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Finding sustainable technologies in patents



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Introduction

One of the biggest challenges facing humanity today is climate change. Scientists and engineers are responding by developing new technologies to reduce carbon dioxide (CO₂) emissions, capture greenhouse gases, generate energy from renewable sources and distribute energy more efficiently. Consequently, significant quantities of information are appearing in patent applications relating to sustainable technologies.

Of the over 90 million patent documents in the European Patent Office's databases, over three million relate to these technologies.

To help engineers, scientists, institutions and decision-makers use this wealth of knowledge in their work, the EPO has developed a dedicated document tagging scheme which will enable users to find these technologies in its databases.

The scheme was devised in close co-operation with expert partners in the field, using technological guidelines produced by the United Nations Framework Convention on Climate Change (UNFCCC) and the Intergovernmental Panel on Climate Change (IPCC).

The new scheme makes it easier to retrieve relevant information quickly and accurately. It also makes it possible to map sustainable technologies, identify trends and facilitate further R&D.

Climate change mitigation technologies (CCMT) focus on controlling, reducing or preventing the anthropogenic emissions of greenhouse gases, as covered by the Kyoto Protocol. The tagging scheme incorporates both CCMTs and smart grids.

Sustainable technologies currently included in the new classification scheme
Climate change mitigation technologies related to buildings, including housing and appliances or related end-user applications
Capture, storage, sequestration or disposal of greenhouse gases (GHG)
Reduction of greenhouse gases (GHG) emission, related to energy generation, transmission or distribution
Climate change mitigation technologies in the production or processing of goods
Climate change mitigation technologies related to transportation
Climate change mitigation technologies related to wastewater treatment or waste management
Smart grid technologies

In this brochure you can read how to make the best use of patent documents as a source of information and how to get started if you want to search for sustainable technology inventions in the EPO's patent databases.

Patents – public documents providing a wealth of useful information

When filing a patent application, applicants must disclose the details of how their invention works. All patents are published, so everyone can benefit from the information they contain.

Patents are freely available in databases on the internet. Anyone can use them to:

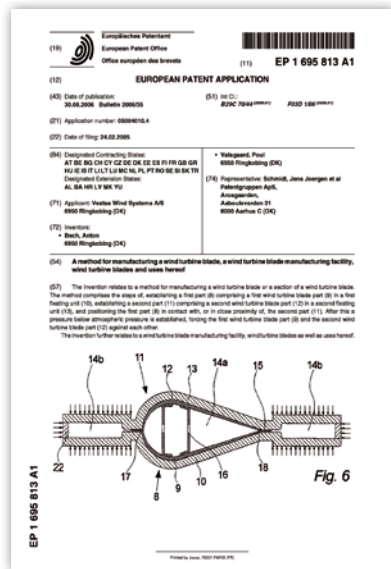
- find out what technology already exists and build on it
- keep track of what other inventors and companies are doing
- avoid infringing other people’s patent rights
- check out where an invention is patented, and where it is not.

Patent documents consist of:

- a first page comprising basic information such as the title of the invention and the name of the inventor
- a detailed description of the invention indicating how it is constructed, how it is used, and what its benefits are compared with what already exists
- claims containing a clear and concise definition of what the patent legally protects
- drawings.

The information you can find in patent documents is:

- detailed and accurate:
Patents have to be written in such a way that a person knowledgeable in the technical field concerned can reproduce the invention. This strict requirement explains why patents can easily be 20 pages long, or more.
- cutting-edge:
To help them secure a competitive advantage through legal protection, companies will generally file their patent applications as soon as possible. Patent applications are normally published 18 months after their first filing date, so they often represent the earliest published information available to the public.



Patent documents describe technologies more precisely and in greater detail than almost any other type of literature. So if you are faced with a technical problem, there is no better way of finding out what solutions already exist than by looking at related patents.



The importance of classification

The total number of patents is so large that a classification scheme is essential.

Patent offices worldwide use the International Patent Classification (IPC), in which each section or sub-section is identified by a symbol combining letters and numbers. When examining patent applications, examiners classify them in one or more sections of the IPC. As a result, when a patent document is published, it always has at least one classification symbol on its front page.

There are approximately 70 000 different IPC classification symbols. Here you can see an example of one such symbol – **A43B13/04** – which is used to classify rubber soles for shoes.

Section	A	Human necessities
Main group	A43	Footwear
Sub-group	A43B	Parts of footwear
Main class	A43B13	Soles
Sub-class (one dot)	A43B13/02	. characterised by the material
Sub-class (two dots)	A43B13/04	.. plastics, rubber or vulcanised fibre

Using IPC symbol **A43B13/04** as a search criterion, searchers can focus exclusively on inventions relating to particular materials used in the soles of shoes or boots. Such symbols transcend language, so, provided they have been correctly classified, you will find documents in languages other than the one you used for your keyword search.

The Cooperative Patent Classification System (CPC) is an extension of the IPC and has been in use by the EPO and the United States Patent and Trademark Office (USPTO) since 1 January 2013. The CPC contains 250 000 classification symbols. For the EPO, it replaces the European Classification (ECLA) scheme, also an extension of the IPC, which was discontinued when the CPC was launched.

Tagging sustainable technology patents

Until recently, documents relating to sustainable technologies were scattered throughout the IPC and ECLA/CPC and did not fall under one single classification section.

To make them easier to identify, the EPO introduced a dedicated **tagging scheme** known as the **Y02/Y04S scheme**. Each time a document relating to a sustainable technology is added to its databases, the EPO assigns it a **Y02** (for CCMTs) or **Y04** (for smart grids) symbol.

This tagging system is included in the EPO's CPC classification scheme.

The table shows the current sub-groups in the Y section:

Sub-group	Description	Comment
Y02B	Climate change mitigation technologies related to buildings, including housing and appliances or related end-user applications	Integration of renewables in buildings, lighting, HVAC (heating, ventilation and air conditioning), home appliances, elevators and escalators, constructional or architectural elements, ICT, power management
Y02C	Capture, storage, sequestration or disposal of greenhouse gases (GHG).	CO ₂ capture and storage, also of other relevant GHG
Y02E	Climate change mitigation technologies in energy generation, transmission and distribution	Renewable energy, efficient combustion, nuclear energy, biofuels, efficient transmission and distribution, energy storage, hydrogen technology
Y02P	Climate change mitigation technologies in the production or processing of goods	Metal processing, chemical/petrochemical industry, minerals processing (e.g. cement, lime, glass), agroalimentary industries,
Y02T	Climate change mitigation technologies related to transportation	e-mobility, hybrid cars, efficient internal combustion engines, efficient technologies in railways and air/waterways transport
Y02W	Climate change mitigation technologies related to wastewater treatment or waste management	Wastewater treatment, solid waste management, bio packaging
Y04S	Smart grid technologies	Power networks operation, end-user applications management, smart metering, electric and hybrid vehicles interoperability, trading and marketing aspects

Each of these sub-groups is further divided into more specific technology tags (see pages 8 to 14). There are over **1300 Y tags**, all relating to sustainable technologies.

There are already **over three million documents with Y tags in the EPO's databases**, and this number will grow as more documents are published. Newly published documents are tagged in batches, at least twice a year.

Y02B: CCMTs in buildings

The Y02B tags cover energy-consuming loads (including home appliances and information and communication technologies) and construction elements (e.g. insulation) that reduce the carbon footprint of a building. There are nine main technical areas, divided into almost 300 different sub-categories in total.

Y02B	Description	Comment
10/00	Integration of renewable energy sources in buildings	Solar power, wind power and geothermal power, especially adapted end-user applications in buildings and dwellings
20/00	Energy efficient lighting technologies	Energy-saving measures for conventional technologies (e.g. for incandescent lamps) but also merging efficient technologies (e.g. so-called LED lamps) adapted for ambient lighting purposes
30/00	Energy efficient heating, ventilation or air conditioning [HVAC]	HVAC technologies and control/operational strategies with an added value in terms of efficiency (e.g. heat pumps for domestic hot water, high-efficiency boilers, efficient regulation, waste heat recovery)
40/00	Technologies aiming at improving the efficiency of home appliances	Energy efficient cooking, washing, vacuum cleaning
50/00	Energy efficient technologies in elevators, escalators and moving walkways	Energy savings, recuperation and storage elevators, escalators
60/00	Information and communication technologies (ICT) aiming at the reduction of own energy use	Energy-efficient computing and communication technologies
70/00	Technologies for an efficient end-user side electric power management and consumption	Use of switch mode power supplies and smart grid technologies in the more efficient power conditioning and management of loads and end-user applications in buildings
80/00	Architectural or constructional elements improving the thermal performance of buildings	Selected insulation technologies and construction elements (e.g. doors, windows, roofs) providing energy savings or benefitting from external conditions
90/00	Enabling technologies or technologies with a potential or indirect contribution to GHG emissions mitigation	Fuel cells and smart-grids (smart metering, particular telecommunication aspects) as enabling technologies contributing to a sustainable energy use in buildings

Y02C: Greenhouse gas capture and storage

Y02C tags cover technologies relating to the capture of greenhouse gases (GHG), including the capture and storage of CO₂. There are two main technical areas divided into ten sub-categories in total.

Y02C	Description
10/00	CO ₂ capture or storage (not used, see subgroups)
10/02	Capture by biological separation
10/04	Capture by chemical separation
10/06	Capture by absorption
10/08	Capture by adsorption
10/10	Capture by membranes or diffusion
10/12	Capture by rectification and condensation
10/14	Subterranean or submarine CO ₂ storage
20/00	Capture or disposal of GHG other than CO ₂ (not used, see subgroups)
20/10	of nitrous oxide (N ₂ O)
20/20	of methane
20/30	of perfluorocarbons [PFC], hydrofluorocarbons [HFC] or sulfur hexafluoride [SF ₆]

Y02E: CCMTs in energy generation, transmission and distribution

Y02E tags cover energy sources that are alternatives to fossil fuels. They also cover technologies for using sustainable fossil fuels for energy generation, as well as more efficient transmission and distribution technologies, and enabling technologies for alternative energy sources. There are seven main technical areas, divided into over 200 sub-categories in total.

Y02E	Description	Comment
10/00	Energy generation through renewable energy sources	Geothermal, hydro, oceanic, solar (PV and thermal), wind
20/00	Combustion technologies with mitigation potential	CHP, CCPP, IGCC, synair, cold flame, etc.
30/00	Energy generation of nuclear origin	Fusion and fission
40/00	Technologies for efficient electrical power generation, transmission or distribution	Reactive power compensation, superconductors, smart grids for the efficient operation of power networks
50/00	Technologies for the production of fuel of non-fossil origin	Biofuels, from waste
60/00	Enabling technologies or technologies with a potential or indirect contribution to GHG emissions mitigation	Energy storage (batteries, ultracapacitors, flywheels), hydrogen technology, fuel cells, smart grids as enabling technology in power distribution
70/00	Other energy conversion or management systems reducing GHG emissions	Synergies among renewable energies, fuel cells and energy storage

Y02P: CCMTs in the production or processing of goods

Y02P tags cover climate change mitigation technologies in a number of energy intensive industries spanning from the chemical and petrochemical to agriculture and agroindustry. The Y02P also includes CCMTs applicable across different sectors, such as technologies relating to the efficient use of energy and enabling technologies with a potential for emissions mitigation, such as smart factories and flexible manufacturing systems. There are eight main technical areas in the Y02P, divided into some 370 sub-categories.

Y02P	Description	Comment
10/00	Technologies related to metal processing	Reduction of GHG emissions, process efficiency (recovery of materials, energy efficiency, use of renewables, cogeneration)
20/00	Technologies relating to chemical industry	General or product-oriented (e.g. chlorine, adipic acid, caprolactam ...) improvements of production processes
30/00	Technologies relating to oil refining and petrochemical industry	Emissions reduction, bio-feedstock, carbon capture and storage specific to hydrogen production, ethylene production
40/00	Technologies relating to the processing of minerals	Production or processing of cement, lime, glass, ceramic materials, sand, and stone
60/00	Technologies relating to agriculture, livestock or agroalimentary industries	Agricultural machinery, land use policy, afforestation and reforestation, livestock and poultry management, fishing, apiculture, food processing
70/00	Climate change mitigation technologies in the production process for final industrial or consumer products	CCMTs in the most common manufacturing operations (shaping, metal working ...), manufacturing of consumer goods
80/00	Climate change mitigation technologies for sector-wide applications	General purpose (in the area of industry) energy efficiency measure, use of renewables, minimisation of material use
90/00	Enabling technologies with a potential contribution to greenhouse gas [GHG] emissions mitigation	Smart factories, hydrogen technology and fuel cells in industry, management or planning, financial and normative instruments for climate change mitigation

Y02T: CCMTs in transportation

Y02T tags cover technologies for making transportation less carbon-intensive (e.g. switching to electricity) and more efficient, as well as other ways of reducing greenhouse gas emissions from transportation. There are five main technical areas, divided into more than 250 sub-categories in total.

Y02T	Description	Comment
10/00	Road transport of goods or passengers	Improved internal combustion engine based vehicles, hybrid vehicles, electric vehicles, energy storage specifically adapted for road transport, resistance reduction
30/00	Transportation of goods or passengers via railways	Energy recovery, alternative energy sources incorporation, lightweight construction, reduced resistance
50/00	Aeronautics or air transport	Drag reduction, weight reduction, efficient propulsion, energy efficient operational measures
70/00	Maritime or waterways transport	Improved hydrodynamics, lightweight materials, efficient propulsion, kites
90/00	Enabling technologies or technologies with a potential or indirect contribution to GHG emission mitigation.	Electric charging of vehicles (including smart grids as interface for battery charging of electric and hybrid vehicles), fuel cell technology and hydrogen technology especially adapted for transportation

Y02W: CCMTs related to wastewater treatment and waste management

Y02W tags cover climate change mitigation technologies related to wastewater treatment (including for instance biological treatment of water, sewage treatment systems and valorisation of by-products of wastewater), and the waste management cycle. The Y02W is divided into three main technical areas further divided in roughly 100 sub-classes.

Y02W	Description	Comment
10/00	Technologies for wastewater treatment	Biological treatment of water and wastewater, sludge processing, use of renewables in wastewater treatment, valorisation of by-products,
30/00	Technologies for solid waste management	Waste collection and transportation, waste separation, reuse, recycling and recovery, mitigation of methane emissions in landfill sites, bio-organic fraction processing
90/00	Enabling technologies or technologies with a potential or indirect contribution to greenhouse gas [GHG] emissions mitigation	Biopackaging

Y04S: Smart grids

Smart grids are automated, widely distributed energy delivery networks with a two-way flow of electricity and information. They are capable of monitoring and responding to changes in everything from power plants to customer preferences, and even individual appliances.

Smart grids play a major role in the efficient, sustainable operation of power systems. They are complex, bringing together aspects of power transmission, telecommunications and computing, and involving network security, cyber security and electronic payment.

By optimising the performance of conventional power generation units (e.g. fossil, nuclear) and facilitating the integration of renewable sources of energy, smart grids make it possible for end users to charge a plug-in electric or hybrid vehicle with power of mainly renewable origin. People can sell energy from the solar panels on their roof at home via the smart grid to the power company and be invoiced or credited accordingly.

Economic interest in smart grids has soared in recent years, as have research and patenting activity in the field.

Y04S tags cover the full smart grid spectrum, from the remote control of power generators to marketing. They are divided into five sections, which are in turn divided into 90 sub-categories.

Y04S	Description	Comment
10/00	Systems supporting electrical power generation, transmission or distribution	Remote operation of power networks
20/00	Systems supporting the management or operation of end-user stationary applications	Load management, smart metering
30/00	Systems supporting specific end-user applications in the transportation sector	Interoperability of electric and hybrid vehicles
40/00	Communication or information technology specific aspects supporting electrical power generation, transmission or distribution	Aspects concerning computing and the overlaying communication network
50/00	Market activities related to the operation of smart grids	Energy trading, billing, invoicing, buying or selling transactions, marketing

Roughly two thirds of the Y04S categories relate to climate change mitigation technologies, so documents classified under Y04S will often also be coded under Y02B, Y02E or Y02T.

Searching sustainable technology patents in Espacenet

You can search the Y02 and Y04 symbols using the free Espacenet service at www.epo.org/espacenet. Espacenet works with the same databases as used by EPO examiners. Here are a few tips to help you get started.

How to search sustainable technologies using Y tags:

Go to the **Advanced search** or **Smart search** screen. Enter the corresponding Y symbol in the **Classification (CPC)** search field and click on **Search**.

How to identify the relevant Y tag for your search:

Experienced patent searchers get to know the classification symbols for their technical field very well and are very aware of the importance of patent classification for their work.

If you are not sure about the relevant classification symbol for your own search, you can use the **Classification search** feature in Espacenet:

- 1 Use the field **Search for a key word** or a classification **symbol** to retrieve classification symbols relevant to your field of technology.
- 2 Scroll through the parts of the classification scheme displayed on the screen and select the appropriate classification symbol(s) by clicking the box on the left-hand side.
- 3 This symbol will then appear in the **Selected classifications** field.
- 4 Click on **Copy** to search form and the classification symbol is automatically copied into the relevant field of the **Advanced search** mask.

If you then click on the **Search** button at the bottom of the page you will retrieve a list of all the patent documents classified under the symbol or symbols you chose. You can also refine your search by adding information in the Espacenet **Advanced search** mask.

The screenshot shows the Espacenet website interface. At the top, there is a navigation bar with the Espacenet logo and language options (Deutsch, English, Français). Below this is a search bar with the text 'Search for a keyword or a classification symbol'. The main content area is titled 'Cooperative Patent Classification' and displays a list of classification symbols and their descriptions. The first symbol is 'Y02', which is selected. The second symbol is 'Y02B', and the third is 'Y02B 10/00'. The 'Selected classifications' field on the left shows 'Y02'. A blue arrow labeled '1' points to the search field. A blue arrow labeled '2' points to the 'Y02' checkbox. A blue arrow labeled '3' points to the 'Y02' symbol in the 'Selected classifications' field. A blue arrow labeled '4' points to the 'Copy to search form' button.

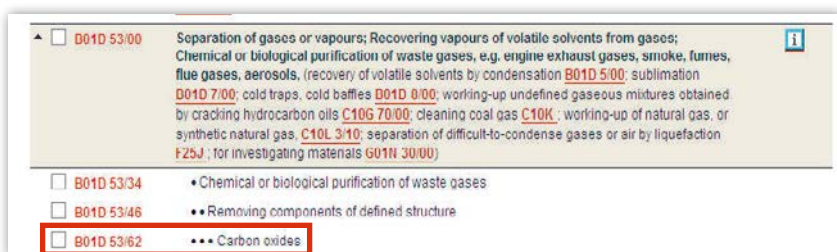
How to narrow down your search if a specific Y symbol yields too many hits

Either enter a more specific Y symbol in the classification search field, or combine the Y symbol with other search terms, such as a keyword in the title or abstract field or another classification symbol.

Example: Capturing carbon dioxide (CO₂) by adsorption

Capturing greenhouse gases, especially CO₂, is one way of reducing greenhouse gas emissions in cases where it is not possible to use non-fossil fuels. There are no IPC or CPC symbols which deal with the capture of specific greenhouse gases such as CO₂.

The closest entry is B01D53/62:



▲ B01D 53/00 Separation of gases or vapours; Recovering vapours of volatile solvents from gases; Chemical or biological purification of waste gases, e.g. engine exhaust gases, smoke, fumes, flue gases, aerosols, (recovery of volatile solvents by condensation B01D 5/00; sublimation B01D 7/00; cold traps, cold baffles D01D 0/00; working-up undefined gaseous mixtures obtained by cracking hydrocarbon oils C10G 70/00; cleaning coal gas C10K; working-up of natural gas, or synthetic natural gas, C10L 3/10; separation of difficult-to-condense gases or air by liquefaction F25J; for investigating materials G01N 30/00) ⓘ

B01D 53/34 • Chemical or biological purification of waste gases

B01D 53/46 •• Removing components of defined structure

B01D 53/62 ••• Carbon oxides

In practice, however, this classification entry is not very helpful when it comes to retrieving documents on CO₂ capture. Firstly, it relates to chemical and biological purification only, and does not include other commonly used separation techniques such as sorption or condensation. Secondly, it covers carbon oxides in general, which include carbon monoxide. Carbon monoxide (CO) is a very useful product in the chemical industry, but it is highly poisonous. Good separation and removal technologies for carbon monoxides are therefore important in many industrial sectors. As a result, a search on **B01D53/62** will retrieve a large number of documents relating to the capture of CO, rather than CO₂.

Y02C (capture, storage, sequestration or disposal of greenhouse gases) contains a number of entries directly relating to CO₂ capture, as can be seen in the Espacenet **Classification search** window:



Symbol	Classification and description
<input type="checkbox"/> Y	GENERAL TAGGING OF NEW TECHNOLOGICAL DEVELOPMENTS; GENERAL TAGGING OF CROSS-SECTIONAL TECHNOLOGIES SPANNING OVER SEVERAL SECTIONS OF THE IPC; TECHNICAL SUBJECTS COVERED BY FORMER USPC CROSS-REFERENCE ART COLLECTIONS [XRACs] AND DIGESTS
<input type="checkbox"/> Y02	TECHNOLOGIES OR APPLICATIONS FOR MITIGATION OR ADAPTATION AGAINST CLIMATE CHANGE
<input type="checkbox"/> Y02C	CAPTURE, STORAGE, SEQUESTRATION OR DISPOSAL OF GREENHOUSE GASES [GHG]
<input checked="" type="checkbox"/> Y02C 10/00	CO ₂ capture or storage (not used, see subgroups)
<input type="checkbox"/> Y02C 10/02	• Capture by biological separation
<input type="checkbox"/> Y02C 10/04	• Capture by chemical separation
<input type="checkbox"/> Y02C 10/06	• Capture by absorption
<input type="checkbox"/> Y02C 10/08	• Capture by adsorption
<input type="checkbox"/> Y02C 10/10	• Capture by membranes or diffusion
<input type="checkbox"/> Y02C 10/12	• Capture by rectification and condensation
<input type="checkbox"/> Y02C 10/14	• Subterranean or submarine CO ₂ storage

To find documents relating to the capture of CO₂ by means of adsorption, enter the relevant symbol (Y02C10/08) in the Espacenet **Advanced search** window:

Enter your search terms - CTRL-ENTER expands the field you are in

Enter keywords in English

Title:

Title or abstract:

Enter numbers with or without country code

Publication number:

Application number:

Priority number:

Enter one or more dates or date ranges

Publication date:

Enter name of one or more persons/organisations

Applicant(s):

Inventor(s):

Enter one or more classification symbols

Cooperative Patent Classification (CPC):

International Patent Classification (IPC):



This will produce a results list with a few thousand documents, which can be further refined by combining the Y02C10/08 symbol with other classes or keywords.

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- International Solid Waste Association (ISWA)
- Organisation for Economic Cooperation and Development (OECD)
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Further reading

Online

Patents and clean energy

www.epo.org/clean-energy

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www.epo.org/inventors-handbook

An introduction to European patents

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Guidelines for Examination in the EPO

www.epo.org/guidelines

A new EPO classification scheme for climate change mitigation technologies

Article in World Patent Information 34(2), June 2012, 106-111, by V. Veefkind, J. Hurtado-Albir, S. Angelucci, K. Karachalios, N. Thumm

www.sciencedirect.com/science/article/pii/S0172219011001979

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