Trends in Nanotech patenting for "clean energy" applications


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ABSTRACT

Based on newly available patent classification systems developed by the European Patent Office, we investigated the patenting of nanotechnology for clean energy applications. This clearly is a high growth area within a high growth area, outpacing both patenting "clean energy" and nanotechnology by a factor 4 to 5.

The area of photovoltaics appears to be dominant in this area, accounting for roughly one half of the patents, followed by fuel cells, batteries and hydrogen storage, but new applications for nanotechnology in wind energy, hydrogen production and carbon capture and storage appear to be patented increasingly.

Using the free-of-charge esp@cenet search engine, information on nanotechnology patents for specific "clean energy" applications is easily retrievable.

Keywords: patents, nanotechnology, clean energy, trends

1 INTRODUCTION

Over the last years, spurred by economic incentives (such as CO2 quota and governmental or regional investment programs), legal initiatives and even commercial or marketing aspects, research and investments into CCMTs has grown tremendously. For example, total investment in renewable energy capacity (excluding large hydro) was about $150 billion in 2009, while "green stimulus" efforts since late-2008 by many of the world's major economies even totaled close to $200 billion [1]. World investment in renewable energy is expected to top $2 trillion on a cumulative basis from 2010 through 2015, driven by growth in Asia, North America and Europe [2].

Nanotechnology is expected to bring improved manufacturing and material properties, such as increased efficiency and strength, which could be quite important in clean energy applications.

The European Patent Office (EPO) was one of the first patent offices to recognize the potential of nanotechnology, and developed a patent classification system especially for nanotechnologies. This was somewhat of a challenge as patents relating to nanotechnologies are to be found in many different technical areas, from chemistry to electronics and from biotechnology to materials science.

The resulting Y01N patent classification scheme [3] was quite successful and much appreciated material for econometric studies into patenting and innovation strength in nanotechnology. In the beginning of 2011 the EPO nanotechnology patent classification scheme formed the basis for an international classification system (called B82Y), which is now used world-wide.

The experience gained in compiling patents from many different technological areas around one central theme was put to good use when a project was started up between the EPO, the United Nations Environmental Program (UNEP) and the International Council on Trade and Sustainable Development (ICTSD), to consolidate their respective expertise on the issue in April 2009 to create a public information platform that would enable in-depth empirical studies to be undertaken on the role of IPRs in the transfer of climate change mitigation technologies (CCMTs), with special focus on “clean energy” [4]. This resulted in the creation of a new patent classification system for CCMTs, called the Y02 classification, which includes a section for renewable energies.

Given the interest in the use of nanotechnology in the clean energy sector we have used the combination of the patent classification systems that were created for nanotechnology and for “clean energy” to gain insight in patenting trends in this area.

2 TRENDS

2.1 General trend

When looking at published patent applications since 1995, the increase in nanotech applications in the clean energy sector is spectacularly higher than the growth in either nanotech or clean energy taken alone. Whereas the yearly total amount of patent applications doubled over this period of time, the amount of nanotechnology applications, as well as those related to “clean energy” quadrupled. Far more spectacular than any of the separate technologies is the growth in patent applications relating to nanotechnology for clean energy, as can be seen from figure 1. The growth of patent applications in nanotechnology for clean energy applications corresponds roughly to the growth in nanotechnology multiplied by the growth in "clean energy".
2.2 Breakdown in technologies

The patent classification scheme for Climate Change Mitigation Technologies (CCMTs) can be looked up and searched free of charge through the esp@cenet site of the European Patent Office [5] and currently exists of two main sections:

- Y02C: Capture, Storage, Sequestration Or Disposal Of Greenhouse Gases.

Around 650,000 documents are currently tagged with at least one of nearly 200 specific technology tags falling within these two sections. Work is currently underway to expand the scheme with sections relating to CCMTs for buildings, transportation and industry.

The currently available sections Y02C and Y02E are subdivided in main technology categories, which are further subdivided in smaller sub-categories, as is usual for a patent classification scheme.

There are seven main categories. The main categories for Y02E most relevant to nanotechnology are:

- Y02E10: Energy generation through renewable energy sources.
- Y02E60: Technologies with potential or indirect contribution to GHG emissions mitigation.

The Y02E10 category includes technologies such as solar power, wind power, hydro-energy etc.

The Y02E60 category includes technologies such as hydrogen generation and storage, fuel cells, batteries and ultracapacitors.

Most of these technologies are then further subdivided into more specific technologies or components. For example, a specific technology tag within solar power relates to "Dye sensitized Solar Cells" and a specific tag within fuel cells relates "Direct methanol Fuel Cells".

By taking the cross section of documents classified in IPC class B82Y (nanotechnology) and ECLA class Y02, and then refining to technology, we obtain the following breakdown:

![Figure 1, relative growth of patent applications (1995=100%)](image-url)
Figure 2 shows the top-10 of most active "clean energy" areas for patenting nanotechnology in 2008, broken down to specific technologies. It is clear that most patenting of nanotechnology takes place in photovoltaic solar cells, followed by "secondary technologies", such as fuel cells, batteries and hydrogen storage.

A possible explanation for this could be that especially these areas are more often than other areas dealing with advanced materials, which may benefit from engineering on a very small scale to benefit from quantum-like effects and surface area increase through miniaturization. This is less likely to be a factor in areas such as large hydro or the production of biofuels.

Figure 3 shows the "clean energy" areas with most nanotech patenting.
It can be seen from Figure 3 that by far the largest application of nanotechnology appears to be in the field of photovoltaic solar cells, followed by fuel cells, batteries and hydrogen storage. Although still the smallest sector, the category "others" had the highest growth percentage from 2007 to 2008, indicating that apart from the more traditional applications, new applications for nanotechnology in clean energy are increasingly patented. Especially in hydrogen production from non-fossil sources, wind energy and carbon capture and storage patenting nanotechnology seems to be on the rise. From a closer look at these patent applications, it seems that they often concern the application of carbon nanotubes.

3 CONCLUSIONS

Patenting "clean energy" has grown more than average patenting of technologies over the last 15 years, as has the patenting of nanotechnology. The patenting of nanotechnology for clean energy applications clearly is a high growth area within a high growth area, outpacing both "clean energy" and nanotechnology by a factor 4 to 5.

The area of photovoltaics appears to be dominant in this area, accounting for roughly one half of the patents, followed by fuel cells, batteries and hydrogen storage, but new applications for nanotechnology in wind energy, hydrogen production and carbon capture and storage appear to be patented increasingly.

Using the free-of-charge esp@cenet search engine, the Y02 "clean energy" patent classification of the EPO and the B82Y nanotechnology patent classification, information on nanotechnology patents for specific "clean energy" applications is easily retrievable.

4 DISCLAIMER

The opinions expressed in this paper are those of the authors. They should not be considered as necessarily the policy of the European Patent Office (EPO), or imply any commitment by the EPO to any particular course of action.

REFERENCES