The Influence of Bioenergy Conversion Patents Funded by the U.S. Department of Energy's Bioenergy 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 bioenergy conversion research funded by the U.S. Department of Energy (DOE)'s Bioenergy Technologies Office (BETO) and its precursor programs, as well as bioenergy conversion 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 BETO-funded bioenergy conversion research has formed a foundation for innovations patented by leading bioenergy conversion organizations. Meanwhile, the primary purpose of the forward tracing is to examine the broader influence of BETO-funded bioenergy conversion research upon subsequent technological developments, both within and outside bioenergy conversion technology. In addition to these BETO-based analyses, we also extend many elements of the analysis to other DOE-funded bioenergy conversion patents, in order to gain insights into their influence.

The main finding of this report is:

- Bioenergy conversion research funded by BETO, and by DOE in general, has had a significant influence on subsequent developments, both within and beyond bioenergy conversion technology. This influence can be seen on innovations associated with the leading bioenergy conversion organizations. It can also be traced to innovations in other technologies, notably chemical production.

More detailed findings from this report include:

- In bioenergy conversion technology, in the period 1976-2018, we identified a total of 29,209 patents (9,456 U.S. patents, 8,609 EPO patents and 11,144 WIPO patents). We grouped these patents into 18,901 patent families, where each family contains all patents resulting from the same initial application (named the priority application).

- 974 bioenergy conversion patents are confirmed to be associated with BETO funding (515 U.S. patents, 241 EPO patents, and 218 WIPO patents). We grouped these BETO-funded bioenergy conversion patents into 295 patent families.

- In addition, we identified a further 467 bioenergy conversion patents (289 U.S. patents, 66 EPO patents and 112 WIPO patents) that are associated with DOE funding. These "Other DOE-funded" patents are grouped into 206 patent families.

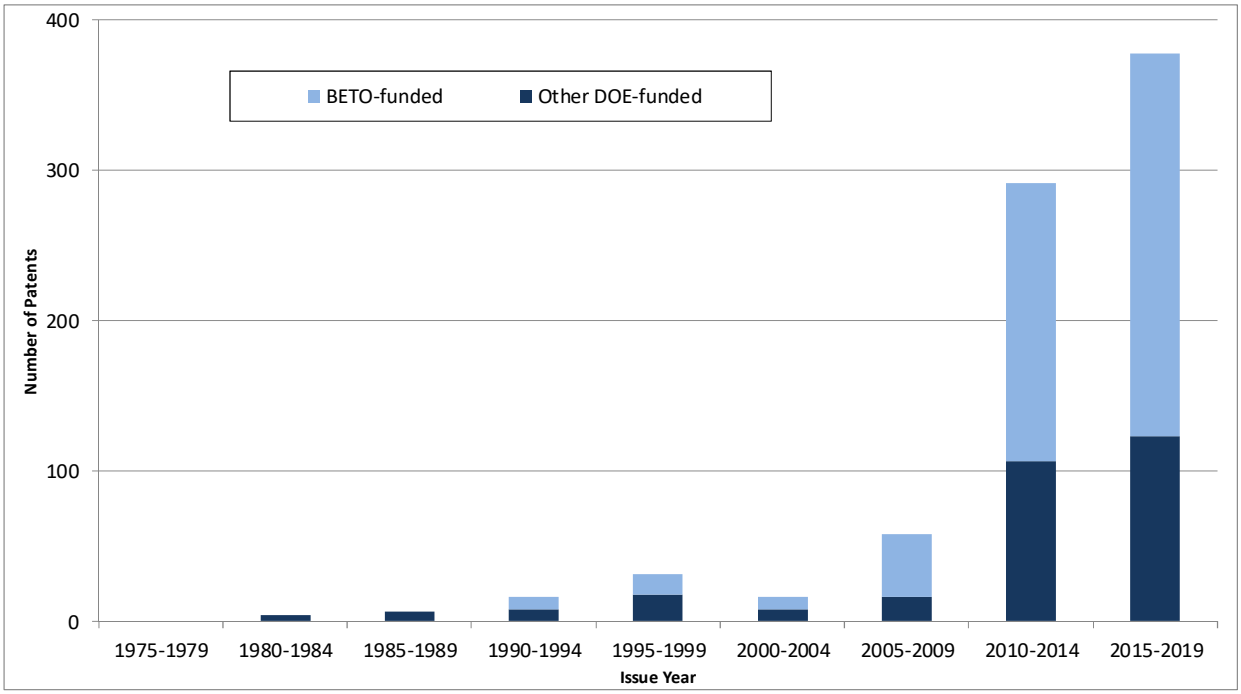
- Out of these 206 Other DOE-funded patent families, 164 are definitely not BETO-funded. These patent families were either funded by a different DOE office, or were marked as being not BETO-funded by inventors or BETO technology managers, but without specifying funding from another DOE source.

- The remaining 42 Other DOE-funded bioenergy conversion patent families could not be linked definitively to a specific DOE funding source, and may in fact have been BETO-funded. Hence, up to 20.4% (42 out of 206) of the Other DOE-funded bioenergy conversion patent families in this analysis may in fact be BETO-funded. As such, the results presented in this report may understate the influence of BETO-funded bioenergy conversion research, relative to the influence of bioenergy conversion research funded by DOE in general.

- The total number of DOE-funded bioenergy conversion patents (BETO-funded plus Other DOE-funded) is 1,443, corresponding to 501 patent families. This represents 2.7% of the total number of bioenergy conversion patent families in the period 1976-2018.

- Figure E-1 shows the number of BETO-funded and Other DOE-funded bioenergy conversion U.S. patents by issue year. This figure reveals that DOE-funded bioenergy conversion patenting was relatively sparse in the earlier time periods in the analysis. The number of DOE-funded U.S. patents started to increase in 2005-2009, with 58 patents issued in this period (42 of which were BETO-funded). DOE-funded patents then continued to increase, totaling 291 (185 BETO-funded) in 2010-2014 and 378 (255 BETO-funded) in 2015-2019, even though data for the latter time period are incomplete (see note below Figure E-1).

Figure E-1 - Number of BETO/Other DOE-funded Bioenergy Conversion 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 included because they are part of families with pre-2019 patents. No new patent search for 2019 was carried out.

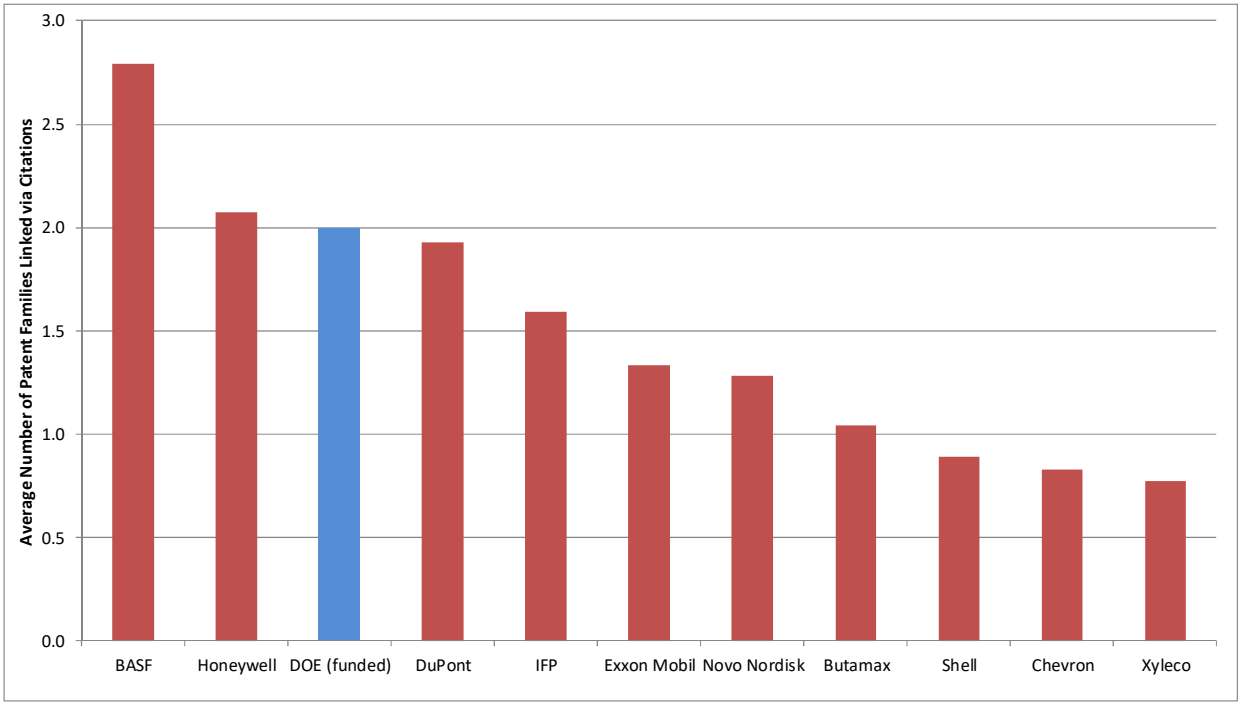
- The ten organizations with the largest bioenergy conversion patent portfolios (including all subsidiaries and acquisitions) are: ExxonMobil (764 patent families); DuPont (459);

Novo Nordisk Foundation (437); Shell (435); Honeywell (297); Institut Français du Pétrole (203); Xyleco (202); Butamax (200); Chevron (184); and BASF (173). In comparison, the portfolio of 501 DOE-funded bioenergy conversion patents (295 BETO-funded and 206 Other DOE-funded) is second only to ExxonMobil in terms of size.

- BETO-funded patents cover a range of bioenergy conversion technologies, including substances such as enzymes used in these technologies, plus systems for producing fuels and other outputs from these substances. Other DOE-funded patents (plus patents assigned to the leading organizations and bioenergy conversion patents in general) share the focus on production systems, but have a lesser concentration on specific substances, such as cellulosic bio-ethanol. This suggests that, during the period covered by the analysis, BETO funding helped fill a research gap not addressed extensively by other organizations.

- On average, DOE-funded bioenergy conversion patent families (a majority of which are BETO-funded) are each linked via citations to two subsequent patent families assigned to the leading bioenergy conversion companies (see Figure E-2). This puts DOE in third place in Figure E-2, behind BASF (with an average of 2.8 linked families) and Honeywell (with an average of 2.1 linked families). It suggests that, even after taking into account relative patent portfolio sizes, DOE-funded patents have had a significant influence on subsequent innovations associated with the leading organizations in bioenergy conversion technology.

Figure E-2 - Average No. of Leading Organization Bioenergy Conversion Patent Families Linked via Citations to Bioenergy Conversion Families from Each Leading Organization e.g. on average, each DOE-funded patent family is linked to two subsequent patent families assigned to leading organizations

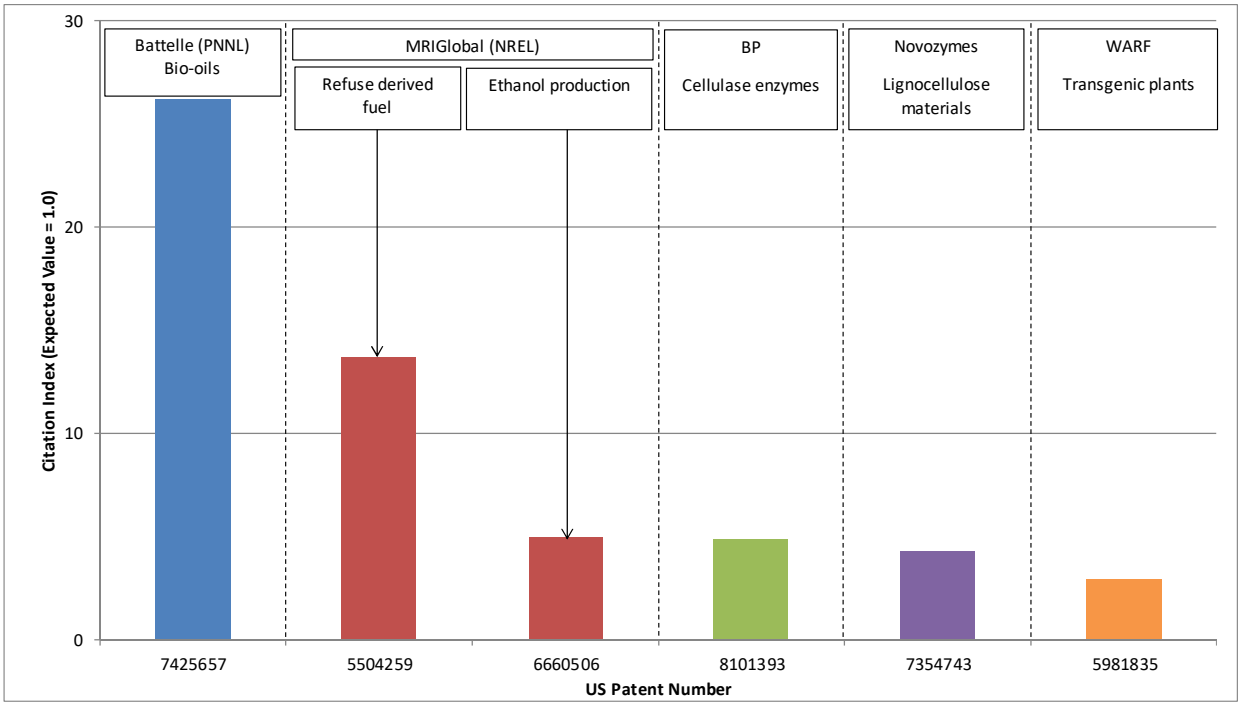


- 70% of Butamax's bioenergy conversion patent families are linked via citations to earlier DOE-funded patents (20% to BETO-funded patents). DuPont has 54% of its patent families linked via citations to DOE (47% to BETO), followed by Xyleco (51% linked to DOE; 40% to BETO) and Novo Nordisk (46% linked to DOE; 44% to BETO). This suggests that these companies have particularly strong links to earlier bioenergy conversion research funded by DOE, and BETO in particular

- BETO-funded bioenergy conversion patents have an average Citation Index value of 1.32 (the Citation Index is a normalized citation metric with an expected value of 1.0; a value of 1.32 shows that, based on their age and technology, BETO-funded bioenergy conversion patents have been cited as prior art 32% more frequently than expected by subsequent patents). The Citation Index for Other DOE-funded bioenergy conversion patents is even higher at 1.87 (i.e. 87% more citations than expected). The influence of BETO-funded and Other DOE-funded bioenergy conversion patents has been primarily within bioenergy conversion technology, but can also be traced in in adjacent technologies, notably chemical production.

- There are a number of individual high-impact BETO-funded bioenergy conversion patents, examples of which are shown in Figure E-3. They include a Battelle Memorial Institute (Pacific Northwest National Laboratory) patent for bio-oil production; MRIGlobal (Midwest Research Institute) patents describing ethanol production and refuse derived fuels; a BP patent for cellulase enzymes; Novozymes patents related to processing lignocellulose materials; and a Wisconsin Alumni Research Foundation (WARF) patent describing transgenic plants.

Figure E-3 – Examples of Highly-Cited BETO-funded Bioenergy Conversion Patents



1.0 Introduction

This report focuses on bioenergy conversion technology. Its objective is to trace the influence of bioenergy conversion research funded by the Department of Energy (DOE) Bioenergy Technologies Office (BETO) – as well as bioenergy conversion research funded by DOE as a whole – upon subsequent developments both within and outside bioenergy conversion technology. The purpose of the report is to:

(i) Locate patents awarded for key BETO-funded (and other DOE-funded) innovations in bioenergy conversion; and
(ii) Determine the extent to which BETO-funded (and other DOE-funded) bioenergy conversion research has influenced subsequent technological developments both within and beyond bioenergy conversion.

The primary focus of the report is on the influence of BETO-funded bioenergy conversion patents. That said, we also extend many elements of the analysis to DOE-funded bioenergy conversion patents that could not be definitively linked to BETO 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 BETO itself upon the development of bioenergy conversion technology, while also tracing the influence of DOE more generally. Meanwhile, in practical terms, determining which patents were funded by BETO, 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 reported 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. For older patents, such information is often unavailable, because 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 BETO-funded, we instead included these patents in the analysis under a separate "Other DOE-funded" category. Some of these 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 may in fact have been funded by BETO, although a definitive link could not be established. Hence, the results reported here may underestimate the influence of BETO-funded bioenergy conversion research, relative to the influence of bioenergy conversion 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 BETO-funded and Other DOE-funded patents. These results show the distribution of BETO-funded (and Other DOE-funded) patents across bioenergy conversion technologies (as defined by Cooperative Patent

Classifications). They also evaluate the extent of BETO's influence (and DOE's influence in general) on subsequent developments in bioenergy conversion and other technologies. Patent level results are then presented to highlight individual BETO-funded bioenergy conversion patents that have been particularly influential, as well as to identify key patents from other organizations that build extensively on BETO-funded bioenergy conversion 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, along with 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 bioenergy conversion industry have used BETO-funded research as a foundation. Meanwhile, the primary purpose of the forward tracing is to examine how BETO-funded bioenergy conversion patents have influenced subsequent technological developments more broadly, both within and outside bioenergy conversion 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 bioenergy conversion 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 bioenergy conversion 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

[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 BETO-funded and Other DOE-funded bioenergy conversion patents. However, referring repeatedly to "BETO-funded/Other DOE-funded patents" or "BETO-funded/Other DOE-funded research" in describing the analyses is lengthy, so we use the collective terms "DOE-funded patents" and "DOE-funded research" in the Project Design and Methodology sections of the report.

to demonstrate how the new invention is original over and above this prior art. Prior art 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 bioenergy conversion research. Specifically, we identify cases where patents cite DOE-funded bioenergy conversion 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 bioenergy conversion patents. These represent second-generation links between innovations and DOE-funded research. The idea behind this analysis is that the later patents build in some way on the earlier DOE-funded bioenergy conversion research. By determining how frequently DOE-funded bioenergy conversion patents have been cited by subsequent patents, it is thus possible to

[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.

evaluate the extent to which DOE-funded research forms a foundation for various technologies both within and beyond bioenergy conversion.

Forward and Backward Tracing

As noted above, the purpose of this analysis is to trace the influence of DOE-funded bioenergy conversion research upon subsequent developments both within and beyond bioenergy conversion 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 bioenergy conversion 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 bioenergy conversion organizations build on earlier BETO-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 bioenergy conversion patents resulting from research funded by DOE (i.e. BETO plus Other DOE). The influence of these patents on later generations of technology is then evaluated. This tracing is not restricted to subsequent bioenergy conversion patents, since the influence of a body of research may extend beyond its immediate technology. Hence, the purpose of the forward tracing element of the project is to measure the influence of DOE-funded bioenergy conversion patents on developments within and beyond 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 bioenergy conversion 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 bioenergy conversion patents owned by leading organizations, and traces back through two generations of patents to identify the technologies upon which they were built, including those funded by DOE. Meanwhile, the forward tracing starts with DOE-funded patents in bioenergy conversion technology. The first generation contains the patents that cite these DOE-funded patents as prior art. The second generation contains the patents that in turn cite these first-generation patents. Hence, the analysis starts with DOE-funded bioenergy conversion patents and traces forward for two generations of subsequent patents.

[4] As noted above, the forward and backward tracing were carried out separately for BETO-funded and Other DOE-funded bioenergy conversion 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 bioenergy conversion patents as a single portfolio.

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

1. **Direct Links**: a patent cites a DOE-funded bioenergy conversion patent as prior art.
2. **Indirect Links**: a patent cites an earlier patent, which in turn cites a DOE-funded bioenergy conversion patent. The DOE patent is linked indirectly to the later 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. That said, 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. 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 prior art references 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 results in multiple patent documents for the same invention.[5] In addition, in some systems – notably the U.S. – inventors may apply for a series of patents based on one 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 bioenergy conversion patents, and also for the patents owned by leading bioenergy conversion organizations. We also assembled families for all patents linked via citations to DOE-funded bioenergy conversion patents. To construct these 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

[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.

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. These metrics 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.

Table 1 – List of Metrics Used in the Analysis

Metric
Trends
• Number of BETO/Other DOE-funded bioenergy conversion patent families by priority year
• Number of BETO/Other DOE-funded granted U.S. bioenergy conversion patents by issue year
• Overall number of bioenergy conversion patent families by priority year
• Percentage of bioenergy conversion patents families funded by BETO/Other DOE by priority year
Assignee Metrics
• Number of bioenergy conversion patent families for leading patenting organizations
• Assignees with largest no. of bioenergy conversion patent families funded by BETO/Other DOE
Technology Metrics
• Patent classification (CPC) distribution for BETO-funded bioenergy conversion patent families (vs Other DOE-funded, leading bioenergy conversion organizations, all bioenergy conversion)
Backward Tracing Metrics
• Total/Average number of leading organization bioenergy conversion patent families linked via citations to earlier patent families from BETO/Other DOE-funding and other leading organizations
• Number of bioenergy conversion patent families for each leading organization linked via citations to earlier BETO/Other DOE-funded patent families
• Total citation links from each leading organization to BETO/Other DOE-funded patent families
• Percentage of leading organization bioenergy conversion patent families linked via citations to earlier BETO/Other DOE-funded patent families
• BETO/Other DOE-funded bioenergy conversion patent families linked via citations to largest number of leading organization bioenergy conversion patent families
• Leading organization bioenergy conversion patent families linked via citations to largest number of BETO-funded bioenergy conversion patent families
• Highly cited leading organization bioenergy conversion patent families linked via citations to earlier BETO-funded bioenergy conversion patent families
Forward Tracing Metrics
• Citation Index for bioenergy conversion patent portfolios owned by leading organizations, plus portfolios of BETO/Other DOE-funded bioenergy conversion patents
• Number of patent families linked via citations to BETO/Other DOE-funded bioenergy conversion patents by patent classification
• Organizations (beyond leading bioenergy conversion organizations) linked via citations to largest number of BETO/Other DOE-funded bioenergy conversion patent families
• Highly cited BETO-funded bioenergy conversion U.S. patents
• BETO/Other DOE-funded bioenergy conversion patent families linked via citations to largest number of subsequent bioenergy conversion/non-bioenergy conversion patent families
• Highly cited patents (not leading organization-owned) linked via citations to BETO-funded bioenergy conversion patents

3.0 Methodology

The previous section of the report outlines the objective of our analysis – that is, to determine the influence of BETO-funded (and Other DOE-funded) bioenergy conversion research on subsequent developments both within and outside bioenergy conversion 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 backward tracing starts from the set of all bioenergy conversion patents owned by leading patenting organizations in this technology. Meanwhile, the forward tracing starts from the sets of bioenergy conversion patents funded by BETO and Other DOE. We therefore had to define various data sets – BETO-funded bioenergy conversion patents; Other DOE-funded bioenergy conversion patents; and bioenergy conversion patents assigned to the leading organizations in this technology.

Identifying BETO-funded and Other DOE-funded Bioenergy Conversion Patents

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

(i) Defining the universe of DOE-funded patents;
(ii) Determining which of these DOE-funded patents are relevant to bioenergy conversion; and
(iii) Categorizing these DOE-funded bioenergy conversion patents according to whether or not they can be linked definitively to BETO 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 may 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 flat 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 code listed on a number of 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 also used in a small number of NSF contracts). We then included any additional DOE funded patents in 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 Bioenergy Conversion Patents

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

Table 2 – Filters used to identify DOE-funded Bioenergy Conversion Patents

Filter A
Cooperative Patent Classification
Y02E 50 – Producing non-fossil fuels
Y02P 30/42 – Ethylene production using bio-feedstocks
Y02P 20/136 – Renewable energy of biological origin – e.g. bioenergy
Y02P 30/20 – Oil and gas technologies using bio-feedstocks
Y02P 80/21 – Climate change technologies using biomass as fuel
Filter B
Cooperative Patent Classification
Y02P 20/145 – Chemical technologies using bio-feedstocks
AND
Title/Abstract
fuel* or bio(-)fuel* or bio(-)gas* or bio(-)diesel* or bio(-)energy or bio(-)mass*
Filter C
Cooperative Patent Classification
C07C – Acyclic or carbocyclic compounds
C10G – Production of liquid hydrocarbons
AND
Title/Abstract
bio(-)fuel* or bio(-)gas* or bio(-)diesel* or bio(-)energy

We manually checked this initial list of patents to determine which of them appear relevant to bioenergy conversion, and then sent the resulting patent list to BETO for review. Following this review, and based on feedback from BETO, the initial list of bioenergy conversion patents funded by DOE contained a total of 727 granted U.S. patents.

Defining BETO-funded vs. Other DOE-funded Bioenergy Conversion 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 727 DOE-funded bioenergy conversion patents in the initial list could be linked definitively to BETO 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 BETO technology managers to verify individual patents,
(iv) Asking BETO 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 BETO, 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 BETO-funded and Other DOE-funded Bioenergy Conversion Patents

Based on the process described above, we divided the initial list of 727 DOE-funded bioenergy conversion U.S. patents into two categories – BETO-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 initial set. We then grouped the patents into families by matching priority documents (see earlier discussion of patent families). Table 3 shows the final number of BETO-funded and Other DOE-funded bioenergy conversion patents and patent families.

Table 3 – Number of BETO-funded and Other DOE-funded Bioenergy Conversion Patents and Patent Families

	# Patent Families	# U.S. Patents	# EPO Patents	# WIPO Patents
BETO-funded	295	515	241	218
Other DOE-funded	206	289	66	112
Total DOE-funded	501	804	307	330

Table 3 reveals that we identified a total of 295 BETO-funded bioenergy conversion patent families, containing 515 U.S. patents, 241 EPO patents, and 218 WIPO patents (see Appendix A for patent list). We also identified 206 Other DOE-funded bioenergy conversion patent families, containing 289 U.S. patents, 66 EPO patents, and 112 WIPO patents (see Appendix B for patent list). The oldest patents in these DOE-funded portfolios date back to the late 1970s.

As noted throughout this report, the approach used to define patents as BETO-funded was very stringent. Hence, a number of the 206 Other DOE-funded patent families may in fact have been funded by BETO, 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 BETO-funded, we divided them into two groups.

The first group contains DOE-funded patent families that were definitely not funded by BETO. These include families linked specifically to funding from an office other than BETO, or that the inventor or BETO technology manager said were not funded by BETO (but without specifying funding from a different office). There are 164 such patent families. The second group contains

DOE-funded patent families where the funding source within DOE could not be established, and inventors and BETO technology managers could not state categorically whether or not they were funded by BETO. There are 42 such patent families. Hence, up to 20.4% (42 out of 206) of the Other DOE-funded patent families in this analysis may in fact be BETO-funded. The findings in this analysis may thus understate the influence of BETO-funded bioenergy conversion patents, relative to the influence of the remainder of DOE patents.

Identifying Bioenergy Conversion Patents Assigned to Leading Organizations

The backward tracing element of our analysis is designed to evaluate the influence of BETO-funded (and Other DOE-funded) research on bioenergy conversion innovations produced by leading organizations in this technology. To identify such organizations, we first defined the universe of bioenergy conversion patents in the period 1976-2018 using the patent filter detailed earlier in Table 2. Based on this filter, we identified a total of 9,456 bioenergy conversion U.S. patents, 8,609 bioenergy conversion EPO patents, and 11,144 bioenergy conversion WIPO patents. We grouped these patents into 18,901 patent families by matching priority documents.

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

Table 4 – Top 10 Patenting Bioenergy Conversion Organizations

Organization	# Bioenergy Conversion Patent Families
Exxon Mobil	764
DuPont	459
Novo Nordisk Foundation	437
Shell	435
Honeywell	297
Institut Français du Pétrole (IFP)	203
Xyleco	202
Butamax	200
Chevron	184
BASF	173

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

[6] Note that these organizations are selected based on patent portfolio size, which does not necessarily reflect units sold or revenues, profits etc. A fuller description would be the leading patenting bioenergy conversion organizations, but this is a cumbersome description to use throughout the results section of the report. Also, note that there are various companies focused on bio-products – e.g. Ginkgo Bioworks, Genomaticaand Amyris - that have numerous patents in the bioenergy conversion patent universe, but not enough to be among the ten leading companies.

patent families assigned to the leading patenting organizations in bioenergy conversion technology. The patent sets for the forward tracing consisted of BETO-funded (and, separately, Other DOE-funded) bioenergy conversion patent families. We then traced backwards through two generations of citations from the leading organizations' bioenergy conversion patents, and forwards through two generations of citations from the BETO/Other DOE-funded bioenergy conversion patents. The tracing 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

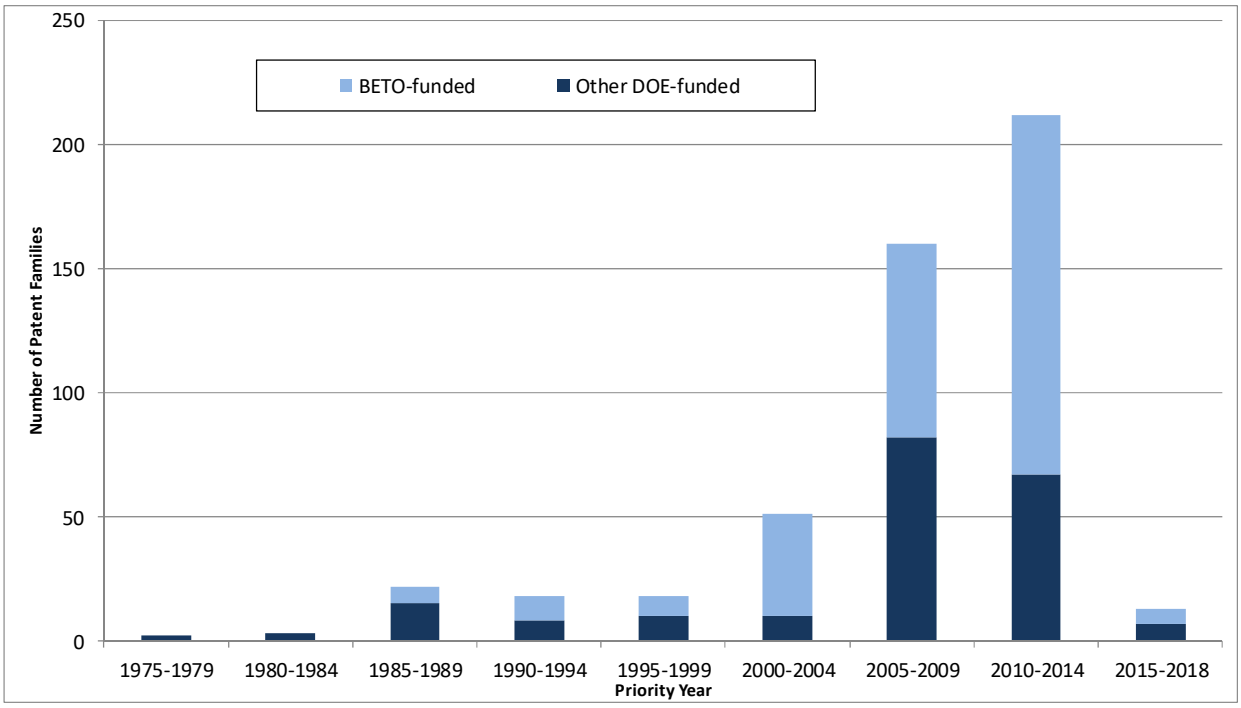
This section of the report outlines the results of our analysis tracing the influence of BETO-funded and Other DOE-funded bioenergy conversion research on subsequent developments both within and beyond bioenergy conversion technology. The results are divided into three main sections. In the first section,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

Overall Trends in Bioenergy Conversion Patenting

Trends in Bioenergy Conversion Patenting over Time

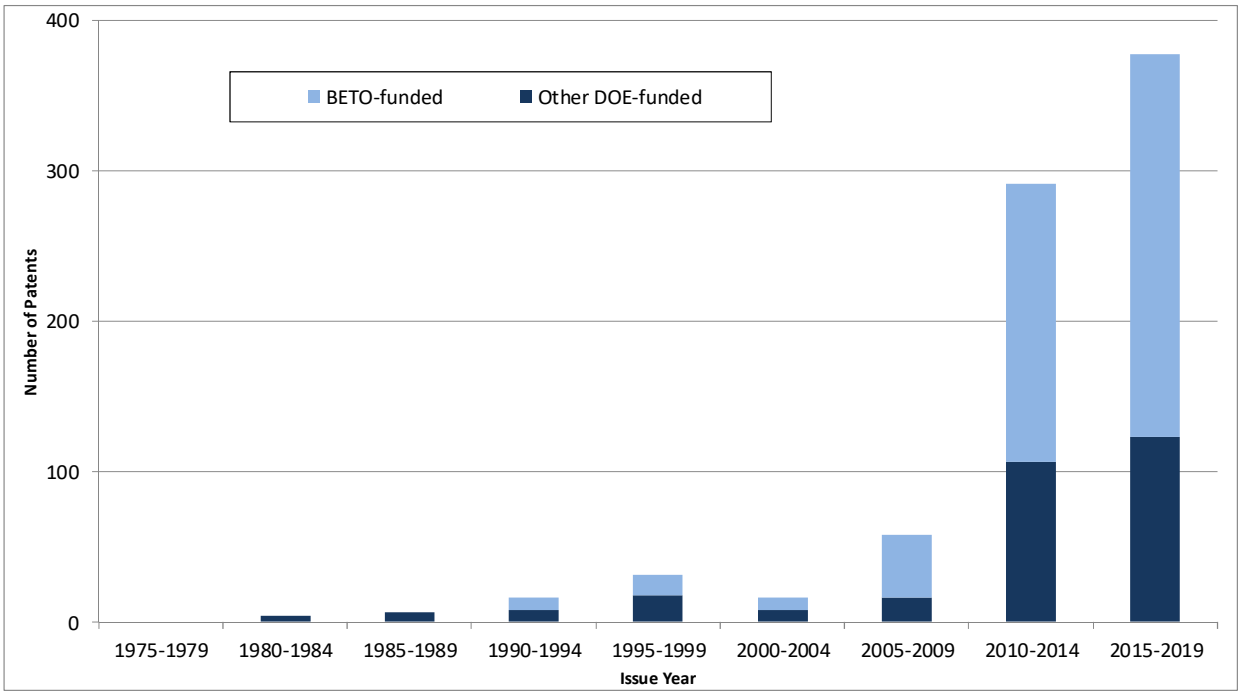
Figure 1 shows the number of BETO-funded and Other DOE-funded bioenergy conversion patent families by priority year – i.e. the year of the first application in each patent family. BETO-funded patent families are shown in light blue and Other DOE-funded families in dark blue. This figure reveals that DOE-funded bioenergy patenting was very sparse in the earlier time periods included in the analysis. There were only five patent families filed between 1975 and 1984, all of them defined as Other DOE-funded. The following time periods showed a slight increase, with around 20 DOE-funded patent families (approximately half of which were BETO-funded) filed in each five-year time period through 1999. The number of DOE-funded patent families then increased rapidly, totaling 51 in 2000-2004 (41 BETO-funded), 160 in 2005-2009 (78 BETO-funded) and 212 in 2010-2015 (145 BETO-funded). The most recent time period saw a decrease to only 13 patent families, although data from this time period are incomplete (see note below Figure 1). Overall, Figure 1 suggests that DOE-funded bioenergy conversion patenting is concentrated in the most recent time periods in the analysis, with BETO-funded patents representing a high percentage of these recent patents.

Figure 1 - Number of BETO/Other DOE-funded Bioenergy Conversion Patent Families 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. Our primary data collection covered only patents issued through 2018. Due to time lags associated with the patenting process, only a fraction of the patent families from 2015-2018 will be included.

Figure 2 - Number of BETO/Other DOE-Funded Bioenergy Conversion Granted U.S. Patents by Issue Year (5-Year Totals)

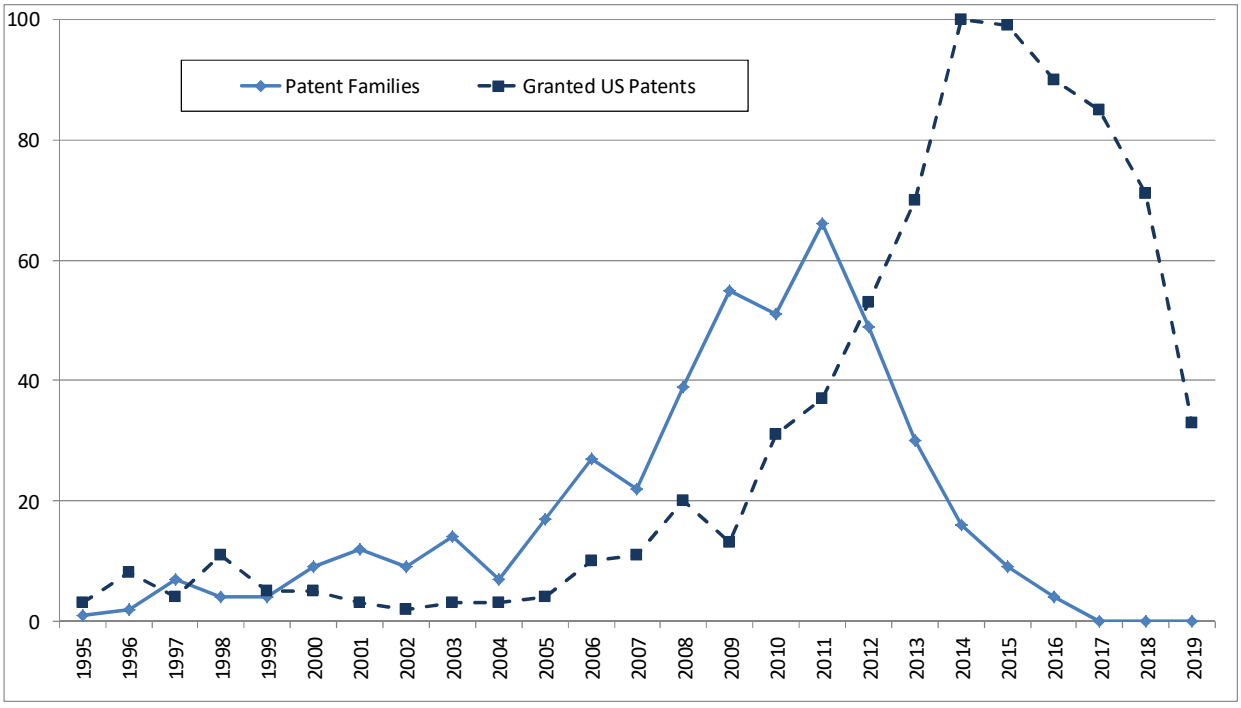


Note: The data collection period for this analysis ended with 2018. Any 2019 patents in the 2015-2019 column are included because they are part of families with pre-2019 patents. No new patent search for 2019 was carried out.

Figure 2 shows the number of bioenergy conversion granted U.S. patents funded by DOE in each time period. This figure follows a similar pattern to Figure 1. There were very few patents granted in the earliest time periods in the analysis, with those few patents all defined as Other DOE-funded. The number of patents then started to increase, gradually at first, reaching 58 in 2005-2009 (42 of which were BETO-funded). It then increased much more rapidly, to 291 (185 BETO-funded) in 2010-2014 and 378 (255 BETO-funded) in 2015-2019, even though data for the most recent time period are incomplete (see note below Figure 2).

Comparing Figures 1 and 2 shows the effect of time lags in the patenting process, with many of the patent families with priority dates in 2005-2009 and 2010-2014 (Figure 1) resulting in granted U.S. patents in 2010-2014 and 2015-2019 (Figure 2). These time lags can also be seen in Figure 3, which shows bioenergy conversion patent family priority years alongside issue years for granted U.S. bioenergy conversion patents (in this figure, BETO and Other DOE are combined, in order to simplify the presentation). In this figure, the growth in patent families filed in 2007-2010 is associated with a subsequent increase in U.S. patents in 2010-2015. More recently, patent family priorities dropped away after 2012, resulting in a decline in U.S. patents from 2016 onwards (although these declines may be due in part to incomplete data – see note below Figure 3).

Figure 3 - Number of DOE-funded Bioenergy Conversion Patent Families (by Priority Year) and Granted U.S. Patents (by Issue Year)

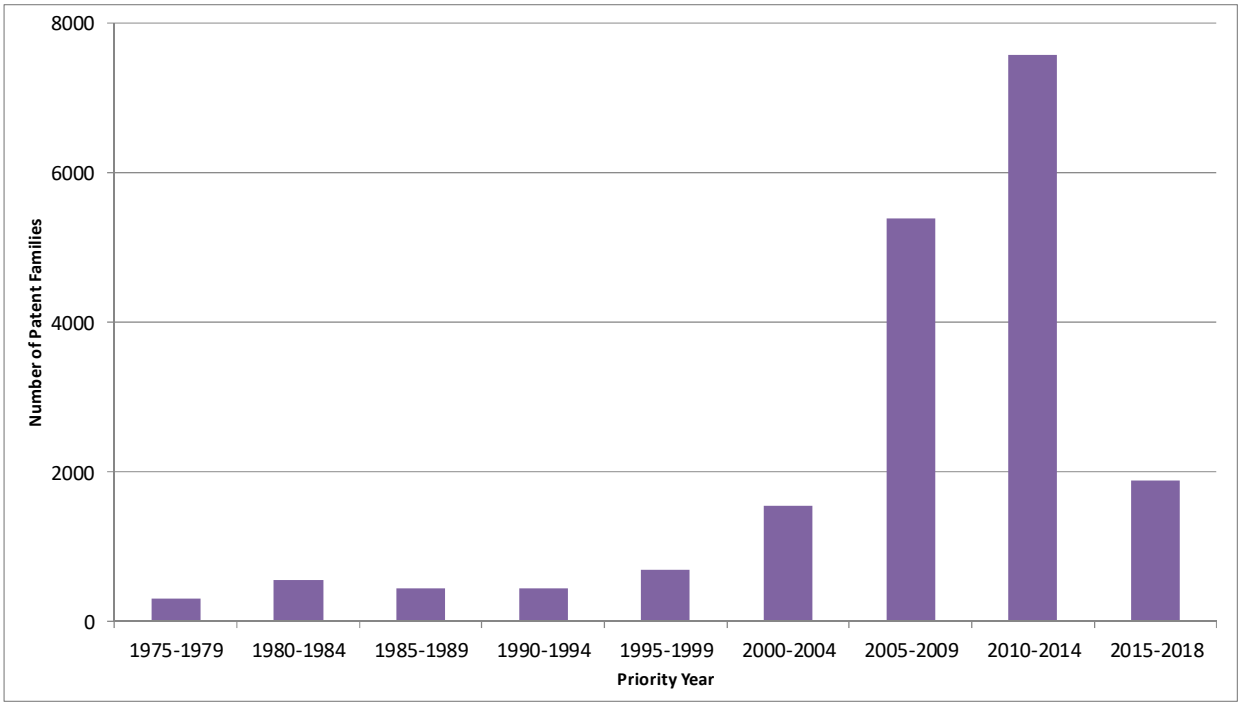


Note: The data collection period for this analysis ended with 2018. Any 2019 patents are included because they are members of the same patent families as pre-2019 patents. No new patent search for 2019 was carried out.

Figures 1-3 focus on DOE-funded bioenergy conversion patent families. Figure 4 broadens the scope, and shows the overall number of bioenergy conversion patent families by priority year (based on USPTO, EPO, and WIPO filings). This chart reveals that overall bioenergy conversion patenting was relatively low throughout the period from 1975 to 1994, averaging around 60-110

patent families per year (i.e. 300-550 families per 5-year period). The number of bioenergy conversion patent families then started to increase, to 697 in 1995-1999 and 1,549 in 2000-2004. This increase continued – and indeed became more substantial – in the following time periods, reaching 5,391 in 2005-2009 and 7,568 in 2010-2014, before declining to 1,886 in 2015-2018 (although data for this time period are incomplete). Thus, more than ten times as many bioenergy conversion patent families were filed in 2010-2014 as in 1995-1999. Comparing Figure 4 with Figure 1 suggests that the trend in DOE-funded (and BETO-funded) bioenergy conversion patenting is in line with the broader trend in this technology, with little activity in the early periods in the analysis, followed by a rapid growth in more recent time periods.

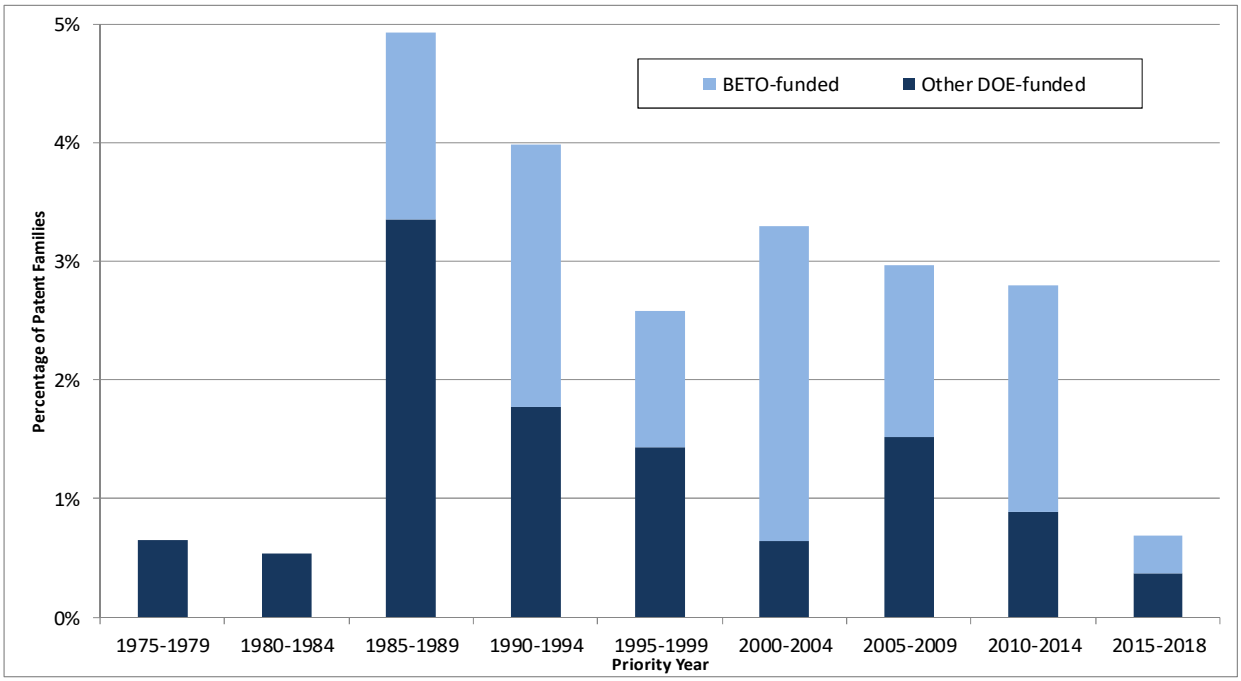
Figure 4 - Total Number of Bioenergy Conversion Patent Families by Priority Year (5-Year Totals)



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

Figure 5 shows the percentage of bioenergy conversion patent families in each time period that were funded by DOE (BETO plus Other DOE). This percentage peaked at 4.9% in 1985-1989 (1.6% BETO-funded), although the number of patent families involved was small. Perhaps more interestingly, as the overall number of bioenergy conversion patent families increased since 2000 (see Figure 4), DOE-funded patent families remained around 3% of the total in each time period (with BETO-funded patents being the majority of these families). This suggests that DOE-funded (and especially BETO-funded) patent families have played in important role in the growing bioenergy conversion patent landscape. The percentage of DOE-funded patent families fell in the most recent time period, although data for this period are again incomplete. Overall, 2.7% of bioenergy conversion patent families in the period 1976-2018 were funded by DOE.

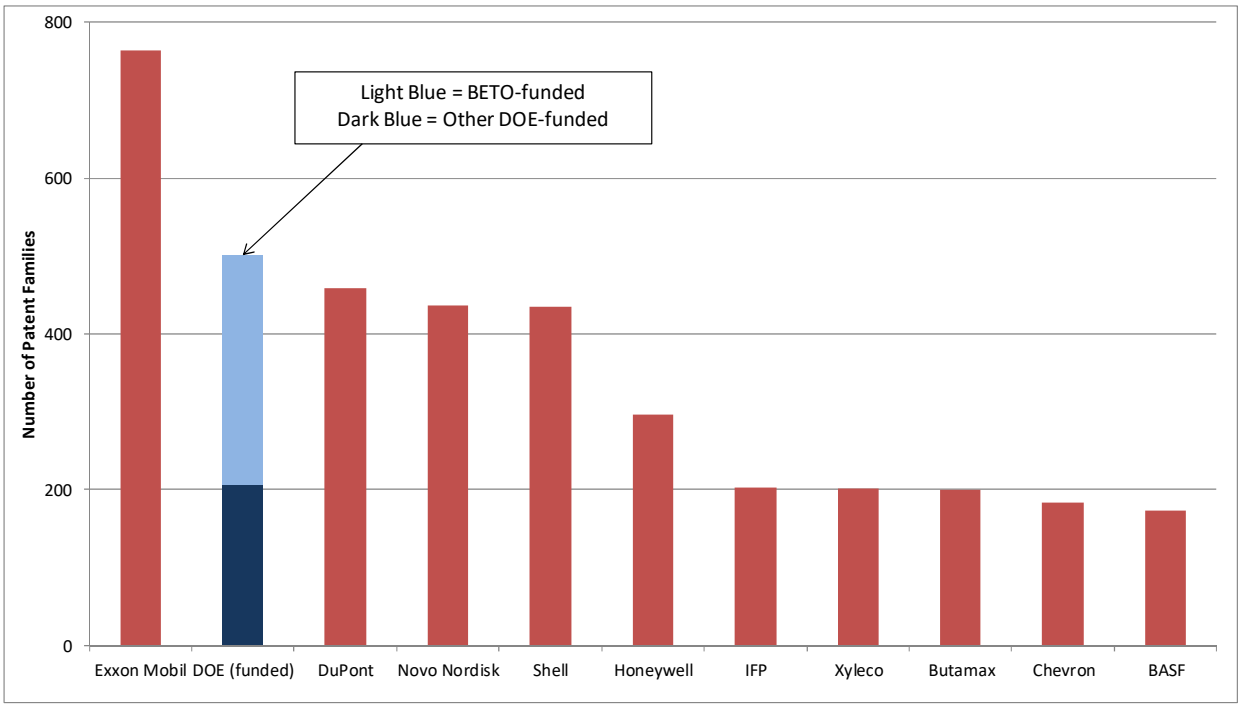
Figure 5 - Percentage of Bioenergy Conversion Patent Families Funded by BETO/Other DOE by Priority Year



Leading Bioenergy Conversion Assignees

The ten leading patenting organizations in bioenergy conversion are listed above in Table 4, along with their number of bioenergy conversion patent families. Figure 6 shows the same information in graphical form, while also including DOE-funded patent families.

Figure 6 – Top 10 Bioenergy Conversion Organizations (based on no. of patent families)



ExxonMobil has the largest bioenergy conversion portfolio in Figure 6, containing 764 patent families. It is followed by the DOE-funded portfolio of 501 patent families (295 BETO-funded; 206 Other DOE-funded). Other organizations with large patent portfolios in Figure 6 include DuPont (459 families), Novo Nordisk Foundation (437 families) and Shell (435 families). It is interesting to note the geographical distribution of the leading bioenergy conversion organizations in Figure 6. These ten organizations (i.e. not including DOE) are almost evenly split between North America (six organizations) and Europe (four organizations). As noted earlier, the counts of patent families in Figure 6 include all subsidiaries and acquisitions associated with each organization. For example, the Novo Nordisk Foundation portfolio includes patent families assigned to Novozymes, while the Honeywell portfolio includes patent families originally assigned to UOP. Meanwhile, Butamax is listed separately, as it is 50/50 joint-venture of BP and DuPont.

It should also be noted that there is some double-counting of patent families in Figure 6, specifically where innovations developed by one of the leading organizations were funded in whole or in part by BETO (or another office within DOE). For example, BETO funded a number of patent families assigned to Novozymes, plus patent families assigned to Genencor (which was subsequently acquired by Danisco, which in turn was bought by DuPont). In Figure 6, these patent families are counted in both the BETO segment of the DOE column, and in the respective company columns (i.e. Novo Nordisk and DuPont). This double-counting is appropriate, since these patent families are both funded by BETO and assigned to a leading organization.

Assignees of BETO/Other DOE-funded Bioenergy Conversion Patents

The DOE-funded bioenergy conversion patent portfolios are constructed somewhat differently from the portfolios of the top ten organizations listed in Figure 6. Specifically, DOE's 501 patent families were funded by DOE, but they are not necessarily assigned to the agency. For example, BETO (or another DOE office) may have funded research projects at DOE labs or companies. In such cases, the assignees of any resulting patents will be the respective DOE lab managers or companies (as in the case of the Novozymes and Genencor families discussed above).

Figure 7 shows the leading assignees on BETO-funded patent families. This chart is headed by Novozymes with 91 patent families, followed by MRI Global with 37 patent families resulting from its management of the National Renewable Energy Laboratory (NREL), and DuPont (including Genencor and Danisco) with 34 families. The remaining organizations in Figure 7 include companies, such as UOP (now owned by Honeywell), Royal DSM and Virent Energy (part of Marathon Petroleum). They also include universities (Florida and Wayne State) and DOE lab managers – Battelle Memorial Institute (Pacific Northwest National Laboratory) and UT-Battelle (Oak Ridge National Laboratory). Figure 7 thus reflects the range of organizations that have carried out BETO-funded bioenergy conversion research.

Figure 8 shows the leading assignees on Other DOE-funded bioenergy conversion patent families. This figure is dominated by universities, DOE lab managers and non-profit organizations. It is headed by the Wisconsin Alumni Research Foundation (WARF) with 24 patent families, followed by Battelle Energy Alliance (Idaho National Laboratory) with 22 families and the University of California (Lawrence Berkeley National Laboratory; University of California Los Angeles) with 19 patent families. DOE itself appears in both Figure 7 and Figure

8. Patents may be assigned to DOE 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.

Figure 7 – Most Prolific Assignees of BETO-Funded Bioenergy Conversion Patent Families

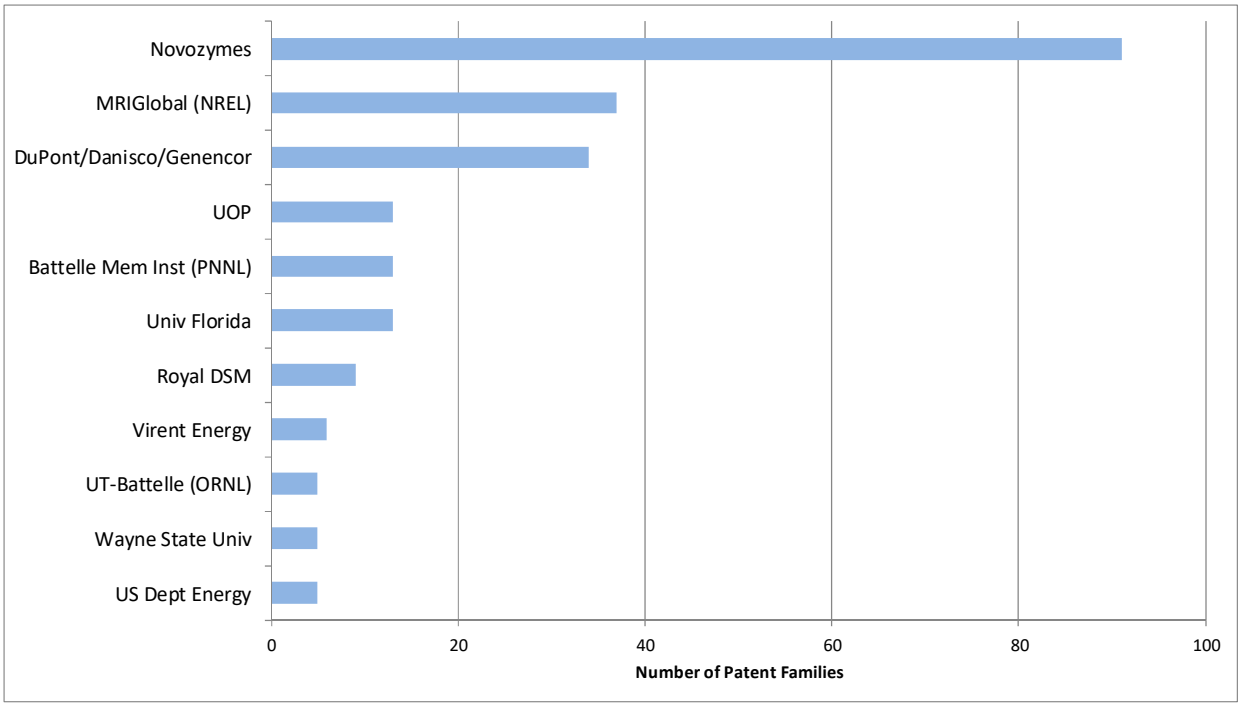
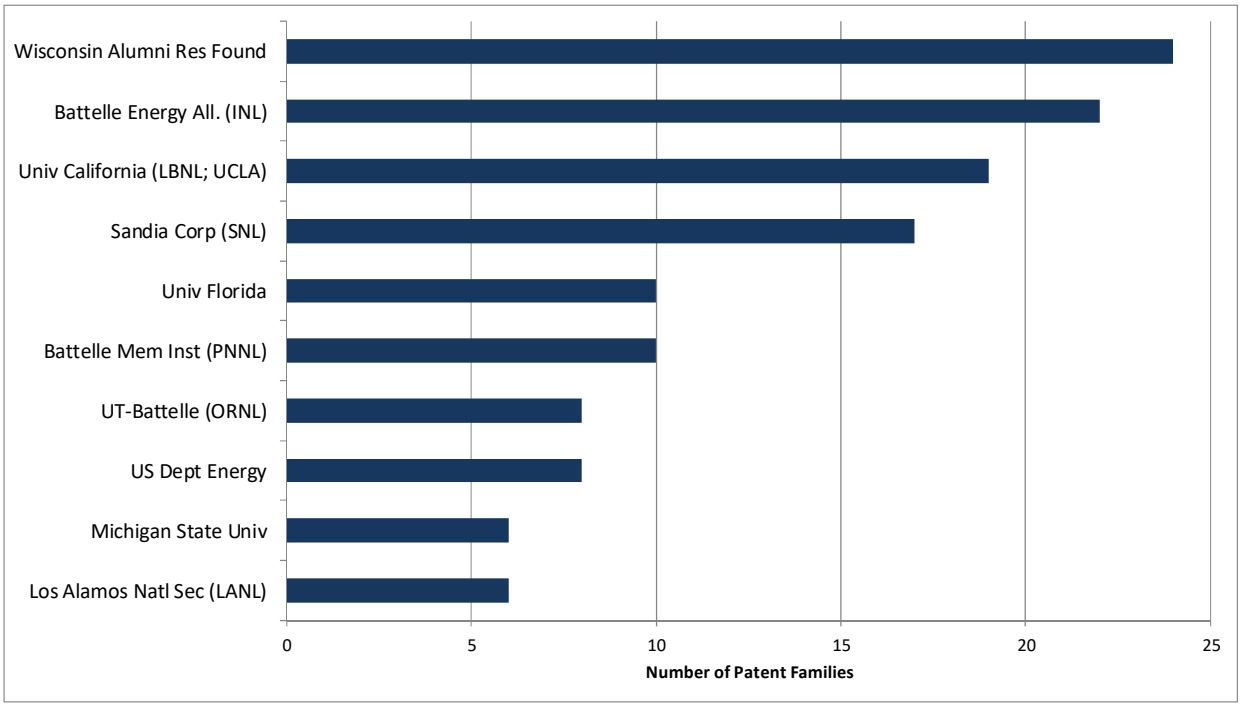


Figure 8 – Most Prolific Assignees of Other DOE-funded Bioenergy Conversion Patent Families

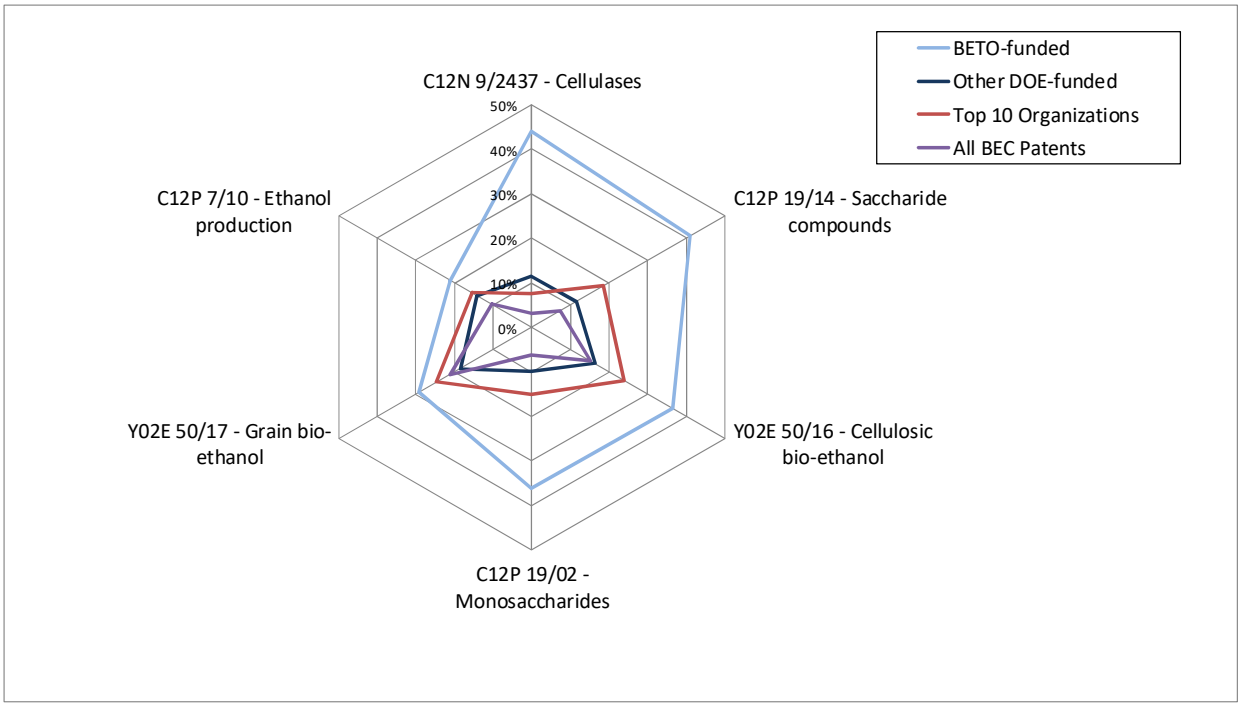


Distribution of Bioenergy Conversion Patents across Patent Classifications

We analyzed the distribution of BETO-funded bioenergy conversion U.S. patents across Cooperative Patent Classifications (CPCs).[7] We then compared this distribution to those associated with Other DOE-funded bioenergy conversion patents; bioenergy conversion patents assigned to the ten leading organizations; and the universe of all bioenergy conversion patents. This analysis provides insights into the technological focus of BETO funding in bioenergy conversion, versus the focus of the rest of DOE, leading bioenergy conversion organizations, and bioenergy conversion technology in general.

The results from this CPC analysis are shown in two separate charts, each from a different perspective. The first chart (Figure 9) is based on the six CPCs that are most prevalent among BETO-funded bioenergy conversion patents. The purpose of this chart is thus to show the main focus areas of BETO-funded bioenergy conversion research, and the extent to which these areas translate to other portfolios (Other DOE-funded; leading bioenergy conversion organizations; all bioenergy conversion).

Figure 9 - Percentage of Bioenergy Conversion U.S. Patents in Most Common Cooperative Patent Classifications (Among BETO-Funded Patents)



This figure shows that BETO-funded research includes relatively balanced coverage across the six CPCs (which is not particularly surprising, since the BETO-funded patent portfolio forms the basis for the CPCs included in the chart). The most common CPC among BETO-funded bioenergy conversion patents is C12N 9/2437, which appears on 44% of these patents. This CPC

[7] The CPC is a patent classification system. Patent offices attach numerous CPC classifications to a patent, covering the different aspects of the subject matter in the claimed invention. In generating these charts, all CPCs associated with each patent are included.

is related to cellulases, enzymes that can be used in biofuel production. Other CPCs in Figure 9 are related to substances with bioenergy applications, including saccharides (CPC C12P 19/14) and monosaccharides (CPC C12P 19/02), plus CPCs connected to ethanol production (Y02E 50/16, Y02E 50/17 and C12P 7/10). The other portfolios in Figure 9 all have a notable presence in the CPCs related to ethanol production, but fewer patents in CPCs covering specific bioenergy substances, such as cellulosic bio-ethanol, suggesting that BETO funding helped fill a research gap not addressed extensively by other organizations.

Figure 10 is similar to Figure 9, except that it is from the perspective of the most common CPCs among all bioenergy conversion patents. Hence, the purpose of this chart is to show the main research areas within bioenergy conversion as a whole, and how these areas are represented in selected bioenergy conversion portfolios (BETO-funded; Other DOE-funded; leading bioenergy conversion organizations). Three of the six most common CPCs among all bioenergy conversion patents also appeared in Figure 9, and are concerned with ethanol production. Meanwhile, the new CPCs in Figure 10 are related to producing gas from bio-feedstocks (Y02P 30/20), bio-diesel production (Y02E 50/13) and producing fuel from waste materials (Y02E 50/30). BETO-funded patents have a notable presence in the first of these CPCs (as do leading organizations), but less so in the other two CPCs. In general, the CPCs in Figure 10 reflect a focus on production techniques, whereas BETO-funded patents cover both substances and production.

Figure 10 - Percentage of Bioenergy Conversion U.S. Patents in Most Common Cooperative Patent Classifications (Among All Bioenergy Conversion Patents)

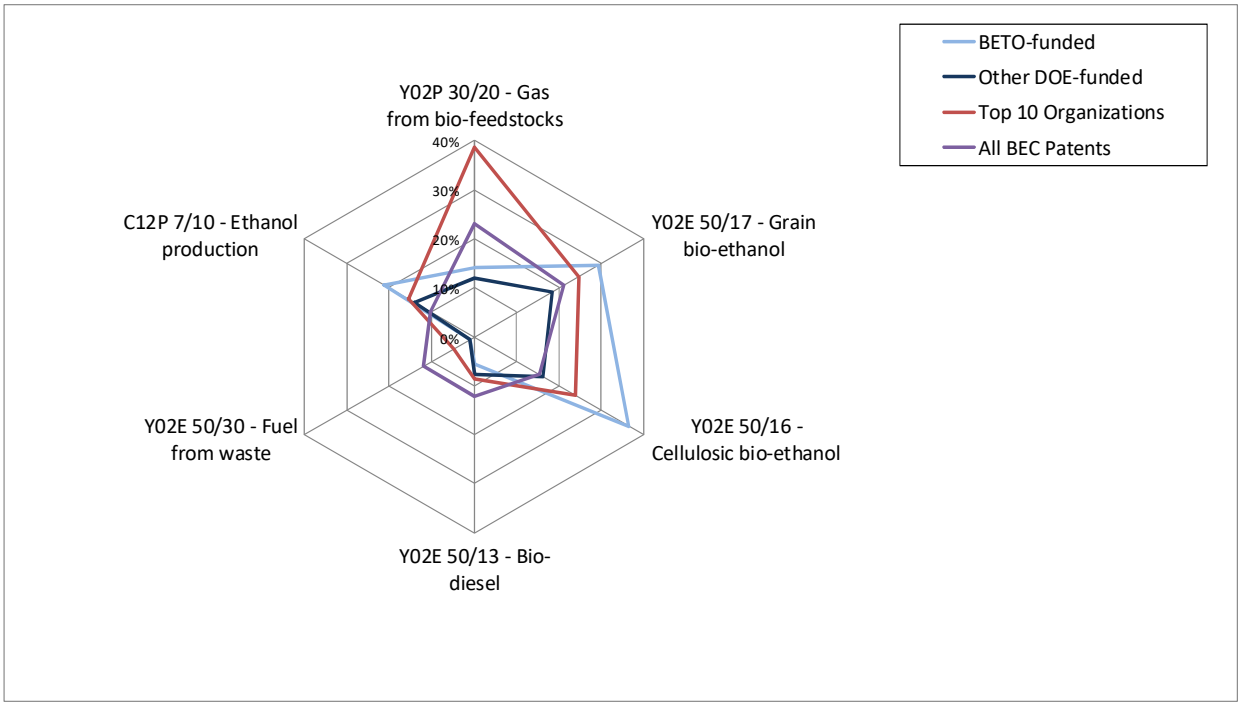
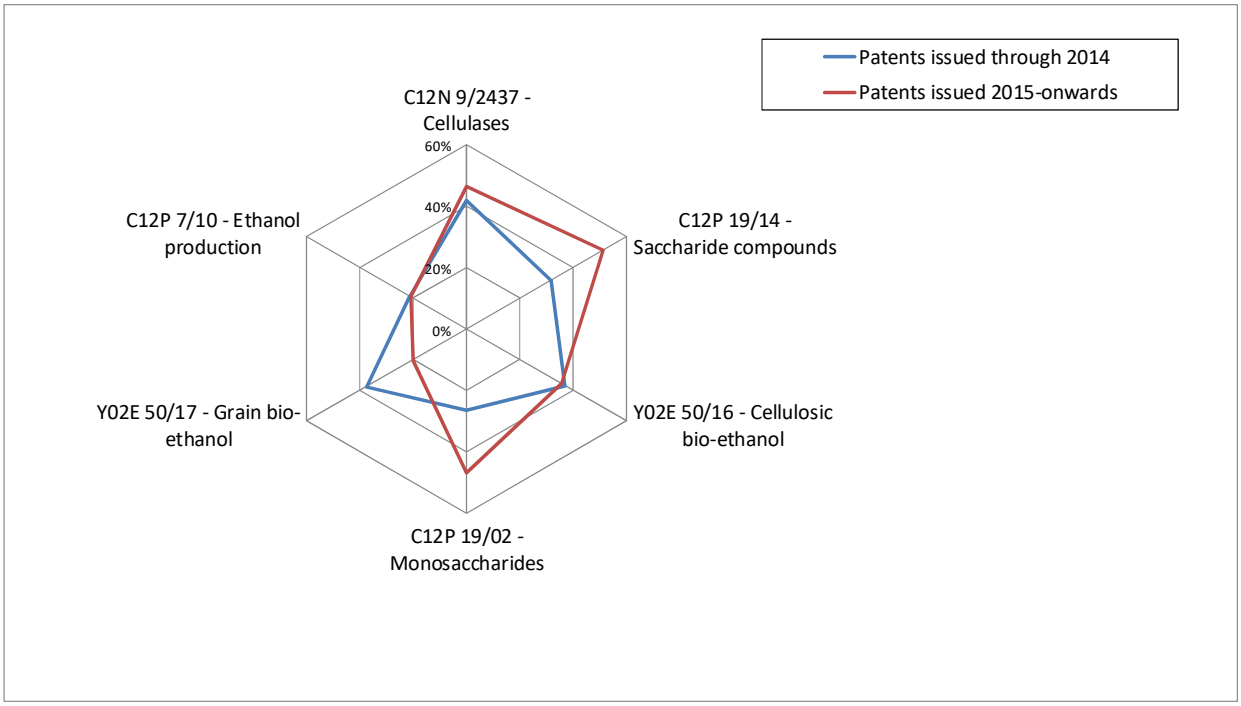


Figure 11 compares the CPC distribution of BETO-funded bioenergy conversion U.S. patents across two time periods – patents issued through 2014, and those issued from 2015 onwards (these dates are selected to divide the patents into two groups of approximately equal size). This figure reveals that the CPCs associated with BETO-funded patents have been relatively

consistent over time, with similar percentages of patents in each CPC across the two time periods. That said, there are some differences, notably a somewhat higher percentage of patents in the later time period in CPCs related to specific substances (C12P 19/02 and C12P 19/14), and a slightly lower percentage in grain-based ethanol production (CPC Y02E 50/17).

Figure 11 - Percentage of BETO-funded Bioenergy Conversion U.S. Patents in Most Common Cooperative Patent Classifications across Two Time Periods



Tracing Backwards from Bioenergy Conversion Patents Owned by Leading Organizations

This section reports the results of an analysis tracing backwards from bioenergy conversion patents owned by leading organizations in this technology to earlier research, including that funded by DOE. 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 BETO-funded (and Other DOE-funded) research forms a foundation for subsequent innovations associated with leading bioenergy conversion organizations. Second, we drill down to the level of individual patents, with a particular focus on BETO-funded bioenergy conversion patents. These patent-level results highlight specific BETO-funded patents that have influenced subsequent innovations associated with the leading organizations. They also highlight which bioenergy conversion patents owned by these leading organizations are linked particularly extensively to earlier BETO-funded research.

Organizational Level Results

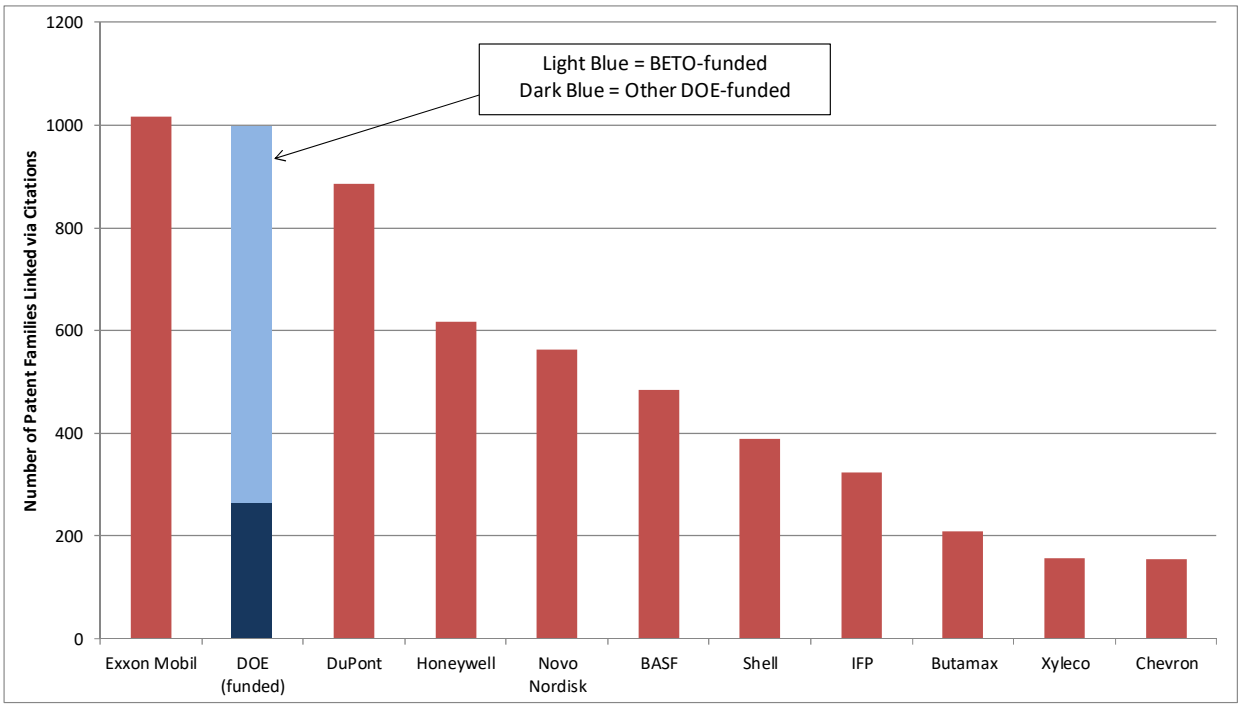
In the organizational level results, we first compare the influence of BETO-funded and Other DOE-funded bioenergy conversion research against the influence of leading bioenergy

conversion organizations. We then look at which of these leading organizations build particularly extensively on DOE-funded bioenergy conversion research.

Figure 12 compares the influence of DOE-funded bioenergy conversion research to the influence of research carried out by the top ten bioenergy conversion organizations. Specifically, this figure shows the number of bioenergy conversion patent families owned by the leading organizations that are linked via citations to earlier bioenergy conversion patent families assigned to each of these leading organizations (plus patent families funded by DOE). In other words, this figure shows the organizations whose patents have had the strongest influence upon subsequent developments made by leading organizations in bioenergy conversion technology.[8]

In total, 1,000 leading company bioenergy conversion patent families (i.e. 5.3% of these 18,901 families) are linked via citations to earlier DOE-funded bioenergy conversion patents, out of which 736 are linked to BETO-funded bioenergy conversion patents. This finding puts DOE-funded patents in second place in Figure 12, behind only ExxonMobil, which has 1,018 leading organization patent families linked via citations to its earlier patents.

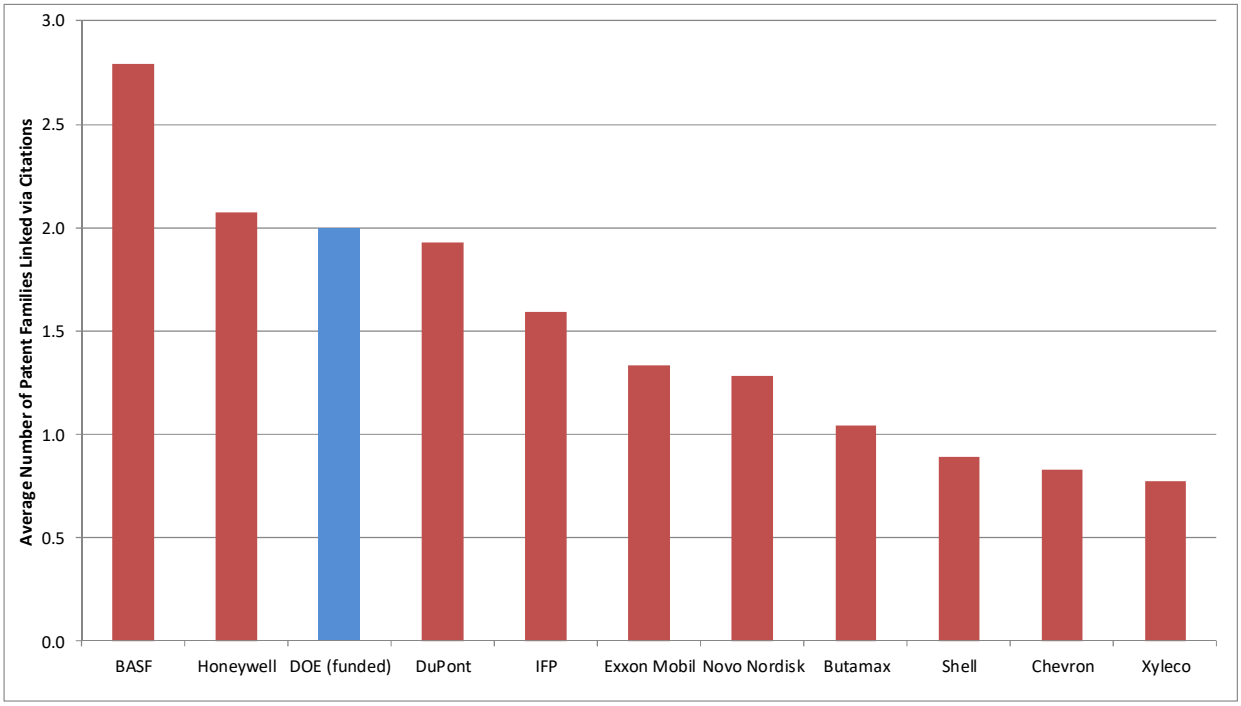
Figure 12 – No. of Leading Organization Bioenergy Conversion Patent Families Linked via Citations to Earlier Bioenergy Conversion Patents from each Leading Organization
e.g. 1,000 leading company families are linked to earlier BETO/Other DOE-funded families



[8] This figure compares the influence of patents *funded* by BETO/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 6, there is some double-counting in Figure 12 and Figure 13, as some patent families assigned to leading organizations were funded by DOE. Also, in Figures 12 and 14-16, leading organization patent families linked to both BETO-funded and Other DOE-funded patents are allocated to the BETO-funded segment of the DOE column, in order to avoid double-counting these families.

Figure 12 does not take into account the different sizes of the patent portfolios associated with the various organizations. For example, it is not surprising that more patent families are linked via citations to ExxonMobil than any other leading organization, since it has by far the most bioenergy conversion patent families available to be cited as prior art. Figure 13 takes into account the differences in patent portfolio size. It shows the average (mean) number of leading organization patent families linked to patent families associated with each of the leading organizations, plus DOE. For example, on average, DOE-funded bioenergy conversion patent families (the majority of which are BETO-funded) are each linked to two patent families assigned to the leading organizations. This puts DOE in third place in Figure 13, behind BASF (with an average of 2.8 linked families) and Honeywell (with an average of 2.1 linked families). It suggests that, even after taking into account relative patent portfolio sizes, DOE-funded patents have had a substantial influence on subsequent innovations associated with the leading organizations in bioenergy conversion technology.

Figure 13 – Average No. of Leading Organization Bioenergy Conversion Patent Families Linked via Citations to Bioenergy Conversion Families from Each Leading Organization
e.g. on average, each DOE-funded family is linked to two subsequent leading organization families



Figures 14 through 16 examine which of the leading organizations build particularly extensively on earlier DOE-funded patents. Figure 14 shows how many bioenergy conversion patent families owned by each of the leading organizations are linked via citations to at least one earlier DOE-funded bioenergy conversion patent. DuPont is at the head of this figure, with 249 patent families linked via citations to earlier DOE-funded patents, out of which 214 are linked to BETO-funded patents. Novo Nordisk is in second place in Figure 14, with 202 patent families linked via citations to DOE (194 to BETO). Note that, while these two companies were both funded by BETO, their patents are not only linked via citations to their own earlier BETO-funded patents, but also to patents from a variety of other BETO-funded organizations. They are

followed in Figure 14 by Butamax, with 139 patent families linked to DOE (40 to BETO), Shell (114 families linked to DOE; 64 to BETO), and Xyleco (103 linked to DOE; 81 to BETO).

Figure 14–No. of Patent Families Linked via Citations to Earlier BETO/Other DOE-funded Bioenergy Conversion Patents for each Leading Bioenergy Conversion Organization

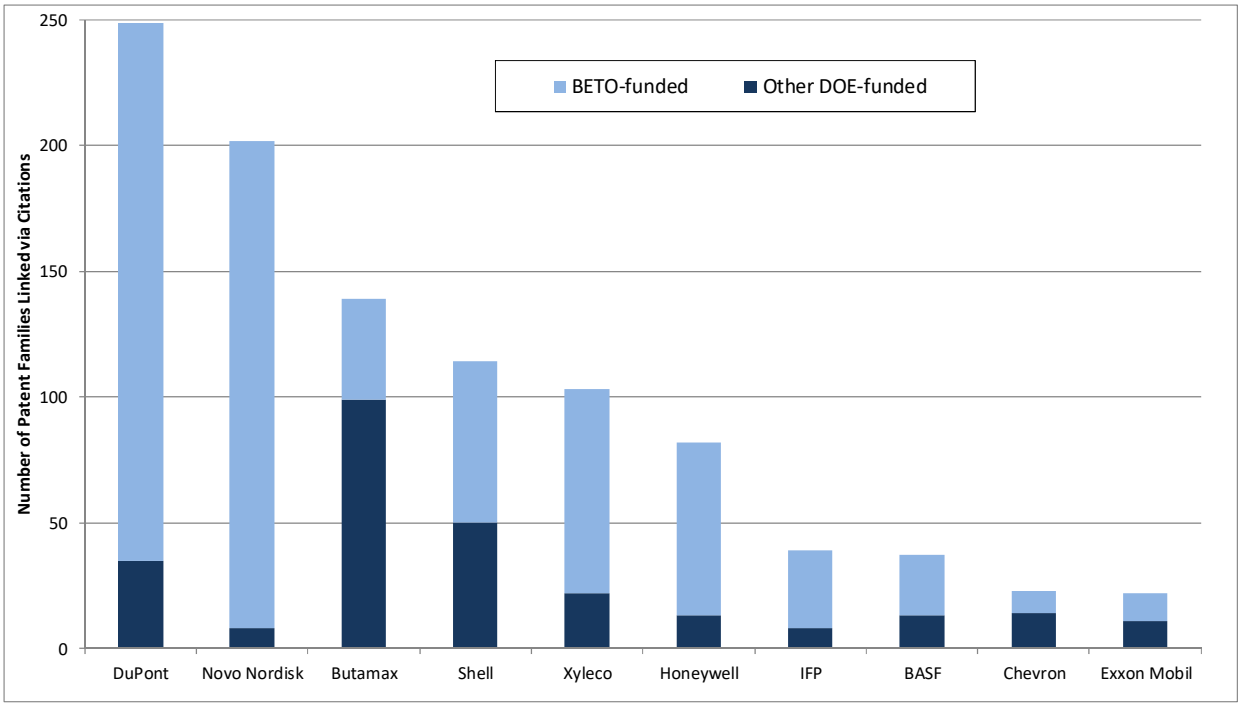


Figure 15 - Number of Citation Links from Leading Bioenergy Conversion Organization Patent Families to Earlier BETO/Other DOE-funded Bioenergy Conversion Patents

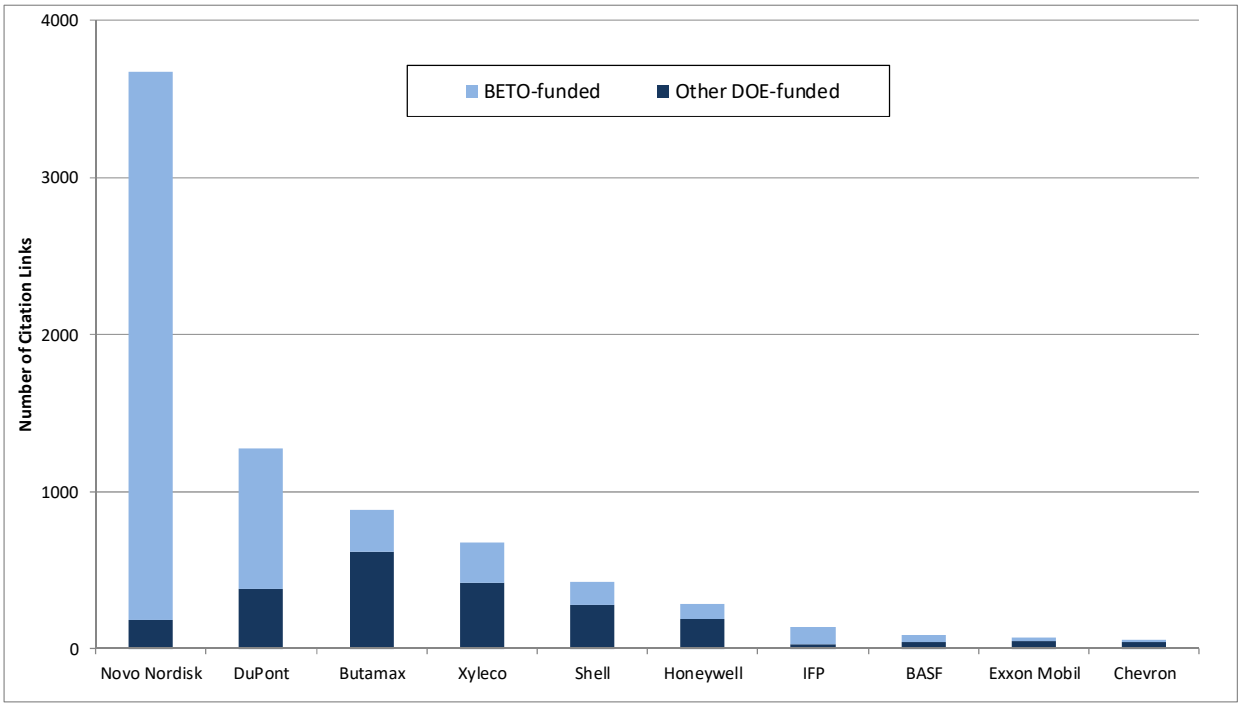
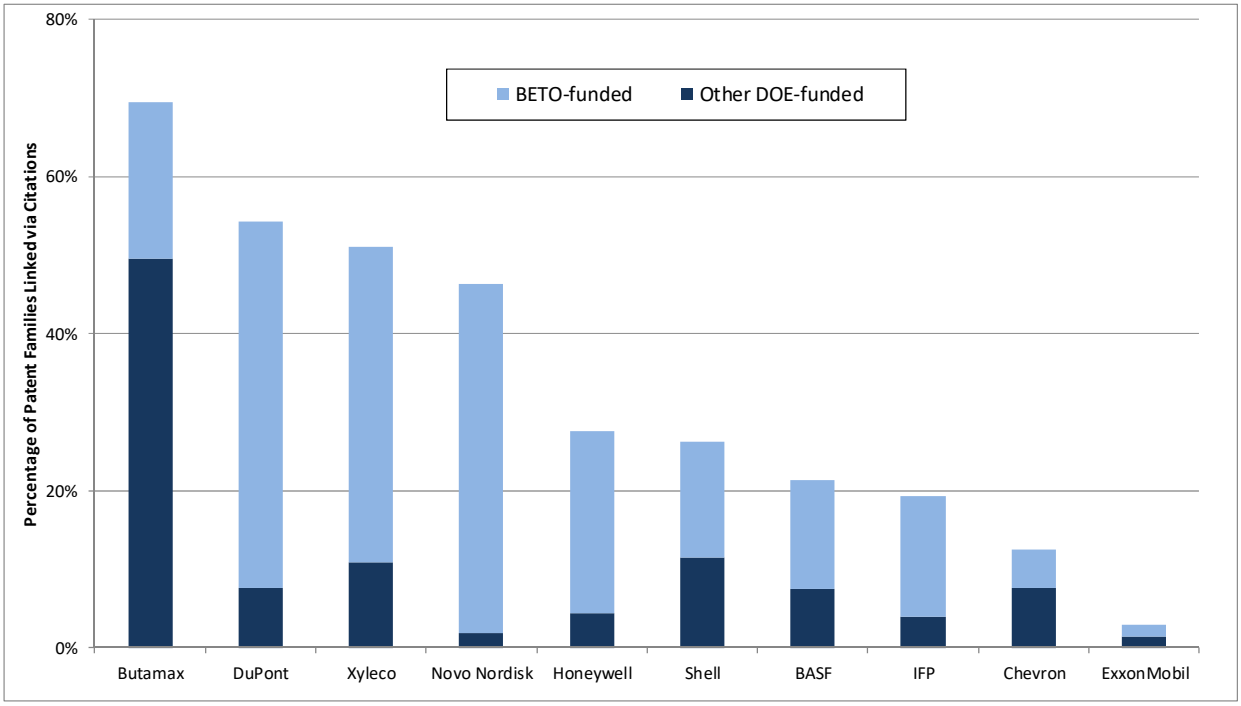


Figure 15 counts the total number of citation links from leading organizations to earlier DOE-funded patents. This differs slightly from the count of linked families in Figure 14, since a single patent family may be linked to multiple earlier DOE-funded patents. Novo Nordisk and DuPont are again at the head of Figure 15, reinforcing their close links to earlier DOE-funded bioenergy conversion research. The main difference between the two figures is that the two companies switch positions, with Novo Nordisk having by far the largest number of citation links to DOE (a total of 3,668 links, of which 3,489 are links to BETO-funded patents).

There is an element of portfolio size bias in the patent family counts in Figures 14 and 15. Organizations with larger bioenergy conversion patent portfolios are likely to have more patent families linked to DOE, simply because they have more families overall. Figure 16 accounts for this portfolio size bias by calculating the percentage of each leading organization's bioenergy conversion patent families that are linked via citations to earlier DOE-funded bioenergy conversion patents, rather than their absolute number. This is a measure of how extensively each organization builds on DOE-funded research, relative to their overall patent output.

Figure 16 - Percentage of Leading Bioenergy Conversion Organization Patent Families Linked via Citations to Earlier BETO/Other DOE-funded Bioenergy Conversion Patents



Butamax is at the head of Figure 16, with 70% of its bioenergy conversion patent families linked via citations to earlier DOE-funded patents (20% to BETO-funded patents). DuPont is in second place, with 54% of its patent families linked via citations to DOE (47% to BETO), followed by Xyleco (51% linked to DOE; 40% to BETO) and Novo Nordisk (46% linked to DOE; 44% to BETO). This further emphasizes the strong links from these organizations to earlier bioenergy conversion research funded by DOE, and BETO in particular.

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 bioenergy conversion patent families (in particular BETO-funded families) that have had a strong influence on subsequent bioenergy conversion patents owned by leading organizations in this technology. Looking in the opposite direction, it also identifies individual bioenergy conversion patents owned by leading organizations that have extensive links to earlier BETO-funded research.

Table 5 shows BETO-funded bioenergy conversion patent families linked via citations to large numbers of subsequent patent families owned by leading organizations in this technology. As such, the families in this table represent BETO-funded technologies that are linked to many subsequent innovations associated with leading organizations in bioenergy conversion.

Table 5 – BETO-Funded Bioenergy Conversion Patent Families Linked via Citations to Many Subsequent Leading Organization Bioenergy Conversion Patent Families

Patent Family #	Representative Patent #	Priority Year	# Linked Families	Original Assignee	Title
33555358	7666648	2003	198	Danisco	Isolated polypeptide having arabinofuranosidase activity
25245678	5275944	1989	155	MRIGlobal (NREL)	Thermostable purified endoglucanas from acidothermus cellulolyticus ATCC 43068
34837563	7271244	2004	142	Novozymes	Polypeptides having cellulolytic enhancing activity and polynucleotides encoding same
34837411	7361495	2004	132	Novozymes	Polypeptide from a cellulolytic fungus having cellulolytic enhancing activity
22856610	5514583	1994	127	MRIGlobal (NREL)	Recombinant zymomonas for pentose fermentation
21842358	7045331	2001	125	Genencor	EGVII endoglucanase and nucleic acids encoding the same
21830126	7005289	2001	111	Genencor	BGL5 .beta.-glucosidase and nucleic acids encoding the same
39743214	7425657	2007	75	Battelle Mem Inst (PNNL)	Palladium catalyzed hydrogenation of bio-oils and organic compounds
39926224	7741119	2006	73	DuPont / Alliance Sust. Energy	Xylitol synthesis mutant of xylose-utilizing zymomonas for ethanol production
38371947	8101393	2006	51	BP Corp	Cellulolytic enzymes, nucleic acids encoding them and methods for making and using them

The BETO-funded patent family linked to the most leading organization families is assigned to Danisco (which was subsequently acquired by DuPont). This patent family (whose representative patent[9] is US #7,666,648) was filed in 2003 and describes compositions containing novel proteins that can be used in multiple applications, including biomass conversion. It is linked via citations to 198 subsequent patent families assigned to the leading organizations, including families from five out of these ten companies (BASF, Butamax, DuPont, IFP and Novo Nordisk). Note that there are also two other patent families in Table 5 assigned to Genencor

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

(which was acquired by Danisco) that share a number of inventors with this Danisco patent family, so may have come from the same research group. The second patent family in Table 5 (representative patent US #5,275,944) is older, having been filed in 1989. It is assigned to MRIGlobal (formerly Midwest Research Institute), through its management of the National Renewable Energy Laboratory, and describes a method for purifying cellulase enzymes. This patent family is linked to 155 subsequent families assigned to the leading organizations, including DuPont, IFP, Novo Nordisk and Shell. Novozymes has the third and fourth placed patent families in Table 5. These patent families (representative patents US #7,271,244 and US #7,361,495) describe polypeptides that can be used to improve conversion of cellulosic feedstocks. They are linked to 142 and 132 leading organization patent families respectively, including families assigned to six of these ten organizations.

Table 5 lists BETO-funded patents linked to large numbers of subsequent bioenergy conversion patent families owned by leading organizations. Table 6 looks in the opposite direction, and lists bioenergy conversion patent families owned by leading organizations that are linked particularly extensively to earlier patents funded by BETO. The table is headed by a 2010 DuPont (Danisco) patent family (representative patent #10,138,499) describing a system designed to improve the yield from simultaneous saccharification and fermentation reactions. This family is linked via citations to 61 earlier BETO-funded bioenergy conversion patent families, including families assigned to a range of BETO-funded organizations, such as Genencor, MRIGlobal and Novozymes. The second patent family in Table 6 (representative patent US #10,035,996) is assigned to Novo Nordisk (Novozymes) and describes polypeptides used in bioenergy conversion (this is similar to the technology outlined in the earlier Novozymes patent family highlighted in Table 5). This family is linked to 47 BETO-funded patent families, again including families assigned to a range of organizations. The third-placed patent family in Table 6 is assigned to Institut Français du Pétrole (IFP) and describes a polypeptide with improved endoglucanase activity for bioenergy conversion. This patent family (representative patent US #10,000,780) is linked to 33 families assigned to various BETO-funded organizations.

Table 6 - Leading Organization Bioenergy Conversion Patent Families Linked via Citations to Large Numbers of BETO-Funded Bioenergy Conversion Patent Families

Patent Family #	Representative Patent #	Priority Year	# BETO Fams	Assignee	Title
44196386	10138499	2010	61	DuPont (Danisco)	Methods for improving the efficiency of simultaneous saccharification
49447842	10035996	2013	47	Novo Nordisk (Novozymes)	Polypeptides having cellulolytic enhancing activity and polynucleotides encoding same
50289839	10000780	2013	33	Institut Français du Pétrole	Endoglucanase variants having improved activity, and uses of same
51753492	9873846	2014	26	DuPont	Fuel compositions containing lignocellulosic biomass fermentation process syrup
39433707	9023628	2014	13	Xyleco	Processing biomass
46516817	8765425	2012	11	Butamax Adv Biofuels	In situ expression of lipase for enzymatic production of alcohol esters during fermentation
45565106	8497097	2010	11	Chevron / Georgia Tech	Chlorine dioxide treatment of biomass feedstock

We also identified high-impact bioenergy conversion patents owned by leading organizations that have citation links to earlier BETO-funded patents.[10] The idea is to highlight key innovations associated with the leading organizations that are linked to earlier bioenergy conversion research funded by BETO. Table 7 lists bioenergy conversion patents owned by leading organizations that have Citation Index values of three or over (i.e. they have been cited at least three times as frequently as expected), and are linked via citations to earlier BETO-funded bioenergy conversion patents. The patents are listed in descending order of their Citation Index.

Table 7 - Highly Cited Leading Organization Bioenergy Conversion Patents Linked via Citations to Earlier BETO-funded Bioenergy Conversion Patents

Patent	Issue Year	# Cites Received	Citation Index	Assignee	Title
7578927	2009	87	10.49	Honeywell (UOP)	Gasoline and diesel production from pyrolytic lignin produced from pyrolysis of cellulosic waste
7708214	2010	37	9.29	Xyleco	Fibrous materials and composites
8288148	2012	26	8.33	DuPont (Danisco)	Compositions and methods for producing isoprene
7741119	2010	42	7.06	DuPont	Xylitol synthesis mutant of xylose-utilizing zymomonas for ethanol production
8519203	2013	28	6.68	Honeywell (UOP)	Low oxygen biomass-derived pyrolysis oils and methods for producing the same
8343747	2013	20	6.64	BASF SE	Amylases and glucoamylases, nucleic acids encoding them and methods for making and using them
7999143	2011	49	3.73	Honeywell (UOP)	Production of diesel fuel from renewable feedstocks with reduced hydrogen consumption

The patent at the head of Table 7 (US #7,578,927) was originally assigned to UOP, which was subsequently acquired by Honeywell. It is one of three highly-cited Honeywell-UOP patents in this table. This patent outlines production of gas and diesel from biomass. Since this patent was issued in 2009, it has been cited as prior art by 87 subsequent patents, which is more than ten times as many citations as expected given its age and technology. In turn, this patent is linked via citations to earlier BETO-funded MRIGlobal (NREL) patent families describing biomass conversion. The second patent in Table 7 (US #7,708,214) is assigned to Xyleco and describes the use of fibrous materials to produce ethanol. This patent is linked via citations to earlier BETO-funded MRIGlobal (NREL) and University of Florida patents for ethanol production. In turn, it has been cited by 37 subsequent patents, more than nine times as many citations as expected. DuPont (Danisco) has the third patent in Table 7 (US #8,288,148), describing a

[10] 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 C12P 7/10 (Ethanol production) 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 a patent has been cited 50% more frequently than expected. Meanwhile a Citation Index of 0.7 reveals 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 been cited less frequently than expected. Note that the Citation Index is calculated for U.S. patents only, since citation rates differ across patent systems.

method for producing isoprene. Since being issued in 2012, this patent has been cited by 26 subsequent patents, more than eight times as many as expected. In turn, it is linked to an earlier BETO-funded MRIGlobal (NREL) patent for ethanol production from cellulosic biomass.

While the patent-level results focus on BETO-funded bioenergy conversion patent families, we also identified Other DOE-funded bioenergy conversion families linked via citations to the largest number of patent families owned by the leading organizations. These Other DOE-funded families are shown in Table 8. This table is headed by a 2005 patent family (representative patent US #7,910,338) co-assigned to DuPont and the Alliance for Sustainable Energy (through its management of NREL). This patent family describes a method for integrating multiple input streams for bioenergy production. It is linked via citations to 224 subsequent families assigned to the leading organizations, including families from seven out of these ten companies. The second patent family in Table 8 (representative patent US #5,000,000) was filed in 1988 and assigned to the University of Florida. It describes an improved ethanol production system, and is linked via citations to 203 subsequent patent families assigned to seven of the ten leading organizations. Michigan State University has the third patent in Table 8 (US #5,063,156). This patent family is linked via citations to 117 leading organization families, including families assigned to four of these organizations. It describes improved fermentation to produce acetone, butanol and ethanol.

Table 8 - Other DOE-Funded Bioenergy Conversion Patent Families Linked via Citations to Many Subsequent Leading Organization Bioenergy Conversion Families

Patent Family #	Representative Patent #	Priority Year	# Linked Families	Assignee	Title
36782581	7910338	2005	224	DuPont / Alliance Sust. Energy (NREL)	Integration of alternative feedstreams for biomass treatment and utilization
26932266	5000000	1988	203	Univ Florida	Ethanol production by escherichia coli strains co-expressing zymomonas PDC and ADH genes
24056382	5063156	1990	117	Michigan State Univ	Process for the fermentative production of acetone, butanol and ethanol
26735707	5959167	1997	99	Univ Utah	Process for conversion of lignin to reformulated hydrocarbon gasoline
25131901	4678860	1985	83	Arizona State Univ	Process of producing liquid hydrocarbon fuels from biomass
26903708	5180868	1988	53	Battelle Mem Inst (PNNL)	Method of upgrading oils containing hydroxyaromatic hydrocarbon compounds to highly aromatic gasoline
39682457	8975049	2007	46	Univ California (UCLA)	Biofuel production by recombinant microorganisms
32230084	6953873	2002	43	Wisconsin Alumni Res Found	Low-temperature hydrocarbon production from oxygenated hydrocarbons
42129581	8097440	2008	42	Gevo Inc / Caltech	Engineered microorganisms capable of producing target compounds under anaerobic conditions

Overall, the backward tracing element of the analysis suggests that the portfolios of BETO-funded and Other DOE-funded bioenergy conversion patents have had an important influence on subsequent innovations associated with the leading bioenergy conversion companies. This

influence can be seen both over time and across technologies, with a number of DOE-funded patent families linked via citations to patents assigned to many of the leading organizations.

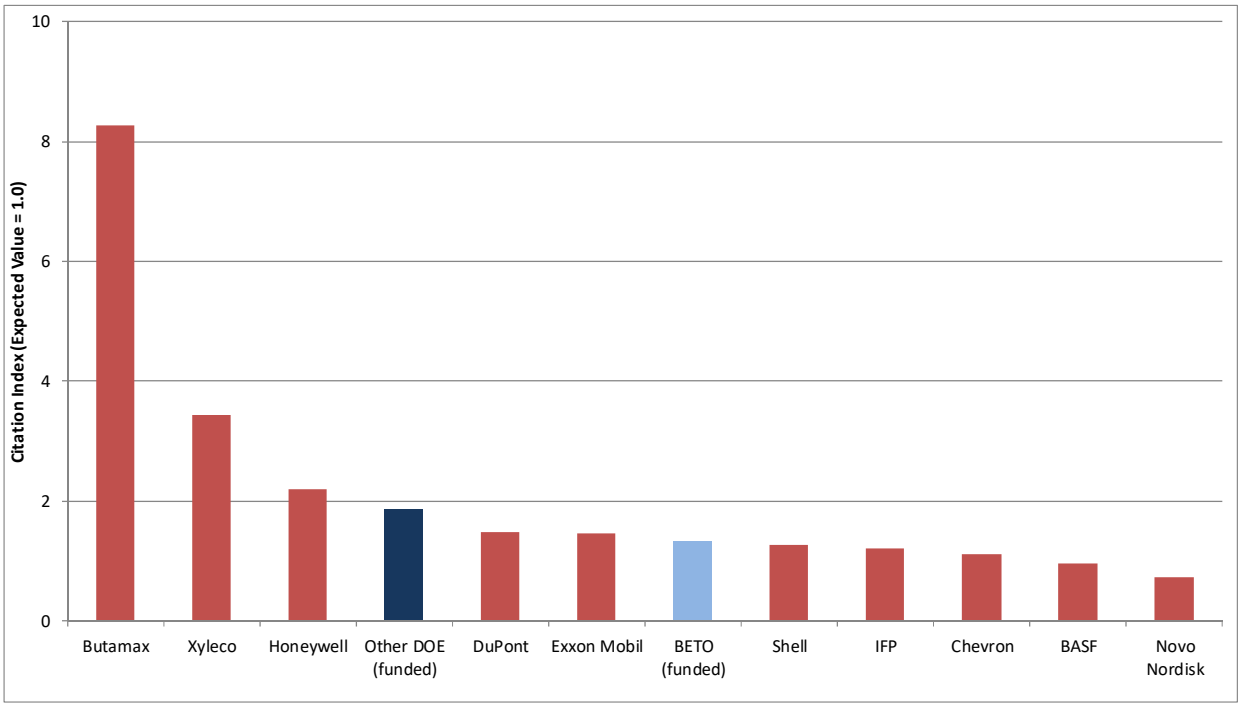
Tracing Forwards from DOE-funded Bioenergy Conversion Patents

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

Organizational Level Results

We first generated Citation Index values for the portfolios of BETO-funded and Other DOE-funded bioenergy conversion patents. We then compared these Citation Indexes against those of the ten leading bioenergy conversion organizations. The results are shown in Figure 17.

Figure 17 - Citation Index for Leading Organizations' Bioenergy Conversion Patents, plus BETO-funded and Other DOE-funded Bioenergy Conversion Patents

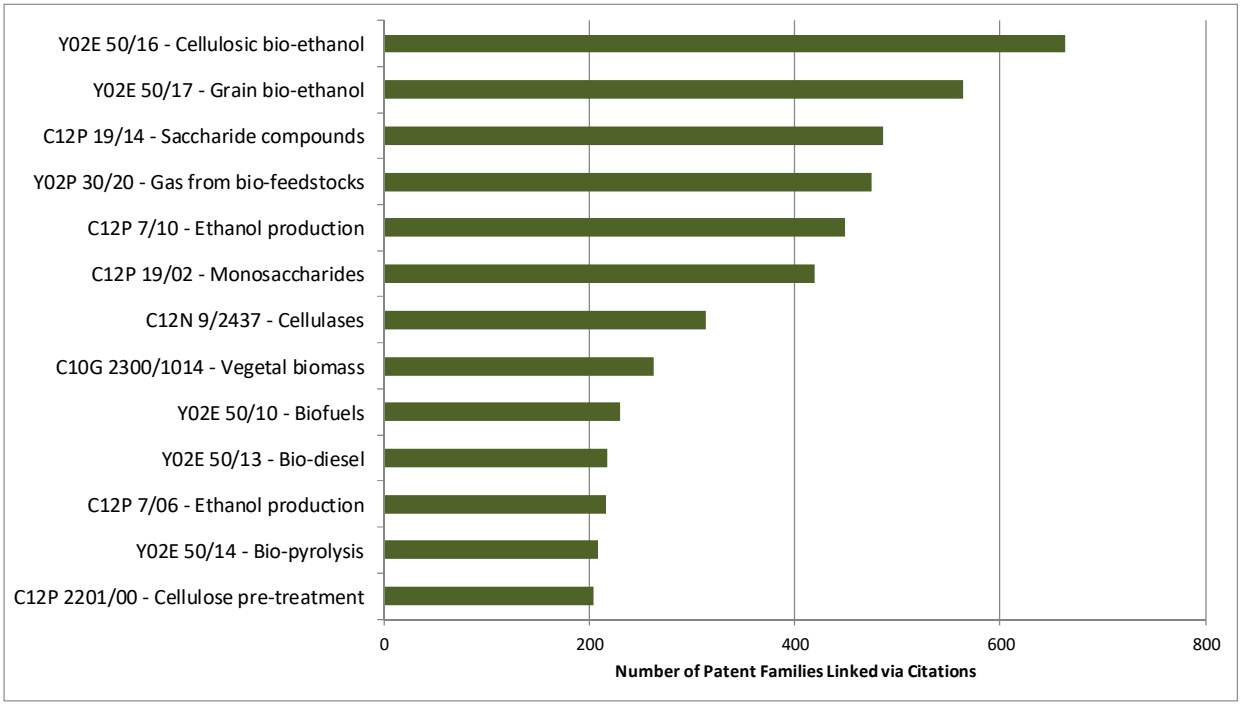


This figure reveals that BETO-funded bioenergy conversion patents have an average Citation Index of 1.32 (showing they have been cited 32% more frequently than expected). The Citation Index for Other DOE-funded bioenergy conversion patents is even higher at 1.87 (i.e. 87% more citations than expected). This puts Other DOE-funded patents in fourth place in Figure 17, and BETO-funded patents in seventh place (the figure is headed by Butamax with a Citation Index of 8.28 and Xyleco with a Citation Index of 3.44). It suggests that both of the DOE-funded patent portfolios have had a higher than expected influence on subsequent technological developments.

The Citation Index measures the overall influence of the DOE-funded bioenergy conversion 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 bioenergy conversion patent families.[11] These CPCs reflect the influence of DOE-funded research across technologies.

Figure 18 shows the CPCs with the largest number of patent families linked via citations to earlier BETO-funded bioenergy conversion patents. Typically, a figure such as this shows CPCs in two different colors – i.e. those related to bioenergy conversion and those beyond this technology. The former represent the influence of BETO-funded patents on bioenergy conversion technology itself, while the latter represent spillovers of the influence of BETO-funded bioenergy conversion research into other technology areas.

Figure 18 - Number of Patent Families Linked via Citations to Earlier BETO-Funded Bioenergy Conversion Patents by CPC

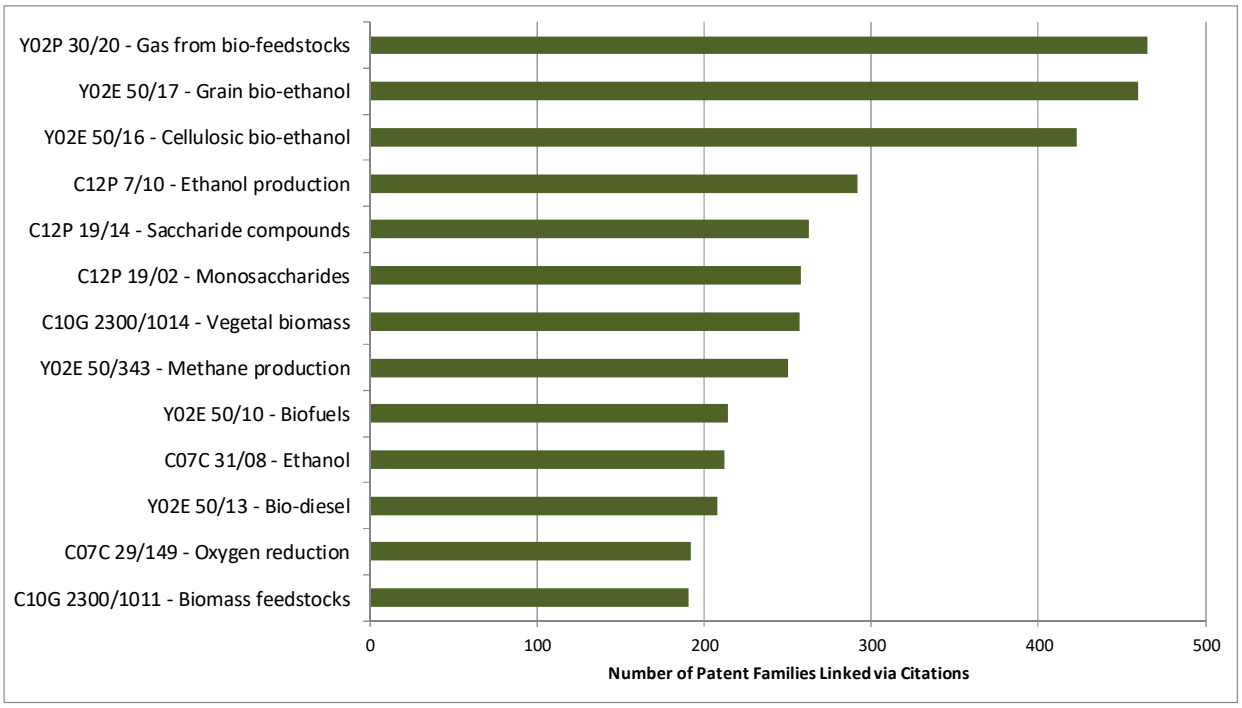


[11] Patents typically have numerous CPCs attached to them, reflecting different aspects of the invention they describe. In this analysis, we include all CPCs attached to the patents linked via citations to earlier DOE-funded bioenergy conversion patent families.

In Figure 18, all of the CPCs are shown in a single color, since they are all connected in some way to bioenergy conversion. This suggests that bioenergy conversion is a relatively self-contained technology, with successive generations building upon earlier research. That said, there are CPCs related to a number of different bioenergy conversion technologies represented in this figure. They include substances (such as enzymes and sugars), production techniques, and final products (including ethanol, biofuel and biodiesel).

Figure 19 is similar to Figure 18, but is based on patent families linked to Other DOE-funded bioenergy conversion patents, rather than BETO-funded bioenergy conversion patents. All of the CPCs are again related to bioenergy conversion, and their distribution is similar to that of the families linked to BETO-funded patents. Again, this shows the influence of Other DOE-funded patents on subsequent innovations across a range of bioenergy conversion technologies.

Figure 19 - Number of Patent Families Linked via Citations to Earlier Other DOE-Funded Bioenergy Conversion Patents by CPC



The organizations with the largest number of patent families linked via citations to earlier BETO-funded bioenergy conversion patents are shown in Figure 20. To avoid repeating the results from earlier, this figure excludes the ten leading bioenergy conversion organizations used in the backward tracing element of the analysis. Also, note that Figure 20 includes all patent families assigned to these organizations, not just their patent families describing bioenergy conversion technology.

Three companies in Figure 20 have more than 100 patent families linked via citations to earlier BETO-funded bioenergy conversion patents. Celanese is at the head of Figure 20, with 220 patent families linked via citations to BETO-funded patents. These Celanese patent families

describe the production of various chemical compounds, notably ethanol. They are linked to earlier BETO-funded patents assigned to the University of Florida for recombinant organisms and Battelle Memorial Institute (Pacific Northwest National Laboratory) for bio-oil production. Halliburton is in second place in Figure 20, with 106 patent families linked via citations to earlier BETO-funded bioenergy conversion patents. These Halliburton patent families describe fluid treatment and materials processing, and are linked to BETO-funded MRIGlobal (NREL) patent families outlining biomass conversion. The third company in Figure 20 with more than 100 patent families linked to BETO-funded patents is Royal DSM, with 105 such families. These DSM families describe carbohydrate degradation and ethanol production, and are linked via citations to earlier BETO-funded Novozymes and Danisco/Genencor patent families outlining novel compositions for use in bioenergy conversion.

Figure 20 - Organizations with Most Patent Families Linked via Citations to BETO-funded Bioenergy Conversion Patents (excluding leading bioenergy conversion organizations)

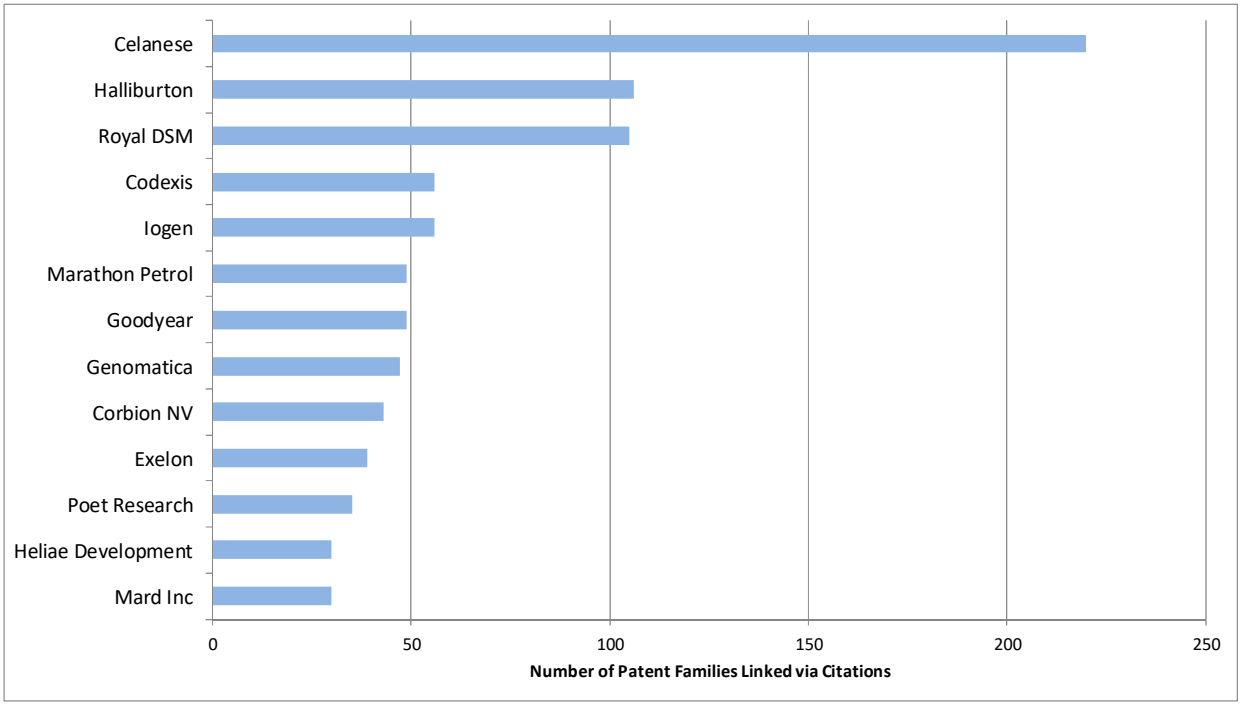
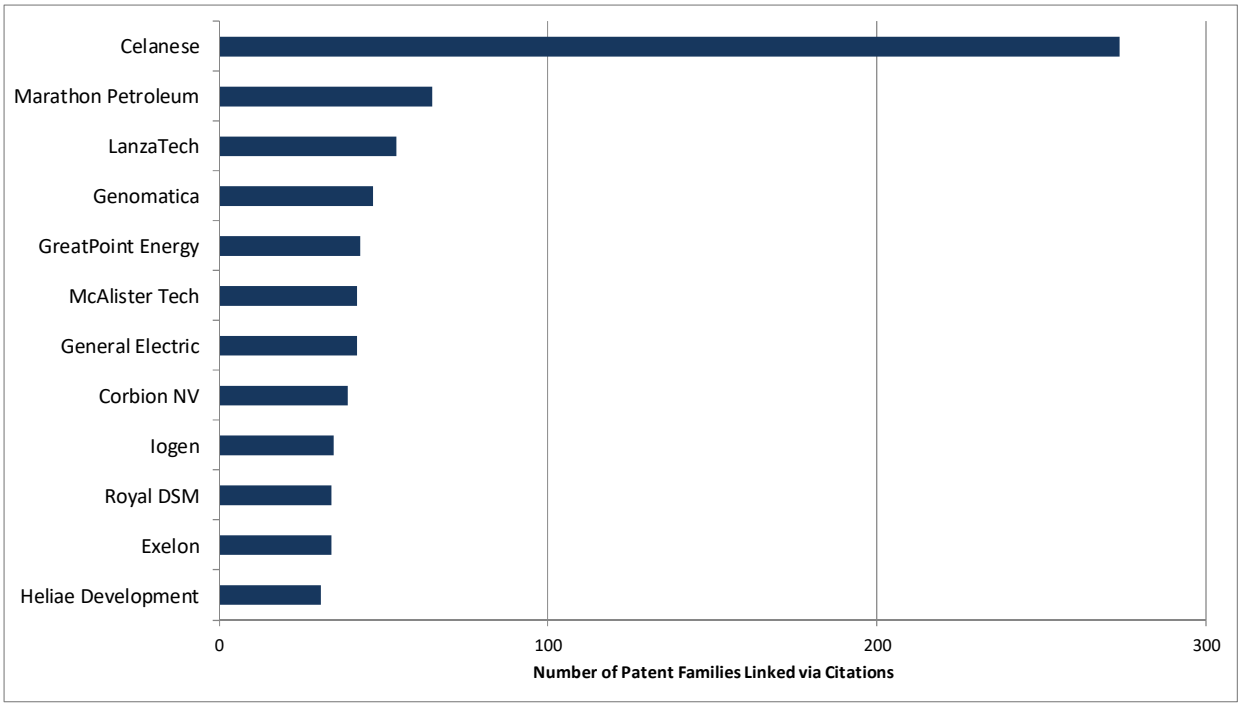


Figure 21 shows the organizations with the largest number of patent families linked to earlier Other DOE-funded bioenergy conversion patents. This figure is again headed by Celanese, with 274 patent families linked via citations to earlier Other DOE-funded bioenergy conversion patents (more than four times as many as any other organization). These Celanese families again describe chemical production, and are linked via citations to earlier DOE-funded patents assigned to a range of organizations (including MIT, University of Florida and WARF) for ethanol production. Marathon Petroleum is in second place in Figure 21, with 65 patent families linked to Other DOE-funded patents. These Marathon patent families outline biomass treatment and liquid fuel processing, and are linked to earlier DOE-funded patents for biofuel production assigned to a range of organizations. LanzaTech is in third place in Figure 21, with 54 patent families linked via citations to Other DOE-funded patents. The LanzaTech families relate to techniques for producing ethanol and other compounds, especially from waste products. They are

linked to numerous earlier Other DOE-funded patents, notably Bioengineering Resources and Ineos patents for improved fermentation systems for ethanol production.

Figure 21 - Organizations with Most Families Linked via Citations to Other DOE-funded Bioenergy Conversion Patents (excluding leading bioenergy conversion organizations)



Patent Level Results

This section of the report drills down to identify individual DOE-funded (and particularly BETO-funded) bioenergy conversion patents whose influence on subsequent technological developments has been particularly strong. It also locates highly-cited patents that have citation links to earlier BETO-funded bioenergy conversion research.

The simplest way of identifying high-impact BETO-funded bioenergy conversion patents is via overall Citation Indexes. The BETO-funded patents with the highest Citation Index values are shown in Table 9, with selected patents also presented in Figure 22. 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.

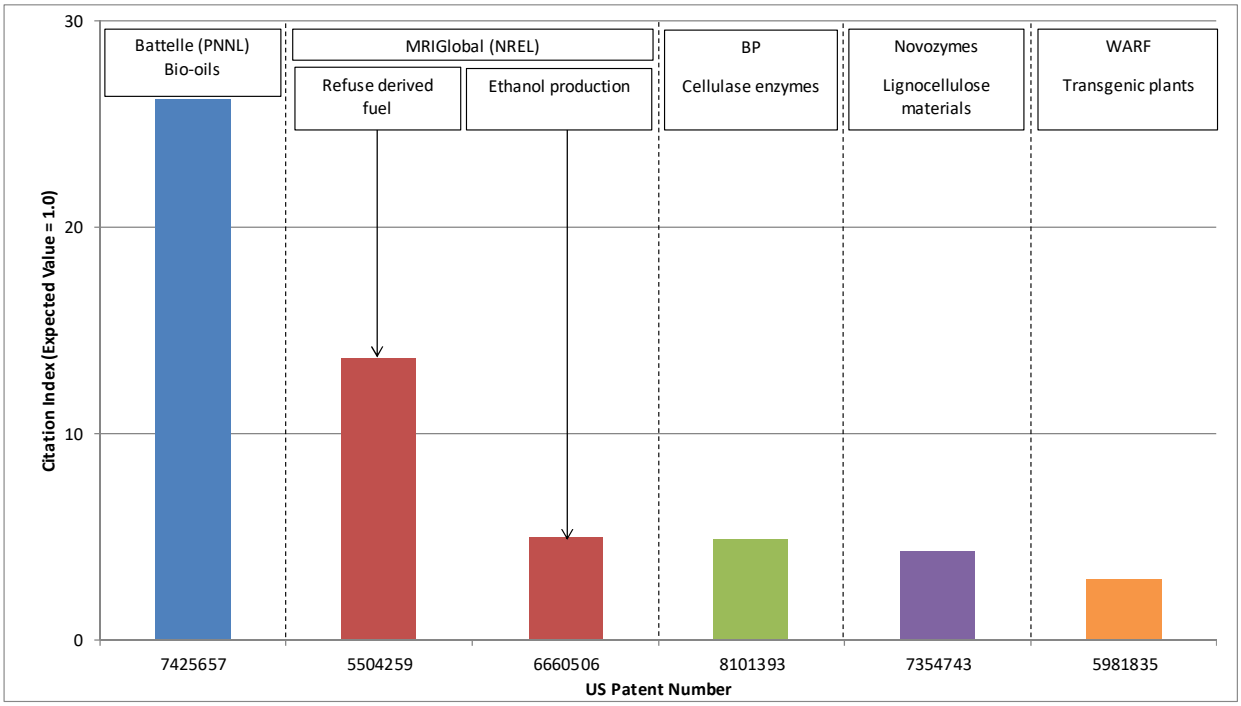
The patent at the head of Table 9 (US #7,425,657) is assigned to Battelle Memorial Institute, through its management of Pacific Northwest National Laboratory. It describes hydrogenation of bio-oils. Since being issued in 2008, this patent has been cited as prior art by 132 subsequent patents, more than 26 times as many citations as expected given its age and technology. Beyond this Battelle patent, Table 9 is dominated by patents assigned to MRIGlobal, through its management of the National Renewable Energy Laboratory. The most highly-cited of these

patents is listed in second place in Table 9. This patent (US #5,504,259) describes a process for converting biomass and waste into ethers and alcohols, which can in turn be blended to produce clean-burning gasoline. It has been cited as prior art by 120 subsequent patents, more than thirteen times as many citations as expected.

Table 9 – List of Highly Cited BETO-Funded Bioenergy Conversion Patents

Patent #	Issue Year	# Cites Received	Citation Index	Assignee	Title
7425657	2008	132	26.24	Battelle Mem Inst (PNNL)	Palladium catalyzed hydrogenation of bio-oils and organic compounds
5504259	1996	120	13.69	MRIGlobal (NREL)	Process to convert biomass and refuse derived fuel to ethers and/or alcohols
6660506	2003	84	4.99	MRIGlobal (NREL)	Ethanol production with dilute acid hydrolysis using partially dried lignocellulosics
8101393	2012	20	4.87	BP Corp	Cellulolytic enzymes, nucleic acids encoding them and methods for making and using them
5514583	1996	64	4.38	MRIGlobal (NREL)	Recombinant zymomonas for pentose fermentation
7354743	2008	32	4.29	Novozymes	Methods for degrading lignocellulosic materials
6423145	2002	71	3.19	MRIGlobal (NREL)	Dilute acid/metal salt hydrolysis of lignocellulosics
5981835	1999	42	2.95	Wisconsin Alumni Res Found	Transgenic plants as an alternative source of lignocellulosic-degrading enzymes
6228177	2001	68	2.72	MRIGlobal (NREL)	Aqueous fractionation of biomass based on novel carbohydrate hydrolysis kinetics
7682811	2010	20	2.68	Univ Massachusetts	Systems and methods for producing biofuels and related materials

Figure 22 – Examples of Highly-Cited BETO-funded Bioenergy Conversion Patents



The Citation Indexes in Table 9 are based on a single generation of citations to BETO-funded bioenergy conversion patents. Table 10 and Table 11 extend this by examining a second generation of citations – i.e. they show the BETO-funded bioenergy conversion patents linked via citations to the largest number of subsequent patent families.[12] These subsequent families are divided into two groups, based on whether they are within or beyond bioenergy conversion technology. This highlights which BETO-funded patent families have been particularly influential within bioenergy conversion, and which have had a wider impact beyond this technology.

Table 10 – Pre-2000 BETO-funded Bioenergy Conversion Patent Families Linked via Citations to Largest Number of Subsequent Bioenergy Conversion/Other Patent Families

Family #	Priority Year	Rep. Patent #	# Linked Families	# Linked BEC Fams	Assignee	Title
25514461	1992	5504259	606	428	MRIGlobal (NREL)	Process to convert biomass and refuse derived fuel to ethers and/or alcohols
23055671	1989	5536655	598	251	MRIGlobal (NREL)	Gene coding for the E1 endoglucanase
25311631	1994	5843760	427	190	MRIGlobal (NREL)	Single zymomonas mobilis strain for xylose and arabinose fermentation
24734685	1991	5125977	367	224	US Dept Energy	Two-stage dilute acid prehydrolysis of biomass
24700839	1991	5372939	209	125	US Dept Energy	Combined enzyme mediated fermentation of cellulous and xylose to ethanol
25121160	1997	5733758	187	130	Abengoa Bioenergy	Tower reactors for bioconversion of lignocellulosic material
26704010	1996	5981835	147	78	Wisconsin Alumni Res Found	Transgenic plants as an alternative source of lignocellulosic-degrading enzymes
24575886	1991	5100791	128	85	US Dept Energy	Simultaneous saccharification and fermentation (SSF) using cellobiose fermenting yeast
25268088	1997	6102690	93	43	Univ Florida	Recombinant organisms capable of fermenting cellobiose

Table 10 contains older BETO-funded patent families, with priority dates prior to 2000. The three patent families at the head of this table are all assigned to MRIGlobal (NREL). The first of these families contains the highly-cited biomass processing patent discussed in Table 9 (US #5,504,259). This family is linked via citations to 606 subsequent patent families, 428 of which are related to bioenergy conversion. The second MRIGlobal family (representative patent US #5,536,655) describes a gene for cellulose degradation, while the third (representative patent US #5,843,760) outlines biomass conversion. These patent families are linked to 598 and 427 subsequent families respectively, just under half of which are related to bioenergy conversion. Other patent families in Table 10 are assigned to DOE, Abengoa, Wisconsin Alumni Research Foundation and the University of Florida, and describe various bioconversion technologies.

[12] The BETO-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.

Table 11 contains newer BETO-funded bioenergy conversion patent families, with priority dates from 2000 onwards. The table is headed by a Danisco patent family describing compositions containing novel proteins that can be used in biomass conversion. This patent family (representative patent US #7,666,648) was highlighted earlier in the backward tracing element of the analysis (See Table 5). It is linked via citations to 641 subsequent patent families, 271 of which are related to bioenergy conversion. MRIGlobal (NREL) has the patent family in second place in Table 11. This family (representative patent US #6,423,145) describes hydrolysis of lignocellulosic materials to improve yields. It is linked to 510 subsequent patent families (294 in bioenergy conversion). The third patent family in Table 11 is the Battelle Memorial Institute (PNNL) bio-oil family containing the highly-cited patent at the head of Table 9. Meanwhile, the next patent families in Table 11 are the Novozymes polypeptides families highlighted earlier in the backward tracing (see Table 5).

Table 11 – Post-1999 BETO-funded Bioenergy Conversion Patent Families Linked via Citations to Largest Number of Subsequent Bioenergy Conversion/Other Patent Families

Family #	Priority Year	Rep. Patent #	# Linked Families	# Linked BEC Fams	Assignee	Title
33555358	2003	7666648	641	271	Danisco	Isolated polypeptide having arabinofuranosidase activity
24545912	2000	6423145	510	294	MRIGlobal (NREL)	Dilute acid/metal salt hydrolysis of lignocellulosics
39743214	2007	7425657	453	210	Battelle Mem Inst (PNNL)	Palladium catalyzed hydrogenation of bio-oils and organic compounds
34837563	2004	7271244	440	240	Novozymes	Polypeptides having cellulolytic enhancing activity and polynucleotides encoding same
34837411	2004	7361495	397	202	Novozymes	Polypeptide from a cellulolytic fungus having cellulolytic enhancing activity
21842358	2001	7045331	362	206	Danisco (Genencor)	EGVII endoglucanase and nucleic acids encoding the same
36579333	2004	8008056	326	165	Danisco	Variant Hypocrea jecorina CBH2 cellulases
24828301	2000	6566107	209	150	MRIGlobal (NREL)	Recombinant Zymomonas mobilis with improved xylose utilization
38371947	2006	8101393	172	81	BP Corp	Cellulolytic enzymes, nucleic acids encoding them and methods for making and using them
32961095	2003	7449550	118	60	All. Sust. Energy (NREL)	Superactive cellulase formulation using cellobiohydrolase-1 from Penicillium funiculosum

One feature of Table 10 and Table 11 is that many of the subsequent patent families linked to the BETO-funded families via citations are themselves concerned with bioenergy conversion. This suggests that bioenergy conversion is a relatively self-contained technology, with successive generations of technology building on earlier innovations from within bioenergy conversion. A similar finding was reported earlier regarding the Cooperative Patent Classifications of patent

families linked via citations to BETO-funded and Other DOE-funded bioenergy conversion patents (see Figure 18 and Figure 19).

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

Table 12 - Highly Cited Patents (not from leading bioenergy conversion organizations) Linked via Citations to Earlier BETO-funded Bioenergy Conversion Patents

Patent #	Issue Year	# Cites Received	Citation Index	Assignee	Title
8277643	2012	52	15.04	Univ Massachusetts	Catalytic pyrolysis of solid biomass and related biofuels, aromatic, and olefin compounds
8450083	2013	45	14.94	Corbion NV	Modified lipids produced from oil-bearing microbial biomass and oils
8361186	2013	56	10.29	Full Circle Biochar	Biochar
8501989	2013	25	9.72	Rennovia	Production of adipic acid and derivatives from carbohydrate-containing materials
8202332	2012	47	9.14	Virginia Tech Univ	Fractional catalytic pyrolysis of biomass
7905990	2011	68	8.69	Ensyn Renewables	Rapid thermal conversion of biomass
7649086	2010	54	8.17	Biojoule Ltd	Integrated processing of plant biomass
6419788	2002	93	7.38	Purevision Technology	Method of treating lignocellulosic biomass to produce cellulose
8153850	2012	51	6.14	Texas A&M Univ	Integrated biofuel production system

The patent at the head of Table 12 (US #8,277,643) was granted in 2012 to the University of Massachusetts, and describes a bioenergy conversion system using catalytic pyrolysis. It has been cited as prior art by 52 subsequent patents, while the expected number of citations for a patent of its age and technology is only slightly above three. The second patent in Table 12 (US #8,450,083) is assigned to Corbion NV, and describes chemical modification of biomass to improve biofuel yields. This patent has been cited as prior art by 45 subsequent patents since it was issued in 2013, almost fifteen times as many citations as expected. In terms of raw citation counts, the most highly cited patent in Table 12 is a 2002 Purevision Technology patent (US #6,419,788) describing biomass treatment to produce cellulose. This patent has been cited as prior art by 93 subsequent patents, more than seven times as many as expected. In general, the patents in Table 12 are assigned to a variety of companies and describe a range of technologies related to bioenergy conversion, showing the breadth of influence of BETO-funded research on subsequent developments in this technology.

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

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

Family #	Priority Year	Rep. Patent #	# Linked Families	# Linked BEC Fams	Assignee	Title
22824550	1994	5821111	795	331	Bioengineering Resources (Ineos)	Bioconversion of waste biomass to useful products
24452252	1990	5173429	657	268	Univ Arkansas	Clostridiumm ljungdahlii, an anaerobic ethanol and acetate producing microorganism
26932265	1988	5028539	598	312	Univ Florida	Ethanol production using engineered mutant E.coli
26986798	1981	4568644	572	264	MIT	Fermentation method producing ethanol
36782581	2005	7910338	521	290	DuPont / All. Sust. Energy (NREL)	Integration of alternative feedstreams for biomass treatment and utilization
27100414	1988	5424202	504	252	Univ Florida	Ethanol production by recombinant hosts
25131901	1985	4678860	409	263	Arizona State Univ	Process of producing liquid hydrocarbon fuels from biomass
26735707	1997	5959167	375	295	Univ Utah	Process for conversion of lignin to reformulated hydrocarbon gasoline
32230084	2002	6953873	300	147	Wisconsin Alumni Res Found	Low-temperature hydrocarbon production from oxygenated hydrocarbons

The patent family at the head of Table 13 (representative patent US #4,651,017) is assigned to Bioengineering Resources (subsequently acquired by Ineos). This patent family describes the conversion of waste biomass into synthesis gas. It is linked via citations to 795 subsequent patent families, 331 of which are related to bioenergy conversion. The second patent family in Table 13 (representative patent US #5,173,429) is assigned to the University of Arkansas, and outlines a micro-organism that can be used to produce ethanol and acetate. It is linked via citations to 657 subsequent patent families, including 268 from within bioenergy conversion. The University of Florida has the third patent family in Table 13, which is linked to 598 subsequent patent families (312 within bioenergy conversion). This family (representative patent #5,028,539) describes production of ethanol from a variety of biomass sources.

Overall, the forward tracing element of the analysis shows that BETO-funded and Other DOE-funded bioenergy conversion research has had a strong influence on subsequent technologies. This influence can be seen most extensively within bioenergy conversion, but can also be traced in related technologies, notably chemical production.

5.0 Conclusions

This report describes the results of an analysis tracing links between bioenergy conversion research funded by DOE (BETO plus Other DOE) and subsequent developments both within and beyond bioenergy conversion 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

BETO-funded (and Other DOE-funded) research forms a foundation for innovations associated with the leading bioenergy conversion organizations. The purpose of the forward tracing is to examine the influence of BETO-funded (and Other DOE-funded) bioenergy conversion patents upon subsequent developments, both within and outside bioenergy conversion technology.

The backward tracing element of the analysis shows that the portfolios of BETO-funded and Other DOE-funded bioenergy conversion patents have had an important influence on subsequent innovations associated with the leading bioenergy conversion organizations. This influence can be seen both over time and across bioenergy conversion technologies. Meanwhile, the forward tracing element of the analysis shows that BETO-funded and Other DOE-funded bioenergy conversion research has had a strong influence on subsequent developments. This influence can be seen primarily within bioenergy conversion, but can also be traced in related technologies, notably chemical production.

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

Appendix A. BETO-funded Bioenergy Conversion Patents used in the Analysis

Patent #	Application Year	Issue / Publication Year	Original Assignees	Title
WO1991005039	1990	1991	MIDWEST RESEARCH INSTITUTE	THERMOSTABLE PURIFIED ENDOGLUCANASES FROM THERMOPHILIC BACTERIUM ACIDOTHERMUS CELLULOLYTICUS
WO1991009890	1990	1991	MIDWEST RESEARCH INSTITUTE	RESOLE RESINS FROM FRACTIONATED FAST-PYROLYSIS OILS
5091499	1989	1992	MIDWEST RESEARCH INSTITUTE	PROCESS FOR PREPARING PHENOLIC FORMALDEHYDE RESOLE RESIN PRODUCTS DERIVED FROM FRACTIONATED FAST-PYROLYSIS OILS
5100791	1991	1992	US DEPARTMENT OF ENERGY	SIMULTANEOUS SACCHARIFICATION AND FERMENTATION (SSF) USING CELLOBIOSE FERMENTING YEAST BRETTANOMYCES CUSTERSII
5110735	1989	1992	MIDWEST RESEARCH INSTITUTE	THERMOSTABLE PURIFIED ENDOGLUCANASE FROM THERMOPHILIC BACTERIUM ACIDOTHERMUS CELLULOLYTICUS
5125977	1991	1992	US DEPARTMENT OF ENERGY	TWO-STAGE DILUTE ACID PREHYDROLYSIS OF BIOMASS
EP0494207	1990	1992	MIDWEST RESEARCH INSTITUTE	THERMOSTABLE PURIFIED ENDOGLUCANASES FROM THERMOPHILIC BACTERIUM ACIDOTHERMUS CELLULOLYTICUS.
5235021	1991	1993	MIDWEST RESEARCH INSTITUTE	RESOLE RESIN PRODUCTS DERIVED FROM FRACTIONATED ORGANIC AND AQUEOUS CONDENSATES MADE BY FAST-PYROLYSIS OF BIOMASS MATERIALS
WO1993015186	1993	1993	MIDWEST RESEARCH INSTITUTE	THERMOSTABLE PURIFIED ENDOGLUCANASES FROM THERMOPHILIC BACTERIUM ACIDOTHERMUS CELLULOLYTICUS
5275944	1992	1994	MIDWEST RESEARCH INSTITUTE	THERMOSTABLE PURIFIED ENDOGLUCANAS FROM ACIDOTHERMUS CELLULOLYTICUS ATCC 43068
5366884	1993	1994	MIDWEST	THERMOSTABLE PURIFIED

			RESEARCH INSTITUTE	ENDOGLUCANASE II FROM ACIDOTHERMUS CELLULOLYTICUS ATCC
5372939	1993	1994	US DEPARTMENT OF ENERGY	COMBINED ENZYME MEDIATED FERMENTATION OF CELLULOUS AND XYLOSE TO ETHANOL BY SCHIZOSACCHAROYCES POMBE, CELLULASE, .BETA.-GLUCOSIDASE, AND XYLOSE ISOMERASE
EP0577823	1993	1994	MIDWEST RESEARCH INSTITUTE	THERMOSTABLE PURIFIED ENDOGLUCANASES FROM THERMOPHILIC BACTERIUM ACIDOTHERMUS CELLULOLYTICUS.
WO1994010107	1993	1994	MIDWEST RESEARCH INSTITUTE	PROCESS TO CONVERT BIOMASS AND REFUSE DERIVED FUEL TO ETHERS AND/OR ALCOHOLS
5413227	1992	1995	MIDWEST RESEARCH INSTITUTE	IMPROVED VORTEX REACTOR SYSTEM
5432075	1994	1995	MIDWEST RESEARCH INSTITUTE	LOW MOLECULAR WEIGHT THERMOSTABLE .BETA.-D-GLUCOSIDASE FROM ACIDOTHERMUS CELLULOLYTICUS
5504259	1992	1996	MIDWEST RESEARCH INSTITUTE	PROCESS TO CONVERT BIOMASS AND REFUSE DERIVED FUEL TO ETHERS AND/OR ALCOHOLS
5514583	1994	1996	MIDWEST RESEARCH INSTITUTE	RECOMBINANT ZYMOMONAS FOR PENTOSE FERMENTATION
5514584	1994	1996	MIDWEST RESEARCH INSTITUTE	CLONING OF CELLULASE GENES FROM ACIDOTHERMUS CELLULOLYTICUS
5536655	1994	1996	MIDWEST RESEARCH INSTITUTE	GENE CODING FOR THE E1 ENDOGLUCANASE
WO1996002551	1995	1996	MIDWEST RESEARCH INSTITUTE	GENE CODING FOR THE E1 ENDOGLUCANASE
WO1996002628	1995	1996	MIDWEST RESEARCH INSTITUTE	LOW MOLECULAR WEIGHT THERMOSTABLE BETA -D-GLUCOSIDASE FROM ACIDOTHERMUS CELLULOLYTICUS
EP0766732	1995	1997	MIDWEST RESEARCH INSTITUTE	LOW MOLECULAR WEIGHT THERMOSTABLE -G(B)-D-GLUCOSIDASE FROM ACIDOTHERMUS CELLULOLYTICUS
EP0771321	1995	1997	MIDWEST	GENE CODING FOR THE E1

			RESEARCH INSTITUTE	ENDOGLUCANASE
5712133	1995	1998	MIDWEST RESEARCH INSTITUTE	PENTOSE FERMENTATION BY RECOMBINANT ZYMOMONAS
5712142	1996	1998	MIDWEST RESEARCH INSTITUTE	METHOD FOR INCREASING THERMOSTABILITY IN CELLULASE ENNZYMES
5726053	1995	1998	MIDWEST RESEARCH INSTITUTE	RECOMBINANT ZYMOMONAS FOR PENTOSE FERMENTATION
5733758	1997	1998	UNASSIGNED	TOWER REACTORS FOR BIOCONVERSION OF LIGNOCELLULOSIC MATERIAL
5843760	1997	1998	MIDWEST RESEARCH INSTITUTE	SINGLE ZYMOMONAS MOBILIS STRAIN FOR XYLOSE AND ARABINOSE FERMENTATION
EP0885955	1990	1998	MIDWEST RESEARCH INSTITUTE	THERMOSTABLE PURIFIED ENDOGLUCANASES FROM THERMOPHILIC BACTERIUM ACIDOTHERMUS CELLULOLYTICUS
WO1998016651	1997	1998	WISCONSIN ALUMNI RESEARCH FOUNDATION	TRANSGENIC PLANTS AS AN ALTERNATIVE SOURCE OF LIGNOCELLULOSIC-DEGRADING ENZYMES
WO1998045451	1998	1998	UNIVERSITY OF FLORIDA	RECOMBINANT MICROORGANISMS CAPABLE OF FERMENTING CELLOBIOSE
WO1998050524	1998	1998	MIDWEST RESEARCH INSTITUTE	SINGLE ZYMOMONAS MOBILIS STRAIN FOR XYLOSE AND ARABINOSE FERMENTATION
5888806	1997	1999	UNASSIGNED	TOWER REACTORS FOR BIOCONVERSION OF LIGNOCELLULOSIC MATERIAL
5981835	1997	1999	WISCONSIN ALUMNI RESEARCH FOUNDATION	TRANSGENIC PLANTS AS AN ALTERNATIVE SOURCE OF LIGNOCELLULOSIC-DEGRADING ENZYMES
EP0932692	1997	1999	WISCONSIN ALUMNI RESEARCH FOUNDATION	TRANSGENIC PLANTS AS AN ALTERNATIVE SOURCE OF LIGNOCELLULOSIC-DEGRADING ENZYMES
6102690	1997	2000	UNIVERSITY OF FLORIDA	RECOMBINANT ORGANISMS CAPABLE OF FERMENTING CELLOBIOSE
EP0973915	1998	2000	UNIVERSITY OF FLORIDA	RECOMBINANT MICROORGANISMS CAPABLE OF FERMENTING CELLOBIOSE
EP1005530	1998	2000	MIDWEST RESEARCH INSTITUTE	SINGLE $I(ZYMOMONAS MOBILIS) STRAIN FOR XYLOSE AND ARABINOSE

				FERMENTATION
WO2000061276	2000	2000	MIDWEST RESEARCH INSTITUTE	AQUEOUS FRACTIONATION OF BIOMASS BASED ON NOVEL CARBOHYDRATE HYDROLYSIS KINETICS
WO2000071729	2000	2000	UNIVERSITY OF FLORIDA	RECOMBINANT HOSTS SUITABLE FOR SIMULTANEOUS SACCHARIFICATION AND FERMENTATION
6228177	1999	2001	MIDWEST RESEARCH INSTITUTE	AQUEOUS FRACTIONATION OF BIOMASS BASED ON NOVEL CARBOHYDRATE HYDROLYSIS KINETICS
WO2001077296	2001	2001	MIDWEST RESEARCH INSTITUTE	METHOD FOR THE SELECTIVE REMOVAL OF FERMENTATION INHIBITORS FROM BIOMASS HYDROLYZATE
6423145	2000	2002	MIDWEST RESEARCH INSTITUTE	DILUTE ACID/METAL SALT HYDROLYSIS OF LIGNOCELLULOSICS
6498029	2001	2002	MIDWEST RESEARCH INSTITUTE	PENTOSE FERMENTATION OF NORMALLY TOXIC LIGNOCELLULOSE PREHYDROLYSATE WITH STRAIN OF PICHIA STIPITIS YEAST USING AIR
EP1177037	2000	2002	MIDWEST RESEARCH INSTITUTE	AQUEOUS FRACTIONATION OF BIOMASS BASED ON NOVEL CARBOHYDRATE HYDROLYSIS KINETICS
EP1185672	2000	2002	UNIVERSITY OF FLORIDA	RECOMBINANT HOSTS SUITABLE FOR SIMULTANEOUS SACCHARIFICATION AND FERMENTATION
WO2002000858	2001	2002	UNIVERSITY OF FLORIDA	METHODS AND COMPOSITIONS FOR SIMULTANEOUS SACCHARIFICATION AND FERMENTATION
WO2002012529	2001	2002	MIDWEST RESEARCH INSTITUTE	DILUTE ACID/METAL SALT HYDROLYSIS OF LIGNOCELLULOSICS
WO2002018610	2001	2002	MIDWEST RESEARCH INSTITUTE	ETHANOL PRODUCTION WITH DILUTE ACID HYDROLYSIS USING PARTIALLY DRIED LIGNOCELLULOSICS
WO2002038740	2000	2002	MIDWEST RESEARCH INSTITUTE	RECOMBINANT ZYMOMONAS MOBILIS WITH IMPROVED XYLOSE UTILIZATION
6566107	2000	2003	MIDWEST RESEARCH INSTITUTE	RECOMBINANT ZYMOMONAS MOBILIS WITH IMPROVED XYLOSE UTILIZATION
6660506	2003	2003	MIDWEST	ETHANOL PRODUCTION WITH

			RESEARCH INSTITUTE	DILUTE ACID HYDROLYSIS USING PARTIALLY DRIED LIGNOCELLULOSICS
EP1272613	2001	2003	MIDWEST RESEARCH INSTITUTE	METHOD FOR THE SELECTIVE REMOVAL OF FERMENTATION INHIBITORS FROM BIOMASS HYDROLYZATE
EP1299552	2001	2003	UNIVERSITY OF FLORIDA	METHODS AND COMPOSITIONS FOR SIMULTANEOUS SACCHARIFICATION AND FERMENTATION
EP1307575	2001	2003	MIDWEST RESEARCH INSTITUTE	ETHANOL PRODUCTION WITH DILUTE ACID HYDROLYSIS USING PARTIALLY DRIED LIGNOCELLULOSICS
EP1307576	2001	2003	MIDWEST RESEARCH INSTITUTE	DILUTE ACID/METAL SALT HYDROLYSIS OF LIGNOCELLULOSICS
EP1330513	2000	2003	MIDWEST RESEARCH INSTITUTE	RECOMBINANT ZYMOMONAS MOBILIS WITH IMPROVED XYLOSE UTILIZATION
WO2003025117	2002	2003	UNIVERSITY OF FLORIDA	CLONING AND SEQUENCING OF PYRUVATE DECARBOXYLASE (PDC) GENES FROM BACTERIA AND USES THEREFOR
WO2003027306	2002	2003	GENENCOR INTERNATIONAL INC	BGL3 BETA-GLUCOSIDASE AND NUCLEIC ACIDS ENCODING THE SAME
WO2003052054	2002	2003	GENENCOR INTERNATIONAL INC	BGL5 BETA-GLUCOSIDASE AND NUCLEIC ACIDS ENCODING THE SAME
WO2003052055	2002	2003	GENENCOR INTERNATIONAL INC	EGVII ENDOGLUCANASE AND NUCLEIC ACIDS ENCODING THE SAME
WO2003052056	2002	2003	GENENCOR INTERNATIONAL INC	EGVIII ENDOGLUCANASE AND NUCLEIC ACIDS ENCODING THE SAME
WO2003052057	2002	2003	GENENCOR INTERNATIONAL INC	EGVIII ENDOGLUCANASE AND NUCLEIC ACIDS ENCODING THE SAME
WO2003052118	2002	2003	GENENCOR INTERNATIONAL INC	BGL4 BETA-GLUCOSIDASE AND NUCLEIC ACIDS ENCODING THE SAME
6737258	2002	2004	MIDWEST RESEARCH INSTITUTE	PROCESS FOR THE CONVERSION OF AND AQUEOUS BIOMASS HYDROLYZATE INTO FUELS OR CHEMICALS BY THE SELECTIVE REMOVAL OF FERMENTATION INHIBITORS
6818803	1999	2004	WISCONSIN ALUMNI RESEARCH	TRANSGENIC PLANTS AS AN ALTERNATIVE SOURCE OF LIGNOCELLULOSIC-

			FOUNDATION	DEGRADING ENZYMES
EP1436309	2002	2004	GENENCOR INTERNATIONAL INC	BGL3 BETA-GLUCOSIDASE AND NUCLEIC ACIDS ENCODING THE SAME
EP1453850	2002	2004	GENENCOR INTERNATIONAL INC	EGVIII ENDOGLUCANASE AND NUCLEIC ACIDS ENCODING THE SAME
EP1453967	2002	2004	GENENCOR INTERNATIONAL INC	BGL5 BETA-GLUCOSIDASE AND NUCLEIC ACIDS ENCODING THE SAME
EP1453968	2002	2004	GENENCOR INTERNATIONAL INC	BGL4 BETA-GLUCOSIDASE AND NUCLEIC ACIDS ENCODING THE SAME
EP1472359	2002	2004	GENENCOR INTERNATIONAL INC	EGVII ENDOGLUCANASE AND NUCLEIC ACIDS ENCODING THE SAME
EP1490497	2002	2004	GENENCOR INTERNATIONAL INC	EGVI ENDOGLUCANASE AND NUCLEIC ACIDS ENCODING THE SAME
WO2004016760	2003	2004	GENENCOR INTERNATIONAL INC	NOVEL VARIANT HYPROCREA JECORINA CBH1 CELLULASES
WO2004035070	2003	2004	GENENCOR INTERNATIONAL INC	INDUCTION OF GENE EXPRESSION USING A HIGH CONCENTRATION SUGAR MIXTURE
WO2004037973	2003	2004	MIDWEST RESEARCH INSTITUTE	ZYMOMONAS PENTOSE-SUGAR FERMENTATING STRAINS AND USES THEREOF
WO2004043980	2003	2004	GENENCOR INTERNATIONAL INC	BGL6 BETA-GLUCOSIDASE AND NUCLEIC ACIDS ENCODING THE SAME
WO2004048592	2003	2004	GENENCOR INTERNATIONAL INC	BGL7 BETA-GLUCOSIDASE AND NUCLEIC ACIDS ENCODING THE SAME
WO2004067760	2003	2004	WISCONSIN ALUMNI RESEARCH FOUNDATION	XYLOSE-FERMENTING RECOMBINANT YEAST STRAINS
WO2004078919	2003	2004	MIDWEST RESEARCH INSTITUTE	SUPERACTIVE CELLULASE FORMULATION USING CELLOBIOHYDROLASE-1 FROM PENICILLIUM FUNICULOSUM
WO2004099228	2004	2004	NOVOZYMES INC	VARIANTS OF BETA-GLUCOSIDASES
WO2004099381	2004	2004	CARGILL INC	GENETICALLY MODIFIED YEAST SPECIES AND FERMENTATION PROCESSES USING GENETICALLY MODIFIED YEAST
WO2004111228	2004	2004	NOVOZYMES INC	METHODS FOR PRODUCING SECRETED POLYPEPTIDES
EP1527164	2002	2005	UNIVERSITY OF FLORIDA	CLONING AND SEQUENCING OF PYRUVATE DECARBOXYLASE (PDC)

				GENES FROM BACTERIA AND USES THEREFOR
EP1545217	2003	2005	GENENCOR INTERNATIONAL INC	INDUCTION OF GENE EXPRESSION USING A HIGH CONCENTRATION SUGAR MIXTURE
EP1549736	2003	2005	MIDWEST RESEARCH INSTITUTE	ZYMOMONAS PENTOSE-SUGAR FERMENTATING STRAINS AND USES THEREOF
EP1556512	2003	2005	GENENCOR INTERNATIONAL INC	BGL6 BETA-GLUCOSIDASE AND NUCLEIC ACIDS ENCODING THE SAME
EP1567543	2003	2005	GENENCOR INTERNATIONAL INC	BGL7 BETA-GLUCOSIDASE AND NUCLEIC ACIDS ENCODING THE SAME
EP1578943	2003	2005	GENENCOR INTERNATIONAL INC	NOVEL VARIANT HYPOCREA JECORINA CBH1 CELLULASES
EP1585808	2003	2005	WISCONSIN ALUMNI RESEARCH FOUNDATION	XYLOSE-FERMENTING RECOMBINANT YEAST STRAINS
EP1606392	2004	2005	GENENCOR INTERNATIONAL INC	NOVEL CBH1 HOMOLOGS AND VARIANT CBH1 CELLULASES
WO2005001036	2004	2005	GENENCOR INTERNATIONAL INC	NOVEL TRICHODERMA GENES
WO2005001065	2004	2005	GENENCOR INTERNATIONAL INC	VARIANT HUMICOLA GRISEA CBH1.1
WO2005024037	2004	2005	DARTMOUTH COLLEGE	LIGNIN BLOCKERS AND USES THEREOF
WO2005028636	2004	2005	GENENCOR INTERNATIONAL INC	NOVEL CBH1 HOMOLOGS AND VARIANT CBH1 CELLULASES
WO2005030926	2004	2005	NOVOZYMES INC	VARIANTS OF GLYCOSIDE HYDROLASES
WO2005047499	2004	2005	NOVOZYMES INC	POLYPEPTIDES HAVING BETA-GLUCOSIDASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
WO2005067531	2005	2005	NOVOZYMES INC	METHODS FOR DEGRADING LIGNOCELLULOSIC MATERIALS
WO2005074647	2005	2005	NOVOZYMES INC	POLYPEPTIDES HAVING CELLULOLYTIC ENHANCING ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
WO2005074656	2005	2005	NOVOZYMES INC	POLYPEPTIDES HAVING CELLULOLYTIC ENHANCING ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME

WO2005093073	2005	2005	GENENCOR INTERNATIONAL INC	EXO-ENDO CELLULASE FUSION PROTEIN
WO2005100582	2005	2005	NOVOZYMES INC	METHODS FOR DEGRADING OR CONVERTING PLANT CELL WALL POLYSACCHARIDES
6982159	2001	2006	GENENCOR INTERNATIONAL INC	TRICHODERMA .BETA.-GLUCOSIDASE
7005289	2001	2006	GENENCOR INTERNATIONAL INC	BGL5 .BETA.-GLUCOSIDASE AND NUCLEIC ACIDS ENCODING THE SAME
7026152	2001	2006	UNIVERSITY OF FLORIDA	METHODS AND COMPOSITIONS FOR SIMULTANEOUS SACCHARIFICATION AND FERMENTATION
7045331	2001	2006	GENENCOR INTERNATIONAL INC	EGVII ENDOGLUCANASE AND NUCLEIC ACIDS ENCODING THE SAME
7045332	2001	2006	GENENCOR INTERNATIONAL INC	BGL4 .BETA.-GLUCOSIDASE AND NUCLEIC ACIDS ENCODING THE SAME
7049125	2001	2006	GENENCOR INTERNATIONAL INC	EGVIII ENDOGLUCANASE AND NUCLEIC ACIDS ENCODING THE SAME
7056721	2001	2006	GENENCOR INTERNATIONAL INC	EGVI ENDOGLUCANASE AND NUCLEIC ACIDS ENCODING THE SAME
7059993	2001	2006	MIDWEST RESEARCH INSTITUTE	THERMAL TOLERANT CELLULASE FROM ACIDOTHERMUS CELLULOLYTICUS
EP1622921	2004	2006	NOVOZYMES INC	VARIANTS OF BETA-GLUCOSIDASES
EP1625219	2004	2006	NOVOZYMES INC	METHODS FOR PRODUCING SECRETED POLYPEPTIDES
EP1626979	2004	2006	NATUREWORKS LLC	GENETICALLY MODIFIED YEAST SPECIES AND FERMENTATION PROCESSES USING GENETICALLY MODIFIED YEAST
EP1627049	2004	2006	GENENCOR INTERNATIONAL INC	NOVEL TRICHODERMA GENES
EP1627050	2004	2006	GENENCOR INTERNATIONAL INC	VARIANT HUMICOLA GRISEA CBH1.1
EP1660637	2004	2006	NOVOZYMES INC	VARIANTS OF GLYCOSIDE HYDROLASES
EP1682656	2004	2006	NOVOZYMES INC	POLYPEPTIDES HAVING BETA-GLUCOSIDASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
EP1709163	2005	2006	NOVOZYMES INC	METHODS FOR DEGRADING

				LIGNOCELLULOSIC MATERIALS
EP1713825	2005	2006	NOVOZYMES INC	POLYPEPTIDES HAVING CELLULOLYTIC ENHANCING ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
EP1733033	2005	2006	NOVOZYMES INC	POLYPEPTIDES HAVING CELLULOLYTIC ENHANCING ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
EP1735454	2005	2006	NOVOZYMES INC	METHODS FOR DEGRADING OR CONVERTING PLANT CELL WALL POLYSACCHARIDES
WO2006074005	2005	2006	GENENCOR INTERNATIONAL INC	NOVEL VARIANT HYPOCREA JECORINA CBH2 CELLULASES
WO2006074435	2006	2006	NOVOZYMES INC	POLYPEPTIDES HAVING CELLOBIOHYDRLASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
WO2006116682	2006	2006	NOVOZYMES INC	POLYPEPTIDES HAVING ENDOGLUCANASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
7220565	2006	2007	NOVOZYMES INC	POLYPEPTIDES HAVING CELLOBIOHYDROLASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
7223575	2002	2007	MIDWEST RESEARCH INSTITUTE	ZYMOMONAS PENTOSE-SUGAR FERMENTING STRAINS AND USES THEREOF
7226735	2003	2007	WISCONSIN ALUMNI RESEARCH FOUNDATION, US DEPT OF ENERGY	XYLOSE-FERMENTING RECOMBINANT YEAST STRAINS
7226776	2003	2007	UNIVERSITY OF FLORIDA	RECOMBINANT HOSTS SUITABLE FOR SIMULTANEOUS SACCHARIFICATION AND FERMENTATION
7244605	2004	2007	NOVOZYMES INC	POLYPEPTIDES HAVING BETA-GLUCOSIDASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
7271244	2005	2007	NOVOZYMES INC	POLYPEPTIDES HAVING CELLULOLYTIC ENHANCING ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
7273742	2005	2007	GENENCOR	BGL3 BETA-GLUCOSIDASE

			INTERNATIONAL INC	AND NUCLEIC ACIDS ENCODING THE SAME
EP1740700	2005	2007	GENENCOR INTERNATIONAL INC	EXO-ENDO CELLULASE FUSION PROTEIN
EP1836299	2006	2007	NOVOZYMES INC	POLYPEPTIDES HAVING CELLOBIOHYDROLASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
EP1838849	2005	2007	GENENCOR INTERNATIONAL INC	VARIANT HYPOCREA JECORINA CBH2 CELLULASES
EP1862539	2004	2007	GENENCOR INTERNATIONAL INC	NOVEL TRICHODERMA GENES
EP1862540	2004	2007	GENENCOR INTERNATIONAL INC	NOVEL TRICHODERMA GENES
EP1862626	2004	2007	GENENCOR INTERNATIONAL INC	NOVEL TRICHODERMA GENES
WO2007002844	2006	2007	COMMUNITY POWER CORP	METHOD AND APPARATUS FOR AUTOMATED, MODULAR, BIOMASS POWER GENERATION
WO2007002847	2006	2007	COMMUNITY POWER CORP	METHOD AND APPARATUS FOR A SELF-CLEANING FILTER
WO2007005646	2006	2007	UNIVERSITY OF FLORIDA	RECOMBINANT HOST CELLS AND MEDIA FOR ETHANOL PRODUCTION
WO2007089290	2006	2007	NOVOZYMES INC	METHODS FOR ENHANCING THE DEGRADATION OR CONVERSION OF CELLULOSIC MATERIAL
WO2007089677	2007	2007	UNIVERSITY OF MASSACHUSETTS	SYSTEMS AND METHODS FOR PRODUCING BIOFUELS AND RELATED MATERIALS
WO2007094852	2006	2007	VERENIUM CORP	CELLULOLYTIC ENZYMES, NUCLEIC ACIDS ENCODING THEM AND METHODS FOR MAKING AND USING THEM
WO2007143245	2007	2007	MIDWEST RESEARCH INSTITUTE	AN L-ARABINOSE FERMENTING YEAST
7320886	2005	2008	GENENCOR INTERNATIONAL INC	BGL4 BETA-GLUCOSIDASE AND NUCLEIC ACIDS ENCODING THE SAME
7326551	2002	2008	UNIVERSITY OF FLORIDA	CLONING AND SEQUENCING OF PYRUVATE DECARBOXYLASE (PDC) GENES FROM BACTERIA AND USES THEREFOR
7344871	2005	2008	GENENCOR INTERNATIONAL	BGL5 .BETA.-GLUCOSIDASE AND NUCLEIC ACIDS

			INC	ENCODING THE SAME
7351568	2006	2008	GENENCOR INTERNATIONAL INC	EGVI ENDOGLUCANASE AND NUCLEIC ACIDS ENCODING THE SAME
7351573	2005	2008	GENENCOR INTERNATIONAL INC	BGL3 BETA-GLUCOSIDASE AND NUCLEIC ACIDS ENCODING THE SAME
7354743	2005	2008	NOVOZYMES INC	METHODS FOR DEGRADING LIGNOCELLULOSIC MATERIALS
7354755	2000	2008	MIDWEST RESEARCH INSTITUTE	STABLE ZYMOMONAS MOBILIS XYLOSE AND ARABINOSE FERMENTING STRAINS
7361495	2005	2008	NOVOZYMES INC	POLYPEPTIDE FROM A CELLULOLYTIC FUNGUS HAVING CELLULOLYTIC ENHANCING ACTIVITY
7364890	2001	2008	MIDWEST RESEARCH INSTITUTE	THERMAL TOLERANT AVICELASE FROM ACIDOTHERMUS CELLULOLYTICUS
7375197	2002	2008	MIDWEST RESEARCH INSTITUTE	CELLOBIOHYDROLASE I GENE AND IMPROVED VARIANTS
7393664	2004	2008	NOVOZYMES INC	METHODS FOR PRODUCING SECRETED POLYPEPTIDES
7393673	2001	2008	MIDWEST RESEARCH INSTITUTE	THERMAL TOLERANT EXOGLUCANASE FROM ACIDOTHERMUS CELLULOLYTICUS
7407788	2002	2008	DANISCO US INC	BGL7 BETA-GLUCOSIDASE AND NUCLEIC ACIDS ENCODING THE SAME
7413882	2005	2008	NOVOZYMES INC	METHODS FOR DEGRADING OR CONVERTING PLANT CELL WALL POLYSACCHARIDES
7413888	2004	2008	NOVOZYMES INC	VARIANTS OF BETA-GLUCOSIDASES
7449319	2006	2008	DANISCO US INC	EGVII ENDOGLUCANASE AND NUCLEIC ACIDS ENCODING THE SAME
7449550	2003	2008	ALLIANCE FOR SUSTAINABLE ENERGY LLC	SUPERACTIVE CELLULASE FORMULATION USING CELLOBIOHYDROLASE-1 FROM PENICILLIUM FUNICULOSUM
7452707	2004	2008	DANISCO US INC	CBH1 HOMOLOGS AND VARIANT CBH1 CELLULASES
7459299	2004	2008	DANISCO US INC	VARIANT HUMICOLA GRISEA CBH1.1
EP1877551	2006	2008	NOVOZYMES INC	POLYPEPTIDES HAVING ENDOGLUCANASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
EP1896368	2006	2008	COMMUNITY	METHOD AND APPARATUS

			POWER CORP	FOR AUTOMATED, MODULAR, BIOMASS POWER GENERATION
EP1984514	2007	2008	UNIVERSITY OF MASSACHUSETTS	SYSTEMS AND METHODS FOR PRODUCING BIOFUELS AND RELATED MATERIALS
EP1989301	2006	2008	VERENIUM CORP	CELLULOLYTIC ENZYMES, NUCLEIC ACIDS ENCODING THEM AND METHODS FOR MAKING AND USING THEM
WO2008018930	2007	2008	UNIVERSITY OF FLORIDA	ETHANOL PRODUCTION IN NON-RECOMBINANT HOSTS
WO2008021141	2007	2008	UNIVERSITY OF FLORIDA	RE-ENGINEERING BACTERIA FOR ETHANOL PRODUCTION
WO2008027472	2007	2008	DANISCO US INC	COMPOSITIONS AND METHODS FOR IMPROVED PROTEIN PRODUCTION
WO2008051348	2007	2008	E I DU PONT DE NEMOURS & CO; MIDWEST RESEARCH INST	ETHANOL PRODUCTION USING XYLITOL SYNTHESIS MUTANT OF XYLOSE-UTILIZING ZYMOMONAS
WO2008051349	2007	2008	E I DU PONT DE NEMOURS & CO; MIDWEST RESEARCH INST	IMPROVED ETHANOL PRODUCTION IN FERMENTATION OF MIXED SUGARS CONTAINING XYLOSE
WO2008057637	2007	2008	NOVOZYMES INC	METHODS OF INCREASING SECRETION OF POLYPEPTIDES HAVING BIOLOGICAL ACTIVITY
WO2008066950	2007	2008	UNIVERSITY OF GEORGIA	MISCIBLE, MULTI-COMPONENT, DIESEL FUELS AND METHODS OF BIO-OIL TRANSFORMATION
WO2008085356	2007	2008	DANISCO US INC	CONDITIONING BIOMASS FOR MICROBIAL GROWTH
WO2008105798	2007	2008	UNIVERSITY OF NORTH DAKOTA	METHOD FOR COLD STABLE BIOJET FUEL
WO2008133638	2007	2008	E I DU PONT DE NEMOURS & CO; MIDWEST RESEARCH INST	XYLITOL SYNTHESIS MUTANT OF XYLOSE-UTILIZING ZYMOMONAS FOR ETHANOL PRODUCTION
WO2008148131	2008	2008	NOVOZYMES INC	POLYPEPTIDES HAVING CELLULOLYTIC ENHANCING ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
WO2008151269	2008	2008	BATTELLE MEMORIAL INSTITUTE	PALLADIUM CATALYZED HYDROGENATION OF BIO-OILS AND ORGANIC COMPOUNDS
7527959	2006	2009	DANISCO US INC	EGVII ENDOGLUCANASE AND NUCLEIC ACIDS ENCODING THE SAME
7534594	2007	2009	NOVOZYMES INC	POLYPEPTIDES HAVING CELLULOLYTIC ENHANCING

				ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
7538200	2002	2009	ALLIANCE FOR SUSTAINABLE ENERGY LLC	THERMAL TOLERANT AVICELASE FROM ACIDOTHERMUS CELLULOLYTICUS
7582462	2003	2009	DANISCO US INC	BGL6 BETA-GLUCOSIDASE AND NUCLEIC ACIDS ENCODING THE SAME
7604967	2003	2009	DARTMOUTH COLLEGE	LIGNIN-BLOCKING TREATMENT OF BIOMASS AND USES THEREOF
7608689	2006	2009	NOVOZYMES INC	METHODS FOR ENHANCING THE DEGRADATION OR CONVERSION OF CELLULOSIC MATERIAL
7629156	2007	2009	E I DU PONT DE NEMOURS & CO, ALLIANCE FOR SUSTAINABLE ENERGY LLC	ETHANOL PRODUCTION IN FERMENTATION OF MIXED SUGARS CONTAINING XYLOSE
7638616	2008	2009	NOVOZYMES INC	VARIANTS OF BETA-GLUCOSIDASE
EP2034024	2005	2009	GENENCOR INTERNATIONAL INC	EXO-ENDO CELLULASE FUSION PROTEIN
EP2035532	2007	2009	UNIVERSITY OF NORTH DAKOTA	METHOD FOR COLD STABLE BIOJET FUEL
EP2041293	2007	2009	UNIVERSITY OF FLORIDA	ETHANOL PRODUCTION IN NON-RECOMBINANT HOSTS
EP2046819	2007	2009	NOVOZYMES INC	METHODS OF INCREASING SECRETION OF POLYPEPTIDES HAVING BIOLOGICAL ACTIVITY
EP2054503	2007	2009	UNIVERSITY OF FLORIDA	RE-ENGINEERING BACTERIA FOR ETHANOL PRODUCTION
EP2066779	2007	2009	E I DU PONT DE NEMOURS & CO; MIDWEST RESEARCH INST	IMPROVED ETHANOL PRODUCTION IN FERMENTATION OF MIXED SUGARS CONTAINING XYLOSE IN THE PRESENCE OF SUGAR ALCOHOLS
EP2066784	2007	2009	E I DU PONT DE NEMOURS & CO; MIDWEST RESEARCH INST	XYLITOL SYNTHESIS MUTANT OF XYLOSE-UTILIZING ZYMOMONAS FOR ETHANOL PRODUCTION
EP2066797	2007	2009	E I DU PONT DE NEMOURS & CO; MIDWEST RESEARCH INST	ETHANOL PRODUCTION USING XYLITOL SYNTHESIS MUTANT OF XYLOSE-UTILIZING ZYMOMONAS
EP2069489	2008	2009	NOVOZYMES INC	POLYPEPTIDES HAVING CELLULOLYTIC ENHANCING ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME

EP2082047	2007	2009	DANISCO US INC	COMPOSITIONS AND METHODS FOR IMPROVED PROTEIN PRODUCTION
EP2099899	2007	2009	DANISCO US INC	CONDITIONING BIOMASS FOR MICROBIAL GROWTH
WO2009042846	2008	2009	NOVOZYMES INC	POLYPEPTIDES HAVING ACETYLXYLAN ESTERASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
WO2009055454	2008	2009	UNIVERSITY OF FLORIDA	XYLAN-UTILIZATION REGULON FOR EFFICIENT BIOPROCESSING OF HEMICELLULOSE AND USES THEREOF
WO2009058927	2008	2009	E I DU PONT DE NEMOURS & CO	ZYMOMONAS WITH IMPROVED ETHANOL PRODUCTION IN MEDIUM CONTAINING CONCENTRATED SUGARS AND ACETATE
WO2009058938	2008	2009	E I DU PONT DE NEMOURS & CO	ZYMOMONAS WITH IMPROVED ETHANOL PRODUCTION IN MEDIUM CONTAINING CONCENTRATED SUGARS AND ACETATE
WO2009079210	2008	2009	NOVOZYMES INC	POLYPEPTIDES HAVING XYLANASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
WO2009099684	2009	2009	BATTELLE MEMORIAL INSTITUTE	METHODS AND APPARATUS FOR CATALYTIC HYDROTHERMAL GASIFICATION OF BIOMASS
WO2009105141	2008	2009	NOVOZYMES INC	POLYPEPTIDES HAVING ENDOGLUCANASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
WO2009108747	2009	2009	WAYNE STATE UNIVERSITY	THE EFFECT OF NATURAL AND SYNTHETIC ANTIOXIDANTS ON THE OXIDATIVE STABILITY OF BIODIESEL
WO2009120731	2009	2009	E I DU PONT DE NEMOURS & CO, ALLIANCE FOR SUSTAINABLE ENERGY LLC	ZYMOMONAS WITH IMPROVED XYLOSE UTILIZATION
WO2009126508	2009	2009	UOP LLC	FUEL AND FUEL BLENDING COMPONENTS FROM BIOMASS DERIVED PYROLYSIS OIL
WO2009129256	2009	2009	BATTELLE MEMORIAL INSTITUTE	PROCESSES AND SYSTEMS FOR PRODUCING PRODUCTS OF HYDROGENOLYSIS OF

				POLYHYDRIC ALCOHOLS
WO2009143159	2009	2009	WAYNE STATE UNIVERSITY	METHODS AND CATALYSTS FOR MAKING BIODIESEL FROM THE TRANSESTERIFICATION AND ESTERIFICATION OF UNREFINED OILS
WO2009149202	2009	2009	DANISCO US INC	COMPOSITIONS AND METHODS COMPRISING CELLULASE VARIANTS WITH REDUCED AFFINITY TO NON-CELLULOSIC MATERIALS
7425657	2006	2010	BATTELLE MEMORIAL INSTITUTE	PALLADIUM CATALYZED HYDROGENATION OF BIO-OILS AND ORGANIC COMPOUNDS
7666648	2004	2010	DANISCO US INC	ISOLATED POLYPEPTIDE HAVING ARABINOFURANOSIDASE ACTIVITY
7670819	2007	2010	NOVOZYMES INC	POLYNUCLEOTIDES ENCODING POLYPEPTIDES HAVING BETA-GLUCOSIDASE ACTIVITY
7682811	2007	2010	UNIVERSITY OF MASSACHUSETTS	SYSTEMS AND METHODS FOR PRODUCING BIOFUELS AND RELATED MATERIALS
7713725	2003	2010	DANISCO US INC	INDUCTION OF GENE EXPRESSION USING A HIGH CONCENTRATION SUGAR MIXTURE
7727754	2007	2010	DANISCO US INC	.BETA.-GLUCOSIDASE 5 (BGL5) COMPOSITIONS
7741074	2008	2010	NOVOZYMES INC	POLYPEPTIDES HAVING ENDOGLUCANASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
7741084	2007	2010	E I DU PONT DE NEMOURS & CO, ALLIANCE FOR SUSTAINABLE ENERGY LLC	ETHANOL PRODUCTION USING XYLITOL SYNTHESIS MUTANT OF XYLOSE-UTILIZING ZYMOMONAS
7741119	2007	2010	E I DU PONT DE NEMOURS & CO, ALLIANCE FOR SUSTAINABLE ENERGY LLC	XYLITOL SYNTHESIS MUTANT OF XYLOSE-UTILIZING ZYMOMONAS FOR ETHANOL PRODUCTION
7741466	2008	2010	NOVOZYMES INC	POLYPEPTIDES HAVING CELLULOLYTIC ENHANCING ACTIVITY AND NUCLEIC ACIDS ENCODING SAME
7803623	2008	2010	E I DU PONT DE NEMOURS & CO, ALLIANCE FOR SUSTAINABLE ENERGY LLC	ZYMOMONAS WITH IMPROVED ETHANOL PRODUCTION IN MEDIUM CONTAINING CONCENTRATED SUGARS

				AND ACETATE
7807434	2006	2010	DANISCO US INC	EGVI ENDOGLUCANASE AND NUCLEIC ACIDS ENCODING THE SAME
7811799	2006	2010	DANISCO US INC	EGVI ENDOGLUCANASE AND NUCLEIC ACIDS ENCODING THE SAME
7819930	2007	2010	UNIVERSITY OF GEORGIA	MISCIBLE, MULTI-COMPONENT, DIESEL FUELS AND METHODS OF BIO-OIL TRANSFORMATION
7824884	2006	2010	NOVOZYMES INC	POLYPEPTIDES HAVING ENDOGLUCANASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
7833320	2006	2010	COMMUNITY POWER CORP	METHOD AND APPARATUS FOR A SELF-CLEANING FILTER
7846712	2007	2010	ALLIANCE FOR SUSTAINABLE ENERGY LLC	L-ARABINOSE FERMENTING YEAST
7851193	2008	2010	NOVOZYMES INC	POLYPEPTIDES HAVING XYLANASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
EP2167612	2008	2010	BATTELLE MEMORIAL INSTITUTE	PALLADIUM CATALYZED HYDROGENATION OF BIO-OILS AND ORGANIC COMPOUNDS
EP2195421	2008	2010	NOVOZYMES INC	POLYPEPTIDES HAVING ACETYLXYLAN ESTERASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
EP2205753	2008	2010	E I DU PONT DE NEMOURS & CO, ALLIANCE FOR SUSTAINABLE ENERGY LLC	PROCESS FOR THE PRODUCTION OF ETHANOL IN A MEDIUM COMPRISING XYLOSE EMPLOYING A RECOMBINANT ZYMOMONAS STRAIN WITH REDUCED HIMA EXPRESSION
EP2209899	2008	2010	E I DU PONT DE NEMOURS & CO, ALLIANCE FOR SUSTAINABLE ENERGY LLC	ZYMOMONAS WITH IMPROVED ETHANOL PRODUCTION IN MEDIUM CONTAINING CONCENTRATED SUGARS AND ACETATE
EP2220219	2008	2010	NOVOZYMES INC	POLYPEPTIDES HAVING XYLANASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
EP2225372	2008	2010	NOVOZYMES INC	POLYPEPTIDES HAVING ENDOGLUCANASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
EP2228440	2004	2010	NOVOZYMES INC	VARIANTS OF BETA-

				GLUCOSIDASES
EP2261326	2004	2010	GENENCOR INTERNATIONAL INC	NOVEL TRICHODERMA GENES
EP2262874	2009	2010	UOP LLC	FUEL AND FUEL BLENDING COMPONENTS FROM BIOMASS DERIVED PYROLYSIS OIL
WO2010006152	2009	2010	OKLAHOMA STATE UNIVERSITY	THERMOCELLULASES FOR LIGNOCELLULOSIC DEGRADATION
WO2010008578	2009	2010	MASCOMA CORPORATION	FLOW-THROUGH BIOLOGICAL CONVERSION OF LIGNOCELLULOSIC BIOMASS
WO2010059616	2009	2010	UNIVERSITY OF FLORIDA	BIOCATALYSTS AND METHODS FOR CONVERSION OF HEMICELLULOSE HYDROLSATES TO BIOBASED PRODUCTS
WO2010075241	2009	2010	E I DU PONT DE NEMOURS & CO, ALLIANCE FOR SUSTAINABLE ENERGY LLC	ZYMOMONAS WITH IMPROVED XYLOSE UTILIZATION IN STRESS CONDITIONS FOR THE PRODUCTION OF ETHANOL
WO2010078528	2009	2010	POET RESEARCH INC	ZEIN COMPOSITION
WO2010099058	2010	2010	UNIVERSITY OF GEORGIA	PRODUCTION OF HIGHER QUALITY BIO-OILS BY IN-LINE ESTERIFICATION OF PYROLYSIS VAPOR
WO2010101665	2010	2010	UNIVERSITY OF FLORIDA	ETHANOLOGENIC BACTERIA AND THEIR USE IN ETHANOL PRODUCTION
WO2010108918	2010	2010	NOVOZYMES INC	POLYPEPTIDES HAVING ACETYL XYLAN ESTERASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
WO2010117843	2010	2010	UNIVERSITY OF FLORIDA	TERMITE ENZYMES AND USES THEREOF FOR IN VITRO CONVERSION OF LIGNIN-CONTAINING MATERIALS TO FERMENTABLE PRODUCTS
WO2010122141	2010	2010	DSM IP ASSETS BV	CARBOHYDRATE DEGRADING POLYPEPTIDE AND USES THEREOF
WO2010126772	2010	2010	NOVOZYMES INC	POLYPEPTIDES HAVING XYLANASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
WO2010141325	2010	2010	NOVOZYMES INC	POLYPEPTIDES HAVING CELLOBIOHYDROLASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
WO2010141779	2010	2010	DANISCO US INC	CELLULASE VARIANTS WITH

				IMPROVED EXPRESSION, ACTIVITY AND/OR STABILITY, AND USE THEREOF
WO2010148057	2010	2010	WAYNE STATE UNIVERSITY	ZNO NANOPARTICLE CATALYSTS FOR USE IN TRANSESTERIFICATION AND ESTERIFICATION REACTIONS AND METHOD OF MAKING
7875444	2005	2011	DARTMOUTH COLLEGE	LIGNIN BLOCKERS AND USES THEREOF
7897396	2008	2011	E I DU PONT DE NEMOURS & CO, ALLIANCE FOR SUSTAINABLE ENERGY LLC	ZYMOMONAS WITH IMPROVED ETHANOL PRODUCTION IN MEDIUM CONTAINING CONCENTRATED SUGARS AND ACETATE
7905930	2007	2011	GENIFUEL CORP	TWO-STAGE PROCESS FOR PRODUCING OIL FROM MICROALGAE
7909899	2006	2011	COMMUNITY POWER CORP	METHOD AND APPARATUS FOR AUTOMATED, MODULAR, BIOMASS POWER GENERATION
7923235	2010	2011	DANISCO US INC	CIP1 POLYPEPTIDES AND THEIR USES
7932054	2009	2011	ALLIANCE FOR SUSTAINABLE ENERGY LLC	METHODS OF USING THERMAL TOLERANT AVICELASE FROM ACIDOTHERMUS CELLULOLYTICUS
7932073	2007	2011	NOVOZYMES INC	VARIANTS OF GLYCOSIDE HYDROLASES
7943350	2007	2011	NOVOZYMES INC	METHODS FOR DEGRADING LIGNOCELLULOSIC MATERIALS
7943366	2004	2011	CARGILL INC	GENETICALLY MODIFIED YEAST SPECIES AND FERMENTATION PROCESSES USING GENETICALLY MODIFIED YEAST
7951570	2008	2011	DANISCO US INC	CBH1 HOMOLOGS AND VARIANT CBH1 CELLULASES
7951571	2008	2011	DANISCO US INC	VARIANT HUMICOLA GRISEA CBH1.1
7956224	2008	2011	BATTELLE MEMORIAL INSTITUTE	PALLADIUM CATALYZED HYDROGENATION OF BIO-OILS AND ORGANIC COMPOUNDS
7960146	2007	2011	DANISCO US INC	BGL3 BETA-GLUCOSIDASE AND NUCLEIC ACIDS ENCODING THE SAME
7960149	2010	2011	NOVOZYMES INC	POLYPEPTIDES HAVING BETA-GLUCOSIDASE ACTIVITY AND POLYNUCLEOTIDES

				ENCODING SAME
7972832	2003	2011	DANISCO US INC	VARIANT HYPOCREA JECORINA CBH1 CELLULASES
7977076	2007	2011	GENIFUEL CORP	INTEGRATED PROCESSES AND SYSTEMS FOR PRODUCTION OF BIOFUELS USING ALGAE
7998711	2007	2011	DANISCO US INC	VARIANT HUMICOLA GRISEA CBH1.1
7998722	2009	2011	E I DU PONT DE NEMOURS & CO, ALLIANCE FOR SUSTAINABLE ENERGY LLC	ZYMOMONAS WITH IMPROVED XYLOSE UTILIZATION
8008056	2005	2011	DANISCO US INC	VARIANT HYPOCREA JECORINA CBH2 CELLULASES
8034996	2008	2011	NOVOZYMES INC	POLYPEPTIDES HAVING ACETYLXYLAN ESTERASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
8044264	2008	2011	NOVOZYMES INC	POLYPEPTIDES HAVING CELLULOLYTIC ENHANCING ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
8071349	2007	2011	DANISCO US INC	BGL4 BETA-GLUCOSIDASE AND NUCLEIC ACIDS ENCODING THE SAME
EP2271743	2009	2011	E I DU PONT DE NEMOURS & CO, ALLIANCE FOR SUSTAINABLE ENERGY LLC	ZYMOMONAS WITH IMPROVED XYLOSE UTILIZATION
EP2276719	2009	2011	BATTELLE MEMORIAL INSTITUTE	PROCESSES AND SYSTEMS FOR PRODUCING PRODUCTS OF HYDROGENOLYSIS OF POLYHYDRIC ALCOHOLS
EP2288698	2009	2011	DANISCO US INC	COMPOSITIONS AND METHODS COMPRISING CELLULASE VARIANTS WITH REDUCED AFFINITY TO NON-CELLULOSIC MATERIALS
EP2292746	2005	2011	GENENCOR INTERNATIONAL INC	VARIANT HYPOCREA JECORINA CBH2 CELLULASES
EP2292747	2005	2011	GENENCOR INTERNATIONAL INC	VARIANT HYPOCREA JECORINA CBH2 CELLULASES
EP2295559	2003	2011	GENENCOR INTERNATIONAL INC	NOVEL VARIANT HYPROCREA JECORINA CBH1 CELLULASES WITH INCREASE THERMAL STABILITY COMPRISING SUBSTITUTION

				OR DELETION AT POSITION T255
EP2298876	2004	2011	GENENCOR INTERNATIONAL INC	NOVEL CBH1 HOMOLOGS AND VARIANT CBH1 CELLULASES
EP2301949	2004	2011	NATUREWORKS LLC	GENETICALLY MODIFIED YEAST SPECIES AND FERMENTATION PROCESSES USING GENETICALLY MODIFIED YEAST
EP2301958	2005	2011	NOVOZYMES INC	POLYPEPTIDES HAVING CELLULOLYTIC ENHANCING ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
EP2302049	2005	2011	GENENCOR INTERNATIONAL INC	VARIANT HYPOCREA JECORINA CBH2 CELLULASES
EP2305702	2005	2011	NOVOZYMES INC	POLYPEPTIDES HAVING CELLULOLYTIC ENHANCING ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
EP2305703	2005	2011	NOVOZYMES INC	POLYPEPTIDES HAVING CELLULOLYTIC ENHANCING ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
EP2305800	2003	2011	GENENCOR INTERNATIONAL INC	NOVEL VARIANT HYPROCREA JECORINA CBH1 CELLULASES
EP2305801	2003	2011	GENENCOR INTERNATIONAL INC	NOVEL VARIANT HYPROCREA JECORINA CBH1 CELLULASES
EP2308890	2005	2011	NOVOZYMES INC	POLYPEPTIDES HAVING CELLULOLYTIC ENHANCING ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
EP2311942	2004	2011	GENENCOR INTERNATIONAL INC	NOVEL CBH1 HOMOLOGS AND VARIANT CBH1 CELLULASES
EP2313479	2009	2011	WAYNE STATE UNIVERSITY	METHODS AND CATALYSTS FOR MAKING BIODIESEL FROM THE TRANSESTERIFICATION AND ESTERIFICATION OF UNREFINED OILS
EP2314605	2005	2011	NOVOZYMES INC	POLYPEPTIDES HAVING CELLULOLYTIC ENHANCING ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
EP2322606	2003	2011	GENENCOR INTERNATIONAL INC	NOVEL VARIANT HYPROCREA JECORINA CBH1 CELLULASES WITH INCREASE

				THERMAL STABILITY COMPRISING SUBSTITUTION OR DELETION AT POSITION T332
EP2322607	2003	2011	GENENCOR INTERNATIONAL INC	NOVEL VARIANT HYPROCREA JECORINA CBH1 CELLULASES WITH INCREASE THERMAL STABILITY COMPRISING SUBSTITUTION OR DELETION AT POSITION S113
EP2338895	2004	2011	CARGILL INC	GENETICALLY MODIFIED YEAST SPECIES AND FERMENTATION PROCESSES USING GENETICALLY MODIFIED YEAST
EP2345662	2004	2011	CARGILL INC	GENETICALLY MODIFIED YEAST SPECIES AND FERMENTATION PROCESSES USING GENETICALLY MODIFIED YEAST
EP2376623	2009	2011	E I DU PONT DE NEMOURS & CO, ALLIANCE FOR SUSTAINABLE ENERGY LLC	ZYMOMONAS WITH IMPROVED XYLOSE UTILIZATION IN STRESS CONDITIONS FOR THE PRODUCTION OF ETHANOL
EP2377931	2004	2011	NOVOZYMES INC	VARIANTS OF GLYCOSIDE HYDROLASES
EP2381760	2009	2011	POET RESEARCH INC	ZEIN COMPOSITION
EP2385103	2004	2011	DANISCO US INC	VARIANT HYPOCREA JECORINA CBH1
EP2385104	2004	2011	DANISCO US INC	VARIANT SCYTALIDIUM THERMOPHILIUM CBH1
WO2011005867	2010	2011	NOVOZYMES INC	POLYPEPTIDES HAVING CELLULOLYTIC ENHANCING ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
WO2011014507	2010	2011	UNIVERSITY OF WYOMING	BIOLOGICAL CLEAN FUEL PROCESSING SYSTEMS AND METHODS
WO2011028554	2010	2011	ABENGOA BIOENERGY INC	METHOD FOR PRODUCING ETHANOL AND CO-PRODUCTS FROM CELLULOSIC BIOMASS
WO2011035027	2010	2011	NOVOZYMES INC	POLYPEPTIDES HAVING CELLULOLYTIC ENHANCING ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
WO2011035029	2010	2011	NOVOZYMES INC	POLYPEPTIDES HAVING BETA-GLUCOSIDASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
WO2011039319	2010	2011	NOVOZYMES INC	POLYPEPTIDES HAVING

				CELLULOLYTIC ENHANCING ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
WO2011041397	2010	2011	NOVOZYMES INC	POLYPEPTIDES HAVING CELLULOLYTIC ENHANCING ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
WO2011041405	2010	2011	NOVOZYMES INC	POLYPEPTIDES HAVING XYLANASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
WO2011041504	2010	2011	NOVOZYMES INC	POLYPEPTIDES DERIVED FROM THERMOASCUS CRUSTACEUS HAVING CELLULOLYTIC ENHANCING ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
WO2011041732	2010	2011	MISSISSIPPI STATE UNIVERSITY	METHOD TO UPGRADE BIO-OILS TO FUEL AND BIO-CRUDE
WO2011041756	2010	2011	MISSISSIPPI STATE UNIVERSITY	METHOD OF INCREASING ANHYDROSUGARS, PYROLIGNEOUS FRACTIONS AND ESTERIFIED BIO-OIL
WO2011050037	2010	2011	NOVOZYMES INC	CELLOBIOHYDROLASE VARIANTS AND POLYNUCLEOTIDES ENCODING SAME
WO2011056991	2010	2011	ABENGOA BIOENERGY INC	HIGH EFFICIENCY ETHANOL PROCESS AND HIGH PROTEIN FEED CO-PRODUCT
WO2011057140	2010	2011	NOVOZYMES INC	COMPOSITIONS FOR SACCHARIFICATION OF CELLULOSIC MATERIAL
WO2011057196	2010	2011	WAYNE STATE UNIVERSITY	METALOXIDE-ZR02 CATALYSTS FOR THE ESTERIFICATION AND TRANSESTERIFICATION OF FREE FATTY ACIDS AND TRIGLYCERIDES TO OBTAIN BIO -DIESEL
WO2011063308	2010	2011	DANISCO US INC	BETA-GLUCOSIDASE VARIANTS WITH IMPROVED PROPERTIES
WO2011098577	2011	2011	DSM IP ASSETS BV	HOST CELL CAPABLE OF PRODUCING ENZYMES USEFUL FOR DEGRADATION OF LIGNOCELLULOSIC MATERIAL
WO2011098580	2011	2011	DSM IP ASSETS BV	POLYPEPTIDE HAVING CELLOBIOHYDROLASE ACTIVITY AND USES THEREOF

WO2011103054	2011	2011	UOP LLC	LOW OXYGEN BIOMASS-DERIVED PYROLYSIS OILS AND METHODS FOR PRODUCING THE SAME
WO2011106048	2010	2011	BATTELLE MEMORIAL INSTITUTE	PROCESSES AND SYSTEMS FOR THE PRODUCTION OF PROPYLENE GLYCOL FROM GLYCEROL
WO2011109548	2011	2011	MASSACHUSETTS INSTITUTE OF TECHNOLOGY	MICROBIAL ENGINEERING FOR THE PRODUCTION OF FATTY ACIDS AND FATTY ACID DERIVATIVES
WO2011123450	2011	2011	NOVOZYMES INC	CELLOBIOHYDROLASE VARIANTS AND POLYNUCLEOTIDES ENCODING SAME
WO2011133536	2011	2011	UNIVERSITY OF TOLEDO	ALDOSE-KETOSE TRANSFORMATION FOR SEPARATION AND/OR CHEMICAL CONVERSION OF C6 AND C5 SUGARS FROM BIOMASS MATERIALS
WO2011140222	2011	2011	ABENGOA BIOENERGY INC	PROCESS FOR RECOVERY OF VALUES FROM A FERMENTATION MASS OBTAINED IN PRODUCING ETHANOL AND PRODUCTS THEREOF
WO2011140386	2011	2011	MASCOMA CORPORATION	DETOXIFICATION OF BIOMASS DERIVED ACETATE VIA METABOLIC CONVERSION TO ETHANOL, ACETONE, ISOPROPANOL, OR ETHYL ACETATE
8097445	2005	2012	DANISCO US INC	EXO-ENDO CELLULASE FUSION PROTEIN
8101393	2006	2012	BP CORP NORTH AMERICA INC	CELLULOLYTIC ENZYMES, NUCLEIC ACIDS ENCODING THEM AND METHODS FOR MAKING AND USING THEM
8110111	2009	2012	US DEPARTMENT OF ENERGY	MEMBRANE CONTACTOR ASSISTED EXTRACTION/REACTION PROCESS EMPLOYING IONIC LIQUIDS
8114655	2008	2012	DANISCO US INC	EGVII ENDOGLUCANASE AND NUCLEIC ACIDS ENCODING THE SAME
8119367	2008	2012	UNIVERSITY OF FLORIDA	NUCLEIC ACIDS, COMPOSITIONS AND USES THEREOF
8119857	2010	2012	NOVOZYMES INC	POLYPEPTIDES HAVING ENDOGLUCANASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
8128717	2008	2012	GAS	MECHANICALLY DRIVEN

			TECHNOLOGY INSTITUTE	CENTRIFUGAL PYROLYZER
8129591	2010	2012	NOVOZYMES INC	POLYPEPTIDES HAVING XYLANASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
8133711	2008	2012	DANISCO US INC	BGL7 BETA-GLUCOSIDASE AND NUCLEIC ACIDS ENCODING THE SAME
8143021	2010	2012	NOVOZYMES INC	POLYPEPTIDES HAVING CELLULOLYTIC ENHANCING ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
8143040	2009	2012	METNA CO	PROCESS FOR WHOLE CELL SACCHARIFICATION OF LIGNOCELLULOSES TO SUGARS USING A DUAL BIOREACTOR SYSTEM
8148103	2010	2012	NOVOZYMES INC	POLYPEPTIDES HAVING CELLULOLYTIC ENHANCING ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
8148495	2009	2012	NOVOZYMES INC	METHODS FOR ENHANCING THE DEGRADATION OR CONVERSION OF CELLULOSIC MATERIAL
8163946	2009	2012	WAYNE STATE UNIVERSITY	METHODS AND CATALYSTS FOR MAKING BIODIESEL FROM THE TRANSESTERIFICATION AND ESTERIFICATION OF UNREFINED OILS
8192854	2009	2012	UT-BATTELLE LLC	MICROBIAL FUEL CELL TREATMENT OF ETHANOL FERMENTATION PROCESS WATER
8202704	2011	2012	DANISCO US INC	TRICHODERMA GENES
8207400	2011	2012	NOVOZYMES INC	POLYPEPTIDES HAVING CELLULOLYTIC ENHANCING ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
8211665	2010	2012	NOVOZYMES INC	POLYPEPTIDES HAVING XYLANASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
8216844	2007	2012	DANISCO US INC	COMPOSITIONS AND METHODS FOR IMPROVED PROTEIN PRODUCTION
8232080	2011	2012	DANISCO US INC	VARIANT HYPROCREA JECORINA CBH1 CELLULASES
8236542	2009	2012	DANISCO US INC	COMPOSITIONS AND METHODS COMPRISING

				CELLULASE VARIANTS WITH REDUCED AFFINITY TO NON-CELLULOSIC MATERIALS
8236546	2011	2012	DANISCO US INC	VARIANT HUMICOLA GRISEA CBH1.1
8241605	2008	2012	BATTELLE MEMORIAL INSTITUTE	METHODS AND APPARATUS FOR CATALYTIC HYDROTHERMAL GASIFICATION OF BIOMASS
8242328	2012	2012	NOVOZYMES INC	POLYPEPTIDES HAVING CELLULOLYTIC ENHANCING ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
8242329	2012	2012	NOVOZYMES INC	POLYPEPTIDES HAVING CELLULOLYTIC ENHANCING ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
8247208	2009	2012	E I DU PONT DE NEMOURS & CO, ALLIANCE FOR SUSTAINABLE ENERGY LLC	ZYMOMONAS WITH IMPROVED XYLOSE UTILIZATION IN STRESS CONDITIONS
8268606	2010	2012	NOVOZYMES INC	POLYPEPTIDES HAVING ENDOGLUCANASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
8278079	2009	2012	DANISCO US INC	BGL6 .BETA.-GLUCOSIDASE AND NUCLEIC ACIDS ENCODING THE SAME
8278507	2010	2012	NOVOZYMES INC	POLYPEPTIDES HAVING CELLOBIOHYDROLASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
8283150	2008	2012	ALLIANCE FOR SUSTAINABLE ENERGY LLC	SUPERACTIVE CELLULASE FORMULATION USING CELLOBIOHYDROLASE-1 FROM PENICILLIUM FUNICULOSUM
8288140	2010	2012	NOVOZYMES INC	POLYPEPTIDES HAVING CELLULOLYTIC ENHANCING ACTIVITY AND NUCLEIC ACIDS ENCODING SAME
8298802	2011	2012	DANISCO US INC	BGL3 BETA-GLUCOSIDASE AND NUCLEIC ACIDS ENCODING THE SAME
8299322	2012	2012	NOVOZYMES INC	POLYPEPTIDES HAVING XYLANASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
8318458	2011	2012	NOVOZYMES INC	POLYPEPTIDES HAVING BETA-GLUCOSIDASE ACTIVITY AND POLYNUCLEOTIDES

				ENCODING SAME
8329969	2009	2012	UOP LLC	FUEL AND FUEL BLENDING COMPONENTS FROM BIOMASS DERIVED PYROLYSIS OIL
EP2403861	2011	2012	ABENGOA BIOENERGY INC	PROCESS FOR RECOVERY OF VALUES FROM A FERMENTATION MASS OBTAINED IN PRODUCING ETHANOL AND PRODUCTS THEREOF
EP2411511	2010	2012	NOVOZYMES INC	POLYPEPTIDES HAVING ACETYL XYLAN ESTERASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
EP2415864	2006	2012	VERENIUM CORP	OLIGOMERASE-2 (OR BETA-XYLOSIDASE) ENZYMES, NUCLEIC ACIDS ENCODING THEM AND METHODS FOR MAKING AND USING THEM
EP2420570	2006	2012	VERENIUM CORP	ARABINOFURANOSIDASE ENZYMES, NUCLEIC ACIDS ENCODING THEM AND METHODS FOR MAKING AND USING THEM
EP2421965	2010	2012	DSM IP ASSETS BV	CARBOHYDRATE DEGRADING POLYPEPTIDE AND USES THEREOF
EP2424995	2010	2012	NOVOZYMES INC	POLYPEPTIDES HAVING XYLANASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
EP2427561	2010	2012	ABENGOA BIOENERGY INC	HIGH EFFICIENCY ETHANOL PROCESS AND HIGH PROTEIN FEED CO-PRODUCT
EP2438163	2010	2012	NOVOZYMES INC	POLYPEPTIDES HAVING CELLOBIOHYDROLASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
EP2438164	2010	2012	DANISCO US INC	CELLULASE VARIANTS WITH IMPROVED EXPRESSION, ACTIVITY AND/OR STABILITY, AND USE THEREOF
EP2444487	2006	2012	VERENIUM CORP	CELLULOLYTIC ENZYMES, NUCLEIC ACIDS ENCODING THEM AND METHODS FOR MAKING AND USING THEM
EP2444488	2006	2012	VERENIUM CORP	CELLUCLOYTIC ENZYMES, NUCLEIC ACIDS ENCODING THEM AND METHODS FOR MAKING AND USING THEM
EP2444489	2006	2012	VERENIUM CORP	CELLUCLOYTIC ENZYMES, NUCLEIC ACIDS ENCODING

				THEM AND METHODS FOR MAKING AND USING THEM
EP2444490	2006	2012	VERENIUM CORP	CELLULOLYTIC ENZYMES, NUCLEIC ACIDS ENCODING THEM AND METHODS FOR MAKING AND USING THEM
EP2447363	2006	2012	VERENIUM CORP	CELLUCLOYTIC ENZYMES, NUCLEIC ACIDS ENCODING THEM AND METHODS FOR MAKING AND USING THEM
EP2450439	2006	2012	VERENIUM CORP	CELLULOLYTIC ENZYMES, NUCLEIC ACIDS ENCODING THEM AND METHODS FOR MAKING AND USING THEM
EP2451957	2010	2012	NOVOZYMES INC	POLYPEPTIDES HAVING CELLULOLYTIC ENHANCING ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
EP2459725	2010	2012	UNIVERSITY OF WYOMING	BIOLOGICAL CLEAN FUEL PROCESSING SYSTEMS AND METHODS
EP2467532	2010	2012	ABENGOA BIOENERGY INC	METHOD FOR PRODUCING ETHANOL AND CO-PRODUCTS FROM CELLULOSIC BIOMASS
EP2478095	2010	2012	NOVOZYMES INC	POLYPEPTIDES HAVING BETA-GLUCOSIDASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
EP2478096	2010	2012	NOVOZYMES INC	POLYPEPTIDES HAVING CELLULOLYTIC ENHANCING ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
EP2483295	2010	2012	NOVOZYMES INC	POLYPEPTIDES HAVING CELLULOLYTIC ENHANCING ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
EP2483296	2010	2012	NOVOZYMES INC	POLYPEPTIDES DERIVED FROM THERMOASCUS CRUSTACEUS HAVING CELLULOLYTIC ENHANCING ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
EP2483402	2010	2012	NOVOZYMES INC	POLYPEPTIDES HAVING CELLULOLYTIC ENHANCING ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
EP2483403	2010	2012	NOVOZYMES INC	POLYPEPTIDES HAVING XYLANASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME

EP2491122	2010	2012	NOVOZYMES INC	CELLOBIOHYDROLASE VARIANTS AND POLYNUCLEOTIDES ENCODING SAME
EP2496694	2010	2012	NOVOZYMES INC	COMPOSITIONS FOR SACCHARIFICATION OF CELLULOSIC MATERIAL
EP2498905	2010	2012	WAYNE STATE UNIVERSITY	METALOXIDE-ZR02 CATALYSTS FOR THE ESTERIFICATION AND TRANSESTERIFICATION OF FREE FATTY ACIDS AND TRIGLYCERIDES TO OBTAIN BIO -DIESEL
EP2501806	2010	2012	DANISCO US INC	BETA-GLUCOSIDASE I VARIANTS WITH IMPROVED PROPERTIES
EP2534243	2011	2012	DSM IP ASSETS BV	POLYPEPTIDE HAVING CELLOBIOHYDROLASE ACTIVITY AND USES THEREOF
EP2534244	2011	2012	DSM IP ASSETS BV	HOST CELL CAPABLE OF PRODUCING ENZYMES USEFUL FOR DEGRADATION OF LIGNOCELLULOSIC MATERIAL
WO2012000886	2011	2012	DSM IP ASSETS BV	POLYPEPTIDE HAVING BETA-GLUCOSIDASE ACTIVITY AND USES THEREOF
WO2012000887	2011	2012	DSM IP ASSETS BV	POLYPEPTIDE HAVING SWOLLENIN ACTIVITY AND USES THEREOF
WO2012000888	2011	2012	DSM IP ASSETS BV	POLYPEPTIDE HAVING ACETYL XYLAN ESTERASE ACTIVITY AND USES THEREOF
WO2012000890	2011	2012	DSM IP ASSETS BV	POLYPEPTIDE HAVING BETA-GLUCOSIDASE ACTIVITY AND USES THEREOF
WO2012000891	2011	2012	DSM IP ASSETS BV	POLYPEPTIDE HAVING CARBOHYDRATE DEGRADING ACTIVITY AND USES THEREOF
WO2012000892	2011	2012	DSM IP ASSETS BV	POLYPEPTIDE HAVING OR ASSISTING IN CARBOHYDRATE MATERIAL DEGRADING ACTIVITY AND USES THEREOF
WO2012003178	2011	2012	E I DU PONT DE NEMOURS & CO	IMPROVED XYLOSE UTILIZATION IN RECOMBINANT ZYMOMONAS HAVING ADDITIONAL XYLOSE ISOMERASE ACTIVITY
WO2012003379	2011	2012	NOVOZYMES INC	POLYPEPTIDES HAVING BETA-GLUCOSIDASE

				ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
WO2012006061	2011	2012	E I DU PONT DE NEMOURS & CO	IMPROVED XYLOSE UTILIZATION IN RECOMBINANT ZYMOMONAS HAVING INCREASED RIBOSE-5 - PHOSPHATE ACTIVITY
WO2012018908	2011	2012	COLORADO STATE UNIVERSITY	DIGESTER FOR HIGH SOLIDS WASTE
WO2012021394	2011	2012	NOVOZYMES INC	COMPOSITIONS COMPRISING A POLYPEPTIDE HAVING CELLULOLYTIC ENHANCING ACTIVITY AND A QUINONE COMPOUND AND USES THEREOF
WO2012021395	2011	2012	NOVOZYMES INC	COMPOSITIONS COMPRISING A POLYPEPTIDE HAVING CELLULOLYTIC ENHANCING ACTIVITY AND A SULFUR-CONTAINING COMPOUND AND USES THEREOF
WO2012021396	2011	2012	NOVOZYMES INC	COMPOSITIONS COMPRISING A POLYPEPTIDE HAVING CELLULOLYTIC ENHANCING ACTIVITY AND AN ORGANIC COMPOUND AND USES THEREOF
WO2012021399	2011	2012	NOVOZYMES INC	COMPOSITIONS COMPRISING A POLYPEPTIDE HAVING CELLULOLYTIC ENHANCING ACTIVITY AND A NITROGEN-CONTAINING COMPOUND AND USES THEREOF
WO2012021400	2011	2012	NOVOZYMES INC	COMPOSITIONS COMPRISING A POLYPEPTIDE HAVING CELLULOLYTIC ENHANCING ACTIVITY AND A HETEROCYCLIC COMPOUND AND USES THEREOF
WO2012021401	2011	2012	NOVOZYMES INC	COMPOSITIONS COMPRISING A POLYPEPTIDE HAVING CELLULOLYTIC ENHANCING ACTIVITY AND A BICYCLIC COMPOUND AND USES THEREOF
WO2012021408	2011	2012	NOVOZYMES INC	COMPOSITIONS COMPRISING A POLYPEPTIDE HAVING CELLULOLYTIC ENHANCING ACTIVITY AND A DIOXY COMPOUND AND USES THEREOF
WO2012021410	2011	2012	NOVOZYMES INC	COMPOSITIONS COMPRISING A POLYPEPTIDE HAVING CELLULOLYTIC ENHANCING

				ACTIVITY AND A LIQUOR AND USES THEREOF
WO2012030799	2011	2012	NOVOZYMES INC	POLYPEPTIDES HAVING CELLULOLYTIC ENHANCING ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
WO2012030811	2011	2012	NOVOZYMES INC	POLYPEPTIDES HAVING CELLOBIOHYDROLASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
WO2012030844	2011	2012	NOVOZYMES INC	POLYPEPTIDES HAVING ENDOGLUCANASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
WO2012030845	2011	2012	NOVOZYMES INC	POLYPEPTIDES HAVING BETA-GLUCOSIDASE ACTIVITY, BETA-XYLOSIDASE ACTIVITY, OR BETA-GLUCOSIDASE AND BETA-XYLOSIDASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
WO2012030849	2011	2012	NOVOZYMES INC	POLYPEPTIDES HAVING XYLANASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
WO2012044836	2011	2012	NOVOZYMES INC	VARIANTS OF POLYPEPTIDES HAVING CELLULOLYTIC ENHANCING ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
WO2012044915	2011	2012	NOVOZYMES INC	BETA-GLUCOSIDASE VARIANTS AND POLYNUCLEOTIDES ENCODING SAME
WO2012059053	2011	2012	NOVOZYMES INC	POLYPEPTIDES HAVING CELLOBIOHYDROLASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
WO2012059069	2011	2012	NOVOZYMES INC	POLYPEPTIDES HAVING CELLOBIOHYDROLASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
WO2012061517	2011	2012	NOVOZYMES INC	METHODS OF PRETREATING CELLULOSIC MATERIAL WITH A GH61 POLYPEPTIDE
WO2012062220	2011	2012	NOVOZYMES INC	POLYPEPTIDES HAVING ENDOGLUCANASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
WO2012068509	2011	2012	NOVOZYMES INC	CHIMERIC POLYPEPTIDES HAVING CELLULOLYTIC

				ENHANCING ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
WO2012071470	2011	2012	CARGILL INC	COMPOSITIONS AND METHODS FOR INCREASED ETHANOL TITER FROM BIOMASS
WO2012082711	2011	2012	E I DU PONT DE NEMOURS & CO	XYLOSE UTILIZING ZYMOMONAS MOBILIS WITH IMPROVED ETHANOL PRODUCTION IN BIOMASS HYDROLYSATE MEDIUM
WO2012101206	2012	2012	NOVOZYMES INC	NOVEL GLYCOSIDE HYDROLASES FROM THERMOPHILIC FUNGI
WO2012103288	2012	2012	NOVOZYMES INC	POLYPEPTIDES HAVING CELLOBIOHYDROLASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
WO2012103293	2012	2012	NOVOZYMES INC	POLYPEPTIDES HAVING CELLOBIOHYDROLASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
WO2012103300	2012	2012	NOVOZYMES INC	POLYPEPTIDES HAVING CELLOBIOHYDROLASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
WO2012103322	2012	2012	NOVOZYMES INC	POLYPEPTIDES HAVING ENDOGLUCANASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
WO2012106701	2012	2012	NOVOZYMES INC	FATTY ACID ESTERIFICATION PROCESS
WO2012122477	2012	2012	NOVOZYMES INC	POLYPEPTIDES HAVING CELLULOLYTIC ENHANCING ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
WO2012135420	2012	2012	UNIVERSITY OF FLORIDA	OVER-EXPRESSION OF HADH-DEPENDENT OXIDOREDUCTASE (FUCO) FOR INCREASING FURFURAL OR 5-HYDROXYMETHYLFURFURAL TOLERANCE
WO2012135659	2012	2012	NOVOZYMES INC	METHODS FOR ENHANCING THE DEGRADATION OR CONVERSION OF CELLULOSIC MATERIAL
WO2012142171	2012	2012	NOVOZYMES INC	IMPROVED CELLULASE VARIANTS
WO2012145123	2012	2012	GAS TECHNOLOGY	BUBBLING BED CATALYTIC HYDROPYROLYSIS PROCESS

			INSTITUTE	UTILIZING LARGER CATALYST PARTICLES AND SMALLER BIOMASS PARTICLES FEATURING AN ANTI-SLUGGING REACTOR
WO2012145179	2012	2012	E I DU PONT DE NEMOURS & CO	PANTOTHENIC ACID BIOSYNTHESIS IN ZYMOMONAS
WO2012149192	2012	2012	NOVOZYMES INC	POLYPEPTIDES HAVING ENDOGLUCANASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
WO2012149344	2012	2012	NOVOZYMES INC	METHODS FOR ENHANCING THE DEGRADATION OR CONVERSION OF CELLULOSIC MATERIAL
WO2012151275	2012	2012	VIRENT ENERGY SYSTEMS INC	APPARATUS AND METHOD FOR CONVERTING BIOMASS TO FEEDSTOCK FOR BIOFUEL AND BIOCHEMICAL MANUFACTURING PROCESSES
WO2012155074	2012	2012	VIRENT ENERGY SYSTEMS INC	PROCESS FOR PURIFYING LIGNOCELLULOSIC FEEDSTOCKS
WO2012159009	2012	2012	NOVOZYMES INC	METHODS FOR ENHANCING THE DEGRADATION OF CELLULOSIC MATERIAL WITH CHITIN BINDING PROTEINS
WO2012162403	2012	2012	VIRENT ENERGY SYSTEMS INC	PRODUCTION OF CHEMICALS AND FUELS FROM BIOMASS
8361767	2012	2013	DANISCO US INC	BGL7 BETA-GLUCOSIDASE AND NUCLEIC ACIDS ENCODING THE SAME
8362306	2010	2013	UNIVERSITY OF MAINE	ENERGY DENSIFICATION OF BIOMASS-DERIVED ORGANIC ACIDS
8372626	2010	2013	ALLIANCE FOR SUSTAINABLE ENERGY LLC	L-ARABINOSE FERMENTING YEAST
8377659	2011	2013	DANISCO US INC	VARIANT HUMICOLA GRISEA CBH1.1
8383385	2011	2013	NOVOZYMES INC	VARIANTS OF GLYCOSIDE HYDROLASES
8404004	2007	2013	GENIFUEL CORP	PROCESS OF PRODUCING OIL FROM ALGAE USING BIOLOGICAL RUPTURING
8420351	2012	2013	NOVOZYMES INC	POLYPEPTIDES HAVING CELLULOLYTIC ENHANCING ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
8431362	2012	2013	NOVOZYMES INC	POLYPEPTIDES HAVING XYLANASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME

8440451	2011	2013	CARGILL INC	GENETICALLY MODIFIED YEAST SPECIES, AND FERMENTATION PROCESSES USING GENETICALLY MODIFIED YEAST
8445240	2010	2013	UNIVERSITY OF FLORIDA	TERMITE ENZYMES AND USES THEREOF FOR IN VITRO CONVERSION OF LIGNIN-CONTAINING MATERIALS TO FERMENTABLE PRODUCTS
8450370	2011	2013	OLD DOMINION UNIVERSITY	PRODUCTION OF GLYCEROL-RELATED PRODUCTS FROM A HIGH TEMPERATURE REACTION
8455699	2012	2013	OLD DOMINION UNIVERSITY	PRODUCTION AND SEPARATION OF GLYCEROL-RELATED PRODUCTS USING VARIOUS FEED STOCKS
8465949	2012	2013	NOVOZYMES INC	POLYPEPTIDES HAVING CELLULOLYTIC ENHANCING ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
8465953	2007	2013	UNIVERSITY OF FLORIDA	ETHANOL PRODUCTION IN NON-RECOMBINANT HOSTS
8465958	2012	2013	NOVOZYMES INC	POLYPEPTIDES HAVING ENDOGLUCANASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
8465961	2012	2013	E I DU PONT DE NEMOURS & CO, ALLIANCE FOR SUSTAINABLE ENERGY LLC	ZYMOMONAS WITH IMPROVED XYLOSE UTILIZATION IN STRESS CONDITIONS
8475543	2011	2013	GENIFUEL CORP	TWO-STAGE PROCESS FOR PRODUCING OIL FROM MICROALGAE
8476048	2011	2013	E I DU PONT DE NEMOURS & CO	XYLOSE UTILIZING ZYMOMONAS MOBILIS WITH IMPROVED ETHANOL PRODUCTION IN BIOMASS HYDROLYSATE MEDIUM
8476480	2009	2013	IOWA STATE UNIVERSITY	BIO-OIL FRACTIONATION AND CONDENSATION
8486667	2011	2013	DANISCO US INC	EGVII ENDOGLUCANASE AND NUCLEIC ACIDS ENCODING THE SAME
8497115	2012	2013	NOVOZYMES INC	METHODS FOR PRODUCING SECRETED POLYPEPTIDES
8507229	2010	2013	UCHICAGO ARGONNE LLC	ELECTROCHEMICAL METHOD FOR PRODUCING A BIODIESEL MIXTURE COMPRISING FATTY ACID ALKYL ESTERS AND GLYCEROL
8519203	2010	2013	UOP LLC	LOW OXYGEN BIOMASS-

				DERIVED PYROLYSIS OILS AND METHODS FOR PRODUCING THE SAME
8529661	2010	2013	AFOGNAK NATIVE CORP	METHOD AND APPARATUS FOR A SELF-CLEANING FILTER
8541651	2010	2013	NOVOZYMES INC	CELLOBIOHYDROLASE VARIANTS AND POLYNUCLEOTIDES ENCODING SAME
8545633	2011	2013	ABENGOA BIOENERGY INC	METHOD FOR PRODUCING ETHANOL AND CO-PRODUCTS FROM CELLULOSIC BIOMASS
8546106	2007	2013	NOVOZYMES INC	METHODS OF INCREASING SECRETION OF POLYPEPTIDES HAVING BIOLOGICAL ACTIVITY
8546635	2012	2013	UOP LLC	METHODS AND APPARATUSES FOR PREPARING UPGRADED PYROLYSIS OIL
8569458	2013	2013	E I DU PONT DE NEMOURS & CO	XYLOSE UTILIZING ZYMOMONAS MOBILIS WITH IMPROVED ETHANOL PRODUCTION IN BIOMASS HYDROLYSATE MEDIUM
8569581	2010	2013	NOVOZYMES INC	POLYPEPTIDES HAVING CELLULOLYTIC ENHANCING ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
8574326	2011	2013	AFOGNAK NATIVE CORP	METHOD AND APPARATUS FOR AUTOMATED, MODULAR, BIOMASS POWER GENERATION
8580536	2010	2013	NOVOZYMES INC	COMPOSITIONS FOR SACCHARIFICATION OF CELLULOSIC MATERIAL
8580541	2010	2013	DARTMOUTH COLLEGE	LIGNIN BLOCKERS AND USES THEREOF
8581042	2011	2013	NOVOZYMES INC	POLYPEPTIDES HAVING BETA-GLUCOSIDASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
8586346	2012	2013	NOVOZYMES INC	POLYPEPTIDES HAVING CELLOBIOHYDROLASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
8586827	2010	2013	NOVOZYMES INC	POLYPEPTIDES HAVING CELLULOLYTIC ENHANCING ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
8586829	2010	2013	NOVOZYMES INC	POLYPEPTIDES HAVING

				CELLULOLYTIC ENHANCING ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
8592190	2009	2013	INEOS BIO LTD	METHODS FOR SEQUESTERING CARBON DIOXIDE INTO ALCOHOLS VIA GASIFICATION FERMENTATION
8603199	2010	2013	MISSISSIPPI STATE UNIVERSITY	METHOD TO UPGRADE BIO-OILS TO FUEL AND BIO-CRUDE
8608981	2012	2013	BATTELLE MEMORIAL INSTITUTE, GENIFUEL CORP	METHODS FOR SULFATE REMOVAL IN LIQUID-PHASE CATALYTIC HYDROTHERMAL GASIFICATION OF BIOMASS
8609931	2010	2013	NOVOZYMES INC	POLYPEPTIDES HAVING BETA-GLUCOSIDASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
8614067	2013	2013	NOVOZYMES INC	POLYPEPTIDES HAVING CELLULOLYTIC ENHANCING ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
EP2539308	2010	2013	BATTELLE MEMORIAL INSTITUTE	PROCESSES AND SYSTEMS FOR THE PRODUCTION OF PROPYLENE GLYCOL FROM GLYCEROL
EP2542671	2011	2013	MASSACHUSETTS INSTITUTE OF TECHNOLOGY	MICROBIAL ENGINEERING FOR THE PRODUCTION OF FATTY ACIDS AND FATTY ACID DERIVATIVES
EP2553093	2011	2013	NOVOZYMES INC	CELLOBIOHYDROLASE VARIANTS AND POLYNUCLEOTIDES ENCODING SAME
EP2588492	2011	2013	DSM IP ASSETS BV	POLYPEPTIDE HAVING BETA-GLUCOSIDASE ACTIVITY AND USES THEREOF
EP2588493	2011	2013	DSM IP ASSETS BV	POLYPEPTIDE HAVING SWOLLENIN ACTIVITY AND USES THEREOF
EP2588494	2011	2013	DSM IP ASSETS BV	POLYPEPTIDE HAVING BETA-GLUCOSIDASE ACTIVITY AND USES THEREOF
EP2588600	2011	2013	DSM IP ASSETS BV	POLYPEPTIDE HAVING ACETYL XYLAN ESTERASE ACTIVITY AND USES THEREOF
EP2588601	2011	2013	DSM IP ASSETS BV	POLYPEPTIDE HAVING CARBOHYDRATE DEGRADING ACTIVITY AND USES THEREOF
EP2588603	2011	2013	DSM IP ASSETS	POLYPEPTIDE HAVING OR

			BV	ASSISTING IN CARBOHYDRATE MATERIAL DEGRADING ACTIVITY AND USES THEREOF
EP2588604	2011	2013	NOVOZYMES INC	POLYPEPTIDES HAVING BETA-GLUCOSIDASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
EP2588606	2011	2013	E I DU PONT DE NEMOURS & CO	IMPROVED XYLOSE UTILIZATION IN RECOMBINANT ZYMOMONAS HAVING INCREASED RIBOSE-5-PHOSPHATE ACTIVITY
EP2588607	2011	2013	E I DU PONT DE NEMOURS & CO	IMPROVED XYLOSE UTILIZATION IN RECOMBINANT ZYMOMONAS HAVING ADDITIONAL XYLOSE ISOMERASE ACTIVITY
EP2599861	2010	2013	DANISCO US INC	BETA-GLUCOSIDASE VARIANTS WITH IMPROVED PROPERTIES
EP2599862	2010	2013	DANISCO US INC	BETA-GLUCOSIDASE VARIANTS WITH IMPROVED PROPERTIES
EP2599863	2010	2013	DANISCO US INC	BETA-GLUCOSIDASE VARIANTS WITH IMPROVED PROPERTIES
EP2599864	2010	2013	DANISCO US INC	BETA-GLUCOSIDASE VARIANTS WITH IMPROVED PROPERTIES
EP2602317	2010	2013	DANISCO US INC	BETA-GLUCOSIDASE VARIANTS WITH IMPROVED PROPERTIES
EP2603593	2011	2013	NOVOZYMES INC	COMPOSITIONS COMPRISING A GH61 POLYPEPTIDE HAVING CELLULOLYTIC ENHANCING ACTIVITY AND A NITROGEN-CONTAINING COMPOUND AND USES THEREOF
EP2603594	2011	2013	NOVOZYMES INC	COMPOSITIONS COMPRISING A POLYPEPTIDE HAVING CELLULOLYTIC ENHANCING ACTIVITY AND A BICYCLIC COMPOUND AND USES THEREOF
EP2603595	2011	2013	NOVOZYMES INC	COMPOSITIONS COMPRISING A POLYPEPTIDE HAVING CELLULOLYTIC ENHANCING ACTIVITY AND A DIOXY COMPOUND AND USES THEREOF
EP2603596	2011	2013	NOVOZYMES INC	COMPOSITIONS COMPRISING A POLYPEPTIDE HAVING

				CELLULOLYTIC ENHANCING ACTIVITY AND A LIQUOR AND USES THEREOF
EP2603597	2011	2013	NOVOZYMES INC	COMPOSITIONS COMPRISING A POLYPEPTIDE HAVING CELLULOLYTIC ENHANCING ACTIVITY AND A HETEROCYCLIC COMPOUND AND USES THEREOF
EP2603598	2011	2013	NOVOZYMES INC	COMPOSITIONS COMPRISING A GH61 POLYPEPTIDE HAVING CELLULOLYTIC ENHANCING ACTIVITY AND A QUINONE COMPOUND AND USES THEREOF
EP2603599	2011	2013	NOVOZYMES INC	COMPOSITIONS COMPRISING A POLYPEPTIDE HAVING CELLULOLYTIC ENHANCING ACTIVITY AND A SULFUR-CONTAINING COMPOUND AND USES THEREOF
EP2611901	2011	2013	NOVOZYMES INC	POLYPEPTIDES HAVING BETA-GLUCOSIDASE ACTIVITY, BETA-XYLOSIDASE ACTIVITY, OR BETA-GLUCOSIDASE AND BETA-XYLOSIDASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
EP2611914	2011	2013	NOVOZYMES INC	POLYPEPTIDES HAVING CELLULOLYTIC ENHANCING ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
EP2617825	2004	2013	NOVOZYMES INC	VARIANTS OF GLYCOSIDE HYDROLASES
EP2617826	2004	2013	NOVOZYMES INC	VARIANTS OF GLYCOSIDE HYDROLASES
EP2622069	2011	2013	NOVOZYMES INC	BETA-GLUCOSIDASE VARIANTS AND POLYNUCLEOTIDES ENCODING SAME
EP2622070	2011	2013	NOVOZYMES INC	VARIANTS OF POLYPEPTIDES HAVING CELLULOLYTIC ENHANCING ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
EP2626422	2009	2013	DANISCO US INC	COMPOSITIONS AND METHODS COMPRISING CELLULASE VARIANTS WITH REDUCED AFFINITY TO NON-CELLULOSIC MATERIALS
EP2628795	2009	2013	DANISCO US INC	COMPOSITIONS AND METHODS COMPRISING CELLULASE VARIANTS WITH REDUCED AFFINITY TO NON-

				CELLULOSIC MATERIALS
EP2628796	2009	2013	DANISCO US INC	COMPOSITIONS AND METHODS COMPRISING CELLULASE VARIANTS WITH REDUCED AFFINITY TO NON-CELLULOSIC MATERIALS
EP2635594	2011	2013	NOVOZYMES INC	POLYPEPTIDES HAVING CELLOBIOHYDROLASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
EP2635689	2011	2013	NOVOZYMES INC	METHODS OF PRETREATING CELLULOSIC MATERIAL WITH A GH61 POLYPEPTIDE
EP2636734	2009	2013	DANISCO US INC	COMPOSITIONS AND METHODS COMPRISING CELLULASE VARIANTS WITH REDUCED AFFINITY TO NON-CELLULOSIC MATERIALS
EP2638153	2011	2013	NOVOZYMES INC	POLYPEPTIDES HAVING ENDOGLUCANASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
EP2640833	2011	2013	NOVOZYMES INC	CHIMERIC POLYPEPTIDES HAVING CELLULOLYTIC ENHANCING ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
EP2643466	2011	2013	CARGILL INC	YEAST CELLS AND PROCESS FOR CONVERTING ACETALDEHYDE TO ETHANOL
EP2652121	2011	2013	E I DU PONT DE NEMOURS & CO	XYLOSE UTILIZING ZYMOMONAS MOBILIS WITH IMPROVED ETHANOL PRODUCTION IN BIOMASS HYDROLYSATE MEDIUM
EP2668265	2012	2013	NOVOZYMES INC	NOVEL GLYCOSIDE HYDROLASES FROM THERMOPHILIC FUNGI
EP2668266	2012	2013	NOVOZYMES INC	POLYPEPTIDES HAVING CELLOBIOHYDROLASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
EP2668267	2012	2013	NOVOZYMES INC	POLYPEPTIDES HAVING CELLOBIOHYDROLASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
EP2668268	2012	2013	NOVOZYMES INC	POLYPEPTIDES HAVING CELLOBIOHYDROLASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
EP2668269	2012	2013	NOVOZYMES INC	POLYPEPTIDES HAVING

				ENDOGLUCANASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
EP2668270	2012	2013	NOVOZYMES INC	POLYPEPTIDES HAVING CELLOBIOHYDROLASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
EP2670854	2012	2013	NOVOZYMES INC	FATTY ACID ESTERIFICATION PROCESS
WO2013009679	2012	2013	UNIVERSITY OF FLORIDA	OVER-EXPRESSION OF A PUTATIVE OXIDOREDUCTASE (UCPA) FOR INCREASING FURFURAL OR 5-HYDROXYMETHYLFURFURAL TOLERANCE
WO2013019328	2012	2013	UOP LLC	PROCESSES FOR CONVERTING LIGNOCELLULOSICS TO REDUCED ACID PYROLYSIS OIL
WO2013019558	2012	2013	GAS TECHNOLOGY INSTITUTE	REMOVAL OF HYDROGEN SULFIDE AS AMMONIUM SULFATE FROM HYDROPYROLYSIS PRODUCT VAPORS
WO2013019780	2012	2013	NOVOZYMES INC	POLYPEPTIDES HAVING ENDOGLUCANASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
WO2013019827	2012	2013	NOVOZYMES INC	POLYPEPTIDES HAVING XYLANASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
WO2013028927	2012	2013	NOVOZYMES INC	ASPERGILLUS FUMIGATUS CELLULOLYTIC ENZYME COMPOSITIONS AND USES THEREOF
WO2013028928	2012	2013	NOVOZYMES INC	CELLULOLYTIC ENZYME COMPOSITIONS AND USES THEREOF
WO2013043981	2012	2013	NOVOZYMES INC	CELLULOLYTIC ENZYME COMPOSITIONS AND USES THEREOF
WO2013063085	2012	2013	WASHINGTON STATE UNIVERSITY	SEQUENTIAL HYDROTHERMAL LIQUIFACTION (SEQHTL) FOR EXTRACTION OF SUPERIOR BIO-OIL AND OTHER ORGANIC COMPOUNDS FROM OLEAGINOUS BIOMASS
WO2013074956	2012	2013	NOVOZYMES INC	POLYPEPTIDES HAVING BETA-GLUCOSIDASE ACTIVITY, BETA-XYLOSIDASE ACTIVITY, OR BETA-GLUCOSIDASE AND

				BETA-XYLOSIDASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
WO2013075644	2012	2013	NOVOZYMES INC	POLYPEPTIDES HAVING BETA-XYLOSIDASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
WO2013079015	2012	2013	NOVOZYMES INC	POLYPEPTIDES HAVING BETA-XYLOSIDASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
WO2013089838	2012	2013	UOP LLC	METHODS FOR DEOXYGENATING BIOMASS-DERIVED PYROLYSIS OIL
WO2013089839	2012	2013	UOP LLC	METHODS FOR DEOXYGENATING BIOMASS-DERIVED PYROLYSIS OIL
WO2013089890	2012	2013	MASCOMA CORPORATION; DARTMOUTH COLLEGE	ENGINEERING MICROORGANISMS TO INCREASE ETHANOL PRODUCTION BY METABOLIC REDIRECTION
WO2013089892	2012	2013	UOP LLC	PYROLYSIS FUELS AND METHODS FOR PROCESSING PYROLYSIS FUELS
WO2013090918	2012	2013	ALLIANCE FOR SUSTAINABLE ENERGY LLC	ENHANCED PROCESSIVE CELLULASES
WO2013091544	2012	2013	NOVOZYMES INC	POLYPEPTIDES HAVING BETA-GLUCOSIDASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
WO2013091577	2012	2013	NOVOZYMES INC	HYBRID POLYPEPTIDES HAVING CELLOBIOHYDROLASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
WO2013096294	2012	2013	NOVOZYMES INC	POLYPEPTIDES HAVING XYLANASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
WO2013096603	2012	2013	NOVOZYMES INC	CELLOBIOHYDROLASE VARIANTS AND POLYNUCLEOTIDES ENCODING SAME
WO2013103768	2013	2013	UNIVERSITY OF MAINE	FORMATE-ASSISTED PYROLYSIS
WO2013148056	2013	2013	UOP LLC	PROCESSES FOR WASHING A SPENT ION EXCHANGE BED
WO2013149014	2013	2013	WAYNE STATE UNIVERSITY	BIMETAL CATALYSTS
WO2013151642	2013	2013	UOP LLC	METHODS AND APPARATUSES FOR PREPARING UPGRADED

				PYROLYSIS OIL
WO2013166469	2013	2013	VIRDIA INC	METHODS FOR TREATING LIGNOCELLULOSIC MATERIALS
WO2013184233	2013	2013	UOP LLC	METHOD AND APPARATUS FOR PRODUCING PYROLYSIS OIL HAVING IMPROVED STABILITY
WO2013184317	2013	2013	BATTELLE MEMORIAL INSTITUTE	COMBINED HYDROTHERMAL LIQUEFACTION AND CATALYTIC HYDROTHERMAL GASIFICATION SYSTEM AND PROCESS FOR CONVERSION OF BIOMASS FEEDSTOCKS
WO2013191788	2013	2013	UOP LLC	METHODS AND APPARATUSES FOR DEOXYGENATING BIOMASS-DERIVED PYROLYSIS OIL
8623623	2011	2014	E I DU PONT DE NEMOURS & CO	XYLOSE UTILIZATION IN RECOMBINANT ZYMOMONAS
8623633	2011	2014	CARGILL INC	GENETICALLY MODIFIED YEAST SPECIES, AND FERMENTATION PROCESSES USING GENETICALLY MODIFIED YEAST
8624082	2011	2014	NOVOZYMES INC	POLYPEPTIDES HAVING XYLANASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
8629325	2011	2014	NOVOZYMES INC	POLYPEPTIDES HAVING BETA-GLUCOSIDASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
8636815	2011	2014	GENIFUEL CORP	PROCESS OF PRODUCING OIL FROM ALGAE USING BIOLOGICAL RUPTURING
8637293	2008	2014	ALLIANCE FOR SUSTAINABLE ENERGY LLC	CELLOBIOHYDROLASE I ENZYMES
8637294	2007	2014	DANISCO US INC	VARIANT HYPOCREA JERCORINA CBH1 CELLULASES
8652817	2006	2014	UNIVERSITY OF FLORIDA	RECOMBINANT HOST CELLS AND MEDIA FOR ETHANOL PRODUCTION
8652818	2009	2014	POET RESEARCH INC	METHOD FOR EXTRACTING PROTEIN FROM A FERMENTATION PRODUCT
8657890	2009	2014	WAYNE STATE UNIVERSITY	EFFECT OF NATURAL AND SYNTHETIC ANTIOXIDANTS ON THE OXIDATIVE STABILITY OF BIODIESEL
8658406	2013	2014	DANISCO US INC	EGVII ENDOGLUCANASE AND NUCLEIC ACIDS ENCODING THE SAME

8658409	2010	2014	NOVOZYMES INC	POLYPEPTIDES HAVING ACETYL XYLAN ESTERASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
8663965	2012	2014	DANISCO US INC	BGL6 BETA-GLUCOSIDASE AND NUCLEIC ACIDS ENCODING THE SAME
8673611	2012	2014	DANISCO US INC	VARIANT HUMICOLA GRISEA CBH1.1
8674062	2007	2014	DANISCO US INC	CELL CULTURE COMPOSITIONS
8679314	2012	2014	US DEPARTMENT OF ENERGY	METHANE PRODUCTION USING RESIN-WAFER ELECTRODEIONIZATION
8679816	2010	2014	DANISCO US INC	CELLULASE VARIANTS WITH IMPROVED EXPRESSION, ACTIVITY AND STABILITY, AND USE THEREOF
8679817	2012	2014	DANISCO US INC	VARIANT HYPOCREA JECORINA CBH1 CELLULASE
8679818	2012	2014	DANISCO US INC	BGL7 BETA-GLUCOSIDASE AND NUCLEIC ACIDS ENCODING THE SAME
8679822	2011	2014	E I DU PONT DE NEMOURS & CO	XYLOSE UTILIZATION IN RECOMBINANT ZYMOMONAS
8709776	2012	2014	NOVOZYMES INC	POLYPEPTIDES HAVING BETA-GLUCOSIDASE ACTIVITY AND BETA-XYLOSIDASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
8715994	2012	2014	NOVOZYMES INC	POLYPEPTIDES HAVING BETA-GLUCOSIDASE AND BETA-XYLOSIDASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
8715995	2012	2014	NOVOZYMES INC	POLYPEPTIDES HAVING BETA-GLUCOSIDASE ACTIVITY AND BETA-XYLOSIDASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
8715997	2011	2014	DANISCO US INC	VARIANT HYPOCREA JECORINA CBH2 CELLULASES
8716002	2007	2014	UNIVERSITY OF FLORIDA	RE-ENGINEERING BACTERIA FOR ETHANOL PRODUCTION
8735549	2013	2014	NOVOZYMES INC	METHODS OF INCREASING SECRETION OF POLYPEPTIDES HAVING BIOLOGICAL ACTIVITY
8741654	2012	2014	DANISCO US INC	COMPOSITIONS AND METHODS FOR IMPROVED PROTEIN PRODUCTION
8754266	2013	2014	BATTELLE MEMORIAL	CHEMICAL PRODUCTION PROCESSES AND SYSTEMS

			INSTITUTE	
8759023	2012	2014	NOVOZYMES INC	POLYPEPTIDES HAVING CELLOBIOHYDROLASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
8759040	2013	2014	NOVOZYMES INC	POLYPEPTIDES HAVING CELLOBIOHYDROLASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
8759041	2013	2014	NOVOZYMES INC	POLYPEPTIDES HAVING XYLANASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
8765404	2011	2014	MASSACHUSETTS INSTITUTE OF TECHNOLOGY	MICROBIAL ENGINEERING FOR THE PRODUCTION OF FATTY ACIDS AND FATTY ACID DERIVATIVES
8765426	2012	2014	E I DU PONT DE NEMOURS & CO	PANTOTHENIC ACID BIOSYNTHESIS IN ZYMOMONAS
8765428	2009	2014	MASCOMA CORPORATION	FLOW-THROUGH BIOLOGICAL CONVERSION OF LIGNOCELLULOSIC BIOMASS
8765440	2011	2014	DANISCO US INC	CBH1 HOMOLOGS AND VARIAN CBH1 CELLULASE
8771993	2013	2014	NOVOZYMES INC	POLYPEPTIDES HAVING ENDOGLUCANSE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
8771994	2013	2014	NOVOZYMES INC	POLYPEPTIDES HAVING CELLOBIOHYDROLASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
8778639	2013	2014	NOVOZYMES INC	POLYPEPTIDES HAVING ENDOGLUCANASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
8778640	2013	2014	NOVOZYMES INC	POLYPEPTIDES HAVING CELLOBIOHYDROLASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
8778641	2013	2014	NOVOZYMES INC	POLYPEPTIDES HAVING CELLOBIOHYDROLASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
8795760	2010	2014	POET RESEARCH INC	ZEIN COMPOSITION AND METHODS OF PRODUCTION
8816144	2012	2014	GAS TECHNOLOGY INSTITUTE	DIRECT PRODUCTION OF FRACTIONATED AND UPGRADED HYDROCARBON FUELS FROM BIOMASS

8822179	2012	2014	UNIVERSITY OF FLORIDA	NUCLEIC ACID COMPOSITIONS AND THE ENCODING PROTEINS
8828701	2011	2014	NOVOZYMES INC	CELLOBIOHYDROLASE VARIANTS AND POLYNUCLEOTIDES ENCODING SAME
8828702	2013	2014	DANISCO US INC	VARIANT HUMICOLA GRISEA CBH1.1
8835717	2013	2014	NOVOZYMES INC	POLYPEPTIDES HAVING CELLULOLYTIC ENHANCING ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
8841090	2013	2014	ALLIANCE FOR SUSTAINABLE ENERGY LLC	L-ARABINOSE FERMENTING YEAST
8841495	2011	2014	GAS TECHNOLOGY INSTITUTE	BUBBLING BED CATALYTIC HYDROPYROLYSIS PROCESS UTILIZING LARGER CATALYST PARTICLES AND SMALLER BIOMASS PARTICLES FEATURING AN ANTI-SLUGGING REACTOR
8846351	2011	2014	NOVOZYMES INC	COMPOSITIONS FOR ENHANCING HYDROYSIS OF CELLULOSIC MATERIAL BY CELLULOLYTIC ENZYME COMPOSITIONS
8846369	2013	2014	ALGENOL BIOFUELS INC	CYANOBACTERIUM SP. HOST CELL AND VECTOR FOR PRODUCTION OF CHEMICAL COMPOUNDS IN CYANOBACTERIAL CULTURES
8846888	2012	2014	NOVOZYMES INC	POLYPEPTIDES HAVING CELLULOLYTIC ENHANCING ACTIVITY AND NUCLEIC ACIDS ENCODING SAME
8847031	2009	2014	OKLAHOMA STATE UNIVERSITY	THERMOCELLULASES FOR LIGNOCELLULOSIC DEGRADATION
8852913	2009	2014	NOVOZYMES INC	VARIANTS OF BETA-GLUCOSIDASES
8858657	2011	2014	ARROWHEAD CENTER INC	DIRECT CONVERSION OF ALGAL BIOMASS TO BIOFUEL
8859227	2012	2014	NOVOZYMES INC	POLYPEPTIDES HAVING XYLANASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
8859253	2013	2014	NOVOZYMES INC	CELLOBIOHYDROLASE VARIANTS AND POLYNUCLEOTIDES ENCODING SAME
8859254	2013	2014	NOVOZYMES INC	POLYPEPTIDES HAVING BETA-GLUCOSIDASE

				ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
8859831	2011	2014	GAS TECHNOLOGY INSTITUTE	REMOVAL OF HYDROGEN SULFIDE AS AMMONIUM SULFATE FROM HYDROPYROLYSIS PRODUCT VAPORS
8865445	2013	2014	NOVOZYMES INC	POLYPEPTIDES HAVING CELLULOLYTIC ENHANCING ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
8865446	2013	2014	NOVOZYMES INC	POLYPEPTIDES HAVING CELLULOLYTIC ENHANCING ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
8865447	2013	2014	NOVOZYMES INC	POLYPEPTIDES HAVING XYLANASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
8871486	2014	2014	NOVOZYMES INC	METHODS OF INCREASING SECRETION OF POLYPEPTIDES HAVING BIOLOGICAL ACTIVITY
8877098	2013	2014	BATTELLE MEMORIAL INSTITUTE, GENIFUEL CORP	METHODS FOR SULFATE REMOVAL IN LIQUID-PHASE CATALYTIC HYDROTHERMAL GASIFICATION OF BIOMASS
8877995	2011	2014	UOP LLC	PYROLYSIS FUELS AND METHODS FOR PROCESSING PYROLYSIS FUELS
8894854	2011	2014	COLORADO STATE UNIVERSITY	DIGESTER FOR HIGH SOLIDS WASTE
8895764	2009	2014	WAYNE STATE UNIVERSITY	ZNO NANOPARTICLE CATALYSTS FOR USE IN BIODIESEL PRODUCTION AND METHOD OF MAKING
8900416	2010	2014	UNIVERSITY OF GEORGIA	PRODUCTION OF HIGHER QUALITY BIO-OILS BY IN-LINE ESTERIFICATION OF PYROLYSIS VAPOR
8920609	2010	2014	UNASSIGNED	METHOD OF INCREASING ANHYDROSUGARS, PYROLIGNEOUS FRACTIONS AND ESTERIFIED BIO-OIL
EP2694648	2012	2014	E I DU PONT DE NEMOURS & CO	PANTOTHENIC ACID BIOSYNTHESIS IN ZYMOMONAS
EP2699642	2012	2014	GAS TECHNOLOGY INSTITUTE	BUBBLING BED CATALYTIC HYDROPYROLYSIS PROCESS UTILIZING LARGER CATALYST PARTICLES AND SMALLER BIOMASS

				PARTICLES FEATURING AN ANTI-SLUGGING REACTOR
EP2702153	2012	2014	NOVOZYMES INC	POLYPEPTIDES HAVING ENDOGLUCANASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
EP2702162	2012	2014	NOVOZYMES INC	METHODS FOR ENHANCING THE DEGRADATION OR CONVERSION OF CELLULOSIC MATERIAL
EP2710133	2012	2014	NOVOZYMES INC	METHODS FOR ENHANCING THE DEGRADATION OF CELLULOSIC MATERIAL WITH CHITIN BINDING PROTEINS
EP2714625	2012	2014	VIRENT ENERGY SYSTEMS INC	PRODUCTION OF CHEMICALS AND FUELS FROM BIOMASS
EP2735611	2011	2014	NOVOZYMES INC	POLYPEPTIDES HAVING CELLULOLYTIC ENHANCING ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
EP2739571	2012	2014	GAS TECHNOLOGY INSTITUTE	REMOVAL OF HYDROGEN SULFIDE AS AMMONIUM SULFATE FROM HYDROPYROLYSIS PRODUCT VAPORS
EP2739727	2012	2014	NOVOZYMES INC	POLYPEPTIDES HAVING XYLANASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
EP2739728	2012	2014	NOVOZYMES INC	POLYPEPTIDES HAVING ENDOGLUCANASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
EP2748305	2012	2014	NOVOZYMES INC	CELLULOLYTIC ENZYME COMPOSITIONS AND USES THEREOF
EP2748313	2012	2014	NOVOZYMES INC	CELLULOLYTIC ENZYME COMPOSITIONS AND USES THEREOF
EP2748314	2012	2014	NOVOZYMES INC	ASPERGILLUS FUMIGATUS CELLULOLYTIC ENZYME COMPOSITIONS AND USES THEREOF
EP2767633	2010	2014	ABENGOA BIOENERGY INC	METHOD FOR PRODUCING ETHANOL, AND CO-PRODUCTS FROM CELLULOSIC BIOMASS
EP2780449	2012	2014	NOVOZYMES INC	POLYPEPTIDES HAVING BETA-GLUCOSIDASE ACTIVITY, BETA-XYLOSIDASE ACTIVITY, OR BETA-GLUCOSIDASE AND BETA-XYLOSIDASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME

EP2782998	2012	2014	NOVOZYMES INC	POLYPEPTIDES HAVING BETA-XYLOSIDASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
EP2785732	2012	2014	NOVOZYMES INC	POLYPEPTIDES HAVING BETA-XYLOSIDASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
EP2791282	2012	2014	UOP LLC	METHODS FOR DEOXYGENATING BIOMASS-DERIVED PYROLYSIS OIL
EP2791283	2012	2014	UOP LLC	METHODS FOR DEOXYGENATING BIOMASS-DERIVED PYROLYSIS OIL
EP2794664	2012	2014	NOVOZYMES INC	HYBRID POLYPEPTIDES HAVING CELLOBIOHYDROLASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
EP2794868	2012	2014	NOVOZYMES INC	POLYPEPTIDES HAVING XYLANASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
EP2794869	2012	2014	NOVOZYMES INC	CELLOBIOHYDROLASE VARIANTS AND POLYNUCLEOTIDES ENCODING SAME
EP2794872	2012	2014	NOVOZYMES INC	POLYPEPTIDES HAVING BETA-GLUCOSIDASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
EP2800798	2013	2014	UNIVERSITY OF MAINE	FORMATE-ASSISTED PYROLYSIS
WO2014035458	2013	2014	MASCOMA CORPORATION	EXPRESSION OF ENZYMES IN YEAST FOR LIGNOCELLULOSE DERIVED OLIGOMER CBP
WO2014055527	2013	2014	GAS TECHNOLOGY INSTITUTE	PRODUCING FRACTIONATED AND UPGRADED FUELS FROM BIOMASS
WO2014077944	2013	2014	UOP LLC	APPARATUSES AND METHODS FOR DEOXYGENATING BIOMASS-DERIVED PYROLYSIS OIL
WO2014093275	2013	2014	DANISCO US INC	VARIANTS OF CELLOBIOHYDROLASES
WO2014100798	2013	2014	ALGENOL BIOFUELS INC	NOVEL SHUTTLE VECTOR CAPABLE OF TRANSFORMING MULTIPLE GENERA OF CYANOBACTERIA
WO2014100799	2013	2014	ALGENOL BIOFUELS INC	CYANOBACTERIUM SP. FOR PRODUCTION OF COMPOUNDS
WO2014137991	2014	2014	UT-BATTELLE	CATALYTIC CONVERSION OF

			LLC	ALCOHOLS TO HYDROCARBONS WITH LOW BENZENE CONTENT
WO2014151528	2014	2014	ALTEX TECH CORP	METHOD AND APPARATUS FOR CONVERSION OF CARBONACEOUS MATERIALS TO LIQUID FUEL
WO2014152370	2014	2014	VIRENT ENERGY SYSTEMS INC	PRODUCTION OF AROMATICS FROM DI-AND POLY-OXYGENATES
8927793	2011	2015	UOP LLC	PROCESSES FOR CONVERTING LIGNOCELLULOSICS TO REDUCED ACID PYROLYSIS OIL
8937202	2010	2015	BATTELLE MEMORIAL INSTITUTE	PROCESSES AND SYSTEMS FOR THE PRODUCTION OF PROPYLENE GLYCOL FROM GLYCEROL
8940515	2010	2015	NOVOZYMES INC	POLYPEPTIDES HAVING XYLANASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
8951767	2012	2015	NOVOZYMES INC	POLYPEPTIDES HAVING ENDOGLUCANASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
8956460	2011	2015	ABENGOA BIOENERGY INC	PROCESS FOR RECOVERY OF VALUES FROM A FERMENTATION MASS OBTAINED IN PRODUCING ETHANOL AND PRODUCTS THEREOF
8957259	2005	2015	BATTELLE MEMORIAL INSTITUTE	DIMETHYL ETHER PRODUCTION FROM METHANOL AND/OR SYNGAS
8969534	2013	2015	WISCONSIN ALUMNI RESEARCH FOUNDATION	SELECTIVE AEROBIC ALCOHOL OXIDATION METHOD FOR CONVERSION OF LIGNIN INTO SIMPLE AROMATIC COMPOUNDS
8975059	2013	2015	NOVOZYMES INC	POLYPEPTIDES HAVING ENDOGLUCANASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
8975062	2013	2015	NOVOZYMES INC	POLYPEPTIDES HAVING CELLOBIOHYDROLASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
8979955	2011	2015	VIRGINIA TECH UNIVERSITY	PRODUCTION OF PYROLYSIS OIL
8981168	2013	2015	UNIVERSITY OF MAINE	FORMATE-ASSISTED PYROLYSIS
8993267	2007	2015	DANISCO US INC	CONDITIONING BIOMASS FOR MICROBIAL GROWTH

8993275	2013	2015	NOVOZYMES INC	POLYPEPTIDES HAVING CELLOBIOHYDROLASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
8993276	2013	2015	ALLIANCE FOR SUSTAINABLE ENERGY LLC	CHIMERIC ENZYMES WITH IMPROVED CELLULASE ACTIVITIES
8993286	2012	2015	NOVOZYMES INC	METHODS FOR ENHANCING THE DEGRADATION OF CELLULOSIC MATERIAL WITH CHITIN BINDING PROTEINS
8993287	2009	2015	UNIVERSITY OF FLORIDA	BIOCATALYSTS AND METHODS FOR CONVERSION OF HEMICELLULOSE HYDROLYSATES TO BIOBASED PRODUCTS
8999692	2012	2015	DANISCO US INC	COMPOSITIONS AND METHODS COMPRISING CELLULASE VARIANTS WITH REDUCED AFFINITY TO NON-CELLULOSIC MATERIALS
9005947	2014	2015	DANISCO US INC	BGL7 BETA-GLUCOSIDASE AND NUCLEIC ACIDS ENCODING THE SAME
9005948	2014	2015	DANISCO US INC	EGVII ENDOGLUCANASE AND NUCLEIC ACIDS ENCODING THE SAME
9006409	2014	2015	NOVOZYMES INC	METHODS OF INCREASING SECRETION OF POLYPEPTIDES HAVING BIOLOGICAL ACTIVITY
9012349	2013	2015	UT-BATTELLE LLC	METHOD OF SYNTHESIZING BULK TRANSITION METAL CARBIDE, NITRIDE AND PHOSPHIDE CATALYSTS
9012699	2014	2015	BATTELLE MEMORIAL INSTITUTE	CHEMICAL PRODUCTION PROCESSES AND SYSTEMS
9034628	2011	2015	DANISCO US INC	INDUCTION OF GENE EXPRESSION USING A HIGH CONCENTRATION SUGAR MIXTURE
9051376	2012	2015	NOVOZYMES INC	POLYPEPTIDES HAVING CELLULOLYTIC ENHANCING ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
9057086	2011	2015	NOVOZYMES INC	COMPOSITIONS COMPRISING A POLYPEPTIDE HAVING CELLULOLYTIC ENHANCING ACTIVITY AND A BICYCLE COMPOUND AND USES THEREOF
9068126	2011	2015	UOP LLC	METHODS FOR DEOXYGENATING BIOMASS-

				DERIVED PYROLYSIS OIL
9068176	2012	2015	NOVOZYMES INC	POLYPEPTIDES HAVING ENDOGLUCANASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
9080109	2011	2015	UOP LLC	METHODS FOR DEOXYGENATING BIOMASS-DERIVED PYROLYSIS OIL
9080160	2011	2015	NOVOZYMES INC	POLYPEPTIDES HAVING CELLOBIOHYDROLASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
9080161	2012	2015	NOVOZYMES INC	POLYPEPTIDES HAVING CELLOBIOHYDROLASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
9080162	2012	2015	NOVOZYMES INC	CELLULASE VARIANTS
9080165	2014	2015	NOVOZYMES INC	VARIANTS OF BETA-GLUCOSIDASE
9080194	2014	2015	NOVOZYMES INC	POLYPEPTIDES HAVING ENDOGLUCANASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
9102929	2014	2015	DANISCO US INC	BGL6 BETA-GLUCOSIDASE AND NUCLEIC ACIDS ENCODING THE SAME
9109213	2011	2015	DSM IP ASSETS BV	POLYPEPTIDE HAVING CARBOHYDRATE DEGRADING ACTIVITY AND USES THEREOF
9109214	2011	2015	DSM IP ASSETS BV	HOST CELL CAPABLE OF PRODUCING ENZYMES USEFUL FOR DEGRADATION OF LIGNOCELLULOSIC MATERIAL
9109215	2013	2015	NOVOZYMES INC	POLYPEPTIDES HAVING XYLANASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
9115375	2015	2015	NOVOZYMES INC	METHODS FOR ENHANCING THE DEGRADATION OF CELLULOSIC MATERIAL WITH CHITIN BINDING PROTEINS
9121013	2011	2015	DSM IP ASSETS BV	POLYPEPTIDE HAVING BETA-GLUCOSIDASE ACTIVITY AND USES THEREOF
9127263	2012	2015	BP CORP NORTH AMERICA INC	CELLULOYTIC ENZYMES, NUCLEIC ACIDS ENCODING THEM AND METHODS FOR MAKING AND USING THEM
9133448	2011	2015	DSM IP ASSETS BV	POLYPEPTIDE HAVING CELLOBIOHYDROLASE ACTIVITY AND USES THEREOF

9139823	2011	2015	NOVOZYMES INC	POLYPEPTIDES HAVING ENDOGLUCANASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
9150887	2010	2015	UNIVERSITY OF FLORIDA	ETHANOLOGENIC BACTERIA WITH INCREASED RESISTANCE TO FURFURAL
9157075	2012	2015	NOVOZYMES INC	POLYPEPTIDES HAVING CELLOBIOHYDROLASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
9157101	2013	2015	ALGENOL BIOFUELS INC	CYANOBACTERIUM SP. FOR PRODUCTION OF COMPOUNDS
9157102	2012	2015	UNIVERSITY OF FLORIDA	OVER-EXPRESSION OF NADH-DEPENDENT OXIDOREDUCTASE (FUCO) FOR INCREASING FURFURAL OR 5-HYDROXYMETHYLFURFURAL TOLERANCE
9163181	2012	2015	UOP LLC	METHODS AND APPARATUSES FOR DEOXYGENATING BIOMASS-DERIVED PYROLYSIS OIL
9163223	2011	2015	DSM IP ASSETS BV	POLYPEPTIDE HAVING ACETYL XYLAN ESTERASE ACTIVITY AND USES THEREOF
9163224	2010	2015	DSM IP ASSETS BV	CARBOHYDRATE DEGRADING POLYPEPTIDE AND USES THEREOF
9169447	2011	2015	ELEVANCE RENEWABLE SCIENCES INC	METHODS OF REFINING NATURAL OILS, AND METHODS OF PRODUCING FUEL COMPOSITIONS
9169473	2013	2015	NOVOZYMES INC	POLYPEPTIDES HAVING XYLANASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
9175050	2011	2015	DSM IP ASSETS BV	POLYPEPTIDE HAVING SWOLLENIN ACTIVITY AND USES THEREOF
9175231	2011	2015	ELEVANCE RENEWABLE SCIENCES INC	METHODS OF REFINING NATURAL OILS AND METHODS OF PRODUCING FUEL COMPOSITIONS
9175235	2013	2015	UNIVERSITY OF GEORGIA	TORREFACTION REDUCTION OF COKE FORMATION ON CATALYSTS USED IN ESTERIFICATION AND CRACKING OF BIOFUELS FROM PYROLYSED LIGNOCELLULOSIC FEEDSTOCKS

9175275	2013	2015	BP CORP NORTH AMERICA INC	CELLULOYTIC ENZYMES, NUCLEIC ACIDS ENCODING THEM AND METHODS FOR MAKING AND USING THEM
9175276	2013	2015	NOVOZYMES INC	POLYPEPTIDES HAVING ENDOGLUCANASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
9175277	2013	2015	NOVOZYMES INC	COMPOSITIONS FOR SACCHARIFICATION OF CELLULOSIC MATERIAL
9181493	2014	2015	UT-BATTELLE LLC	CATALYTIC CONVERSION OF ALCOHOLS HAVING AT LEAST THREE CARBON ATOMS TO HYDROCARBON BLENDSTOCK
9187740	2013	2015	NOVOZYMES INC	POLYPEPTIDES HAVING CELLOBIOHYDROLASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
9187741	2015	2015	NOVOZYMES INC	POLYPEPTIDES HAVING ENDOGLUCANASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
9187742	2011	2015	NOVOZYMES INC	POLYPEPTIDES HAVING CELLOBIOHYDROLASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
9187776	2015	2015	NOVOZYMES INC	POLYPEPTIDES HAVING CELLOBIOHYDROLASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
9192931	2012	2015	UOP LLC	PROCESSES FOR WASHING A SPENT ION EXCHANGE BED AND FOR TREATING BIOMASS-DERIVED PYROLYSIS OIL, AND APPARATUSES FOR TREATING BIOMASS-DERIVED PYROLYSIS OIL
9199889	2013	2015	ALTEX TECH CORP	METHOD AND APPARATUS FOR CONVERSION OF CARBONACEOUS MATERIALS TO LIQUID FUEL
9206367	2007	2015	UNIVERSITY OF NORTH DAKOTA	METHOD FOR COLD STABLE BIOJET FUEL
9206445	2014	2015	ALLIANCE FOR SUSTAINABLE ENERGY LLC	BIOCATALYSTS WITH ENHANCED INHIBITOR TOLERANCE
9212320	2012	2015	VIRENT ENERGY SYSTEMS INC	PRODUCTION OF CHEMICALS AND FUELS FROM BIOMASS
9212328	2012	2015	VIRENT ENERGY SYSTEMS INC	APPARATUS AND METHOD FOR CONVERTING BIOMASS

				TO FEEDSTOCK FOR BIOFUEL AND BIOCHEMICAL MANUFACTURING PROCESSES
9212354	2011	2015	NOVOZYMES INC	POLYPEPTIDES HAVING CELLOBIOHYDROLASE ACTIVITIY AND POLYNUCLEOTIDES ENCODING SAME
9222032	2013	2015	MISSISSIPPI STATE UNIVERSITY	COMPOSITION AND METHODS FOR IMPROVED FUEL PRODUCTION
9222037	2012	2015	UOP LLC	APPARATUSES AND METHODS FOR DEOXYGENATING BIOMASS-DERIVED PYROLYSIS OIL
EP2831203	2013	2015	UOP LLC	PROCESSES FOR WASHING A SPENT ION EXCHANGE BED
EP2847202	2013	2015	VIRDIA INC	METHODS FOR TREATING LIGNOCELLULOSIC MATERIALS
EP2858743	2013	2015	UOP LLC	METHOD AND APPARATUS FOR PRODUCING PYROLYSIS OIL HAVING IMPROVED STABILITY
EP2859070	2013	2015	BATTELLE MEMORIAL INSTITUTE	COMBINED HYDROTHERMAL LIQUEFACTION AND CATALYTIC HYDROTHERMAL GASIFICATION SYSTEM AND PROCESS FOR CONVERSION OF BIOMASS FEEDSTOCKS
EP2862890	2013	2015	VIRDIA INC	METHOD FOR THE EXTRACTION OF LIGNIN FROM BIOMASS
EP2878349	2013	2015	VIRDIA INC	FRACTIONATION OF A MIXTURE BY SEQUENTIAL SIMULATED MOVING BED CHROMATOGRAPHY
EP2878614	2013	2015	VIRDIA INC	METHODS FOR TREATING LIGNOCELLULOSIC MATERIALS
EP2890784	2013	2015	LALLEMAND HUNGARY LIQUIDITY MANAGEMENT LLC	EXPRESSION OF ENZYMES IN YEAST FOR LIGNOCELLULOSE DERIVED OLIGOMER CBP
EP2904073	2013	2015	GAS TECHNOLOGY INSTITUTE	PRODUCING FRACTIONATED AND UPGRADED FUELS FROM BIOMASS
EP2920274	2013	2015	UOP LLC	APPARATUSES AND METHODS FOR DEOXYGENATING BIOMASS-DERIVED PYROLYSIS OIL
EP2931887	2013	2015	DANISCO US INC	VARIANTS OF CELLOBIOHYDROLASES
EP2935566	2013	2015	ALGENOL	CYANOBACTERIUM SP. FOR

			BIOFUELS INC	PRODUCTION OF COMPOUNDS
WO2015002922	2014	2015	UT-BATTELLE LLC	CATALYTIC CONVERSION OF ALCOHOLS HAVING AT LEAST THREE CARBON ATOMS TO HYDROCARBON BLENDSTOCK
WO2015017254	2014	2015	DANISCO US INC	VARIANT ENZYMES
WO2015017255	2014	2015	DANISCO US INC	VARIANT ENZYMES
WO2015017256	2014	2015	DANISCO US INC	VARIANT ENZYMES
WO2015069845	2014	2015	BATTELLE MEMORIAL INSTITUTE; GENIFUEL CORP	SYSTEM AND PROCESS FOR EFFICIENT SEPARATION OF BIOCRUDES AND WATER IN A HYDROTHERMAL LIQUEFACTION SYSTEM
WO2015200354	2015	2015	TETHYS RESEARCH LLC	ENZYMES THAT CLEAVE NON-GLYCOSIDIC ETHER BONDS BETWEEN LIGNINS OR DERIVATIVES THEREOF AND SACCHARIDES
9242222	2011	2016	UNIVERSITY OF TOLEDO	ALDOSE-KETOSE TRANSFORMATION FOR SEPARATION AND/OR CHEMICAL CONVERSION OF C6 AND C5 SUGARS FROM BIOMASS MATERIALS
9249432	2013	2016	ALLIANCE FOR SUSTAINABLE ENERGY LLC	ENZYMES FOR IMPROVED BIOMASS CONVERSION
9260704	2011	2016	DSM IP ASSETS BV	POLYPEPTIDE HAVING OR ASSISTING IN CARBOHYDRATE MATERIAL DEGRADING ACTIVITY AND USES THEREOF
9267126	2011	2016	NOVOZYMES INC	POLYPEPTIDES HAVING ENDOGLUCANASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
9273335	2011	2016	NOVOZYMES INC	COMPOSITIONS COMPRISING A POLYPEPTIDE HAVING CELLULOLYTIC ENHANCING ACTIVITY AND A QUINONE COMPOUND AND USES THEREOF
9278892	2014	2016	UT-BATTELLE LLC	CATALYTIC CONVERSION OF ALCOHOLS TO HYDROCARBONS WITH LOW BENZENE CONTENT
9303074	2011	2016	NOVOZYMES INC	POLYPEPTIDES HAVING CELLULOLYTIC ENHANCING ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
9308501	2012	2016	UT-BATTELLE LLC	SUPER-SURFACE SELECTIVE NANOMEMBRANES PROVIDING SIMULTANEOUS

				HIGH PERMEATION FLUX AND HIGH SELECTIVITY
9315832	2014	2016	ALGENOL BIOFUELS INC	CYANOBACTERIUM SP. HOST CELL AND VECTOR FOR PRODUCTION OF CHEMICAL COMPOUNDS IN CYANOBACTERIAL CULTURES
9321815	2014	2016	POET RESEARCH INC	SYSTEM FOR EXTRACTING PROTEIN FROM A FERMENTATION PRODUCT
9335043	2010	2016	ABENGOA BIOENERGY INC	METHOD FOR PRODUCING ETHANOL AND CO-PRODUCTS FROM CELLULOSIC BIOMASS
9340810	2012	2016	NOVOZYMES INC	POLYPEPTIDES HAVING CELLULOLYTIC ENHANCING ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
9347077	2012	2016	UNIVERSITY OF FLORIDA	OVER-EXPRESSION OF A PUTATIVE OXIDOREDUCTASE (UCPA) FOR INCREASING FURFURAL OR 5-HYDROXYMETHYLFURFURAL TOLERANCE
9353360	2015	2016	NOVOZYMES INC	POLYPEPTIDES HAVING XYLANASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
9353363	2012	2016	NOVOZYMES AS	GLYCOSIDE HYDROLASES FROM THERMOPHILIC FUNGI
9353391	2011	2016	NOVOZYMES INC	COMPOSITIONS COMPRISING A POLYPEPTIDE HAVING CELLULOLYTIC ENHANCING ACTIVITY AND A NITROGEN-CONTAINING COMPOUND AND USES THEREOF
9365843	2015	2016	NOVOZYMES INC	POLYPEPTIDES HAVING CELLULOLYTIC ENHANCING ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
9371551	2015	2016	NOVOZYMES INC	METHODS FOR ENHANCING THE DEGRADATION OF CELLULOSIC MATERIAL WITH CHITIN BINDING PROTEINS
9376670	2014	2016	NOVOZYMES INC	POLYPEPTIDES HAVING CELLOBIOHYDROLASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
9382185	2014	2016	VIRENT ENERGY SYSTEMS INC	PROCESSES FOR CONVERTING BIOMASS-DERIVED FEEDSTOCKS TO CHEMICALS AND LIQUID FUELS

9388364	2015	2016	BATTELLE MEMORIAL INSTITUTE	LIQUEFACTION PROCESSES AND SYSTEMS AND LIQUEFACTION PROCESS INTERMEDIATE COMPOSITIONS
9394555	2011	2016	NOVOZYMES INC	COMPOSITIONS COMPRISING A POLYPEPTIDE HAVING CELLULOLYTIC ENHANCING ACTIVITY AND A DIOXY COMPOUND AND USES THEREOF
9403736	2014	2016	VIRENT ENERGY SYSTEMS INC	PRODUCTION OF AROMATICS FROM DI- AND POLYOXYGENATES
9404063	2014	2016	BATTELLE MEMORIAL INSTITUTE, GENIFUEL CORP	SYSTEM AND PROCESS FOR EFFICIENT SEPARATION OF BIOCRUDES AND WATER IN A HYDROTHERMAL LIQUEFACTION SYSTEM
9404137	2011	2016	NOVOZYMES INC	COMPOSITIONS COMPRISING A POLYPEPTIDE HAVING CELLULOLYTIC ENHANCING ACTIVITY AND A HETEROCYCLIC COMPOUND AND USES THEREOF
9409958	2012	2016	NOVOZYMES INC	POLYPEPTIDES HAVING CELLULOLYTIC ENHANCING ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
9410136	2012	2016	NOVOZYMES INC	METHODS FOR ENHANCING THE DEGRADATION OR CONVERSION OF CELLULOSIC MATERIAL
9410158	2013	2016	CARGILL INC	GENETICALLY MODIFIED YEAST SPECIES, AND FERMENTATION PROCESSES USING GENETICALLY MODIFIED YEAST
9410165	2014	2016	NOVOZYMES INC	POLYPEPTIDES HAVING CELLULOLYTIC ENHANCING ACTIVITY AND NUCLEIC ACIDS ENCODING SAME
9422537	2015	2016	UNASSIGNED	METHODS FOR USING POLYPEPTIDES HAVING CELLOBIOHYDROLASE ACTIVITY
9422584	2012	2016	NOVOZYMES INC	FATTY ACID ESTERIFICATION PROCESS
9433924	2010	2016	WAYNE STATE UNIVERSITY	METALOXIDE—ZRO2 CATALYSTS FOR THE ESTERIFICATION AND TRANSESTERIFICATION OF FREE FATTY ACIDS AND TRIGLYCERIDES TO OBTAIN BIO-DIESEL

9434658	2013	2016	UT-BATTELLE LLC	CATALYTIC CONVERSION OF ALCOHOLS TO HYDROCARBONS WITH LOW BENZENE CONTENT
9440892	2014	2016	VIRENT ENERGY SYSTEMS INC	PRODUCTION OF AROMATICS FROM DI- AND POLYOXYGENATES
9441214	2011	2016	DSM IP ASSETS BV	POLYPEPTIDE HAVING BETA-GLUCOSIDASE ACTIVITY AND USES THEREOF
9441248	2011	2016	UCHICAGO ARGONNE LLC	ENGINEERED PHOTOSYNTHETIC BACTERIA, METHOD OF MANUFACTURE OF BIOFUELS
9447400	2010	2016	DANISCO US INC	BETA-GLUCOSIDASE I VARIANTS WITH IMPROVED PROPERTIES
9453181	2014	2016	UOP LLC	METHODS FOR REMOVING CONTAMINANTS FROM ALGAL OIL
9458483	2015	2016	NOVOZYMES INC	COMPOSITIONS COMPRISING A POLYPEPTIDE HAVING CELLULOLYTIC ENHANCING ACTIVITY AND A BICYCLIC COMPOUND AND USES THEREOF
9476036	2012	2016	NOVOZYMES INC	CELLULOLYTIC ENZYME COMPOSITIONS AND USES THEREOF
9476067	2015	2016	ALGENOL BIOFUELS INC	SHUTTLE VECTOR CAPABLE OF TRANSFORMING MULTIPLE GENERA OF CYANOBACTERIA
9476068	2010	2016	ABENGOA BIOENERGY INC	HIGH EFFICIENCY PROCESS AND HIGH PROTEIN FEED CO-PRODUCT
9481897	2012	2016	NOVOZYMES INC	HYBRID POLYPEPTIDES HAVING CELLOBIOHYDROLASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
9487565	2014	2016	POET RESEARCH INC	ZEIN COMPOSITION AND METHODS OF PRODUCTION
9493793	2011	2016	CARGILL INC	COMPOSITIONS AND METHODS FOR INCREASED ETHANOL TITER FROM BIOMASS
9493851	2013	2016	VIRDIA INC	METHODS FOR TREATING LIGNOCELLULOSIC MATERIALS
9499806	2016	2016	NOVOZYMES INC	POLYPEPTIDES HAVING CELLULOLYTIC ENHANCING ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME

9506048	2012	2016	NOVOZYMES INC	POLYPEPTIDES HAVING CELLOBIOHYDROLASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
9506049	2014	2016	NOVOZYMES INC	POLYPEPTIDES HAVING CELLULOLYTIC ENHANCING ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
9512364	2014	2016	GAS TECHNOLOGY INSTITUTE	BUBBLING BED CATALYTIC HYDROPYROLYSIS PROCESS UTILIZINIG LARGER CATALYST PARTICLES AND SMALL BIOMASS PARTICLES FEATURING AN ANTI-SLUGGING REACTOR
9518253	2015	2016	NOVOZYMES INC	POLYPEPTIDES HAVING CELLOBIOHYDROLASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
9522965	2012	2016	WASHINGTON STATE UNIVERSITY	SEQUENTIAL HYDROTHERMAL LIQUIFACTION (SEQHTL) FOR EXTRACTION OF SUPERIOR BIO-OIL AND OTHER ORGANIC COMPOUNDS FROM OLEAGINOUS BIOMASS
9523087	2014	2016	DANISCO US INC	CELLULASE VARIANTS WITH IMPROVED EXPRESSION, ACTIVITY AND STABILITY, AND USE THEREOF
9527022	2012	2016	UOP LLC	METHOD AND APPARATUS FOR PRODUCING PYROLYSIS OIL HAVING IMPROVED STABILITY
EP2964380	2014	2016	UT-BATTELLE LLC	CATALYTIC CONVERSION OF ALCOHOLS TO HYDROCARBONS WITH LOW BENZENE CONTENT
EP2970775	2014	2016	VIRENT ENERGY SYSTEMS INC	PRODUCTION OF AROMATICS FROM DI-AND POLY-OXYGENATES
EP2970790	2014	2016	ALTEX TECH CORP	METHOD FOR CONVERSION OF CARBONACEOUS MATERIALS TO LIQUID FUEL
EP2977382	2010	2016	NOVOZYMES INC	POLYPEPTIDES HAVING CELLULOLYTIC ENHANCING ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
EP2987857	2004	2016	NOVOZYMES INC	VARIANTS OF GLYCOSIDE HYDROLASES
EP3016923	2014	2016	UT-BATTELLE LLC	CATALYTIC CONVERSION OF ALCOHOLS SELECTED FROM

				N-HEPTANOL AND N-OCTANOL TO A HYDROCARBON BLENDSTOCK
EP3023492	2011	2016	NOVOZYMES INC	BETA-GLUCOSIDASE VARIANTS AND POLYNUCLEOTIDES ENCODING SAME
EP3027741	2014	2016	DANISCO US INC	GH61 ENZYME VARIANTS
EP3027742	2014	2016	DANISCO US INC	VARIANT ENZYMES
EP3027743	2014	2016	DANISCO US INC	VARIANT ENZYMES
EP3091073	2012	2016	NOVOZYMES INC	POLYPEPTIDES HAVING XYLANASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
WO2016024215	2015	2016	LALLEMAND HUNGARY LIQUIDITY MANAGEMENT LLC	MUTATIONS IN IRON-SULFUR CLUSTER PROTEINS THAT IMPROVE XYLOSE UTILIZATION
WO2016067032	2015	2016	BATTELLE MEMORIAL INSTITUTE	SYSTEMS AND PROCESSES FOR CONVERSION OF ETHYLENE FEEDSTOCKS TO HYDROCARBON FUELS
WO2016067033	2015	2016	BATTELLE MEMORIAL INSTITUTE	SYSTEMS AND PROCESSES FOR CONVERSION OF ETHYLENE FEEDSTOCKS TO HYDROCARBON FUELS
WO2016077577	2015	2016	UCHICAGO ARGONNE LLC	METHOD FOR GENERATING METHANE FROM A CARBONACEOUS FEEDSTOCK
WO2016085562	2015	2016	UOP LLC	METHODS AND APPARATUSES FOR DEOXYGENATING PYROLYSIS OIL
WO2016201059	2016	2016	BATTELLE MEMORIAL INSTITUTE	LIQUEFACTION PROCESSES AND SYSTEMS AND LIQUEFACTION PROCESS INTERMEDIATE COMPOSITIONS
9562222	2012	2017	NOVOZYMES INC	POLYPEPTIDES HAVING BETA-GLUCOSIDASE ACTIVITY, BETA-XYLOSIDASE ACTIVITY, OR BETA-GLUCOSIDASE AND BETA-XYLOSIDASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
9562248	2015	2017	NOVOZYMES INC	POLYPEPTIDES HAVING CELLOBIOHYDROLASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
9587262	2015	2017	NOVOZYMES INC	COMPOSITIONS FOR SACCHARIFICATION OF CELLULOSIC MATERIAL

9593054	2013	2017	VIRENT ENERGY SYSTEMS INC	PRODUCTION OF DISTILLATE FUELS FROM BIOMASS-DERIVED POLYOXYGENATES
9593282	2014	2017	GAS TECHNOLOGY INSTITUTE	REMOVAL OF HYDROGEN SULFIDE AS AMMONIUM SULFATE FROM HYDROPYROLYSIS PRODUCT VAPORS
9605037	2016	2017	NOVOZYMES INC	RECOMBINANT HOST CELLS AND NUCLEIC ACID CONSTRUCTS ENCODING POLYPEPTIDES HAVING CELLULOLYTIC ENHANCING ACTIVITY
9605269	2011	2017	LALLEMAND HUNGARY LIQUIDITY MANAGEMENT LLC	DETOXIFICATION OF BIOMASS DERIVED ACETATE VIA METABOLIC CONVERSION TO ETHANOL, ACETONE, ISOPROPANOL, OR ETHYL ACETATE
9611439	2013	2017	IOWA STATE UNIVERSITY	BIO-OIL FRACTIONATION AND CONDENSATION
9611463	2014	2017	NOVOZYMES INC	CELLOBIOHYDROLASE VARIANTS AND POLYNUCLEOTIDES ENCODING SAME
9617574	2014	2017	AUBURN UNIVERSITY	EFFICIENT PROCESS FOR PRODUCING SACCHARIDES AND ETHANOL FROM A BIOMASS FEEDSTOCK
9624481	2012	2017	NOVOZYMES INC	POLYPEPTIDES HAVING BETA-XYLOSIDASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
9624518	2012	2017	NOVOZYMES INC	METHODS FOR ENHANCING THE DEGRADATION OR CONVERSION OF CELLULOSIC MATERIAL
9631146	2013	2017	ALLIANCE FOR SUSTAINABLE ENERGY LLC	HYDROXIDE CATALYSTS FOR LIGNIN DEPOLYMERIZATION
9631246	2014	2017	VIRDIA INC	METHODS FOR TREATING LIGNOCELLULOSIC MATERIALS
9636664	2016	2017	ALLIANCE FOR SUSTAINABLE ENERGY LLC	METAL PHOSPHIDE CATALYSTS AND METHODS FOR MAKING THE SAME AND USES THEREOF
9637725	2012	2017	NOVOZYMES INC	POLYPEPTIDES HAVING CATALASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
9637727	2014	2017	NOVOZYMES INC	POLYPEPTIDES HAVING XYLANASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME

9644192	2014	2017	DANISCO US INC	VARIANT HUMICOLA GRISEA CBH1.1
9650687	2014	2017	VIRDIA INC	METHODS FOR TREATING LIGNOCELLULOSIC MATERIALS
9656937	2016	2017	VIRENT ENERGY SYSTEMS INC	PROCESSES FOR CONVERTING BIOMASS-DERIVED FEEDSTOCKS TO CHEMICALS AND LIQUID FUELS
9663416	2014	2017	BATTELLE MEMORIAL INSTITUTE	SYSTEMS AND PROCESSES FOR CONVERSION OF ETHYLENE FEEDSTOCKS TO HYDROCARBON FUELS
9663435	2016	2017	BATTELLE MEMORIAL INSTITUTE	PROCESS FOR CONVERSION OF LEVULINIC ACID TO KETONES
9663772	2012	2017	NOVOZYMES INC	ASPERGILLUS FUMIGATUS CELLULOLYTIC ENZYME COMPOSITIONS AND USES THEREOF
9663774	2015	2017	NOVOZYMES INC	POLYPEPTIDES HAVING ENDOGLUCANASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
9663808	2014	2017	NOVOZYMES INC	COMPOSITIONS COMPRISING A POLYPEPTIDE HAVING CELLULOLYTIC ENHANCING ACTIVITY AND AN ORGANIC COMPOUND AND USES THEREOF
9676830	2011	2017	NOVOZYMES INC	CHIMERIC POLYPEPTIDES HAVING CELLULOLYTIC ENHANCING ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
9683225	2012	2017	NOVOZYMES INC	POLYPEPTIDES HAVING XYLANASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
9683248	2012	2017	ALLIANCE FOR SUSTAINABLE ENERGY LLC	ENHANCED PROCESSIVE CELLULASES
9688975	2011	2017	NOVOZYMES INC	BETA-GLUCOSIDASE VARIANTS AND POLYNUCLEOTIDES ENCODING SAME
9695094	2016	2017	VIRENT ENERGY SYSTEMS INC	PRODUCTION OF AROMATICS FROM DI- AND POLYOXYGENATES
9695407	2015	2017	DANISCO US INC	COMPOSITIONS AND METHODS COMPRISING CELLULASE VARIANTS WITH REDUCED AFFINITY TO NON-CELLULOSIC MATERIALS
9695433	2012	2017	NOVOZYMES INC	POLYPEPTIDES HAVING

				BETA-XYLOSIDASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
9701951	2014	2017	NOVOZYMES INC	VARIANTS OF GLYCOSIDE HYDROLASES
9708591	2012	2017	NOVOZYMES INC	POLYPEPTIDES HAVING ENDOGLUCANASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
9714416	2012	2017	NOVOZYMES INC	CELLULOLYTIC ENZYME COMPOSITIONS AND USES THEREOF
9718748	2016	2017	SANDIA CORP	METAL-ORGANIC FRAMEWORK CATALYSTS FOR SELECTIVE CLEAVAGE OF ARYL-ETHER BONDS
9725489	2017	2017	NOVOZYMES INC	POLYPEPTIDES HAVING CELLULOLYTIC ENHANCING ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
9738874	2012	2017	NOVOZYMES INC	POLYPEPTIDES HAVING LACCASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
9738881	2015	2017	DSM IP ASSETS BV	HOST CELL CAPABLE OF PRODUCING ENZYMES USEFUL FOR DEGRADATION OF LIGNOCELLULOSIC MATERIAL
9745560	2013	2017	LALLEMAND HUNGARY LIQUIDITY MANAGEMENT LLC	EXPRESSION OF ENZYMES IN YEAST FOR LIGNOCELLULOSE DERIVED OLIGOMER CBP
9751916	2016	2017	NOVOZYMES INC	POLYPEPTIDES HAVING CELLULOLYTIC ENHANCING ACTIVITY AND NUCLEIC ACIDS ENCODING SAME
9752168	2016	2017	NOVOZYMES INC	COMPOSITIONS COMPRISING A POLYPEPTIDE HAVING CELLULOLYTIC ENHANCING ACTIVITY AND A QUINONE COMPOUND AND USES THEREOF
9758441	2014	2017	UOP LLC	METHODS AND APPARATUSES FOR DEOXYGENATING PYROLYSIS OIL
9758728	2013	2017	BATTELLE MEMORIAL INSTITUTE	COMBINED HYDROTHERMAL LIQUEFACTION AND CATALYTIC HYDROTHERMAL GASIFICATION SYSTEM AND PROCESS FOR CONVERSION OF BIOMASS FEEDSTOCKS
9758799	2016	2017	CARGILL INC	GENETICALLY MODIFIED

				YEAST SPECIES, AND FERMENTATION PROCESSES USING GENETICALLY MODIFIED YEAST
9764279	2013	2017	UNIVERSITY OF WYOMING	BIOLOGICAL REDUCTION OF CARBON DIOXIDE POLLUTANTS SYSTEMS AND METHODS
9765362	2013	2017	GENIFUEL CORP	CLOSED-LOOP SYSTEM FOR GROWTH OF AQUATIC BIOMASS AND GASIFICATION THEREOF
9765372	2014	2017	NOVOZYMES INC	POLYPEPTIDES HAVING CELLULOLYTIC ENHANCING ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
9771533	2014	2017	BATTELLE MEMORIAL INSTITUTE	SYSTEMS AND PROCESSES FOR CONVERSION OF ETHYLENE FEEDSTOCKS TO HYDROCARBON FUELS
9771568	2012	2017	NOVOZYMES INC	POLYPEPTIDES HAVING BETA-GLUCOSIDASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
9771569	2016	2017	NOVOZYMES INC	POLYPEPTIDES HAVING XYLANASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
9776177	2013	2017	WAYNE STATE UNIVERSITY	BIMETAL CATALYSTS
9777224	2016	2017	BATTELLE MEMORIAL INSTITUTE	METHODS FOR CONVERSION OF LIGNOCELLULOSIC-DERIVED PRODUCTS TO TRANSPORTATION FUEL PRECURSORS
9783861	2014	2017	VIRDIA INC	METHODS FOR TREATING LIGNOCELLULOSIC MATERIALS
9790249	2015	2017	ALLIANCE FOR SUSTAINABLE ENERGY LLC	HYDROXIDE CATALYSTS FOR LIGNIN DEPOLYMERIZATION
9790530	2017	2017	NOVOZYMES INC	METHODS FOR ENHANCING THE DEGRADATION OR CONVERSION OF CELLULOSIC MATERIAL
9796969	2015	2017	TETHYS RESEARCH LLC	ENZYMES THAT CLEAVE NON-GLYCOSIDIC ETHER BONDS BETWEEN LIGNINS OR DERIVATIVES THEREOF AND SACCHARIDES
9803221	2012	2017	ENCHI CORP, DARTMOUTH COLLEGE	ENGINEERING MICROORGANISMS TO INCREASE ETHANOL PRODUCTION BY METABOLIC

				REDIRECTION
9809781	2015	2017	UNIVERSITY OF TOLEDO	THERMAL FRACTIONATION OF BIOMASS OF NON-LIGNOCELLULOSIC ORIGIN FOR MULTIPLE HIGH-QUALITY BIOFUELS
9816082	2011	2017	NOVOZYMES INC	VARIANTS OF POLYPEPTIDES HAVING CELLULOLYTIC ENHANCING ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
9822350	2016	2017	NOVOZYMES INC	POLYPEPTIDES HAVING CELLOBIOHYDROLASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
EP3161134	2015	2017	TETHYS RESEARCH LLC	ENZYMES THAT CLEAVE NON-GLYCOSIDIC ETHER BONDS BETWEEN LIGNINS OR DERIVATIVES THEREOF AND SACCHARIDES
EP3180419	2015	2017	LALLEMAND HUNGARY LIQUIDITY MANAGEMENT LLC	MUTATIONS IN IRON-SULFUR CLUSTER PROTEINS THAT IMPROVE XYLOSE UTILIZATION
EP3190165	2012	2017	GAS TECHNOLOGY INSTITUTE	BUBBLING BED CATALYTIC HYDROPYROLYSIS PROCESS UTILIZING LARGER CATALYST PARTICLES AND SMALLER BIOMASS PARTICLES FEATURING AN ANTI-SLUGGING REACTOR
EP3212736	2015	2017	BATTELLE MEMORIAL INSTITUTE	SYSTEMS AND PROCESSES FOR CONVERSION OF ETHYLENE FEEDSTOCKS TO HYDROCARBON FUELS
EP3212737	2015	2017	BATTELLE MEMORIAL INSTITUTE	SYSTEMS AND PROCESSES FOR CONVERSION OF ETHYLENE FEEDSTOCKS TO HYDROCARBON FUELS
EP3219806	2005	2017	NOVOZYMES INC	METHODS FOR DEGRADING OR CONVERTING PLANT CELL WALL POLYSACCHARIDES
EP3222716	2010	2017	NOVOZYMES INC	COMPOSITION FOR SACCHARIFICATION OF CELLULOSIC MATERIAL
EP3235903	2012	2017	NOVOZYMES INC	POLYPEPTIDES HAVING CELLOBIOHYDROLASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
9862893	2012	2018	VIRENT ENERGY SYSTEMS INC	PROCESS FOR PURIFYING LIGNOCELLULOSIC FEEDSTOCKS
9862974	2013	2018	ALGENOL	CYANOBACTERIUM SP. HOST

			BIOFUELS INC	CELL AND VECTOR FOR PRODUCTION OF CHEMICAL COMPOUNDS IN CYANOBACTERIAL CULTURES
9873837	2015	2018	VIRENT ENERGY SYSTEMS INC	PRODUCTION OF CHEMICALS AND FUELS FROM BIOMASS
9879242	2017	2018	NOVOZYMES INC	POLYPEPTIDES HAVING ENDOGLUCANASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
9885029	2017	2018	NOVOZYMES INC	POLYPEPTIDES HAVING XYLANASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
9896674	2016	2018	DANISCO US INC	VARIANT HYPROCREA JECORINA CBH1 CELLULASES
9920312	2015	2018	LALLEMAND HUNGARY LIQUIDITY MANAGEMENT LLC	MUTATIONS IN IRON-SULFUR CLUSTER PROTEINS THAT IMPROVE XYLOSE UTILIZATION
9926547	2012	2018	NOVOZYMES INC	POLYPEPTIDES HAVING ENDOGLUCANASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
9932414	2011	2018	NOVOZYMES INC	METHODS OF PRETREATING CELLULOSIC MATERIAL WITH A FAMILY 61 POLYPEPTIDE
9932531	2017	2018	BATTELLE MEMORIAL INSTITUTE	SYSTEMS AND PROCESSES FOR CONVERSION OF ETHYLENE FEEDSTOCKS TO HYDROCARBON FUELS
9938551	2013	2018	DANISCO US INC	VARIANTS OF CELLOBIOHYDROLASES
9944581	2017	2018	VIRENT ENERGY SYSTEMS INC	PROCESSES FOR CONVERTING BIOMASS-DERIVED FEEDSTOCKS TO CHEMICALS AND LIQUID FUELS
9944861	2015	2018	UT-BATTELLE LLC	CATALYTIC CONVERSION OF ALCOHOLS HAVING AT LEAST THREE CARBON ATOMS TO HYDROCARBON BLENDSTOCK
9957491	2016	2018	NOVOZYMES INC	POLYPEPTIDES HAVING CELLULOLYTIC ENHANCING ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
9961909	2015	2018	DANISCO US INC	BGL6 BETA-GLUCOSIDASE AND NUCLEIC ACIDS ENCODING THE SAME
9969993	2008	2018	NOVOZYMES INC	FILAMENTOUS FUNGAL HOST CELLS AND METHODS OF RECOMBINANTLY

				PRODUCING PROTEINS
9969994	2016	2018	NOVOZYMES INC	HYBRID POLYPEPTIDES HAVING CELLOBIOHYDROLASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
9970015	2017	2018	NOVOZYMES INC	ASPERGILLUS FUMIGATUS CELLULOLYTIC ENZYME COMPOSITIONS AND USES THEREOF
9994832	2016	2018	NOVOZYMES INC	RECOMBINANT HOST CELL EXPRESSING A FAMILY GLYCOSIDE HYDROLASE 61 POLYPEPTIDE
9994870	2014	2018	UCHICAGO ARGONNE LLC	METHOD FOR GENERATING METHANE FROM A CARBONACEOUS FEEDSTOCK
10005700	2016	2018	VIRENT ENERGY SYSTEMS INC	PRODUCTION OF AROMATICS FROM DI- AND POLYOXYGENATES
10005974	2017	2018	BATTELLE MEMORIAL INSTITUTE	SYSTEMS AND PROCESSES FOR CONVERSION OF ETHYLENE FEEDSTOCKS TO HYDROCARBON FUELS
10006012	2014	2018	NOVOZYMES INC	POLYPEPTIDES HAVING CELLULOLYTIC ENHANCING ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
10006015	2017	2018	NOVOZYMES INC	POLYPEPTIDES HAVING BETA-XYLOSIDASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
10006065	2014	2018	MASSACHUSETTS INSTITUTE OF TECHNOLOGY	MICROBIAL ENGINEERING FOR THE PRODUCTION OF FATTY ACIDS AND FATTY ACID DERIVATIVES
10017753	2012	2018	NOVOZYMES INC	POLYPEPTIDES HAVING CELLULOLYTIC ENHANCING ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
10017755	2016	2018	NOVOZYMES INC	POLYPEPTIDES HAVING CELLOBIOHYDROLASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
10017792	2015	2018	ALLIANCE FOR SUSTAINABLE ENERGY LLC	BIOMASS CONVERSION TO FUELS AND CHEMICALS
10030205	2015	2018	UNIVERSITY OF NEVADA RENO	COMPOSITIONS AND METHODS OF MAKING BIOFUEL
10035828	2017	2018	NOVOZYMES INC	METHODS OF USING POLYPEPTIDES HAVING

				CELLULOLYTIC ENHANCING ACTIVITY
10035999	2017	2018	DSM IP ASSETS BV	HOST CELL CAPABLE OF PRODUCING ENZYMES USEFUL FOR DEGRADATION OF LIGNOCELLULOSIC MATERIAL
10036049	2017	2018	NOVOZYMES INC	METHODS FOR ENHANCING THE DEGRADATION OR CONVERSION OF CELLULOSIC MATERIAL
10036050	2012	2018	NOVOZYMES INC	CELLOBIOHYDROLASE VARIANTS AND POLYNUCLEOTIDES ENCODING SAME
10036051	2017	2018	ALLIANCE FOR SUSTAINABLE ENERGY LLC	ENHANCED PROCESSIVE CELLULASES
10041101	2016	2018	NOVOZYMES INC	COMPOSITIONS COMPRISING A POLYPEPTIDE HAVING CELLULOLYTIC ENHANCING ACTIVITY AND A HETEROCYCLIC COMPOUND AND USES THEREOF
10059933	2018	2018	NOVOZYMES INC	POLYPEPTIDES HAVING ENDOGLUCANASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
10066237	2017	2018	NOVOZYMES INC	POLYPEPTIDES HAVING BETA-XYLOSIDASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
10066251	2017	2018	NOVOZYMES INC	POLYPEPTIDES HAVING CATALASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
10072280	2017	2018	NOVOZYMES INC	COMPOSITIONS FOR SACCHARIFICATION OF CELLULOSIC MATERIAL
10077435	2016	2018	DSM IP ASSETS BV	HOST CELL CAPABLE OF PRODUCING ENZYMES USEFUL FOR DEGRADATION OF LIGNOCELLULOSIC MATERIAL
10077454	2015	2018	NATL TECH & ENG SOLUTIONS OF SANDIA LLC	TANDEM BIOCHEMICAL AND THERMOCHEMICAL CONVERSION OF ALGAL BIOMASS
10081802	2014	2018	DANISCO US INC	VARIANT ENZYMES
10081824	2016	2018	NOVOZYMES INC	CELLULOLYTIC ENZYME COMPOSITIONS AND USES THEREOF
10087425	2017	2018	ALLIANCE FOR SUSTAINABLE ENERGY LLC	CHIMERIC ENZYMES FOR CONVERSION OF LIGNIN-DERIVED CHEMICALS
10087478	2016	2018	NOVOZYMES INC	COMPOSITIONS COMPRISING

				A POLYPEPTIDE HAVING CELLULOLYTIC ENHANCING ACTIVITY AND A NITROGEN-CONTAINING COMPOUND AND USES THEREOF
10131893	2017	2018	NOVOZYMES INC	POLYPEPTIDES HAVING ENDOGLUCANASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
10138426	2017	2018	BATTELLE MEMORIAL INSTITUTE	COMBINED HYDROTHERMAL LIQUEFACTION AND CATALYTIC HYDROTHERMAL GASIFICATION SYSTEM AND PROCESS FOR CONVERSION OF BIOMASS FEEDSTOCKS
10144920	2017	2018	NOVOZYMES INC	CELLOBIOHYDROLASE VARIANTS AND POLYNUCLEOTIDES ENCODING SAME
EP3269804	2010	2018	NOVOZYMES INC	POLYPEPTIDES HAVING CELLULOLYTIC ENHANCING ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
EP3290515	2013	2018	DANISCO US INC	VARIANTS OF CELLOBIOHYDROLASES
EP3312271	2011	2018	MASSACHUSETTS INSTITUTE OF TECHNOLOGY	MICROBIAL ENGINEERING FOR THE PRODUCTION OF FATTY ACIDS AND FATTY ACID DERIVATIVES
EP3317375	2015	2018	UOP LLC	METHODS AND APPARATUSES FOR DEOXYGENATING PYROLYSIS OIL
EP3318574	2011	2018	DSM IP ASSETS BV	POLYPEPTIDE HAVING BETA-GLUCOSIDASE ACTIVITY AND USES THEREOF
EP3342860	2012	2018	NOVOZYMES INC	POLYPEPTIDES HAVING BETA-XYLOSIDASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
EP3382016	2012	2018	NOVOZYMES INC	POLYPEPTIDES HAVING XYLANASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
EP3382017	2012	2018	NOVOZYMES INC	POLYPEPTIDES HAVING BETA-GLUCOSIDASE ACTIVITY, BETA-XYLOSIDASE ACTIVITY, OR BETA-GLUCOSIDASE AND BETA-XYLOSIDASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
EP3409769	2012	2018	NOVOZYMES INC	POLYPEPTIDES HAVING BETA-GLUCOSIDASE

				ACTIVITY, BETA-XYLOSIDASE ACTIVITY, OR BETA-GLUCOSIDASE AND BETA-XYLOSIDASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
EP3415614	2013	2018	ALGENOL BIOFUELS INC	CYANOBACTERIUM SP. FOR PRODUCTION OF COMPOUNDS
10167460	2014	2019	DANISCO US INC	VARIANT ENZYMES
10167461	2016	2019	NOVOZYMES INC	POLYPEPTIDES HAVING CELLULOLYTIC ENHANCING ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
10179313	2016	2019	UT-BATTELLE LLC	SUPER-SURFACE SELECTIVE NANOMEMBRANES PROVIDING SIMULTANEOUS HIGH PERMEATION FLUX AND HIGH SELECTIVITY
10179904	2018	2019	NOVOZYMES INC	POLYPEPTIDES HAVING CELLOBIOHYDROLASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
10227614	2017	2019	NOVOZYMES INC	POLYPEPTIDES HAVING BETA-GLUCOSIDASE ACTIVITY, BETA-XYLOSIDASE ACTIVITY, OR BETA-GLUCOSIDASE AND BETA-XYLOSIDASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
10233435	2016	2019	NOVOZYMES INC	GLYCOSIDE HYDROLASES FROM THERMOPHLIC FUNGI
10233473	2018	2019	NOVOZYMES INC	CELLULOLYTIC ENZYME COMPOSITIONS AND USES THEREOF
10246693	2018	2019	NOVOZYMES INC	POLYPEPTIDES HAVING CELLULOLYTIC ENHANCING ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
10253342	2018	2019	NOVOZYMES INC	POLYPEPTIDES HAVING CATALASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
10260058	2017	2019	NOVOZYMES INC	BETA-GLUCOSIDASE VARIANTS POLYNUCLEOTIDES ENCODING SAME
10280201	2017	2019	NOVOZYMES INC	POLYPEPTIDES HAVING CELLULOLYTIC ENHANCING ACTIVITY AND NUCLEIC ACIDS ENCODING SAME

10280413	2017	2019	NOVOZYMES INC	POLYPEPTIDES HAVING CELLOBIOHYDROLASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
10316343	2016	2019	NOVOZYMES INC	COMPOSITIONS COMPRISING A POLYPEPTIDE HAVING CELLULOLYTIC ENHANCING ACTIVITY AND A LIQUOR AND USES THEREOF
10316344	2016	2019	NOVOZYMES INC	METHODS FOR DEGRADING OR CONVERTING PLANT CELL WALL POLYSACCHARIDES
10329593	2017	2019	AUBURN UNIVERSITY	EFFICIENT PROCESS FOR PRODUCING SACCHARIDES AND ETHANOL FROM A BIOMASS FEEDSTOCK
10337034	2018	2019	ALLIANCE FOR SUSTAINABLE ENERGY LLC	BIOMASS CONVERSION TO FUELS AND CHEMICALS
10350583	2017	2019	ALLIANCE FOR SUSTAINABLE ENERGY LLC	METAL PHOSPHIDE CATALYSTS AND METHODS FOR MAKING THE SAME AND USES THEREOF
10364423	2018	2019	NOVOZYMES INC	POLYPEPTIDES HAVING BETA-XYLOSIDASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
10465181	2018	2019	LALLEMAND HUNGARY LIQUIDITY MANAGEMENT LLC	MUTATIONS IN IRON-SULFUR CLUSTER PROTEINS THAT IMPROVE XYLOSE UTILIZATION
10479983	2014	2019	DANISCO US INC	VARIANT ENZYMES
10507426	2017	2019	UNIVERSITY OF WYOMING	SYSTEMS AND METHODS FOR BIOLOGICAL CONVERSION OF CARBON DIOXIDE POLLUTANTS INTO USEFUL PRODUCTS
EP3470514	2011	2019	NOVOZYMES INC	POLYPEPTIDES HAVING CELLULOLYTIC ENHANCING ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
EP3550016	2010	2019	NOVOZYMES INC	COMPOSITION FOR SACCHARIFICATION OF CELLULOSIC MATERIAL
10544195	2018	2020	NOVOZYMES INC	POLYPEPTIDES HAVING CELLULOLYTIC ENHANCING ACTIVITY AND NUCLEIC ACIDS ENCODING SAME
10570384	2018	2020	NOVOZYMES INC	POLYPEPTIDES HAVING XYLANASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
10570431	2018	2020	NOVOZYMES INC	COMPOSITIONS COMPRISING

				A POLYPEPTIDE HAVING CELLULOLYTIC ENHANCING ACTIVITY AND A HETEROCYCLIC COMPOUND AND USES THEREOF
10577622	2018	2020	NOVOZYMES INC	POLYPEPTIDES HAVING BETA-XYLOSIDASE ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME

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

Patent #	Application Year	Issue / Publication Year	Original Assignees	Title
6942998	1979	1981	US DEPARTMENT OF ENERGY	PROCESS FOR GENERATION OF HYDROGEN GAS FROM VARIOUS FEEDSTOCKS USING THERMOPHILIC BACTERIA
7968764	1979	1981	PURDUE RESEARCH FOUNDATION	METHODS FOR INCREASING THE YIELD OF FERMENTABLE SUGARS FROM PLANT STOVER
4385117	1981	1983	UNIVERSITY OF GEORGIA	HIGH ETHANOL PRODUCING DERIVATIVES OF THERMOANAEROBACTER ETHANOLICUS
EP0093162	1982	1983	UNIVERSITY OF GEORGIA	HIGH ETHANOL PRODUCING DERIVATIVES OF THERMOANAEROBACTER ETHANOLICUS.
WO1983001628	1982	1983	UNIVERSITY OF GEORGIA	HIGH ETHANOL PRODUCING DERIVATIVES OF THERMOANAEROBACTER ETHANOLICUS
8431391	1981	1984	US DEPARTMENT OF ENERGY	PLANT FOR PRODUCING AN OXYGEN-CONTAINING ADDITIVE AS AN ECOLOGICALLY BENEFICIAL COMPONENT FOR LIQUID MOTOR FUELS
8629324	1984	1986	NOVOZYMES INC	POLYPEPTIDES HAVING EXPANSIN ACTIVITY AND POLYNUCLEOTIDES ENCODING SAME
4678860	1985	1987	ARIZONA STATE UNIVERSITY	PROCESS OF PRODUCING LIQUID HYDROCARBON FUELS FROM BIOMASS
EP0221679	1986	1987	ARIZONA STATE UNIVERSITY	PROCESS OF PRODUCING LIQUID HYDROCARBON FUELS FROM BIOMASS.
4795841	1987	1989	UNASSIGNED	PROCESS FOR UPGRADING BIOMASS PYROLYZATES
4828581	1987	1989	BATTELLE DEVELOPMENT CORP	LOW INLET GAS VELOCITY HIGH THROUGHPUT BIOMASS GASIFIER
8865441	1985	1989	STANFORD UNIVERSITY	EFFICIENT CELL-FREE HYDROGEN PRODUCTION
8921648	1986	1989	PURDUE RESEARCH FOUNDATION	METHODS FOR INCREASING THE YIELD OF FERMENTABLE SUGARS FROM PLANT STOVER
4292406	1986	1990	US DEPARTMENT OF ENERGY	ANAEROBIC THERMOPHILIC CULTURE SYSTEM
WO1990002193	1989	1990	UNIVERSITY OF	ETHANOL PRODUCTION BY

			FLORIDA	GENETICALLY ENGINEERED ESCHERICHIA COLI STRAINS
4292407	1990	1991	US DEPARTMENT OF ENERGY	ANAEROBIC THERMOPHILIC CULTURE
5000000	1989	1991	UNIVERSITY OF FLORIDA	ETHANOL PRODUCTION BY ESCHERICHIA COLI STRAINS CO-EXPRESSING ZYMOMONAS PDC AND ADH GENES
5028539	1988	1991	UNIVERSITY OF FLORIDA	ETHANOL PRODUCTION USING ENGINEERED MUTANT E. COLI
EP0431047	1989	1991	UNIVERSITY OF FLORIDA	ETHANOL PRODUCTION BY GENETICALLY ENGINEERED ESCHERICHIA COLI STRAINS.
4425136	1990	1992	US DEPARTMENT OF ENERGY	MINIMALLY REFINED BIOMASS FUEL
WO1992016615	1992	1992	UNIVERSITY OF FLORIDA; BIOENERGY INTERNATIONAL LC	ETHANOL PRODUCTION BY RECOMBINANT HOSTS
5180868	1990	1993	BATTELLE MEMORIAL INSTITUTE	METHOD OF UPGRADING OILS CONTAINING HYDROXYAROMATIC HYDROCARBON COMPOUNDS TO HIGHLY AROMATIC GASOLINE
4568644	1992	1994	MASSACHUSETTS INSTITUTE OF TECHNOLOGY	FERMENTATION METHOD PRODUCING ETHANOL
4840903	1993	1994	US DEPARTMENT OF ENERGY	PROCESS FOR PRODUCING ETHANOL FROM PLANT BIOMASS USING THE FUNGUS PAECILOMYCES SP.
EP0576621	1992	1994	UNIVERSITY OF FLORIDA; BIOENERGY INTERNATIONAL LC	ETHANOL PRODUCTION BY RECOMBINANT HOSTS.
5424202	1992	1995	UNIVERSITY OF FLORIDA	ETHANOL PRODUCTION BY RECOMBINANT HOSTS
WO1995004815	1994	1995	UNASSIGNED	SECRETION OF CLOSTRIDIUM CELLULASE BY E. COLI
WO1995027064	1995	1995	UNIVERSITY OF FLORIDA	ETHANOL PRODUCTION BY TRANSFORMATION OF GRAM-POSITIVE MICROBES
4818295	1994	1996	US DEPARTMENT OF ENERGY	CYCLONE REACTOR
5482846	1994	1996	UNIVERSITY OF FLORIDA	ETHANOL PRODUCTION IN GRAM-POSITIVE MICROBES
5487989	1992	1996	BIOENERGY INTERNATIONAL LC	ETHANOL PRODUCTION BY RECOMBINANT HOSTS
5496725	1993	1996	UNASSIGNED	SECRETION OF CLOSTRIDIUM CELLULASE BY E. COLI

EP0699651	1994	1996	UNASSIGNED	PROCESS AND APPARATUS FOR THE PRODUCTION OF METHANOL FROM CONDENSED CARBONACEOUS MATERIAL
4891459	1996	1997	GEORGIA TECH RESEARCH CORP	OIL PRODUCTION BY ENTRAINED PYROLYSIS OF BIOMASS AND PROCESSING OF OIL AND CHAR
5602030	1994	1997	UNIVERSITY OF FLORIDA	RECOMBINANT GLUCOSE UPTAKE SYSTEM
5698429	1996	1997	LOCKHEED MARTIN ENERGY SYSTEMS INC	CELLULASE-CONTAINING CELL-FREE FERMENTATE PRODUCED FROM MICROORGANISM ATCC 55702
5702940	1996	1997	LOCKHEED MARTIN ENERGY SYSTEMS INC	CELLULASE PRODUCING MICROORGANISM ATCC 55702
5756337	1996	1998	LOCKHEED MARTIN ENERGY SYSTEMS INC	METHOD OF PRODUCING A CELLULASE-CONTAINING CELL-FREE FERMENTATE PRODUCED FROM MICROORGANISM ATCC 55702
5759845	1996	1998	UNASSIGNED	SECRETION OF CLOSTRIDIUM CELLULASE BY E. COLI
5780422	1996	1998	LOCKHEED MARTIN ENERGY SYSTEMS INC	DETERGENT COMPOSITION COMPRISING A CELLULASE CONTAINING CELL-FREE FERMENTATE PRODUCED FROM MICROORGANISM ATCC 55702 OR MUTANT THEREOF
5789227	1995	1998	LOCKHEED MARTIN ENERGY SYSTEMS INC	PROCESSING OF CELLULOSIC MATERIAL BY A CELLULASE-CONTAINING CELL-FREE FERMENTATE PRODUCED FROM CELLULASE-PRODUCING BACTERIA, ATCC 55702
5821093	1994	1998	UNIVERSITY OF FLORIDA	RECOMBINANT CELLS THAT HIGHLY EXPRESS CHROMOSOMALLY-INTEGRATED HETEROLOGOUS GENES
5821111	1997	1998	BIOENGINEERING RESOURCES INC	BIOCONVERSION OF WASTE BIOMASS TO USEFUL PRODUCTS
WO1998045418	1998	1998	UNIVERSITY OF FLORIDA; BIOENERGY INTERNATIONAL LC	IMPROVEMENT OF ETHANOL PRODUCTION FROM LIGNOCELLULOSE
5063156	1998	1999	UNASSIGNED	PROCESS FOR THE FERMENTATIVE PRODUCTION OF ACETONE, BUTANOL AND ETHANOL

5916787	1995	1999	UNIVERSITY OF FLORIDA	ETHANOL PRODUCTION IN GRAM-POSITIVE MICROBES
5958740	1997	1999	LOCKHEED MARTIN ENERGY SYSTEMS INC	GENETICALLY ENHANCED CELLULASE PRODUCTION IN PSEUDOMONAS CELLULOSA USING RECOMBINANT DNA TECHNOLOGY
WO1999010450	1998	1999	UNIVERSITY OF UTAH	PROCESS FOR CONVERSION OF LIGNIN TO REFORMULATED HYDROCARBON GASOLINE
5173429	1999	2000	UNIVERSITY OF ARKANSAS	CLOSTRIDIUMM LJUNGDAHLII, AN ANAEROBIC ETHANOL AND ACETATE PRODUCING MICROORGANISM
6107093	1998	2000	UNIVERSITY OF FLORIDA	RECOMBINANT CELLS THAT HIGHLY EXPRESS CHROMOSOMALLY-INTEGRATED HETEROLOGOUS GENES
6110720	1998	2000	UNIVERSITY OF GEORGIA	ORPINOMYCES CELLULASE CELE PROTEIN AND CODING SEQUENCES
6130076	1997	2000	UNIVERSITY OF FLORIDA	ETHANOL PRODUCTION USING A SOY HYDROLYSATE-BASED MEDIUM OR A YEAST AUTOLYSATE-BASED MEDIUM
EP0981608	1998	2000	UNIVERSITY OF FLORIDA	IMPROVEMENT OF ETHANOL PRODUCTION FROM LIGNOCELLULOSE
WO2000011112	1999	2000	UNIVERSITY OF UTAH	PROCESS FOR CONVERSION OF LIGNIN TO REFORMULATED, PARTIALLY OXYGENATED GASOLINE
5348871	1999	2001	MARTIN MARIETTA ENERGY SYSTEMS INC	PROCESS FOR CONVERTING CELLULOSIC MATERIALS INTO FUELS AND CHEMICALS
6333181	1997	2001	UNIVERSITY OF FLORIDA	ETHANOL PRODUCTION FROM LIGNOCELLULOSE
WO2001088258	2001	2001	MASSACHUSETTS INSTITUTE OF TECHNOLOGY	THERMAL CONVERSION OF BIOMASS TO VALUABLE FUELS, CHEMICAL FEEDSTOCKS AND CHEMICALS
WO2002006503	2001	2002	US DEPARTMENT OF ENERGY	PROCESS FOR GENERATION OF HYDROGEN GAS FROM VARIOUS FEEDSTOCKS USING THERMOPHILIC BACTERIA
WO2002008438	2001	2002	BIOENGINEERING RESOURCES INC	METHODS FOR INCREASING THE PRODUCTION OF ETHANOL FROM MICROBIAL FERMENTATION

WO2002067691	2001	2002	BATTELLE MEMORIAL INSTITUTE	HYDROLYSIS OF BIOMASS MATERIAL
WO2002102511	2002	2002	BATTELLE MEMORIAL INSTITUTE	METHODS OF MAKING TEXTURED CATALYSTS
6670300	2001	2003	BATTELLE MEMORIAL INSTITUTE	TEXTURED CATALYSTS, METHODS OF MAKING TEXTURED CATALYSTS, AND METHODS OF CATALYZING REACTIONS CONDUCTED IN HYDROTHERMAL CONDITIONS
EP1290272	2001	2003	MASSACHUSETTS INSTITUTE OF TECHNOLOGY	THERMAL CONVERSION OF BIOMASS TO VALUABLE FUELS, CHEMICAL FEEDSTOCKS AND CHEMICALS
EP1301617	2001	2003	VAN OOTEGHEM SUELLEN A	PROCESS FOR GENERATION OF HYDROGEN GAS FROM VARIOUS FEEDSTOCKS USING THERMOPHILIC BACTERIA
EP1303629	2001	2003	BIOENGINEERING RESOURCES INC	METHODS FOR INCREASING THE PRODUCTION OF ETHANOL FROM MICROBIAL FERMENTATION
6692578	2001	2004	BATTELLE MEMORIAL INSTITUTE	HYDROLYSIS OF BIOMASS MATERIAL
WO2004039918	2003	2004	WISCONSIN ALUMNI RESEARCH FOUNDATION	LOW-TEMPERATURE HYDROCARBON PRODUCTION FROM OXYGENATED HYDROCARBONS
5344848	1999	2005	UNASSIGNED	PROCESS AND APPARATUS FOR THE PRODUCTION OF METHANOL FROM CONDENSED CARBONACEOUS MATERIAL
5508183	2002	2005	MARTIN MARIETTA ENERGY SYSTEMS INC	ENHANCED ATTRITION BIOREACTOR FOR ENZYME HYDROLYSIS OR CELLULOSIC MATERIALS
6849434	2001	2005	UNIVERSITY OF FLORIDA	ETHANOL PRODUCTION IN RECOMBINANT HOSTS
6953873	2003	2005	WISCONSIN ALUMNI RESEARCH FOUNDATION	LOW-TEMPERATURE HYDROCARBON PRODUCTION FROM OXYGENATED HYDROCARBONS
EP1549594	2003	2005	WISCONSIN ALUMNI RESEARCH FOUNDATION	LOW-TEMPERATURE HYDROCARBON PRODUCTION FROM OXYGENATED HYDROCARBONS

WO2005042694	2003	2005	MIDWEST RESEARCH INSTITUTE	MULTI-STAGE MICROBIAL SYSTEM FOR CONTINUOUS HYDROGEN PRODUCTION
WO2005072254	2005	2005	UNIVERSITY OF CALIFORNIA	MODULATION OF SULFATE PERMEASE FOR PHOTOSYNTHETIC HYDROGEN PRODUCTION
5637502	2000	2006	LOCKHEED MARTIN ENERGY SYSTEMS INC	ENHANCED ATTRITION BIOREACTOR FOR ENZYME HYDROLYSIS OF CELLULOSIC MATERIALS
6982328	2003	2006	BATTELLE MEMORIAL INSTITUTE	METHODS OF PRODUCING COMPOUNDS FROM PLANT MATERIAL
WO2006093998	2006	2006	MIDWEST RESEARCH INSTITUTE	PROCESS AND GENES FOR EXPRESSION AND OVER-EXPRESSION OF ACTIVE [FEFE] HYDROGENASES
WO2006101584	2006	2006	DIVERSA CORP	CELLULASES, NUCLEIC ACIDS ENCODING THEM AND METHODS FOR MAKING AND USING THEM
WO2006110891	2006	2006	E I DU PONT DE NEMOURS & CO	TREATMENT OF BIOMASS TO OBTAIN A TARGET CHEMICAL
WO2006110899	2006	2006	E I DU PONT DE NEMOURS & CO	INTEGRATION OF ALTERNATIVE FEEDSTREAMS IN BIOMASS TREATMENT AND UTILIZATION
WO2006110900	2006	2006	E I DU PONT DE NEMOURS & CO	TREATMENT OF BIOMASS TO OBTAIN ETHANOL
WO2006110901	2006	2006	E I DU PONT DE NEMOURS & CO	TREATMENT OF BIOMASS TO OBTAIN FERMENTABLE SUGARS
WO2006110902	2006	2006	E I DU PONT DE NEMOURS & CO	SYSTEM AND PROCESS FOR BIOMASS TREATMENT
WO2006119318	2006	2006	PURDUE RESEARCH FOUNDATION	METHODS FOR INCREASING THE YIELD OF FERMENTABLE SUGARS FROM PLANT STOVER
WO2006121584	2006	2006	BATTELLE ENERGY ALLIANCE LLC	PRODUCTION OF BIODIESEL USING EXPANDED GAS SOLVENTS
7176005	2004	2007	UNIVERSITY OF CALIFORNIA	MODULATION OF SULFATE PERMEASE FOR PHOTOSYNTHETIC HYDROGEN PRODUCTION
7186668	2003	2007	BATTELLE MEMORIAL INSTITUTE	TEXTURED CATALYSTS AND METHODS OF MAKING TEXTURED CATALYSTS
7192772	2000	2007	UNIVERSITY OF FLORIDA	RECOMBINANT CELLS THAT HIGHLY EXPRESS CHROMOSOMALLY-INTEGRATED HETEROLOGOUS GENE
7285402	2001	2007	EMMAUS	METHODS FOR INCREASING

			FOUNDATION INC	THE PRODUCTION OF ETHANOL FROM MICROBIAL FERMENTATION
EP1853716	2006	2007	MIDWEST RESEARCH INSTITUTE	PROCESS AND GENES FOR EXPRESSION AND OVER-EXPRESSION OF ACTIVE [FEFE] HYDROGENASES
EP1861506	2006	2007	DIVERSA CORP	CELLULASES, NUCLEIC ACIDS ENCODING THEM AND METHODS FOR MAKING AND USING THEM
EP1869194	2006	2007	E I DU PONT DE NEMOURS & CO	TREATMENT OF BIOMASS TO OBTAIN A TARGET CHEMICAL
EP1869197	2006	2007	E I DU PONT DE NEMOURS & CO	TREATMENT OF BIOMASS TO OBTAIN ETHANOL
EP1869201	2006	2007	E I DU PONT DE NEMOURS & CO	INTEGRATION OF ALTERNATIVE FEEDSTREAMS IN BIOMASS TREATMENT AND UTILIZATION
EP1869202	2006	2007	E I DU PONT DE NEMOURS & CO	TREATMENT OF BIOMASS TO OBTAIN FERMENTABLE SUGARS
WO2007032791	2006	2007	BATTELLE ENERGY ALLIANCE LLC	METHOD FOR REMOVING IMPURITIES FROM AN IMPURITY-CONTAINING FLUID STREAM
WO2007055984	2006	2007	BATTELLE ENERGY ALLIANCE LLC	ENZYME AND METHODOLOGY FOR THE TREATMENT OF A BIOMASS
WO2007089527	2007	2007	BATTELLE MEMORIAL INSTITUTE	METHOD OF FORMING A DIANHYDROSUGAR ALCOHOL
WO2007103858	2007	2007	WISCONSIN ALUMNI RESEARCH FOUNDATION	STABLE, AQUEOUS-PHASE, BASIC CATALYSTS AND REACTIONS CATALYZED THEREBY
WO2007112314	2007	2007	WISCONSIN ALUMNI RESEARCH FOUNDATION	METHOD FOR PRODUCING BIO-FUEL THAT INTEGRATES HEAT FROM CARBON-CARBON BOND-FORMING REACTIONS TO DRIVE BIOMASS GASIFICATION REACTIONS
WO2007127912	2007	2007	C5 6 TECHNOLOGIES INC	THERMOSTABLE CELLULASE AND METHODS OF USE
5959167	2007	2008	UNIVERSITY OF UTAH	PROCESS FOR CONVERSION OF LIGNIN TO REFORMULATED HYDROCARBON GASOLINE
EP1877359	2006	2008	BATTELLE ENERGY ALLIANCE LLC	PRODUCTION OF BIODIESEL USING EXPANDED GAS SOLVENTS
EP1877586	2006	2008	PURDUE RESEARCH	METHODS FOR INCREASING THE YIELD OF FERMENTABLE

			FOUNDATION	SUGARS FROM PLANT STOVER
EP1885840	2006	2008	E I DU PONT DE NEMOURS & CO	SYSTEM AND PROCESS FOR BIOMASS TREATMENT
EP1948812	2006	2008	BATTELLE ENERGY ALLIANCE LLC	ENZYME AND METHODOLOGY FOR THE TREATMENT OF A BIOMASS
EP2007850	2007	2008	WISCONSIN ALUMNI RESEARCH FOUNDATION	METHOD FOR PRODUCING BIO-FUEL THAT INTEGRATES HEAT FROM CARBON-CARBON BOND-FORMING REACTIONS TO DRIVE BIOMASS GASIFICATION REACTIONS
WO2008021602	2007	2008	BATTELLE ENERGY ALLIANCE LLC	STRUCTURES INCLUDING CATALYTIC MATERIALS DISPOSED WITHIN POROUS ZEOLITE MATERIALS, SYSTEMS AND METHODS FOR USING THE SAME, AND METHODS OF FABRICATING CATALYTIC STRUCTURES
WO2008039450	2007	2008	UT-BATTELLE LLC	DESIGNER ORGANISMS FOR PHOTOSYNTHETIC PRODUCTION OF ETHANOL FROM CARBON DIOXIDE AND WATER
WO2008069830	2007	2008	VIRENT ENERGY SYSTEMS INC	METHODS AND SYSTEMS FOR GENERATING POLYOLS
WO2008082693	2007	2008	BATTELLE MEMORIAL INSTITUTE	BIOMOLECULAR HYBRID MATERIAL AND PROCESS FOR PREPARING SAME AND USES FOR SAME
WO2008098227	2008	2008	SANDIA CORP, UNIVERSITY OF CALIFORNIA	BIOFUEL PRODUCTION BY RECOMBINANT MICROORGANISMS
WO2008109129	2008	2008	UNIVERSITY OF MINNESOTA	SOLID FUEL VOLATILIZATION TO PRODUCE SYNTHESIS
WO2008116104	2008	2008	BATTELLE ENERGY ALLIANCE LLC	A PRECURSOR OF A CATALYTIC STRUCTURE, A CATALYTIC STRUCTURE, A METHOD OF FABRICATING THE SAME, AND A SYSTEM AND A METHOD FOR USING THE SAME
WO2008130437	2007	2008	ARIZONA STATE UNIVERSITY	MODIFIED CYANOBACTERIA
WO2008132548	2007	2008	US DEPARTMENT OF ENERGY	A PLANT FOR PRODUCING THE OXYGEN-CONTAINING ADDITIVE AS AN ECOLOGICALLY BENEFICIAL COMPONENT FOR LIQUID MOTOR FUELS
WO2008140617	2007	2008	VIRENT ENERGY SYSTEMS INC	REACTOR SYSTEM FOR PRODUCING GASEOUS

				PRODUCTS
WO2008147986	2008	2008	PENN STATE UNIVERSITY	COMPOSITIONS AND METHODS RELATING TO TRANSGENIC PLANTS AND CELLULOSIC ETHANOL PRODUCTION
6071729	2005	2009	UNASSIGNED	DISRUPTION OF THE CYTOCHROME C GENE IN XYLOSE-FERMENTING YEAST
6172272	2007	2009	UNIVERSITY OF UTAH	PROCESS FOR CONVERSION OF LIGNIN TO REFORMULATED, PARTIALLY OXYGENATED GASOLINE
7494637	2001	2009	MASSACHUSETTS INSTITUTE OF TECHNOLOGY	THERMAL CONVERSION OF BIOMASS TO VALUABLE FUELS, CHEMICAL FEEDSTOCKS AND CHEMICALS
7510857	2007	2009	C5 6 TECHNOLOGIES INC	THERMOSTABLE CELLULASE AND METHODS OF USE
7611835	2005	2009	BATTELLE MEMORIAL INSTITUTE	PROCESS FOR PREPARING MULTILAYER ENZYME COATING ON A FIBER
EP2013338	2007	2009	C5 6 TECHNOLOGIES INC	THERMOSTABLE CELLULASE AND METHODS OF USE
EP2016037	2007	2009	VIRENT ENERGY SYSTEMS INC	METHODS AND SYSTEMS FOR GENERATING POLYOLS
EP2041279	2007	2009	BATTELLE MEMORIAL INSTITUTE	BIOMOLECULAR HYBRID MATERIAL AND PROCESS FOR PREPARING SAME AND USES FOR SAME
EP2087096	2007	2009	UNIVERSITY OF ARIZONA	MODIFIED CYANOBACTERIA
EP2111291	2007	2009	VIRENT ENERGY SYSTEMS INC	REACTOR SYSTEM AND PROCESS FOR PRODUCING GASEOUS PRODUCTS FROM OXYGENATED HYDROCARBONS
EP2118266	2008	2009	UNIVERSITY OF CALIFORNIA	BIOFUEL PRODUCTION BY RECOMBINANT MICROORGANISMS
WO2009006429	2008	2009	UNIVERSITY OF CALIFORNIA	HOST CELLS AND METHODS FOR PRODUCING 3-METHYL-2-BUTEN-1-OL, 3-METHYL-3-BUTEN-1-OL, AND 3-METHYL-BUTAN-1-OL
WO2009045627	2008	2009	VERENIUM CORP	XYLANASES, NUCLEIC ACIDS ENCODING THEM AND METHODS FOR MAKING AND USING THEM
WO2009059253	2008	2009	GEVO INC	METHODS FOR THE ECONOMICAL PRODUCTION OF BIOFUEL FROM BIOMASS
WO2009059254	2008	2009	GEVO INC	METHODS FOR THE

				ECONOMICAL PRODUCTION OF BIOFUEL PRECURSOR THAT IS ALSO A BIOFUEL FROM BIOMASS
WO2009094187	2009	2009	BATTELLE ENERGY ALLIANCE LLC	THERMAL AND ACID TOLERANT BETA-XYLOSIDASES, GENES ENCODING, RELATED ORGANISMS, AND METHODS
WO2009099858	2009	2009	BATTELLE ENERGY ALLIANCE LLC	THERMOPHILIC AND THERMOACIDOPHILIC BIOPOLYMER- DEGRADING GENES AND ENZYMES FROM ALICYCLOBACILLUS ACIDOCALDARIUS AND RELATED ORGANISMS, METHODS
WO2009129019	2009	2009	WISCONSIN ALUMNI RESEARCH FOUNDATION	SINGLE-REACTOR PROCESS FOR PRODUCING LIQUID-PHASE ORGANIC COMPOUNDS FROM BIOMASS
WO2009134631	2009	2009	BATTELLE MEMORIAL INSTITUTE	METHOD OF CONVERSION OF CARBOHYDRATE POLYMERS TO VALUE-ADDED CHEMICAL PRODUCTS
WO2009134899	2009	2009	SANDIA CORP, UNIVERSITY OF CALIFORNIA	PRODUCING BIOFUELS USING POLYKETIDE SYNTHASES
WO2009137145	2009	2009	BATTELLE ENERGY ALLIANCE LLC	TRANSCRIPTIONAL CONTROL IN ALICYCLOBACILLUS ACIDOCALDARIUS AND ASSOCIATED GENES, PROTEINS, AND METHODS
WO2009145944	2009	2009	BATTELLE ENERGY ALLIANCE LLC	THERMOPHILIC AND THERMOACIDOPHILIC SUGAR TRANSPORTER GENES AND ENZYMES FROM ALICYCLOBACILLUS ACIDOCALDARIUS AND RELATED ORGANISMS, METHODS
WO2009145945	2009	2009	BATTELLE ENERGY ALLIANCE LLC	THERMOPHILIC AND THERMOACIDOPHILIC METABOLISM GENES AND ENZYMES FROM ALICYCLOBACILLUS ACIDOCALDARIUS AND RELATED ORGANISMS, METHODS
6887283	2003	2010	BECHTEL BWXT IDAHO LLC	PROCESS FOR PRODUCING BIODIESEL, LUBRICANTS, AND FUEL AND LUBRICANT ADDITIVES IN A CRITICAL FLUID MEDIUM
6989252	2005	2010	MIDWEST RESEARCH	HYDROGEN PRODUCTION USING HYDROGENASE-

			INSTITUTE	CONTAINING OXYGENIC PHOTOSYNTHETIC ORGANISMS
7514575	2007	2010	BATTELLE ENERGY ALLIANCE LLC	PRODUCTION OF BIODIESEL USING EXPANDED GAS SOLVENTS
7649099	2006	2010	BATTELLE MEMORIAL INSTITUTE	METHOD OF FORMING A DIANHYDROSUGAR ALCOHOL
7652131	2004	2010	BATTELLE MEMORIAL INSTITUTE	METHODS OF PRODUCING COMPOUNDS FROM PLANT MATERIALS
7671246	2007	2010	WISCONSIN ALUMNI RESEARCH FOUNDATION	METHOD TO MAKE ALKANES AND SATURATED POLYHYDROXY COMPOUNDS FROM CARBONYL COMPOUNDS
7727755	2005	2010	BATTELLE ENERGY ALLIANCE LLC	ENZYME AND METHODOLOGY FOR THE TREATMENT OF A BIOMASS
7767867	2007	2010	VIRENT ENERGY SYSTEMS INC	METHODS AND SYSTEMS FOR GENERATING POLYOLS
7776782	2007	2010	BATTELLE MEMORIAL INSTITUTE	METHODS OF MAKING TEXTURED CATALYSTS
7781191	2006	2010	E I DU PONT DE NEMOURS & CO, ALLIANCE FOR SUSTAINABLE ENERGY LLC	TREATMENT OF BIOMASS TO OBTAIN A TARGET CHEMICAL
7803601	2007	2010	UNIVERSITY OF TEXAS	PRODUCTION AND SECRETION OF GLUCOSE IN PHOTOSYNTHETIC PROKARYOTES (CYANOBACTERIA)
7838273	2008	2010	BATTELLE MEMORIAL INSTITUTE	BIOMOLECULAR HYBRID MATERIAL AND PROCESS FOR PREPARING SAME AND USES FOR SAME
7858353	2009	2010	BATTELLE ENERGY ALLIANCE LLC	THERMOPHILIC AND THERMOACIDOPHILIC BIOPOLYMER-DEGRADING GENES AND ENZYMES FROM ALICYCLOBACILLUS ACIDOCALDARIUS AND RELATED ORGANISMS, METHODS
EP2139819	2007	2010	US DEPARTMENT OF ENERGY	A PLANT FOR PRODUCING THE OXYGEN-CONTAINING ADDITIVE AS AN ECOLOGICALLY BENEFICIAL COMPONENT FOR LIQUID MOTOR FUELS
EP2205744	2008	2010	VERENIUM CORP	XYLANASES, NUCLEIC ACIDS ENCODING THEM AND METHODS FOR MAKING AND

				USING THEM
EP2215243	2008	2010	GEVO INC	METHODS FOR THE ECONOMICAL PRODUCTION OF BIOFUEL PRECURSOR THAT IS ALSO A BIOFUEL FROM BIOMASS
EP2235174	2009	2010	BATTELLE ENERGY ALLIANCE LLC	THERMOPHILIC AND THERMOACIDOPHILIC BIOPOLYMER- DEGRADING GENES AND ENZYMES FROM ALICYCLOBACILLUS ACIDOCALDARIUS AND RELATED ORGANISMS, METHODS
EP2242841	2009	2010	BATTELLE ENERGY ALLIANCE LLC	THERMAL AND ACID TOLERANT BETA-XYLOSIDASES, GENES ENCODING, RELATED ORGANISMS, AND METHODS
EP2245040	2009	2010	BATTELLE ENERGY ALLIANCE LLC	TRANSCRIPTIONAL CONTROL IN ALICYCLOBACILLUS ACIDOCALDARIUS AND ASSOCIATED GENES, PROTEINS, AND METHODS
EP2245143	2009	2010	BATTELLE ENERGY ALLIANCE LLC	THERMOPHILIC AND THERMOACIDOPHILIC METABOLISM GENES AND ENZYMES FROM ALICYCLOBACILLUS ACIDOCALDARIUS AND RELATED ORGANISMS, METHODS
EP2257566	2009	2010	BATTELLE ENERGY ALLIANCE LLC	THERMOPHILIC AND THERMOACIDOPHILIC SUGAR TRANSPORTER GENES AND ENZYMES FROM ALICYCLOBACILLUS ACIDOCALDARIUS AND RELATED ORGANISMS, METHODS
WO2010036550	2009	2010	BATTELLE ENERGY ALLIANCE LLC	METHODS FOR RECOVERING A POLAR SOLVENT FROM A FLUID STREAM CONTAMINATED WITH AT LEAST ONE POLAR IMPURITY
WO2010051527	2009	2010	GEVO INC, CALIFORNIA INSTITUTE OF TECHNOLOGY	ENGINEERED MICROORGANISMS CAPABLE OF PRODUCING TARGET COMPOUNDS UNDER ANAEROBIC CONDITIONS
WO2010071851	2009	2010	SANDIA CORP, UNIVERSITY OF CALIFORNIA	CONVERSION OF CO2 TO HIGHER ALCOHOLS USING PHOTOSYSNTHETIC MICROORGANISMS
WO2010088463	2010	2010	NOVOZYMES INC	POLYPEPTIDES HAVING EXPANSIN ACTIVITY AND

				POLYNUCLEOTIDES ENCODING SAME
WO2010104844	2010	2010	WAYNE STATE UNIVERSITY	SUPPORTED CATALYST SYSTEMS AND METHOD OF MAKING BIODIESEL PRODUCTS USING SUCH CATALYSTS
WO2010124266	2010	2010	SANDIA CORP, UNIVERSITY OF CALIFORNIA	THERMOSTABLE CELLULASES, AND MUTANTS THEREOF, CAPABLE OF HYDROLYZING CELLULOSE IN IONIC LIQUID
WO2010132123	2010	2010	UNIVERSITY OF NORTH DAKOTA	METHOD FOR CREATING HIGH CARBON CONTENT PRODUCTS FROM BIOMASS OIL
WO2010141604	2010	2010	WISCONSIN ALUMNI RESEARCH FOUNDATION	COMBINATORIAL DISCOVERY OF ENZYMES WITH UTILITY IN BIOMASS TRANSFORMATION
WO2010151343	2010	2010	WISCONSIN ALUMNI RESEARCH FOUNDATION	CATALYTIC CONVERSION OF CELLULOSE TO LIQUID HYDROCARBON FUELS BY PROGRESSIVE REMOVAL OF OXYGEN TO FACILITATE SEPARATION PROCESSES AND ACHIEVE HIGH SELECTIVITIES
7592291	2006	2011	BATTELLE ENERGY ALLIANCE LLC	METHOD OF FABRICATING A CATALYTIC STRUCTURE
7691270	2009	2011	BATTELLE ENERGY ALLIANCE LLC	METHOD FOR REMOVING IMPURITIES FROM AN IMPURITY-CONTAINING FLUID STREAM
7732174	2006	2011	ALLIANCE FOR SUSTAINABLE ENERGY LLC	MULTI-STAGE MICROBIAL SYSTEM FOR CONTINUOUS HYDROGEN PRODUCTION
7872054	2007	2011	WISCONSIN ALUMNI RESEARCH FOUNDATION, VIRENT ENERGY SYSTEMS	METHOD FOR PRODUCING BIO-FUEL THAT INTEGRATES HEAT FROM CARBON-CARBON BOND-FORMING REACTIONS TO DRIVE BIOMASS GASIFICATION REACTIONS
7910338	2006	2011	E I DU PONT DE NEMOURS & CO, ALLIANCE FOR SUSTAINABLE ENERGY LLC	INTEGRATION OF ALTERNATIVE FEEDSTREAMS FOR BIOMASS TREATMENT AND UTILIZATION
7923234	2009	2011	BATTELLE ENERGY ALLIANCE LLC	THERMAL AND ACID TOLERANT BETA-XYLOSIDASES, GENES ENCODING, RELATED ORGANISMS, AND METHODS
7932063	2006	2011	E I DU PONT DE	TREATMENT OF BIOMASS TO

			NEMOURS & CO, ALLIANCE FOR SUSTAINABLE ENERGY LLC	OBTAIN FERMENTABLE SUGARS
7960534	2009	2011	BATTELLE ENERGY ALLIANCE LLC	THERMOPHILIC AND THERMOACIDOPHILIC SUGAR TRANSPORTER GENES AND ENZYMES FROM ALICYCLOBACILLUS ACIDOCALDARIUS AND RELATED ORGANISMS, METHODS
7972082	2008	2011	UNASSIGNED	COLLECTION OF LANDFILL GAS AT VARIABLE RATES TO MATCH TEMPORAL NEEDS FOR ENERGY GENERATION
7973214	2007	2011	UT-BATTELLE LLC	DESIGNER ORGANISMS FOR PHOTOSYNTHETIC PRODUCTION OF ETHANOL FROM CARBON DIOXIDE AND WATER
7985567	2009	2011	UNIVERSITY OF CALIFORNIA	HOST CELLS AND METHODS FOR PRODUCING 3-METHYL-2-BUTEN-1-OL, 3-METHYL-3-BUTEN-1-OL, AND 3-METHYL-BUTAN-1-OL
7989664	2010	2011	VIRENT ENERGY SYSTEMS INC	METHODS AND SYSTEMS FOR GENERATING POLYOLS
7998713	2006	2011	E I DU PONT DE NEMOURS & CO, ALLIANCE FOR SUSTAINABLE ENERGY LLC	TREATMENT OF BIOMASS TO OBTAIN ETHANOL
8071748	2011	2011	BATTELLE ENERGY ALLIANCE LLC	THERMOPHILIC AND THERMOACIDOPHILIC SUGAR TRANSPORTER GENES AND ENZYMES FROM ALICYCLOBACILLUS ACIDOCALDARIUS AND RELATED ORGANISMS, METHODS
8075642	2008	2011	WISCONSIN ALUMNI RESEARCH FOUNDATION	SINGLE-REACTOR PROCESS FOR PRODUCING LIQUID-PHASE ORGANIC COMPOUNDS FROM BIOMASS
EP2268828	2009	2011	UNIVERSITY OF CALIFORNIA	PRODUCING BIOFUELS USING POLYKETIDE SYNTHASES
EP2271676	2009	2011	BATTELLE MEMORIAL INSTITUTE	METHOD OF CONVERSION OF CARBOHYDRATE POLYMERS TO VALUE-ADDED CHEMICAL PRODUCTS
EP2346998	2009	2011	GEVO INC, CALIFORNIA INSTITUTE OF TECHNOLOGY	ENGINEERED MICROORGANISMS CAPABLE OF PRODUCING TARGET COMPOUNDS UNDER ANAEROBIC CONDITIONS

WO2011002660	2010	2011	WISCONSIN ALUMNI RESEARCH FOUNDATION	BIOMASS HYDROLYSIS
WO2011022041	2010	2011	LOS ALAMOS NATIONAL SECURITY LLC	METHOD OF CARBON CHAIN EXTENSION USING NOVEL ALDOL REACTION
WO2011022042	2010	2011	LOS ALAMOS NATIONAL SECURITY LLC	METHOD OF CARBON CHAIN EXTENSION USING NOVEL ALDOL REACTION
WO2011031320	2010	2011	UNIVERSITY OF MASSACHUSETTS	SYSTEMS AND PROCESSES FOR CATALYTIC PYROLYSIS OF BIOMASS AND HYDROCARBONACEOUS MATERIALS FOR PRODUCTION OF AROMATICS WITH OPTIONAL OLEFIN RECYCLE, AND CATALYSTS HAVING SELECTED PARTICLE SIZE FOR CATALYTIC PYROLYSIS
WO2011031580	2010	2011	PRATT & WHITNEY ROCKETDYNE INC	BIOMASS TORREFACTION MILL
WO2011041455	2010	2011	SANDIA CORP, UNIVERSITY OF CALIFORNIA	RECOVERY OF SUGARS FROM IONIC LIQUID BIOMASS LIQUOR BY SOLVENT EXTRACTION
WO2011041660	2010	2011	BATTELLE ENERGY ALLIANCE LLC	METHODS OF COMBINED BIOPROCESSING AND RELATED MICROORGANISMS, THERMOPHILIC AND/OR ACIDOPHILIC ENZYMES, AND NUCLEIC ACIDS ENCODING SAID ENZYMES
WO2011056286	2010	2011	BATTELLE MEMORIAL INSTITUTE	ADSORPTION SEPARATION PROCESSES FOR IONIC LIQUID CATALYTIC PROCESSES
WO2011072122	2010	2011	ALGENOL BIOTECH LLC	WATER/CARBONATE STRIPPING FOR CO2 CAPTURE ADSORBER REGENERATION AND CO2 DELIVERY TO PHOTOAUTOTROPHS
WO2011082253	2010	2011	MICHIGAN STATE UNIVERSITY	A METHOD TO PRODUCE ACETYLDIACYLGLYCEROLS (AC-TAGS) BY EXPRESSION OFAN ACETYLTRANSFERASE GENE ISOLATED FROM EUONYMUS ALATUS (BURNING BUSH)
WO2011087821	2010	2011	UNIVERSITY OF MASSACHUSETTS	MICROBIAL PRODUCTION OF MULTI-CARBON CHEMICALS AND FUELS FROM WATER AND CARBON DIOXIDE USING ELECTRIC CURRENT

WO2011088425	2011	2011	SANDIA CORP, UNIVERSITY OF CALIFORNIA	ELECTRO-AUTOTROPHIC SYNTHESIS OF HIGHER ALCOHOLS
WO2011133571	2011	2011	MICHIGAN STATE UNIVERSITY	DIGESTIBLE LIGNOCELLULOSIC BIOMASS AND EXTRACTIVES AND METHODS FOR PRODUCING SAME
WO2011139994	2011	2011	BATTELLE ENERGY ALLIANCE LLC	GENETIC ELEMENTS, PROTEINS, AND ASSOCIATED METHODS INCLUDING APPLICATION OF ADDITIONAL GENETIC INFORMATION TO GRAM (+) THERMOACIDOPHILES
WO2011160057	2011	2011	SANDIA CORP, UNIVERSITY OF CALIFORNIA	INHIBITION OF SNL6 EXPRESSION FOR BIOFUEL PRODUCTION
7682813	2007	2012	ARROWHEAD CENTER INC	METHANE GENERATION FROM WASTE MATERIALS
7718051	2008	2012	BATTELLE ENERGY ALLIANCE LLC	CONVERSION OF CROP SEED OILS TO JET FUEL AND ASSOCIATED METHODS
7879749	2008	2012	BATTELLE ENERGY ALLIANCE LLC	METHODS OF USING STRUCTURES INCLUDING CATALYTIC MATERIALS DISPOSED WITHIN POROUS ZEOLITE MATERIALS TO SYNTHESIZE HYDROCARBONS
7951747	2009	2012	SANDIA CORP	SINGLE-LAYER TRANSITION METAL SULFIDE CATALYSTS
8097440	2011	2012	GEVO INC, CALIFORNIA INSTITUTE OF TECHNOLOGY	ENGINEERED MICROORGANISMS CAPABLE OF PRODUCING TARGET COMPOUNDS UNDER ANAEROBIC CONDITIONS
8110667	2008	2012	BATTELLE MEMORIAL INSTITUTE	METHOD FOR CONVERSION OF CARBOHYDRATE POLYMERS TO VALUE-ADDED CHEMICAL PRODUCTS
8148553	2009	2012	WISCONSIN ALUMNI RESEARCH FOUNDATION	CATALYTIC CONVERSION OF CELLULOSE TO LIQUID HYDROCARBON FUELS BY PROGRESSIVE REMOVAL OF OXYGEN TO FACILITATE SEPARATION PROCESSES AND ACHIEVE HIGH SELECTIVITIES
8153698	2010	2012	WISCONSIN ALUMNI RESEARCH FOUNDATION, VIRENT ENERGY SYSTEMS	METHOD FOR PRODUCING BIO-FUEL THAT INTEGRATES HEAT FROM CARBON-CARBON BOND-FORMING REACTIONS TO DRIVE BIOMASS GASIFICATION

				REACTIONS
8163976	2010	2012	PENN STATE UNIVERSITY	COMPOSITIONS AND METHODS RELATING TO TRANSGENIC PLANTS AND CELLULOSIC ETHANOL PRODUCTION
8178331	2011	2012	WISCONSIN ALUMNI RESEARCH FOUNDATION	RECOMBINANT YEAST WITH IMPROVED ETHANOL TOLERANCE AND RELATED METHODS OF USE
8198486	2011	2012	VIRENT ENERGY SYSTEMS INC	METHODS AND SYSTEMS FOR GENERATING POLYOLS
8202716	2010	2012	BATTELLE ENERGY ALLIANCE LLC	THERMOPHILIC AND THERMOACIDOPHILIC BIOPOLYMER-DEGRADING GENES AND ENZYMES FROM ALICYCLOBACILLUS ACIDOCALDARIUS AND RELATED ORGANISMS, METHODS
8226909	2010	2012	BATTELLE ENERGY ALLIANCE LLC	SYSTEMS INCLUDING CATALYSTS IN POROUS ZEOLITE MATERIALS WITHIN A REACTOR FOR USE IN SYNTHESIZING HYDROCARBONS
8247009	2009	2012	UCHICAGO ARGONNE LLC	BIOLOGICAL METHANE PRODUCTION FROM COAL, MANURE, SLUDGE, WASTES, OR OTHER CARBONACEOUS FEEDSTOCKS WITH SIMULTANEOUS SEQUESTRATION OF CO ₂
8268897	2010	2012	UNIVERSITY OF KENTUCKY	INCORPORATION OF CATALYTIC DEHYDROGENATION INTO FISCHER-TROPSCH SYNTHESIS TO LOWER CARBON DIOXIDE EMISSIONS
8304212	2010	2012	DYADIC INTL; BATTELLE MEMORIAL INST; IOWA CORN PRODUCTION BOARD	METHODS AND COMPOSITIONS FOR DEGRADATION OF LIGNOCELLULOSIC MATERIAL
8309324	2005	2012	UNIVERSITY OF ROCHESTER	PROMOTERS AND PROTEINS FROM CLOSTRIDIUM THERMOCELLUM AND USES THEREOF
8333949	2010	2012	UNIVERSITY OF NORTH DAKOTA	METHOD FOR CREATING HIGH CARBON CONTENT PRODUCTS FROM BIOMASS OIL
EP2429976	2010	2012	UNIVERSITY OF NORTH DAKOTA	METHOD FOR CREATING HIGH CARBON CONTENT

				PRODUCTS FROM BIOMASS OIL
EP2445992	2010	2012	WISCONSIN ALUMNI RESEARCH FOUNDATION	CATALYTIC CONVERSION OF CELLULOSE TO LIQUID HYDROCARBON FUELS BY PROGRESSIVE REMOVAL OF OXYGEN TO FACILITATE SEPARATION PROCESSES AND ACHIEVE HIGH SELECTIVITIES
EP2448951	2010	2012	WISCONSIN ALUMNI RESEARCH FOUNDATION	BIOMASS HYDROLYSIS
EP2468848	2007	2012	ARIZONA STATE UNIVERSITY	MODIFIED CYANOBACTERIA
EP2475749	2010	2012	PRATT & WHITNEY ROCKETDYNE INC	BIOMASS TORREFACTION MILL
EP2494008	2010	2012	UNIVERSITY OF MASSACHUSETTS; ANELLOTECH INC	SYSTEMS AND PROCESSES FOR CATALYTIC PYROLYSIS OF BIOMASS AND HYDROCARBONACEOUS MATERIALS FOR PRODUCTION OF AROMATICS WITH OPTIONAL OLEFIN RECYCLE, AND CATALYSTS HAVING SELECTED PARTICLE SIZE FOR CATALYTIC PYROLYSIS
EP2522735	2007	2012	UNIVERSITY OF ARIZONA	MODIFIED CYANOBACTERIA
EP2524029	2011	2012	UNIVERSITY OF CALIFORNIA	ELECTRO-AUTOTROPHIC SYNTHESIS OF HIGHER ALCOHOLS
WO2012003460	2011	2012	ARIZONA STATE UNIVERSITY	COMPOSITIONS AND METHODS FOR BACTERIAL LYSIS AND NEUTRAL LIPID PRODUCTION
WO2012034023	2011	2012	UNIVERSITY OF DELAWARE	RECOMBINANT CLOSTRIDIA THAT FIX CO2 AND CO AND USES THEREOF
WO2012037107	2011	2012	MICHIGAN STATE UNIVERSITY	COMPOSITIONS AND METHODS FOR XYLEM-SPECIFIC EXPRESSION IN PLANT CELLS
WO2012037215	2011	2012	WISCONSIN ALUMNI RESEARCH FOUNDATION	RECOMBINANT YEAST WITH IMPROVED ETHANOL TOLERANCE AND RELATED METHODS OF USE
WO2012061653	2011	2012	SANDIA CORP, UNIVERSITY OF CALIFORNIA	BIOFUEL AND CHEMICAL PRODUCTION BY RECOMBINANT MICROORGANISMS VIA FERMENTATION OF PROTEINACIOUS BIOMASS

WO2012088429	2011	2012	MICHIGAN STATE UNIVERSITY	METHODS FOR PRETREATING BIOMASS
WO2012129555	2012	2012	BUTAMAX ADVANCED BIOFUELS LLC	HOST CELLS AND METHODS FOR PRODUCTION OF ISOBUTANOL
WO2012151214	2012	2012	SANDIA CORP, UNIVERSITY OF CALIFORNIA	GLYCOSIDE HYDROLASES HAVING MULTIPLE HYDROLASE ACTIVITIES
WO2012154626	2012	2012	SOLAZYME INC	GENETICALLY ENGINEERED MICROORGANISMS THAT METABOLIZE XYLOSE
8143020	2009	2013	US DEPARTMENT OF ENERGY	ENHANCED METABOLITE GENERATION
8236973	2012	2013	BATTELLE MEMORIAL INSTITUTE	ADSORPTION SEPARATION PROCESSES FOR IONIC LIQUID CATALYTIC PROCESSES
8252561	2012	2013	UNIVERSITY OF GEORGIA	PRODUCTION OF BIOFUEL USING MOLLUSCAN PSEUDOFECES DERIVED FROM ALGAL CELLS
8308954	2008	2013	BATTELLE ENERGY ALLIANCE LLC	METHODS FOR RECOVERING A POLAR SOLVENT FROM A FLUID STREAM CONTAMINATED WITH AT LEAST ONE POLAR IMPURITY
8349587	2011	2013	GINKGO BIOWORKS INC	METHODS AND SYSTEMS FOR CHEMOAUTOTROPHIC PRODUCTION OF ORGANIC COMPOUNDS
8354517	2011	2013	BATTELLE ENERGY ALLIANCE LLC	THERMOPHILIC AND THERMOACIDOPHILIC SUGAR TRANSPORTER GENES AND ENZYMES FROM ALICYCLOBACILLUS ACIDOCALDARIUS AND RELATED ORGANISMS, METHODS
8362226	2012	2013	BATTELLE ENERGY ALLIANCE LLC	THERMOPHILIC AND THERMOACIDOPHILIC SUGAR TRANSPORTER GENES AND ENZYMES FROM ALICYCLOBACILLUS ACIDOCALDARIUS AND RELATED ORGANISMS, METHODS
8366902	2013	2013	BATTELLE ENERGY ALLIANCE LLC	METHODS AND SYSTEMS FOR PRODUCING SYNGAS
8366907	2010	2013	BATTELLE MEMORIAL INSTITUTE	DEOXYGENATION OF FATTY ACIDS FOR PREPARATION OF HYDROCARBONS
8388829	2012	2013	BATTELLE MEMORIAL INSTITUTE	DEOXYGENATION OF FATTY ACIDS FOR PREPARATION OF HYDROCARBONS
8410183	2012	2013	WISCONSIN	METHOD FOR PRODUCING

			ALUMNI RESEARCH FOUNDATION, VIRENT ENERGY SYSTEMS	BIO-FUEL THAT INTEGRATES HEAT FROM CARBON-CARBON BOND-FORMING REACTIONS TO DRIVE BIOMASS GASIFICATION REACTIONS
8420833	2009	2013	UNIVERSITY OF CALIFORNIA	PRODUCING BIOFUELS USING POLYKETIDE SYNTHASES
8426184	2006	2013	BP CORP NORTH AMERICA INC, VERENIUM CORP	CELLULASES, NUCLEIC ACIDS ENCODING THEM AND METHODS FOR MAKING AND USING THEM
8426185	2010	2013	BATTELLE ENERGY ALLIANCE LLC	THERMOPHILIC AND THERMOACIDOPHILIC BIOPOLYMER-DEGRADING GENES AND ENZYMES FROM ALICYCLOBACILLUS ACIDOCALDARIUS AND RELATED ORGANISMS, METHODS
8431374	2008	2013	GEVO INC	METHODS FOR THE ECONOMICAL PRODUCTION OF BIOFUEL FROM BIOMASS
8431379	2010	2013	BATTELLE ENERGY ALLIANCE LLC	THERMAL AND ACID TOLERANT BETA XYLOSIDASES, ARABINOFURANOSIDASES, GENES ENCODING, RELATED ORGANISMS, AND METHODS
8440107	2010	2013	UNIVERSITY OF MICHIGAN	CATALYTIC REFORMING METHODS
8440870	2009	2013	PENN STATE UNIVERSITY	ONE-STEP CATALYTIC CONVERSION OF BIOMASS-DERIVED CARBOHYDRATES TO LIQUID FUELS
8486680	2008	2013	BP CORP NORTH AMERICA INC, VERENIUM CORP	XYLANASES, NUCLEIC ACIDS ENCODING THEM AND METHODS FOR MAKING AND USING THEM
8492114	2009	2013	BATTELLE ENERGY ALLIANCE LLC	METHODS OF COMBINED BIOPROCESSING AND RELATED MICROORGANISMS, THERMOPHILIC AND/OR ACIDOPHILIC ENZYMES, AND NUCLEIC ACIDS ENCODING SAID ENZYMES
8492595	2012	2013	VIRENT ENERGY SYSTEMS INC	METHODS AND SYSTEMS FOR GENERATING POLYOLS
8497110	2010	2013	BATTELLE ENERGY ALLIANCE LLC	THERMOPHILIC AND THERMOACIDOPHILIC BIOPOLYMER-DEGRADING GENES AND ENZYMES FROM ALICYCLOBACILLUS ACIDOCALDARIUS AND RELATED ORGANISMS, METHODS

8507700	2013	2013	LOS ALAMOS NATIONAL SECURITY LLC	METHOD OF CARBON CHAIN EXTENSION USING NOVEL ALDOL REACTION
8530211	2012	2013	WISCONSIN ALUMNI RESEARCH FOUNDATION, US DEPT OF ENERGY	CO-FERMENTATION OF GLUCOSE, XYLOSE AND/OR CELLOBIOSE BY YEAST
8557557	2010	2013	BATTELLE ENERGY ALLIANCE LLC	THERMOPHILIC AND THERMOACIDOPHILIC BIOPOLYMER-DEGRADING GENES AND ENZYMES FROM ALICYCLOBACILLUS ACIDOCALDARIUS AND RELATED ORGANISMS, METHODS
8569030	2012	2013	BATTELLE ENERGY ALLIANCE LLC	TYPE II RESTRICTION-MODIFICATION SYSTEM METHYLATION SUBUNIT OF ALICYCLOBACILLUS ACIDOCALDARIUS
8574879	2011	2013	INEOS BIO LTD	METHODS FOR INCREASING THE PRODUCTION OF ETHANOL FROM MICROBIAL FERMENTATION
8575323	2012	2013	BATTELLE ENERGY ALLIANCE LLC	THERMOPHILIC AND THERMOACIDOPHILIC SUGAR TRANSPORTER GENES AND ENZYMES FROM ALICYCLOBACILLUS ACIDOCALDARIUS AND RELATED ORGANISMS, METHODS
EP2561084	2011	2013	MICHIGAN STATE UNIVERSITY	DIGESTIBLE LIGNOCELLULOSIC BIOMASS AND EXTRACTIVES AND METHODS FOR PRODUCING SAME
EP2565176	2007	2013	VIRENT ENERGY SYSTEMS INC	METHODS FOR GENERATING POLYOLS
EP2614139	2011	2013	UNIVERSITY OF DELAWARE	RECOMBINANT CLOSTRIDIA THAT FIX CO2 AND CO AND USES THEREOF
EP2635673	2011	2013	UNIVERSITY OF CALIFORNIA	BIOFUEL AND CHEMICAL PRODUCTION BY RECOMBINANT MICROORGANISMS VIA FERMENTATION OF PROTEINACIOUS BIOMASS
EP2655638	2011	2013	MICHIGAN STATE UNIVERSITY	METHODS FOR PRETREATING BIOMASS
WO2013016717	2012	2013	BUTAMAX ADVANCED BIOFUELS LLC	KETO-ISOVALERATE DECARBOXYLASE ENZYMES AND METHODS OF USE THEREOF
WO2013040210	2012	2013	SANDIA CORP,	METHODS FOR INCREASING

			UNIVERSITY OF CALIFORNIA	PRODUCTION OF 3-METHYL-2-BUTENOL USING FUSION PROTEINS
WO2013049424	2012	2013	WISCONSIN ALUMNI RESEARCH FOUNDATION	CATALYTIC CONVERSION OF CELLULOSE TO FUELS AND CHEMICALS USING BORONIC ACIDS
WO2013066848	2012	2013	GINKGO BIOWORKS INC	METHODS AND SYSTEMS FOR CHEMOAUTOTROPHIC PRODUCTION OF ORGANIC COMPOUNDS
WO2013074371	2012	2013	UNIVERSITY OF CALIFORNIA	HYBRID ORGANIC-INORGANIC SYSTEM FOR PRODUCING BIOFUELS
WO2013090041	2012	2013	WISCONSIN ALUMNI RESEARCH FOUNDATION	SOLUTE-ENHANCED PRODUCTION OF GAMMA-VALEROLACTONE (GVL) FROM AQUEOUS SOLUTIONS LEVULINIC ACID
WO2013123326	2013	2013	COLUMBIA UNIVERSITY	METHODS AND SYSTEMS FOR PRODUCING PRODUCTS USING ENGINEERED SULFUR OXIDIZING BACTERIA
WO2013126230	2013	2013	PURDUE RESEARCH FOUNDATION	NOVEL LIGNASES AND ALDO-KETO REDUCTASES FOR CONVERSION OF LIGNIN-CONTAINING MATERIALS TO FERMENTABLE PRODUCTS
WO2013134391	2013	2013	RESEARCH TRIANGLE INSTITUTE	CATALYTIC BIOMASS PYROLYSIS PROCESS
WO2013142177	2013	2013	LOS ALAMOS NATIONAL SECURITY LLC	HYDROGENATION OF BIOMASS-DERIVED SUBSTRATES
WO2013176909	2013	2013	BUTAMAX ADVANCED BIOFUELS LLC	KETOL-ACID REDUCTOISOMERASE ENZYMES AND METHODS OF USE
WO2013192520	2013	2013	MASSACHUSETTS INSTITUTE OF TECHNOLOGY	ENGINEERED MICROBES AND METHODS FOR MICROBIAL OIL OVERPRODUCTION FROM CELLULOSIC MATERIALS
8497386	2006	2014	LOS ALAMOS NATIONAL SECURITY LLC	METHOD OF CARBON CHAIN EXTENSION USING NOVEL ALDOL REACTION
8609910	2010	2014	UOP LLC	CATALYTIC PYROLYSIS USING UZM-39 ALUMINOSILICATE ZEOLITE
8609911	2010	2014	UOP LLC	CATALYTIC PYROLYSIS USING UZM-44 ALUMINOSILICATE ZEOLITE
8624043	2012	2014	WISCONSIN ALUMNI RESEARCH FOUNDATION	CATALYTIC CONVERSION OF CELLULOSE TO LIQUID HYDROCARBON FUELS BY PROGRESSIVE REMOVAL OF OXYGEN TO FACILITATE

				SEPARATION PROCESSES AND ACHIEVE HIGH SELECTIVITIES
8629255	2011	2014	UT-BATTELLE LLC	NUCLEIC ACID MOLECULES CONFERRING ENHANCED ETHANOL TOLERANCE AND MICROORGANISMS HAVING ENHANCED TOLERANCE TO ETHANOL
8642301	2011	2014	INEOS BIO LTD	METHODS FOR INCREASING THE PRODUCTION OF ETHANOL FROM MICROBIAL FERMENTATION
8642302	2011	2014	INEOS BIO LTD	METHODS FOR INCREASING THE PRODUCTION OF ETHANOL FROM MICROBIAL FERMENTATION
8647851	2011	2014	INEOS BIO LTD	METHODS FOR INCREASING THE PRODUCTION OF ETHANOL FROM MICROBIAL FERMENTATION
8674150	2011	2014	PENN STATE UNIVERSITY	ONE-STEP CATALYTIC CONVERSION OF BIOMASS-DERIVED CARBOHYDRATES TO LIQUID FUELS
8674152	2011	2014	SAVANNAH RIVER NUCLEAR SOLUTIONS LLC	COAL LIQUEFACTION BY BASE-CATALYZED HYDROLYSIS WITH CO2 CAPTURE
8691525	2013	2014	BATTELLE ENERGY ALLIANCE LLC	METHODS OF COMBINED BIOPROCESSING AND RELATED MICROORGANISMS, THERMOPHILIC AND/OR ACIDOPHILIC ENZYMES, AND NUCLEIC ACIDS ENCODING SAID ENZYMES
8710285	2013	2014	UOP LLC	CATALYTIC PYROLYSIS USING UZM-44 ALUMINOSILICATE ZEOLITE
8716011	2009	2014	BATTELLE ENERGY ALLIANCE LLC	TRANSCRIPTIONAL CONTROL IN ALICYCLOBACILLUS ACIDOCALDARIUS AND ASSOCIATED GENES, PROTEINS, AND METHODS
8722878	2010	2014	WISCONSIN ALUMNI RESEARCH FOUNDATION	BIOMASS HYDROLYSIS
8728803	2009	2014	BATTELLE ENERGY ALLIANCE LLC	THERMOPHILIC AND THERMOACIDOPHILIC METABOLISM GENES AND ENZYMES FROM ALICYCLOBACILLUS ACIDOCALDARIUS AND RELATED ORGANISMS, METHODS

8747673	2011	2014	BATTELLE ENERGY ALLIANCE LLC	METHODS FOR RECOVERING A SOLVENT FROM A FLUID VOLUME AND METHODS OF REMOVING AT LEAST ONE COMPOUND FROM A NONPOLAR SOLVENT
8753840	2007	2014	ARIZONA STATE UNIVERSITY	MODIFIED CYANOBACTERIA
8753844	2012	2014	UNIVERSITY OF CALIFORNIA	OVERPRODUCTION OF LIGNINOLYTIC ENZYMES
8754263	2013	2014	VIRENT ENERGY SYSTEMS INC	METHODS AND SYSTEMS FOR GENERATING POLYOLS
8759070	2011	2014	UNIVERSITY OF DELAWARE	RECOMBINANT CLOSTRIDIA THAT FIX CO2 AND CO AND USES THEREOF
8772515	2012	2014	WISCONSIN ALUMNI RESEARCH FOUNDATION	METHOD TO CONVERT BIOMASS TO 5-(HYDROXYMETHYL)-FURFURAL (HMF) AND FURFURAL USING LACTONES, FURANS, AND PYRANS AS SOLVENTS
8785159	2010	2014	ALLIANCE FOR SUSTAINABLE ENERGY LLC	EXTRACELLULAR SECRETION OF RECOMBINANT PROTEINS
8790546	2008	2014	UNIVERSITY OF MINNESOTA	SOLID FUEL VOLATILIZATION TO PRODUCE SYNTHESIS GAS
8790902	2012	2014	UT-BATTELLE LLC	MICROORGANISMS HAVING ENHANCED TOLERANCE TO INHIBITORS AND STRESS
8795996	2012	2014	WISCONSIN ALUMNI RESEARCH FOUNDATION	GENES RELATED TO XYLOSE FERMENTATION AND METHODS OF USING SAME FOR ENHANCED BIOFUEL PRODUCTION
8834587	2012	2014	VIRENT ENERGY SYSTEMS INC	METHOD OF PRODUCING GASEOUS PRODUCTS USING A DOWNFLOW REACTOR
8835153	2011	2014	ALLIANCE FOR SUSTAINABLE ENERGY LLC	PROCESS AND GENES FOR EXPRESSION AND OVEREXPRESSION OF ACTIVE [FEFE] HYDROGENASES
8846352	2012	2014	SOLAZYME INC	GENETICALLY ENGINEERED MICROORGANISMS THAT METABOLIZE XYLOSE
8853477	2013	2014	UOP LLC	CATALYTIC PYROLYSIS USING UZM-39 ALUMINOSILICATE ZEOLITE
8865440	2012	2014	UT-BATTELLE LLC	MICROORGANISMS HAVING ENHANCED RESISTANCE TO ACETATE AND METHODS OF USE
8882990	2012	2014	BATTELLE MEMORIAL INSTITUTE	DEOXYGENATION OF FATTY ACIDS FOR PREPARATION OF HYDROCARBONS

8895272	2013	2014	GEVO INC	METHODS FOR THE ECONOMICAL PRODUCTION OF BIOFUEL FROM BIOMASS
EP2689014	2012	2014	BUTAMAX ADVANCED BIOFUELS LLC	HOST CELLS AND METHODS FOR PRODUCTION OF ISOBUTANOL
EP2705138	2012	2014	SOLAZYME INC	GENETICALLY ENGINEERED MICROORGANISMS THAT METABOLIZE XYLOSE
EP2708602	2008	2014	VERENIUM CORP	XYLANASES, NUCLEIC ACIDS ENCODING THEM AND METHODS FOR MAKING AND USING THEM
EP2737073	2012	2014	BUTAMAX ADVANCED BIOFUELS LLC	KETO-ISOVALERATE DECARBOXYLASE ENZYMES AND METHODS OF USE THEREOF
EP2814970	2013	2014	COLUMBIA UNIVERSITY	METHODS AND SYSTEMS FOR PRODUCING PRODUCTS USING ENGINEERED SULFUR OXIDIZING BACTERIA
WO2014008301	2013	2014	COLORADO STATE UNIVERSITY	BIOREFINING COMPOUNDS AND ORGANOCATALYTIC UPGRADING METHODS
WO2014011199	2012	2014	LOS ALAMOS NATIONAL SECURITY LLC	CONVERSION OF OLIGOMERIC STARCH, CELLULOSE, OR SUGARS TO HYDROCARBONS
WO2014058859	2013	2014	WISCONSIN ALUMNI RESEARCH FOUNDATION	METHOD TO CONVERT MONOSACCHARIDES TO 5-(HYDROXYMETHYL) FURFURAL (HMF) USING BIOMASS-DERIVED SOLVENTS
WO2014081973	2013	2014	SANDIA CORP, UNIVERSITY OF CALIFORNIA	NUCLEIC ACIDS USEFUL FOR INTEGRATING INTO AND GENE EXPRESSION IN HYPERTHERMOPHILIC ACIDOPHILIC ARCHAEA
WO2014110084	2014	2014	WISCONSIN ALUMNI RESEARCH FOUNDATION	METHOD TO PRODUCE WATER-SOLUBLE SUGARS FROM BIOMASS USING SOLVENTS CONTAINING LACTONES
WO2014149156	2014	2014	UNIVERSITY OF TEXAS	PROCESSES FOR LIQUEFYING CARBONACEOUS FEEDSTOCKS AND RELATED COMPOSITIONS
WO2014151190	2014	2014	BUTAMAX ADVANCED BIOFUELS LLC	DHAD VARIANTS AND METHODS OF SCREENING
WO2014164320	2014	2014	CORNELL UNIVERSITY	PHOTOBIOREACTOR APPARATUS, METHOD AND APPLICATION
8945902	2010	2015	WISCONSIN ALUMNI	COMBINATORIAL DISCOVERY OF ENZYMES

			RESEARCH FOUNDATION	WITH UTILITY IN BIOMASS TRANSFORMATION
8962867	2011	2015	WISCONSIN ALUMNI RESEARCH FOUNDATION	SOLUTE-ENHANCED PRODUCTION OF GAMMA-VALEROLACTONE (GVL) FROM AQUEOUS SOLUTIONS OF LEVULINIC ACID
8968515	2010	2015	MICHIGAN STATE UNIVERSITY	METHODS FOR PRETREATING BIOMASS
8969033	2010	2015	BATTELLE ENERGY ALLIANCE LLC	ALTERATION AND MODULATION OF PROTEIN ACTIVITY BY VARYING POST-TRANSLATIONAL MODIFICATION
8975049	2008	2015	UNIVERSITY OF CALIFORNIA	BIOFUEL PRODUCTION BY RECOMBINANT MICROORGANISMS
9024111	2012	2015	SANDIA CORP	METHODS AND MATERIALS FOR DECONSTRUCTION OF BIOMASS FOR BIOFUELS PRODUCTION
9029114	2013	2015	BATTELLE ENERGY ALLIANCE LLC	TYPE II RESTRICTION-MODIFICATION SYSTEM METHYLATION SUBUNIT OF ALICYCLOBACILLUS ACIDOCALDARIUS
9045741	2013	2015	BATTELLE ENERGY ALLIANCE LLC	THERMOPHILIC AND THERMOACIDOPHILIC BIOPOLYMER-DEGRADING GENES AND ENZYMES FROM ALICYCLOBACILLUS ACIDOCALDARIUS AND RELATED ORGANISMS, METHODS
9045764	2012	2015	PENN STATE UNIVERSITY	COMPOSITIONS AND METHODS RELATING TO TRANSGENIC PLANTS AND CELLULOSIC ETHANOL PRODUCTION
9045804	2013	2015	WISCONSIN ALUMNI RESEARCH FOUNDATION	METHOD TO PRODUCE WATER-SOLUBLE SUGARS FROM BIOMASS USING SOLVENTS CONTAINING LACTONES
9067903	2013	2015	WISCONSIN ALUMNI RESEARCH FOUNDATION	CATALYTIC CONVERSION OF CELLULOSE TO LIQUID HYDROCARBON FUELS BY PROGRESSIVE REMOVAL OF OXYGEN TO FACILITATE SEPARATION PROCESSES AND ACHIEVE HIGH SELECTIVITIES
9096876	2013	2015	MASSACHUSETTS INSTITUTE OF TECHNOLOGY	ENGINEERED MICROBES AND METHODS FOR MICROBIAL OIL OVERPRODUCTION FROM CELLULOSIC MATERIALS

9101093	2012	2015	ALGENOL BIOTECH LLC, GEORGIA TECH RESEARCH CORP	WATER/CARBONATE STRIPPING FOR CO2 CAPTURE ADSORBER REGENERATION AND CO2 DELIVERY TO PHOTOAUTOTROPHS
9120834	2014	2015	CMS TECHNOLOGIES HOLDINGS INC	MEMBRANE SEPARATION OF IONIC LIQUID SOLUTIONS
9145542	2011	2015	UNIVERSITY OF CALIFORNIA	METHOD FOR PRODUCING ALDEHYDE FROM CO2
9145551	2013	2015	WISCONSIN ALUMNI RESEARCH FOUNDATION	MULTIFUNCTIONAL CELLULASE AND HEMICELLULASE
9145567	2014	2015	WISCONSIN ALUMNI RESEARCH FOUNDATION	GENES RELATED TO XYLOSE FERMENTATION AND METHODS OF USING SAME FOR ENHANCED BIOFUEL PRODUCTION
9150889	2011	2015	UNIVERSITY OF CALIFORNIA	ELECTRO-AUTOTROPHIC SYNTHESIS OF HIGHER ALCOHOLS
9157130	2012	2015	SANDIA CORP, UNIVERSITY OF CALIFORNIA	RECOVERY OF SUGARS FROM IONIC LIQUID BIOMASS LIQUOR BY SOLVENT EXTRACTION
9162212	2010	2015	WAYNE STATE UNIVERSITY	SUPPORTED CATALYST SYSTEMS AND METHOD OF MAKING BIODIESEL PRODUCTS USING SUCH CATALYSTS
9162999	2012	2015	WISCONSIN ALUMNI RESEARCH FOUNDATION	CATALYTIC CONVERSION OF CELLULOSE TO FUELS AND CHEMICALS USING BORONIC ACIDS
9169442	2010	2015	UNIVERSITY OF MASSACHUSETTS	SYSTEMS AND PROCESSES FOR CATALYTIC PYROLYSIS OF BIOMASS AND HYDROCARBONACEOUS MATERIALS FOR PRODUCTION OF AROMATICS WITH OPTIONAL OLEFIN RECYCLE, AND CATALYSTS HAVING SELECTED PARTICLE SIZE FOR CATALYTIC PYROLYSIS
9169467	2013	2015	BUTAMAX ADVANCED BIOFUELS LLC	KETOL-ACID REDUCTOISOMERASE ENZYMES AND METHODS OF USE
9175408	2010	2015	UNIVERSITY OF MASSACHUSETTS	MICROBIAL PRODUCTION OF MULTI-CARBON CHEMICALS AND FUELS FROM WATER AND CARBON DIOXIDE USING ELECTRIC CURRENT
9187753	2014	2015	BATTELLE	TRANSCRIPTIONAL CONTROL

			ENERGY ALLIANCE LLC	IN ALICYCLOBACILLUS ACIDOCALDARIUS AND ASSOCIATED GENES, PROTEINS, AND METHODS
9206145	2011	2015	WISCONSIN ALUMNI RESEARCH FOUNDATION	SINGLE-REACTOR PROCESS FOR PRODUCING LIQUID-PHASE ORGANIC COMPOUNDS FROM BIOMASS
9206436	2013	2015	UT-BATTELLE LLC	KEY GENE REGULATING CELL WALL BIOSYNTHESIS AND RECALCITRANCE IN POPULUS, GENE Y
9222094	2014	2015	BATTELLE ENERGY ALLIANCE LLC	THERMOPHILIC AND THERMOACIDOPHILIC METABOLISM GENES AND ENZYMES FROM ALICYCLOBACILLUS ACIDOCALDARIUS AND RELATED ORGANISMS, METHODS
EP2823019	2013	2015	RESEARCH TRIANGLE INSTITUTE	CATALYTIC BIOMASS PYROLYSIS PROCESS
EP2847326	2013	2015	BUTAMAX ADVANCED BIOFUELS LLC	KETOL-ACID REDUCTOISOMERASE ENZYMES AND METHODS OF USE
EP2870146	2013	2015	COLORADO STATE UNIVERSITY	BIOREFINING COMPOUNDS AND ORGANOCATALYTIC UPGRADING METHODS
EP2922957	2013	2015	UNIVERSITY OF CALIFORNIA	NUCLEIC ACIDS USEFUL FOR INTEGRATING INTO AND GENE EXPRESSION IN HYPERTHERMOPHILIC ACIDOPHILIC ARCHAEA
EP2943594	2014	2015	WISCONSIN ALUMNI RESEARCH FOUNDATION	METHOD TO PRODUCE WATER-SOLUBLE SUGARS FROM BIOMASS USING SOLVENTS CONTAINING LACTONES
EP2949756	2006	2015	BP CORP NORTH AMERICA INC	CELLULASES, NUCLEIC ACIDS ENCODING THEM AND METHODS FOR MAKING AND USING THEM
WO2015061802	2014	2015	PURDUE RESEARCH FOUNDATION	CATALYTIC BIOMASS CONVERSION METHODS, CATALYSTS, AND METHODS OF MAKING THE SAME
WO2015066245	2014	2015	CMS TECHNOLOGIES HOLDINGS INC	MEMBRANE SEPARATION OF IONIC LIQUID SOLUTIONS
WO2015108777	2015	2015	UNIVERSITY OF DELAWARE	SYNTHETIC METHYLOTROPHY TO LIQUID FUELS AND CHEMICALS
WO2015138563	2015	2015	WISCONSIN ALUMNI	SELECTIVE C-O BOND CLEAVAGE OF OXIDIZED

			RESEARCH FOUNDATION	LIGNIN AND LIGNIN-TYPE MATERIALS INTO SIMPLE AROMATIC COMPOUNDS
9238828	2012	2016	BUTAMAX ADVANCED BIOFUELS LLC	KETO-ISOVALERATE DECARBOXYLASE ENZYMES AND METHODS OF USE THEREOF
9242952	2014	2016	WISCONSIN ALUMNI RESEARCH FOUNDATION	METHOD FOR SELECTIVELY PREPARING 5-HYDROXYMETHYLFURFUAL (HMF) FROM BIOMASS IN POLAR APROTIC SOLVENTS
9249442	2013	2016	UT-BATTELLE LLC	CONSOLIDATED BIOPROCESSING METHOD USING THERMOPHILIC MICROORGANISMS
9255283	2011	2016	ARIZONA STATE UNIVERSITY	COMPOSITIONS AND METHODS FOR BACTERIAL LYSIS AND NEUTRAL LIPID PRODUCTION
9273330	2013	2016	BUTAMAX ADVANCED BIOFUELS LLC	BUTANOL TOLERANCE IN MICROORGANISMS
9284566	2011	2016	UNIVERSITY OF CALIFORNIA	BIOFUEL AND CHEMICAL PRODUCTION BY RECOMBINANT MICROORGANISMS VIA FERMENTATION OF PROTEINACEOUS BIOMASS
9290768	2013	2016	LAWRENCE LIVERMORE NATIONAL SECURITY LLC	ENGINEERED MICROORGANISMS HAVING RESISTANCE TO IONIC LIQUIDS
9290784	2014	2016	BATTELLE ENERGY ALLIANCE LLC	METHODS OF COMBINED BIOPROCESSING AND RELATED MICROORGANISMS, THERMOPHILIC AND/OR ACIDOPHILIC ENZYMES, AND NUCLEIC ACIDS ENCODING SAID ENZYMES
9303264	2013	2016	ARIZONA STATE UNIVERSITY	PHOTOSYNTHETIC MICROORGANISMS EXPRESSING THERMOSTABLE LIPASE
9309542	2013	2016	UNIVERSITY OF GEORGIA	RECOMBINANT CALDICELLULOSIRUPTOR BESCII AND METHODS OF USE
9322042	2010	2016	SANDIA CORP, UNIVERSITY OF CALIFORNIA	THERMOSTABLE CELLULASES, AND MUTANTS THEREOF, CAPABLE OF HYDROLYZING CELLULOSE IN IONIC LIQUID
9328335	2010	2016	MICHIGAN STATE UNIVERSITY	METHOD TO PRODUCE ACETYLDIACYLGLYCEROLS (AC-TAGS) BY EXPRESSION

				OF AN ACETYLTRANSFERASE GENE ISOLATED FROM EUONYMUS ALATUS (BURNING BUSH)
9340741	2009	2016	GAS TECHNOLOGY INSTITUTE	BIOMASS TORREFACTION MILL
9359319	2013	2016	LOS ALAMOS NATIONAL SECURITY LLC	HYDROGENATION OF BIOMASS-DERIVED SUBSTRATES
9359391	2014	2016	WISCONSIN ALUMNI RESEARCH FOUNDATION	SELECTIVE C-O BOND CLEAVAGE OF OXIDIZED LIGNIN AND LIGNIN-TYPE MATERIALS INTO SIMPLE AROMATIC COMPOUNDS
9376411	2015	2016	WISCONSIN ALUMNI RESEARCH FOUNDATION	SOLUTE-ENHANCED PRODUCTION OF GAMMA-VALEROLACTONE (GVL) FROM AQUEOUS SOLUTIONS OF LEVULINIC ACID
9376451	2014	2016	WISCONSIN ALUMNI RESEARCH FOUNDATION	METHOD FOR SELECTIVELY PREPARING EVOGLUCOSENONE (LGO) AND OTHER ANHYDROSUGARS FROM BIOMASS IN POLAR APROTIC SOLVENTS
9376728	2012	2016	SANDIA CORP, UNIVERSITY OF CALIFORNIA	USEFUL HALOPHILIC, THERMOSTABLE AND IONIC LIQUIDS TOLERANT CELLULASES
9388392	2015	2016	BUTAMAX ADVANCED BIOFUELS LLC	KETOL-ACID REDUCTOISOMERASE ENZYMES AND METHODS OF USE
9388398	2015	2016	BATTELLE ENERGY ALLIANCE LLC	ALTERATION AND MODULATION OF PROTEIN ACTIVITY BY VARYING POST-TRANSLATIONAL MODIFICATION
9404134	2015	2016	BATTELLE ENERGY ALLIANCE LLC	THERMOPHILIC AND THERMOACIDOPHILIC BIOPOLYMER DEGRADING GENES AND ENZYMES FROM ALICYCLOBACILLUS ACIDOCALDARIUS AND RELATED ORGANISMS, METHODS
9404136	2013	2016	MICHIGAN STATE UNIVERSITY	A-XYLOSIDASE ENHANCED CONVERSION OF PLANT BIOMASS INTO FERMENTABLE SUGARS
9416378	2015	2016	UNIVERSITY OF CALIFORNIA	BIOFUEL PRODUCTION BY RECOMBINANT MICROORGANISMS
9422581	2013	2016	BUTAMAX	HOST CELLS AND METHODS

			ADVANCED BIOFUELS LLC	FOR PRODUCTION OF ISOBUTANOL
9422582	2013	2016	BUTAMAX ADVANCED BIOFUELS LLC	HOST CELLS AND METHODS FOR PRODUCTION OF ISOBUTANOL
9428726	2011	2016	UNIVERSITY OF CALIFORNIA	MODIFIED HOST CELLS WITH EFFLUX PUMPS
9441256	2013	2016	PURDUE RESEARCH FOUNDATION	LIGNASES AND ALDO-KETO REDUCTASES FOR CONVERSION OF LIGNIN-CONTAINING MATERIALS TO FERMENTABLE PRODUCTS
9453166	2015	2016	UNIVERSITY OF MASSACHUSETTS	SYSTEMS AND PROCESSES FOR CATALYTIC PYROLYSIS OF BIOMASS AND HYDROCARBONACEOUS MATERIALS FOR PRODUCTION OF AROMATICS WITH OPTIONAL OLEFIN RECYCLE, AND CATALYSTS HAVING SELECTED PARTICLE SIZE FOR CATALYTIC PYROLYSIS
9469574	2012	2016	LOS ALAMOS NATIONAL SECURITY LLC	CONVERSION OF OLIGOMERIC STARCH, CELLULOSE, OR SUGARS TO HYDROCARBONS
9469626	2013	2016	COLORADO STATE UNIVERSITY	BIOREFINING COMPOUNDS AND ORGANOCATALYTIC UPGRADING METHODS
9481898	2015	2016	UNIVERSITY OF CALIFORNIA	ELECTRO-AUTOTROPHIC SYNTHESIS OF HIGHER ALCOHOLS
9499824	2015	2016	BATTELLE ENERGY ALLIANCE LLC	TRANSCRIPTIONAL CONTROL IN ALICYCLOBACILLUS ACIDOCALDARIUS AND ASSOCIATED GENES, PROTEINS, AND METHODS
9499845	2014	2016	TERRAVIA HOLDINGS INC	GENETICALLY ENGINEERED MICROORGANISMS THAT METABOLIZE XYLOSE
9506084	2013	2016	PURDUE RESEARCH FOUNDATION	PRODUCTION OF HYDROGEN USING AN ANAEROBIC BIOLOGICAL PROCESS
9506088	2015	2016	WISCONSIN ALUMNI RESEARCH FOUNDATION	GENES RELATED TO XYLOSE FERMENTATION AND METHODS OF USING SAME FOR ENHANCED BIOFUEL PRODUCTION
9523070	2014	2016	CORNELL UNIVERSITY	PHOTOBIOREACTOR APPARATUS, METHOD AND APPLICATION
EP3060718	2014	2016	PURDUE RESEARCH FOUNDATION	CATALYTIC BIOMASS CONVERSION METHODS, CATALYSTS, AND METHODS OF MAKING THE SAME

EP3095789	2010	2016	WISCONSIN ALUMNI RESEARCH FOUNDATION	BIOMASS HYDROLYSIS
EP3106220	2016	2016	SOUTHERN RESEARCH INSTITUTE	SULFUR RESISTANT NICKEL ALUMINATE CATALYSTS, SOL-GEL PREPARATION METHOD AND USE IN METHANE REFORMING OF SUCH CATALYSTS
WO2016167882	2016	2016	WISCONSIN ALUMNI RESEARCH FOUNDATION	METHOD TO PRODUCE BIOMASS-DERIVED COMPOUNDS USING A CO-SOLVENT SYSTEM CONTAINING GAMMA-VALEROLACTONE
9556088	2012	2017	IOWA STATE UNIVERSITY	ADSORBENT CATALYTIC NANOPARTICLES AND METHODS OF USING THE SAME
9567595	2015	2017	BATTELLE ENERGY ALLIANCE LLC	TYPE II RESTRICTION MODIFICATION SYSTEM METHYLATION SUBUNIT OF ALICYCLOBACILLUS ACIDOCALDARIUS
9580659	2014	2017	UNIVERSITY OF TEXAS	PROCESSES FOR LIQUEFYING CARBONACEOUS FEEDSTOCKS AND RELATED COMPOSITIONS
9580705	2014	2017	BUTAMAX ADVANCED BIOFUELS LLC	DHAD VARIANTS AND METHODS OF SCREENING
9624482	2010	2017	SANDIA CORP	THERMOPHILIC CELLOBIOHYDROLASE
9631210	2012	2017	UNIVERSITY OF CALIFORNIA	METHODS FOR INCREASING PRODUCTION OF 3-METHYL-2-BUTENOL USING FUSION PROTEINS
9644222	2011	2017	MICHIGAN STATE UNIVERSITY	METHODS FOR PRETREATING BIOMASS
9650657	2011	2017	MICHIGAN STATE UNIVERSITY	METHODS FOR PRODUCING EXTRACTED AND DIGESTED PRODUCTS FROM PRETREATED LIGNOCELLULOSIC BIOMASS
9688845	2015	2017	WISCONSIN ALUMNI RESEARCH FOUNDATION	METHOD TO PRODUCE BIOMASS-DERIVED COMPOUNDS USING A CO-SOLVENT SYSTEM CONTAINING GAMMA-VALEROLACTONE
9695426	2009	2017	UNIVERSITY OF CALIFORNIA	BIOFUEL PRODUCTION BY RECOMBINANT MICROORGANISMS
9718748	2016	2017	SANDIA CORP	METAL-ORGANIC FRAMEWORK CATALYSTS

				FOR SELECTIVE CLEAVAGE OF ARYL-ETHER BONDS
9725749	2012	2017	SANDIA CORP, UNIVERSITY OF CALIFORNIA	GLYCOSIDE HYDROLASES HAVING MULTIPLE HYDROLASE ACTIVITIES
9725776	2015	2017	WISCONSIN ALUMNI RESEARCH FOUNDATION	METHOD TO PRODUCE WATER-SOLUBLE SUGARS FROM BIOMASS USING SOLVENTS CONTAINING LACTONES
9732330	2016	2017	BATTELLE ENERGY ALLIANCE LLC	METHODS OF COMBINED BIOPROCESSING AND RELATED MICROORGANISMS, THERMOPHILIC AND/OR ACIDOPHILIC ENZYMES, AND NUCLEIC ACIDS ENCODING SAID ENZYMES
9745601	2013	2017	COLUMBIA UNIVERSITY	METHODS AND SYSTEMS FOR PRODUCING PRODUCTS USING ENGINEERED SULFUR OXIDIZING BACTERIA
9751815	2016	2017	LOS ALAMOS NATIONAL SECURITY LLC	CONVERSION OF OLIGOMERIC STARCH, CELLULOSE, HYDROLYSATES OR SUGARS TO HYDROCARBONS
9777300	2014	2017	UNIVERSITY OF CALIFORNIA	HYBRID ORGANIC-INORGANIC SYSTEM FOR PRODUCING BIOFUELS
9783474	2014	2017	PURDUE RESEARCH FOUNDATION	CATALYTIC BIOMASS CONVERSION METHODS, CATALYSTS, AND METHODS OF MAKING THE SAME
9783477	2016	2017	LOS ALAMOS NATIONAL SECURITY LLC	SYNTHESIS OF FUELS AND FEEDSTOCKS
9790521	2012	2017	BUTAMAX ADVANCED BIOFUELS LLC	HOST CELLS AND METHODS FOR PRODUCTION OF ISOBUTANOL
9803182	2015	2017	SANDIA CORP, UNIVERSITY OF CALIFORNIA	IONIC LIQUID-TOLERANT CELLULASE ENZYMES
9828354	2016	2017	COLORADO STATE UNIVERSITY	BIOREFINING COMPOUNDS AND ORGANOCATALYTIC UPGRADING METHODS
9845478	2011	2017	MICHIGAN STATE UNIVERSITY	COMPOSITIONS AND METHODS FOR XYLEM-SPECIFIC EXPRESSION IN PLANT CELLS
9850505	2015	2017	WISCONSIN ALUMNI RESEARCH FOUNDATION	MICROORGANISMS AND METHODS FOR PRODUCING PYRUVATE, ETHANOL, AND OTHER COMPOUNDS
9856449	2015	2018	UNIVERSITY OF MASSACHUSETTS	MICROBIAL PRODUCTION OF MULTI-CARBON CHEMICALS AND FUELS FROM WATER

				AND CARBON DIOXIDE USING ELECTRIC CURRENT
9862981	2016	2018	BATTELLE ENERGY ALLIANCE LLC	THERMOPHILIC ACETYLXYLAN ESTERASE GENES AND ENZYMES FROM ALICYCLOBACILLUS ACIDOCALDARIUS AND RELATED ORGANISMS AND METHODS
9862982	2016	2018	SANDIA CORP, UNIVERSITY OF CALIFORNIA	METHODS OF HYDROLYZING A CELLULOSE USING HALOPHILIC, THERMOSTABLE AND IONIC LIQUIDS TOLERANT CELLULASES
9879247	2016	2018	BATTELLE ENERGY ALLIANCE LLC	THERMOPHILIC AND THERMOACIDOPHILIC METABOLISM GENES AND ENZYMES FROM ALICYCLOBACILLUS ACIDOCALDARIUS AND RELATED ORGANISMS, METHODS
9879248	2015	2018	MASSACHUSETTS INSTITUTE OF TECHNOLOGY	ENGINEERED MICROBES AND METHODS FOR MICROBIAL OIL OVERPRODUCTION FROM CELLULOSIC MATERIALS
9884804	2016	2018	UT-BATTELLE LLC, UNIVERSITY OF TENNESSEE	SURFACE TREATED CARBON CATALYSTS PRODUCED FROM WASTE TIRES FOR FATTY ACIDS TO BIOFUEL CONVERSION
9890385	2016	2018	BATTELLE ENERGY ALLIANCE LLC	TYPE II RESTRICTION MODIFICATION SYSTEM METHYLATION SUBUNIT OF ALICYCLOBACILLUS ACIDOCALDARIUS
9896707	2016	2018	BATTELLE ENERGY ALLIANCE LLC	THERMOPHILIC AND THERMOACIDOPHILIC BIOPOLYMER-DEGRADING GENES AND ENZYMES FROM ALICYCLOBACILLUS ACIDOCALDARIUS AND RELATED ORGANISMS, METHODS
9902980	2012	2018	GINKGO BIOWORKS INC	METHODS AND SYSTEMS FOR CHEMOAUTOTROPHIC PRODUCTION OF ORGANIC COMPOUNDS
9932601	2011	2018	UNIVERSITY OF CALIFORNIA	INHIBITION OF SNL6 EXPRESSION FOR BIOFUEL PRODUCTION
9944857	2013	2018	RESEARCH TRIANGLE INSTITUTE	CATALYTIC BIOMASS PYROLYSIS PROCESS
9951359	2016	2018	UT-BATTELLE	HEAT-STABLE, FE-

			LLC	DEPENDENT ALCOHOL DEHYDROGENASE FOR ALDEHYDE DETOXIFICATION
9957510	2016	2018	BATTELLE ENERGY ALLIANCE LLC	TRANSCRIPTIONAL CONTROL IN ALICYCLOBACILLUS ACIDOCALDARIUS AND ASSOCIATED GENES, PROTEINS, AND METHODS
9970034	2015	2018	WOODS HOLE OCEANOGRAPHIC INST, WESTERN WASHINGTON UNIV, MARINE BIOLOGICAL LABORATORY	USE OF MARINE ALGAE FOR CO-PRODUCING ALKENONES, ALKENONE DERIVATIVES, AND CO-PRODUCTS
10006039	2013	2018	MICHIGAN STATE UNIVERSITY	PRODUCTION OF OIL IN VEGETATIVE TISSUES
10006057	2015	2018	WISCONSIN ALUMNI RESEARCH FOUNDATION	RECOMBINANT YEAST HAVING ENHANCED GAMMA VALEROLACTONE TOLERANCE AND METHODS OF USE
10059920	2015	2018	UNIVERSITY OF DELAWARE	SYNTHETIC METHYLOTROPHY TO LIQUID FUELS AND CHEMICALS
10066223	2013	2018	UNIVERSITY OF CALIFORNIA	NUCLEIC ACIDS USEFUL FOR INTEGRATING INTO AND GENE EXPRESSION IN HYPERTHERMOPHILIC ACIDOPHILIC ARCHAEA
10144000	2016	2018	SOUTHERN RESEARCH INSTITUTE	SULFUR RESISTANT NICKEL BASED CATALYSTS, METHODS OF FORMING AND USING SUCH CATALYSTS
10144938	2016	2018	WISCONSIN ALUMNI RESEARCH FOUNDATION	METHODS OF PROCESSING AROMATIC COMPOUNDS
10144941	2015	2018	WISCONSIN ALUMNI RESEARCH FOUNDATION	METHOD AND COMPOSITIONS FOR IMPROVED LIGNOCELLULOSIC MATERIAL HYDROLYSIS
10155908	2013	2018	RESEARCH TRIANGLE INSTITUTE	CATALYST COMPOSITIONS AND USE THEREOF IN CATALYTIC BIOMASS PYROLYSIS
EP3415233	2013	2018	RESEARCH TRIANGLE INSTITUTE	CATALYTIC BIOMASS PYROLYSIS SYSTEM
RE046733	2015	2018	BP CORP NORTH AMERICA INC	XYLANASES, NUCLEIC ACIDS ENCODING THEM AND METHODS FOR MAKING AND USING THEM
10208321	2018	2019	WOODS HOLE OCEANOGRAPHIC	USE OF MARINE ALGAE FOR CO-PRODUCING ALKENONES,

			INST, WESTERN WASHINGTON UNIV	ALKENONE DERIVATIVES, AND CO-PRODUCTS
10214737	2018	2019	BATTELLE ENERGY ALLIANCE LLC	THERMOPHILIC AND THERMOACIDOPHILIC METABOLISM GENES AND ENZYMES FROM ALICYCLOBACILLUS ACIDOCALDARIUS AND RELATED ORGANISMS, METHODS
10214758	2012	2019	WISCONSIN ALUMNI RESEARCH FOUNDATION	METHOD AND COMPOSITIONS FOR IMPROVED LIGNOCELLULOSIC MATERIAL HYDROLYSIS
10240177	2018	2019	BATTELLE ENERGY ALLIANCE LLC	THERMOPHILIC AND THERMOACIDOPHILIC BIOPOLYMER-DEGRADING GENES AND ENZYMES FROM ALICYCLOBACILLUS ACIDOCALDARIUS AND RELATED ORGANISMS, METHODS
10246724	2016	2019	PURDUE RESEARCH FOUNDATION	PRODUCTION OF HYDROGEN USING AN ANAEROBIC BIOLOGICAL PROCESS
10246725	2017	2019	WISCONSIN ALUMNI RESEARCH FOUNDATION	MICROORGANISMS AND METHODS FOR PRODUCING PYRUVATE, ETHANOL, AND OTHER COMPOUNDS
10287566	2017	2019	BUTAMAX ADVANCED BIOFUELS LLC	DHAD VARIANTS AND METHODS OF SCREENING
10351835	2017	2019	BATTELLE ENERGY ALLIANCE LLC	METHODS OF COMBINED BIOPROCESSING AND RELATED MICROORGANISMS, THERMOPHILIC AND/OR ACIDOPHILIC ENZYMES, AND NUCLEIC ACIDS ENCODING SAID ENZYMES
10378000	2017	2019	SANDIA CORP, UNIVERSITY OF CALIFORNIA	IONIC LIQUID-TOLERANT CELLULASE ENZYMES
10428397	2017	2019	WISCONSIN ALUMNI RESEARCH FOUNDATION	METHOD TO PRODUCE WATER-SOLUBLE SUGARS FROM BIOMASS USING SOLVENTS CONTAINING LACTONES
10494624	2019	2019	BATTELLE ENERGY ALLIANCE LLC	THERMOPHILIC AND THERMOACIDOPHILIC METABOLISM GENES AND ENZYMES FROM ALICYCLOBACILLUS ACIDOCALDARIUS AND RELATED ORGANISMS,

				METHODS
10519469	2017	2019	COLUMBIA UNIVERSITY	METHODS AND SYSTEMS FOR PRODUCING PRODUCTS USING ENGINEERED SULFUR OXIDIZING BACTERIA

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