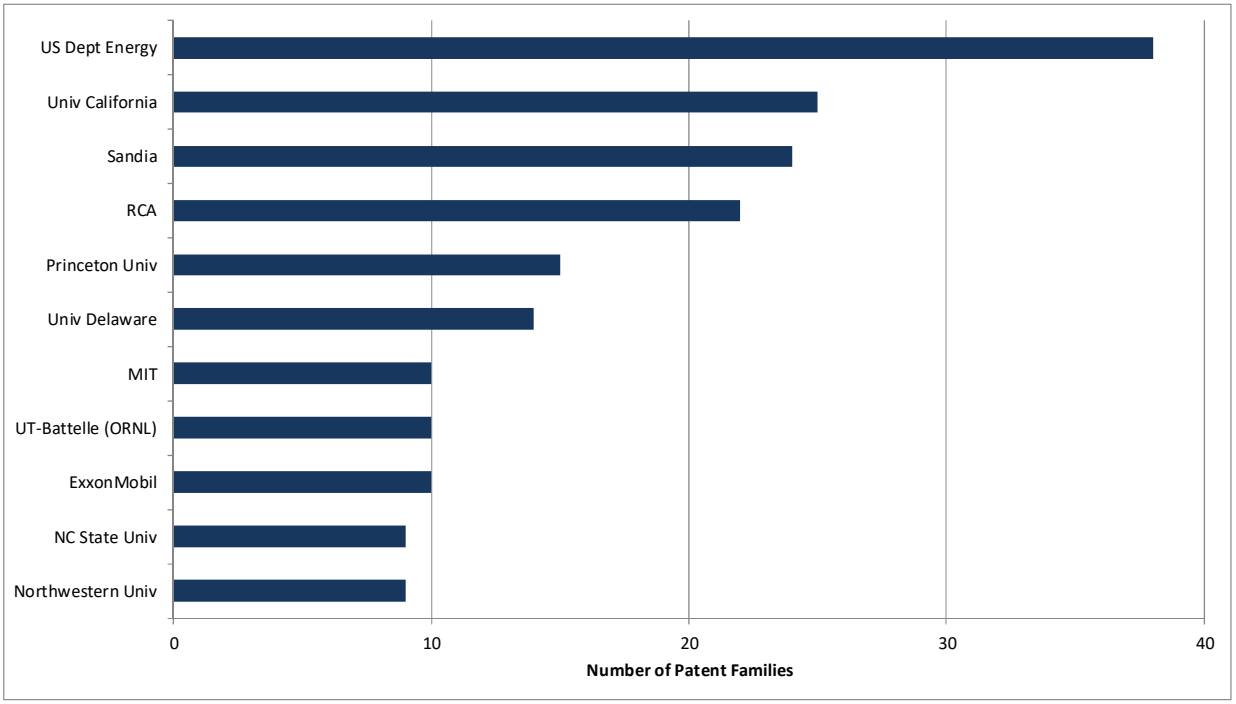


Figure 9 shows the leading assignees on SETO-funded PV patent families. This chart is headed by MRIGlobal (formerly Midwest Research Institute) with 77 PV patent families. These patent families result from MRIGlobal's management of the National Renewable Energy Laboratory (NREL). Note also that the third leading assignee in Figure 9 is the Alliance for Sustainable

Energy, which currently manages NREL, and is co-owned by MRIGlobal and Battelle. The other major assignee on SETO-funded patents is SunPower (58 families, as noted above). There is then a gap in Figure 9 to a number of assignees with fewer SETO-funded PV families, although these assignees include major companies such as IBM, Dow, Boeing and BP. This figure thus suggests that SETO has funded PV research both internally within DOE labs, especially NREL, and also externally at major companies.

Figure 10 shows the leading assignees on Other DOE-funded PV patent families. The assignee with the largest number of patent families in this figure is DOE itself, with 38 families, many from the earliest years in this analysis.[8] Another notable feature of Figure 10 is the presence of numerous universities, including the University of California system, Princeton, Delaware, MIT, North Carolina State and Northwestern.

Figure 10 - Assignees with Largest Number of Other DOE-funded PV Patent Families



Distribution of PV Patents across Patent Classifications

We analyzed the distribution of SETO-funded PV U.S. patents across Cooperative Patent Classifications (CPCs).[9] We then compared this distribution to those associated with Other DOE-funded PV patents; PV patents assigned to the ten leading organizations; and the universe of all PV patents. This analysis provides insights into the technological focus of SETO funding in PV,

[8] Patents may be assigned to DOE itself for various reasons, including where the inventors are federal employees; where the funding recipient elects not to pursue patent protection for, or take title to, the invention; or where the funding recipient does not have the right to take title to the invention.

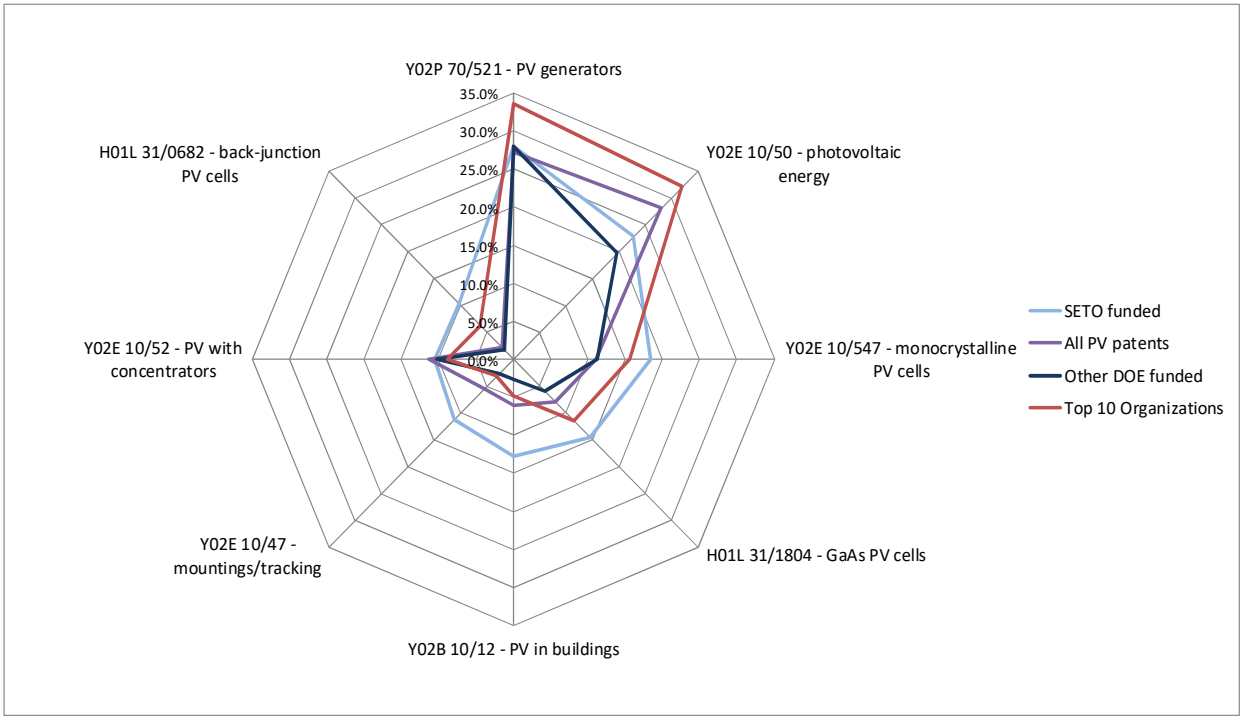
[9] The CPC is a patent classification system. Patent offices attach at least one (and often numerous) CPC classifications to patents covering the different aspects of the subject matter in the claimed invention. All CPCs attached to patents are included in this analysis.

versus the focus of the remainder of DOE, leading PV organizations, and PV technology in general.

The results from this CPC analysis are shown in two separate charts, each from a different perspective. The first chart (Figure 11) is based on the eight CPCs that are most prevalent among SETO-funded PV patents. The purpose of this chart is thus to show the main focus areas of SETO-funded PV research, and the extent to which these areas translate to other portfolios (Other DOE-funded; leading PV organizations; all PV).

This figure shows that SETO-funded research includes relatively balanced coverage across the eight CPC groups (which is not particularly surprising, since the SETO-funded patent portfolio forms the basis for the CPCs included in the chart). The CPC Y02P 70/521, which is concerned with PV-based electricity generation, is the most common CPC among SETO-funded PV U.S. patents. Almost 30% of SETO-funded PV U.S. patents include this CPC.[10] Monocrystalline PV cells (CPC Y02E 10/547) are also prominent, with 18% of SETO-funded PV U.S. patents including this CPC.

Figure 11 - Percentage of PV US Patents in Most Common Cooperative Patent Classifications (Among SETO-Funded PV Patents)



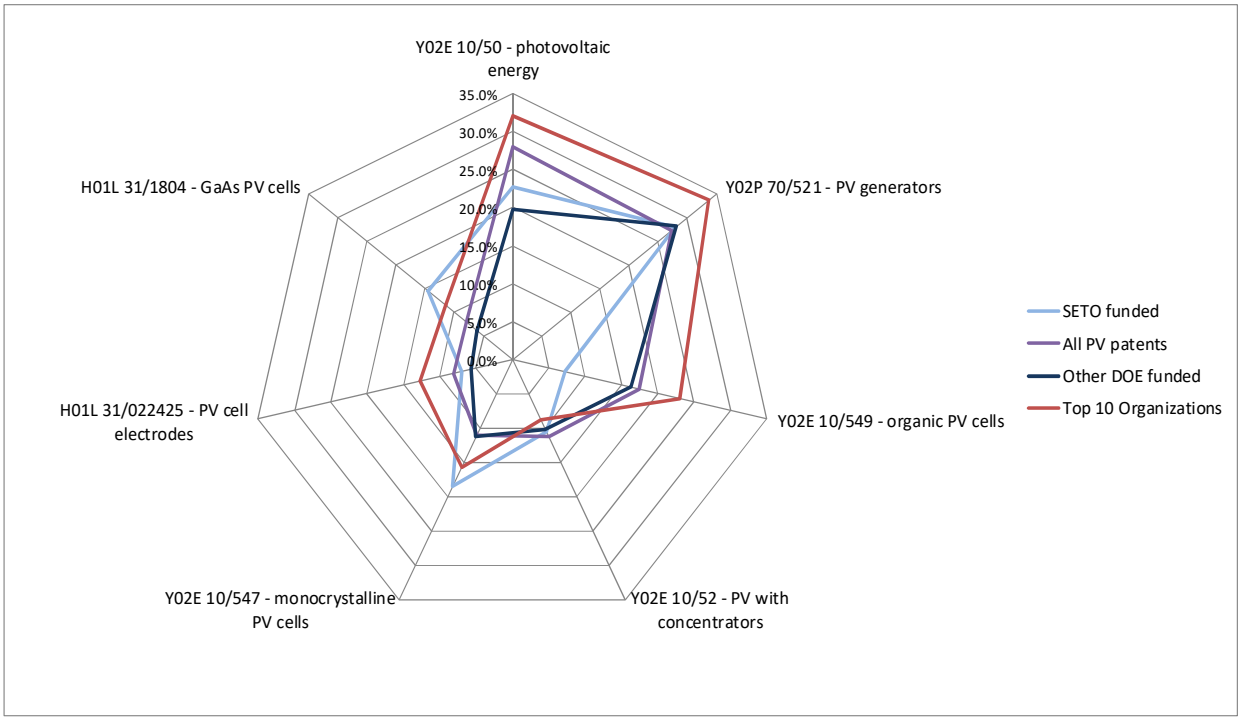
The other three patent portfolios in Table 11 (Other DOE-funded; Top 10 organizations; All PV patents) have generally similar CPC distributions to SETO-funded PV patents. This suggests that SETO PV funding has been in line with the major developments in PV technology. Having said

[10] CPCs such as Y02P 70/521 (PV-based electricity generation) and Y02E 10/50 (PV energy) are relatively general, and may cover a range of technologies, hence their prominence among the PV portfolios. One could potentially drill down further, and cluster the patents in these CPCs via textual content or citation links, but such an undertaking is beyond the scope of the high-level discussion of technology distributions presented here.

this, there are CPCs where SETO-funded patents have a greater concentration than the other portfolios. These include the application of PV in buildings (CPC Y02B 10/12), and back-junction PV cells (CPC H01L 31/0682). These are areas where SETO funding may have filled a research gap where other organizations were less active.

Figure 12 is similar to Figure 11, except that it is from the perspective of the most common CPCs among all PV patents. Hence, the purpose of this chart is to show the main focus areas within PV as a whole, and how these areas are represented in selected PV portfolios (SETO-funded; Other DOE-funded; leading PV organizations).

Figure 12 - Percentage of PV US Patents in Most Common Cooperative Patent Classifications (Among All PV Patents)

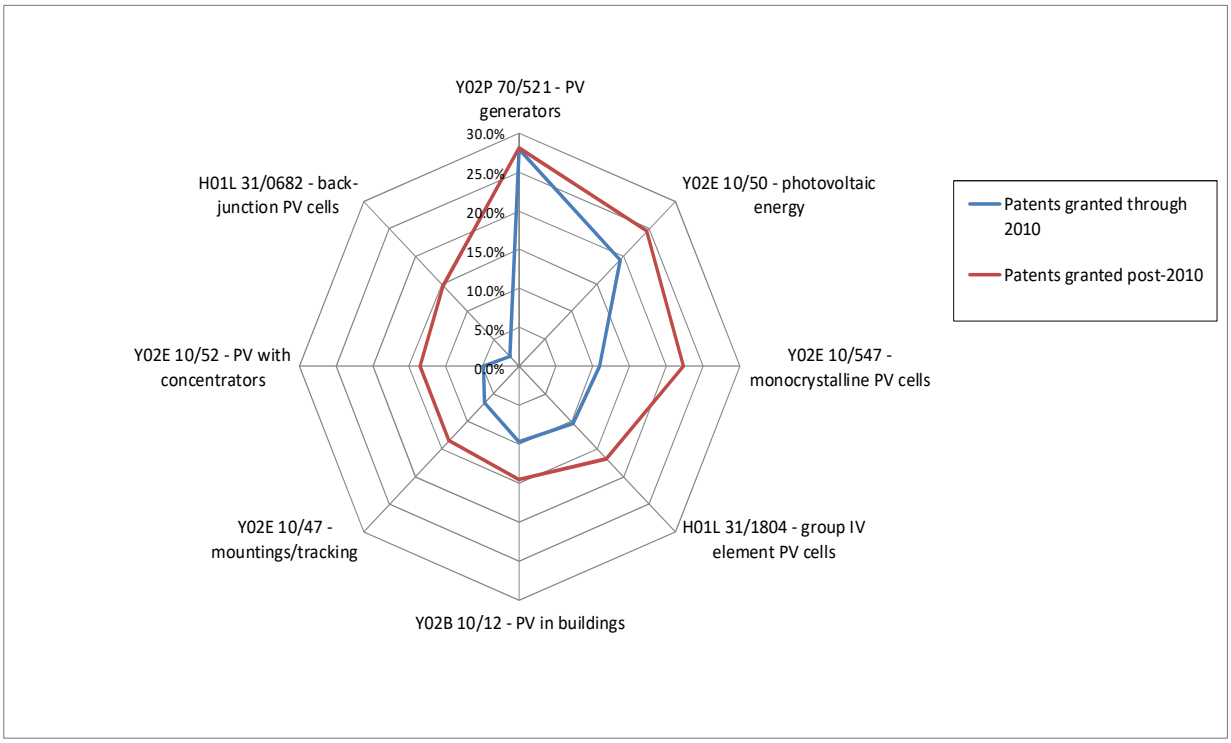


The biggest difference between the CPCs in the two figures is the presence of CPC Y02E 10/549 in Figure 12. This CPC is concerned with organic PV cells. Over 17% of all PV patents include this CPC, plus 23% of PV patents owned by the ten leading organizations, and 16% of Other DOE-funded patents. Meanwhile, only 7.2% of SETO-funded patents include this CPC. As such, this appears to be a research area where recipients of SETO funding have been less active.

Figure 13 compares the CPC distribution of SETO-funded PV U.S. patents across two time periods – i.e. patents issued through the end of 2010, and patents issued from 2011 onwards. This figure reveals that, in both time periods, almost 30% of SETO-funded patents have CPC Y02P 70/521 attached, which is related to PV-based electricity generation. Beyond that CPC, the contrast between the two time periods is interesting. In the latter time period, the leading CPCs appear on a much higher percentage of patents, whereas there was a much less concentrated

distribution of CPCs in the earlier time period.[11] There has been a particular growth in SETO-funded PV patents related to back-junction solar cells (CPC H01L 31/0682) and PV systems incorporating concentrators (CPC Y02E 10/52). The former CPC was on 14.8% of post-2010 SETO-funded PV patents (compared to less than 2% in the earlier time period), while the latter appeared on 13.5% of post-2010 SETO-funded PV patents (compared to less than 5% in the earlier time period). This suggests that these are areas of increasing focus for recipients of SETO PV funding.

Figure 13 - Percentage of SETO-funded PV US Patents in Most Common Cooperative Patent Classifications Across Two Time Periods



Tracing Backwards from PV Patents Owned by Leading Organizations

This section reports the results of an analysis tracing backwards from PV patents owned by leading organizations in this technology to earlier research, including that funded by SETO (and by DOE in general). The results in this section are examined at two levels. First, we report results at the organizational level. These results reveal the extent to which SETO-funded and Other DOE-funded research forms a foundation for subsequent innovations associated with leading PV organizations. Second, we drill down to the level of individual patents, with a particular focus on SETO-funded PV patents. These patent-level results highlight specific SETO-funded patents that have had a particularly strong influence on subsequent patents owned by leading organizations in this technology. They also highlight which PV patents owned by these leading organizations are linked particularly extensively to earlier SETO-funded research.

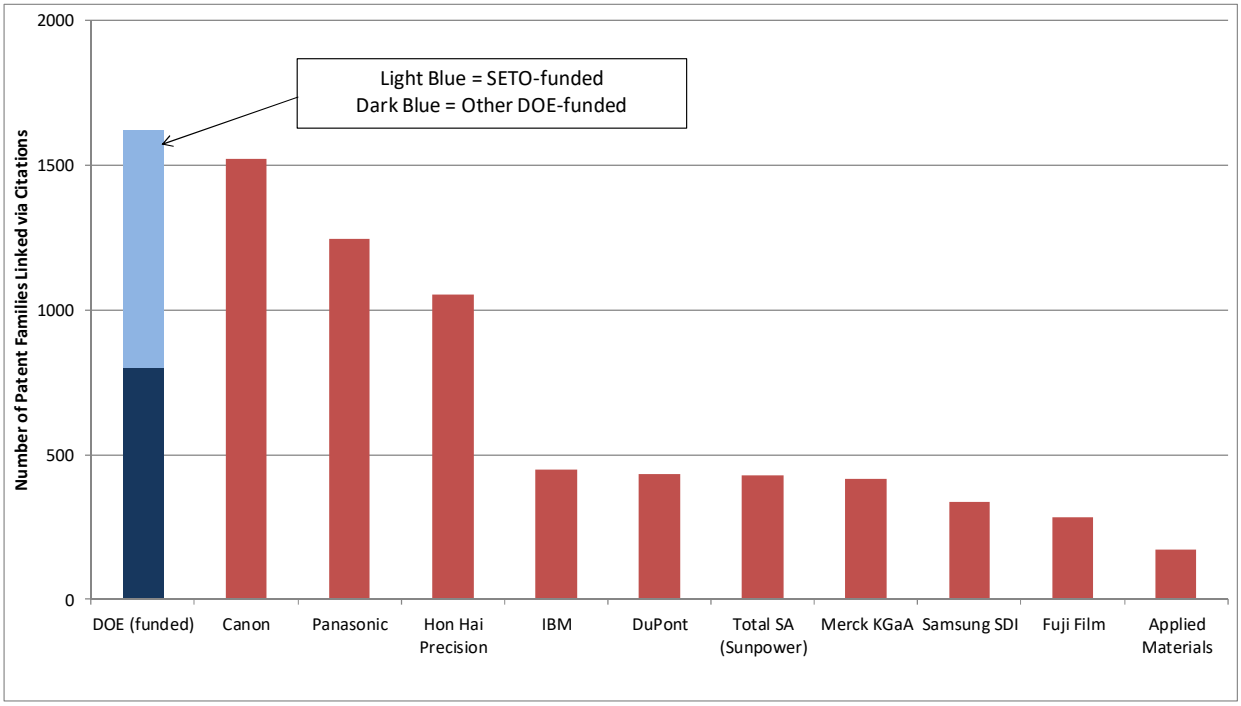
[11] The average number of CPCs patents is somewhat higher for post-2010 SETO-funded PV patents, making it more likely for a given CPC to appear on these patents. However, the difference is not large enough to account for the greater concentration of CPCs among post-2010 patents.

Organizational Level Results

In the organizational level results, we first compare the influence of SETO-funded and Other DOE-funded PV research against the influence of leading organizations in this technology. We then examine which of these leading organizations build particularly extensively on SETO-funded (and Other DOE-funded) PV research.

Figure 14 compares the influence of DOE-funded PV research to the influence of research carried out by the top ten PV organizations listed above. Specifically, this figure shows the number of PV patent families owned by the leading organizations that are linked via citations to earlier PV patent families assigned to each of these leading organizations (plus patent families funded by DOE). That is, the figure shows the organizations whose patents have had the strongest influence upon subsequent innovations from leading organizations in PV technology.[12]

Figure 14 - Number of Leading Organization PV Patent Families Linked via Citations to Earlier PV Patents Assigned to Each Leading Organization
e.g. 1621 leading organization PV families are linked to earlier SETO/Other DOE-funded families



In total, 1,621 leading organization PV patent families (i.e. 24.8% of their 6,537 families) are linked via citations to earlier DOE-funded PV patents, out of which 820 are linked to SETO-

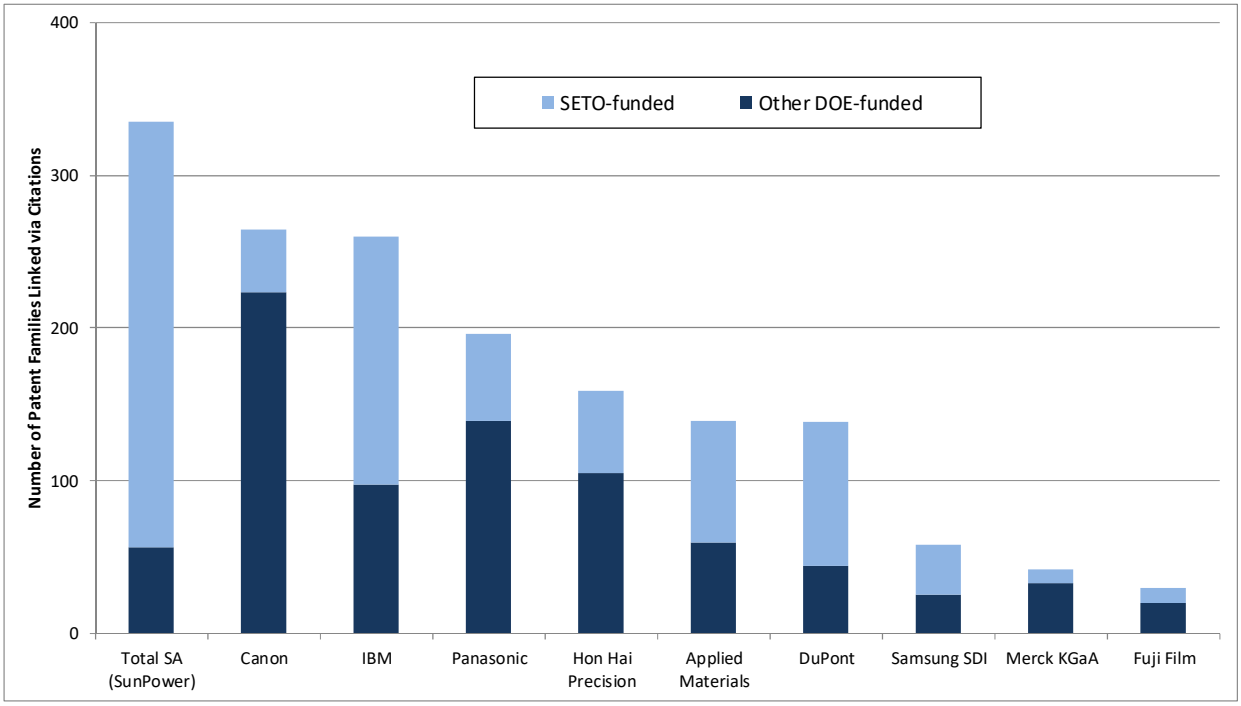
[12] This figure compares the influence of patents *funded* by SETO/DOE against patents *owned* by (i.e. assigned to) organizations. Such a comparison is reasonable, since patents funded by organizations through their R&D budgets will be assigned to those organizations. Also, organizations cannot choose to reference the patents of a non-competitor (such as DOE) rather than the patents of a competitor in order to reduce the "credit" given to that competitor. Such an omission could lead to the invalidation of their patents. Note that, as in Figure 8, there is an element of double-counting in Figure 14, where patent families assigned to a leading PV organization were also funded by DOE. Also, in Figures 14-17, leading company patent families linked to both VTO-funded and Other DOE-funded patents are allocated to the VTO-funded segment of the DOE column, in order to avoid double-counting these families.

funded PV patents. This finding puts DOE-funded patents at the head of Figure 14. It means that more PV patent families owned by leading organizations are linked via citations to DOE-funded PV patents than are linked to the PV patents assigned to any other leading organization. This is an impressive result, since DOE-funded patents represent only the third largest portfolio among the leading organizations.

Figure 14 suggests that DOE-funded research has helped form an important part of the foundation for research carried out by leading PV organizations. Indeed, this figure may underestimate the influence of SETO-funded PV research (relative to Other DOE-funded research), since some of the early Other DOE-funded PV patent families may in fact have been funded by SETO, as discussed earlier.

Figures 15 through 17 examine which of the leading PV organizations build particularly extensively on earlier DOE-funded patents. Figure 15 shows how many PV patent families owned by each of the leading organizations are linked via citations to at least one earlier DOE-funded PV patent.

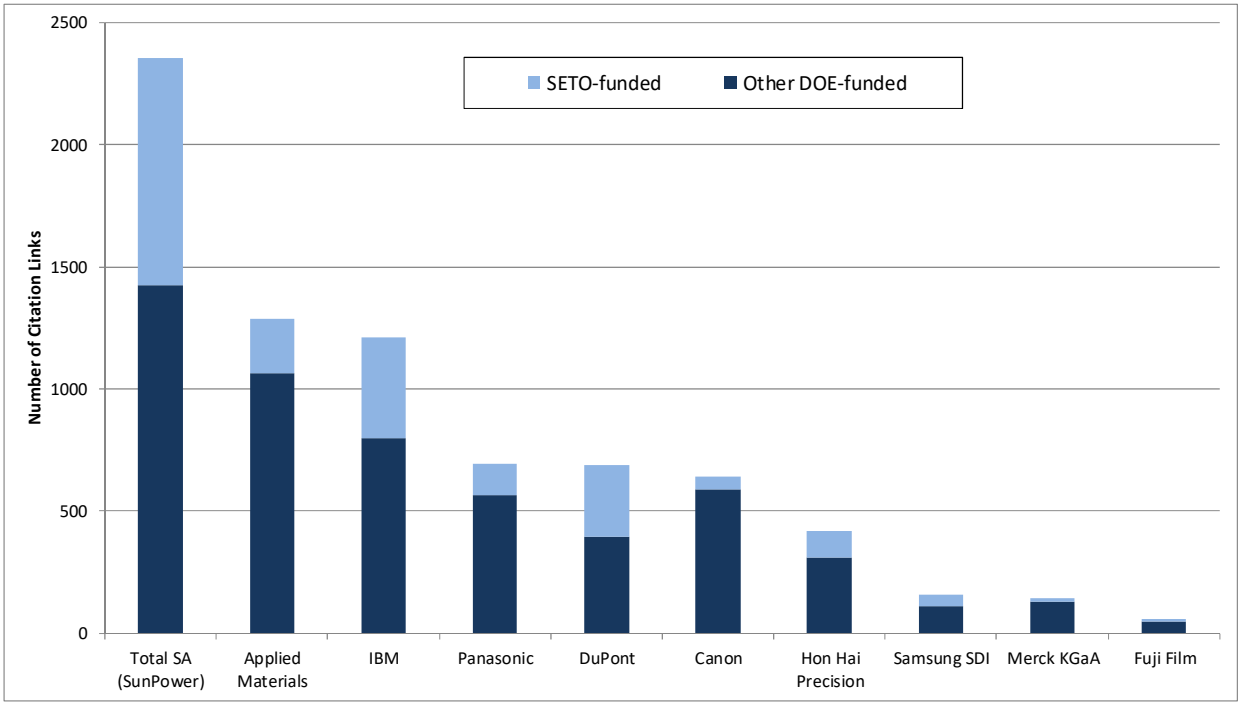
Figure 15 - Number of Patent Families Assigned to Leading PV Companies that are Linked via Citations to Earlier SETO/Other DOE-Funded PV Patents



Total SA (SunPower) heads this list, with 335 patent families linked to DOE-funded patents, 279 of which are linked to SETO. These include links from SunPower patents to its own earlier patents funded by SETO. Canon is second in Figure 15, with 264 patent families linked to DOE-funded patents, only 41 of which are linked to SETO. IBM, which appears third in Figure 15, has much more extensive links to SETO. Out of its 260 patent families linked to DOE, 163 are linked to SETO. Among other leading PV companies, both Applied Materials and DuPont also have relatively strong links to SETO-funded PV patents.

Figure 16 counts the total number of citation links from leading organizations to earlier DOE-funded patents. This differs slightly from the count of linked families in Figure 15, since a single patent family can be linked to multiple earlier DOE-funded patents. Total SA is again at the head of this chart, with a total of 2,354 citation links to DOE-funded PV patents, 932 of which are links to SETO-funded patents. Applied Materials is in second place, with 1,287 links to DOE, 223 of which are linked to SETO, followed by IBM (1,211 links to DOE, of which 414 are links to SETO). In comparing Figures 15 and 16, it is interesting to note that Other DOE-funded patents are more prominent when counting number of citation links (Figure 16) versus number of linked families (Figure 15). This may be due to the relative age profile of the Other DOE-funded and SETO-funded patent families, with the former skewing older, so having more time to develop multiple links within the citation network.

Figure 16 - Total Number of Citation Links from Leading PV Company Patent Families to Earlier SETO/Other DOE-Funded PV Patents

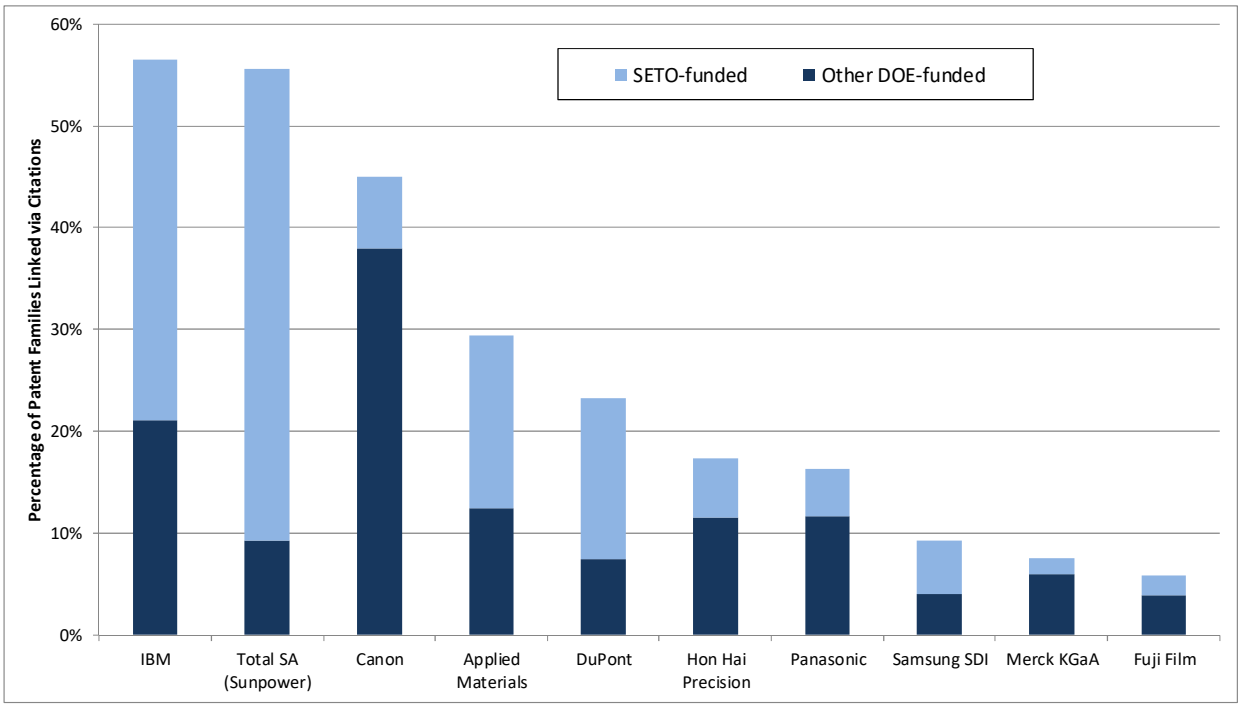


There is an element of portfolio size bias in the patent family counts in Figures 15 and 16. Organizations with larger PV patent portfolios are likely to have more patent families linked to DOE, simply because they have more families overall. Figure 17 accounts for this portfolio size bias by calculating the percentage of each leading company's PV patent families that are linked via citations to earlier DOE-funded PV patents, rather than their absolute number. This is a measure of how extensively each company builds on DOE-funded research, relative to their overall patent output.

Figure 17 reveals that three of the ten leading PV organizations have more than 40% of their PV patent families linked via citations to earlier DOE-funded PV patents – IBM, Total SA (SunPower) and Canon. The first two of these are linked particularly extensively to SETO. Over 56% of IBM's PV patent families are linked to DOE (35% to SETO), while 55% of Total's PV

patents families are linked to DOE (46% to SETO). Out of the other leading companies, Applied Materials and DuPont both have more than 15% of their PV patent families linked to earlier SETO-funded PV patents.

Figure 17 - Percentage of Leading PV Company Patent Families Linked via Citations to Earlier SETO/ Other DOE-Funded PV Patents



Patent Level Results

The previous section of the report examined results at the level of entire patent portfolios. The purpose of this section is to drill down to identify individual DOE-funded PV patent families (in particular SETO-funded families) that have had a particularly strong influence on subsequent PV patents owned by leading organizations in this technology. Looking in the opposite direction, it also identifies individual PV patents owned by leading organizations that have extensive citation links to earlier SETO-funded research.

Table 5 shows the SETO-funded PV patent families linked via citations to the largest number of subsequent patent families owned by leading organizations in this technology. Many of the patents in this table are relatively old. This is not surprising, since older patents have had a longer time period to become connected to subsequent generations of technology. As such, most of the patent families in Table 5 represent older foundational technologies that are linked to subsequent innovations associated with leading organizations in the PV industry.

Among these SETO-funded patent families, one in particular stands out in terms of the number of leading organizations' patent families linked to it via citations. This SETO-funded family

(whose representative patent[13] is US #5,053,083) is assigned to Stanford University. It describes bi-level contact solar cells, and is linked to 238 PV patent families assigned to leading organizations. These include patent families owned by eight of the ten leading organizations (i.e. all except Merck and Fuji Film). Examples include patents for solar cell encapsulation assigned to DuPont, solar cell interconnects assigned to Applied Materials, and thin-film PV cells assigned to Total SA (SunPower). Many of these leading organization patents are relatively new, thus showing how an early innovation funded by SETO has fed through into more recent developments in PV technology.

Table 5 – SETO-Funded PV Patent Families Linked via Citations to Most Subsequent Leading Organization PV Patent Families

Patent Family #	Representative Patent #	Priority Year	# Linked Families	Assignee	Title
23367734	5053083	1989	238	Stanford Univ	Bilevel contact solar cells
24521389	5746839	1996	85	Powerlight Corp	Lightweight, self-ballasting photovoltaic roofing assembly
25411110	6114046	1997	67	Evergreen Solar Corp	Encapsulant material for solar cell module and laminated glass applications
27486847	6061978	1997	67	Powerlight Corp	Vented cavity radiant barrier assembly and method
46202364	5441897	1993	58	MRIGlobal (NREL)	Method of fabricating high efficiency Cu(In,Ga)(SeS).sub.2 thin films for solar cells
23130761	5436204	1993	56	MRIGlobal (NREL)	Recrystallization method to selenization of thin film Cu(In,Ga)Se.sub.2 for semiconductor device applications
25411113	6353042	1997	55	Evergreen Solar Corp	UV-light stabilization additive package for solar cell module and laminated glass applications
25540364	5972732	1997	55	Sandia Corp	Method of monolithic module assembly
46255262	6091021	1996	55	Sandia Corp	Silicon cells made by self-aligned selective-emitter plasma-etchback process
25540256	5951786	1997	54	Sandia Corp	Laminated photovoltaic modules using back-contact solar cells

The SETO-funded patent family in second place in Table 5 has representative patent US #5,746,839. This patent family was originally assigned to PowerLight, which was subsequently acquired by SunPower (and in turn by Total SA). This patent family is linked to 85 subsequent patent families assigned to the leading PV organizations. These include Canon patents describing solar modules, IBM patents for solar concentrators, and Total SA patents related to solar panel installation.

Table 5 also contains patents assigned to MRIGlobal (NREL) describing CIGS PV cells, Evergreen Solar patents for solar cell encapsulation materials, and Sandia patents outlining solar modules and solar cell manufacturing. This table thus reflects the breadth of PV research

[13] The representative patent is a single patent from a family, but it is not necessarily the priority filing.

supported by SETO that has had a notable influence on technologies developed by the leading PV companies.

Table 6 looks in the opposite direction to Table 5, and lists PV patent families owned by leading organizations that are linked particularly extensively to earlier patents funded by SETO. Applied Materials has the patent family with the most links to SETO-funded PV patents. This family (representative patent US #7,863,084) describes back contact solar cells. It is linked to 18 earlier SETO-funded patent families, including MRIGlobal patents for CIGS cells, Stanford patents describing bi-level PV cells, and Sandia patents outlining solar cell encapsulation. Table 6 also contains a number of Total SA patent families for solar panel installation that are linked to earlier SETO-funded patent families assigned to Evergreen Solar describing materials for encapsulating solar modules. Beyond these patents, Table 6 also contains patents assigned to DuPont, Hon Hai, IBM and Panasonic, showing that SETO-funded PV patents have influenced a variety of technological developments associated with many of the leading PV companies.

Table 6 - Leading Organization PV Patent Families Linked via Citations to Largest Number of SETO-Funded PV Patent Families

Patent Family #	Representative Patent #	Priority Year	# SETO Fams	Assignee	Title
34831070	7863084	2009	18	Applied Materials	Contact fabrication of emitter wrap-through back contact silicon solar cells
58260068	10090430	2016	14	Total SA	System for manufacturing a shingled solar cell module
54007221	9777948	2016	13	Total SA	End clamps for solar systems
44858134	9263183	2013	12	Total SA	Modular photovoltaic power supply assembly
58051435	10084104	2016	12	Total SA	Solar panel
39562962	EP2100336	2006	11	Applied Materials	Interconnect technologies for back contact solar cells
53269718	WO2015171575	2014	10	DuPont	Encapsulant composition
50363902	8955266	2012	10	Hon Hai Precision	Locking apparatus
43924096	8614115	2009	10	IBM	Photovoltaic solar cell device manufacture
45723344	8735206	2010	10	Panasonic	Method of manufacturing solar cell module
34831070	7863084	2009	18	Applied Materials	Contact fabrication of emitter wrap-through back contact silicon solar cells

We also identified high-impact PV patents owned by leading organizations that have citations links to earlier SETO-funded patents.[14] The idea is to highlight important technologies owned by

[14] High-impact patents are identified using 1790's Citation Index metric. This metric is derived by first counting the number of times a patent is cited as prior art by subsequent patents. This number is then divided by the mean number of citations received by peer patents from the same issue year and technology (as defined by their first listed Cooperative Patent Classification). For example, the number of citations received by a 2010 patent in CPC H01L 31/042 (PV modules) is divided by the mean number of citations received by all patents in that CPC issued in 2010. The expected Citation Index for an individual patent is one. The extent to which a patent's Citation Index is greater or less than one reveals whether it has been cited more or less frequently than expected, and by how much. For example, a Citation Index of 1.5 shows that a patent has been cited 50% more frequently than expected. Meanwhile a Citation Index of 0.7 reveals that a patent has been cited 30% less frequently than expected. By extension, the expected Citation Index for a portfolio of patents is also one, with values above one showing that a portfolio has been cited more than expected, and values below one showing that a portfolio has not been cited as frequently as

leading PV organizations that are linked to earlier PV research funded by SETO. Table 7 lists PV patents owned by leading organizations that have Citation Index values over four (i.e. they have been cited at least four times as frequently as expected), and that are linked via citations to earlier SETO-funded PV patents.

The patents in this table are listed in descending order according to their Citation Index values. The list is headed by three SunPower patents, including patents describing back contact solar cells (US #7,468,485) and solar cell installations (US #8,158,877). Each of these patents has been cited by more than ten times as many subsequent patents as expected. Following these SunPower patents is an IBM patent (US #8,247,261) describing substrate fabrication for PV cells, which has been cited more than eight times as frequently as expected. Table 7 also includes highly-cited patents assigned to Canon for PV-based power generation (e.g. US #7,733,069) and to Applied Materials for solar cell manufacturing (e.g. US #7,727,866). One notable feature of the patents in Table 7 is that they are relatively recent, having been granted within the last decade. As such, they represent comparatively recent high-impact innovations that build upon earlier SETO-funded PV research.

Table 7 - Highly Cited Leading Company PV Patents Linked via Citations to Earlier SETO-funded PV Patents

Patent #	Issue Year	# Cites Received	Citation Index	Assignee	Title
8158877	2012	86	11.48	Total SA (SunPower)	Localized power point optimizer for solar cell installations
7339110	2008	130	11.16	Total SA (SunPower)	Solar cell and method of manufacture
7468485	2008	125	10.73	Total SA (SunPower)	Back side contact solar cell with doped polysilicon regions
8247261	2012	42	8.53	IBM	Thin substrate fabrication using stress-induced substrate spalling
7733069	2010	60	7.11	Canon	Power converting apparatus and power generating apparatus
8093675	2012	39	6.05	Hon Hai Precision	Photoelectric conversion element, photoelectric conversion element assembly and photoelectric conversion module
7727866	2010	37	5.53	Applied Materials	Use of chained implants in solar cells
7144751	2006	66	5.14	Applied Materials	Back-contact solar cells and methods for fabrication
6897370	2005	72	4.33	Canon	Power generation apparatus and its control method

While the patent-level results above focus on SETO-funded PV patent families, we also identified Other DOE-funded PV families linked to the largest number of subsequent patent families owned by the leading PV organizations. As noted throughout this report, some of these Other DOE-funded families may in fact be SETO-funded.

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expected. Note that the Citation Index is calculated for U.S. patents only, since citation rates differ across patent systems.

RCA is the assignee on three of the four Other DOE-funded families linked to the largest number of leading company PV patent families. These RCA patent families (e.g. representative patent #4,167,015) date from the late 1970s through 1980, and describe amorphous silicon solar cells. They are each linked to over 100 patent families assigned to the leading PV organizations.

The remaining patent families in Table 8 are assigned to a wide range of organizations, including companies (e.g. Boeing, BP, Solarex), DOE lab managers (Sandia, University of California), universities (Delaware) and DOE itself. The patent families also range in terms of filing dates from the late 1970s to the late 1990s.

Table 8 - Other DOE-Funded PV Patent Families Linked via Citations to Most Subsequent Leading Organization PV Families

Patent Family #	Representative Patent #	Priority Year	# Linked Families	Assignee	Title
25410655	4167015	1978	168	RCA CORP	CERMET LAYER FOR AMORPHOUS SILICON SOLAR CELLS
22558022	4292092	1980	133	RCA CORP	LASER PROCESSING TECHNIQUE FOR FABRICATING SOLAR CELLS INTO A SOLAR BATTERY
22232574	5468652	1993	128	SANDIA CORP	Method of making a back contacted solar cell
26707276	4272641	1979	126	RCA CORP	TANDEM JUNCTION AMORPHOUS SILICON SOLAR CELLS
22516852	4377723	1980	114	UNIV DELAWARE	HIGH EFFICIENCY THIN-FILM MULTIPLE-GAP PHOTOVOLTAIC DEVICE
22800288	5538564	1994	90	UNIV CALIFORNIA	Three dimensional amorphous silicon/microcrystalline silicon solar cells
22360587	6077722	1998	89	BP CORP	Producing thin film photovoltaic modules with high integrity interconnects and dual layer contacts
27005714	5078804	1989	88	BOEING	I-III-VI.SUB.2 BASED SOLAR CELL
24233837	4491681	1983	85	US DEPT ENERGY	LIQUID COOLED, LINEAR FOCUS SOLAR CELL RECEIVER
22204120	4816082	1987	83	ENERGY CONVERSION DEVICES	THIN FILM SOLAR CELL INCLUDING A SPATIALLY MODULATED INTRINSIC LAYER
22812580	5646050	1994	82	AMOCO ENRON SOLAR	Increasing stabilized performance of amorphous silicon based devices
24934268	5246506	1991	80	SOLAREX CORP	Multi-junction photovoltaic device and fabrication method

Overall, the backward tracing element of the analysis suggests that SETO-funded and Other DOE-funded PV patents have had a strong influence on subsequent innovations associated with

the leading PV organizations. This influence can be seen both over time, and across these leading organizations.

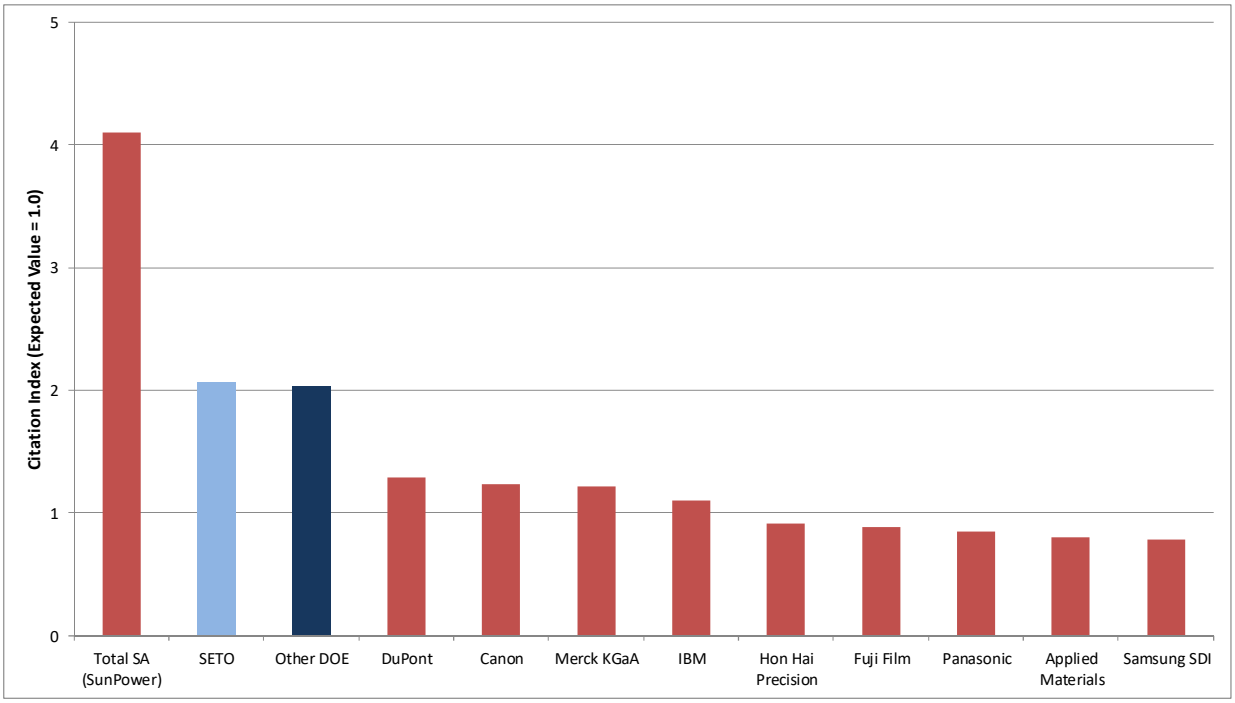
Tracing Forwards from DOE-funded PV Patents

The previous section of the report examines the influence of DOE-funded PV research upon technological developments associated with leading PV organizations. That analysis was based on tracing backwards from the patents of leading organizations to previous generations of research. This section reports the results of an analysis tracing in the opposite direction – starting with SETO-funded (and Other DOE-funded) PV patents, and tracing forwards in time through two generations of citations. Hence, while the previous section of the report focuses on DOE's influence upon a specific patent set (i.e. patents owned by leading PV organizations), this section of the report focuses on the broader influence of DOE-funded PV research, both within and beyond the PV industry. Also, in order to avoid repeating earlier results, the forward tracing concentrates primarily on patents that are linked to DOE-funded PV research, but are not owned by leading PV organizations.

Organizational Level Results

We first generated Citation Indexes for the portfolios of SETO-funded and Other DOE-funded PV patents. For context, we then compared these Citation Index values against those of the ten leading PV organizations. The results are shown in Figure 18.

Figure 18 - Citation Index for Leading Companies' PV Patent Portfolios, plus SETO-funded and Other DOE-funded PV Patents



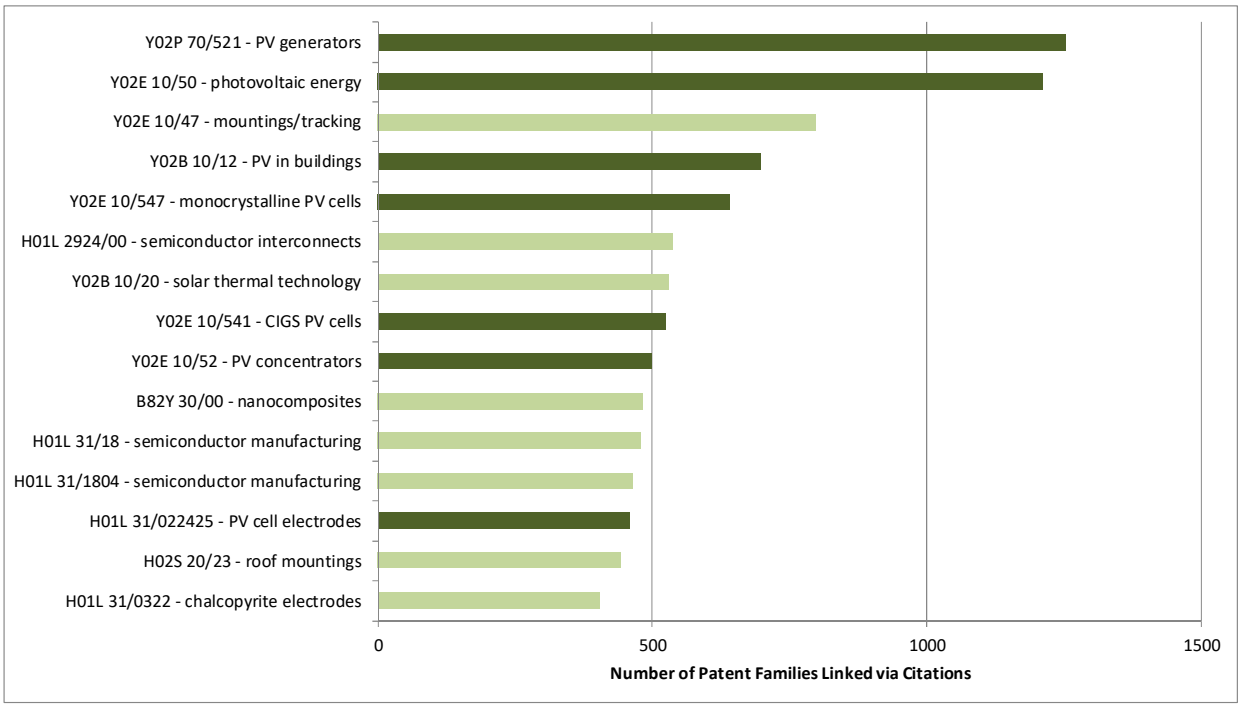
This figure reveals that SETO-funded PV patents have a Citation Index of 2.06, showing they have been cited more than twice as frequently as expected. The Citation Index for Other DOE-

funded PV patents is only slightly lower at 2.03, again meaning that these patents have been cited more than twice as frequently as expected. Overall, SETO ranks second in Figure 18, behind Total SA (SunPower), while Other DOE is third. The remaining leading PV companies all have Citation Index values below 1.3. This suggests that the portfolios of SETO-funded and Other DOE-funded PV patents are relatively high-impact compared to those of the leading companies in this technology.

The Citation Index measures the overall influence of the DOE-funded PV patent portfolios, but does not necessarily address the breadth of this influence across technologies. To analyze this question, we therefore identified the Cooperative Patent Classifications (CPCs) of the patent families linked via citations to earlier DOE-funded PV patent families.[15] These CPCs reflect the influence of DOE-funded research across technologies.

Figure 19 shows the CPCs with the largest number of patent families linked to SETO-funded PV patents. The CPCs in this figure are divided into two groups – those related to PV technology (shown in dark green) and those beyond PV technology (shown in light green). The former represent the influence of SETO-funded patents on PV technology itself, while the latter represent spillovers of the influence of SETO-funded PV research into other technology areas.

Figure 19 - Number of Patent Families Linked via Citations to Earlier SETO-Funded PV Patents by CPC (Dark Green = PV technology; Light Green = Other technology)



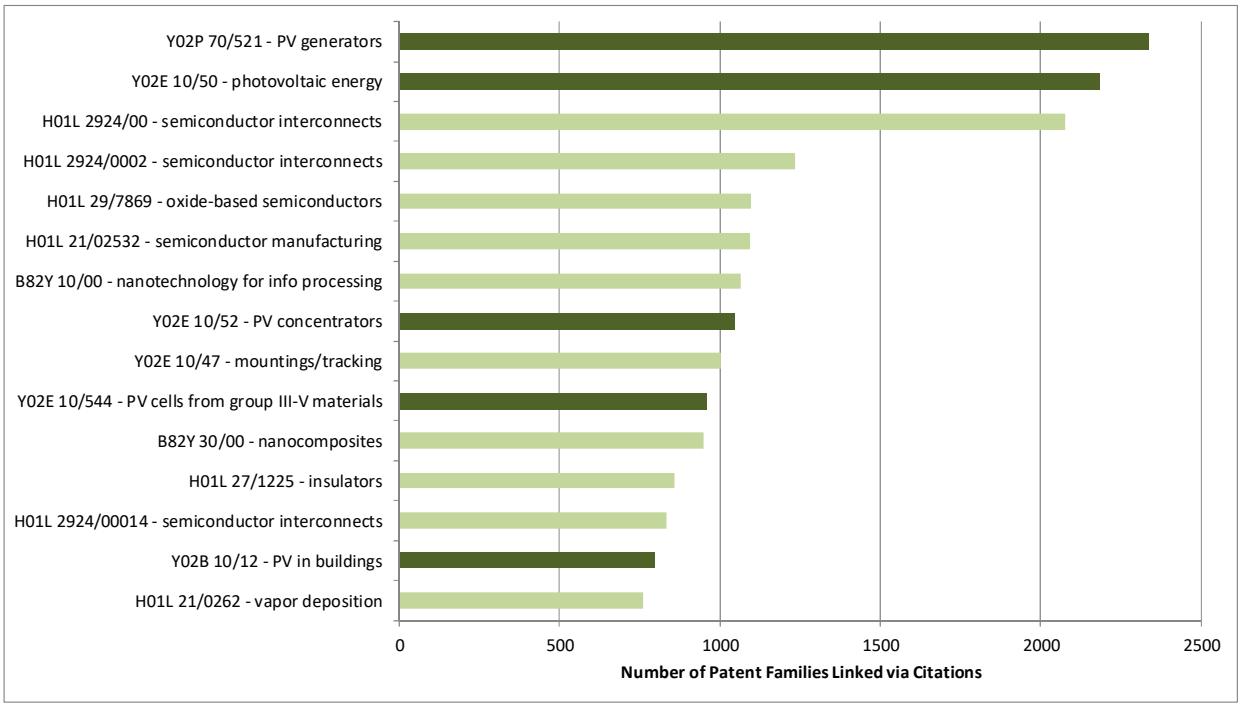
Almost half of the CPCs in Figure 19 are related to PV, showing the influence of SETO-funded research in this technology. These include CPCs directed to generic PV technology (Y02P

[15] Patents typically have numerous CPCs attached to them, reflecting different aspects of the invention they describe. In this analysis, we include all CPCs attached to the patents linked to earlier DOE-funded PV patent families.

70/521 and Y02E 10/50), plus CPCs related to monocrystalline PV cells (Y02E 10/547) and the application of PV in buildings (Y02B 10/12). There are also a number of CPCs in Figure 19 related to technologies beyond PV. These include CPCs connected to solar thermal technology (Y02E 10/47 and Y02B 10/20), semiconductors (H01L 2924/00 and H01L 31/18) and nanomaterials (B82Y 30/00). This reflects how SETO-funded PV research has influenced developments in other related technologies.

Figure 20 is similar to Figure 19, but is based on patent families linked to Other DOE-funded PV patents, rather than SETO-funded PV patents. This figure is headed by the same CPCs related to generic PV technology (Y02P 70/521 and Y02E 10/50) that are also at the top of Figure 19. Beyond these two CPCs, the remainder of Figure 20 has less of a PV focus. In particular there are numerous CPCs related to semiconductors (e.g. H01L 2924/00 and H01L 2924/0002) and nanomaterials (e.g. B82Y 10/00 and B82Y 20/30). This suggests that much of the influence of Other DOE-funded PV research has been beyond PV technology (keeping in mind that some of this Other DOE-funded research may in fact have been SETO-funded).

Figure 20 - Number of Patent Families Linked via Citations to Earlier Other DOE-Funded PV Patents by CPC (Dark Green = PV technology; Light Green = Other technology)



The organizations with the largest number of patent families linked to earlier SETO-funded PV patents are shown in Figure 21. To avoid repeating the results from earlier, this figure excludes the ten leading PV organizations used in the backward tracing element of the analysis. Also, note that Figure 21 includes all patent families assigned to the organizations listed within it, not just their patent families describing PV technology. A wide range of organizations appear in this figure. These include specialist PV companies such as First Solar, semiconductor companies including Semiconductor Energy Lab and Micron, plus multinationals such as Samsung, General Electric and Corning. This reflects the influence of SETO-funded PV research on innovations developed by many different types of organization.

Figure 21 - Organizations with Largest Number of Patent Families Linked via Citations to SETO-funded PV Patents (excluding top 10 PV companies)

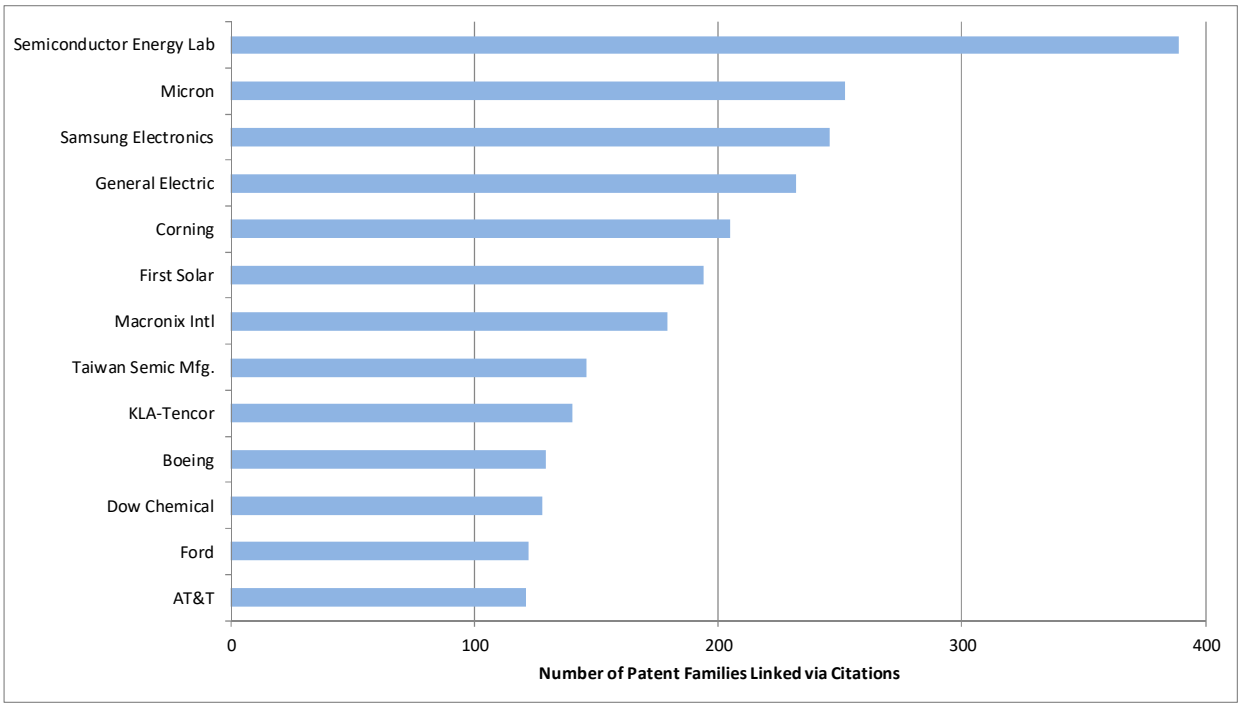
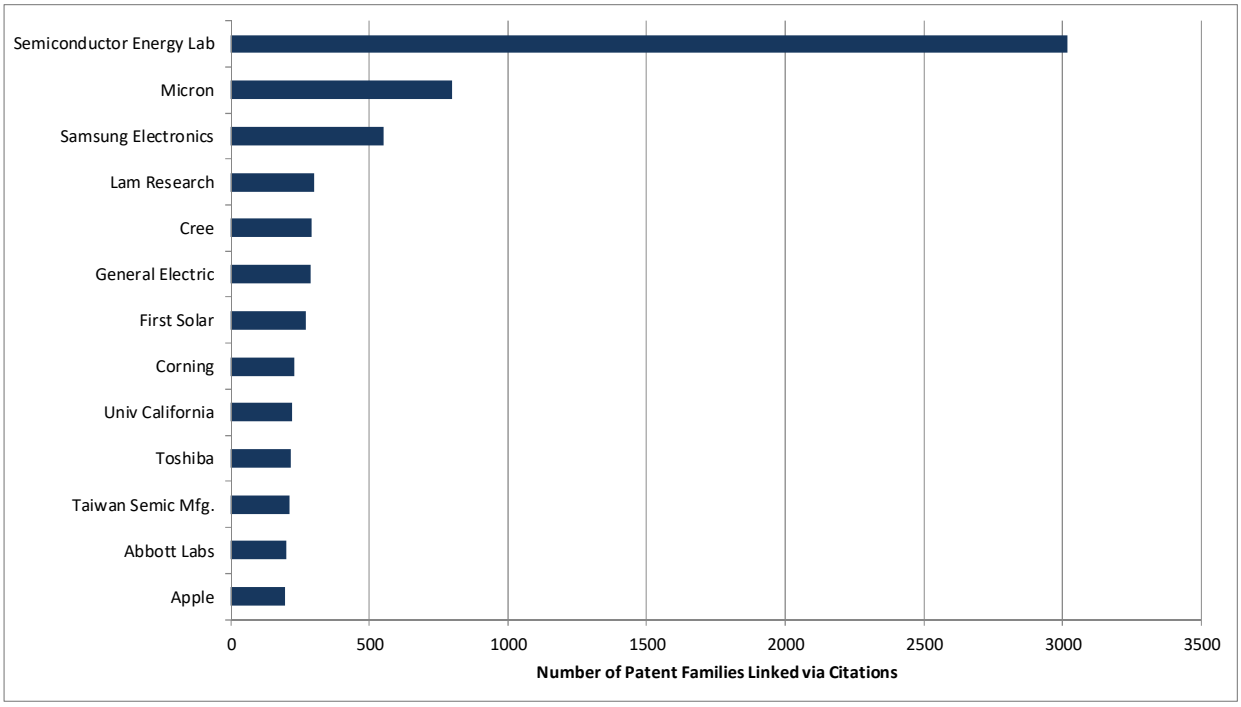


Figure 22 shows the organizations with the largest number of patent families linked to earlier Other DOE-funded PV patents (excluding the top 10 PV organizations).

Figure 22 - Organizations with Largest Number of Patent Families Linked via Citations to Other DOE-funded PV Patents (excluding top 10 PV companies)



This figure is dominated by semiconductor companies, in particular Semiconductor Energy Lab, which has almost four times as many patent families linked to Other DOE-funded PV patents as any other company. Other semiconductor companies in Figure 22 include Micron, Lam Research and Taiwan Semiconductor. The figure also includes the PV company First Solar, lighting company Cree and electronics and technology companies Samsung, Toshiba and Apple.

Patent Level Results

This section of the report drills down to identify individual DOE-funded (and particularly SETO-funded) PV patents whose influence on subsequent technological developments has been particularly strong. Looking in the opposite direction, it also highlights patents that have extensive citation links to earlier SETO-funded PV research.

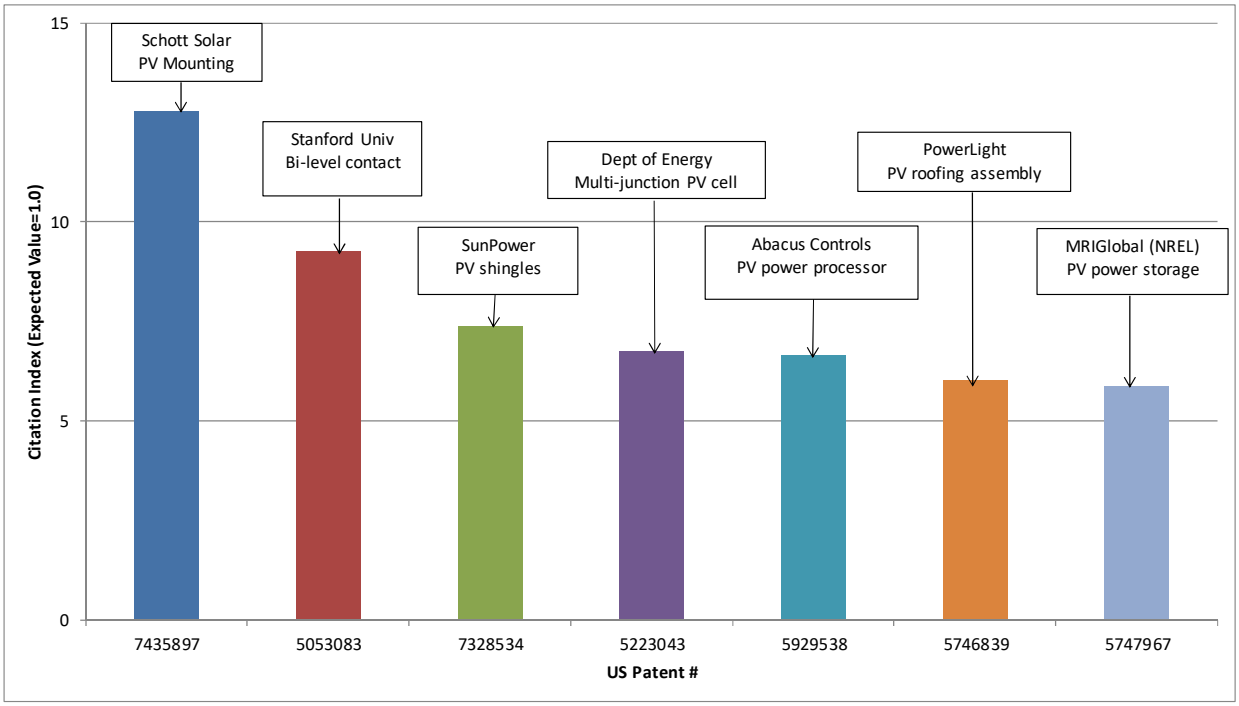
The simplest way of identifying high-impact SETO-funded PV patents is through overall Citation Indexes. The SETO-funded patents with the highest Citation Index values are shown in Table 9, with details of selected patents also presented in Figure 23.

Table 9 – List of Highly Cited SETO-Funded PV Patents

Patent #	Issue Year	# Cites Received	Citation Index	Assignee	Title
7435897	2008	149	12.80	Schott Solar	Apparatus and method for mounting photovoltaic power generating systems on buildings
5053083	1991	196	9.28	Stanford Univ	Bilevel contact solar cells
7328534	2008	118	7.38	SunPower Corp	Shingle system
5223043	1993	158	6.75	US Dept Energy	Current-matched high-efficiency, multijunction monolithic solar cells
5929538	1999	163	6.64	Abacus Controls	Multimode power processor
5746839	1998	170	6.03	Powerlight Corp	Lightweight, self-ballasting photovoltaic roofing assembly
5747967	1998	218	5.90	MRIGlobal (NREL)	Apparatus and method for maximizing power delivered by a photovoltaic array
6750391	2004	183	5.39	Sandia Corp	Alternating current photovoltaic building block
6114046	2000	100	5.26	Evergreen Solar	Encapsulant material for solar cell module and laminated glass applications
6126740	2000	115	5.22	MRIGlobal (NREL)	Solution synthesis of mixed-metal chalcogenide nanoparticles and spray deposition of precursor films
6055089	2000	132	4.66	3M	Photovoltaic powering and control system for electrochromic windows
6061978	2000	127	4.64	Powerlight Corp	Vented cavity radiant barrier assembly and method
5436204	1995	150	4.52	MRIGlobal (NREL)	Recrystallization method to selenization of thin-film CuInGaSe2 for semiconductor device applications
5342453	1994	107	4.23	MRIGlobal (NREL)	Heterojunction solar cell
6809251	2004	126	4.17	Powerlight Corp	Inclined photovoltaic assembly
5441897	1995	137	4.12	MRIGlobal (NREL)	Method of fabricating high-efficiency CuInGaSe2 thin films for solar cells
5376185	1994	104	4.12	MRIGlobal (NREL)	Single junction solar cells with the optimum band gap for terrestrial concentrator applications

The patents in this table are a mix of older patents that have received large numbers of citations from subsequent generations of patents, and more recent patents that have attracted more citations than expected. One advantage of using Citation Indexes is that these two groups of patents can be compared directly, since each is benchmarked against peer patents of the same age and technology.

Figure 23 – Examples of Highly-Cited SETO-funded PV Patents



The patent at the head of Table 9 (US #7,435,897) is a Schott Solar patent describing apparatus for mounting PV systems on buildings. It has been cited by 149 subsequent patents, which is more than twelve times as many citations as expected for a patent from its issue year and patent classification. The second patent in Table 9 (US #5,053,083) is the Stanford bi-level solar cell patent discussed earlier in the backward tracing element of the analysis. This patent has been cited by 196 subsequent patents, which is more than nine times as many citations as expected.

Table 9 also contains highly-cited patents SETO-funded PV patents assigned to a range of other organizations. They include companies such as SunPower, Abacus Controls, PowerLight and 3M, and also DOE lab managers, notably MRIGlobal (NREL) and Sandia. These highly-cited patents cover a range of PV technologies, all the way from PV materials, to solar cell fabrication, to solar panel installation. This reflects the breadth of PV research funded by SETO.

The Citation Indexes in Table 9 are based on a single generation of citations to SETO-funded PV patents. Tables 10 and 11 extend this by examining a second generation of citations – i.e. they show the SETO-funded PV patents linked directly or indirectly to the largest number of subsequent patent families.[16] These subsequent families are divided into two groups, according

[16] The SETO-funded patent families are divided into two tables based on their age, since older patents tend to be connected to larger numbers of subsequent patents, simply because there has been more time for them to become linked to future generations of technology.

to whether they are within or beyond PV technology. This provides insights into which SETO-funded patent families have been particularly influential within PV technology, and which have had a broader impact beyond PV.

Table 10 contains older SETO-funded PV patent families (i.e. with priority dates prior to 2000) linked via citations to the largest number of subsequent patent families. The patent family at the head of this table (representative patent US #5,929,538) is assigned to Abacus Controls (which was subsequently acquired by Myers Power Products). This patent family differs in focus from many of the families in this analysis, as it describes an electric power processor that can be used in conjunction with a PV array. It is linked to 1,252 subsequent patent families, only 166 of which are within PV technology.

Table 10 - Pre-2000 SETO-funded PV Patent Families Linked via Citations to Largest Number of Subsequent PV/Other Patent Families

Family #	Priority Year	Rep. Patent #	# Linked Families	# Linked PV Families	Assignee	Title
25384355	1997	5929538	1252	166	Abacus Controls	Multimode power processor
23367734	1989	5053083	1191	839	Stanford Univ	Bilevel contact solar cells
24423306	1996	5747967	1096	523	MRIGlobal (NREL)	Apparatus and method for maximizing power delivered by a photovoltaic array
24929053	1985	4642140	1058	367	US Dept Energy	Process for producing chalcogenide semiconductors
24521389	1996	5746839	1028	735	Powerlight Corp	Lightweight, self-ballasting photovoltaic roofing assembly
24138149	1995	5711803	925	218	MRIGlobal (NREL)	Preparation of a semiconductor thin film
22952165	1988	4963949	917	187	US Dept Energy	Substrate structures for inp-based devices
21764810	1995	6126740	873	225	MRIGlobal (NREL)	Solution synthesis of mixed-metal chalcogenide nanoparticles and spray deposition of precursor films
25464833	1992	5304509	871	155	MRIGlobal (NREL)	Back-side hydrogenation technique for defect passivation in silicon solar cells
27486847	1997	6061978	860	568	Powerlight Corp	Vented cavity radiant barrier assembly and method
23130761	1993	5436204	776	539	MRIGlobal (NREL)	Recrystallization method to selenization of thin-film CuInGaSe2 for semiconductor device applications
25519401	1992	5384653	712	64	MRIGlobal (NREL)	Stand-alone photovoltaic (PV) powered electrochromic window
22088767	1993	5456205	648	29	MRIGlobal (NREL)	System for monitoring the growth of crystalline films on stationary substrates

The fact that much of the influence of the Abacus Controls patent family can be seen outside PV technology is not particularly surprising. Its primary focus is on handling the output from PV cells, rather than detailing the contents of the cells themselves. There are also other patent families in Table 10 with extensive links outside PV technology. They include an MRIGlobal (NREL) patent family (representative patent #5,384,653) describing energy-saving PV-powered windows, plus a patent family assigned to DOE itself related to InP-based semiconductor substrates (representative patent #4,963,949). These are examples of SETO-funded PV research influencing developments beyond PV.

In contrast, a number of the other SETO-funded patent families in Table 10 have much more extensive links within PV technology. These include the Stanford bi-level solar cell patent family referred to earlier (representative patent US #5,053,083) and a PowerLight patent family (representative patent US #5,746,839) describing a lightweight PV roofing assembly. Both of these patent families are linked to over 1,000 subsequent families, over 70% of which are related to PV. This suggests that these SETO-funded patent families have had a strong influence on developments in PV technology.

Table 11 contains newer SETO-funded patent families, with priority dates from 2000 on. That said, these families are still relatively old, dating from the very start of this century.

Table 11 - Post-1999 SETO-funded PV Patent Families Linked via Citations to Largest Number of Subsequent PV/Other Patent Families

Family #	Priority Year	Rep. Patent #	# Linked Families	# Linked PV Families	Assignee	Title
23312763	2001	6750391	1029	455	Sandia Corp	Alternating current photovoltaic building block
25415919	2001	6534703	650	490	Powerlight Corp	Multi-position photovoltaic assembly
25415936	2001	6570084	630	461	Powerlight Corp	Pressure equalizing photovoltaic assembly and method
25415901	2001	6495750	530	392	Powerlight Corp	Stabilized PV system
29250703	2002	7435897	504	350	Schott Solar	Apparatus and method for mounting photovoltaic power generating systems on buildings
29711044	2002	6660930	368	180	Schott Solar	Solar cell modules with improved backskin
26927561	2000	6784361	288	156	BP Corp	Amorphous silicon photovoltaic devices
27732936	2002	6883290	285	193	Powerlight Corp	Shingle system and method
27732937	2002	7328534	268	219	Sunpower Corp	Shingle system
27732939	2002	7178295	265	174	Powerlight Corp	Shingle assembly
25475715	2001	6583350	177	28	Sandia Corp	Thermophotovoltaic energy conversion using photonic bandgap selective emitters
24240779	2000	6421966	174	86	Kawneer Co	Sunshade for building exteriors
33540074	2003	7170001	173	157	Advent Solar	Fabrication of back contacted silicon solar cells using thermomigration

The patent family at the head of this table (representative patent #US 6,750,391) is assigned to Sandia and describes a modular PV system. It is linked via citations to over 1,000 subsequent patent families, almost half of them related to PV technology. The next three patent families in Table 11 are all assigned to PowerLight (e.g. representative patent US #6534703), and describe solar module assembly and installation. Most of the subsequent patent families linked to these PowerLight families are related to PV, suggesting that much of their influence has been within PV technology. The same is true for most of the patent families listed in Table 11, suggesting that the influence of more recent SETO-funded patents has been particularly strong within PV technology.

The tables above identify SETO-funded patent families linked particularly strongly to subsequent technological developments. Table 12 looks in the opposite direction, and identifies highly-cited patents linked via citations to earlier SETO-funded PV patents. As such, these are examples where SETO-funded PV research has formed part of the foundation for subsequent high-impact technologies, many of them outside PV. This table focuses on patent families not owned by the leading PV organizations, since those families were examined in the backward tracing element of the analysis.

Table 12 - Highly Cited Patents (not from leading PV companies) Linked via Citations to Earlier SETO-funded PV Patents

Patent #	Issue Year	# Cites Received	Citation Index	Assignee	Title
5707745	1998	1021	34.40	Princeton University	Multicolor organic light emitting devices
7054513	2006	428	26.00	Virginia Tech / Lambda Inst.	Optical fiber with quantum dots
8019567	2011	217	23.79	EcoFactor Inc	System and method for evaluating changes in the efficiency of an HVAC system
6818530	2004	459	22.08	Seiko Epson Corporation	Exfoliating method, transferring method of thin film device, and thin film device
6957608	2005	128	21.32	Thin Film Elect	Contact print methods
6501111	2002	419	20.01	Intel Corporation	Three-dimensional (3D) programmable device
7910993	2011	134	19.31	Murata Manufacturing	Method and apparatus for use in improving linearity of MOSFET's using an accumulated charge sink
7674687	2010	127	18.19	Silicon Genesis Corporation	Method and structure for fabricating multiple tiled regions onto a plate using a controlled cleaving process
6710366	2004	359	17.99	Ultradots Inc	Nanocomposite materials with engineered properties
7605498	2009	203	17.56	Ampt LLC	Systems for highly efficient solar power conversion

The highly-cited patents in Table 12 cover a wide range of technologies. The most highly-cited patent (US #5,707,745) is assigned to Princeton University and describes an organic LED (OLED) device. This patent has been cited by more than 1,000 subsequent patents, over 30 times as many citations as expected. There are also patents in Table 12 for optical fibers, nanomaterials, semiconductors, along with an Ampt patent for solar power conversion. A number of these patents are relatively recent, showing how SETO-funded PV research has influenced recent developments across a range of technologies.

As with the backward tracing element of the analysis, the patent-level results from the forward tracing focus on SETO-funded PV patents. However, within the forward tracing we did also identify Other DOE-funded PV patent families linked to the largest number of subsequent patent families within and beyond PV technology. These Other DOE-funded PV families are shown in Table 13.

Table 13 - Other DOE-funded PV Patent Families Linked via Citations to Largest Number of Subsequent PV/Other Patent Families

Family #	Priority Year	Rep. Patent #	# Linked Families	# Linked PV Families	Assignee	Title
25478736	1997	6268014	2768	422	NANOSOLAR	Method for forming solar cell materials from particulars
26960448	2001	6882051	2600	404	UNIV CALIFORNIA	Nanowires, nanostructures and devices fabricated therefrom
22558022	1980	4292092	1649	920	RCA CORP	Laser processing technique for fabricating solar cells
26759603	1987	4891330	1400	100	ENERGY CONV DEVICES	Method of fabricating microcrystalline semiconductor material
25378967	1992	5248349	1339	673	SOLAR CELLS INC	Process for making photovoltaic devices and resultant product
26856229	1980	4379020	1279	123	MIT	Polycrystalline semiconductor processing
22139684	1987	4775425	1119	227	ENERGY CONV DEVICES	P and n-type microcrystalline semiconductor alloy material
26916111	1980	4392451	1037	416	BOEING	Apparatus for forming thin-film heterojunction solar cells
27005714	1989	5078804	969	765	BOEING	I-III-VI2 based solar cell
26707276	1979	4272641	906	689	RCA CORP	Tandem junction amorphous silicon solar cells
22360587	1998	6077722	900	595	BP CORP	Producing thin film photovoltaic modules with high integrity interconnects and dual layer contacts
22812580	1994	5646050	879	368	AMOCO ENRON SOLAR	Increasing stabilized performance of amorphous silicon based devices produced by highly hydrogen diluted lower temperature plasma deposition
24694430	1996	5741370	789	613	EVERGREEN SOLAR	Solar cell modules with improved backskin and methods for forming same

The patent family at the head of Table 13 (representative patent US #6,268,014) is assigned to Nanosolar and describes a process for forming films designed for use in PV cells. It is linked to over 2,700 subsequent patent families, many of which are outside PV technology. The second patent family in this table (representative patent US #6,882,051) is assigned to the University of California, and was funded by both DOE and NSF. It describes nanowires, one of the applications for which is in PV cells, and is linked to 2,600 subsequent patent families, many

from outside PV technology. These are examples of patents describing technologies – thin films, nanomaterials – with applications in PV, but also in many other technologies, so it is not surprising that their influence is not restricted to PV technology. This is also true for a number of other patent families in Table 13, although the table does also include patents whose influence is much more focused within PV. These include RCA and Evergreen Solar patents for fabricating solar cells, a Boeing patent for CIGS cells, and a BP patent for a thin-film PV module.

Overall, the forward tracing element of the analysis shows that SETO-funded and Other DOE-funded PV research has had a strong influence on subsequent technologies. This influence can be seen both within PV technology, and in other technologies such as semiconductors, nanomaterials, optics and displays.

5.0 Conclusions

This report describes the results of an analysis tracing links between PV research funded by DOE (SETO plus Other DOE) and subsequent developments both within and beyond PV technology. This tracing is carried out both backwards and forwards in time. The purpose of the backward tracing is to determine the extent to which DOE-funded research forms a foundation for innovations developed by leading PV organizations. The purpose of the forward tracing is to examine the influence of DOE-funded PV patents upon subsequent developments, both within and outside PV technology.

The backward tracing element of the analysis shows that SETO-funded and Other DOE-funded PV patents have had a strong influence on subsequent innovations associated with the leading PV organizations. This influence can be seen both over time, and across these leading organizations. Meanwhile, the forward tracing shows that DOE-funded PV patents have had a strong influence on subsequent generations of patents. This influence can be seen both within PV technology, and in other technologies, notably semiconductors and nanomaterials.

Overall, the analysis presented in this report reveals that PV research funded by SETO, and by DOE in general, has had a significant influence on subsequent developments, both within and beyond PV technology. This influence can be seen on innovations associated with the leading PV organizations, plus innovations associated with large companies across a range of other technologies.

Appendix A. SETO-Funded PV Patents Used in the Analysis

Patent #	Application Year	Issue / Publication Year	Original Assignees	Title
4642140	1985	1987	US DEPT OF ENERGY	PROCESS FOR PRODUCING CHALCOGENIDE SEMICONDUCTORS
4650541	1984	1987	US DEPT OF ENERGY	APPARATUS AND METHOD FOR THE HORIZONTAL, CRUCIBLE-FREE GROWTH OF SILICON SHEET CRYSTALS
4652332	1984	1987	US DEPT OF ENERGY	METHOD OF SYNTHESIZING AND GROWING COPPER-INDIUM-DISELENIDE (CUINSE2) CRYSTALS
4667059	1985	1987	US DEPT OF ENERGY	CURRENT AND LATTICE MATCHED TANDEM SOLAR CELL
4691075	1985	1987	US DEPT OF ENERGY	ENERGY CONVERSION SYSTEM
4963949	1988	1990	US DEPT OF ENERGY	SUBSTRATE STRUCTURES FOR INP-BASED DEVICES
5019177	1989	1991	US DEPT OF ENERGY	MONOLITHIC TANDEM SOLAR CELL
5047112	1990	1991	US DEPT OF ENERGY	METHOD FOR PREPARING HOMOGENEOUS SINGLE CRYSTAL TERNARY III-V ALLOYS
5053083	1989	1991	STANFORD UNIV	BILEVEL CONTACT SOLAR CELLS
5223043	1992	1993	US DEPT OF ENERGY	CURRENT-MATCHED HIGH-EFFICIENCY, MULTIJUNCTION MONOLITHIC SOLAR CELLS
5223453	1991	1993	US DEPT OF ENERGY	CONTROLLED METAL-SEMICONDUCTOR SINTERING/ALLOYING BY ONE-DIRECTIONAL REVERSE ILLUMINATION
WO1993023591	1993	1993	MIDWEST RESEARCH INSTITUTE	CRYSTALLIZATION FROM HIGH-TEMPERATURE SOLUTIONS OF SI IN COPPER
5304509	1992	1994	MIDWEST RESEARCH INSTITUTE	BACK-SIDE HYDROGENATION TECHNIQUE FOR DEFECT PASSIVATION IN SILICON SOLAR CELLS
5314571	1992	1994	MIDWEST RESEARCH INSTITUTE	CRYSTALLIZATION FROM HIGH TEMPERATURE SOLUTIONS OF SI IN COPPER
5316593	1992	1994	MIDWEST RESEARCH INSTITUTE	HETEROJUNCTION SOLAR CELL WITH PASSIVATED EMITTER SURFACE
5322572	1991	1994	US DEPT OF ENERGY	MONOLITHIC TANDEM SOLAR CELL
5342453	1992	1994	MIDWEST RESEARCH INSTITUTE	HETEROJUNCTION SOLAR CELL
5356839	1993	1994	MIDWEST RESEARCH INSTITUTE	ENHANCED QUALITY THIN FILM CU(IN,GA)SE.SUB.2 FOR SEMICONDUCTOR DEVICE

				APPLICATIONS BY VAPOR-PHASE RECRYSTALLIZATION
5358574	1993	1994	MIDWEST RESEARCH INSTITUTE	DRY TEXTURING OF SOLAR CELLS
5376185	1993	1994	MIDWEST RESEARCH INSTITUTE	SINGLE-JUNCTION SOLAR CELLS WITH THE OPTIMUM BAND GAP FOR TERRESTRIAL CONCENTRATOR APPLICATIONS
5377037	1992	1994	MIDWEST RESEARCH INSTITUTE	ELECTROCHROMIC-PHOTOVOLTAIC FILM FOR LIGHT-SENSITIVE CONTROL OF OPTICAL TRANSMITTANCE
WO1994005036	1993	1994	MIDWEST RESEARCH INSTITUTE	IMPROVED BACK-SIDE HYDROGENATION TECHNIQUE FOR DEFECT PASSIVATION IN SILICON SOLAR CELLS
WO1994011777	1993	1994	MIDWEST RESEARCH INSTITUTE	ELECTROCHROMIC-PHOTOVOLTAIC FILM FOR LIGHT-SENSITIVE CONTROL OF OPTICAL TRANSMITTANCE
WO1994011778	1993	1994	MIDWEST RESEARCH INSTITUTE	STAND-ALONE PHOTOVOLTAIC (PV) POWERED ELECTROCHROMIC WINDOW
WO1994011905	1993	1994	MIDWEST RESEARCH INSTITUTE	HETEROJUNCTION SOLAR CELL
WO1994011906	1993	1994	MIDWEST RESEARCH INSTITUTE	HETEROJUNCTION SOLAR CELL WITH PASSIVATED EMITTER SURFACE
WO1994024696	1994	1994	MIDWEST RESEARCH INSTITUTE	ENHANCED QUALITY THIN FILM CU(IN,GA)SE2 FOR SEMICONDUCTOR DEVICE APPLICATIONS BY VAPOR-PHASE RECRYSTALLIZATION
WO1994027136	1994	1994	MIDWEST RESEARCH INSTITUTE	IMPROVED DEFECT MAPPING SYSTEM
5384653	1992	1995	MIDWEST RESEARCH INSTITUTE	STAND-ALONE PHOTOVOLTAIC (PV) POWERED ELECTROCHROMIC WINDOW
5396332	1993	1995	MIDWEST RESEARCH INSTITUTE	APPARATUS AND METHOD FOR MEASURING THE THICKNESS OF A SEMICONDUCTOR WAFER
5397737	1994	1995	US DEPT OF ENERGY	DEPOSITION OF DEVICE QUALITY LOW H CONTENT, AMORPHOUS SILICON FILMS
5401331	1993	1995	MIDWEST RESEARCH INSTITUTE	SUBSTRATE FOR THIN SILICON SOLAR CELLS
5406367	1993	1995	MIDWEST RESEARCH INSTITUTE	DEFECT MAPPING SYSTEM
5426061	1994	1995	MIDWEST RESEARCH INSTITUTE	IMPURITY GETTERING IN SEMICONDUCTORS

5429985	1994	1995	MIDWEST RESEARCH INSTITUTE	FABRICATION OF OPTICALLY REFLECTING OHMIC CONTACTS FOR SEMICONDUCTOR DEVICES
5436204	1994	1995	MIDWEST RESEARCH INSTITUTE	RECRYSTALLIZATION METHOD TO SELENIZATION OF THIN-FILM CU(IN,GA)SE.SUB.2 FOR SEMICONDUCTOR DEVICE APPLICATIONS
5441897	1994	1995	MIDWEST RESEARCH INSTITUTE	METHOD OF FABRICATING HIGH-EFFICIENCY CU(IN,GA)(SES).SUB.2 THIN FILMS FOR SOLAR CELLS
5456205	1993	1995	MIDWEST RESEARCH INSTITUTE	SYSTEM FOR MONITORING THE GROWTH OF CRYSTALLINE FILMS ON STATIONARY SUBSTRATES
EP0656149	1993	1995	MIDWEST RESEARCH INSTITUTE	IMPROVED BACK-SIDE HYDROGENATION TECHNIQUE FOR DEFECT PASSIVATION IN SILICON SOLAR CELLS.
EP0669012	1993	1995	MIDWEST RESEARCH INSTITUTE	STAND-ALONE PHOTOVOLTAIC (PV) POWERED ELECTROCHROMIC WINDOW.
WO1995007549	1994	1995	MIDWEST RESEARCH INSTITUTE	SUBSTRATE FOR THIN SILICON SOLAR CELLS
WO1995015010	1994	1995	MIDWEST RESEARCH INSTITUTE	DRY TEXTURING OF SOLAR CELLS
WO1995019641	1995	1995	MIDWEST RESEARCH INSTITUTE	FABRICATION OF OPTICALLY REFLECTING OHMIC CONTACTS FOR SEMICONDUCTOR DEVICES
5484736	1994	1996	MIDWEST RESEARCH INSTITUTE	PROCESS FOR PRODUCING LARGE GRAIN CADMIUM TELLURIDE
5487792	1994	1996	MIDWEST RESEARCH INSTITUTE	MOLECULAR ASSEMBLIES AS PROTECTIVE BARRIERS AND ADHESION PROMOTION INTERLAYER
5541118	1995	1996	MIDWEST RESEARCH INSTITUTE	PROCESS FOR PRODUCING CADMIUM SULFIDE ON A CADMIUM TELLURIDE SURFACE
5544616	1994	1996	MIDWEST RESEARCH INSTITUTE	CRYSTALLIZATION FROM HIGH TEMPERATURE SOLUTIONS OF SI IN CU/AL SOLVENT
5581346	1994	1996	MIDWEST RESEARCH INSTITUTE	SYSTEM FOR CHARACTERIZING SEMICONDUCTOR MATERIALS AND PHOTOVOLTAIC DEVICE
5588995	1995	1996	MIDWEST RESEARCH INSTITUTE	SYSTEM FOR MONITORING THE GROWTH OF CRYSTALLINE FILMS ON STATIONARY SUBSTRATES
EP0694209	1994	1996	MIDWEST RESEARCH INSTITUTE	ENHANCED QUALITY THIN FILM CU(IN,GA)SE 2 FOR SEMICONDUCTOR DEVICE APPLICATIONS BY VAPOR-PHASE RECRYSTALLIZATION
EP0700512	1994	1996	MIDWEST RESEARCH	IMPROVED DEFECT MAPPING SYSTEM

			INSTITUTE	
EP0724775	1995	1996	MIDWEST RESEARCH INSTITUTE	RECRYSTALLIZATION METHOD TO SELENIZATION OF THIN-FILM CU(IN,GA)SE2 FOR SEMICONDUCTOR DEVICE APPLICATIONS
WO1996006454	1995	1996	MIDWEST RESEARCH INSTITUTE	RECRYSTALLIZATION METHOD TO SELENIZATION OF THIN-FILM CU(IN,GA)SE2 FOR SEMICONDUCTOR DEVICE APPLICATIONS
WO1996009900	1995	1996	MIDWEST RESEARCH INSTITUTE	APPLICATION OF OPTICAL PROCESSING FOR GROWTH OF SILICON DIOXIDE
WO1996010171	1995	1996	MIDWEST RESEARCH INSTITUTE	SYSTEM FOR CHARACTERIZING SEMICONDUCTOR MATERIALS AND PHOTOVOLTAIC DEVICES
WO1996025768	1995	1996	MIDWEST RESEARCH INSTITUTE	METHOD OF FABRICATING HIGH-EFFICIENCY CU(IN,GA)(SE,S)2 THIN FILMS FOR SOLAR CELLS
5620904	1996	1997	EVERGREEN SOLAR INC	METHODS FOR FORMING WRAPAROUND ELECTRICAL CONTACTS ON SOLAR CELLS
5627081	1994	1997	MIDWEST RESEARCH INSTITUTE	METHOD FOR PROCESSING SILICON SOLAR CELLS
5639520	1996	1997	MIDWEST RESEARCH INSTITUTE	APPLICATION OF OPTICAL PROCESSING FOR GROWTH OF SILICON DIOXIDE
WO1997012082	1996	1997	MIDWEST RESEARCH INSTITUTE	PREPARATION OF A SEMICONDUCTOR THIN FILM
WO1997023004	1996	1997	MIDWEST RESEARCH INSTITUTE	PRODUCTION OF FILMS AND POWDERS FOR SEMICONDUCTOR DEVICE APPLICATIONS
WO1997034325	1997	1997	EVERGREEN SOLAR INC	METHODS FOR FORMING WRAPAROUND ELECTRICAL CONTACTS ON SOLAR CELLS
WO1997038185	1997	1997	POWERLIGHT CORP	LIGHTWEIGHT, SELF-BALLASTING PHOTOVOLTAIC ROOFING ASSEMBLY
5711803	1995	1998	MIDWEST RESEARCH INSTITUTE	PREPARATION OF A SEMICONDUCTOR THIN FILM
5712187	1995	1998	MIDWEST RESEARCH INSTITUTE	VARIABLE TEMPERATURE SEMICONDUCTOR FILM DEPOSITION
5731031	1995	1998	MIDWEST RESEARCH INSTITUTE	PRODUCTION OF FILMS AND POWDERS FOR SEMICONDUCTOR DEVICE APPLICATIONS
5746839	1996	1998	POWERLIGHT CORP	LIGHTWEIGHT, SELF-BALLASTING PHOTOVOLTAIC ROOFING ASSEMBLY
5747967	1996	1998	MIDWEST RESEARCH INSTITUTE	APPARATUS AND METHOD FOR MAXIMIZING POWER DELIVERED BY A PHOTOVOLTAIC ARRAY

5757474	1995	1998	MIDWEST RESEARCH INSTITUTE	SYSTEM FOR CHARACTERIZING SEMICONDUCTOR MATERIALS AND PHOTOVOLTAIC DEVICES THROUGH CALIBRATION
5776819	1994	1998	MIDWEST RESEARCH INSTITUTE	DEPOSITION OF DEVICE QUALITY, LOW HYDROGEN CONTENT, AMORPHOUS SILICON FILMS BY HOT FILAMENT TECHNIQUE USING "SAFE" SILICON SOURCE GAS
5779877	1997	1998	DRINKARD METALOX INC	RECYCLING OF CIS PHOTOVOLTAIC WASTE
5785769	1995	1998	MIDWEST RESEARCH INSTITUTE	SUBSTRATE FOR THIN SILICON SOLAR CELLS
5792280	1996	1998	SANDIA CORP	METHOD FOR FABRICATING SILICON CELLS
WO1998000856	1996	1998	MIDWEST RESEARCH INSTITUTE	VARIBLE TEMPERATURE SEMICONDUCTOR FILM DEPOSITION
WO1998047702	1997	1998	MIDWEST RESEARCH INSTITUTE	PHOTOVOLTAIC DEVICE AND ITS METHOD OF PREPARATION
WO1998053500	1998	1998	MIDWEST RESEARCH INSTITUTE	INTERDIGITATED PHOTOVOLTAIC POWER CONVERSION DEVICE
WO1998059122	1998	1998	POWERLIGHT CORP	VENTED CAVITY RADIANT BARRIER ASSEMBLY AND METHOD
5871591	1996	1999	SANDIA CORP	SILICON SOLAR CELLS MADE BY A SELF-ALIGNED, SELECTIVE-EMITTER, PLASMA-ETCHBACK PROCESS
5897331	1996	1999	MIDWEST RESEARCH INSTITUTE	HIGH EFFICIENCY LOW COST THIN FILM SILICON SOLAR CELL DESIGN AND METHOD FOR MAKING
5897685	1997	1999	DRINKARD METALOX INC	RECYCLING OF CDTE PHOTOVOLTAIC WASTE
5897715	1997	1999	MIDWEST RESEARCH INSTITUTE	INTERDIGITATED PHOTOVOLTAIC POWER CONVERSION DEVICE
5909632	1997	1999	MIDWEST RESEARCH INSTITUTE	USE OF SEPARATE ZNTE INTERFACE LAYERS TO FORM OHMIC CONTACTS TO P-CDTE FILMS
5922142	1996	1999	MIDWEST RESEARCH INSTITUTE	PHOTOVOLTAIC DEVICES COMPRISING CADMIUM STANNATE TRANSPARENT CONDUCTING FILMS AND METHOD FOR MAKING
5929538	1997	1999	ABACUS CONTROLS INC	MULTIMODE POWER PROCESSOR
5929652	1997	1999	MIDWEST RESEARCH INSTITUTE	APPARATUS FOR MEASURING MINORITY CARRIER LIFETIMES IN SEMICONDUCTOR MATERIALS
5948176	1997	1999	MIDWEST RESEARCH INSTITUTE	CADMIUM-FREE JUNCTION FABRICATION PROCESS FOR CUINSE.SUB.2 THIN FILM SOLAR CELLS
5951786	1997	1999	SANDIA CORP	LAMINATED PHOTOVOLTAIC

				MODULES USING BACK-CONTACT SOLAR CELLS
5972732	1997	1999	SANDIA CORP	METHOD OF MONOLITHIC MODULE ASSEMBLY
5976614	1998	1999	MIDWEST RESEARCH INSTITUTE	PREPARATION OF CUXINYGAZSEN PRECURSOR FILMS AND POWDERS BY ELECTROLESS DEPOSITION
5997718	1998	1999	DRINKARD METALOX INC	RECYCLING OF CDTE PHOTOVOLTAIC WASTE
EP0892877	1997	1999	POWERLIGHT CORP	LIGHTWEIGHT, SELF-BALLASTING PHOTOVOLTAIC ROOFING ASSEMBLY
EP0956599	1997	1999	EVERGREEN SOLAR INC	METHODS FOR FORMING WRAPAROUND ELECTRICAL CONTACTS ON SOLAR CELLS
WO1999004971	1998	1999	EVERGREEN SOLAR INC	ENCAPSULANT MATERIAL FOR SOLAR CELL MODULE AND LAMINATED GLASS APPLICATIONS
WO1999005206	1998	1999	EVERGREEN SOLAR INC	UV LIGHT STABILIZATION ADDITIVE PACKAGE FOR SOLAR CELL MODULE AND LAMINATED GLASS APPLICATIONS
WO1999012045	1998	1999	MIDWEST RESEARCH INSTITUTE	APPARATUS FOR MEASURING MINORITY CARRIER LIFETIMES IN SEMICONDUCTOR MATERIALS
WO1999017377	1998	1999	MIDWEST RESEARCH INSTITUTE	CADMIUM-FREE JUNCTION FABRICATION PROCESS FOR CUINSE2 THIN FILM SOLAR CELLS
WO1999017379	1998	1999	EVERGREEN SOLAR INC	METHODS FOR IMPROVING POLYMERIC MATERIALS FOR USE IN SOLAR CELL APPLICATIONS
WO1999037832	1999	1999	MIDWEST RESEARCH INSTITUTE	SOLUTION SYNTHESIS OF MIXED-METAL CHALCOGENIDE NANOPARTICLES AND SPRAY DEPOSITION OF PRECURSOR FILMS
6037758	1999	2000	STATE UNIV OF NEW YORK	LOAD CONTROLLER AND METHOD TO ENHANCE EFFECTIVE CAPACITY OF A PHOTOVOLTAIC POWER SUPPLY
6055089	1999	2000	3M CO	PHOTOVOLTAIC POWERING AND CONTROL SYSTEM FOR ELECTROCHROMIC WINDOWS
6061978	1998	2000	POWERLIGHT CORP	VENTED CAVITY RADIANT BARRIER ASSEMBLY AND METHOD
6063995	1998	2000	FIRST SOLAR LLC	RECYCLING SILICON PHOTOVOLTAIC MODULES
6091021	1998	2000	SANDIA CORP	SILICON CELLS MADE BY SELF-ALIGNED SELECTIVE-EMITTER PLASMA-ETCHBACK PROCESS
6114046	1997	2000	EVERGREEN SOLAR INC	ENCAPSULANT MATERIAL FOR SOLAR CELL MODULE AND LAMINATED GLASS APPLICATIONS
6124186	1998	2000	MIDWEST RESEARCH INSTITUTE	DEPOSITION OF DEVICE QUALITY, LOW HYDROGEN CONTENT, HYDROGENATED AMORPHOUS SILICON AT HIGH DEPOSITION

				RATES WITH INCREASED STABILITY USING THE HOT WIRE FILAMENT TECHNIQUE
6126740	1998	2000	MIDWEST RESEARCH INSTITUTE	SOLUTION SYNTHESIS OF MIXED-METAL CHALCOGENIDE NANOPARTICLES AND SPRAY DEPOSITION OF PRECURSOR FILMS
6137048	1998	2000	MIDWEST RESEARCH INSTITUTE	PROCESS FOR FABRICATING POLYCRYSTALLINE SEMICONDUCTOR THIN-FILM SOLAR CELLS, AND CELLS PRODUCED THEREBY
6139811	1999	2000	ASE AMERICAS INC	EFG CRYSTAL GROWTH APPARATUS
EP0991827	1998	2000	POWERLIGHT CORP	VENTED CAVITY RADIANT BARRIER ASSEMBLY AND METHOD
EP0998389	1998	2000	EVERGREEN SOLAR INC	ENCAPSULANT MATERIAL FOR SOLAR CELL MODULE AND LAMINATED GLASS APPLICATIONS
EP0998524	1998	2000	EVERGREEN SOLAR INC	UV LIGHT STABILIZATION ADDITIVE PACKAGE FOR SOLAR CELL MODULE AND LAMINATED GLASS APPLICATIONS
EP1010012	1998	2000	MIDWEST RESEARCH INSTITUTE	APPARATUS FOR MEASURING MINORITY CARRIER LIFETIMES IN SEMICONDUCTOR MATERIALS
EP1025594	1998	2000	EVERGREEN SOLAR INC	METHODS FOR IMPROVING POLYMERIC MATERIALS FOR USE IN SOLAR CELL APPLICATIONS
WO2000011726	1999	2000	UNITED SOLAR SYSTEMS CORP	METHOD FOR DEPOSITING LAYERS OF HIGH QUALITY SEMICONDUCTOR MATERIAL
WO2000014812	1999	2000	MIDWEST RESEARCH INSTITUTE	PHOTOVALTAIC DEVICES COMPRISING ZINC STANNATE BUFFER LAYER AND METHOD FOR MAKING
WO2000043573	2000	2000	MIDWEST RESEARCH INSTITUTE	PASSIVATING ETCHANTS FOR METALLIC PARTICLES
WO2000047343	2000	2000	FIRST SOLAR LLC	METHOD AND APPARATUS FOR ETCHING COATED SUBSTRATES
WO2000057980	2000	2000	ASE AMERICAS INC	EFG CRYSTAL GROWTH APPARATUS
WO2000060368	2000	2000	MIDWEST RESEARCH INSTITUTE	IMPROVED APPARATUS AND METHOD FOR MEASURING MINORITY CARRIER LIFETIMES IN SEMICONDUCTOR MATERIALS
WO2000067001	2000	2000	MIDWEST RESEARCH INSTITUTE	OPTICAL SYSTEM FOR DETERMINING PHYSICAL CHARACTERISTICS OF A SOLAR CELL
WO2000077837	2000	2000	MIDWEST RESEARCH INSTITUTE	PROCESS FOR POLYCRYSTALLINE SILICON FILM GROWTH AND APPARATUS FOR SAME
6169246	1998	2001	MIDWEST RESEARCH	PHOTOVOLTAIC DEVICES COMPRISING ZINC STANNATE

			INSTITUTE	BUFFER LAYER AND METHOD FOR MAKING
6187448	1998	2001	EVERGREEN SOLAR INC	ENCAPSULANT MATERIAL FOR SOLAR CELL MODULE AND LAMINATED GLASS APPLICATIONS
6201261	1998	2001	MIDWEST RESEARCH INSTITUTE	HIGH EFFICIENCY, LOW COST, THIN FILM SILICON SOLAR CELL DESIGN AND METHOD FOR MAKING
6221495	1996	2001	MIDWEST RESEARCH INSTITUTE	THIN TRANSPARENT CONDUCTING FILMS OF CADMIUM STANNATE
6239354	1999	2001	MIDWEST RESEARCH INSTITUTE	ELECTRICAL ISOLATION OF COMPONENT CELLS IN MONOLITHICALLY INTERCONNECTED MODULES
6251183	1999	2001	MIDWEST RESEARCH INSTITUTE	RAPID LOW-TEMPERATURE EPITAXIAL GROWTH USING A HOT-ELEMENT ASSISTED CHEMICAL VAPOR DEPOSITION PROCESS
6274461	1999	2001	UNITED SOLAR SYSTEMS CORP	METHOD FOR DEPOSITING LAYERS OF HIGH QUALITY SEMICONDUCTOR MATERIAL
6275060	1999	2001	MIDWEST RESEARCH INSTITUTE	APPARATUS AND METHOD FOR MEASURING MINORITY CARRIER LIFETIMES IN SEMICONDUCTOR MATERIALS
6275295	1999	2001	MIDWEST RESEARCH INSTITUTE	OPTICAL SYSTEM FOR DETERMINING PHYSICAL CHARACTERISTICS OF A SOLAR CELL
6281035	1997	2001	MIDWEST RESEARCH INSTITUTE	ION-BEAM TREATMENT TO PREPARE SURFACES OF P-CDTE FILMS
6281098	1999	2001	MIDWEST RESEARCH INSTITUTE	PROCESS FOR POLYCRYSTALLINE FILM SILICON GROWTH
6281426	2000	2001	MIDWEST RESEARCH INSTITUTE	MULTI-JUNCTION, MONOLITHIC SOLAR CELL USING LOW-BAND-GAP MATERIALS LATTICE MATCHED TO GAAS OR GE
6295818	2000	2001	POWERLIGHT CORP	PV-THERMAL SOLAR POWER ASSEMBLY
6300557	1999	2001	MIDWEST RESEARCH INSTITUTE	LOW-BANDGAP DOUBLE-HETEROSTRUCTURE INASP/GAINAS PHOTOVOLTAIC CONVERTERS
6320116	1997	2001	EVERGREEN SOLAR INC	METHODS FOR IMPROVING POLYMERIC MATERIALS FOR USE IN SOLAR CELL APPLICATIONS
6329296	2000	2001	SANDIA CORP	METAL CATALYST TECHNIQUE FOR TEXTURING SILICON SOLAR CELLS
EP1066416	2000	2001	MIDWEST RESEARCH INSTITUTE	PASSIVATING ETCHANTS FOR METALLIC PARTICLES
EP1066418	1999	2001	MIDWEST RESEARCH INSTITUTE	SOLUTION SYNTHESIS OF MIXED-METAL CHALCOGENIDE NANOPARTICLES AND SPRAY

				DEPOSITION OF PRECURSOR FILMS
EP1110248	1999	2001	UNITED SOLAR SYSTEMS CORP	METHOD FOR DEPOSITING LAYERS OF HIGH QUALITY SEMICONDUCTOR MATERIAL
EP1149961	2001	2001	KAWNEER CO INC	SUNSHADE FOR BUILDING EXTERIORS
WO2001001498	2000	2001	POWERLIGHT CORP	PV/THERMAL SOLAR POWER ASSEMBLY
WO2001037324	2000	2001	MIDWEST RESEARCH INSTITUTE	A NOVEL PROCESSING APPROACH TOWARDS THE FORMATION OF THIN-FILM CU(IN,GA)SE2
WO2001067503	2001	2001	MIDWEST RESEARCH INSTITUTE	A1 PROCESSING FOR IMPURITY GETTERING IN SILICON
6348159	1999	2002	FIRST SOLAR LLC	METHOD AND APPARATUS FOR ETCHING COATED SUBSTRATES
6353042	1997	2002	EVERGREEN SOLAR INC	UV-LIGHT STABILIZATION ADDITIVE PACKAGE FOR SOLAR CELL MODULE AND LAMINATED GLASS APPLICATIONS
6416814	2000	2002	FIRST SOLAR INC	VOLATILE ORGANOMETALLIC COMPLEXES OF LOWERED REACTIVITY SUITABLE FOR USE IN CHEMICAL VAPOR DEPOSITION OF METAL OXIDE FILMS
6421966	2000	2002	KAWNEER CO INC	SUNSHADE FOR BUILDING EXTERIORS
6436305	2001	2002	MIDWEST RESEARCH INSTITUTE	PASSIVATING ETCHANTS FOR METALLIC PARTICLES
6458254	1997	2002	MIDWEST RESEARCH INSTITUTE	PLASMA AND REACTIVE ION ETCHING TO PREPARE OHMIC CONTACTS
6468885	2000	2002	MIDWEST RESEARCH INSTITUTE	DEPOSITION OF DEVICE QUALITY, LOW HYDROGEN CONTENT, HYDROGENATED AMORPHOUS SILICON AT HIGH DEPOSITION RATES
6468886	2001	2002	MIDWEST RESEARCH INSTITUTE	PURIFICATION AND DEPOSITION OF SILICON BY AN IODIDE DISPROPORTIONATION REACTION
6495750	2001	2002	POWERLIGHT CORP	STABILIZED PV SYSTEM
EP1171211	2000	2002	ASE AMERICAS INC	EFG CRYSTAL GROWTH APPARATUS
EP1194950	2000	2002	MIDWEST RESEARCH INSTITUTE	PROCESS FOR POLYCRYSTALLINE SILICON FILM GROWTH AND APPARATUS FOR SAME
WO2002013279	2001	2002	SANDIA CORP	METAL CATALYST TECHNIQUE FOR TEXTURING SILICON SOLAR CELLS
WO2002017359	2001	2002	MIDWEST RESEARCH INSTITUTE	HIGH CARRIER CONCENTRATION P-TYPE TRANSPARENT CONDUCTING OXIDE FILMS
WO2002046242	2001	2002	FIRST SOLAR INC	VOLATILE ORGANOMETALLIC COMPLEXES OF LOWERED REACTIVITY SUITABLE FOR USE IN

				CHEMICAL VAPOR DEPOSITION OF METAL OXIDE FILMS
WO2002081044	2001	2002	ASE AMERICAS INC	EFG CRYSTAL GROWTH APPARATUS AND METHOD
6518086	2001	2003	MIDWEST RESEARCH INSTITUTE	PROCESSING APPROACH TOWARDS THE FORMATION OF THIN-FILM CU(IN,GA)SE2
6534703	2001	2003	POWERLIGHT CORP	MULTI-POSITION PHOTOVOLTAIC ASSEMBLY
6537845	2001	2003	UNIV DELAWARE	CHEMICAL SURFACE DEPOSITION OF ULTRA-THIN SEMICONDUCTORS
6542791	2000	2003	STATE UNIV OF NEW YORK	LOAD CONTROLLER AND METHOD TO ENHANCE EFFECTIVE CAPACITY OF A PHOTOVOTAIC POWER SUPPLY USING A DYNAMICALLY DETERMINED EXPECTED PEAK LOADING
6559411	2001	2003	FIRST SOLAR INC	METHOD AND APPARATUS FOR LASER SCRIBING GLASS SHEET SUBSTRATE COATINGS
6562132	2001	2003	ASE AMERICAS INC	EFG CRYSTAL GROWTH APPARATUS AND METHOD
6570084	2001	2003	POWERLIGHT CORP	PRESSURE EQUALIZING PHOTOVOLTAIC ASSEMBLY AND METHOD
6583350	2002	2003	SANDIA CORP	THERMOPHOTOVOLTAIC ENERGY CONVERSION USING PHOTONIC BANDGAP SELECTIVE EMITTERS
6586271	2001	2003	EVERGREEN SOLAR INC	METHODS FOR IMPROVING POLYMERIC MATERIALS FOR USE IN SOLAR CELL APPLICATIONS
6611085	2001	2003	SANDIA CORP	PHOTONICALLY ENGINEERED INCANDESCENT EMITTER
6627765	2002	2003	FIRST SOLAR INC	VOLATILE ORGANOMETALLIC COMPLEXES SUITABLE FOR USE IN CHEMICAL VAPOR DEPOSITIONS ON METAL OXIDE FILMS
6660930	2002	2003	RWE SCHOTT SOLAR INC	SOLAR CELL MODULES WITH IMPROVED BACKSKIN
EP1288163	2002	2003	MIDWEST RESEARCH INSTITUTE	PURIFIED SILICON PRODUCTION SYSTEM
EP1316115	2001	2003	SANDIA CORP	METAL CATALYST TECHNIQUE FOR TEXTURING SILICON SOLAR CELLS
EP1356132	2001	2003	FIRST SOLAR INC	VOLATILE ORGANOMETALLIC COMPLEXES OF LOWERED REACTIVITY SUITABLE FOR USE IN CHEMICAL VAPOR DEPOSITION OF METAL OXIDE FILMS
WO2003007388	2002	2003	POWERLIGHT CORP	PRESSURE-EQUALIZING PHOTOVOLTAIC ASSEMBLY AND METHOD
WO2003013778	2002	2003	FIRST SOLAR INC	METHOD AND APPARATUS FOR LASER SCRIBING GLASS SHEET SUBSTRATE COATINGS
WO2003017380	2002	2003	POWERLIGHT	MULTI-POSITION PHOTOVOLTAIC

			CORP	ASSEMBLY
WO2003017381	2002	2003	POWERLIGHT CORP	STABILIZED PV SYSTEM
WO2003019680	2002	2003	SANDIA CORP	PHOTONICALLY ENGINEERED INCANDESCENT EMITTER
WO2003021648	2002	2003	UNIV DELAWARE	CHEMICAL SURFACE DEPOSITION OF ULTRA-THIN SEMICONDUCTORS
WO2003036687	2002	2003	ENERGY CONVERSION DEVICES INC	NON-CONTACTING CAPACITIVE DIAGNOSTIC DEVICE
WO2003036688	2002	2003	SANDIA CORP	ALTERNATING CURRENT PHOTOVOLTAIC BUILDING BLOCK
WO2003044832	2002	2003	ENERGY PHOTOVOLTAICS	METHOD OF JUNCTION FORMATION FOR CIGS PHOTOVOLTAIC DEVICES
WO2003071047	2003	2003	POWERLIGHT CORP	SHINGLE ASSEMBLY
WO2003071054	2003	2003	POWERLIGHT CORP	SHINGLE SYSTEM
WO2003072891	2003	2003	POWERLIGHT CORP	SHINGLE SYSTEM AND METHOD
WO2003087493	2002	2003	RWE SCHOTT SOLAR INC	APPARATUS AND METHOD FOR MOUNTING PHOTOVOLTAIC POWER GENERATING SYSTEMS ON BUILDINGS
WO2003095718	2003	2003	RWE SCHOTT SOLAR INC	PROCESS FOR COATING SILICON SHOT WITH DOPANT FOR ADDITION OF DOPANT IN CRYSTAL GROWTH
WO2003107438	2003	2003	RWE SCHOTT SOLAR INC	SOLAR CELL MODULES WITH IMPROVED BACKSKIN
WO2003107439	2003	2003	RWE SCHOTT SOLAR INC	PHOTOVOLTAIC MODULE WITH LIGHT REFLECTING BACKSKIN
6675580	2001	2004	POWERLIGHT CORP	PV/THERMAL SOLAR POWER ASSEMBLY
6712908	2002	2004	MIDWEST RESEARCH INSTITUTE	PURIFIED SILICON PRODUCTION SYSTEM
6713400	2000	2004	MIDWEST RESEARCH INSTITUTE	METHOD FOR IMPROVING THE STABILITY OF AMORPHOUS SILICON
6740158	2002	2004	RWE SCHOTT SOLAR INC	PROCESS FOR COATING SILICON SHOT WITH DOPANT FOR ADDITION OF DOPANT IN CRYSTAL GROWTH
6750391	2002	2004	SANDIA CORP	ATERNATING CURRENT PHOTOVOLTAIC BUILDING BLOCK
6784361	2001	2004	BP CORP	AMORPHOUS SILICON PHOTOVOLTAIC DEVICES
6787385	2003	2004	MIDWEST RESEARCH INSTITUTE	METHOD OF PREPARING NITROGEN CONTAINING SEMICONDUCTOR MATERIAL
6809251	2002	2004	POWERLIGHT CORP	INCLINED PHOTOVOLTAIC ASSEMBLY
6809253	2003	2004	POWERLIGHT CORP	PRESSURE-EQUALIZING PV ASSEMBLY AND METHOD
6815246	2003	2004	RWE SCHOTT SOLAR INC	SURFACE MODIFICATION OF SILICON NITRIDE FOR THICK FILM

				SILVER METALLIZATION OF SOLAR CELL
6815736	2001	2004	MIDWEST RESEARCH INSTITUTE	ISOELECTRONIC CO-DOPING
EP1372805	2001	2004	RWE SCHOTT SOLAR INC	EFG CRYSTAL GROWTH APPARATUS AND METHOD
EP1410432	2001	2004	MIDWEST RESEARCH INSTITUTE	A1 PROCESSING FOR IMPURITY GETTERING IN SILICON
EP1412988	2002	2004	POWERLIGHT CORP	PRESSURE-EQUALIZING PHOTOVOLTAIC ASSEMBLY AND METHOD FOR REDUCING WIND UPLIFT FORCES
EP1423229	2002	2004	FIRST SOLAR INC	METHOD AND APPARATUS FOR LASER SCRIBING GLASS SHEET SUBSTRATE COATINGS
EP1423881	2002	2004	SANDIA CORP	PHOTONICALLY ENGINEERED INCANDESCENT EMITTER
EP1428250	2002	2004	UNIV DELAWARE	CHEMICAL SURFACE DEPOSITION OF ULTRA-THIN SEMICONDUCTORS
EP1442473	2002	2004	SANDIA CORP	ALTERNATING CURRENT PHOTOVOLTAIC BUILDING BLOCK
EP1476614	2003	2004	POWERLIGHT CORP	SHINGLE SYSTEM AND METHOD FOR MOUNTING THE SAME
EP1476617	2003	2004	POWERLIGHT CORP	SHINGLE SYSTEM
WO2004070850	2004	2004	BP CORP	IMPROVED PHOTOVOLTAIC CELL AND PRODUCTION THEREOF
WO2004075252	2004	2004	RWE SCHOTT SOLAR INC	SURFACE MODIFICATION OF SILICON NITRIDE FOR THICK FILM SILVER METALLIZATION OF SOLAR CELL
6852371	2002	2005	MIDWEST RESEARCH INSTITUTE	METAL PROCESSING FOR IMPURITY GETTERING IN SILICON
6852614	2001	2005	UNIV MAINE	METHOD OF MANUFACTURING SEMICONDUCTOR HAVING GROUP II-GROUP VI COMPOUNDS DOPED WITH NITROGEN
6869330	2003	2005	SANDIA CORP	METHOD FOR FABRICATING A PHOTONIC CRYSTAL
6883290	2002	2005	POWERLIGHT CORP	SHINGLE SYSTEM AND METHOD
6908782	2001	2005	MIDWEST RESEARCH INSTITUTE	HIGH CARRIER CONCENTRATION P-TYPE TRANSPARENT CONDUCTING OXIDE FILMS
6917209	2001	2005	ENERGY CONVERSION DEVICES INC	NON- CONTACTING CAPACITIVE DIAGNOSTIC DEVICE
6919530	2003	2005	FIRST SOLAR INC	METHOD AND APPARATUS FOR LASER SCRIBING GLASS SHEET SUBSTRATE COATINGS
EP1573145	2003	2005	POWERLIGHT CORP	SHINGLE ASSEMBLY
EP1597775	2004	2005	BP CORP	IMPROVED PHOTOVOLTAIC CELL

				AND METHOD OF PRODUCTION THEREOF
EP1602132	2004	2005	RWE SCHOTT SOLAR INC	SURFACE MODIFICATION OF SILICON NITRIDE FOR THICK FILM SILVER METALLIZATION OF SOLAR CELL
WO2005018007	2004	2005	ADVENT SOLAR INC, SANDIA CORP	BACK-CONTACTED SOLAR CELLS WITH INTEGRAL CONDUCTIVE VIAS AND METHOD OF MAKING
WO2005029592	2004	2005	MIDWEST RESEARCH INSTITUTE	ORGANIC PHOTOVOLTAIC CELLS WITH AN ELECTRIC FIELD INTEGRALLY-FORMED AT THE HETEROJUNCTION INTERFACE
WO2005034247	2003	2005	MIDWEST RESEARCH INSTITUTE	ZNO/CU(INGA)SE2 SOLAR CELLS PREPARED BY VAPOR PHASE ZN DOPING
WO2005036601	2004	2005	MIDWEST RESEARCH INSTITUTE	WAFER CHARACTERISTICS VIA REFLECTOMEYTRY AND WAFER PROCESSING APPARATUS AND METHOD
WO2005072302	2005	2005	UNITED SOLAR SYSTEMS CORP	METHOD FOR DEPOSITING HIGH-QUALITY MICROCRYSTALLINE SEMICONDUCTOR MATERIALS
WO2005105944	2004	2005	MIDWEST RESEARCH INSTITUTE	ZNS/ZN(O, OH)S-BASED BUFFER LAYER DEPOSITION FOR SOLAR CELLS
6984263	2001	2006	MIDWEST RESEARCH INSTITUTE	SHALLOW MELT APPARATUS FOR SEMICONTINUOUS CZOCHRALSKI CRYSTAL GROWTH
7019208	2002	2006	ENERGY PHOTOVOLTAICS	METHOD OF JUNCTION FORMATION FOR CIGS PHOTOVOLTAIC DEVICES
7053294	2001	2006	MIDWEST RESEARCH INSTITUTE	THIN-FILM SOLAR CELL FABRICATED ON A FLEXIBLE METALLIC SUBSTRATE
7067850	2001	2006	MIDWEST RESEARCH INSTITUTE	STACKED SWITCHABLE ELEMENT AND DIODE COMBINATION
7095050	2002	2006	MIDWEST RESEARCH INSTITUTE	VOLTAGE-MATCHED, MONOLITHIC, MULTI-BAND-GAP DEVICES
7098058	2005	2006	UNIV TOLEDO	PHOTOVOLTAIC HEALING OF NON-UNIFORMITIES IN SEMICONDUCTOR DEVICES
7122736	2001	2006	MIDWEST RESEARCH INSTITUTE	METHOD AND APPARATUS FOR FABRICATING A THIN-FILM SOLAR CELL UTILIZING A HOT WIRE CHEMICAL VAPOR DEPOSITION TECHNIQUE
7135069	2004	2006	RWE SCHOTT SOLAR INC	COATING SILICON PELLETS WITH DOPANT FOR ADDITION OF DOPANT IN CRYSTAL GROWTH
EP1642344	2004	2006	ADVENT SOLAR INC, SANDIA CORP	BACK-CONTACTED SOLAR CELLS WITH INTEGRAL CONDUCTIVE VIAS AND METHOD OF MAKING
RE038988	2003	2006	POWERLIGHT	LIGHTWEIGHT, SELF-BALLASTING

			CORP	PHOTOVOLTAIC ROOFING ASSEMBLY
WO2006025820	2004	2006	MIDWEST RESEARCH INSTITUTE	METHOD FOR PASSIVATING CRYSTAL SILICON SURFACES
7157641	2004	2007	MIDWEST RESEARCH INSTITUTE	ORGANIC PHOTOVOLTAIC CELLS WITH AN ELECTRIC FIELD INTEGRALLY-FORMED AT THE HETEROJUNCTION INTERFACE
7170001	2003	2007	ADVENT SOLAR INC, SANDIA CORP	FABRICATION OF BACK-CONTACTED SILICON SOLAR CELLS USING THERMOMIGRATION TO CREATE CONDUCTIVE VIAS
7178295	2002	2007	POWERLIGHT CORP	SHINGLE ASSEMBLY
7179665	2005	2007	MIDWEST RESEARCH INSTITUTE	OPTICAL METHOD FOR DETERMINING THE DOPING DEPTH PROFILE IN SILICON
7179677	2003	2007	MIDWEST RESEARCH INSTITUTE	ZNO/CU(INGA)SE ₂ SOLAR CELLS PREPARED BY VAPOR PHASE ZN DOPING
7229498	2002	2007	MIDWEST RESEARCH INSTITUTE	NANOSTRUCTURES PRODUCED BY PHASE-SEPARATION DURING GROWTH OF (III-V) _{1-X} (IV ₂) _X ALLOYS
7238878	2003	2007	RWE SCHOTT SOLAR INC	PHOTOVOLTAIC MODULE WITH LIGHT REFLECTING BACKSKIN
7238912	2004	2007	MIDWEST RESEARCH INSTITUTE	WAFER CHARACTERISTICS VIA REFLECTOMETRY AND WAFER PROCESSING APPARATUS AND METHOD
7300890	2003	2007	MIDWEST RESEARCH INSTITUTE	METHOD AND APPARATUS FOR FORMING CONFORMAL SIN _X FILMS
7309832	2001	2007	MIDWEST RESEARCH INSTITUTE	MULTI-JUNCTION SOLAR CELL DEVICE
EP1743360	2005	2007	UNITED SOLAR SYSTEMS CORP	METHOD FOR DEPOSITING HIGH-QUALITY MICROCRYSTALLINE SEMICONDUCTOR MATERIALS
WO2007041413	2006	2007	PRINCETON UNIVERSITY	HIGH MOBILITY HIGH EFFICIENCY ORGANIC FILMS BASED ON PURE ORGANIC MATERIALS
WO2007084934	2007	2007	BP CORP	METHODS AND APPARATUSES FOR MANUFACTURING MONOCRYSTALLINE CAST SILICON AND MONOCRYSTALLINE CAST SILICON BODIES FOR PHOTOVOLTAICS
WO2007084936	2007	2007	BP CORP	METHODS AND APPARATUSES FOR MANUFACTURING GEOMETRIC MULTICRYSTALLINE CAST SILICON AND GEOMETRIC MULTICRYSTALLINE CAST SILICON BODIES FOR PHOTOVOLTAICS

WO2007120788	2007	2007	UNIV SOUTHERN CALIFORNIA	ORGANIC ELECTRONIC DEVICES USING PHTHALIMIDE COMPOUNDS
WO2007139704	2007	2007	UNIV MICHIGAN, PRINCETON UNIVERSITY, USC	ORGANIC PHOTOSENSITIVE DEVICES USING SUBPHTHALOCYANINE COMPOUNDS
7328534	2005	2008	SUNPOWER CORP	SHINGLE SYSTEM
7402448	2004	2008	BP CORP	PHOTOVOLTAIC CELL AND PRODUCTION THEREOF
7435897	2002	2008	RWE SCHOTT SOLAR INC	APPARATUS AND METHOD FOR MOUNTING PHOTOVOLTAIC POWER GENERATING SYSTEMS ON BUILDINGS
7459188	2004	2008	ALLIANCE FOR SUST ENERGY LLC	METHOD AND APPARATUS FOR MAKING DIAMOND-LIKE CARBON FILMS
EP1938400	2006	2008	PRINCETON UNIVERSITY	HIGH MOBILITY HIGH EFFICIENCY ORGANIC FILMS BASED ON PURE ORGANIC MATERIALS
EP1974076	2007	2008	BP CORP	METHODS AND APPARATUSES FOR MANUFACTURING GEOMETRIC MULTICRYSTALLINE CAST SILICON AND GEOMETRIC MULTICRYSTALLINE CAST SILICON BODIES FOR PHOTOVOLTAICS
EP1974077	2007	2008	BP CORP	METHODS AND APPARATUSES FOR MANUFACTURING MONOCRYSTALLINE CAST SILICON AND MONOCRYSTALLINE CAST SILICON BODIES FOR PHOTOVOLTAICS
EP2005500	2007	2008	UNIV SOUTHERN CALIFORNIA	ORGANIC ELECTRONIC DEVICES USING PHTHALIMIDE COMPOUNDS
WO2008008477	2007	2008	UNIV MICHIGAN, PRINCETON UNIVERSITY	ARCHITECTURES AND CRITERIA FOR THE DESIGN OF HIGH EFFICIENCY ORGANIC PHOTOVOLTAIC CELLS
WO2008013547	2006	2008	MIDWEST RESEARCH INSTITUTE	SCREENING OF SILICON WAFERS USED IN PHOTOVOLTAICS
WO2008042194	2007	2008	SUNPOWER CORP	FORMED PHOTOVOLTAIC MODULE BUSBARS
WO2008063519	2007	2008	UNIV MICHIGAN, PRINCETON UNIVERSITY	ORGANIC HYBRID PLANAR-NANOCRYSTALLINE BULK HETEROJUNCTIONS
WO2008066910	2007	2008	UNIV MICHIGAN, PRINCETON UNIVERSITY	ORGANIC PHOTOVOLTAIC CELLS UTILIZING ULTRATHIN SENSITIZING LAYER
WO2008088551	2007	2008	MIDWEST RESEARCH	TRANSPARENT CONDUCTING OXIDES AND PRODUCTION

			INSTITUTE	THEREOF
WO2008097258	2007	2008	UNIV MICHIGAN, PRINCETON UNIVERSITY	CONTROLLED GROWTH OF LARGER HETEROJUNCTION INTERFACE AREA FOR ORGANIC PHOTOSENSITIVE DEVICES
WO2008118518	2008	2008	SUNPOWER CORP	STACKABLE TRACKING SOLAR COLLECTOR ASSEMBLY
WO2008118519	2008	2008	SUNPOWER CORP	TRACKING SOLAR COLLECTOR ASSEMBLY
WO2008118520	2008	2008	SUNPOWER CORP	TILT ASSEMBLY FOR TRACKING SOLAR COLLECTOR ASSEMBLY
WO2008137174	2008	2008	GEORGIA TECH RES CORP	FORMATION OF HIGH QUALITY BACK CONTACT WITH SCREEN-PRINTED LOCAL BACK SURFACE FIELD
7482195	2006	2009	PRINCETON UNIVERSITY	HIGH MOBILITY HIGH EFFICIENCY ORGANIC FILMS BASED ON PURE ORGANIC MATERIALS
7517784	2002	2009	ALLIANCE FOR SUST ENERGY LLC	METHOD FOR PRODUCING HIGH CARRIER CONCENTRATION P-TYPE TRANSPARENT CONDUCTING OXIDES
7574842	2005	2009	RWE SCHOTT SOLAR INC	APPARATUS FOR MOUNTING PHOTOVOLTAIC POWER GENERATING SYSTEMS ON BUILDINGS
7611573	2004	2009	ALLIANCE FOR SUST ENERGY LLC	ZNS/ZN(O,OH)S-BASED BUFFER LAYER DEPOSITION FOR SOLAR CELLS
7629236	2004	2009	ALLIANCE FOR SUST ENERGY LLC	METHOD FOR PASSIVATING CRYSTAL SILICON SURFACES
7638356	2006	2009	UNIV MICHIGAN, PRINCETON UNIVERSITY	CONTROLLED GROWTH OF LARGER HETEROJUNCTION INTERFACE AREA FOR ORGANIC PHOTOSENSITIVE DEVICES
EP2020047	2007	2009	UNIV MICHIGAN, PRINCETON UNIVERSITY, USC	ORGANIC PHOTOSENSITIVE DEVICES USING SUBPHTHALOCYANINE COMPOUNDS
EP2041817	2007	2009	UNIV MICHIGAN, PRINCETON UNIVERSITY	ARCHITECTURES AND CRITERIA FOR THE DESIGN OF HIGH EFFICIENCY ORGANIC PHOTOVOLTAIC CELLS
EP2070131	2007	2009	UNIV MICHIGAN, PRINCETON UNIVERSITY	CONTROLLED GROWTH OF LARGER HETEROJUNCTION INTERFACE AREA FOR ORGANIC PHOTOSENSITIVE DEVICES
EP2082433	2007	2009	SUNPOWER CORP	FORMED PHOTOVOLTAIC MODULE BUSBARS
EP2089920	2007	2009	UNIV MICHIGAN, PRINCETON UNIVERSITY	ORGANIC PHOTOVOLTAIC CELLS UTILIZING ULTRATHIN SENSITIZING LAYER
EP2089921	2007	2009	UNIV	ORGANIC HYBRID PLANAR-

			MICHIGAN, PRINCETON UNIVERSITY	NANOCRYSTALLINE BULK HETEROJUNCTIONS
EP2130231	2008	2009	SUNPOWER CORP	SOLAR COLLECTOR ASSEMBLY AND METHOD FOR CONSTRUCTING A SOLAR COLLECTOR INSTALLATION
WO2009005824	2008	2009	MICROLINK DEVICES INC	THIN FILM III-V COMPOUND SOLAR CELL
WO2009005825	2008	2009	MICROLINK DEVICES INC	METHODS FOR FABRICATING THIN FILM III-V COMPOUND SOLAR CELL
WO2009008945	2008	2009	GEORGIA TECH RES CORP	METHOD FOR CLEANING A SOLAR CELL SURFACE OPENING MADE WITH A SOLAR ETCH PASTE
WO2009015167	2008	2009	BP CORP	METHODS FOR MANUFACTURING MONOCRYSTALLINE OR NEAR-MONOCRYSTALLINE CAST MATERIALS
WO2009015168	2008	2009	BP CORP	METHODS FOR MANUFACTURING GEOMETRIC MULTI-CRYSTALLINE CAST MATERIALS
WO2009017552	2008	2009	BRP MFG CO, ALL FOR SUST ENERGY	ENCAPSULANT MATERIALS AND ASSOCIATED DEVICES
WO2009017906	2008	2009	BOEING CO	STRUCTURALLY ISOLATED THERMAL INTERFACE
WO2009059302	2008	2009	ALLIANCE FOR SUST ENERGY LLC	FABRICATION OF CONTACTS FOR SILICON SOLAR CELLS INCLUDING PRINTING BURN THROUGH LAYERS
WO2009061322	2007	2009	MIDWEST RESEARCH INSTITUTE	LOW-TEMPERATURE JUNCTION GROWTH USING HOT-WIRE CHEMICAL VAPOR DEPOSITION
WO2009075944	2008	2009	NANOSOLAR INC	IMPROVED SOLUTION DEPOSITION ASSEMBLY
WO2009099605	2009	2009	LIGHT PRESCRIPTIONS INNOVATORS LLC	TRANSPARENT HEAT-SPREADER FOR OPTOELECTRONIC APPLICATIONS
WO2009099838	2009	2009	SUNPOWER CORP	NON-CONTACT EDGE COATING APPARATUS FOR SOLAR CELL SUBSTRATES AND METHODS FOR USING SAME
WO2009099839	2009	2009	SUNPOWER CORP	CONTROL SYSTEM FOR NON-CONTACT EDGE COATING APPARATUS FOR SOLAR CELL SUBSTRATES
WO2009105314	2009	2009	SUNPOWER CORP	FRONT CONTACT SOLAR CELL WITH FORMED EMITTER
WO2009120955	2009	2009	GREENRAY INC	AN ELECTRICAL CABLE HARNESS AND ASSEMBLY FOR TRANSMITTING AC ELECTRICAL POWER
WO2009137347	2009	2009	DOW GLOBAL TECH INC	CONNECTOR DEVICE FOR BUILDING INTEGRATED PHOTOVOLTAIC DEVICE
WO2009137348	2009	2009	DOW GLOBAL	IMPROVED PHOTOVOLTAIC DEVICE

			TECH INC	AND METHOD
WO2009137351	2009	2009	DOW GLOBAL TECH INC	IMPROVED METHOD FOR ENCAPSULATING THE EDGE OF A FLEXIBLE SHEET
WO2009137352	2009	2009	DOW GLOBAL TECH INC	SYSTEM FOR INSTALLATION OF PHOTOVOLTAIC DEVICES ON A STRUCTURE
WO2009137353	2009	2009	DOW GLOBAL TECH INC	PHOTOVOLTAIC DEVICE ASSEMBLY AND METHOD
WO2009139896	2009	2009	SOLIANT ENERGY INC	CONCENTRATING PHOTOVOLTAIC SOLAR PANEL
WO2009139918	2009	2009	SOLIANT ENERGY INC	SOLAR SYSTEMS THAT INCLUDE ONE OR MORE SHADE-TOLERANT WIRING SCHEMES
WO2009139935	2009	2009	ALLIANCE FOR SUST ENERGY LLC	HIGH PERFORMANCE, HIGH BANDGAP, LATTICE-MISMATCHED, GAINP SOLAR CELLS
WO2009140174	2009	2009	UNIVERSITY OF ARIZONA	SOLAR CONCENTRATOR APPARATUS WITH LARGE, MULTIPLE, CO-AXIAL DISH REFLECTORS
WO2009140175	2009	2009	UNIVERSITY OF ARIZONA	PHOTOVOLTAIC GENERATOR WITH A SPHERICAL IMAGING LENS FOR USE WITH A PARABOLOIDAL SOLAR REFLECTOR
WO2009140176	2009	2009	UNIVERSITY OF ARIZONA	METHOD OF MANUFACTURING LARGE DISH REFLECTORS FOR A SOLAR CONCENTRATOR APPARATUS
WO2009143253	2009	2009	GREENRAY INC	AN AC PHOTOVOLTAIC MODULE AND INVERTER ASSEMBLY
WO2009151808	2009	2009	SUNPOWER CORP	TRENCH PROCESS AND STRUCTURE FOR BACKSIDE CONTACT SOLAR CELLS WITH POLYSILICON DOPED REGIONS
WO2009151809	2009	2009	SUNPOWER CORP	TRENCH PROCESS AND STRUCTURE FOR BACKSIDE CONTACT SOLAR CELLS WITH POLYSILICON DOPED REGIONS
WO2009158710	2009	2009	SUNPOWER CORP	BALLASTED PHOTOVOLTAIC MODULE AND MODULE ARRAYS
WO2009158712	2009	2009	SUNPOWER CORP	PHOTOVOLTAIC MODULE KIT INCLUDING CONNECTOR ASSEMBLY FOR NON-PENETRATING ARRAY INSTALLATION
WO2009158714	2009	2009	SUNPOWER CORP	PHOTOVOLTAIC MODULE WITH REMOVABLE WIND DEFLECTOR
WO2009158715	2009	2009	SUNPOWER CORP	PHOTOVOLTAIC MODULE AND MODULE ARRAYS
7652209	2006	2010	ENERGY PHOTOVOLTAICS	METHOD OF JUNCTION FORMATION FOR CIGS PHOTOVOLTAIC DEVICES
7741225	2008	2010	GEORGIA TECH RES CORP	METHOD FOR CLEANING A SOLAR CELL SURFACE OPENING MADE WITH A SOLAR ETCH PASTE
7743763	2007	2010	BOEING CO	STRUCTURALLY ISOLATED

				THERMAL INTERFACE
7790298	2007	2010	UNIV SOUTHERN CALIFORNIA	ORGANIC ELECTRONIC DEVICES USING PHTHALIMIDE COMPOUNDS
7790574	2005	2010	GEORGIA TECH RES CORP	BORON DIFFUSION IN SILICON DEVICES
7803419	2006	2010	ABOUND SOLAR INC	APPARATUS AND METHOD FOR RAPID COOLING OF LARGE AREA SUBSTRATES IN VACUUM
7812250	2009	2010	SUNPOWER CORP	TRENCH PROCESS AND STRUCTURE FOR BACKSIDE CONTACT SOLAR CELLS WITH POLYSILICON DOPED REGIONS
7842596	2008	2010	GEORGIA TECH RES CORP	METHOD FOR FORMATION OF HIGH QUALITY BACK CONTACT WITH SCREEN-PRINTED LOCAL BACK SURFACE FIELD
7851698	2009	2010	SUNPOWER CORP	TRENCH PROCESS AND STRUCTURE FOR BACKSIDE CONTACT SOLAR CELLS WITH POLYSILICON DOPED REGIONS
EP2140211	2008	2010	SUNPOWER CORP	TRACKING SOLAR COLLECTOR ASSEMBLY
EP2140212	2008	2010	SUNPOWER CORP	TILT ASSEMBLY FOR TRACKING SOLAR COLLECTOR ASSEMBLY
EP2149155	2008	2010	GEORGIA TECH RES CORP	FORMATION OF HIGH QUALITY BACK CONTACT WITH SCREEN-PRINTED LOCAL BACK SURFACE FIELD
EP2149156	2008	2010	GEORGIA TECH RES CORP	METHOD FOR CLEANING A SOLAR CELL SURFACE OPENING MADE WITH A SOLAR ETCH PASTE
EP2168171	2008	2010	MICROLINK DEVICES INC	THIN FILM III-V COMPOUND SOLAR CELL
EP2168172	2008	2010	MICROLINK DEVICES INC	METHODS FOR FABRICATING THIN FILM III-V COMPOUND SOLAR CELL
EP2185646	2008	2010	BRP MFG CO, ALL FOR SUST ENERGY	ENCAPSULANT MATERIALS AND ASSOCIATED DEVICES
EP2206141	2008	2010	NANOSOLAR INC	IMPROVED SOLUTION DEPOSITION ASSEMBLY
EP2240283	2009	2010	SUNPOWER CORP	NON-CONTACT EDGE COATING APPARATUS FOR SOLAR CELL SUBSTRATES
EP2240284	2009	2010	SUNPOWER CORP	CONTROL SYSTEM FOR NON-CONTACT EDGE COATING APPARATUS FOR SOLAR CELL SUBSTRATES
EP2245671	2009	2010	SUNPOWER CORP	FRONT-CONTACT SOLAR CELL WITH BACKSIDE POLY-CRYSTALLINE SILICON EMITTER
WO2010002635	2009	2010	SUNPOWER CORP	FRONT CONTACT SOLAR CELL WITH FORMED ELECTRICALLY CONDUCTING LAYERS ON THE FRONT SIDE AND BACKSIDE
WO2010017364	2009	2010	MAYATERIALS	LOW COST ROUTES TO HIGH

			INC	PURITY SILICON AND DERIVATIVES THEREOF
WO2010017373	2009	2010	ELECTRODYNAMIC APPLIC INC	PLASMA PROCESSES FOR PRODUCING SILANES AND DERIVATIVES THEREOF
WO2010021623	2008	2010	MIDWEST RESEARCH INSTITUTE	EPITAXIAL GROWTH OF SILICON FOR LAYER TRANSFER
WO2010027833	2009	2010	BP CORP	SYSTEM AND METHOD FOR LIQUID SILICON CONTAINMENT
WO2010027869	2009	2010	AMONIX INC	A HIGH-STIFFNESS, LIGHTWEIGHT BEAM STRUCTURE
WO2010036776	2009	2010	ALLIANCE FOR SUST ENERGY LLC	THIN FILM ELECTRONIC DEVICES WITH CONDUCTIVE AND TRANSPARENT GAS AND MOISTURE PERMEATION BARRIERS
WO2010051258	2009	2010	UNIV MICHIGAN	INVERTED ORGANIC PHOTOSENSITIVE DEVICES
WO2010051355	2009	2010	DOW CORNING CORP	PHOTOVOLTAIC CELL MODULE AND METHOD OF FORMING
WO2010065434	2009	2010	SUNPOWER CORP	BACKSIDE CONTACT SOLAR CELL WITH FORMED POLYSILICON DOPED REGIONS
WO2010077535	2009	2010	SUNPOWER CORP	MOUNTING SUPPORT FOR A PHOTOVOLTAIC MODULE
WO2010088419	2010	2010	UNIV WASHINGTON	CROSS-CONJUGATED POLYMERS FOR ORGANIC ELECTRONIC DEVICES AND RELATED METHODS
WO2010098806	2009	2010	SUNPOWER CORP	PHOTOVOLTAIC ASSEMBLIES AND METHODS FOR TRANSPORTING
WO2010098903	2010	2010	SUNPOWER CORP	PHOTOVOLTAIC MODULE AND INTERLOCKED STACK OF PHOTOVOLTAIC MODULES
WO2010102178	2010	2010	UNIV FLORIDA	AIR STABLE ORGANIC-INORGANIC NANOPARTICLES HYBRID SOLAR CELLS
WO2010107522	2010	2010	BOEING CO	HIGHLY DOPED LAYER FOR TUNNEL JUNCTIONS IN SOLAR CELLS
WO2010111125	2010	2010	DOW GLOBAL TECH INC	OPTOELECTRONIC DEVICE
WO2010115007	2010	2010	UNIVERSITY OF ARKANSAS	PHOTOVOLTAIC DEVICE USING SINGLE WALL CARBON NANOTUBES AND METHOD OF FABRICATING THE SAME
WO2010120397	2010	2010	SUNPOWER CORP	PHOTOVOLTAIC ARRAY WITH MINIMALLY PENETRATING ROOFTOP SUPPORT SYSTEM
WO2010124212	2010	2010	UNIV CHICAGO	MATERIALS AND METHODS FOR THE PREPARATION OF NANOCOMPOSITES
WO2010148024	2010	2010	UNIV HOUSTON	WRAPPED OPTOELECTRONIC DEVICES AND METHODS FOR MAKING SAME
7877937	2008	2011	AMONIX INC	HIGH-STIFFNESS, LIGHTWEIGHT BEAM STRUCTURE

7897429	2006	2011	PRINCETON UNIVERSITY, USC	ORGANIC HYBRID PLANAR-NANOCRYSTALLINE BULK HETEROJUNCTIONS
7902049	2004	2011	UNITED SOLAR OVONIC LLC	METHOD FOR DEPOSITING HIGH-QUALITY MICROCRYSTALLINE SEMICONDUCTOR MATERIALS
7902301	2008	2011	BRP MFG CO, ALL FOR SUST ENERGY	ENCAPSULANT MATERIALS AND ASSOCIATED DEVICES
7955889	2006	2011	PRINCETON UNIVERSITY	ORGANIC PHOTOSENSITIVE CELLS GROWN ON ROUGH ELECTRODE WITH NANO-SCALE MORPHOLOGY CONTROL
7973307	2009	2011	UNIV MICHIGAN, PRINCETON UNIVERSITY, USC	ORGANIC PHOTOSENSITIVE DEVICES USING SUBPHTHALOCYANINE COMPOUNDS
7994419	2008	2011	MICROLINK DEVICES INC	METHODS FOR FABRICATING THIN FILM III-V COMPOUND SOLAR CELL
8006566	2006	2011	ALLIANCE FOR SUST ENERGY LLC	SCREENING OF SILICON WAFERS USED IN PHOTOVOLTAICS
8013240	2006	2011	PRINCETON UNIVERSITY	ORGANIC PHOTOVOLTAIC CELLS UTILIZING ULTRATHIN SENSITIZING LAYER
8023266	2009	2011	GREENRAY INC	AC PHOTOVOLTAIC MODULE AND INVERTER ASSEMBLY
8048221	2007	2011	AMG IDEALCAST SOLAR CORP	METHODS AND APPARATUSES FOR MANUFACTURING MONOCRYSTALLINE CAST SILICON AND MONOCRYSTALLINE CAST SILICON BODIES FOR PHOTOVOLTAICS
8061091	2009	2011	SUNPOWER CORP	PHOTOVOLTAIC MODULE KIT INCLUDING CONNECTOR ASSEMBLY FOR NON-PENETRATING ARRAY INSTALLATION
8065844	2009	2011	SUNPOWER CORP	BALLASTED PHOTOVOLTAIC MODULE AND MODULE ARRAYS
8067687	2004	2011	ALLIANCE FOR SUST ENERGY LLC	HIGH-EFFICIENCY, MONOLITHIC, MULTI-BANDGAP, TANDEM PHOTOVOLTAIC ENERGY CONVERTERS
8075792	2008	2011	ALLIANCE FOR SUST ENERGY LLC	NANOPARTICLE-BASED ETCHING OF SILICON SURFACES
8082755	2009	2011	UNIVERSITY OF ARIZONA	METHOD OF MANUFACTURING LARGE DISH REFLECTORS FOR A SOLAR CONCENTRATOR APPARATUS
EP2272096	2009	2011	DOW GLOBAL TECH INC	SYSTEM FOR INSTALLATION OF PHOTOVOLTAIC DEVICES ON A STRUCTURE
EP2272141	2009	2011	GREENRAY INC	AN ELECTRICAL CABLE HARNESS AND ASSEMBLY FOR

				TRANSMITTING AC ELECTRICAL POWER
EP2274776	2009	2011	DOW GLOBAL TECH INC	IMPROVED PHOTOVOLTAIC DEVICE AND METHOD
EP2282891	2009	2011	DOW GLOBAL TECH INC	IMPROVED METHOD FOR ENCAPSULATING THE EDGE OF A FLEXIBLE SHEET
EP2282976	2009	2011	UNIVERSITY OF ARIZONA	METHOD OF MANUFACTURING LARGE DISH REFLECTORS FOR A SOLAR CONCENTRATOR APPARATUS
EP2283543	2009	2011	DOW GLOBAL TECH INC	CONNECTOR DEVICE FOR BUILDING INTEGRATED PHOTOVOLTAIC DEVICE
EP2286466	2009	2011	UNIVERSITY OF ARIZONA	SOLAR CONCENTRATOR APPARATUS WITH LARGE MULTIPLE CO-AXIAL DISH REFLECTORS
EP2286467	2009	2011	UNIVERSITY OF ARIZONA	PHOTOVOLTAIC GENERATOR WITH A SPHERICAL IMAGING LENS FOR USE WITH A PARABOLOIDAL SOLAR REFLECTOR
EP2286645	2009	2011	GREENRAY INC	AN AC PHOTOVOLTAIC MODULE AND INVERTER ASSEMBLY
EP2294629	2009	2011	SOLIANT ENERGY INC	CONCENTRATING PHOTOVOLTAIC SOLAR PANEL
EP2294630	2009	2011	SOLIANT ENERGY INC	SOLAR SYSTEMS THAT INCLUDE ONE OR MORE SHADE-TOLERANT WIRING SCHEMES
EP2297788	2009	2011	SUNPOWER CORP	BACK-CONTACTED SOLAR CELLS WITH DOPED POLYSILICON REGIONS SEPARATED VIA TRENCH STRUCTURES AND FABRICATION PROCESS THEREFOR
EP2297789	2009	2011	SUNPOWER CORP	TRENCH PROCESS AND STRUCTURE FOR BACKSIDE CONTACT SOLAR CELLS WITH POLYSILICON DOPED REGIONS
EP2298955	2010	2011	AIR PRODUCTS & CHEMICALS INC	ADDITIVES TO SILANE FOR THIN FILM SILICON PHOTOVOLTAIC DEVICES
EP2301079	2009	2011	DOW GLOBAL TECH INC	PHOTOVOLTAIC DEVICE ASSEMBLY AND METHOD
EP2304807	2009	2011	SUNPOWER CORP	BALLASTED PHOTOVOLTAIC MODULE AND MODULE ARRAYS
EP2304810	2009	2011	SUNPOWER CORP	PHOTOVOLTAIC MODULE KIT INCLUDING CONNECTOR ASSEMBLY FOR NON-PENETRATING ARRAY INSTALLATION
EP2304811	2009	2011	SUNPOWER CORP	PHOTOVOLTAIC MODULE WITH REMOVABLE WIND DEFLECTOR
EP2304812	2009	2011	SUNPOWER CORP	PHOTOVOLTAIC MODULE AND MODULE ARRAYS
EP2311102	2009	2011	SUNPOWER CORP	FRONT CONTACT SOLAR CELL WITH FORMED ELECTRICALLY CONDUCTING LAYERS ON THE

				FRONT SIDE AND BACKSIDE
EP2321221	2009	2011	MAYATERIALS INC	LOW COST ROUTES TO HIGH PURITY SILICON AND DERIVATIVES THEREOF
EP2331277	2009	2011	AMONIX INC	A HIGH-STIFFNESS, LIGHTWEIGHT BEAM STRUCTURE
EP2337881	2009	2011	BP CORP	SYSTEM AND METHOD FOR LIQUID SILICON CONTAINMENT
EP2342770	2009	2011	UNIV MICHIGAN	INVERTED ORGANIC PHOTOSENSITIVE DEVICES
EP2351102	2009	2011	DOW CORNING CORP	PHOTOVOLTAIC CELL MODULE AND METHOD OF FORMING
EP2367758	2009	2011	ELECTRODYNAMIC APPLIC INC	PLASMA PROCESSES FOR PRODUCING SILANES AND DERIVATIVES THEREOF
EP2374160	2009	2011	SUNPOWER CORP	BACKSIDE CONTACT SOLAR CELL WITH FORMED POLYSILICON DOPED REGIONS
EP2378583	2007	2011	UNIV MICHIGAN, PRINCETON UNIVERSITY	METHOD OF FABRICATING AN ORGANIC PHOTOVOLTAIC CELLS UTILIZING ULTRATHIN SENSITIZING LAYER
EP2378586	2007	2011	UNIV SOUTHERN CALIFORNIA	ORGANIC ELECTRONIC DEVICES USING PHTHALIMIDE COMPOUNDS
WO2011016894	2010	2011	SUNPOWER CORP	MODULE LEVEL SOLUTIONS TO SOLAR CELL POLARIZATION
WO2011034640	2010	2011	BOEING CO	ENCLOSED, OFF-AXIS SOLAR CONCENTRATOR
WO2011034676	2010	2011	BOEING CO	PHOTOVOLTAIC CONCENTRATOR ASSEMBLY WITH OPTICALLY ACTIVE COVER
WO2011038227	2010	2011	GREENRAY INC	MODIFIED ZERO VOLTAGE TRANSITION (ZVT) FULL BRIDGE CONVERTER AND PHOTOVOLTAIC (PV) ARRAY USING THE SAME
WO2011046578	2010	2011	SUNLINK CORP	PHOTOVOLTAIC PANEL CLAMP
WO2011046579	2010	2011	SUNLINK CORP	PHOTOVOLTAIC MODULE MOUNTING SYSTEM
WO2011049933	2010	2011	UNIV TOLEDO	BACK CONTACT BUFFER LAYER FOR THIN-FILM SOLAR CELLS
WO2011049944	2010	2011	DOW GLOBAL TECH INC	A DIRECT MOUNTED PHOTOVOLTAIC DEVICE WITH IMPROVED FRONT CLIP
WO2011050225	2010	2011	DOW GLOBAL TECH INC	A DIRECT MOUNTED PHOTOVOLTAIC DEVICE WITH IMPROVED ADHESION AND METHOD THEREOF
WO2011057207	2010	2011	NANO C INC	FULLERENE-FUNCTIONALIZED PARTICLES, METHODS FOR MAKING THE SAME AND THEIR USE IN BLUKHETEROJUNCTION ORGANIC PHOTOVOLTAIC DEVICES
WO2011060193	2010	2011	ALLIANCE FOR SUST ENERGY LLC	WET-CHEMICAL SYSTEMS AND METHODS FOR PRODUCING BLACK SILICON SUBSTRATES

WO2011068590	2010	2011	SUNPOWER CORP	SOLAR CELL CONTACT FORMATION USING LASER ABLATION
WO2011069054	2010	2011	MASSACHUSETTS INST TECHNOLOGY	PHONON-ENHANCED CRYSTAL GROWTH AND LATTICE HEALING
WO2011071596	2010	2011	DOW GLOBAL TECH INC	A DIRECT MOUNTED PHOTOVOLTAIC DEVICE WITH IMPROVED CLIP
WO2011103341	2011	2011	ALLIANCE FOR SUST ENERGY LLC	MOISTURE BARRIER
WO2011109058	2010	2011	SUNPOWER CORP	METHOD OF FABRICATING A BACK-CONTACT SOLAR CELL AND DEVICE THEREOF
WO2011112612	2011	2011	ALLIANCE FOR SUST ENERGY LLC	BORON, BISMUTH CO-DOPING OF GALLIUM ARSENIDE AND OTHER COMPOUNDS FOR PHOTONIC AND HETEROJUNCTION BIPOLAR TRANSISTOR DEVICES
WO2011112759	2011	2011	DOW GLOBAL TECH INC	IMPROVED PHOTOVOLTAIC DEVICE
WO2011126593	2011	2011	SUNPOWER CORP	LEAKAGE PATHWAY LAYER FOR SOLAR CELL
WO2011127186	2011	2011	UNIV MICHIGAN; UNIV SOUTHERN CALIFORNIA	ENHANCED BULK HETEROJUNCTION DEVICES PREPARED BY THERMAL AND SOLVENT VAPOR ANNEALING PROCESSES
WO2011133236	2011	2011	SUNPOWER CORP	PHOTOVOLTAIC LAMINATE SEGMENTS AND SEGMENTED PHOTOVOLTAIC MODULES
WO2011139395	2011	2011	SUNPOWER CORP	METHODS AND APPARATUSES TO SUPPORT PHOTOVOLTAIC MODULES
WO2011150290	2011	2011	UNIV TOLEDO	PHOTOVOLTAIC STRUCTURES HAVING A LIGHT SCATTERING INTERFACE LAYER AND METHODS OF MAKING THE SAME
WO2011156043	2011	2011	SUNPOWER CORP	ABLATION OF FILM STACKS IN SOLAR CELL FABRICATION PROCESSES
WO2011160031	2011	2011	UNIV FLORIDA	THIN FILM PHOTOVOLTAIC DEVICES WITH MICROLENS ARRAYS
8088499	2006	2012	AGILTRON INC	OPTOELECTRONIC DEVICE WITH NANOPARTICLE EMBEDDED HOLE INJECTION/TRANSPORT LAYER
8101849	2008	2012	SUNPOWER CORP	TILT ASSEMBLY FOR TRACKING SOLAR COLLECTOR ASSEMBLY
8134217	2010	2012	SUNPOWER CORP	BYPASS DIODE FOR A SOLAR CELL
8156697	2009	2012	SUNLINK CORP	PHOTOVOLTAIC MODULE MOUNTING SYSTEM
8173891	2008	2012	ALLIANCE FOR SUST ENERGY LLC	MONOLITHIC, MULTI-BANDGAP, TANDEM, ULTRA-THIN, STRAIN-COUNTERBALANCED,

				PHOTOVOLTAIC ENERGY CONVERTERS WITH OPTIMAL SUBCELL BANDGAPS
8183329	2011	2012	BRP MFG CO, ALL FOR SUST ENERGY	ENCAPSULANT MATERIALS AND ASSOCIATED DEVICES
8188363	2009	2012	SUNPOWER CORP	MODULE LEVEL SOLUTIONS TO SOLAR CELL POLARIZATION
8191320	2009	2012	SUNLINK CORP	PHOTOVOLTAIC PANEL CLAMP
8201994	2008	2012	BOEING CO	FLEXIBLE THERMAL CYCLE TEST EQUIPMENT FOR CONCENTRATOR SOLAR CELLS
8207444	2008	2012	SUNPOWER CORP	FRONT CONTACT SOLAR CELL WITH FORMED ELECTRICALLY CONDUCTING LAYERS ON THE FRONT SIDE AND BACKSIDE
8211731	2010	2012	SUNPOWER CORP	ABLATION OF FILM STACKS IN SOLAR CELL FABRICATION PROCESSES
8220210	2009	2012	SUNPOWER CORP	PHOTOVOLTAIC MODULE AND MODULE ARRAYS
8222516	2008	2012	SUNPOWER CORP	FRONT CONTACT SOLAR CELL WITH FORMED EMITTER
8234824	2009	2012	SUNPOWER CORP	PHOTOVOLTAIC MODULE WITH REMOVABLE WIND DEFLECTOR
8239165	2008	2012	ALLIANCE FOR SUST ENERGY LLC	ULTRA-FAST DETERMINATION OF QUANTUM EFFICIENCY OF A SOLAR CELL
8242350	2009	2012	SOLIANT ENERGY INC	CONCENTRATING PHOTOVOLTAIC SOLAR PANEL
8242354	2009	2012	SUNPOWER CORP	BACKSIDE CONTACT SOLAR CELL WITH FORMED POLYSILICON DOPED REGIONS
8242493	2011	2012	UNIV MICHIGAN, PRINCETON UNIVERSITY, USC	ORGANIC PHOTOSENSITIVE DEVICES USING SUBPHTHALOCYANINE COMPOUNDS
8247243	2010	2012	NANOSOLAR INC	SOLAR CELL INTERCONNECTION
8258395	2009	2012	SUNPOWER CORP	PHOTOVOLTAIC MODULE AND INTERLOCKED STACK OF PHOTOVOLTAIC MODULES
8263899	2010	2012	SUNPOWER CORP	HIGH THROUGHPUT SOLAR CELL ABLATION SYSTEM
8266848	2012	2012	SUNLINK CORP	PHOTOVOLTAIC MODULE MOUNTING SYSTEM
8291654	2011	2012	SUNPOWER CORP	PHOTOVOLTAIC MODULE KIT INCLUDING CONNECTOR ASSEMBLY FOR NON-PENETRATING ARRAY INSTALLATION
8293385	2010	2012	UNIV SOUTHERN CALIFORNIA	ORGANIC ELECTRONIC DEVICES USING PHTHALIMIDE COMPOUNDS
8294022	2009	2012	SUNPOWER CORP	PHOTOVOLTAIC ARRAY WITH MINIMALLY PENETRATING

				ROOFTOP SUPPORT SYSTEM
8302554	2010	2012	COLORADA STATE UNIV	APPARATUS AND METHOD FOR RAPID COOLING OF LARGE AREA SUBSTRATES IN VACUUM
8304302	2010	2012	UNIVERSITY OF ARKANSAS	PHOTOVOLTAIC DEVICE USING SINGLE WALL CARBON NANOTUBES AND METHOD OF FABRICATING THE SAME
8322300	2008	2012	SUNPOWER CORP	EDGE COATING APPARATUS WITH MOVABLE ROLLER APPLICATOR FOR SOLAR CELL SUBSTRATES
8324015	2010	2012	SUNPOWER CORP	SOLAR CELL CONTACT FORMATION USING LASER ABLATION
8330299	2011	2012	GENERAL ELECTRIC CO	DC TO DC POWER CONVERTERS AND METHODS OF CONTROLLING THE SAME
8334161	2010	2012	SUNPOWER CORP	METHOD OF FABRICATING A SOLAR CELL WITH A TUNNEL DIELECTRIC LAYER
EP2401769	2009	2012	SUNPOWER CORP	PHOTOVOLTAIC ASSEMBLIES AND METHODS FOR TRANSPORTING
EP2401770	2010	2012	SUNPOWER CORP	PHOTOVOLTAIC MODULE AND INTERLOCKED STACK OF PHOTOVOLTAIC MODULES
EP2409334	2010	2012	BOEING CO	HIGHLY DOPED LAYER FOR TUNNEL JUNCTIONS IN SOLAR CELLS
EP2414743	2010	2012	SUNPOWER CORP	PHOTOVOLTAIC ARRAY WITH MINIMALLY PENETRATING ROOFTOP SUPPORT SYSTEM
EP2416394	2007	2012	UNIV MICHIGAN, PRINCETON UNIVERSITY	ORGANIC HYBRID PLANAR - NANOCRYSTALLINE BULK HETEROJUNCTIONS
EP2417631	2010	2012	DOW GLOBAL TECH INC	OPTOELECTRONIC DEVICE
EP2430112	2010	2012	UNIV CHICAGO	MATERIALS AND METHODS FOR THE PREPARATION OF NANOCOMPOSITES
EP2443683	2010	2012	UNIV HOUSTON	WRAPPED OPTOELECTRONIC DEVICES AND METHODS FOR MAKING SAME
EP2462623	2010	2012	SUNPOWER CORP	MODULE LEVEL SOLUTIONS TO PREVENT SOLAR CELL POLARIZATION
EP2478569	2010	2012	BOEING CO	ENCLOSED, OFF-AXIS SOLAR CONCENTRATOR
EP2481090	2010	2012	BOEING CO	PHOTOVOLTAIC CONCENTRATOR ASSEMBLY WITH OPTICALLY ACTIVE COVER
EP2485276	2009	2012	DOW CORNING CORP	PHOTOVOLTAIC CELL MODULE AND METHOD OF FORMING
EP2485277	2009	2012	DOW CORNING CORP	PHOTOVOLTAIC CELL MODULE AND METHOD OF FORMING
EP2491315	2010	2012	DOW GLOBAL TECH INC	A DIRECT MOUNTED PHOTOVOLTAIC DEVICE WITH

				IMPROVED CLIP
EP2491597	2010	2012	DOW GLOBAL TECH INC	A DIRECT MOUNTED PHOTOVOLTAIC DEVICE WITH IMPROVED FRONT CLIP
EP2491598	2010	2012	DOW GLOBAL TECH INC	A DIRECT MOUNTED PHOTOVOLTAIC DEVICE WITH IMPROVED ADHESION AND METHOD THEREOF
EP2497130	2010	2012	NANO C INC	FULLERENE-FUNCTIONALIZED PARTICLES, METHODS FOR MAKING THE SAME AND THEIR USE IN BULKHETEROJUNCTION ORGANIC PHOTOVOLTAIC DEVICES
EP2507844	2010	2012	SUNPOWER CORP	SOLAR CELL CONTACT FORMATION USING LASER ABLATION
EP2518855	2012	2012	GENERAL ELECTRIC CO	SWITCHING COORDINATION OF DISTRIBUTED DC-DC CONVERTERS FOR HIGHLY EFFICIENT PHOTOVOLTAIC POWER PLANTS
WO2012003032	2011	2012	SUNPOWER CORP	FABRICATION OF SOLAR CELLS WITH COUNTER DOPING PREVENTION
WO2012003033	2011	2012	SUNPOWER CORP	HIGH THROUGHPUT SOLAR CELL ABLATION SYSTEM
WO2012003038	2011	2012	SUNPOWER CORP	METHOD OF FABRICATING A SOLAR CELL WITH A TUNNEL DIELECTRIC LAYER
WO2012039830	2011	2012	SUNPOWER CORP	METHOD OF FABRICATING A SOLAR CELL
WO2012044762	2011	2012	DOW GLOBAL TECH INC	AN IMPROVED CONNECTOR AND ELECTRONIC CIRCUIT ASSEMBLY FOR IMPROVED WET INSULATION RESISTANCE
WO2012047749	2011	2012	3M CO	ANTI-REFLECTIVE ARTICLES WITH NANOSILICA-BASED COATINGS AND BARRIER LAYER
WO2012074523	2010	2012	ALLIANCE FOR SUST ENERGY LLC	METHODS OF PRODUCING FREE-STANDING SEMICONDUCTORS USING SACRIFICIAL BUFFER LAYERS AND RECYCLABLE SUBSTRATES
WO2012074524	2010	2012	ALLIANCE FOR SUST ENERGY LLC	COINCIDENT SITE LATTICE-MATCHED GROWTH OF SEMICONDUCTORS ON SUBSTRATES USING COMPLIANT BUFFER LAYERS
WO2012074602	2011	2012	SUNPOWER CORP	METHOD OF FORMING CONTACTS FOR A BACK-CONTACT SOLAR CELL
WO2012078227	2011	2012	PPG INDUSTRIES OHIO INC	CORROSION RESISTANT SOLAR MIRROR
WO2012082604	2011	2012	DOW GLOBAL TECH INC	IMPROVED PHOTOVOLTAIC DEVICE
WO2012082608	2011	2012	DOW GLOBAL TECH INC	IMPROVED PHOTOVOLTAIC DEVICE
WO2012082613	2011	2012	DOW GLOBAL	IMPROVED PHOTOVOLTAIC DEVICE

			TECH INC	
WO2012096715	2011	2012	SUNPOWER CORP	SUPPORT FOR SOLAR ENERGY COLLECTORS
WO2012102777	2011	2012	SUNPOWER CORP	FRAME-MOUNTED WIRE MANAGEMENT DEVICE
WO2012108882	2011	2012	ALLIANCE FOR SUST ENERGY LLC	WAFER SCREENING DEVICE AND METHODS FOR WAFER SCREENING
WO2012112191	2011	2012	SUNPOWER CORP	PROCESS AND STRUCTURES FOR FABRICATION OF SOLAR CELLS
WO2012112880	2012	2012	ALLIANCE FOR SUST ENERGY LLC	IN SITU OPTICAL DIAGNOSTIC FOR MONITORING OR CONTROL OF SODIUM DIFFUSION IN PHOTOVOLTAICS MANUFACTURING
WO2012129355	2012	2012	DOW GLOBAL TECH INC	IMPROVED PHOTOVOLTAIC BUILDING SHEATHING ELEMENT WITH ANTI-SLIDE FEATURES
WO2012129356	2012	2012	DOW GLOBAL TECH INC	IMPROVED PHOTOVOLTAIC SHEATHING ELEMENT WITH ONE OR MORE TABS
WO2012145012	2011	2012	UNIV MICHIGAN	LIGHT TRAPPING ARCHITECTURE FOR PHOTOVOLTAIC AND PHOTODETECTOR APPLICATIONS
WO2012148523	2012	2012	SUNPOWER CORP	METHOD OF FORING EMITTERS FOR A BACK-CONTACT SOLAR CELL
WO2012154307	2012	2012	DOW GLOBAL TECH INC	IMPROVED PHOTOVOLTAIC SHEATHING ELEMENT WITH A FLEXIBLE CONNECTOR ASSEMBLY
WO2012158847	2012	2012	UNIV CHICAGO	MATERIALS AND METHODS FOR THE PREPARATION OF NANOCOMPOSITES
WO2012177804	2012	2012	ALLIANCE FOR SUST ENERGY LLC	IMPROVED CDTE DEVICES AND METHOD OF MANUFACTURING SAME
8350145	2009	2013	UNIVERSITY OF ARIZONA	PHOTOVOLTAIC GENERATOR WITH A SPHERICAL IMAGING LENS FOR USE WITH A PARABOLOIDAL SOLAR REFLECTOR
8377358	2009	2013	DOW GLOBAL TECH INC	METHOD FOR ENCAPSULATING THE EDGE OF A FLEXIBLE SHEET
8377738	2010	2013	SUNPOWER CORP	FABRICATION OF SOLAR CELLS WITH COUNTER DOPING PREVENTION
8383943	2009	2013	GREENRAY INC	ELECTRICAL CABLE HARNESS AND ASSEMBLY FOR TRANSMITTING AC ELECTRICAL POWER
8397448	2012	2013	SUNLINK CORP	PHOTOVOLTAIC PANEL CLAMP
8399109	2012	2013	UNIV SOUTHERN CALIFORNIA	ORGANIC ELECTRONIC DEVICES USING PHTHALIMIDE COMPOUNDS
8402703	2009	2013	SUNPOWER CORP	MOUNTING SUPPORT FOR A PHOTOVOLTAIC MODULE
8409902	2012	2013	SUNPOWER CORP	ABLATION OF FILM STACKS IN SOLAR CELL FABRICATION PROCESSES

8415757	2011	2013	UNIV MICHIGAN, PRINCETON UNIVERSITY	ORGANIC HYBRID PLANAR-NANOCRYSTALLINE BULK HETEROJUNCTIONS
8418688	2009	2013	GREENRAY INC	ASSEMBLY AND METHOD FOR MOUNTING SOLAR PANELS TO STRUCTURAL SURFACES
8430090	2009	2013	UNIVERSITY OF ARIZONA	SOLAR CONCENTRATOR APPARATUS WITH LARGE, MULTIPLE, CO-AXIAL DISH REFLECTORS
8448391	2012	2013	SUNPOWER CORP	PHOTOVOLTAIC MODULE WITH REMOVABLE WIND DEFLECTOR
8449674	2009	2013	AMG IDEALCAST SOLAR CORP	SYSTEM AND METHOD FOR LIQUID SILICON CONTAINMENT
8450134	2010	2013	SUNPOWER CORP	TRENCH PROCESS AND STRUCTURE FOR BACKSIDE CONTACT SOLAR CELLS WITH POLYSILICON DOPED REGIONS
8450704	2010	2013	MASSACHUSETTS INST TECHNOLOGY	PHONON-ENHANCED CRYSTAL GROWTH AND LATTICE HEALING
8460963	2010	2013	SUNPOWER CORP	TRENCH PROCESS AND STRUCTURE FOR BACKSIDE CONTACT SOLAR CELLS WITH POLYSILICON DOPED REGIONS
8466447	2009	2013	ALLIANCE FOR SUST ENERGY LLC	BACK CONTACT TO FILM SILICON ON METAL FOR PHOTOVOLTAIC CELLS
8475758	2009	2013	MAYATERIALS INC	LOW COST ROUTES TO HIGH PURITY SILICON AND DERIVATIVES THEREOF
8492253	2010	2013	SUNPOWER CORP	METHOD OF FORMING CONTACTS FOR A BACK-CONTACT SOLAR CELL
8501526	2012	2013	ALLIANCE FOR SUST ENERGY LLC	SYNTHESIZING PHOTOVOLTAIC THIN FILMS OF HIGH QUALITY COPPER-ZINC-TIN ALLOY WITH AT LEAST ONE CHALCOGEN SPECIES
8507365	2009	2013	ALLIANCE FOR SUST ENERGY LLC	GROWTH OF COINCIDENT SITE LATTICE MATCHED SEMICONDUCTOR LAYERS AND DEVICES ON CRYSTALLINE SUBSTRATES
8513050	2010	2013	US DEPT OF ENERGY	BI-SE DOPED WITH CU, P-TYPE SEMICONDUCTOR
8516754	2012	2013	SUNPOWER CORP	PHOTOVOLTAIC MODULE AND MODULE ARRAYS
8519262	2010	2013	NANO C INC	FULLERENE-FUNCTIONALIZED PARTICLES, METHODS FOR MAKING THE SAME AND THEIR USE IN BULK-HETEROJUNCTION ORGANIC PHOTOVOLTAIC DEVICES
8534007	2009	2013	SUNPOWER CORP	PHOTOVOLTAIC ASSEMBLIES AND METHODS FOR TRANSPORTING
8535760	2010	2013	AIR PRODUCTS	ADDITIVES TO SILANE FOR THIN

			& CHEMICALS INC	FILM SILICON PHOTOVOLTAIC DEVICES
8552288	2009	2013	SUNPOWER CORP	PHOTOVOLTAIC MODULE WITH ADHESION PROMOTER
8552419	2011	2013	UNIV WASHINGTON	CROSS-CONJUGATED POLYMERS FOR ORGANIC ELECTRONIC DEVICES AND RELATED METHODS
8568828	2010	2013	ALLIANCE FOR SUST ENERGY LLC	AMORPHOUS TIN-CADMIUM OXIDE FILMS AND THE PRODUCTION THEREOF
8572836	2010	2013	SUNPOWER CORP	METHOD OF MANUFACTURING A LARGE-AREA SEGMENTED PHOTOVOLTAIC MODULE
8572908	2010	2013	DOW GLOBAL TECH INC	DIRECT MOUNTED PHOTOVOLTAIC DEVICE WITH IMPROVED FRONT CLIP
8575471	2009	2013	ALLIANCE FOR SUST ENERGY LLC	LATTICE MATCHED SEMICONDUCTOR GROWTH ON CRYSTALLINE METALLIC SUBSTRATES
8580599	2012	2013	SUNPOWER CORP	BYPASS DIODE FOR A SOLAR CELL
8580661	2011	2013	US DEPT OF ENERGY	METHOD FOR THE HYDROGENATION OF POLY-SI
8584406	2010	2013	SUNPOWER CORP	HOLE-THRU-LAMINATE MOUNTING SUPPORTS FOR PHOTOVOLTAIC MODULES
8584407	2010	2013	DOW GLOBAL TECH INC	DIRECT MOUNTED PHOTOVOLTAIC DEVICE WITH IMPROVED SIDE CLIP
8586397	2011	2013	SUNPOWER CORP	METHOD FOR FORMING DIFFUSION REGIONS IN A SILICON SUBSTRATE
8586403	2011	2013	SUNPOWER CORP	PROCESS AND STRUCTURES FOR FABRICATION OF SOLAR CELLS WITH LASER ABLATION STEPS TO FORM CONTACT HOLES
8591649	2008	2013	AMG IDEALCAST SOLAR CORP	METHODS FOR MANUFACTURING GEOMETRIC MULTI-CRYSTALLINE CAST MATERIALS
8592673	2009	2013	BOEING CO	ENCLOSED, OFF-AXIS SOLAR CONCENTRATOR
8604333	2011	2013	UNIVERSITY OF ARIZONA	METHOD OF MANUFACTURING REFLECTORS FOR A SOLAR CONCENTRATOR APPARATUS
8609994	2009	2013	ALLIANCE FOR SUST ENERGY LLC	THIN FILM ELECTRONIC DEVICES WITH CONDUCTIVE AND TRANSPARENT GAS AND MOISTURE PERMEATION BARRIERS
8615941	2012	2013	SUNPOWER CORP	PHOTOVOLTAIC MODULE KIT INCLUDING CONNECTOR ASSEMBLY FOR NON-PENETRATING ARRAY INSTALLATION
EP2541747	2012	2013	GENERAL ELECTRIC CO	DC TO DC POWER CONVERTERS AND METHODS OF CONTROLLING THE SAME
EP2545591	2011	2013	DOW GLOBAL TECH INC	IMPROVED PHOTOVOLTAIC DEVICE

EP2556548	2011	2013	UNIV MICHIGAN; UNIV SOUTHERN CALIFORNIA	ENHANCED BULK HETEROJUNCTION DEVICES PREPARED BY THERMAL AND SOLVENT VAPOR ANNEALING PROCESSES
EP2567409	2011	2013	SUNPOWER CORP	METHODS AND APPARATUSES TO SUPPORT PHOTOVOLTAIC MODULES
EP2576128	2011	2013	SUNPOWER CORP	ABLATION OF FILM STACKS IN SOLAR CELL FABRICATION PROCESSES
EP2577736	2011	2013	UNIV TOLEDO	PHOTOVOLTAIC STRUCTURES HAVING A LIGHT SCATTERING INTERFACE LAYER AND METHODS OF MAKING THE SAME
EP2588267	2011	2013	SUNPOWER CORP	HIGH THROUGHPUT SOLAR CELL ABLATION SYSTEM
EP2589086	2011	2013	SUNPOWER CORP	FABRICATION OF SOLAR CELLS WITH COUNTER DOPING PREVENTION
EP2589087	2011	2013	SUNPOWER CORP	METHOD OF FABRICATING A SOLAR CELL WITH A TUNNEL DIELECTRIC LAYER
EP2619805	2011	2013	SUNPOWER CORP	METHOD OF FABRICATING A SOLAR CELL
EP2622646	2011	2013	DOW GLOBAL TECH INC	AN IMPROVED CONNECTOR AND ELECTRONIC CIRCUIT ASSEMBLY FOR IMPROVED WET INSULATION RESISTANCE
EP2625314	2011	2013	3M CO	ANTI-REFLECTIVE ARTICLES WITH NANOSILICA-BASED COATINGS AND BARRIER LAYER
EP2647056	2011	2013	SUNPOWER CORP	METHOD OF FORMING CONTACTS FOR A BACK-CONTACT SOLAR CELL
EP2649652	2011	2013	PPG INDUSTRIES OHIO INC	CORROSION RESISTANT SOLAR MIRROR
EP2652795	2011	2013	SUNPOWER CORP	BYPASS DIODE FOR A SOLAR CELL
EP2652797	2011	2013	DOW GLOBAL TECH INC	IMPROVED PHOTOVOLTAIC DEVICE
EP2652798	2011	2013	DOW GLOBAL TECH INC	PHOTOVOLTAIC DEVICE
EP2652799	2011	2013	DOW GLOBAL TECH INC	IMPROVED PHOTOVOLTAIC DEVICE
EP2663816	2011	2013	SUNPOWER CORP	SUPPORT FOR SOLAR ENERGY COLLECTORS
EP2668671	2011	2013	SUNPOWER CORP	FRAME-MOUNTED WIRE MANAGEMENT DEVICE
EP2676302	2011	2013	SUNPOWER CORP	PROCESS AND STRUCTURES FOR FABRICATION OF SOLAR CELLS
WO2013002882	2012	2013	PPG INDUSTRIES OHIO INC	REFLECTIVE ARTICLE HAVING A SACRIFICIAL CATHODIC LAYER
WO2013006223	2012	2013	SUNPOWER CORP	PHOTOVOLTAIC MODULE AND LAMINATE

WO2013006616	2012	2013	DOW GLOBAL TECH INC	OPTOELECTRONIC DEVICES INCORPORATING FLUOROPOLYMER COMPOSITIONS FOR PROTECTION
WO2013028196	2011	2013	ALLIANCE FOR SUST ENERGY LLC	ON-LINE, CONTINUOUS MONITORING IN SOLAR CELL AND FUEL CELL MANUFACTURING USING SPECTRAL REFLECTANCE IMAGING
WO2013033729	2012	2013	ALLIANCE FOR SUST ENERGY LLC	ELECTRODEPOSTION OF GALLIUM FOR PHOTOVOLTAICS
WO2013049215	2012	2013	SUNPOWER CORP	DOPANT INK COMPOSITION AND METHOD OF FABRICATING A SOLAR CELL THERE FROM
WO2013049216	2012	2013	SUNPOWER CORP	METHOD FOR FORMING DIFFUSION REGIONS IN A SILICON SUBSTRATE
WO2013058724	2011	2013	SUNPOWER CORP	BYPASS DIODE FOR A SOLAR CELL
WO2013089879	2012	2013	SUNPOWER CORP	SOLAR CELL WITH DOPED GROOVE REGIONS SEPARATED BY RIDGES
WO2013095924	2012	2013	SUNPOWER CORP	LASER CONTACT PROCESSES, LASER SYSTEM, AND SOLAR CELL STRUCTURES FOR FABRICATING SOLAR CELLS WITH SILICON NANOPARTICLES
WO2013119550	2013	2013	ALLIANCE FOR SUST ENERGY LLC	THIN FILM PHOTOVOLTAIC DEVICES WITH A MINIMALLY CONDUCTIVE BUFFER LAYER
WO2013130652	2013	2013	ALLIANCE FOR SUST ENERGY LLC	SYSTEMS AND METHODS FOR FORMING SOLAR CELLS WITH CUINSE2 AND CU(IN,GA)SE2 FILMS
WO2013138132	2013	2013	UNIV MICHIGAN	METAL OXIDE CHARGE TRANSPORT MATERIAL DOPED WITH ORGANIC MOLECULES
WO2013152132	2013	2013	CALIFORNIA INST TECHNOLOGY	SEMICONDUCTOR STRUCTURES FOR FUEL GENERATION
WO2013158177	2013	2013	PLANT PV INC	MULTI-CRYSTALLINE II-VI BASED MULTIJUNCTION SOLAR CELLS
8624105	2010	2014	SYNKERA TECHNOLOGIES INC	ENERGY CONVERSION DEVICE WITH SUPPORT MEMBER HAVING PORE CHANNELS
8628614	2011	2014	AMG IDEALCAST SOLAR CORP	METHODS AND APPARATUS FOR MANUFACTURING MONOCRYSTALLINE CAST SILICON AND MONOCRYSTALLINE CAST SILICON BODIES FOR PHOTOVOLTAICS
8631757	2009	2014	NANOSOLAR INC	SOLUTION DEPOSITION ASSEMBLY
8633376	2009	2014	BOEING CO	PHOTOVOLTAIC CONCENTRATOR ASSEMBLY WITH OPTICALLY ACTIVE COVER
8642450	2007	2014	ALLIANCE FOR SUST ENERGY LLC	LOW TEMPERATURE JUNCTION GROWTH USING HOT-WIRE CHEMICAL VAPOR DEPOSITION

8647897	2012	2014	STANFORD UNIV	AIR-STABLE INK FOR SCALABLE, HIGH-THROUGHPUT LAYER DEPOSITION
8647911	2012	2014	SUNPOWER CORP	BACKSIDE CONTACT SOLAR CELL WITH FORMED POLYSILICON DOPED REGIONS
8650813	2013	2014	SUNPOWER CORP	PHOTOVOLTAIC MODULE WITH REMOVABLE WIND DEFLECTOR
8658454	2010	2014	SUNPOWER CORP	METHOD OF FABRICATING A SOLAR CELL
8659880	2011	2014	GREENRAY INC	AC PHOTOVOLTAIC MODULE AND INVERTER ASSEMBLY
8662008	2008	2014	SUNPOWER CORP	EDGE COATING APPARATUS FOR SOLAR CELL SUBSTRATES
8665610	2010	2014	GREENRAY INC	MODIFIED ZERO VOLTAGE TRANSITION (ZVT) FULL BRIDGE CONVERTER AND PHOTOVOLTAIC (PV) ARRAY USING THE SAME
8673673	2013	2014	SUNPOWER CORP	TRENCH PROCESS AND STRUCTURE FOR BACKSIDE CONTACT SOLAR CELLS WITH POLYSILICON DOPED REGIONS
8677701	2008	2014	BOEING CO	ATTACHING SOLAR COLLECTORS TO A STRUCTURAL FRAMEWORK UTILIZING A FLEXIBLE CLIP
8679438	2011	2014	MAYATERIALS INC	PLASMA PROCESSES FOR PRODUCING SILANES AND DERIVATIVES THEREOF
8685781	2011	2014	ALLIANCE FOR SUST ENERGY LLC	SECONDARY TREATMENT OF FILMS OF COLLOIDAL QUANTUM DOTS FOR OPTOELECTRONICS AND DEVICES PRODUCED THEREBY
8691663	2009	2014	ALLIANCE FOR SUST ENERGY LLC	METHODS OF MANIPULATING STRESSED EPISTRUCTURES
8697983	2012	2014	SUNCORE PHOTOVOLTAICS INC	CONCENTRATING PHOTOVOLTAIC SOLAR PANEL
8709154	2008	2014	AMG IDEALCAST SOLAR CORP	METHODS FOR MANUFACTURING MONOCRYSTALLINE OR NEAR-MONOCRYSTALLINE CAST MATERIALS
8709851	2012	2014	SUNPOWER CORP	METHOD OF FABRICATING A SOLAR CELL WITH A TUNNEL DIELECTRIC LAYER
8734621	2007	2014	ALLIANCE FOR SUST ENERGY LLC	TRANSPARENT CONDUCTING OXIDES AND PRODUCTION THEREOF
8735202	2011	2014	ALLIANCE FOR SUST ENERGY LLC	HIGH-EFFICIENCY, MONOLITHIC, MULTI-BANDGAP, TANDEM, PHOTOVOLTAIC ENERGY CONVERTERS
8735204	2013	2014	ALLIANCE FOR SUST ENERGY LLC	CONTACT FORMATION AND GETTERING OF PRECIPITATED IMPURITIES BY MULTIPLE FIRING DURING SEMICONDUCTOR DEVICE

				FABRICATION
8740642	2009	2014	DOW GLOBAL TECH INC	CONNECTOR DEVICE FOR BUILDING INTEGRATED PHOTOVOLTAIC DEVICE
8741060	2013	2014	AMG IDEALCAST SOLAR CORP	SYSTEM AND METHOD FOR LIQUID SILICON CONTAINMENT
8744791	2011	2014	SUNPOWER CORP	AUTOMATIC GENERATION AND ANALYSIS OF SOLAR CELL IV CURVES
8757567	2010	2014	SUNPOWER CORP	BRACKET FOR PHOTOVOLTAIC MODULES
8759144	2008	2014	ALLIANCE FOR SUST ENERGY LLC	FABRICATION OF CONTACTS FOR SILICON SOLAR CELLS INCLUDING PRINTING BURN THROUGH LAYERS
8772623	2012	2014	ALLIANCE FOR SUST ENERGY LLC	LOW-BANDGAP, MONOLITHIC, MULTI-BANDGAP, OPTOELECTRONIC DEVICES
8772628	2009	2014	ALLIANCE FOR SUST ENERGY LLC	HIGH PERFORMANCE, HIGH BANDGAP, LATTICE-MISMATCHED, GAINP SOLAR CELLS
8772894	2013	2014	SUNPOWER CORP	TRENCH PROCESS AND STRUCTURE FOR BACKSIDE CONTACT SOLAR CELLS WITH POLYSILICON DOPED REGIONS
8778787	2013	2014	SUNPOWER CORP	METHOD OF FORMING CONTACTS FOR A BACK-CONTACT SOLAR CELL
8780343	2011	2014	ALLIANCE FOR SUST ENERGY LLC	WAFER SCREENING DEVICE AND METHODS FOR WAFER SCREENING
8785236	2012	2014	SUNPOWER CORP	SOLAR CELL CONTACT FORMATION USING LASER ABLATION
8790957	2010	2014	SUNPOWER CORP	METHOD OF FABRICATING A BACK-CONTACT SOLAR CELL AND DEVICE THEREOF
8793942	2013	2014	SUNPOWER CORP	PHOTOVOLTAIC ASSEMBLIES AND METHODS FOR TRANSPORTING
8802486	2012	2014	SUNPOWER CORP	METHOD OF FORMING EMITTERS FOR A BACK-CONTACT SOLAR CELL
8815104	2012	2014	ALLIANCE FOR SUST ENERGY LLC	COPPER-ASSISTED, ANTI-REFLECTION ETCHING OF SILICON SURFACES
8816195	2009	2014	BOEING CO	LIGHT SHIELD FOR SOLAR CONCENTRATORS
8822262	2011	2014	SUNPOWER CORP	FABRICATING SOLAR CELLS WITH SILICON NANOPARTICLES
8822812	2012	2014	SUNPOWER CORP	PHOTOVOLTAIC MODULE AND INTERLOCKED STACK OF PHOTOVOLTAIC MODULES
8828765	2010	2014	ALLIANCE FOR SUST ENERGY LLC	FORMING HIGH EFFICIENCY SILICON SOLAR CELLS USING DENSITY-GRADED ANTI-REFLECTION SURFACES
8829342	2010	2014	UNIV TOLEDO	BACK CONTACT BUFFER LAYER FOR THIN-FILM SOLAR CELLS
8829634	2010	2014	DOW GLOBAL	OPTOELECTRONIC DEVICE

			TECH INC	
8829715	2011	2014	GENERAL ELECTRIC CO	SWITCHING COORDINATION OF DISTRIBUTED DC-DC CONVERTERS FOR HIGHLY EFFICIENT PHOTOVOLTAIC POWER PLANTS
8852994	2010	2014	MASIMO SEMICONDUCTOR INC	METHOD OF FABRICATING BIFACIAL TANDEM SOLAR CELLS
8859933	2012	2014	SUNPOWER CORP	HIGH THROUGHPUT SOLAR CELL ABLATION SYSTEM
8860424	2012	2014	SOLAR JUNCTION CORP	APPARATUS AND METHOD FOR HIGHLY ACCELERATED LIFE TESTING OF SOLAR CELLS
8878053	2012	2014	SUNPOWER CORP	FRONT CONTACT SOLAR CELL WITH FORMED EMITTER
8879253	2009	2014	LIGHT PRESCRIPTIONS INNOVATORS LLC	TRANSPARENT HEAT-SPREADER FOR OPTOELECTRONIC APPLICATIONS
8895844	2011	2014	STANFORD UNIV	SOLAR CELL COMPRISING A PLASMONIC BACK REFLECTOR AND METHOD THEREFOR
8898971	2013	2014	ZEP SOLAR LLC	PHOTOVOLTAIC ARRAY MOUNTING APPARATUS, SYSTEMS, AND METHODS
8912038	2014	2014	SUNPOWER CORP	METHOD OF FORMING EMITTERS FOR A BACK-CONTACT SOLAR CELL
8912426	2011	2014	DOW GLOBAL TECH INC	PHOTOVOLTAIC DEVICE
8915030	2010	2014	DOW GLOBAL TECH INC	DIRECT MOUNTED PHOTOVOLTAIC DEVICE WITH IMPROVED ADHESION AND METHOD THEREOF
EP2689467	2012	2014	DOW GLOBAL TECH INC	IMPROVED PHOTOVOLTAIC SHEATHING ELEMENT WITH ONE OR MORE TABS
EP2689469	2012	2014	DOW GLOBAL TECH INC	IMPROVED PHOTOVOLTAIC BUILDING SHEATHING ELEMENT WITH ANTI-SLIDE FEATURES
EP2689470	2012	2014	DOW GLOBAL TECH INC	IMPROVED PHOTOVOLTAIC SHEATHING ELEMENT WITH A FLEXIBLE CONNECTOR ASSEMBLY
EP2697820	2010	2014	ALLIANCE FOR SUST ENERGY LLC	WET-CHEMICAL METHOD FOR PRODUCING A BLACK SILICON SUBSTRATE
EP2700114	2011	2014	UNIV MICHIGAN	LIGHT TRAPPING ARCHITECTURE FOR PHOTOVOLTAIC AND PHOTODETECTOR APPLICATIONS
EP2702614	2012	2014	SUNPOWER CORP	METHOD OF FORMING EMITTERS FOR A BACK-CONTACT SOLAR CELL
EP2726918	2012	2014	PPG INDUSTRIES OHIO INC	REFLECTIVE ARTICLE HAVING A SACRIFICIAL CATHODIC LAYER
EP2727237	2012	2014	SUNPOWER CORP	PHOTOVOLTAIC MODULE AND LAMINATE
EP2729260	2012	2014	DOW GLOBAL TECH INC	OPTOELECTRONIC DEVICES INCORPORATING FLUOROPOLYMER

				COMPOSITIONS FOR PROTECTION
EP2761671	2012	2014	SUNPOWER CORP	SOLAR CELL WITH DOPED GROOVE REGIONS SEPARATED BY RIDGES
WO2014082002	2013	2014	UNIV MICHIGAN	USE OF INVERSE QUASI-EPITAXY TO MODIFY ORDER DURING POST-DEPOSITION PROCESSING OR ORGANIC PHOTOVOLTAICS
WO2014085639	2013	2014	UNIV MICHIGAN	HYBRID PLANAR-GRADED HETEROJUNCTION FOR ORGANIC PHOTOVOLTAICS
WO2014099308	2013	2014	SUNPOWER CORP	SOLAR CELL WITH SILICON OXYNITRIDE DIELECTRIC LAYER
WO2014100004	2013	2014	SUNPOWER CORP	HYBRID EMITTER ALL BACK CONTACT SOLAR CELL
WO2014138558	2014	2014	ALLIANCE FOR SUST ENERGY LLC	METHODS FOR PRODUCING THIN FILM CHARGE SELECTIVE TRANSPORT LAYERS
WO2014150485	2014	2014	SOLARBRIDGE TECHNOLOGIES INC	INVERTER COMMUNICATIONS USING OUTPUT SIGNAL
WO2014160942	2014	2014	GEORGIA TECH RES CORP	MOUNTING CLIPS FOR PANEL INSTALLATION
WO2014169270	2014	2014	UNIV MICHIGAN; UNIV SOUTHERN CALIFORNIA	ORGANIC PHOTOSENSITIVE DEVICES WITH EXCITON-BLOCKING CHARGE CARRIER FILTERS
8938920	2009	2015	DOW GLOBAL TECH INC	PHOTOVOLTAIC DEVICE AND METHOD
8940999	2009	2015	BOEING CO	MODULAR OFF-AXIS SOLAR CONCENTRATOR
8951344	2007	2015	AMG IDEALCAST SOLAR CORP	METHODS AND APPARATUSES FOR MANUFACTURING GEOMETRIC MULTICRYSTALLINE CAST SILICON AND GEOMETRIC MULTICRYSTALLINE CAST SILICON BODIES FOR PHOTOVOLTAICS
8955267	2013	2015	SUNPOWER CORP	HOLE-THRU-LAMINATE MOUNTING SUPPORTS FOR PHOTOVOLTAIC MODULES
8962082	2012	2015	SUNPOWER CORP	CONTROL SYSTEM FOR NON-CONTACT EDGE COATING APPARATUS FOR SOLAR CELL SUBSTRATES
8975717	2014	2015	SUNPOWER CORP	TRENCH PROCESS AND STRUCTURE FOR BACKSIDE CONTACT SOLAR CELLS WITH POLYSILICON DOPED REGIONS
8981204	2011	2015	SUNCORE PHOTOVOLTAICS INC	INTEGRATED SHIPPING AND INSTALLATION RACKING
8987115	2008	2015	ALLIANCE FOR SUST ENERGY LLC	EPITAXIAL GROWTH OF SILICON FOR LAYER TRANSFER
8987589	2006	2015	UNIV MICHIGAN,	ARCHITECTURES AND CRITERIA FOR THE DESIGN OF HIGH

			PRINCETON UNIVERSITY	EFFICIENCY ORGANIC PHOTOVOLTAIC CELLS
8992803	2011	2015	SUNPOWER CORP	DOPANT INK COMPOSITION AND METHOD OF FABRICATING A SOLAR CELL THERE FROM
8993881	2013	2015	UNIV MICHIGAN, PRINCETON UNIVERSITY	ARCHITECTURES AND CRITERIA FOR THE DESIGN OF HIGH EFFICIENCY ORGANIC PHOTOVOLTAIC CELLS
9003729	2014	2015	ZEP SOLAR LLC	PHOTOVOLTAIC ARRAY MOUNTING APPARATUS, SYSTEMS, AND METHODS
9013018	2011	2015	BENEQ OY, U S DEPT OF ENERGY	MULTILAYER MOISTURE BARRIER
9018033	2013	2015	SUNPOWER CORP	METHOD FOR FORMING DIFFUSION REGIONS IN A SILICON SUBSTRATE
9018516	2012	2015	SUNPOWER CORP	SOLAR CELL WITH SILICON OXYNITRIDE DIELECTRIC LAYER
9034216	2010	2015	ALLIANCE FOR SUST ENERGY LLC	WET-CHEMICAL SYSTEMS AND METHODS FOR PRODUCING BLACK SILICON SUBSTRATES
9041027	2010	2015	ALLIANCE FOR SUST ENERGY LLC	METHODS OF PRODUCING FREE-STANDING SEMICONDUCTORS USING SACRIFICIAL BUFFER LAYERS AND RECYCLABLE SUBSTRATES
9048358	2011	2015	DOW GLOBAL TECH INC	PHOTOVOLTAIC DEVICE
9054251	2011	2015	BOEING CO	SOLAR COLLECTOR ARRAY
9054264	2013	2015	ALLIANCE FOR SUST ENERGY LLC	SYSTEMS AND METHODS FOR SOLAR CELLS WITH CIS AND CIGS FILMS MADE BY REACTING EVAPORATED COPPER CHLORIDES WITH SELENIUM
9070811	2013	2015	PLANT PV INC	MULTI-CRYSTALLINE II-VI BASED MULTIJUNCTION SOLAR CELLS AND MODULES
9075012	2012	2015	ALLIANCE FOR SUST ENERGY LLC	PHOTOLUMINESCENCE-BASED QUALITY CONTROL FOR THIN FILM ABSORBER LAYERS OF PHOTOVOLTAIC DEVICES
9076903	2014	2015	ALLIANCE FOR SUST ENERGY LLC	FORMING HIGH-EFFICIENCY SILICON SOLAR CELLS USING DENSITY-GRADED ANTI-REFLECTION SURFACES
9076915	2011	2015	ALLIANCE FOR SUST ENERGY LLC	BORON, BISMUTH CO-DOPING OF GALLIUM ARSENIDE AND OTHER COMPOUNDS FOR PHOTONIC AND HETEROJUNCTION BIPOLAR TRANSISTOR DEVICES
9087939	2014	2015	SUNPOWER CORP	SOLAR CELL CONTACT FORMATION USING LASER ABLATION
9093661	2013	2015	ALLIANCE FOR SUST ENERGY LLC	THIN FILM ELECTRONIC DEVICES WITH CONDUCTIVE AND TRANSPARENT GAS AND MOISTURE

				PERMEATION BARRIERS
9112066	2014	2015	SUNPOWER CORP	METHOD OF FABRICATING A SOLAR CELL WITH A TUNNEL DIELECTRIC LAYER
9123847	2011	2015	DOW GLOBAL TECH INC	PHOTOVOLTAIC DEVICE
9130091	2012	2015	DOW GLOBAL TECH INC	PHOTOVOLTAIC BUILDING SHEATHING ELEMENT WITH ANTI-SLIDE FEATURES
9130092	2010	2015	SANDIA CORP	PHOTOVOLTAIC SOLAR CELL
9136184	2012	2015	ALLIANCE FOR SUST ENERGY LLC	IN SITU OPTICAL DIAGNOSTIC FOR MONITORING OR CONTROL OF SODIUM DIFFUSION IN PHOTOVOLTAICS MANUFACTURING
9142696	2014	2015	SUNPOWER CORP	SOLAR CELLS WITH SILICON NANOPARTICLES THAT ARE COATED WITH NANOPARTICLE PASSIVATION FILM
9147786	2009	2015	DOW GLOBAL TECH INC	PHOTOVOLTAIC DEVICE ASSEMBLY AND METHOD
9147793	2012	2015	ALLIANCE FOR SUST ENERGY LLC	CDTE DEVICES AND METHOD OF MANUFACTURING SAME
9147795	2014	2015	SUNPOWER CORP	METHOD OF FORMING EMITTERS FOR A BACK-CONTACT SOLAR CELL
9147852	2010	2015	UNIV FLORIDA	AIR STABLE ORGANIC-INORGANIC NANOPARTICLES HYBRID SOLAR CELLS
9153720	2011	2015	BOEING CO	ELECTRICAL INTERCONNECT
9159851	2011	2015	UNIV TOLEDO	PHOTOVOLTAIC STRUCTURES HAVING A LIGHT SCATTERING INTERFACE LAYER AND METHODS OF MAKING THE SAME
9163861	2013	2015	GEORGIA TECH RES CORP, RADIANCE SOLAR	SOLAR PANEL TRUSS MOUNTING SYSTEMS AND METHODS
9166079	2014	2015	SUNPOWER CORP	METHOD OF FORMING CONTACTS FOR A BACK-CONTACT SOLAR CELL
9184310	2014	2015	DOW GLOBAL TECH INC	CONNECTOR DEVICE FOR BUILDING INTEGRATED PHOTOVOLTAIC DEVICE
9184327	2006	2015	SUNPOWER CORP	FORMED PHOTOVOLTAIC MODULE BUSBARS
9186741	2009	2015	SUNPOWER CORP	INDUCTION SOLDERING OF PHOTOVOLTAIC SYSTEM COMPONENTS
9196756	2015	2015	DOW GLOBAL TECH INC	PHOTOVOLTAIC DEVICE AND METHOD
9202960	2010	2015	SUNPOWER CORP	LEAKAGE PATHWAY LAYER FOR SOLAR CELL
9214574	2012	2015	UNIV WASHINGTON	FULLERENE SURFACTANTS AND THEIR USE IN POLYMER SOLAR CELLS
9219182	2012	2015	DOW GLOBAL	OPTOELECTRONIC DEVICES

			TECH INC	INCORPORATING FLUOROPOLYMER COMPOSITIONS FOR PROTECTION
EP2826081	2013	2015	UNIV MICHIGAN	METAL OXIDE CHARGE TRANSPORT MATERIAL DOPED WITH ORGANIC MOLECULES
EP2834853	2013	2015	ALLIANCE FOR SUST ENERGY LLC	METHOD FOR FORMING SOLAR CELLS WITH CUINSE2 AND CU(IN,GA)SE2 FILMS
EP2923390	2013	2015	UNIV MICHIGAN	USE OF INVERSE QUASI-EPITAXY TO MODIFY ORDER DURING POST-DEPOSITION PROCESSING OF ORGANIC PHOTOVOLTAICS
EP2926387	2013	2015	UNIV MICHIGAN	HYBRID PLANAR-GRADED HETEROJUNCTION FOR ORGANIC PHOTOVOLTAICS
EP2936570	2013	2015	SUNPOWER CORP	HYBRID EMITTER ALL BACK CONTACT SOLAR CELL AND METHOD OF MANUFACTURING THE SAME
WO2015026932	2014	2015	MASSACHUSETTS INST TECHNOLOGY	INTERNALLY-HEATED THERMAL AND EXTERNALLY-COOL PHOTOVOLTAIC CASCADE SOLAR ENERGY SYSTEM FOR FULL SOLAR SPECTRUM UTILIZATION
WO2015038340	2014	2015	ADVANCED SILICON GROUP INC	METAL ASSISTED ETCH COMBINED WITH REGULARIZING ETCH
WO2015081204	2014	2015	SUNPOWER CORP	INTEGRATION OF MICROINVERTER WITH PHOTOVOLTAIC MODULE
WO2015123013	2015	2015	PICASOLAR INC	SOLAR CELLS AND METHODS OF FABRICATION THEREOF
WO2015148156	2015	2015	VARIAN SEMICONDUCTOR	SYSTEM AND METHOD FOR CRYSTALLINE SHEET GROWTH USING A COLD BLOCK AND GAS JET
9231135	2014	2016	ALLIANCE FOR SUST ENERGY LLC	LOW-BANDGAP, MONOLITHIC, MULTI-BANDGAP, OPTOELECTRONIC DEVICES
9231145	2015	2016	SUNPOWER CORP	TRENCH PROCESS AND STRUCTURE FOR BACKSIDE CONTACT SOLAR CELLS WITH POLYSILICON DOPED REGIONS
9231517	2015	2016	SOLARCITY CORP	PHOTOVOLTAIC ARRAY MOUNTING APPARATUS, SYSTEMS, AND METHODS
9234843	2011	2016	ALLIANCE FOR SUST ENERGY LLC	ON-LINE, CONTINUOUS MONITORING IN SOLAR CELL AND FUEL CELL MANUFACTURING USING SPECTRAL REFLECTANCE IMAGING
9236511	2014	2016	ALLIANCE FOR SUST ENERGY LLC	FABRICATION OF IONIC LIQUID ELECTRODEPOSITED CU—SN—ZN—S—SE THIN FILMS AND METHOD OF MAKING
9243818	2008	2016	SUNPOWER CORP	STACKABLE TRACKING SOLAR COLLECTOR ASSEMBLY
9263602	2013	2016	SUNPOWER	LASER PROCESSING OF SOLAR

			CORP	CELLS WITH ANTI-REFLECTIVE COATING
9263622	2014	2016	SUNPOWER CORP	METHOD OF FABRICATING A SOLAR CELL
9281429	2012	2016	SUNPOWER CORP	MODULE LEVEL SOLUTIONS TO SOLAR CELL POLARIZATION
9285584	2011	2016	3M CO	ANTI-REFLECTIVE ARTICLES WITH NANOSILICA-BASED COATINGS AND BARRIER LAYER
9287426	2014	2016	IBM CORP	EPITAXIAL GROWTH OF CZT(S,SE) ON SILICON
9287430	2007	2016	SANDIA CORP	PHOTOVOLTAIC SOLAR CONCENTRATOR
9287431	2014	2016	ALLIANCE FOR SUST ENERGY LLC	SUPERSTRATE SUB-CELL VOLTAGE-MATCHED MULTIJUNCTION SOLAR CELLS
9293615	2015	2016	ALLIANCE FOR SUST ENERGY LLC	LOW-BANDGAP, MONOLITHIC, MULTI-BANDGAP, OPTOELECTRONIC DEVICES
9300140	2012	2016	GENERAL ELECTRIC CO	SYSTEM AND METHOD FOR DESIGN AND OPTIMIZATION OF GRID CONNECTED PHOTOVOLTAIC POWER PLANT WITH MULTIPLE PHOTOVOLTAIC MODULE TECHNOLOGIES
9312406	2012	2016	SUNPOWER CORP	HYBRID EMITTER ALL BACK CONTACT SOLAR CELL
9324562	2015	2016	ALLIANCE FOR SUST ENERGY LLC	METAL HALIDE SOLID-STATE SURFACE TREATMENT FOR NANOCRYSTAL MATERIALS
9324898	2013	2016	ALLIANCE FOR SUST ENERGY LLC	VARYING CADMIUM TELLURIDE GROWTH TEMPERATURE DURING DEPOSITION TO INCREASE SOLAR CELL RELIABILITY
9343378	2014	2016	ALLIANCE FOR SUST ENERGY LLC	OPTICAL CONTROL OF MULTI-STAGE THIN FILM SOLAR CELL PRODUCTION
9346998	2010	2016	UNIV CHICAGO	MATERIALS AND METHODS FOR THE PREPARATION OF NANOCOMPOSITES
9362429	2014	2016	ALLIANCE FOR SUST ENERGY LLC	PHOTOVOLTAIC SEMICONDUCTOR MATERIALS BASED ON ALLOYS OF TIN SULFIDE, AND METHODS OF PRODUCTION
9368670	2015	2016	UNIV OREGON	GAAS THIN FILMS AND METHODS OF MAKING AND USING THE SAME
9368671	2014	2016	MASIMO SEMICONDUCTOR INC	BIFACIAL TANDEM SOLAR CELLS
9379660	2015	2016	GEORGIA TECH RES CORP, RADIANCE SOLAR	SOLAR PANEL TRUSS MOUNTING SYSTEMS AND METHODS
9391223	2012	2016	DOW GLOBAL TECH INC	PHOTOVOLTAIC SHEATHING ELEMENT WITH A FLEXIBLE CONNECTOR ASSEMBLY

9391380	2013	2016	SUNEDISON INC	ELECTRICAL CABLE HARNESS AND ASSEMBLY FOR TRANSMITTING AC ELECTRICAL POWER
9397240	2010	2016	PPG INDUSTRIES OHIO INC	CORROSION RESISTANT SOLAR MIRROR
9398712	2011	2016	DOW GLOBAL TECH INC	CONNECTOR AND ELECTRONIC CIRCUIT ASSEMBLY FOR IMPROVED WET INSULATION RESISTANCE
9406821	2014	2016	SUNPOWER CORP	METHOD OF FABRICATING A BACK-CONTACT SOLAR CELL AND DEVICE THEREOF
9410259	2012	2016	ALLIANCE FOR SUST ENERGY LLC	ELECTRODEPOSITION OF GALLIUM FOR PHOTOVOLTAICS
9412960	2011	2016	UNIV MICHIGAN	LIGHT TRAPPING ARCHITECTURE FOR PHOTOVOLTAIC AND PHOTODECTOR APPLICATIONS
9419170	2015	2016	ALLIANCE FOR SUST ENERGY LLC	CONTROLLING THE STOICHIOMETRY AND DOPING OF SEMICONDUCTOR MATERIALS
9425249	2010	2016	ALLIANCE FOR SUST ENERGY LLC	COINCIDENT SITE LATTICE-MATCHED GROWTH OF SEMICONDUCTORS ON SUBSTRATES USING COMPLIANT BUFFER LAYERS
9431621	2012	2016	UNIV MICHIGAN	METAL OXIDE CHARGE TRANSPORT MATERIAL DOPED WITH ORGANIC MOLECULES
9437755	2012	2016	SUNPOWER CORP	FRONT CONTACT SOLAR CELL WITH FORMED ELECTRICALLY CONDUCTING LAYERS ON THE FRONT SIDE AND BACKSIDE
9437763	2015	2016	SUNPOWER CORP	TRENCH PROCESS AND STRUCTURE FOR BACKSIDE CONTACT SOLAR CELLS WITH POLYSILICON DOPED REGIONS
9450130	2011	2016	SUNPOWER CORP	FRAME-MOUNTED WIRE MANAGEMENT DEVICE
9457429	2004	2016	FIRST SOLAR INC	METHOD AND APPARATUS FOR LASER SCRIBING GLASS SHEET SUBSTRATE COATINGS
9482449	2011	2016	SUNPOWER CORP	SUPPORT FOR SOLAR ENERGY COLLECTORS
9484480	2014	2016	ALLIANCE FOR SUST ENERGY LLC	HIGH PERFORMANCE, HIGH BANDGAP, LATTICE-MISMATCHED, GAINP SOLAR CELLS
9496426	2013	2016	ALLIANCE FOR SUST ENERGY LLC	THIN FILM PHOTOVOLTAIC DEVICES WITH A MINIMALLY CONDUCTIVE BUFFER LAYER
9515275	2009	2016	UNIV MICHIGAN	INVERTED ORGANIC PHOTOSENSITIVE DEVICES
9527164	2014	2016	SUNPOWER CORP	HIGH THROUGHPUT LASER PROCESSING
9530908	2014	2016	IBM CORP	HYBRID VAPOR PHASE-SOLUTION PHASE GROWTH TECHNIQUES FOR

				IMPROVED CZT(S,SE) PHOTOVOLTAIC DEVICE PERFORMANCE
EP2965366	2014	2016	ALLIANCE FOR SUST ENERGY LLC	METHODS FOR PRODUCING THIN FILM CHARGE SELECTIVE TRANSPORT LAYERS
EP2973979	2014	2016	SUNPOWER CORP	INVERTER COMMUNICATIONS USING OUTPUT SIGNAL
EP2984690	2014	2016	UNIV MICHIGAN; UNIV SOUTHERN CALIFORNIA	ORGANIC PHOTOSENSITIVE DEVICES WITH EXCITON-BLOCKING CHARGE CARRIER FILTERS
EP2999009	2009	2016	DOW GLOBAL TECH INC	PHOTOVOLTAIC DEVICE ASSEMBLY AND METHOD
EP3065184	2009	2016	SUNPOWER CORP	TRENCH PROCESS AND STRUCTURE FOR BACKSIDE CONTACT SOLAR CELLS WITH POLYSILICON DOPED REGIONS
EP3065191	2009	2016	UNIV MICHIGAN	INVERTED ORGANIC PHOTOSENSITIVE DEVICES
EP3075218	2014	2016	SUNPOWER CORP	INTEGRATION OF MICROINVERTER WITH PHOTOVOLTAIC MODULE
EP3093890	2010	2016	SUNPOWER CORP	PHOTOVOLTAIC MODULE AND INTERLOCKED STACK OF PHOTOVOLTAIC MODULES
EP3105797	2015	2016	PICASOLAR INC	SOLAR CELLS AND METHODS OF FABRICATION THEREOF
WO2016057429	2015	2016	CALIFORNIA INST TECH	PHOTON AND CARRIER MANAGEMENT DESIGN FOR NONPLANAR THIN-FILM COPPER INDIUM GALLIUM DISELENIDE PHOTOVOLTAICS
WO2016118975	2016	2016	ALLIANCE FOR SUST ENERGY LLC	LUMINESCENCE IMAGING SYSTEMS AND METHODS FOR EVALUATING PHOTOVOLTAIC DEVICES
9537030	2015	2017	SUNPOWER CORP	METHOD OF FABRICATING A SOLAR CELL WITH A TUNNEL DIELECTRIC LAYER
9537444	2014	2017	TAU SCIENCE CORP	METHODS AND SYSTEMS FOR CHARACTERIZING PHOTOVOLTAIC CELL AND MODULE PERFORMANCE AT VARIOUS STAGES IN THE MANUFACTURING PROCESS
9540741	2013	2017	CALIFORNIA INST TECHNOLOGY	LIGHT-DRIVEN HYDROIODIC ACID SPLITTING FROM SEMICONDUCTIVE FUEL GENERATOR
9543537	2014	2017	ALLIANCE FOR SUST ENERGY LLC	SOLUTION PROCESSED METAL OXIDE THIN FILM HOLE TRANSPORT LAYERS FOR HIGH PERFORMANCE ORGANIC SOLAR CELLS
9559228	2011	2017	SUNPOWER CORP	SOLAR CELL WITH DOPED GROOVE REGIONS SEPARATED BY RIDGES
9564545	2012	2017	DOW GLOBAL TECH INC	PHOTOVOLTAIC SHEATHING ELEMENT WITH ONE OR MORE

				TABS
9564551	2016	2017	SUNPOWER CORP	METHOD OF MANUFACTURING A HYBRID EMITTER ALL BACK CONTACT SOLAR CELL
9564835	2013	2017	SUNPOWER CORP	INVERTER COMMUNICATIONS USING OUTPUT SIGNAL
9571031	2014	2017	GEORGIA TECH RES CORP	MOUNTING CLIPS FOR PANEL INSTALLATION
9583667	2013	2017	ALLIANCE FOR SUST ENERGY LLC	SYSTEMS AND METHODS FOR FORMING SOLAR CELLS WITH CUINSE(SUB)2 AND CU(IN,GA)SE(SUB)2 FILMS
9583724	2016	2017	NUTECH VENTURES	SYSTEMS AND METHODS FOR SCALABLE PEROVSKITE DEVICE FABRICATION
9590131	2014	2017	ALLIANCE FOR SUST ENERGY LLC	SYSTEMS AND METHODS FOR ADVANCED ULTRA-HIGH-PERFORMANCE INP SOLAR CELLS
9602046	2011	2017	DOW GLOBAL TECH INC	PHOTOVOLTAIC DEVICE
9608141	2015	2017	IBM CORP	FLUORINATED TIN OXIDE BACK CONTACT FOR AZTSSE PHOTOVOLTAIC DEVICES
9641125	2016	2017	ALLIANCE FOR SUST ENERGY LLC	LUMINESCENCE IMAGING SYSTEMS AND METHODS FOR EVALUATING PHOTOVOLTAIC DEVICES
9647158	2014	2017	ALLIANCE FOR SUST ENERGY LLC	PHOTOVOLTAIC SUB-CELL INTERCONNECTS
9660125	2015	2017	BOEING CO	METHOD OF MAKING A MODULAR OFF-AXIS SOLAR CONCENTRATOR
9666735	2016	2017	SUNPOWER CORP	TRENCH PROCESS AND STRUCTURE FOR BACKSIDE CONTACT SOLAR CELLS WITH POLYSILICON DOPED REGIONS
9685904	2013	2017	GENERAL ELECTRIC CO	PHOTOVOLTAIC SYSTEM WITH IMPROVED DC CONNECTIONS AND METHOD OF MAKING SAME
9705103	2010	2017	UNIV HOUSTON	WRAPPED OPTOELECTRONIC DEVICES AND METHODS FOR MAKING SAME
9705447	2013	2017	GEORGIA TECH RES CORP	MOUNTING CLIPS FOR PANEL INSTALLATION
9716195	2015	2017	IBM CORP	DRY ETCH METHOD FOR TEXTURING SILICON AND DEVICE
9722111	2015	2017	ALLIANCE FOR SUST ENERGY LLC	SURFACE PASSIVATION FOR CDTE DEVICES
9722122	2015	2017	ALLIANCE FOR SUST ENERGY LLC	BORON, BISMUTH CO-DOPING OF GALLIUM ARSENIDE AND OTHER COMPOUNDS FOR PHOTONIC AND HETEROJUNCTION BIPOLAR TRANSISTOR DEVICES
9722131	2009	2017	BOEING CO	HIGHLY DOPED LAYER FOR TUNNEL JUNCTIONS IN SOLAR CELLS

9743501	2014	2017	SUNPOWER CORP	APPARATUSES TO SUPPORT PHOTOVOLTAIC MODULES
9758426	2011	2017	VITRO SAB DE C V	REFLECTIVE ARTICLE HAVING A SACRIFICIAL CATHODIC LAYER
9768015	2016	2017	ALLIANCE FOR SUST ENERGY LLC	METHODS OF FORMING CIGS FILMS
9768402	2011	2017	UNIV SOUTHERN CALIFORNIA	ENHANCED BULK HETEROJUNCTION DEVICES PREPARED BY THERMAL AND SOLVENT VAPOR ANNEALING PROCESSES
9799783	2015	2017	SUNPOWER CORP	DOPANT INK COMPOSITION AND METHOD OF FABRICATING A SOLAR CELL THERE FROM
9812660	2016	2017	NUTECH VENTURES	METHOD FOR SINGLE CRYSTAL GROWTH OF PHOTOVOLTAIC PEROVSKITE MATERIAL AND DEVICES
9825193	2015	2017	CALIFORNIA INST TECH	PHOTON AND CARRIER MANAGEMENT DESIGN FOR NONPLANAR THIN-FILM COPPER INDIUM GALLIUM DISELENIDE PHOTOVOLTAICS
9831359	2016	2017	SUNPOWER CORP	LASER PROCESS AND CORRESPONDING STRUCTURES FOR FABRICATION OF SOLAR CELLS WITH SHUNT PREVENTION DIELECTRIC
9842952	2015	2017	DOW CORNING CORP	PHOTOVOLTAIC CELL MODULE AND METHOD OF FORMING
9847487	2013	2017	UNIV MICHIGAN	USE OF INVERSE QUASI-EPITAXY TO MODIFY ORDER DURING POST-DEPOSITION PROCESSING OF ORGANIC PHOTOVOLTAICS
EP3123523	2015	2017	VARIAN SEMICONDUCTOR	SYSTEM AND METHOD FOR CRYSTALLINE SHEET GROWTH USING A COLD BLOCK AND GAS JET
EP3136448	2007	2017	SUNPOWER CORP	FORMED PHOTOVOLTAIC MODULE BUSBARS
EP3151420	2009	2017	SUNPOWER CORP	PHOTOVOLTAIC MODULE AND MODULE ARRAYS
EP3248283	2016	2017	ALLIANCE FOR SUST ENERGY LLC	LUMINESCENCE IMAGING SYSTEMS AND METHODS FOR EVALUATING PHOTOVOLTAIC DEVICES
9859515	2014	2018	ALLIANCE FOR SUST ENERGY LLC	METHODS FOR PRODUCING THIN FILM CHARGE SELECTIVE TRANSPORT LAYERS
9876130	2016	2018	IBM CORP	METHOD FOR FORMING SILVER-COPPER MIXED KESTERITE SEMICONDUCTOR FILM
9882001	2012	2018	UNIV CHICAGO	MATERIALS AND METHODS FOR THE PREPARATION OF NANOCOMPOSITES
9882524	2016	2018	GEORGIA TECH RES CORP,	SOLAR PANEL TRUSS MOUNTING SYSTEMS AND METHODS

			RADIANCE SOLAR	
9893678	2013	2018	GENERAL ELECTRIC CO	PHOTOVOLTAIC SYSTEM WITH IMPROVED AC CONNECTIONS AND METHOD OF MAKING SAME
9897642	2015	2018	NATL TECH & ENG SOLUTIONS OF SANDIA	DETECTION OF ARCING LOCATION ON PHOTOVOLTAIC SYSTEMS USING FILTERS
9911873	2016	2018	ALLIANCE FOR SUST ENERGY LLC	HYDROGENATION OF PASSIVATED CONTACTS
9911878	2014	2018	ADVANCED SILICON GROUP INC	METAL-ASSISTED ETCH COMBINED WITH REGULARIZING ETCH
9929296	2009	2018	SUNPOWER CORP	EDGE REFLECTOR OR REFRACTOR FOR BIFACIAL SOLAR MODULE
9929298	2017	2018	SUNPOWER CORP	TRENCH PROCESS AND STRUCTURE FOR BACKSIDE CONTACT SOLAR CELLS WITH POLYSILICON DOPED REGIONS
9935214	2015	2018	IBM CORP	LIFTOFF PROCESS FOR EXFOLIATION OF THIN FILM PHOTOVOLTAIC DEVICES AND BACK CONTACT FORMATION
9939485	2013	2018	NATL TECH & ENG SOLUTIONS OF SANDIA	PROGNOSTICS AND HEALTH MANAGEMENT OF PHOTOVOLTAIC SYSTEMS
9941435	2011	2018	SUNPOWER CORP	PHOTOVOLTAIC MODULE AND LAMINATE
9947816	2013	2018	CALIFORNIA INST TECH	SEMICONDUCTOR STRUCTURES FOR FUEL GENERATION
9957636	2014	2018	VARIAN SEMICONDUCTOR	SYSTEM AND METHOD FOR CRYSTALLINE SHEET GROWTH USING A COLD BLOCK AND GAS JET
9960287	2014	2018	PICASOLAR INC	SOLAR CELLS AND METHODS OF FABRICATION THEREOF
9985159	2016	2018	ALLIANCE FOR SUST ENERGY LLC	PASSIVATED CONTACT FORMATION USING ION IMPLANTATION
9995796	2014	2018	NATL TECH & ENG SOLUTIONS OF SANDIA	IDENTIFYING AN ARC-FAULT TYPE IN PHOTOVOLTAIC ARRAYS
10008618	2017	2018	IBM CORP	LIFTOFF PROCESS FOR EXFOLIATION OF THIN FILM PHOTOVOLTAIC DEVICES AND BACK CONTACT FORMATION
10008979	2014	2018	SUNPOWER CORP	INTEGRATION OF MICROINVERTER WITH PHOTOVOLTAIC MODULE
10014423	2016	2018	IBM CORP	CHALCOGEN BACK SURFACE FIELD LAYER
10026856	2017	2018	ALLIANCE FOR SUST ENERGY LLC	SYSTEMS AND METHODS FOR ADVANCED ULTRA-HIGH-PERFORMANCE INP SOLAR CELLS

10032949	2015	2018	IBM CORP	PHOTOVOLTAIC DEVICE BASED ON AG(SUB)2ZNSN(S,SE)(SUB)4 ABSORBER
10043922	2013	2018	UNIV TOLEDO	BACK CONTACT LAYER FOR PHOTOVOLTAIC CELLS
10043932	2014	2018	MASSACHUSETTS INST TECHNOLOGY	INTERNALLY-HEATED THERMAL AND EXTERNALLY-COOL PHOTOVOLTAIC CASCADE SOLAR ENERGY SYSTEM FOR FULL SOLAR SPECTRUM UTILIZATION
10069095	2014	2018	UNIV SOUTHERN CALIFORNIA	ORGANIC PHOTOSENSITIVE DEVICES WITH EXCITON-BLOCKING CHARGE CARRIER FILTERS
10079321	2016	2018	IBM CORP	TECHNIQUE FOR ACHIEVING LARGE-GRAIN AG(SUB)2ZNSN(S,SE)(SUB)4THIN FILMS
10121910	2015	2018	SUNPOWER CORP	FORMED PHOTOVOLTAIC MODULE BUSBARS
10121911	2015	2018	DOW GLOBAL TECH INC	PHOTOVOLTAIC DEVICE ASSEMBLY AND METHOD
10121925	2011	2018	UNIV FLORIDA	THIN FILM PHOTOVOLTAIC DEVICES WITH MICROLENS ARRAYS
10121952	2016	2018	UNIV CHICAGO	MATERIALS AND METHODS FOR THE PREPARATION OF NANOCOMPOSITES
10128395	2018	2018	SUNPOWER CORP	TRENCH PROCESS AND STRUCTURE FOR BACKSIDE CONTACT SOLAR CELLS WITH POLYSILICON DOPED REGIONS
10134929	2015	2018	IBM CORP	ACHIEVING BAND GAP GRADING OF CZTS AND CZTSE MATERIALS
10135386	2014	2018	SMASH SOLAR INC	SENSING, INTERLOCKING SOLAR MODULE SYSTEM AND INSTALLATION METHOD
10141531	2013	2018	UNIV MICHIGAN	HYBRID PLANAR-GRADED HETEROJUNCTION FOR ORGANIC PHOTOVOLTAICS
EP3299109	2011	2018	SUNPOWER CORP	HIGH THROUGHPUT SOLAR CELL ABLATION SYSTEM
EP3327811	2014	2018	UNIV MICHIGAN; UNIV SOUTHERN CALIFORNIA	ORGANIC PHOTOSENSITIVE DEVICES WITH EXCITON-BLOCKING CHARGE CARRIER FILTERS
10193092	2017	2019	NUTECH VENTURES	SYSTEMS AND METHODS FOR SCALABLE PEROVSKITE DEVICE FABRICATION
10211349	2015	2019	SUNPOWER CORP	SOLAR CELL CONTACT FORMATION USING LASER ABLATION
10230014	2016	2019	IBM CORP	HYBRID VAPOR PHASE-SOLUTION PHASE GROWTH TECHNIQUES FOR IMPROVED CZT(S,SE) PHOTOVOLTAIC DEVICE PERFORMANCE

10269994	2017	2019	IBM CORP	LIFTOFF PROCESS FOR EXFOLIATION OF THIN FILM PHOTOVOLTAIC DEVICES AND BACK CONTACT FORMATION
10304972	2015	2019	SUNPOWER CORP	SOLAR CELL WITH SILICON OXYNITRIDE DIELECTRIC LAYER
10319871	2018	2019	IBM CORP	PHOTOVOLTAIC DEVICE BASED ON AG2ZNSN(S,SE)4 ABSORBER
10326042	2016	2019	BOEING CO	HIGHLY DOPED LAYER FOR TUNNEL JUNCTIONS IN SOLAR CELLS
10396230	2018	2019	SUNPOWER CORP	BACKSIDE CONTACT SOLAR CELLS WITH SEPARATED POLYSILICON DOPED REGIONS
10396704	2017	2019	GEORGIA TECH RES CORP	SOLAR PANEL TRUSS MOUNTING SYSTEMS AND METHODS
10404190	2017	2019	ENPHASE ENERGY INC	INVERTER COMMUNICATIONS USING OUTPUT SIGNAL
10475945	2016	2019	SUNPOWER CORP	FRONT CONTACT SOLAR CELL WITH FORMED ELECTRICALLY CONDUCTING LAYERS ON THE FRONT SIDE AND BACKSIDE
EP3425682	2009	2019	SUNPOWER CORP	FRONT CONTACT SOLAR CELL WITH BACKSIDE POLY-CRYSTALLINE SILICON EMITTER
EP3496164	2009	2019	SUNPOWER CORP	FRONT CONTACT SOLAR CELL WITH FORMED ELECTRICALLY CONDUCTING LAYERS ON THE FRONT SIDE AND BACKSIDE
10536110	2016	2020	SUNPOWER CORP	FRAME-MOUNTED WIRE MANAGEMENT DEVICE

Appendix B. Other DOE-Funded PV Patents used in the Analysis

Patent #	Application Year	Issue / Publication Year	Original Assignees	Title
4029519	1976	1977	US DEPT OF ENERGY	SOLAR COLLECTOR HAVING A SOLID TRANSMISSION MEDIUM
4089705	1976	1978	NATIONAL AERONAUTICS & SPACE ADMIN	HEXAGON SOLAR POWER PANEL
4105470	1977	1978	US DEPT OF ENERGY	DYE-SENSITIZED SCHOTTKY BARRIER SOLAR CELLS
4118249	1977	1978	US DEPT OF ENERGY	MODULAR ASSEMBLY OF A PHOTOVOLTAIC SOLAR ENERGY RECEIVER
4129463	1977	1978	US DEPT OF ENERGY	POLYCRYSTALLINE SILICON SEMICONDUCTING MATERIAL BY NUCLEAR TRANSMUTATION DOPING
4139858	1977	1979	RCA CORP	SOLAR CELL WITH A GALLIUM NITRIDE ELECTRODE
4147563	1978	1979	US DEPT OF ENERGY	METHOD FOR FORMING P-N JUNCTIONS AND SOLAR-CELLS BY LASER-BEAM PROCESSING
4152175	1978	1979	US DEPT OF ENERGY	SILICON SOLAR CELL ASSEMBLY
4162505	1978	1979	RCA CORP	INVERTED AMORPHOUS SILICON SOLAR CELL UTILIZING CERMET LAYERS
4163677	1978	1979	RCA CORP	SCHOTTKY BARRIER AMORPHOUS SILICON SOLAR CELL WITH THIN DOPED REGION ADJACENT METAL SCHOTTKY BARRIER
4166880	1978	1979	SOLAMAT INC	SOLAR ENERGY DEVICE
4166918	1978	1979	RCA CORP	METHOD OF REMOVING THE EFFECTS OF ELECTRICAL SHORTS AND SHUNTS CREATED DURING THE FABRICATION PROCESS OF A SOLAR CELL
4166919	1978	1979	RCA CORP	AMORPHOUS SILICON SOLAR CELL ALLOWING INFRARED TRANSMISSION
4167015	1978	1979	RCA CORP	CERMET LAYER FOR AMORPHOUS SILICON SOLAR CELLS
4177093	1978	1979	EXXON RESEARCH & ENGINEERING CO	METHOD OF FABRICATING CONDUCTING OXIDE-SILICON SOLAR CELLS UTILIZING ELECTRON BEAM SUBLIMATION AND DEPOSITION OF THE OXIDE
4178395	1977	1979	PHOTON POWER INC	METHODS FOR IMPROVING SOLAR CELL OPEN CIRCUIT VOLTAGE
4190950	1978	1980	US DEPT OF ENERGY	DYE-SENSITIZED SOLAR CELLS
4193821	1979	1980	EXXON RESEARCH &	FABRICATION OF HETEROJUNCTION SOLAR CELLS BY IMPROVED TIN

			ENGINEERING CO	OXIDE DEPOSITION ON INSULATING LAYER
4195305	1978	1980	VARIAN ASSOCIATES INC	LATTICE CONSTANT GRADING IN THE ALYGA1-YAS1-XSBX ALLOY SYSTEM
4200473	1979	1980	RCA CORP	AMORPHOUS SILICON SCHOTTKY BARRIER SOLAR CELLS INCORPORATING A THIN INSULATING LAYER AND A THIN DOPED LAYER
4205265	1978	1980	RCA CORP	LASER BEAM APPARATUS AND METHOD FOR ANALYZING SOLAR CELLS
4215185	1979	1980	RCA CORP	LIQUID JUNCTION SCHOTTKY BARRIER SOLAR CELL
4217148	1979	1980	RCA CORP	COMPENSATED AMORPHOUS SILICON SOLAR CELL
4226643	1979	1980	RCA CORP	METHOD OF ENHANCING THE ELECTRONIC PROPERTIES OF AN UNDOPED AND/OR N-TYPE HYDROGENATED AMORPHOUS SILICON FILM
4237150	1979	1980	US DEPT OF ENERGY	METHOD OF PRODUCING HYDROGENATED AMORPHOUS SILICON FILM
4237151	1979	1980	US DEPT OF ENERGY	THERMAL DECOMPOSITION OF SILANE TO FORM HYDROGENATED AMORPHOUS SI FILM
4239553	1979	1980	UNIVERSITY OF DELAWARE	THIN FILM PHOTOVOLTAIC CELLS HAVING INCREASED DURABILITY AND OPERATING LIFE AND METHOD FOR MAKING SAME
EP0007192	1979	1980	EXXON RESEARCH & ENGINEERING CO	PROCESS FOR PREPARING HETROJUNCTION SOLAR-CELL DEVICES.
EP0008236	1979	1980	EXXON RESEARCH & ENGINEERING CO	PROCESS FOR FORMING TIN OXIDE SEMICONDUCTOR HETEROJUNCTION DEVICES.
EP0009401	1979	1980	UNIVERSITY OF DELAWARE	PHOTOVOLTAIC CELLS EMPLOYING A ZINC PHOSPHIDE ABSORBER-GENERATOR.
EP0010828	1979	1980	RCA CORP	AMORPHOUS SILICON SOLAR CELL ALLOWING INFRARED TRANSMISSION.
4246050	1979	1981	VARIAN ASSOCIATES INC	LATTICE CONSTANT GRADING IN THE AL/Y\ CA/1-Y\ AS/1-X\ SB/X\ ALLOY SYSTEM
4249957	1979	1981	CALIFORNIA INSTITUTE OF TECHNOLOGY	COPPER DOPED POLYCRYSTALLINE SILICON SOLAR CELL
4251287	1979	1981	UNIVERSITY OF DELAWARE	AMORPHOUS SEMICONDUCTOR SOLAR CELL
4253882	1980	1981	UNIVERSITY OF DELAWARE	MULTIPLE GAP PHOTOVOLTAIC DEVICE

4267398	1979	1981	UNIVERSITY OF DELAWARE	THIN FILM PHOTOVOLTAIC CELLS
4272641	1980	1981	RCA CORP	TANDEM JUNCTION AMORPHOUS SILICON SOLAR CELLS
4287473	1979	1981	US DEPT OF ENERGY	NONDESTRUCTIVE METHOD FOR DETECTING DEFECTS IN PHOTODETECTOR AND SOLAR CELL DEVICES
4292092	1980	1981	RCA CORP	LASER PROCESSING TECHNIQUE FOR FABRICATING SERIES-CONNECTED AND TANDEM JUNCTION SERIES-CONNECTED SOLAR CELLS INTO A SOLAR BATTERY
4311870	1980	1982	CALIFORNIA INSTITUTE OF TECHNOLOGY	EFFICIENCY OF SILICON SOLAR CELLS CONTAINING CHROMIUM
4316049	1980	1982	RCA CORP	HIGH VOLTAGE SERIES CONNECTED TANDEM JUNCTION SOLAR BATTERY
4320251	1980	1982	SOLAMAT INC	OHMIC CONTACTS FOR SOLAR CELLS BY ARC PLASMA SPRAYING
4322253	1980	1982	RCA CORP	METHOD OF MAKING SELECTIVE CRYSTALLINE SILICON REGIONS CONTAINING ENTRAPPED HYDROGEN BY LASER TREATMENT
4328390	1980	1982	UNIVERSITY OF DELAWARE	THIN FILM PHOTOVOLTAIC CELL
4331707	1980	1982	EXXON RESEARCH & ENGINEERING CO	PROCESS FOR THIN FILM DEPOSITION OF CADMIUM SULFIDE
4335266	1980	1982	BOEING CO	METHODS FOR FORMING THIN-FILM HETEROJUNCTION SOLAR CELLS FROM I-III-VI/2 \ CHALCOPYRITE COMPOUNDS, AND SOLAR CELLS PRODUCED THEREBY
4339470	1981	1982	RCA CORP	FABRICATING AMORPHOUS SILICON SOLAR CELLS BY VARYING THE TEMPERATURE OF THE SUBSTRATE DURING DEPOSITION OF THE AMORPHOUS SILICON LAYER
4342879	1980	1982	UNIVERSITY OF DELAWARE	THIN FILM PHOTOVOLTAIC DEVICE
4350836	1980	1982	US DEPT OF ENERGY	SOLAR ARRAY CONSTRUCTION
4356341	1981	1982	VARIAN ASSOCIATES INC	CASCADE SOLAR CELL HAVING CONDUCTIVE INTERCONNECTS
4360702	1981	1982	EXXON RESEARCH & ENGINEERING CO	COPPER OXIDE/N-SILICON HETEROJUNCTION PHOTOVOLTAIC DEVICE
4364508	1980	1982	US DEPT OF ENERGY	METHOD OF FABRICATING A SOLAR CELL ARRAY
4366335	1981	1982	EXXON	INDIUM OXIDE/N-SILICON

			RESEARCH & ENGINEERING CO	HETEROJUNCTION SOLAR CELLS
EP0060363	1981	1982	EXXON RESEARCH & ENGINEERING CO	METHOD OF MANUFACTURE OF A PIN AMORPHOUS SILICON SEMI-CONDUCTOR DEVICE.
EP0067860	1981	1982	BOEING CO	METHODS AND APPARATUS FOR FORMING THIN-FILM HETEROJUNCTION SOLAR CELLS FROM I-III-VI2 CHALCOPYRITE COMPOUNDS, AND SOLAR CELLS PRODUCED THEREBY.
WO1982002459	1981	1982	BOEING CO	METHODS AND APPARATUS FOR FORMING THIN-FILM HETEROJUNCTION SOLAR CELLS FROM I-III-VI2 CHALCOPYRITE COMPOUNDS,AND SOLAR CELLS PRODUCED THEREBY
4371738	1981	1983	RCA CORP	METHOD OF RESTORING DEGRADED SOLAR CELLS
4377723	1980	1983	UNIVERSITY OF DELAWARE	HIGH EFFICIENCY THIN-FILM MULTIPLE-GAP PHOTOVOLTAIC DEVICE
4378460	1981	1983	RCA CORP	METAL ELECTRODE FOR AMORPHOUS SILICON SOLAR CELLS
4379020	1981	1983	MASSACHUSETTS INSTITUTE OF TECHNOLOGY	POLYCRYSTALLINE SEMICONDUCTOR PROCESSING
4387265	1981	1983	UNIVERSITY OF DELAWARE	TANDEM JUNCTION AMORPHOUS SEMICONDUCTOR PHOTOVOLTAIC CELL
4388483	1981	1983	MONOSOLAR INC	THIN FILM HETEROJUNCTION PHOTOVOLTAIC CELLS AND METHODS OF MAKING THE SAME
4392011	1981	1983	RCA CORP	SOLAR CELL STRUCTURE INCORPORATING A NOVEL SINGLE CRYSTAL SILICON MATERIAL
4392451	1981	1983	BOEING CO	APPARATUS FOR FORMING THIN-FILM HETEROJUNCTION SOLAR CELLS EMPLOYING MATERIALS SELECTED FROM THE CLASS OF I-III-VI/2 \ CHALCOPYRITE COMPOUNDS
4400244	1982	1983	MONOSOLAR INC	PHOTO-VOLTAIC POWER GENERATING MEANS AND METHODS
4407710	1981	1983	EXXON RESEARCH & ENGINEERING CO	HYBRID METHOD OF MAKING AN AMORPHOUS SILICON P-I-N SEMICONDUCTOR DEVICE
4409424	1982	1983	US DEPT OF ENERGY	COMPENSATED AMORPHOUS SILICON SOLAR CELL
4417092	1981	1983	EXXON RESEARCH & ENGINEERING	SPUTTERED PIN AMORPHOUS SILICON SEMI-CONDUCTOR DEVICE AND METHOD THEREFOR

			CO	
EP0077601	1982	1983	EXXON RESEARCH & ENGINEERING CO	PHOTOVOLTAIC SEMICONDUCTOR DEVICE.
4425194	1983	1984	MONOSOLAR INC	PHOTO-VOLTAIC POWER GENERATING MEANS AND METHODS
4427840	1981	1984	US DEPT OF ENERGY	PLASTIC SCHOTTKY BARRIER SOLAR CELLS
4431858	1982	1984	UNIVERSITY OF FLORIDA	METHOD OF MAKING QUASI-GRAIN BOUNDARY-FREE POLYCRYSTALLINE SOLAR CELL STRUCTURE AND SOLAR CELL STRUCTURE OBTAINED THEREBY
4436557	1982	1984	US DEPT OF ENERGY	MODIFIED LASER-ANNEALING PROCESS FOR IMPROVING THE QUALITY OF ELECTRICAL P-N JUNCTIONS AND DEVICES
4436558	1982	1984	US DEPT OF ENERGY	ELECTROCHEMICAL PHOTOVOLTAIC CELL HAVING TERNARY ALLOY FILM
4436765	1982	1984	EXXON RESEARCH & ENGINEERING CO	METHOD FOR FORMING INDIUM OXIDE/N-SILICON HETEROJUNCTION SOLAR CELLS
4442082	1982	1984	SRI INTERNATIONAL	PROCESS FOR OBTAINING SILICON FROM FLUOSILICIC ACID
4442185	1982	1984	US DEPT OF ENERGY	PHOTOELECTROCHEMICAL CELLS FOR CONVERSION OF SOLAR ENERGY TO ELECTRICITY AND METHODS OF THEIR MANUFACTURE
4443653	1982	1984	UNIVERSITY OF DELAWARE	THIN FILM PHOTOVOLTAIC DEVICE WITH MULTILAYER SUBSTRATE
4444992	1982	1984	MASSACHUSETTS INSTITUTE OF TECHNOLOGY	PHOTOVOLTAIC-THERMAL COLLECTORS
4471036	1983	1984	US DEPT OF ENERGY	ELECTROCHEMICAL PHOTOVOLTAIC CELLS AND ELECTRODES
4475682	1982	1984	US DEPT OF ENERGY	PROCESS FOR REDUCING SERIES RESISTANCE OF SOLAR CELL METAL CONTACT SYSTEMS WITH A SOLDERING FLUX ETCHANT
4477688	1978	1984	UNIVERSITY OF DELAWARE	PHOTOVOLTAIC CELLS EMPLOYING ZINC PHOSPHIDE
4482780	1982	1984	US DEPT OF ENERGY	SOLAR CELLS WITH LOW COST SUBSTRATES AND PROCESS OF MAKING SAME
4485265	1982	1984	HARVARD COLLEGE	PHOTOVOLTAIC CELL
4488943	1982	1984	US DEPT OF ENERGY	POLYMER BLENDS FOR USE IN PHOTOELECTROCHEMICAL CELLS FOR CONVERSION OF SOLAR

				ENERGY TO ELECTRICITY AND METHODS FOR MANUFACTURING SUCH BLENDS
EP0118579	1983	1984	MONOSOLAR INC	THIN FILM HETEROJUNCTION PHOTOVOLTAIC CELLS AND METHODS OF MAKING THE SAME.
EP0125301	1983	1984	HARVARD COLLEGE	PHOTOVOLTAIC CELL.
WO1984002229	1983	1984	HARVARD COLLEGE	PHOTOVOLTAIC CELL
WO1984002514	1983	1984	SRI INTERNATIONAL	PROCESS AND APPARATUS FOR OBTAINING SILICON FROM FLUOSILICIC ACID
WO1984002515	1983	1984	SRI INTERNATIONAL	PROCESS AND APPARATUS FOR OBTAINING SILICON FROM FLUOSILICIC ACID
WO1984002516	1983	1984	SRI INTERNATIONAL	PROCESS AND APPARATUS FOR OBTAINING SILICON FROM FLUOSILICIC ACID
WO1984002539	1983	1984	SRI INTERNATIONAL	PROCESS AND APPARATUS FOR OBTAINING SILICON FROM FLUOSILICIC ACID
4491681	1983	1985	US DEPT OF ENERGY	LIQUID COOLED, LINEAR FOCUS SOLAR CELL RECEIVER
4502225	1983	1985	RCA CORP	MECHANICAL SCRIBER FOR SEMICONDUCTOR DEVICES
4508609	1983	1985	EXXON RESEARCH & ENGINEERING CO	METHOD FOR SPUTTERING A PIN MICROCRYSTALLINE/AMORPHOUS SILICON SEMICONDUCTOR DEVICE WITH THE P AND N-LAYERS SPUTTERED FROM BORON AND PHOSPHOROUS HEAVILY DOPED TARGETS
4523051	1983	1985	BOEING CO	THIN FILMS OF MIXED METAL COMPOUNDS
4525375	1983	1985	RCA CORP	METHOD OF CONTROLLONG THE DEPOSITION OF HYDROGENATED AMORPHOUS SILICON AND APPARATUS THEREFOR
4526809	1983	1985	UNIVERSITY OF DELAWARE	PROCESS AND APPARATUS FOR FORMATION OF PHOTOVOLTAIC COMPOUNDS
4528082	1983	1985	EXXON RESEARCH & ENGINEERING CO	METHOD FOR SPUTTERING A PIN AMORPHOUS SILICON SEMI-CONDUCTOR DEVICE HAVING PARTIALLY CRYSTALLIZED P AND N-LAYERS
4528503	1981	1985	US DEPT OF ENERGY	METHOD AND APPARATUS FOR I-V DATA ACQUISITION FROM SOLAR CELLS
4529576	1982	1985	SRI INTERNATIONAL	PROCESS AND APPARATUS FOR OBTAINING SILICON FROM FLUOSILICIC ACID
4547622	1984	1985	MASSACHUSETTS INSTITUTE OF	SOLAR CELLS AND PHOTODETECTORS

			TECHNOLOGY	
4556788	1983	1985	RCA CORP	AMORPHOUS SILICON CELL ARRAY POWERED SOLAR TRACKING APPARATUS
4559924	1984	1985	US DEPT OF ENERGY	THIN FILM ABSORBER FOR A SOLAR COLLECTOR
EP0129555	1983	1985	SRI INTERNATIONAL	PROCESS AND APPARATUS FOR OBTAINING SILICON.
EP0130996	1983	1985	SRI INTERNATIONAL	PROCESS AND APPARATUS FOR OBTAINING SILICON FROM FLUOSILICIC ACID.
EP0131586	1983	1985	SRI INTERNATIONAL	PROCESS AND APPARATUS FOR OBTAINING SILICON FROM FLUOSILICIC ACID.
EP0139487	1984	1985	EXXON RESEARCH & ENGINEERING CO	A METHOD FOR SPUTTERING A PIN OR NIP AMORPHOUS SILICON SEMI-CONDUCTOR DEVICE HAVING PARTIALLY CRYSTALLISED P AND N-LAYERS.
EP0139488	1984	1985	EXXON RESEARCH & ENGINEERING CO	A METHOD FOR SPUTTERING A PIN OR NIP AMORPHOUS SILICON SEMICONDUCTOR DEVICE WITH THE P AND N-LAYERS SPUTTERED FROM BORON AND PHOSPHORUS HEAVILY DOPED TARGETS.
EP0151569	1983	1985	SRI INTERNATIONAL	PROCESS AND APPARATUS FOR OBTAINING SILICON FROM FLUOSILICIC ACID.
RE031968	1984	1985	BOEING CO	METHODS FOR FORMING THIN-FILM HETEROJUNCTION SOLAR CELLS FROM I-III-VI2 CHALCOPYRITE COMPOUNDS, AND SOLAR CELLS PRODUCED THEREBY
WO1985005221	1985	1985	ADVANCED ENERGY FUND LP	SILICON-GAAS EPITAXIAL COMPOSITIONS AND PROCESS OF MAKING SAME
WO1985005226	1985	1985	MASSACHUSETTS INSTITUTE OF TECHNOLOGY	SOLAR CELLS AND PHOTODETECTORS
4564720	1983	1986	US DEPT OF ENERGY	PURE SILVER OHMIC CONTACTS TO N- AND P- TYPE GALLIUM ARSENIDE MATERIALS
4575576	1984	1986	US DEPT OF ENERGY	THREE-JUNCTION SOLAR CELL
4584181	1982	1986	SRI INTERNATIONAL	PROCESS AND APPARATUS FOR OBTAINING SILICON FROM FLUOSILICIC ACID
4585581	1984	1986	US DEPT OF ENERGY	POLYMER BLENDS FOR USE IN PHOTOELECTROCHEMICAL CELLS FOR CONVERSION OF SOLAR ENERGY TO ELECTRICITY
4588451	1984	1986	ADVANCED ENERGY FUND LP	METAL ORGANIC CHEMICAL VAPOR DEPOSITION OF 111-V COMPOUNDS ON SILICON

4590043	1982	1986	SRI INTERNATIONAL	APPARATUS FOR OBTAINING SILICON FROM FLUOSILICIC ACID
4594229	1981	1986	US DEPT OF ENERGY	APPARATUS FOR MELT GROWTH OF CRYSTALLINE SEMICONDUCTOR SHEETS
4597948	1984	1986	SRI INTERNATIONAL	APPARATUS FOR OBTAINING SILICON FROM FLUOSILICIC ACID
4616246	1982	1986	CHRONAR CORP	ENHANCEMENT OF PHOTOCONDUCTIVITY IN PYROLYTICALLY PREPARED SEMICONDUCTORS
EP0179138	1985	1986	ADVANCED ENERGY FUND LP	A METHOD OF FORMING A COMPOSITE SEMICONDUCTOR STRUCTURE.
EP0179896	1985	1986	MASSACHUSETTS INSTITUTE OF TECHNOLOGY	SOLAR CELLS AND PHOTODETECTORS.
4640002	1985	1987	UNIVERSITY OF DELAWARE	METHOD AND APPARATUS FOR INCREASING THE DURABILITY AND YIELD OF THIN FILM PHOTOVOLTAIC DEVICES
4676845	1986	1987	SPIRE CORP	PASSIVATED DEEP P/N JUNCTION
4684761	1986	1987	BOEING CO	METHOD FOR MAKING GRADED I-III-VI2 SEMICONDUCTORS AND SOLAR CELL OBTAINED THEREBY
4688068	1986	1987	US DEPT OF ENERGY	QUANTUM WELL MULTIJUNCTION PHOTOVOLTAIC CELL
4696702	1986	1987	CHRONAR CORP	METHOD OF DEPOSITING WIDE BANDGAP AMORPHOUS SEMICONDUCTOR MATERIALS
4718947	1986	1988	SOLAREX CORP	SUPERLATTICE DOPED LAYERS FOR AMORPHOUS SILICON PHOTOVOLTAIC CELLS
4748014	1985	1988	SRI INTERNATIONAL	PROCESS AND APPARATUS FOR OBTAINING SILICON FROM FLUOSILICIC ACID
4753783	1985	1988	SRI INTERNATIONAL	PROCESS AND APPARATUS FOR OBTAINING SILICON FROM FLUOSILICIC ACID
4762808	1987	1988	DOW CORNING CORP	METHOD OF FORMING SEMICONDUCTING AMORPHOUS SILICON FILMS FROM THE THERMAL DECOMPOSITION OF FLUOROHYDRIDODISILANES
4775425	1987	1988	ENERGY CONVERSION DEVICES INC	P AND N-TYPE MICROCRYSTALLINE SEMICONDUCTOR ALLOY MATERIAL INCLUDING BAND GAP WIDENING ELEMENTS, DEVICES UTILIZING SAME
4779980	1987	1988	MIDWEST RESEARCH INSTITUTE	ATMOSPHERIC OPTICAL CALIBRATION SYSTEM
4781565	1986	1988	SRI	APPARATUS FOR OBTAINING

			INTERNATION AL	SILICON FROM FLUOSILICIC ACID
4783421	1987	1988	SOLAREX CORP	METHOD FOR MANUFACTURING ELECTRICAL CONTACTS FOR A THIN-FILM SEMICONDUCTOR DEVICE
EP0296702	1988	1988	DOW CORNING CORP	METHOD OF FORMING SEMICONDUCTING AMORPHOUS SILICON FILMS FROM THE THERMAL DECOMPOSITON OF FLUOROHYDRIDODISILANES.
WO1988006718	1988	1988	MIDWEST RESEARCH INSTITUTE	ATMOSPHERIC OPTICAL CALIBRATION SYSTEM
4816082	1987	1989	ENERGY CONVERSION DEVICES INC	THIN FILM SOLAR CELL INCLUDING A SPATIALLY MODULATED INTRINSIC LAYER
4845043	1987	1989	AMOCO CORP	METHOD FOR FABRICATING PHOTOVOLTAIC DEVICE HAVING IMPROVED SHORT WAVELENGTH PHOTORESPONSE
4854974	1988	1989	SOLAREX CORP	ELECTRICAL CONTACTS FOR A THIN-FILM SEMICONDUCTOR DEVICE
4873201	1987	1989	3M CORP	METHOD FOR FABRICATING AN INTERCONNECTED ARRAY OF SEMICONDUCTOR DEVICES
EP0301686	1988	1989	ENERGY CONVERSION DEVICES INC	METHODS OF FABRICATING N-TYPE AND-P-TYPE MICROCRYSTALLINE SEMICONDUCTOR ALLOY MATERIALS.
EP0304145	1988	1989	ENERGY CONVERSION DEVICES INC	THIN FILM SOLAR CELL INCLUDING A SPATIALLY MODULATED INTRINSIC LAYER.
EP0320089	1988	1989	3M CORP	INTERCONNECTED SEMICONDUCTOR DEVICES.
4891330	1988	1990	ENERGY CONVERSION DEVICES INC	METHOD OF FABRICATING N-TYPE AND P-TYPE MICROCRYSTALLINE SEMICONDUCTOR ALLOY MATERIAL INCLUDING BAND GAP WIDENING ELEMENTS
4909863	1988	1990	UNIVERSITY OF DELAWARE	PROCESS FOR LEVELLING FILM SURFACES AND PRODUCTS THEREOF
4940495	1988	1990	3M CORP	PHOTOVOLTAIC DEVICE HAVING LIGHT TRANSMITTING ELECTRICALLY CONDUCTIVE STACKED FILMS
4950615	1989	1990	INTERNATION AL SOLAR ELECTRIC TECHNOLOGY INC	METHOD AND MAKING GROUP IIB METAL - TELLURIDE FILMS AND SOLAR CELLS
4965655	1989	1990	3M CORP	INTERCONNECTED SEMICONDUCTOR DEVICES
4968355	1989	1990	UNASSIGNED	TWO-AXIS TRACKING SOLAR

				COLLECTOR MECHANISM
4971633	1989	1990	US DEPT OF ENERGY	PHOTOVOLTAIC CELL ASSEMBLY
EP0372929	1989	1990	3M CORP	LIGHT TRANSMITTING ELECTRICALLY CONDUCTIVE STACKED FILM.
EP0372930	1989	1990	3M CORP	ELECTROLYTIC ETCH FOR PREVENTING ELECTRICAL SHORTS IN SOLAR CELLS ON POLYMER SURFACES.
WO1990011247	1990	1990	HARVARD COLLEGE	ZINC OXYFLUORIDE TRANSPARENT CONDUCTOR
WO1990013147	1990	1990	UNASSIGNED	TWO-AXIS TRACKING SOLAR COLLECTOR MECHANISM
WO1990015445	1990	1990	INTERNATIONAL SOLAR ELECTRIC TECHNOLOGY INC	IMPROVED GROUP I-III-VI2 SEMICONDUCTOR FILMS FOR SOLAR CELL APPLICATION
4990286	1989	1991	HARVARD COLLEGE	ZINC OXYFLUORIDE TRANSPARENT CONDUCTOR
5022930	1989	1991	PHOTON ENERGY INC	THIN FILM PHOTOVOLTAIC PANEL AND METHOD
5028274	1989	1991	INTERNATIONAL SOLAR ELECTRIC TECHNOLOGY INC	GROUP I-III-VI.SUB.2 SEMICONDUCTOR FILMS FOR SOLAR CELL APPLICATION
5055416	1988	1991	3M CORP	ELECTROLYTIC ETCH FOR PREVENTING ELECTRICAL SHORTS IN SOLAR CELLS ON POLYMER SURFACES
EP0424981	1983	1991	SRI INTERNATIONAL	PARALLELEPIPED SHAPED CRUCIBLE FOR SINGLE OR QUASI-SINGLE CRYSTAL SILICON INGOTS.
5078804	1990	1992	BOEING CO	I-III-VI.SUB.2 BASED SOLAR CELL UTILIZING THE STRUCTURE CUINGASE.SUB.2 CDZNS/ZNO
5085939	1990	1992	3M CORP	THIN FILM-COATED POLYMER WEBS
5110531	1982	1992	SRI INTERNATIONAL	PROCESS AND APPARATUS FOR CASTING MULTIPLE SILICON WAFER ARTICLES
5112410	1990	1992	BOEING CO	CADMIUM ZINC SULFIDE BY SOLUTION GROWTH
5141564	1991	1992	BOEING CO	MIXED TERNARY HETEROJUNCTION SOLAR CELL
5153780	1991	1992	US DEPT OF ENERGY	METHOD AND APPARATUS FOR UNIFORMLY CONCENTRATING SOLAR FLUX FOR PHOTOVOLTAIC APPLICATIONS
5167724	1991	1992	US DEPT OF ENERGY	PLANAR PHOTOVOLTAIC SOLAR CONCENTRATOR MODULE
EP0463079	1990	1992	HARVARD COLLEGE	ZINC OXYFLUORIDE TRANSPARENT CONDUCTOR.
5221854	1991	1993	UNITED SOLAR	PROTECTIVE LAYER FOR THE BACK

			SYSTEMS CORP	REFLECTOR OF A PHOTOVOLTAIC DEVICE
5228926	1991	1993	UNITED SOLAR SYSTEMS CORP	PHOTOVOLTAIC DEVICE WITH INCREASED LIGHT ABSORPTION AND METHOD FOR ITS MANUFACTURE
5230746	1992	1993	AMOCO CORP	PHOTOVOLTAIC DEVICE HAVING ENHANCED REAR REFLECTING CONTACT
5246506	1991	1993	SOLAREX CORP	MULTIJUNCTION PHOTOVOLTAIC DEVICE AND FABRICATION METHOD
5248349	1992	1993	SOLAR CELLS INC	PROCESS FOR MAKING PHOTOVOLTAIC DEVICES AND RESULTANT PRODUCT
5256887	1991	1993	SOLAREX CORP	PHOTOVOLTAIC DEVICE INCLUDING A BORON DOPING PROFILE IN AN I-TYPE LAYER
EP0523919	1992	1993	AMOCO CORP	MULTIJUNCTION PHOTOVOLTAIC DEVICE AND FABRICATION METHOD.
WO1993008605	1992	1993	UNITED SOLAR SYSTEMS CORP	PHOTOVOLTAIC DEVICE WITH INCREASED LIGHT ABSORPTION AND METHOD FOR ITS MANUFACTURE
WO1993010562	1992	1993	UNITED SOLAR SYSTEMS CORP	PROTECTIVE LAYER FOR THE BACK REFLECTOR OF A PHOTOVOLTAIC DEVICE
WO1993014523	1993	1993	PHOTON ENERGY INC	PHOTOVOLTAIC CELL WITH THIN CDS LAYER
WO1993023881	1993	1993	SOLAR CELLS INC	PROCESS AND APPARATUS FOR MAKING PHOTOVOLTAIC DEVICES AND RESULTANT PRODUCT
5279678	1992	1994	PHOTON ENERGY INC	PHOTOVOLTAIC CELL WITH THIN CS LAYER
5306646	1992	1994	MARTIN MARIETTA ENERGY SYSTEMS INC	METHOD FOR PRODUCING TEXTURED SUBSTRATES FOR THIN-FILM PHOTOVOLTAIC CELLS
5358755	1993	1994	AMOCO CORP	AMORPHOUS HYDROGENATED SILICON-CARBON ALLOYS AND SOLAR CELLS AND OTHER SEMICONDUCTOR DEVICES PRODUCED THEREFROM
5360491	1993	1994	US DEPT OF ENERGY	.BETA.-SILICON CARBIDE PROTECTIVE COATING AND METHOD FOR FABRICATING SAME
5372646	1993	1994	SOLAR CELLS INC	APPARATUS FOR MAKING PHOTOVOLTAIC DEVICES
EP0608282	1992	1994	UNITED SOLAR SYSTEMS CORP	PHOTOVOLTAIC DEVICE WITH INCREASED LIGHT ABSORPTION AND METHOD FOR ITS MANUFACTURE.
EP0613584	1992	1994	UNITED SOLAR SYSTEMS CORP	PROTECTIVE LAYER FOR THE BACK REFLECTOR OF A PHOTOVOLTAIC DEVICE.

EP0623246	1993	1994	PHOTON ENERGY INC	PHOTOVOLTAIC CELL WITH THIN CDS LAYER.
WO1994027327	1994	1994	PHOTON ENERGY INC	SERIES INTERCONNECTED PHOTOVOLTAIC CELLS AND METHOD FOR MAKING SAME
5385614	1993	1995	PHOTON ENERGY INC	SERIES INTERCONNECTED PHOTOVOLTAIC CELLS AND METHOD FOR MAKING SAME
5393675	1993	1995	UNIVERSITY OF TOLEDO	PROCESS FOR RF SPUTTERING OF CADMIUM TELLURIDE PHOTOVOLTAIC CELL
5403404	1993	1995	AMOCO CORP	MULTIJUNCTION PHOTOVOLTAIC DEVICE AND METHOD OF MANUFACTURE
5425860	1993	1995	UNIVERSITY OF CALIFORNIA	PULSED ENERGY SYNTHESIS AND DOPING OF SILICON CARBIDE
5456763	1994	1995	UNIVERSITY OF CALIFORNIA	SOLAR CELLS UTILIZING PULSED-ENERGY CRYSTALLIZED MICROCRYSTALLINE/POLYCRYSTALLINE SILICON
5460660	1993	1995	PHOTON ENERGY INC	APPARATUS FOR ENCAPSULATING A PHOTOVOLTAIC MODULE
5466301	1994	1995	TEXAS INSTRUMENTS INC	SOLAR CELL HAVING AN OUTPUT-INCREASING, PROTECTIVE COVER
5466302	1994	1995	UNIVERSITY OF CALIFORNIA	SOLAR CELL ARRAY INTERCONNECTS
5468304	1994	1995	TEXAS INSTRUMENTS INC	OUTPUT-INCREASING, PROTECTIVE COVER FOR A SOLAR CELL
5468652	1994	1995	SANDIA CORP	METHOD OF MAKING A BACK CONTACTED SOLAR CELL
5470397	1994	1995	SOLAR CELLS INC	PROCESS FOR MAKING PHOTOVOLTAIC DEVICES AND RESULTANT PRODUCT
5474621	1994	1995	ENERGY CONVERSION DEVICES INC	CURRENT COLLECTION SYSTEM FOR PHOTOVOLTAIC CELLS
5477088	1993	1995	UNIVERSITY OF ILLINOIS	MULTI-PHASE BACK CONTACTS FOR CIS SOLAR CELLS
EP0640247	1993	1995	SOLAR CELLS INC	PROCESS AND APPARATUS FOR MAKING PHOTOVOLTAIC DEVICES AND RESULTANT PRODUCT.
WO1995003631	1994	1995	PHOTON ENERGY INC	APPARATUS FOR ENCAPSULATING A PHOTOVOLTAIC MODULE
WO1995026571	1995	1995	AMOCO ENRON SOLAR	STABILIZED AMORPHOUS SILICON AND DEVICES CONTAINING SAME
5498297	1994	1996	ENTECH INC	PHOTOVOLTAIC RECEIVER
5501744	1994	1996	PHOTON ENERGY INC	PHOTOVOLTAIC CELL HAVING A P-TYPE POLYCRYSTALLINE LAYER WITH LARGE CRYSTALS
5503684	1994	1996	SILICON ENERGY CORP	TERMINATION SYSTEM FOR SOLAR PANELS
5503898	1994	1996	MARTIN	METHOD FOR PRODUCING

			MARIETTA ENERGY SYSTEMS INC	TEXTURED SUBSTRATES FOR THIN-FILM PHOTOVOLTAIC CELLS
5510271	1994	1996	GEORGIA TECH RESEARCH CORP	PROCESSES FOR PRODUCING LOW COST, HIGH EFFICIENCY SILICON SOLAR CELLS
5536333	1995	1996	SOLAR CELLS INC	PROCESS FOR MAKING PHOTOVOLTAIC DEVICES AND RESULTANT PRODUCT
5538564	1994	1996	UNIVERSITY OF CALIFORNIA	THREE DIMENSIONAL AMORPHOUS SILICON/MICROCRYSTALLINE SILICON SOLAR CELLS
5551977	1994	1996	ASE AMERICAS INC	SUSCEPTOR FOR EFG CRYSTAL GROWTH APPARATUS
5556791	1995	1996	TEXAS INSTRUMENTS INC	METHOD OF MAKING OPTICALLY FUSED SEMICONDUCTOR POWDER FOR SOLAR CELLS
5558712	1994	1996	ASE AMERICAS INC	CONTOURED INNER AFTER-HEATER SHIELD FOR REDUCING STRESS IN GROWING CRYSTALLINE BODIES
5578502	1995	1996	PHOTON ENERGY INC	PHOTOVOLTAIC CELL MANUFACTURING PROCESS
WO1996008043	1995	1996	GEORGIA TECH RESEARCH CORP	PROCESSES FOR PRODUCING LOW COST, HIGH EFFICIENCY SILICON SOLAR CELLS
WO1996009650	1995	1996	ENERGY CONVERSION DEVICES INC	CURRENT COLLECTION SYSTEM FOR PHOTOVOLTAIC CELLS
WO1996021054	1996	1996	ONTARIO HYDRO	OPTICALLY FUSED SEMICONDUCTOR POWDER FOR SOLAR CELLS
5604162	1996	1997	UNIVERSITY OF CHICAGO	PROCESS OF PREPARING TRITIATED POROUS SILICON
5605171	1995	1997	UNIVERSITY OF CHICAGO	POROUS SILICON WITH EMBEDDED TRITIUM AS A STAND-ALONE PRIME POWER SOURCE FOR OPTOELECTRONIC APPLICATIONS
5614020	1996	1997	TEXAS INSTRUMENTS INC	APPARATUS FOR MAKING OPTICALLY FUSED SEMICONDUCTOR POWDER FOR SOLAR CELLS
5626687	1995	1997	US DEPT OF ENERGY	THERMOPHOTOVOLTAIC IN-SITU MIRROR CELL
5646050	1996	1997	AMOCO ENRON SOLAR	INCREASING STABILIZED PERFORMANCE OF AMORPHOUS SILICON BASED DEVICES PRODUCED BY HIGHLY HYDROGEN DILUTED LOWER TEMPERATURE PLASMA DEPOSITION
5674325	1995	1997	PHOTON ENERGY INC	THIN FILM PHOTOVOLTAIC DEVICE AND PROCESS OF MANUFACTURE
5674555	1995	1997	UNIVERSITY OF DELAWARE	PROCESS FOR PREPARING GROUP IB-IIIA-VIA SEMICONDUCTING FILMS
5679963	1995	1997	SANDIA CORP	SEMICONDUCTOR TUNNEL JUNCTION WITH ENHANCEMENT

				LAYER
5688337	1995	1997	TEXAS INSTRUMENTS INC	TEMPERATURE COMPENSATED PHOTOVOLTAIC ARRAY
5700332	1996	1997	US DEPT OF ENERGY	SEGREGATED TANDEM FILTER FOR ENHANCED CONVERSION EFFICIENCY IN A THERMOPHOTOVOLTAIC ENERGY CONVERSION SYSTEM
WO1997022152	1996	1997	DAVIS JOSEPH & NEGLEY	PREPARATION OF CUXINYGAZSEN (X=0-2, Y=0-2, Z=0-2, N=0-3) PRECURSOR FILMS BY ELECTRODEPOSITION FOR FABRICATING HIGH EFFICIENCY SOLAR CELLS
WO1997050130	1997	1997	EVERGREEN SOLAR INC	SOLAR CELL MODULES WITH IMPROVED BACKSKIN AND METHODS FOR FORMING SAME
WO1997050131	1997	1997	EVERGREEN SOLAR INC	SOLAR MODULES WITH INTEGRAL MOUNTING STRUCTURE AND METHODS FOR FORMING SAME
5714404	1993	1998	UNIVERSITY OF CALIFORNIA	FABRICATION OF POLYCRYSTALLINE THIN FILMS BY PULSED LASER PROCESSING
5720827	1996	1998	UNIVERSITY OF FLORIDA	DESIGN FOR THE FABRICATION OF HIGH EFFICIENCY SOLAR CELLS
5730808	1996	1998	AMOCO ENRON SOLAR	PRODUCING SOLAR CELLS BY SURFACE PREPARATION FOR ACCELERATED NUCLEATION OF MICROCRYSTALLINE SILICON ON HETEROGENEOUS SUBSTRATES
5730852	1995	1998	DAVIS JOSEPH & NEGLEY	PREPARATION OF CUXINYGAZSEN (X=0-2, Y=0-2, Z=0-2, N=0-3) PRECURSOR FILMS BY ELECTRODEPOSITION FOR FABRICATING HIGH EFFICIENCY SOLAR CELLS
5741370	1996	1998	EVERGREEN SOLAR INC	SOLAR CELL MODULES WITH IMPROVED BACKSKIN AND METHODS FOR FORMING SAME
5762720	1996	1998	EVERGREEN SOLAR INC	SOLAR CELL MODULES WITH INTEGRAL MOUNTING STRUCTURE AND METHODS FOR FORMING SAME
5763320	1995	1998	MATRIX SOLAR TECHNOLOGIES INC	BORON DOPING A SEMICONDUCTOR PARTICLE
5765680	1996	1998	UNIVERSITY OF CHICAGO	POROUS SILICON WITH EMBEDDED TRITIUM AS A STAND-ALONE PRIME POWER SOURCE FOR OPTOELECTRONIC APPLICATIONS
5766964	1995	1998	GEORGIA TECH RESEARCH CORP	PROCESSES FOR PRODUCING LOW COST, HIGH EFFICIENCY SILICON SOLAR CELLS
5804054	1997	1998	DAVIS JOSEPH & NEGLEY	PREPARATION OF COPPER INDIUM GALLIUM DISELENIDE FILMS FOR

				SOLAR CELLS
EP0830465	1996	1998	ONTARIO HYDRO	OPTICALLY FUSED SEMICONDUCTOR POWDER FOR SOLAR CELLS
EP0881695	1998	1998	INTERNATIONAL SOLAR ELECTRIC TECHNOLOGY INC	A METHOD OF MAKING GROUP IB-IIIA-VIA COMPUND SEMICONDUCTOR FILMS AND METHOD OF FABRICATING A PHOTOVOLTAIC DEVICE
WO1998004006	1997	1998	UNIVERSITY OF FLORIDA	HIGH EFFICIENCY SOLAR CELLS AND THEIR FABRICATION
WO1998026459	1997	1998	ENERGY CONVERSION DEVICES INC	SEMICONDUCTOR HAVING LARGE VOLUME FRACTION OF INTERMEDIATE RANGE ORDER MATERIAL
5868869	1997	1999	PHOTON ENERGY INC	THIN FILM PHOTOVOLTAIC DEVICE AND PROCESS OF MANUFACTURE
5871630	1997	1999	DAVIS JOSEPH & NEGLEY	PREPARATION OF COPPER-INDIUM-GALLIUM-DISELENIDE PRECURSOR FILMS BY ELECTRODEPOSITION FOR FABRICATING HIGH EFFICIENCY SOLAR CELLS
5926727	1995	1999	MATRIX SOLAR TECHNOLOGIES INC	PHOSPHOROUS DOPING A SEMICONDUCTOR PARTICLE
5942049	1997	1999	AMOCO ENRON SOLAR	INCREASING STABILIZED PERFORMANCE OF AMORPHOUS SILICON BASED DEVICES PRODUCED BY HIGHLY HYDROGEN DILUTED LOWER TEMPERATURE PLASMA DEPOSITION
5944913	1997	1999	SANDIA CORP	HIGH-EFFICIENCY SOLAR CELL AND METHOD FOR FABRICATION
5972784	1997	1999	GEORGIA TECH RESEARCH CORP	ARRANGEMENT, DOPANT SOURCE, AND METHOD FOR MAKING SOLAR CELLS
5977476	1996	1999	UNITED SOLAR SYSTEMS CORP	HIGH EFFICIENCY PHOTOVOLTAIC DEVICE
5985691	1997	1999	INTERNATIONAL SOLAR ELECTRIC TECHNOLOGY INC	METHOD OF MAKING COMPOUND SEMICONDUCTOR FILMS AND MAKING RELATED ELECTRONIC DEVICES
5986203	1997	1999	EVERGREEN SOLAR INC	SOLAR CELL ROOF TILE AND METHOD OF FORMING SAME
5994641	1998	1999	ASE AMERICAS INC	SOLAR MODULE HAVING REFLECTOR BETWEEN CELLS
EP0909463	1997	1999	EVERGREEN SOLAR INC	SOLAR MODULES WITH INTEGRAL MOUNTING STRUCTURE AND METHODS FOR FORMING SAME
EP0953214	1997	1999	ENERGY CONVERSION DEVICES INC	SEMICONDUCTOR HAVING LARGE VOLUME FRACTION OF INTERMEDIATE RANGE ORDER MATERIAL
EP0956600	1996	1999	DAVIS JOSEPH	PREPARATION OF CU X-IN Y-GA Z-

			& NEGLEY	SE N- (X=0-2, Y=0-2, Z=0-2, N=0-3) PRECURSOR FILMS BY ELECTRODEPOSITION FOR FABRICATING HIGH EFFICIENCY SOLAR CELLS
EP0957523	1998	1999	MATRIX SOLAR TECHNOLOGIES INC	BORON DOPING A SEMICONDUCTOR PARTICLE
EP0958616	1997	1999	EVERGREEN SOLAR INC	SOLAR CELL MODULES WITH IMPROVED BACKSKIN AND METHOD FOR FORMING SAME
WO1999017889	1998	1999	NANOSOLAR INC	METHOD FOR FORMING SOLAR CELL MATERIALS FROM PARTICULATES
WO1999023706	1998	1999	EVERGREEN SOLAR INC	SOLAR CELL ROOF TILE AND METHOD OF FORMING SAME
WO1999027587	1998	1999	SANDIA CORP	HIGH-EFFICIENCY SOLAR CELL AND METHOD FOR FABRICATION
WO1999027588	1998	1999	MIDWEST RESEARCH INSTITUTE	COMPOSITION AND METHOD FOR ENCAPSULATING PHOTOVOLTAIC DEVICES
WO1999056317	1999	1999	ASE AMERICAS INC	SOLAR MODULE HAVING REFLECTOR BETWEEN CELLS
WO1999059734	1999	1999	UNIVERSITY OF CALIFORNIA	GENERATION OF LOW WORK FUNCTION, STABLE COMPOUND THIN FILMS BY LASER ABLATION
6020554	1999	2000	PHOTOVOLTAICS INTERNATIONAL LLC	TRACKING SOLAR ENERGY CONVERSION UNIT ADAPTED FOR FIELD ASSEMBLY
6072116	1998	2000	AUBURN UNIVERSITY	THERMOPHOTOVOLTAIC CONVERSION USING SELECTIVE INFRARED LINE EMITTERS AND LARGE BAND GAP PHOTOVOLTAIC DEVICES
6077722	1998	2000	BP CORP NORTH AMERICA INC	PRODUCING THIN FILM PHOTOVOLTAIC MODULES WITH HIGH INTEGRITY INTERCONNECTS AND DUAL LAYER CONTACTS
6087580	1996	2000	ENERGY CONVERSION DEVICES INC	SEMICONDUCTOR HAVING LARGE VOLUME FRACTION OF INTERMEDIATE RANGE ORDER MATERIAL
6093757	1997	2000	MIDWEST RESEARCH INSTITUTE	COMPOSITION AND METHOD FOR ENCAPSULATING PHOTOVOLTAIC DEVICES
6114287	1998	2000	UT-BATTELLE LLC	METHOD OF DEFORMING A BIAXIALLY TEXTURED BUFFER LAYER ON A TEXTURED METALLIC SUBSTRATE AND ARTICLES THEREFROM
6118572	1999	2000	UNIVERSITY OF CALIFORNIA	PHOTOCHROMIC, ELECTROCHROMIC, PHOTOELECTROCHROMIC AND PHOTOVOLTAIC DEVICES

6127202	1998	2000	INTERNATIONAL SOLAR ELECTRIC TECHNOLOGY INC	OXIDE-BASED METHOD OF MAKING COMPOUND SEMICONDUCTOR FILMS AND MAKING RELATED ELECTRONIC DEVICES
6134784	1999	2000	PHOTOVOLTAICS INTERNATIONAL LLC	METHOD OF MAKING SOLAR COLLECTORS BY IN-SITU ENCAPSULATION OF SOLAR CELLS
6162707	1998	2000	UNIVERSITY OF CALIFORNIA	LOW WORK FUNCTION, STABLE THIN FILMS
EP0978882	1999	2000	INTERNATIONAL SOLAR ELECTRIC TECHNOLOGY INC	AN OXIDE-BASED METHOD OF MAKING COMPOUND SEMICONDUCTOR FILMS AND MAKING RELATED ELECTRONIC DEVICES
EP1029367	1998	2000	EVERGREEN SOLAR INC	SOLAR CELL ROOF TILE AND METHOD OF FORMING SAME
EP1038322	1998	2000	SANDIA CORP	HIGH-EFFICIENCY SOLAR CELL AND METHOD FOR FABRICATION
WO2000038216	1999	2000	UNIVERSITY OF CALIFORNIA	HIGH VOLTAGE PHOTOVOLTAIC POWER CONVERTER
WO2000052745	2000	2000	ASE AMERICAS INC	ETCHING OF SEMICONDUCTOR WAFER EDGES
WO2000057486	2000	2000	PHOTOVOLTAICS INTERNATIONAL LLC	TRACKING SOLAR ENERGY CONVERSION UNIT ADAPTED FOR FIELD ASSEMBLY
6235615	2000	2001	UNIVERSITY OF CALIFORNIA	GENERATION OF LOW WORK FUNCTION, STABLE COMPOUND THIN FILMS BY LASER ABLATION
6251701	2000	2001	US DEPT OF ENERGY	ALL-VAPOR PROCESSING OF P-TYPE TELLURIUM-CONTAINING II-VI SEMICONDUCTOR AND OHMIC CONTACTS THEREOF
6252287	1999	2001	SANDIA CORP	INGAASN/GAAS HETEROJUNCTION FOR MULTI-JUNCTION SOLAR CELLS
6258620	1998	2001	UNIVERSITY OF SOUTH FLORIDA	METHOD OF MANUFACTURING CIGS PHOTOVOLTAIC DEVICES
6265653	1999	2001	UNIVERSITY OF CALIFORNIA	HIGH VOLTAGE PHOTOVOLTAIC POWER CONVERTER
6268014	1997	2001	NANOSOLAR INC	METHOD FOR FORMING SOLAR CELL MATERIALS FROM PARTICULARS
6288325	2000	2001	BP CORP NORTH AMERICA INC	PRODUCING THIN FILM PHOTOVOLTAIC MODULES WITH HIGH INTEGRITY INTERCONNECTS AND DUAL LAYER CONTACTS
6300593	1999	2001	FIRST SOLAR INC	APPARATUS AND METHOD FOR LASER SCRIBING A COATED SUBSTRATE
EP1080498	1999	2001	ASE AMERICAS	SOLAR MODULE HAVING

			INC	REFLECTOR BETWEEN CELLS
EP1160880	2001	2001	ABOUND SOLAR INC	PROCESS FOR THE MASS PRODUCTION OF PHOTOVOLTAIC MODULES
WO2001041967	2000	2001	FIRST SOLAR INC	APPARATUS AND METHOD FOR LASER SCRIBING A COATED SUBSTRATE
WO2001078154	2001	2001	DAVIS JOSEPH & NEGLEY	PREPARATION OF CIGS-BASED SOLAR CELLS USING A BUFFERED ELECTRODEPOSITION BATH
6340403	1995	2002	UNIVERSITY OF CALIFORNIA	SOLAR CELL MODULE LAMINATION PROCESS
6359211	2000	2002	CHEMMOTIF INC	SPECTRAL SENSITIZATION OF NANOCRYSTALLINE SOLAR CELLS
6402881	1995	2002	UNIVERSITY OF CALIFORNIA	PROCESS FOR ELECTRICALLY INTERCONNECTING ELECTRODES
6407330	2000	2002	NORTH CAROLINA STATE UNIVERSITY, JOHNS HOPKINS UNIVERSITY	SOLAR CELLS INCORPORATING LIGHT HARVESTING ARRAYS
6420648	2000	2002	NORTH CAROLINA STATE UNIVERSITY	LIGHT HARVESTING ARRAYS
6423565	2000	2002	ABOUND SOLAR INC	APPARATUS AND PROCESSES FOR THE MASSPRODUCTION OF PHOTOVOTAIC MODULES
6426399	2000	2002	UNIVERSITY OF TEXAS	METHODS FOR THE SYNTHESIS AND POLYMERIZATION OF .ALPHA.,.ALPHA.'-DIHALO-P-XYLENES
EP1173884	2000	2002	ASE AMERICAS INC	ETCHING OF SEMICONDUCTOR WAFER EDGES
WO2002005352	2001	2002	BP CORP NORTH AMERICA INC	PARTIALLY TRANSPARENT PHOTOVOLTAIC MODULES
WO2002009196	2001	2002	NORTH CAROLINA STATE UNIVERSITY	LIGHT HARVESTING ARRAYS
WO2002009197	2001	2002	NORTH CAROLINA STATE UNIVERSITY, JOHNS HOPKINS UNIVERSITY	SOLAR CELLS INCORPORATING LIGHT HARVESTING ARRAYS
WO2002080280	2002	2002	UNIVERSITY OF CALIFORNIA	METHODS OF FABRICATING NANSTRUCTURES AND NANOWIRES AND DEVICES FABRICATED THEREFROM

WO2002084725	2002	2002	CALIFORNIA INSTITUTE OF TECHNOLOGY	A METHOD OF USING A GERMANIUM LAYER TRANSFER TO SI FOR PHOTOVOLTAIC APPLICATIONS AND HETEROSTRUCTURE MADE THEREBY
6559374	2001	2003	NORTH CAROLINA STATE UNIVERSITY	TRANS BETA SUBSTITUTED CHLORINS AND METHODS OF MAKING AND USING THE SAME
6596935	2002	2003	NORTH CAROLINA STATE UNIVERSITY	SOLAR CELLS INCORPORATING LIGHT HARVESTING ARRAYS
6603070	2001	2003	NORTH CAROLINA STATE UNIVERSITY	CONVERGENT SYNTHESIS OF MULTIPORPHYRIN LIGHT-HARVESTING RODS
6660643	1999	2003	RWE SCHOTT SOLAR INC	ETCHING OF SEMICONDUCTOR WAFER EDGES
EP1303884	2001	2003	NORTH CAROLINA STATE UNIVERSITY	SOLAR CELLS INCORPORATING LIGHT HARVESTING ARRAYS
EP1319255	2001	2003	NORTH CAROLINA STATE UNIVERSITY	LIGHT HARVESTING ARRAYS
EP1320892	2001	2003	BP CORP NORTH AMERICA INC	PARTIALLY TRANSPARENT PHOTOVOLTAIC MODULES
WO2003019621	2002	2003	NORTH CAROLINA STATE UNIVERSITY	CONVERGENT SYNTHESIS OF MULTIPORPHYRIN LIGHT-HARVESTING RODS
WO2003038508	2002	2003	COLORADO STATE UNIV, UNIVERSITY OF FERRARA	METAL COMPLEX-BASED ELECTRON-TRANSFER MEDIATORS IN DYE-SENSITIZED SOLAR CELLS
WO2003044840	2001	2003	MIDWEST RESEARCH INSTITUTE	REACTIVE CODOPING OF GAALINP COMPOUND SEMICONDUCTORS
WO2003050082	2002	2003	NORTH CAROLINA STATE UNIVERSITY	REGIOISOMERICALLY PURE OXOCHLORINS AND METHODS OF SYNTHESIS
WO2003105237	2003	2003	NORTH CAROLINA STATE UNIVERSITY	SYNTHESIS OF PERYLENE-PORPHYRIN BUILDING BLOCKS AND POLYMERS THEREOF FOR THE PRODUCTION OF LIGHT-HARVESTING ARRAYS
6765092	2001	2004	NORTH CAROLINA STATE UNIVERSITY	REGIOISOMERICALLY PURE OXOCHLORINS AND METHODS OF SYNTHESIS
6821559	2001	2004	NANOSOLAR	METHOD OF FORMING

			INC	PARTICULATE MATERIALS FOR THIN-FILM SOLAR CELLS
EP1374309	2002	2004	UNIVERSITY OF CALIFORNIA	METHODS OF FABRICATING NANOSTRUCTURES AND NANOWIRES AND DEVICES FABRICATED THEREFROM
EP1386349	2002	2004	CALIFORNIA INSTITUTE OF TECHNOLOGY	A METHOD OF USING A GERMANIUM LAYER TRANSFER TO SI FOR PHOTOVOLTAIC APPLICATIONS AND HETEROSTRUCTURE MADE THEREBY
WO2004007634	2003	2004	MASSACHUSETTS INSTITUTE OF TECHNOLOGY	EMISSIVE, HIGH CHARGE TRANSPORT POLYMERS
WO2004027957	2003	2004	WISCONSIN ALUMNI RES FOUND	CONTROL OF SMALL DISTRIBUTED ENERGY RESOURCES
WO2004109768	2004	2004	NORTH CAROLINA STATE UNIVERSITY	METHODS AND INTERMEDIATES FOR THE SYNTHESIS OF DIPYRRIN-SUBSTITUTED PORPHYRINIC MACROCYCLES
6858461	2002	2005	BP CORP NORTH AMERICA INC	PARTIALLY TRANSPARENT PHOTOVOLTAIC MODULES
6858462	2001	2005	GRATINGS INC, SANDIA CORP	ENHANCED LIGHT ABSORPTION OF SOLAR CELLS AND PHOTODETECTORS BY DIFFRACTION
6882051	2002	2005	UNIVERSITY OF CALIFORNIA	NANOWIRES, NANOSTRUCTURES AND DEVICES FABRICATED THEREFROM
6911593	2002	2005	UNIVERSITY OF ARKANSAS	TRANSPARENT SELF-CLEANING DUST SHIELD
6916982	2002	2005	NORTH CAROLINA STATE UNIVERSITY	SYNTHESIS OF PERYLENE-PORPHYRIN BUILDING BLOCKS AND POLYMERS THEREOF FOR THE PRODUCTION OF LIGHT-HARVESTING ARRAYS
EP1540791	2003	2005	WISCONSIN ALUMNI RES FOUND	CONTROL OF SMALL DISTRIBUTED ENERGY RESOURCES
WO2005002745	2004	2005	PRINCETON UNIVERISTY	IMPROVED SOLAR CELLS
WO2005017957	2004	2005	UNIVERSITY OF CALIFORNIA	NANOWIRE ARRAY AND NANOWIRE SOLAR CELLS AND METHODS FOR FORMING THE SAME
WO2005062440	2004	2005	GENERAL ELECTRIC CO	PHOTOVOLTAIC POWER CONVERTER CONFIGURED FOR COMPENSATING LOAD HARMONICS
WO2005079198	2004	2005	CALIFORNIA INSTITUTE OF TECHNOLOGY	WAFER BONDED VIRTUAL SUBSTRATE AND METHOD FOR FORMING THE SAME
WO2005101523	2005	2005	PRINCETON UNIVERISTY	HIGH EFFICIENCY ORGANIC PHOTOVOLTAIC CELLS EMPLOYING

				HYBRIDIZED MIXED-PLANAR HETEROJUNCTIONS
WO2005104236	2005	2005	BOSTON UNIVERSITY	OPTICAL DEVICES FEATURING TEXTURED SEMICONDUCTOR LAYERS
6996147	2002	2006	UNIVERSITY OF CALIFORNIA	METHODS OF FABRICATING NANOSTRUCTURES AND NANOWIRES AND DEVICES FABRICATED THEREFROM
7019138	2002	2006	COLORADO STATE UNIV, UNIVERSITY OF FERRARA	METAL COMPLEX-BASED ELECTRON-TRANSFER MEDIATORS IN DYE-SENSITIZED SOLAR CELLS
7019339	2002	2006	CALIFORNIA INSTITUTE OF TECHNOLOGY	METHOD OF USING A GERMANIUM LAYER TRANSFER TO SI FOR PHOTOVOLTAIC APPLICATIONS AND HETEROSTRUCTURE MADE THEREBY
7041910	2003	2006	MASSACHUSETTS INSTITUTE OF TECHNOLOGY	EMISSIVE, HIGH CHARGE TRANSPORT POLYMERS
7116010	2002	2006	WISCONSIN ALUMNI RES FOUND	CONTROL OF SMALL DISTRIBUTED ENERGY RESOURCES
7141834	2005	2006	CALIFORNIA INSTITUTE OF TECHNOLOGY	METHOD OF USING A GERMANIUM LAYER TRANSFER TO SI FOR PHOTOVOLTAIC APPLICATIONS AND HETEROSTRUCTURE MADE THEREBY
7141863	2003	2006	UNIVERSITY OF TOLEDO	METHOD OF MAKING DIODE STRUCTURES
EP1644135	2004	2006	PRINCETON UNIVERISTY	IMPROVED SOLAR CELLS
EP1735838	2005	2006	BOSTON UNIVERSITY	OPTICAL DEVICES FEATURING TEXTURED SEMICONDUCTOR LAYERS
WO2006007212	2005	2006	POWERLIGHT CORP	FIRE RESISTANT PV SHINGLE ASSEMBLY
WO2006015328	2005	2006	UT-BATTELLE LLC	PULSE THERMAL PROCESSING OF FUNCTIONAL MATERIALS USING DIRECTED PLASMA ARC
WO2006017403	2005	2006	PRINCETON UNIVERISTY	STACKED ORGANIC PHOTOSENSITIVE DEVICES
WO2006017530	2005	2006	PRINCETON UNIVERISTY	STACKED ORGANIC PHOTOSENSITIVE DEVICES
WO2006026070	2005	2006	PRINCETON UNIVERISTY	ORGANIC PHOTOSENSITIVE DEVICES
WO2006078319	2005	2006	MASSACHUSETTS INSTITUTE OF TECHNOLOGY	LIGHT TRAPPING IN THIN FILM SOLAR CELLS USING TEXTURED PHOTONIC CRYSTAL
WO2006086040	2005	2006	PRINCETON UNIVERISTY	ORGANIC PHOTOSENSITIVE OPTOELECTRONIC DEVICE HAVING A PHENANTHROLINE EXCITON BLOCKING LAYER

WO2006133163	2006	2006	UNIVERSITY OF CALIFORNIA	INTERNAL GETTERING BY METAL ALLOY CLUSTERS
WO2006137870	2005	2006	PRINCETON UNIVERISTY	ORGANIC PHOTOSENSITIVE DEVICES
WO2006137915	2005	2006	UNIVERSITY OF CALIFORNIA	BIOLOGICALLY INSPIRED SYNTHESIS OF THIN FILMS AND MATERIALS
WO2006137940	2005	2006	UNIVERSITY OF CALIFORNIA	METHODS OF MAKING FUNCTIONALIZED NANORODS
WO2006138078	2006	2006	PRINCETON UNIVERSITY, TECHNION RES & DEV	ORGANIC DOUBLE-HETEROSTRUCTURE PHOTOVOLTAIC CELLS HAVING RECIPROCAL-CARRIER EXCITON BLOCKING LAYER
7155870	2004	2007	POWERLIGHT CORP	SHINGLE ASSEMBLY WITH SUPPORT BRACKET
7196366	2004	2007	PRINCETON UNIVERISTY	STACKED ORGANIC PHOTOSENSITIVE DEVICES
7202143	2004	2007	UNIVERSITY OF ARKANSAS	LOW TEMPERATURE PRODUCTION OF LARGE-GRAIN POLYCRYSTALLINE SEMICONDUCTORS
7202411	2003	2007	US DEPT OF ENERGY	PHOTOVOLTAIC AND THERMOPHOTOVOLTAIC DEVICES WITH QUANTUM BARRIERS
7217882	2003	2007	CORNELL RESEARCH FOUND, UNIV CALIFORNIA	BROAD SPECTRUM SOLAR CELL
7220321	2004	2007	ABOUND SOLAR INC	APPARATUS AND PROCESSES FOR THE MASS PRODUCTION OF PHOTOVOLTAIC MODULES
7220936	2004	2007	UT-BATTELLE LLC	PULSE THERMAL PROCESSING OF FUNCTIONAL MATERIALS USING DIRECTED PLASMA ARC
7230269	2005	2007	PRINCETON UNIVERSITY, TECHNION RES & DEV	ORGANIC PHOTOSENSITIVE CELLS HAVING A RECIPROCAL-CARRIER EXCITON BLOCKING LAYER
7238622	2004	2007	CALIFORNIA INSTITUTE OF TECHNOLOGY	WAFER BONDED VIRTUAL SUBSTRATE AND METHOD FOR FORMING THE SAME
7265037	2004	2007	UNIVERSITY OF CALIFORNIA	NANOWIRE ARRAY AND NANOWIRE SOLAR CELLS AND METHODS FOR FORMING THE SAME
7288332	2005	2007	LOS ALAMOS NATIONAL SECURITY LLC	CONDUCTIVE LAYER FOR BIAXIALLY ORIENTED SEMICONDUCTOR FILM GROWTH
7297865	2003	2007	SUNPOWER CORP	COMPACT MICRO-CONCENTRATOR FOR PHOTOVOLTAIC CELLS
7297868	2003	2007	DAVIS JOSEPH & NEGLEY	PREPARATION OF CIGS-BASED SOLAR CELLS USING A BUFFERED ELECTRODEPOSITION BATH
EP1756885	2005	2007	PRINCETON	HIGH EFFICIENCY ORGANIC

			UNIVERISTY	PHOTOVOLTAIC CELLS EMPLOYING HYBRIDIZED MIXED-PLANAR HETEROJUNCTIONS
EP1774117	2005	2007	POWERLIGHT CORP	FIRE RESISTANT PV SHINGLE ASSEMBLY
EP1774604	2005	2007	PRINCETON UNIVERISTY	STACKED ORGANIC PHOTOSENSITIVE DEVICES
EP1782470	2005	2007	PRINCETON UNIVERISTY	STACKED ORGANIC PHOTOSENSITIVE DEVICES
EP1782471	2005	2007	PRINCETON UNIVERISTY	ORGANIC PHOTOSENSITIVE DEVICES
EP1805824	2005	2007	PRINCETON UNIVERISTY	USE OF ORGANIC PHOTOSENSITIVE DEVICES
EP1815544	2005	2007	PRINCETON UNIVERISTY	ORGANIC PHOTOSENSITIVE OPTOELECTRONIC DEVICE HAVING A PHENANTHROLINE EXCITON BLOCKING LAYER
EP1838994	2005	2007	UNIVERSITY OF CALIFORNIA	METHODS OF MAKING FUNCTIONALIZED NANORODS
EP1870943	1999	2007	INTERNATIONAL SOLAR ELECTRIC TECHNOLOGY INC	AN OXIDE-BASED METHOD OF MAKING COMPOUND SEMICONDUCTOR FILMS AND MAKING RELATED ELECTRONIC DEVICES
WO2007044322	2006	2007	LOS ALAMOS NATIONAL SECURITY LLC	CONDUCTIVE LAYER FOR BIAXIALLY ORIENTED SEMICONDUCTOR FILM GROWTH
WO2007047952	2006	2007	UNIVERSITY OF SOUTH FLORIDA	CLATHRATE COMPOUNDS AND METHODS OF MANUFACTURING
WO2007055931	2006	2007	PRINCETON UNIVERISTY	ORGANIC PHOTOVOLTAIC CELLS UTILIZING ULTRATHIN SENSITIZING LAYER
WO2007065039	2006	2007	UNIVERSITY OF CALIFORNIA	NANOCRYSTAL SOLAR CELLS PROCESSED FROM SOLUTION
WO2007073467	2006	2007	PRINCETON UNIVERISTY	INTERMEDIATE-BAND PHOTOSENSITIVE DEVICE WITH QUANTUM DOTS HAVING TUNNELING BARRIER EMBEDDED IN ORGANIC MATRIX
WO2007079382	2006	2007	POWERLIGHT CORP	SUPPORTED PV MODULE ASSEMBLY
WO2007089886	2007	2007	LOS ALAMOS NATIONAL SECURITY LLC	BIAXIALLY ORIENTED FILM ON FLEXIBLE POLYMERIC SUBSTRATE
WO2007103882	2007	2007	POWERLIGHT CORP	PHOTOVOLTAIC MODULE MOUNTING CLIP WITH INTEGRAL GROUNDING
7314773	2005	2008	PRINCETON UNIVERISTY	LOW RESISTANCE THIN FILM ORGANIC SOLAR CELL ELECTRODES
7326955	2004	2008	PRINCETON UNIVERISTY	STACKED ORGANIC PHOTOSENSITIVE DEVICES
7329554	2001	2008	MIDWEST	REACTIVE CODOPING OF GAALINP

			RESEARCH INSTITUTE	COMPOUND SEMICONDUCTORS
7332599	2003	2008	NORTH CAROLINA STATE UNIVERSITY	METHODS AND INTERMEDIATES FOR THE SYNTHESIS OF DIPYRRIN-SUBSTITUTED PORPHYRINIC MACROCYCLES
7341927	2004	2008	CALIFORNIA INSTITUTE OF TECHNOLOGY	WAFER BONDED EPITAXIAL TEMPLATES FOR SILICON HETEROSTRUCTURES
7368658	2003	2008	US DEPT OF ENERGY	HIGH EFFICIENCY DIAMOND SOLAR CELLS
7368659	2002	2008	GENERAL ELECTRIC CO	ELECTRODES MITIGATING EFFECTS OF DEFECTS IN ORGANIC ELECTRONIC DEVICES
7375370	2004	2008	PRINCETON UNIVERISTY	STACKED ORGANIC PHOTOSENSITIVE DEVICES
7408058	2004	2008	NORTH CAROLINA STATE UNIVERSITY	REGIOISOMERICALLY PURE OXOCHLORINS AND METHODS OF SYNTHESIS
7414294	2005	2008	PRINCETON UNIVERISTY	INTERMEDIATE-BAND PHOTOSENSITIVE DEVICE WITH QUANTUM DOTS HAVING TUNNELING BARRIER EMBEDDED IN ORGANIC MATRIX
7419846	2004	2008	PRINCETON UNIVERISTY	METHOD OF FABRICATING AN OPTOELECTRONIC DEVICE HAVING A BULK HETEROJUNCTION
7435134	2007	2008	SUNPOWER CORP	PHOTOVOLTAIC MODULE MOUNTING CLIP WITH INTEGRAL GROUNDING
7435617	2004	2008	PRINCETON UNIVERISTY	METHOD OF FABRICATING AN OPTOELECTRONIC DEVICE HAVING A BULK HETEROJUNCTION
7465872	2003	2008	GENERAL ELECTRIC CO	PHOTOVOLTAIC POWER CONVERTER SYSTEM WITH A CONTROLLER CONFIGURED TO ACTIVELY COMPENSATE LOAD HARMONICS
EP1889300	2006	2008	UNIVERSITY OF CALIFORNIA	INTERNAL GETTERING BY METAL ALLOY CLUSTERS
EP1900007	2006	2008	PRINCETON UNIVERSITY, TECHNION RES & DEV	ORGANIC DOUBLE-HETEROSTRUCTURE PHOTOVOLTAIC CELLS HAVING RECIPROCAL-CARRIER EXCITON BLOCKING LAYER
EP1903614	1993	2008	FIRST SOLAR INC	METHOD OF MANUFACTURING A PHOTOVOLTAIC DEVICE
EP1920480	2006	2008	PRINCETON UNIVERISTY	LOW RESISTANCE THIN FILM ORGANIC SOLAR CELL ELECTRODES
EP1928039	2005	2008	PRINCETON UNIVERISTY	ORGANIC PHOTOSENSITIVE DEVICES
EP1938390	2006	2008	UNIVERSITY OF	NANOCRYSTAL SOLAR CELLS PROCESSED FROM SOLUTION

			CALIFORNIA	
EP1952455	2006	2008	PRINCETON UNIVERISTY	ORGANIC PHOTOVOLTAIC CELLS UTILIZING ULTRATHIN SENSITIZING LAYER
EP1969640	2006	2008	SUNPOWER CORP	SUPPORTED PV MODULE ASSEMBLY
EP1969652	2006	2008	PRINCETON UNIVERISTY	INTERMEDIATE-BAND PHOTOSENSITIVE DEVICE WITH QUANTUM DOTS HAVING TUNNELING BARRIER EMBEDDED IN ORGANIC MATRIX
EP1978561	2005	2008	PRINCETON UNIVERISTY	STACKED ORGANIC PHOTOSENSITIVE DEVICES
EP1994565	2007	2008	LOS ALAMOS NATIONAL SECURITY LLC	OPTOELECTRONIC DEVICES UTILIZING MATERIALS HAVING ENHANCED ELECTRONIC TRANSITIONS
EP2008343	2007	2008	POWERLIGHT CORP	PHOTOVOLTAIC MODULE MOUNTING CLIP WITH INTEGRAL GROUNDING
WO2008005027	2006	2008	PRINCETON UNIVERISTY	LOW RESISTANCE THIN FILM ORGANIC SOLAR CELL ELECTRODES
WO2008014037	2007	2008	GENERAL ELECTRIC CO	ORGANIC IRIDIUM COMPOSITIONS AND THEIR USE IN ELECTRONIC DEVICES
WO2008018982	2007	2008	NORTH CAROLINA STATE UNIVERSITY	SELF-ASSEMBLED PHOTOSYNTHESIS-INSPIRED LIGHT HARVESTING MATERIAL AND SOLAR CELLS CONTAINING THE SAME
WO2008036837	2007	2008	UNIVERSITY OF ILLINOIS	RELEASE STRATEGIES FOR MAKING TRANSFERABLE SEMICONDUCTOR STRUCTURES, DEVICES AND DEVICE COMPONENTS
WO2008063190	2006	2008	MIDWEST RESEARCH INSTITUTE	PRECURSORS FOR FORMATION OF COPPER SELENIDE, INDIUM SELENIDE, COPPER INDIUM DISELENIDE, AND/OR COPPER INDIUM GALLIUM DISELENIDE FILMS
WO2008063209	2007	2008	LOS ALAMOS NATIONAL SECURITY LLC	OPTOELECTRONIC DEVICES UTILIZING MATERIALS HAVING ENHANCED ELECTRONIC TRANSITIONS
WO2008066933	2007	2008	UNIVERSITY OF CALIFORNIA	ENHANCING PERFORMANCE CHARACTERISTICS OF ORGANIC SEMICONDUCTING FILMS BY IMPROVED SOLUTION PROCESSING
WO2008109467	2008	2008	ARIZONA STATE UNIVERSITY	ELECTRICALLY CONDUCTING PORPHYRIN AND PORPHYRIN-FULLERENE ELECTROPOLYMERS
WO2008112639	2008	2008	WISCONSIN ALUMNI RES FOUND	GRAPHITE-BASED PHOTOVOLTAIC CELLS
WO2008143635	2007	2008	UNIVERSITY	OPTICAL SYSTEMS FABRICATED BY

			OF ILLINOIS	PRINTING-BASED ASSEMBLY
WO2008143885	2008	2008	SUNPOWER CORP	PROTECTION LAYER FOR FABRICATING A SOLAR CELL
WO2008157637	2008	2008	ROSESTREET LABS ENERGY INC	SINGLE P-N JUNCTION TANDEM PHOTOVOLTAIC DEVICE
7482532	2005	2009	MASSACHUSETTS INSTITUTE OF TECHNOLOGY	LIGHT TRAPPING IN THIN FILM SOLAR CELLS USING TEXTURED PHOTONIC CRYSTAL
7534414	2008	2009	UNIVERSITY OF SOUTH FLORIDA	CLATHRATE COMPOUNDS AND METHOD OF MANUFACTURING
7545051	2007	2009	UNIVERSITY OF CALIFORNIA	NANOWIRE ARRAY AND NANOWIRE SOLAR CELLS AND METHODS FOR FORMING THE SAME
7560641	2003	2009	UNASSIGNED	THIN FILM SOLAR CELL CONFIGURATION AND FABRICATION METHOD
7569847	2005	2009	UNIVERSITY OF CALIFORNIA	METHODS OF FABRICATING NANOSTRUCTURES AND NANOWIRES AND DEVICES FABRICATED THEREFROM
7569941	2006	2009	UNIVERSITY OF CALIFORNIA	METHODS OF FABRICATING NANOSTRUCTURES AND NANOWIRES AND DEVICES FABRICATED THEREFROM
7592539	2003	2009	PRINCETON UNIVERISTY	SOLID STATE PHOTOSENSITIVE DEVICES WHICH EMPLOY ISOLATED PHOTOSYNTHETIC COMPLEXES
7597927	2004	2009	PRINCETON UNIVERISTY	SOLAR CELLS
7601430	2006	2009	LOS ALAMOS NATIONAL SECURITY LLC	BIAXIALLY ORIENTED FILM ON FLEXIBLE POLYMERIC SUBSTRATE
7632701	2007	2009	UNIVERSITY OF CENTRAL FLORIDA	THIN FILM SOLAR CELLS BY SELENIZATION SULFURIZATION USING DIETHYL SELENIUM AS A SELENIUM PRECURSOR
7633007	2007	2009	NORTH CAROLINA STATE UNIVERSITY	SELF-ASSEMBLED PHOTOSYNTHESIS-INSPIRED LIGHT HARVESTING MATERIAL AND SOLAR CELLS CONTAINING THE SAME
EP2049555	2007	2009	GENERAL ELECTRIC CO	ORGANIC IRIDIUM COMPOSITIONS AND THEIR USE IN ELECTRONIC DEVICES
EP2064734	2007	2009	UNIVERSITY OF ILLINOIS	METHOD OF PRINTING TRANSFERABLE FUNCTIONAL STRUCTURES
EP2087537	2007	2009	UNIVERSITY OF CALIFORNIA	ENHANCING PERFORMANCE CHARACTERISTICS OF ORGANIC SEMICONDUCTING FILMS BY IMPROVED SOLUTION PROCESSING
EP2101931	2006	2009	MIDWEST RESEARCH	PRECURSORS FOR FORMATION OF COPPER SELENIDE, INDIUM

			INSTITTUE	SELENIDE, COPPER INDIUM DISELENIDE, AND/OR COPPER INDIUM GALLIUM DISELENIDE FILMS
EP2104954	2007	2009	UNIVERSITY OF ILLINOIS, SEMPRIUS INC	OPTICAL SYSTEMS FABRICATED BY PRINTING-BASED ASSEMBLY
EP2135301	2008	2009	WISCONSIN ALUMNI RES FOUND; UNIV UTAH	GRAPHITE-BASED PHOTOVOLTAIC CELLS
WO2009012397	2008	2009	UNIVERSITY OF CALIFORNIA	SURFACE PLASMON-ENHANCED PHOTOVOLTAIC DEVICE
WO2009012469	2008	2009	CALIFORNIA INSTITUTE OF TECHNOLOGY	STRUCTURES OF AND METHODS FOR FORMING VERTICALLY ALIGNED SI WIRE ARRAYS
WO2009026097	2008	2009	NORTHWESTERN UNIVERSITY	P-TYPE SEMICONDUCTING NICKEL OXIDE AS AN EFFICIENCY-ENHANCING ANODAL INTERFACIAL LAYER IN BULK HETEROJUNCTION SOLAR CELLS
WO2009032358	2008	2009	NORTHWESTERN UNIVERSITY	TFB:TPDSI2 INTERFACIAL LAYER USABLE IN ORGANIC PHOTOVOLTAIC CELLS
WO2009064736	2008	2009	BATTELLE ENERGY ALLIANCE LLC	STRUCTURES, SYSTEMS AND METHODS FOR HARVESTING ENERGY FROM ELECTROMAGNETIC RADIATION
WO2009148661	2009	2009	BATTELLE ENERGY ALLIANCE LLC	METHODS FOR FORMING PARTICLES FROM SINGLE SOURCE PRECURSORS, METHODS OF FORMING SEMICONDUCTOR DEVICES, AND DEVICES FORMED USING SUCH METHODS
7667133	2003	2010	UNIVERSITY OF TOLEDO	HYBRID WINDOW LAYER FOR PHOTOVOLTAIC CELLS
7670638	2008	2010	SUNPOWER CORP	PROTECTION LAYER FOR FABRICATING A SOLAR CELL
7691292	2006	2010	GENERAL ELECTRIC CO	ORGANIC IRIDIUM COMPOSITIONS AND THEIR USE IN ELECTRONIC DEVICES
7709728	2004	2010	UNIVERSITY OF CALIFORNIA	MULTIBAND SEMICONDUCTOR COMPOSITIONS FOR PHOTOVOLTAIC DEVICES
7718087	2006	2010	GENERAL ELECTRIC CO	ORGANIC IRIDIUM COMPOSITIONS AND THEIR USE IN ELECTRONIC DEVICES
7723513	2007	2010	NORTH CAROLINA STATE UNIVERSITY	METHODS AND INTERMEDIATES FOR THE SYNTHESIS OF DIPYRRIN-SUBSTITUTED PORPHYRINIC MACROCYCLES
7755109	2006	2010	CALIFORNIA INSTITUTE OF TECHNOLOGY	BONDED SEMICONDUCTOR SUBSTRATE
7763095	2006	2010	UNIVERSITY	INTERNAL GETTERING BY METAL

			OF CALIFORNIA	ALLOY CLUSTERS
7777241	2005	2010	BOSTON UNIVERSITY	OPTICAL DEVICES FEATURING TEXTURED SEMICONDUCTOR LAYERS
7777303	2003	2010	UNIVERSITY OF CALIFORNIA	SEMICONDUCTOR-NANOCRYSTAL/CONJUGATED POLYMER THIN FILMS
7780472	2008	2010	SUNPOWER CORP	PHOTOVOLTAIC MODULE MOUNTING CLIP WITH INTEGRAL GROUNDING
7816715	2007	2010	PRINCETON UNIVERISTY	STACKED ORGANIC PHOTOSENSITIVE DEVICES
7834264	2006	2010	UNIVERSITY OF CALIFORNIA	METHODS OF FABRICATING NANOSTRUCTURES AND NANOWIRES AND DEVICES FABRICATED THEREFROM
7856769	2006	2010	PVT SOLAR INC	RACK ASSEMBLY FOR MOUNTING SOLAR MODULES
7858876	2007	2010	WISCONSIN ALUMNI RES FOUND; UNIV UTAH	GRAPHITE-BASED PHOTOVOLTAIC CELLS
EP2158610	2008	2010	ROSESTREET LABS ENERGY INC	SINGLE P-N JUNCTION TANDEM PHOTOVOLTAIC DEVICE
EP2158613	2008	2010	SUNPOWER CORP	PROTECTION LAYER FOR FABRICATING A SOLAR CELL
EP2168175	2008	2010	UNIVERSITY OF CALIFORNIA	SURFACE PLASMON-ENHANCED PHOTOVOLTAIC DEVICE
EP2171745	2008	2010	CALIFORNIA INSTITUTE OF TECHNOLOGY	STRUCTURES OF AND METHODS FOR FORMING VERTICALLY ALIGNED SI WIRE ARRAYS
EP2186148	2008	2010	NORTHWESTERN UNIVERSITY	P-TYPE SEMICONDUCTING NICKEL OXIDE AS AN EFFICIENCY-ENHANCING ANODAL INTERFACIAL LAYER IN BULK HETEROJUNCTION SOLAR CELLS
EP2195851	2008	2010	NORTHWESTERN UNIVERSITY	TFB:TPDSI2 INTERFACIAL LAYER USABLE IN ORGANIC PHOTOVOLTAIC CELLS
WO2010017115	2009	2010	UNIVERSITY OF WASHINGTON	DYE-SENSITIZED SOLAR CELL EMPLOYING ZINC OXIDE AGGREGATES GROWN IN THE PRESENCE OF LITHIUM
WO2010036807	2009	2010	UNIVERSITY OF ILLINOIS	ARRAYS OF ULTRATHIN SILICON SOLAR MICROCELLS
WO2010042344	2009	2010	UNIVERSITY OF UTAH	ORGANIC SPINTRONIC DEVICES AND METHODS FOR MAKING THE SAME
WO2010056464	2009	2010	SUNPOWER CORP	FLEXIBLE WIND DEFLECTOR FOR PHOTOVOLTAIC ARRAY PERIMETER ASSEMBLY
WO2010129277	2010	2010	TUFTS COLLEGE	MICROPLASMA GENERATOR AND METHODS THEREFOR

WO2010135309	2010	2010	INNOVALIGHT INC	METHODS AND APPARATUS FOR ALIGNING A SET OF PATTERNS ON A SILICON SUBSTRATE
WO2010141580	2010	2010	UNIVERSITY OF FLORIDA	SOLAR-POWERED LIGHTING MODULE
7879644	2007	2011	UNIVERSITY OF TOLEDO	HYBRID WINDOW LAYER FOR PHOTOVOLTAIC CELLS
7888593	2008	2011	NORTHWESTERN UNIVERSITY	TFB:TPDSI2 INTERFACIAL LAYER USABLE IN ORGANIC PHOTOVOLTAIC CELLS
7893352	2005	2011	PRINCETON UNIVERSITY, TECHNION RES & DEV	ORGANIC PHOTOSENSITIVE OPTOELECTRONIC DEVICE HAVING A PHENANTHROLINE EXCITON BLOCKING LAYER
7893512	2007	2011	LOS ALAMOS NATIONAL SECURITY LLC	OPTOELECTRONIC DEVICES UTILIZING MATERIALS HAVING ENHANCED ELECTRONIC TRANSITIONS
7915701	2008	2011	PRINCETON UNIVERISTY	STACKED ORGANIC PHOTOSENSITIVE DEVICES
7919770	2006	2011	NORTH CAROLINA STATE UNIVERSITY	SUBSTITUTED BENZAZOLOPORPHYRAZINES FOR POLYMERIZATION AND SURFACE ATTACHMENT AND ARTICLES FORMED THEREFROM
7932123	2007	2011	UNIVERSITY OF ILLINOIS	RELEASE STRATEGIES FOR MAKING TRANSFERABLE SEMICONDUCTOR STRUCTURES, DEVICES AND DEVICE COMPONENTS
7947828	2010	2011	NORTH CAROLINA STATE UNIVERSITY	METHODS AND INTERMEDIATES FOR THE SYNTHESIS OF DIPYRRIN-SUBSTITUTED PORPHYRINIC MACROCYCLES
7947897	2005	2011	PRINCETON UNIVERISTY	ORGANIC PHOTOVOLTAIC CELLS UTILIZING ULTRATHIN SENSITIZING LAYER
7956281	2008	2011	SUNPOWER CORP	FLEXIBLE WIND DEFLECTOR FOR PHOTOVOLTAIC ARRAY PERIMETER ASSEMBLY
7972875	2007	2011	UNIVERSITY OF ILLINOIS	OPTICAL SYSTEMS FABRICATED BY PRINTING-BASED ASSEMBLY
7994421	2008	2011	VOXTEL INC	PHOTOVOLTAIC DEVICES HAVING NANOPARTICLE DIPOLES FOR ENHANCED PERFORMANCE AND METHODS FOR MAKING SAME
8003070	2008	2011	BATTELLE ENERGY ALLIANCE LLC	METHODS FOR FORMING PARTICLES FROM SINGLE SOURCE PRECURSORS
8030120	2007	2011	UNIVERSITY OF TOLEDO	HYBRID WINDOW LAYER FOR PHOTOVOLTAIC CELLS
8034745	2008	2011	UNASSIGNED	HIGH PERFORMANCE DEVICES ENABLED BY EPITAXIAL, PREFERENTIALLY ORIENTED, NANODOTS AND/OR NANORODS
8035113	2006	2011	BOSTON UNIVERSITY	OPTICAL DEVICES FEATURING TEXTURED SEMICONDUCTOR

				LAYERS
8039740	2007	2011	ROSESTREET LABS ENERGY INC	SINGLE P-N JUNCTION TANDEM PHOTOVOLTAIC DEVICE
8048814	2009	2011	INNOVALIGHT INC	METHODS AND APPARATUS FOR ALIGNING A SET OF PATTERNS ON A SILICON SUBSTRATE
8071931	2007	2011	BATTELLE ENERGY ALLIANCE LLC	STRUCTURES, SYSTEMS AND METHODS FOR HARVESTING ENERGY FROM ELECTROMAGNETIC RADIATION
EP2273552	2002	2011	UNIVERSITY OF CALIFORNIA	METHODS OF FABRICATING NANSTRUCTURES AND NANOWIRES AND DEVICES FABRICATED THEREFROM
EP2299508	2005	2011	PRINCETON UNIVERSITY, TECHNION RES & DEV	ORGANIC PHOTOSENSITIVE OPTOELECTRONIC DEVICE HAVING A PHENANTHROLINE EXCITON BLOCKING LAYER
EP2364506	2009	2011	SUNPOWER CORP	FLEXIBLE WIND DEFLECTOR FOR PHOTOVOLTAIC ARRAY PERIMETER ASSEMBLY
WO2011031683	2010	2011	ROSESTREET LABS ENERGY INC	DILUTE GROUP III-V NITRIDE INTERMEDIATE BAND SOLAR CELLS WITH CONTRACT BLOCKING LAYERS
WO2011050179	2010	2011	STANFORD UNIVERSITY	OPTOELECTRONIC SEMICONDUCTOR DEVICE AND METHOD OF FABRICATION
WO2011051292	2010	2011	UNIVERSITY OF WASHINGTON	COPOLYMER SEMICONDUCTORS COMPRISING THIAZOLOTHIAZOLE OR BENZOBISTHIAZOLE, OR BENZOBISOXAZOLE ELECTRON ACCEPTOR SUBUNITS, AND ELECTRON DONOR SUBUNITS, AND THEIR USES IN TRANSISTORS AND SOLAR CELLS
WO2011059559	2010	2011	SUNPOWER CORP	WATER-RESISTANT APPARATUSES FOR PHOTOVOLTAIC MODULES
WO2011066029	2010	2011	UNIVERSITY OF MICHIGAN	METHODS OF PREPARING FLEXIBLE PHOTOVOLTAIC DEVICES USING EPITAXIAL LIFTOFF, AND PRESERVING THE INTEGRITY OF GROWTH SUBSTRATES USED IN EPITAXIAL GROWTH
WO2011066529	2010	2011	CALIFORNIA INSTITUTE OF TECHNOLOGY	THREE-DIMENSIONAL PATTERNING METHODS AND RELATED DEVICES
WO2011066570	2010	2011	CALIFORNIA INSTITUTE OF TECHNOLOGY	SEMICONDUCTOR WIRE ARRAY STRUCTURES, AND SOLAR CELLS AND PHOTODETECTORS BASED ON SUCH STRUCTURES
WO2011087753	2010	2011	LOS ALAMOS NATIONAL SECURITY LLC	PHOTOVOLTAIC DEVICE COMPRISING COMPOSITIONALLY GRADED INTRINSIC PHOTOACTIVE LAYER

WO2011127475	2011	2011	ARIZONA STATE UNIVERSITY	ORGANIC PHOTOVOLTAIC DEVICES COMPRISING SOLUTION-PROCESSED SUBSTITUTED METAL-PHTHALOCYANINES AND EXHIBITING NEAR-IR PHOTO-SENSITIVITY
WO2011146115	2011	2011	HELIOVOLT CORP, ALLIANCE FOR SUSTAINABLE ENERGY LLC	LIQUID PRECURSOR FOR DEPOSITION OF COPPER SELENIDE AND METHOD OF PREPARING THE SAME
8093494	2005	2012	UNIVERSITY OF CALIFORNIA	METHODS OF MAKING FUNCTIONALIZED NANORODS
8106393	2011	2012	NORTH CAROLINA STATE UNIVERSITY	SUBSTITUTED BENZAZOLOPORPHYRAZINES FOR POLYMERIZATION AND SURFACE ATTACHMENT AND ARTICLES FORMED THEREFROM
8119571	2006	2012	UNASSIGNED	HIGH PERFORMANCE ELECTRICAL, MAGNETIC, ELECTROMAGNETIC AND ELECTROOPTICAL DEVICES ENABLED BY THREE DIMENSIONALLY ORDERED NANODOTS AND NANORODS
8129520	2011	2012	NORTH CAROLINA STATE UNIVERSITY	METHODS AND INTERMEDIATES FOR THE SYNTHESIS OF DIPYRRIN-SUBSTITUTED PORPHYRINIC MACROCYCLES
8129614	2011	2012	ROSESTREET LABS ENERGY INC	SINGLE P-N JUNCTION TANDEM PHOTOVOLTAIC DEVICE
8129615	2008	2012	UNIVERSITY OF CALIFORNIA	MULTIBAND SEMICONDUCTOR COMPOSITIONS FOR PHOTOVOLTAIC DEVICES
8178221	2008	2012	UNASSIGNED	{100}<100> OR 45.DEGREE.-ROTATED {100}<100>, SEMICONDUCTOR-BASED, LARGE-AREA, FLEXIBLE, ELECTRONIC DEVICES
8211400	2009	2012	UNIVERSITY OF SOUTH FLORIDA	METHOD OF MANUFACTURING A CLATHRATE COMPOUND
8221909	2010	2012	UT-BATTELLE LLC	PHASE-SEPARATED, EPITAXIAL COMPOSITE CAP LAYERS FOR ELECTRONIC DEVICE APPLICATIONS AND METHOD OF MAKING THE SAME
8232470	2009	2012	ROSESTREET LABS ENERGY INC	DILUTE GROUP III-V NITRIDE INTERMEDIATE BAND SOLAR CELLS WITH CONTACT BLOCKING LAYERS
8237175	2011	2012	BOSTON UNIVERSITY	OPTICAL DEVICES FEATURING TEXTURED SEMICONDUCTOR LAYERS
8247325	2009	2012	UCHICAGO ARGONNE LLC	DIRECT GROWTH OF METAL NANOPLATES ON SEMICONDUCTOR SUBSTRATES

8256170	2010	2012	PVT SOLAR INC	RACK ASSEMBLY FOR MOUNTING SOLAR MODULES
8258398	2007	2012	UCHICAGO ARGONNE LLC	HETEROJUNCTION PHOTOVOLTAIC ASSEMBLED WITH ATOMIC LAYER DEPOSITION
8269100	2009	2012	UCHICAGO ARGONNE LLC	HYBRID SOLAR CELLS VIA UV-POLYMERIZATION OF POLYMER PRECURSOR
8273599	2007	2012	UNIVERSITY OF CALIFORNIA	ENHANCING PERFORMANCE CHARACTERISTICS OF ORGANIC SEMICONDUCTING FILMS BY IMPROVED SOLUTION PROCESSING
8276329	2005	2012	SUNPOWER CORP	FIRE RESISTANT PV SHINGLE ASSEMBLY
8283619	2011	2012	BATTELLE ENERGY ALLIANCE LLC	ENERGY HARVESTING DEVICES FOR HARVESTING ENERGY FROM TERAHERTZ ELECTROMAGNETIC RADIATION
8288176	2011	2012	INNOVALIGHT INC	METHOD FOR MANUFACTURING A PHOTOVOLTAIC CELL
8318127	2011	2012	STC UNM	METHODS FOR PREPARING HIGH CRYSTALLINITY AND SURFACE AREA POROUS METAL OXIDES
8318532	2007	2012	UNIVERSITY OF CALIFORNIA	ENHANCING PERFORMANCE CHARACTERISTICS OF ORGANIC SEMICONDUCTING FILMS BY IMPROVED SOLUTION PROCESSING
8329503	2010	2012	SANDIA CORP	PHOTOVOLTAIC SOLAR CONCENTRATOR
8338772	2011	2012	BATTELLE ENERGY ALLIANCE LLC	DEVICES, SYSTEMS, AND METHODS FOR HARVESTING ENERGY AND METHODS FOR FORMING SUCH DEVICES
EP2425459	2010	2012	TUFTS COLLEGE	MICROPLASMA GENERATOR AND METHODS THEREFOR
EP2433298	2010	2012	INNOVALIGHT INC	METHODS AND APPARATUS FOR ALIGNING A SET OF PATTERNS ON A SILICON SUBSTRATE
EP2442367	2011	2012	ROHM & HAAS INC, ALLIANCE FOR SUSTAINABLE ENERGY LLC	IMPROVED METHOD FOR FORMING METAL CONTACTS
EP2462631	2010	2012	UNIVERSITY OF MICHIGAN	METHODS OF PREPARING FLEXIBLE PHOTOVOLTAIC DEVICES USING EPITAXIAL LIFTOFF, AND PRESERVING THE INTEGRITY OF GROWTH SUBSTRATES USED IN EPITAXIAL GROWTH
EP2493960	2010	2012	UNIVERSITY OF WASHINGTON	COPOLYMER SEMICONDUCTORS COMPRISING THIAZOLOTHIAZOLE OR BENZOBISTHIAZOLE, OR BENZOBISOXAZOLE ELECTRON ACCEPTOR SUBUNITS, AND ELECTRON DONOR SUBUNITS, AND THEIR USES IN TRANSISTORS AND

				SOLAR CELLS
EP2507842	2010	2012	CALIFORNIA INSTITUTE OF TECHNOLOGY	THREE-DIMENSIONAL PATTERNING METHODS AND RELATED DEVICES
EP2507843	2010	2012	CALIFORNIA INSTITUTE OF TECHNOLOGY	SEMICONDUCTOR WIRE ARRAY STRUCTURES, AND SOLAR CELLS AND PHOTODETECTORS BASED ON SUCH STRUCTURES
WO2012012117	2011	2012	UNIV SOUTHERN CALIFORNIA USC STEVENS INST FOR INNOVATION; UNIV MICHIGAN	FUSING PORPHYRINS WITH POLYCYCLIC AROMATIC HYDROCARBONS AND HETEROCYCLES FOR OPTOELECTRIC APPLICATIONS
WO2012023973	2011	2012	HELIOVOLT CORP, ALLIANCE FOR SUSTAINABLE ENERGY LLC	LIQUID PRECURSOR FOR DEPOSITION OF INDIUM SELENIDE AND METHOD OF PREPARING THE SAME
WO2012024592	2011	2012	MASSACHUSETTS INSTITUTE OF TECHNOLOGY	COMPOSITIONS, METHODS, AND SYSTEMS COMPRISING FLUOROUS-SOLUBLE POLYMERS
WO2012031083	2011	2012	IOWA STATE UNIVERSITY	TEXTURED MICROMETER SCALE TEMPLATES AS LIGHT MANAGING FABRICATION PLATFORM FOR ORGANIC SOLAR CELLS
WO2012034066	2011	2012	UNIVERSITY OF SOUTHERN CALIFORNIA	BROADLY ABSORBING METALLOPORPHYRIN-BASED MULTICHROMOPHORIC ARRAYS FOR TRIPLET HARVESTING
WO2012050616	2011	2012	LOS ALAMOS NATIONAL SECURITY LLC	COMPOSITE MATERIALS WITH METAL OXIDE ATTACHED TO LEAD CHALCOGENIDE NANOCRYSTAL QUANTUM DOTS WITH LINKERS
WO2012074853	2011	2012	UNIVERSITY OF CALIFORNIA	ORGANIC SMALL MOLECULE SEMICONDUCTING CHROMOPHORES FOR USE IN ORGANIC ELECTRONIC DEVICES
WO2012122387	2012	2012	COLUMBIA UNIVERSITY	GRAPHENE ELECTRODES FOR ELECTRONIC DEVICES
WO2012129511	2012	2012	NORTHWESTERN UNIVERSITY	SEMICONDUCTING COMPOUNDS AND DEVICES INCORPORATING SAME
WO2012138480	2012	2012	UT-BATTELLE LLC	METHODS FOR PRODUCING COMPLEX FILMS, AND FILMS PRODUCED THEREBY
WO2012161773	2012	2012	UNIVERSITY OF MICHIGAN	ORGANIC PHOTOVOLTAIC CELL INCORPORATING ELECTRON CONDUCTING EXCITON BLOCKING LAYERS
8357849	2004	2013	PRINCETON UNIVERISTY	ORGANIC PHOTOSENSITIVE DEVICES
8378385	2010	2013	UNIVERSITY	METHODS OF PREPARING FLEXIBLE

			OF MICHIGAN	PHOTOVOLTAIC DEVICES USING EPITAXIAL LIFTOFF, AND PRESERVING THE INTEGRITY OF GROWTH SUBSTRATES USED IN EPITAXIAL GROWTH
8389853	2010	2013	UNIVERSITY OF TEXAS; SANDIA CORPORATION	ASPHALTENE BASED PHOTOVOLTAIC DEVICES
8399761	2010	2013	NORTHWESTERN UNIVERSITY	ORGANIC PHOTOVOLTAIC DEVICE WITH INTERFACIAL LAYER AND METHOD OF FABRICATING SAME
8415758	2011	2013	LOS ALAMOS NATIONAL SECURITY LLC	OPTOELECTRONIC DEVICES UTILIZING MATERIALS HAVING ENHANCED ELECTRONIC TRANSITIONS
8420928	2008	2013	PPG INDUSTRIES OHIO INC	USE OF PHOTOVOLTAICS FOR WASTE HEAT RECOVERY
8424255	2007	2013	SUNPOWER CORP	PV MODULE MOUNTING METHOD AND MOUNTING ASSEMBLY
8431815	2009	2013	LOS ALAMOS NATIONAL SECURITY LLC	PHOTOVOLTAIC DEVICE COMPRISING COMPOSITIONALLY GRADED INTRINSIC PHOTOACTIVE LAYER
8440906	2006	2013	UNIVERSITY OF CALIFORNIA	NANOCRYSTAL SOLAR CELLS PROCESSED FROM SOLUTION
8445388	2011	2013	BATTELLE ENERGY ALLIANCE LLC	METHODS OF FORMING SEMICONDUCTOR DEVICES AND DEVICES FORMED USING SUCH METHODS
8466004	2009	2013	PRINCETON UNIVERISTY	SOLAR CELLS
8518526	2010	2013	UT-BATTELLE LLC	STRUCTURES WITH THREE DIMENSIONAL NANOFENCES COMPRISING SINGLE CRYSTAL SEGMENTS
8530338	2008	2013	CALIFORNIA INSTITUTE OF TECHNOLOGY	STRUCTURES OF AND METHODS FOR FORMING VERTICALLY ALIGNED SI WIRE ARRAYS
8536049	2011	2013	ROHM & HAAS INC, ALLIANCE FOR SUSTAINABLE ENERGY LLC	METHOD FOR FORMING METAL CONTACTS
8536098	2011	2013	UNASSIGNED	HIGH PERFORMANCE SUPERCONDUCTING DEVICES ENABLED BY THREE DIMENSIONALLY ORDERED NANODOTS AND/OR NANORODS
8558101	2006	2013	SUNPOWER CORP	SUPPORTED PV MODULE ASSEMBLY
8558107	2011	2013	UNIVERSITY OF WASHINGTON	DYE-SENSITIZED SOLAR CELL EMPLOYING ZINC OXIDE AGGREGATES GROWN IN THE

				PRESENCE OF LITHIUM
8568686	2007	2013	UNIVERSITY OF CALIFORNIA	SYNTHESIS OF THIN FILMS AND MATERIALS UTILIZING A GASEOUS CATALYST
8585886	2012	2013	UT-BATTELLE LLC	METHOD FOR SYNTHESIS OF TITANIUM DIOXIDE NANOTUBES USING IONIC LIQUIDS
8586967	2004	2013	PRINCETON UNIVERISTY	HIGH EFFICIENCY ORGANIC PHOTOVOLTAIC CELLS EMPLOYING HYBRIDIZED MIXED-PLANAR HETEROJUNCTIONS
8592249	2012	2013	SANDIA CORP	PHOTOVOLTAIC SOLAR CELL
8592680	2004	2013	PRINCETON UNIVERISTY	ORGANIC PHOTOSENSITIVE DEVICES
8614395	2011	2013	SANDIA CORP	SOLAR CELL WITH BACK SIDE CONTACTS
EP2590983	2011	2013	UNIV SOUTHERN CALIFORNIA; UNIV MICHIGAN	FUSING PORPHYRINS WITH POLYCYCLIC AROMATIC HYDROCARBONS AND HETEROCYCLES FOR OPTOELECTRIC APPLICATIONS
EP2600216	2003	2013	WISCONSIN ALUMNI RES FOUND	CONTROL OF SMALL DISTRIBUTED ENERGY RESOURCES
EP2614684	2011	2013	UNIVERSITY OF SOUTHERN CALIFORNIA	BROADLY ABSORBING METALLOPORPHYRIN-BASED MULTICHROMOPHORIC ARRAYS FOR TRIPLET HARVESTING
EP2631014	2004	2013	PRINCETON UNIVERISTY	IMPROVED SOLAR CELLS
EP2637228	2006	2013	PRINCETON UNIVERSITY, TECHNION RES & DEV	ORGANIC DOUBLE-HETEROSTRUCTURE PHOTOVOLTAIC CELLS HAVING RECIPROCAL-CARRIER EXCITON BLOCKING LAYER
EP2643865	2011	2013	UNIVERSITY OF CALIFORNIA	ORGANIC SMALL MOLECULE SEMICONDUCTING CHROMOPHORES FOR USE IN ORGANIC ELECTRONIC DEVICES
WO2013067181	2012	2013	UNIVERSITY OF MICHIGAN	METHOD OF PREPARING THE SURFACE OF METAL SUBSTRATES FOR ORGANIC PHOTOSENSITIVE DEVICES
WO2013109948	2013	2013	NORTHWESTERN UNIVERSITY	METHODS OF MAKING NON-COVALENTLY BONDED CARBON-TITANIA NANOCOMPOSITE THIN FILMS AND APPLICATIONS OF THE SAME
WO2013126385	2013	2013	NORTHWESTERN UNIVERSITY	PHOTOLUMINESCENT COMPOUNDS
WO2013126537	2013	2013	NORTHWESTERN UNIVERSITY	LIQUID ELECTROLYTE-FREE, SOLID-STATE SOLAR CELLS WITH INORGANIC HOLE TRANSPORT MATERIALS
8647915	2010	2014	UT-BATTELLE LLC,	HETERO-JUNCTION PHOTOVOLTAIC DEVICE AND METHOD OF

			UNIVERSITY OF TENNESSEE	FABRICATING THE DEVICE
8661753	2010	2014	SUNPOWER CORP	WATER-RESISTANT APPARATUSES FOR PHOTOVOLTAIC MODULES
8664095	2011	2014	UNIVERSITY OF CALIFORNIA	BLACK GE BASED ON CRYSTALLINE/AMORPHOUS CORE/SHELL NANONEEDLE ARRAYS
8669359	2009	2014	ARIZONA STATE UNIVERSITY	ELECTRICALLY CONDUCTING PORPHYRIN AND PORPHYRIN-FULLERENE ELECTROPOLYMERS
8679730	2011	2014	BROOKHAVEN SCIENCE ASSOCIATES LLC	AZIDE FUNCTIONALIZED POLY(3-HEXYLTHIOPHENE) AND METHOD OF FORMING SAME
8679888	2009	2014	UNIVERSITY OF ILLINOIS	ARRAYS OF ULTRATHIN SILICON SOLAR MICROCELLS
8709304	2010	2014	UNIVERSITY OF NEVADA RENO	HYDROTHERMAL SYNTHESIS OF NANOCUBES OF SILLENITE TYPE COMPOUNDS FOR PHOTOVOLTAIC APPLICATIONS AND SOLAR ENERGY CONVERSION OF CARBON DIOXIDE TO FUELS
8722458	2011	2014	UNIVERSITY OF ILLINOIS, SEMPRIUS INC	OPTICAL SYSTEMS FABRICATED BY PRINTING-BASED ASSEMBLY
8723169	2012	2014	UNIVERSITY OF CALIFORNIA	ENHANCING PERFORMING CHARACTERISTICS OF ORGANIC SEMICONDUCTING FILMS BY IMPROVED SOLUTION PROCESSING
8728857	2013	2014	SANDIA CORP	PHOTOVOLTAIC SOLAR CELL
8736108	2011	2014	SANDIA CORP	PHOTOVOLTAIC SYSTEM
8745936	2012	2014	SUNEDISON LLC	RACK ASSEMBLY FOR MOUNTING SOLAR MODULES
8748740	2013	2014	UNIVERSITY OF TEXAS; SANDIA CORPORATION	ASPHALTENE BASED PHOTOVOLTAIC DEVICES
8753916	2005	2014	UNIVERSITY OF CALIFORNIA	SEMICONDUCTOR-NANOCRYSTAL/CONJUGATED POLYMER THIN FILMS
8754188	2012	2014	NORTHWESTERN UNIVERSITY	SEMICONDUCTING COMPOUNDS AND DEVICES INCORPORATING SAME
8778724	2010	2014	UT-BATTELLE LLC	HIGH VOLUME METHOD OF MAKING LOW-COST, LIGHTWEIGHT SOLAR MATERIALS
8785905	2013	2014	SANDIA CORP	AMBER LIGHT-EMITTING DIODE COMPRISING A GROUP III-NITRIDE NANOWIRE ACTIVE REGION
8795854	2008	2014	UNASSIGNED	SEMICONDUCTOR-BASED, LARGE-AREA, FLEXIBLE, ELECTRONIC DEVICES ON {110}<100> ORIENTED SUBSTRATES
8808933	2010	2014	CALIFORNIA INSTITUTE OF TECHNOLOGY	SEMICONDUCTOR WIRE ARRAY STRUCTURES, AND SOLAR CELLS AND PHOTODETECTORS BASED ON

				SUCH STRUCTURES
8809110	2010	2014	UT-BATTELLE LLC	HIGH THROUGHPUT PARALLEL BACKSIDE CONTACTING AND PERIODIC TEXTURING FOR HIGH-EFFICIENCY SOLAR CELLS
8816332	2012	2014	UNIVERSITY OF MICHIGAN	ORGANIC PHOTOVOLTAIC CELL INCORPORATING ELECTRON CONDUCTING EXCITON BLOCKING LAYERS
8829930	2011	2014	UT-BATTELLE LLC	RAPID SCREENING BUFFER LAYERS IN PHOTOVOLTAICS
8841549	2009	2014	UNIVERSITY OF UTAH	ORGANIC SPINTRONIC DEVICES AND METHODS FOR MAKING THE SAME
8853526	2008	2014	UNIVERSITY OF CALIFORNIA	SURFACE PLASMON-ENHANCED PHOTOVOLTAIC DEVICE
8871884	2010	2014	UNIVERSITY OF WASHINGTON	COPOLYMER SEMICONDUCTORS COMPRISING THIAZOLOTHIAZOLE OR BENZOBISTHIAZOLE, OR BENZOBISOXAZOLE ELECTRON ACCEPTOR SUBUNITS, AND ELECTRON DONOR SUBUNITS, AND THEIR USES IN TRANSISTORS AND SOLAR CELLS
8876971	2006	2014	ALLIANCE FOR SUSTAINABLE ENERGY LLC	PRECURSORS FOR FORMATION OF COPPER SELENIDE, INDIUM SELENIDE, COPPER INDIUM DISELENIDE, AND/OR COPPER INDIUM GALLIUM DISELENIDE FILMS
8883548	2011	2014	LAWRENCE LIVERMORE NATIONAL SECURITY LLC	DEVELOPMENT OF AN ELECTRONIC DEVICE QUALITY ALUMINUM ANTIMONIDE (ALSB) SEMICONDUCTOR FOR SOLAR CELL APPLICATIONS
8889342	2014	2014	BROOKHAVEN SCIENCE ASSOCIATES LLC	AZIDE FUNCTIONALIZED POLY(3-HEXYLTHIOPHENE) AND METHODS OF FORMING SAME
8895337	2013	2014	SANDIA CORP	METHOD OF FABRICATING VERTICALLY ALIGNED GROUP III-V NANOWIRES
8895406	2011	2014	UNIVERSITY OF ILLINOIS	RELEASE STRATEGIES FOR MAKING TRANSFERABLE SEMICONDUCTOR STRUCTURES, DEVICES AND DEVICE COMPONENTS
8895416	2013	2014	ALLIANCE FOR SUSTAINABLE ENERGY LLC	SEMICONDUCTOR DEVICE PN JUNCTION FABRICATION USING OPTICAL PROCESSING OF AMORPHOUS SEMICONDUCTOR MATERIAL
8895848	2008	2014	NORTHWESTERN UNIVERSITY	P-TYPE SEMICONDUCTING NICKEL OXIDE AS AN EFFICIENCY-ENHANCING ANODAL INTERFACIAL LAYER IN BULK HETEROJUNCTION

				SOLAR CELLS
8896077	2010	2014	STANFORD UNIVERSITY	OPTOELECTRONIC SEMICONDUCTOR DEVICE AND METHOD OF FABRICATION
8904717	2012	2014	SUNPOWER CORP	FIRE RESISTANT PV SHINGLE ASSEMBLY
8911887	2011	2014	LOS ALAMOS NATIONAL SECURITY LLC	COMPOSITE MATERIALS WITH METAL OXIDE ATTACHED TO LEAD CHALCOGENIDE NANOCRYSTAL QUANTUM DOTS WITH LINKERS
8912037	2011	2014	FIRST SOLAR INC	METHOD FOR MAKING PHOTOVOLTAIC DEVICES USING OXYGENATED SEMICONDUCTOR THIN FILM LAYERS
8920767	2011	2014	UT-BATTELLE LLC	ARRAY OF TITANIUM DIOXIDE NANOSTRUCTURES FOR SOLAR ENERGY UTILIZATION
8921687	2012	2014	MAGNOLIA SOLAR INC	HIGH EFFICIENCY QUANTUM WELL WAVEGUIDE SOLAR CELLS AND METHODS FOR CONSTRUCTING THE SAME
EP2678890	2012	2014	UNIVERSITY OF MICHIGAN	ORGANIC PHOTOVOLTAIC CELL INCORPORATING ELECTRON CONDUCTING EXCITON BLOCKING LAYERS
EP2777084	2012	2014	UNIV MICHIGAN; UNIV DANKOOK	METHOD OF PREPARING THE SURFACE OF METAL SUBSTRATES FOR ORGANIC PHOTOSENSITIVE DEVICES
WO2014004610	2013	2014	ARIZONA STATE UNIVERSITY	SYSTEM AND METHOD FOR ELECTROREFINING OF SILICON
WO2014035555	2013	2014	BATTELLE ENERGY ALLIANCE LLC	ENERGY HARVESTING DEVICES, SYSTEMS, AND RELATED METHODS
WO2014036446	2013	2014	SANDIA CORP	DYNAMICALLY RECONFIGURABLE PHOTOVOLTAIC SYSTEM
WO2014052530	2013	2014	UNIVERSITY OF SOUTHERN CALIFORNIA, UNIVERSITY OF MICHIGAN	EXCITONIC ENERGY TRANSFER TO INCREASE INORGANIC SOLAR CELL EFFICIENCY
WO2014058918	2013	2014	SANDIA CORP	TRANSPARENT CONTACTS FOR STACKED COMPOUND PHOTOVOLTAIC CELLS
WO2014070888	2013	2014	MASSACHUSETTS INSTITUTE OF TECHNOLOGY	ORGANIC CONDUCTIVE MATERIALS AND DEVICES
WO2014089235	2013	2014	NORTHWESTERN UNIVERSITY, POLYERA CORP	CONJUGATED POLYMERS AND THEIR USE IN OPTOELECTRONIC DEVICES
WO2014143895	2014	2014	SANDIA CORP	SOLAR TRACKING SYSTEM
WO2014151383	2014	2014	SANDIA CORP	PHOTOELECTROCHEMICALLY DRIVEN SELF-ASSEMBLY

WO2014152592	2014	2014	SANDIA CORP	PRINTED CRYSTALLINE MICROELECTRONIC DEVICES
WO2014152731	2014	2014	SANDIA CORP	CUSTOMIZED COLOR PATTERNING OF PHOTOVOLTAIC CELLS
WO2014189690	2014	2014	PRINCETON UNIVERISTY	HYPERUNIFORM AND NEARLY HYPERUNIFORM RANDOM NETWORK MATERIALS
8927319	2013	2015	UNIVERSITY OF MICHIGAN	METHODS OF PREPARING FLEXIBLE PHOTOVOLTAIC DEVICES USING EPITAXIAL LIFTOFF, AND PRESERVING THE INTEGRITY OF GROWTH SUBSTRATES USED IN EPITAXIAL GROWTH
8950886	2010	2015	UNIVERSITY OF FLORIDA	SOLAR-POWERED LIGHTING MODULE
8962992	2012	2015	ROSESTREET LABS ENERGY INC	DILUTE GROUP III-V NITRIDE INTERMEDIATE BAND SOLAR CELLS WITH CONTACT BLOCKING LAYERS
8969831	2013	2015	MASSACHUSETTS INSTITUTE OF TECHNOLOGY	EXCITATION ENHANCEMENT AND EXTRACTION ENHANCEMENT WITH PHOTONIC CRYSTALS
8987736	2008	2015	UNASSIGNED	[100] OR [110] ALIGNED, SEMICONDUCTOR-BASED, LARGE-AREA, FLEXIBLE, ELECTRONIC DEVICES
9006972	2010	2015	TUFTS COLLEGE	MICROPLASMA GENERATOR AND METHODS THEREFOR
9012770	2012	2015	BROOKHAVEN SCIENCE ASSOCIATES LLC	CONDUCTIVE POLYMER/FULLERENE BLEND THIN FILMS WITH HONEYCOMB FRAMEWORK FOR TRANSPARENT PHOTOVOLTAIC APPLICATION
9024367	2013	2015	UNIVERSITY OF CALIFORNIA	FIELD-EFFECT P-N JUNCTION
9029239	2013	2015	SANDIA CORP	SEPARATING SEMICONDUCTOR DEVICES FROM SUBSTRATE BY ETCHING GRADED COMPOSITION RELEASE LAYER DISPOSED BETWEEN SEMICONDUCTOR DEVICES AND SUBSTRATE INCLUDING FORMING PROTUBERANCES THAT REDUCE STICTION
9029681	2010	2015	SANDIA CORP	MICROSYSTEM ENABLED PHOTOVOLTAIC MODULES AND SYSTEMS
9040113	2010	2015	UCHICAGO ARGONNE LLC	ATOMIC LAYER DEPOSITION OF METAL SULFIDE THIN FILMS USING NON-HALOGENATED PRECURSORS
9076972	2013	2015	ARIZONA STATE UNIVERSITY	SOLUBLE PORPHYRIN POLYMERS
9093586	2012	2015	SANDIA CORP	PHOTOVOLTAIC POWER GENERATION SYSTEM FREE OF

				BYPASS DIODES
9105782	2014	2015	UNIVERSITY OF ILLINOIS	ARRAYS OF ULTRATHIN SILICON SOLAR MICROCELLS
9105797	2012	2015	ALLIANCE FOR SUSTAINABLE ENERGY LLC	LIQUID PRECURSOR INKS FOR DEPOSITION OF IN—SE, GA—SE AND IN—GA—SE
9112100	2014	2015	SANDIA CORP	METHOD FOR FABRICATING PIXELATED SILICON DEVICE CELLS
9112164	2013	2015	PRINCETON UNIVERISTY	HIGH EFFICIENCY ORGANIC PHOTOVOLTAIC CELLS EMPLOYING HYBRIDIZED MIXED-PLANAR HETEROJUNCTIONS
9113535	2011	2015	UNIVERSITY OF SOUTHERN CALIFORNIA, UNIVERSITY OF MICHIGAN	FUSING PORPHYRINS WITH POLYCYCLIC AROMATIC HYDROCARBONS AND HETEROCYCLES FOR OPTOELECTRONIC APPLICATIONS
9117940	2014	2015	UNIVERSITY OF ILLINOIS, SEMPRIUS INC	OPTICAL SYSTEMS FABRICATED BY PRINTING-BASED ASSEMBLY
9126392	2011	2015	SANDIA CORP	PHOTOVOLTAIC SOLAR CONCENTRATOR
9130084	2013	2015	ALLIANCE FOR SUSTAINABLE ENERGY LLC	LIQUID PRECURSOR FOR DEPOSITION OF COPPER SELENIDE AND METHOD OF PREPARING THE SAME
9130170	2012	2015	UNIVERSITY OF MICHIGAN	INVERTED ORGANIC PHOTOSENSITIVE DEVICE
9136483	2015	2015	UNIVERSITY OF CALIFORNIA	THIOPHENE FUSED AZACORONENES: REGIOSELECTIVE SYNTHESIS, SELF ORGANIZATION, CHARGE TRANSPORT, AND ITS INCORPORATION IN CONJUGATED POLYMERS
9141413	2012	2015	SANDIA CORP	OPTIMIZED MICROSYSTEMS-ENABLED PHOTOVOLTAICS
9142408	2011	2015	ALLIANCE FOR SUSTAINABLE ENERGY LLC	LIQUID PRECURSOR FOR DEPOSITION OF INDIUM SELENIDE AND METHOD OF PREPARING THE SAME
9143053	2013	2015	SANDIA CORP, UNIVERSITY OF ILLINOIS	MICROINVERTERS FOR EMPLOYMENT IN CONNECTION WITH PHOTOVOLTAIC MODULES
9156938	2011	2015	MASSACHUSETTS INSTITUTE OF TECHNOLOGY	COMPOSITIONS, METHODS, AND SYSTEMS COMPRISING FLUOROUS-SOLUBLE POLYMERS
9166084	2011	2015	UNIVERSITY OF OKLAHOMA	INTERBAND CASCADE (IC) PHOTOVOLTAIC (PV) ARCHITECTURE FOR PV DEVICES
9178160	2014	2015	NORTHWESTERN UNIVERSITY, POLYERA CORP	FUSED THIOPHENE-BASED CONJUGATED POLYMERS AND THEIR USE IN OPTOELECTRONIC DEVICES
9181475	2013	2015	NORTHWESTERN UNIVERSITY	PHOTOLUMINESCENT COMPOUNDS

9190542	2014	2015	SANDIA CORP	PHOTOVOLTAIC CELL WITH LIGHT TRAPPING FOR ENHANCED EFFICIENCY
9190546	2010	2015	SANDIA CORP	SOLAR PHOTOVOLTAIC REFLECTIVE TROUGH COLLECTION STRUCTURE
9196760	2012	2015	UT-BATTELLE LLC	METHODS FOR PRODUCING COMPLEX FILMS, AND FILMS PRODUCED THEREBY
9203030	2014	2015	GEORGIA TECH RESEARCH CORP, PURDUE RES FOUND, US DEPT AGRICULTURE	RECYCLABLE ORGANIC SOLAR CELLS ON SUBSTRATES COMPRISING CELLULOSE NANOCRYSTALS (CNC)
EP2891004	2013	2015	BATTELLE ENERGY ALLIANCE LLC	ENERGY HARVESTING DEVICES, SYSTEMS, AND RELATED METHODS
EP2891187	2013	2015	SANDIA CORP	DYNAMICALLY RECONFIGURABLE PHOTOVOLTAIC SYSTEM
EP2901494	2013	2015	UNIVERSITY OF SOUTHERN CALIFORNIA, UNIVERSITY OF MICHIGAN	EXCITONIC ENERGY TRANSFER TO INCREASE INORGANIC SOLAR CELL EFFICIENCY
EP2944383	2006	2015	ALLIANCE FOR SUSTAINABLE ENERGY LLC	PRECURSORS FOR FORMATION OF COPPER SELENIDE, INDIUM SELENIDE, COPPER INDIUM DISELENIDE, AND/OR COPPER INDIUM GALLIUM DISELENIDE FILMS
WO2015035127	2014	2015	MASSACHUSETTS INSTITUTE OF TECHNOLOGY	METALLIC DIELECTRIC PHOTONIC CRYSTALS AND METHODS OF FABRICATION
WO2015038671	2014	2015	UNIVERSITY OF WASHINGTON	NON-FULLERENE ELECTRON ACCEPTORS FOR ORGANIC PHOTOVOLTAIC DEVICES
WO2015058105	2014	2015	STC UNM	METHODS TO INTRODUCE SUB-MICROMETER, SYMMETRY-BREAKING SURFACE CORRUGATION TO SILICON SUBSTRATES TO INCREASE LIGHT TRAPPING
WO2015061360	2014	2015	STC UNM	SYSTEMS AND METHODS FOR DISTRIBUTING POWER USING PHOTOVOLTAIC RESOURCES AND A SHIFTING BATTERY SYSTEM
WO2015061770	2014	2015	UNIVERSITY OF MICHICAN, DANKOOK UNIVERSITY	PHOTOVOLTAIC CELLS WITH A GRADED ACTIVE REGION ACHIVED USING STAMP TRANSFER PRINTING
WO2015073714	2014	2015	STANFORD UNIVERSITY	ILLUMINATION AND RADIATIVE COOLING
WO2015160410	2015	2015	UNIVERSITY OF PENNSYLVANI	HIGH-PERFORMING BULK PHOTOVOLTAICS

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WO2015164731	2015	2015	NORTHWESTERN UNIVERSITY	SOLAR CELLS WITH PEROVSKITE-BASED LIGHT SENSITIZATION LAYERS
WO2015171689	2015	2015	UNIVERSITY OF MASSACHUSETTS	FUNCTIONAL INTERLAYERS OF FULLERENE DERIVATIVES AND APPLICATIONS IN ORGANIC SOLAR CELLS
WO2015178678	2015	2015	ORION CO LTD	GLASS MATERIAL FOR SEALING LARGE-AREA DYE-SENSITIZED SOLAR CELL
9236194	2013	2016	NORTHWESTERN UNIVERSITY	METAL OXIDE-ENCAPSULATED DYE-SENSITIZED PHOTOANODES FOR DYE-SENSITIZED SOLAR CELLS
9240556	2014	2016	NORTHWESTERN UNIVERSITY	SEMICONDUCTING COMPOUNDS AND DEVICES INCORPORATING SAME
9293266	2014	2016	UNIVERSITY OF TEXAS	ASPHALTENE BASED PHOTOVOLTAIC DEVICES
9293553	2012	2016	COLUMBIA UNIVERSITY	GRAPHENE ELECTRODES FOR ELECTRONIC DEVICES
9336919	2013	2016	UNIVERSITY OF PENNSYLVANIA	METHODS FOR PREPARING COLLOIDAL NANOCRYSTAL-BASED THIN FILMS
9349900	2014	2016	UNIVERSITY OF ILLINOIS	RELEASE STRATEGIES FOR MAKING TRANSFERABLE SEMICONDUCTOR STRUCTURES, DEVICES AND DEVICE COMPONENTS
9356173	2013	2016	SANDIA CORP	DYNAMICALLY RECONFIGURABLE PHOTOVOLTAIC SYSTEM
9356241	2012	2016	UNIVERSITY OF CALIFORNIA	END-GROUP-DIRECTED SELF-ASSEMBLY OF ORGANIC COMPOUNDS USEFUL FOR PHOTOVOLTAIC APPLICATIONS
9368677	2014	2016	SANDIA CORP	SELECTIVE LAYER DISORDERING IN III-NITRIDES WITH A CAPPING LAYER
9371226	2011	2016	BATTELLE ENERGY ALLIANCE LLC	METHODS FOR FORMING PARTICLES
9388499	2014	2016	UCHICAGO ARGONNE LLC	ATOMIC LAYER EPITAXY OF HEMATITE ON INDIUM TIN OXIDE FOR APPLICATION IN SOLAR ENERGY CONVERSION
9391557	2013	2016	SANDIA CORP	SOLAR TRACKING SYSTEM
9393550	2013	2016	NORTHWESTERN UNIVERSITY	METHODS OF MAKING NON-COVALENTLY BONDED CARBON-TITANIA NANOCOMPOSITE THIN FILMS AND APPLICATIONS OF THE SAME
9401442	2011	2016	IOWA STATE UNIVERSITY	TEXTURED MICROMETER SCALE TEMPLATES AS LIGHT MANAGING FABRICATION PLATFORM FOR ORGANIC SOLAR CELLS
9425413	2015	2016	ARIZONA	CONJUGATED SIDE-STRAPPED

			STATE UNIVERSITY	PHTHALOCYANINES AND METHODS FOR PRODUCING AND USING THE SAME
9447107	2011	2016	UNIVERSITY OF SOUTHERN CALIFORNIA	BROADLY ABSORBING METALLOPORPHYRIN-BASED MULTICHROMOPHORIC ARRAYS FOR TRIPLET HARVESTING
9472699	2012	2016	BATTELLE ENERGY ALLIANCE LLC	ENERGY HARVESTING DEVICES, SYSTEMS, AND RELATED METHODS
9472702	2012	2016	SANDIA CORP, UNIVERSITY OF TEXAS	PHOTOVOLTAIC CELL WITH NANO-PATTERNED SUBSTRATE
9472764	2013	2016	NORTHWESTERN UNIVERSITY, POLYERA CORP	CONJUGATED POLYMERS AND THEIR USE IN OPTOELECTRONIC DEVICES
9484475	2012	2016	UNIVERSITY OF PENNSYLVANIA, DREXEL UNIVERSITY	SEMICONDUCTOR FERROELECTRIC COMPOSITIONS AND THEIR USE IN PHOTOVOLTAIC DEVICES
9496448	2013	2016	SANDIA CORP	CUSTOMIZED COLOR PATTERNING OF PHOTOVOLTAIC CELLS
9505770	2011	2016	ARIZONA STATE UNIVERSITY	ORGANIC PHOTOVOLTAIC DEVICES COMPRISING SOLUTION-PROCESSED SUBSTITUTED METAL-PHTHALOCYANINES AND EXHIBITING NEAR-IR PHOTO-SENSITIVITY
9508881	2012	2016	SANDIA CORP	TRANSPARENT CONTACTS FOR STACKED COMPOUND PHOTOVOLTAIC CELLS
9509250	2014	2016	SINTON CONSULTING INC	RAPID MEASUREMENT OF CURRENT-VOLTAGE CHARACTERISTICS OF SOLAR CELLS AND MODULES
9523152	2014	2016	MASSACHUSETTS INSTITUTE OF TECHNOLOGY	METALLIC DIELECTRIC PHOTONIC CRYSTALS AND METHODS OF FABRICATION
9530906	2014	2016	STC UNM	METHODS TO INTRODUCE SUB-MICROMETER, SYMMETRY-BREAKING SURFACE CORRUGATION TO SILICON SUBSTRATES TO INCREASE LIGHT TRAPPING
9530912	2010	2016	CALIFORNIA INSTITUTE OF TECHNOLOGY	THREE-DIMENSIONAL PATTERNING METHODS AND RELATED DEVICES
9531322	2016	2016	SANDIA CORP	DYNAMICALLY RECONFIGURABLE PHOTOVOLTAIC SYSTEM
WO2016051783	2015	2016	SHARP KK	HYBRID TROUGH SOLAR POWER SYSTEM USING PHOTOVOLTAIC TWO-STAGE LIGHT CONCENTRATION
WO2016187265	2016	2016	NORTHWESTER	DOPANT-FREE POLYMERIC HOLE-

			N UNIVERSITY	TRANSPORTING FOR PEROVSKITE SOLAR CELL
WO2016209333	2016	2016	MASSACHUSETTS INSTITUTE OF TECHNOLOGY	ELIMINATING EMISSIVE SUB-BANDGAP STATES IN NANOCRYSTALS
9548411	2013	2017	SANDIA CORP	PHOTOELECTROCHEMICALLY DRIVEN SELF-ASSEMBLY METHOD
9559219	2015	2017	SANDIA CORP	FAST PROCESS FLOW, ON-WAFER INTERCONNECTION AND SINGULATION FOR MEPV
9559222	2014	2017	ARIZONA STATE UNIVERSITY	METHOD AND TOOL TO REVERSE THE CHARGES IN ANTI-REFLECTION FILMS USED FOR SOLAR CELL APPLICATIONS
9588058	2015	2017	LAWRENCE LIVERMORE NATIONAL SECURITY LLC	NON-DESTRUCTIVE EVALUATION OF WATER INGRESS IN PHOTOVOLTAIC MODULES
9589792	2013	2017	SORAA INC	HIGH QUALITY GROUP-III METAL NITRIDE CRYSTALS, METHODS OF MAKING, AND METHODS OF USE
9595682	2013	2017	MASSACHUSETTS INSTITUTE OF TECHNOLOGY	ORGANIC CONDUCTIVE MATERIALS AND DEVICES
9601671	2015	2017	UNIVERSITY OF ILLINOIS, SEMPRIUS INC	OPTICAL SYSTEMS FABRICATED BY PRINTING-BASED ASSEMBLY
9685580	2016	2017	NATL TECH & ENG SOLUTIONS OF SANDIA LLC	METHOD OF MAKING PHOTOVOLTAIC CELL
9692234	2014	2017	STC UNM	SYSTEMS AND METHODS FOR DISTRIBUTING POWER USING PHOTOVOLTAIC RESOURCES AND A SHIFTING BATTERY SYSTEM
9711728	2015	2017	NORTHWESTERN UNIVERSITY, FLEXTERRA INC	FUSED THIOPHENE-BASED CONJUGATED POLYMERS AND THEIR USE IN OPTOELECTRONIC DEVICES
9722113	2015	2017	UNIVERSITY OF MICHIGAN	TETRADYMITE LAYER ASSISTED HETEROEPITAXIAL GROWTH AND APPLICATIONS
9735306	2013	2017	PRINCETON UNIVERSITY, TECHNION RES & DEV	WUSTITE-BASED PHOTOELECTRODES WITH LITHIUM, HYDROGEN, SODIUM, MAGNESIUM, MANGANESE, ZINC AND NICKEL ADDITIVES
9748415	2016	2017	SANDIA CORP	FAST PROCESS FLOW, ON-WAFER INTERCONNECTION AND SINGULATION FOR MEPV
9761748	2015	2017	NATL TECH & ENG SOLUTIONS OF SANDIA LLC	MICROSYSTEM ENABLED PHOTOVOLTAIC MODULES AND SYSTEMS

9763370	2013	2017	SANDIA CORP	APPARATUS FOR ASSEMBLY OF MICROELECTRONIC DEVICES
9773934	2014	2017	SHARP KK	HYBRID TROUGH SOLAR POWER SYSTEM USING PHOTOVOLTAIC TWO-STAGE LIGHT CONCENTRATION
9773991	2015	2017	UCHICAGO ARGONNE LLC	NON-HYDROLYTIC METAL OXIDE FILMS FOR PEROVSKITE HALIDE OVERCOATING AND STABILIZATION
9799779	2014	2017	UNIVERSITY OF ILLINOIS	SYSTEMS AND METHODS FOR PHOTOVOLTAIC STRING PROTECTION
9803136	2013	2017	NORTHWESTERN UNIVERSITY	LIQUID ELECTROLYTE-FREE, SOLID-STATE SOLAR CELLS WITH INORGANIC HOLE TRANSPORT MATERIALS
9809594	2014	2017	UNIVERSITY OF WASHINGTON	NON-FULLERENE ELECTRON ACCEPTORS FOR ORGANIC PHOTOVOLTAIC DEVICES
9831369	2013	2017	NATL TECH & ENG SOLUTIONS OF SANDIA LLC	PHOTOVOLTAIC POWER GENERATION SYSTEM WITH PHOTOVOLTAIC CELLS AS BYPASS DIODES
9837953	2016	2017	MASSACHUSETTS INSTITUTE OF TECHNOLOGY	METALLIC DIELECTRIC PHOTONIC CRYSTALS AND METHODS OF FABRICATION
9852927	2016	2017	UNIVERSITY OF CALIFORNIA	NEAR-UNITY PHOTOLUMINESCENCE QUANTUM YIELD IN MOS(SUB)2
EP3202030	2015	2017	SHARP KK	HYBRID TROUGH SOLAR POWER SYSTEM USING PHOTOVOLTAIC TWO-STAGE LIGHT CONCENTRATION
WO2017117471	2016	2017	LAWRENCE LIVERMORE NATIONAL SECURITY LLC	NON-DESTRUCTIVE EVALUATION OF WATER INGRESS IN PHOTOVOLTAIC MODULES
9881999	2009	2018	UNIVERSITY OF CALIFORNIA	METHODS OF FABRICATING NANOSTRUCTURES AND NANOWIRES AND DEVICES FABRICATED THEREFROM
9893294	2011	2018	UNIVERSITY OF CALIFORNIA	ORGANIC SMALL MOLECULE SEMICONDUCTING CHROMOPHORES FOR USE IN ORGANIC ELECTRONIC DEVICES
9911871	2015	2018	NATL TECH & ENG SOLUTIONS OF SANDIA LLC	REFLECTIVE PHOTOVOLTAICS
9923111	2014	2018	STANFORD UNIVERSITY	ILLUMINATION AND RADIATIVE COOLING
9941426	2016	2018	STC UNM	METHODS TO INTRODUCE SUB-MICROMETER, SYMMETRY-BREAKING SURFACE CORRUGATION TO SILICON SUBSTRATES TO

				INCREASE LIGHT TRAPPING
9966198	2015	2018	NORTHWESTERN UNIVERSITY	SOLAR CELLS WITH PEROVSKITE-BASED LIGHT SENSITIZATION LAYERS
9978895	2013	2018	NATL TECH & ENG SOLUTIONS OF SANDIA LLC	FLEXIBLE PACKAGING FOR MICROELECTRONIC DEVICES
9978968	2014	2018	UNIVERSITY OF MICHICAN, DANKOOK UNIVERSITY	PHOTOVOLTAIC CELLS WITH A GRADED ACTIVE REGION ACHIEVED USING STAMP TRANSFER PRINTING
9991443	2016	2018	UNIVERSITY OF MASSACHUSETTS	CONJUGATED POLYMER ZWITTERIONS AND SOLAR CELLS COMPRISING CONJUGATED POLYMER ZWITTERIONS
9994766	2015	2018	NORTHWESTERN UNIVERSITY	PHOTOLUMINESCENT COMPOUNDS
10002983	2017	2018	NATL TECH & ENG SOLUTIONS OF SANDIA LLC	NANOCOMPOSITE BARRIER FILMS FOR PHOTOVOLTAIC APPLICATIONS
10038113	2015	2018	NATL TECH & ENG SOLUTIONS OF SANDIA LLC	MOLDABLE PHOTOVOLTAIC SOLAR CELL MODULE
10056554	2015	2018	UNIVERSITY OF MASSACHUSETTS	FUNCTIONAL INTERLAYERS OF FULLERENE DERIVATIVES AND APPLICATIONS IN ORGANIC SOLAR CELLS
10059596	2014	2018	PRINCETON UNIVERISTY	HYPERUNIFORM AND NEARLY HYPERUNIFORM RANDOM NETWORK MATERIALS
10062793	2014	2018	MAGNOLIA SOLAR INC	HIGH EFFICIENCY QUANTUM WELL WAVEGUIDE SOLAR CELLS AND METHODS FOR CONSTRUCTING THE SAME
10068712	2015	2018	ORION CO LTD	GLASS MATERIAL FOR SEALING LARGE-AREA DYE-SENSITIZED SOLAR CELL
10072345	2014	2018	ARIZONA STATE UNIVERSITY	SYSTEM AND METHOD FOR ELECTROREFINING OF SILICON
10074751	2015	2018	HANYANG UNIVERSITY	SOLAR CELL AND METHOD OF FABRICATING THE SAME
10074820	2013	2018	UNIVERSITY OF SOUTHERN CALIFORNIA, UNIVERSITY OF MICHIGAN	EXCITONIC ENERGY TRANSFER TO INCREASE INORGANIC SOLAR CELL EFFICIENCY
10096729	2015	2018	UNIVERSITY OF PENNSYLVANIA	HIGH-PERFORMING BULK PHOTOVOLTAICS
10096733	2016	2018	UNIVERSITY OF	METHODS FOR THE PREPARATION OF COLLOIDAL NANOCRYSTAL

			PENNSYLVANIA	DISPERSION
10096734	2016	2018	UNIVERSITY OF PENNSYLVANIA	METHODS OF FORMING COLLOIDAL NANOCRYSTAL-BASED THIN FILM DEVICES
10109760	2016	2018	MASSACHUSETTS INSTITUTE OF TECHNOLOGY	ELIMINATING EMISSIVE SUB-BANDGAP STATES IN NANOCRYSTALS
10115917	2016	2018	NORTHWESTERN UNIVERSITY	DOPANT-FREE POLYMERIC HOLE-TRANSPORTING MATERIALS FOR PEROVSKITE SOLAR CELL
10147553	2017	2018	UNIVERSITY OF MASSACHUSETTS	HYDROPHILIC CONJUGATED POLYMERS, AND METHODS OF PREPARATION AND USE THEREOF
10243095	2018	2019	NATL TECH & ENG SOLUTIONS OF SANDIA LLC	MOLDABLE PHOTOVOLTAIC SOLAR CELL MODULE
10361180	2017	2019	UNIV ILLINOIS; SEMPRIUS INC; X CELEPRINT LTD	OPTICAL SYSTEMS FABRICATED BY PRINTING-BASED ASSEMBLY
10424572	2017	2019	UNIV ILLINOIS; SEMPRIUS INC; X CELEPRINT LTD	OPTICAL SYSTEMS FABRICATED BY PRINTING-BASED ASSEMBLY
10483415	2018	2019	STC UNM	METHODS TO INTRODUCE SUB-MICROMETER, SYMMETRY-BREAKING SURFACE CORRUGATION TO SILICON SUBSTRATES TO INCREASE LIGHT TRAPPING
10504882	2017	2019	UNIV ILLINOIS; SEMPRIUS INC; X CELEPRINT LTD	OPTICAL SYSTEMS FABRICATED BY PRINTING-BASED ASSEMBLY

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