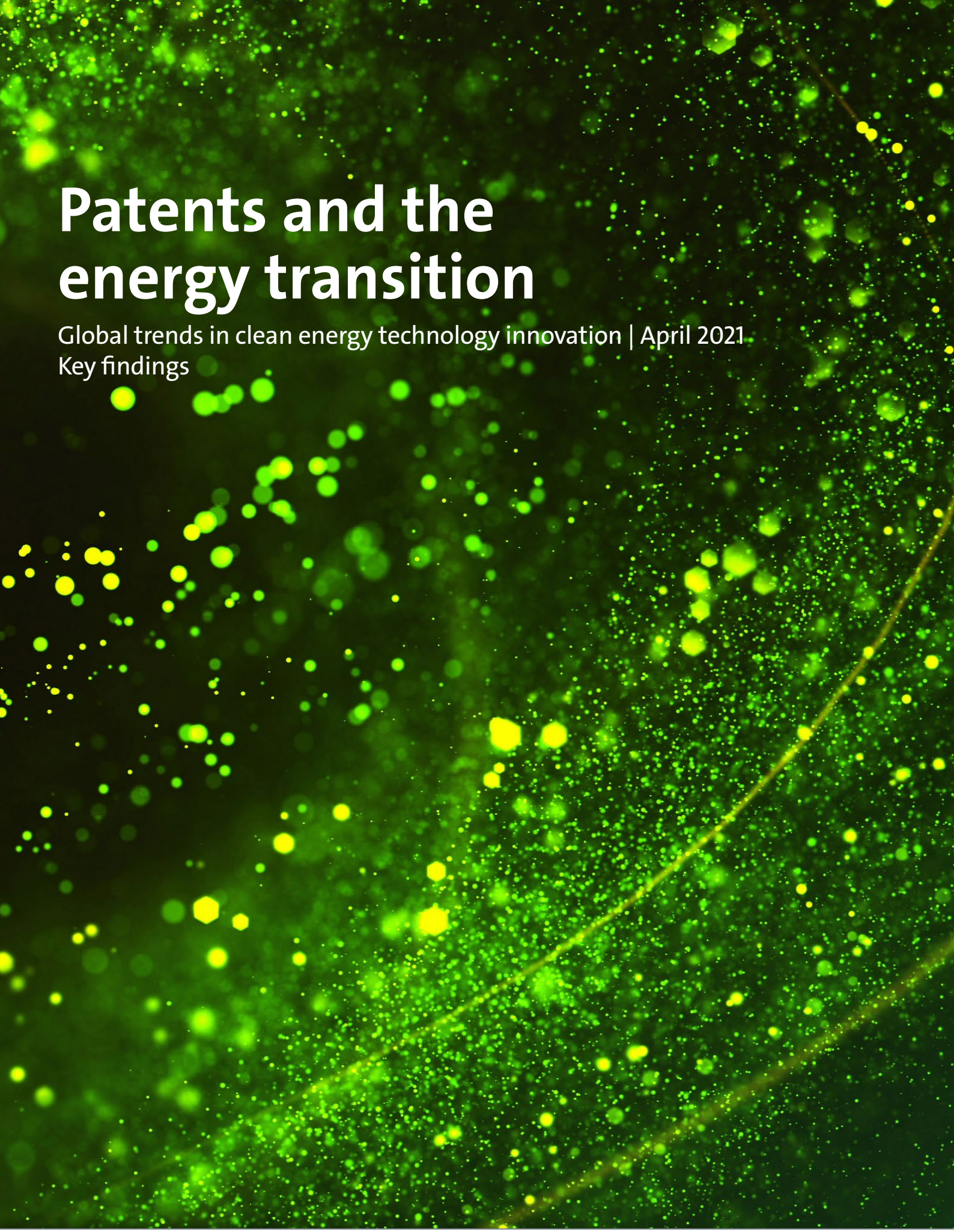


Patents and the energy transition

Global trends in clean energy technology innovation | April 2021
Key findings

Europäisches Patentamt
European Patent Office
Office européen des brevets

International Energy Agency

Purpose of the study

Over the last year, many of the planet's largest economies and companies have committed to eliminate their contribution to greenhouse gas emissions by the middle of this century, or soon thereafter. However, reaching that goal will not be possible without a significant and concerted global push to accelerate innovation in the energy sectors (IEA, 2020). Climate change mitigation thus demands urgent and informed strategic decisions about innovation, in a context where investment in new technology fields has taken centre stage in proposed recovery plans to combat the impacts of the COVID-19 pandemic.

Aimed at decision-makers in both the private and public sectors, this joint report is a unique source of intelligence on trends in low-carbon energy (LCE) innovation. Drawing on the International Energy Agency's expertise in LCE technologies and on the European Patent Office's dedicated patent classification scheme for such technologies, the data presented in the report show the latest trends in high-value inventions for which patents have been filed in more than one office by counting international patent families (IPFs)[1].

At a time where trends in LCE innovation have never been more important to policymaking, the report highlights the fields that are gathering momentum, as well cross-fertilisation taking place between those fields. It thereby provides a guide for policy and business decision-makers to direct resources towards an effective energy transition.

About patents and patent information

Patents are exclusive rights for inventions that are new and inventive. High-quality patents are assets for inventors because they can help attract investment, secure licensing deals and provide market exclusivity. Patents are not secret. In exchange for these exclusive rights, all patent applications are published, revealing the technical details of the inventions in them. Patent databases therefore contain the latest technical information, much of which cannot be found in any other source, which anyone can use for their own research purposes.

This patent information provides early indications of technological developments that are bound to transform the economy and can thus reveal how innovation is driving the energy transition. The study builds on the EPO's dedicated classification scheme for climate mitigation technologies. The scheme consists of 372 cross-sectional classes that cover specific clean energy technologies that have been applied to over 3 million documents. This Y02/Y04S scheme is available in the EPO's free database, *Espacenet*, which contains more than 120 million patent documents from around the world, and features a machine translation tool in 32 languages.

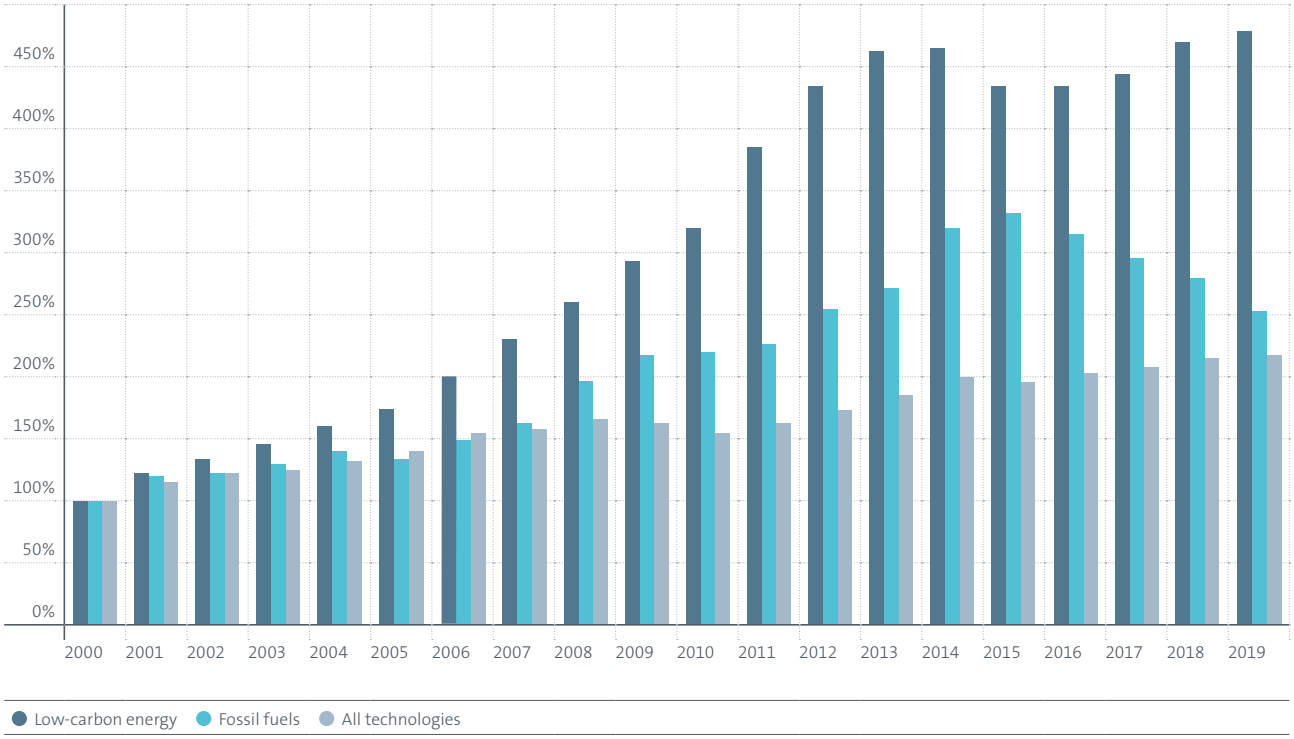
1 Each IPF covers a single invention and includes patent applications filed and published at several patent offices. It is a reliable proxy for inventive activity because it provides a degree of control for patent quality by only representing inventions for which the inventor considers the value sufficient to seek protection internationally. The patent trend data presented in this report refer to numbers of IPFs.

Innovation in LCE technology has resumed growth since 2017

After a slump between 2014 and 2016, latest data show three years of growth of international patent families (IPFs) in LCE technology. This trend is encouraging as it contrasts with a decline observed in fossil energy. However, the current growth rate of IPFs in LCE (3.3% since 2017) remains slower than that before 2013 (12.5% average growth of the period 2000-2013) and an acceleration of activity would be needed to make up for the lost years.

Figure KF1

Global growth of IPFs in low-carbon energy technologies versus (i) fossil fuel technologies and (ii) all technologies, 2000-2019 (base 100 in 2000)



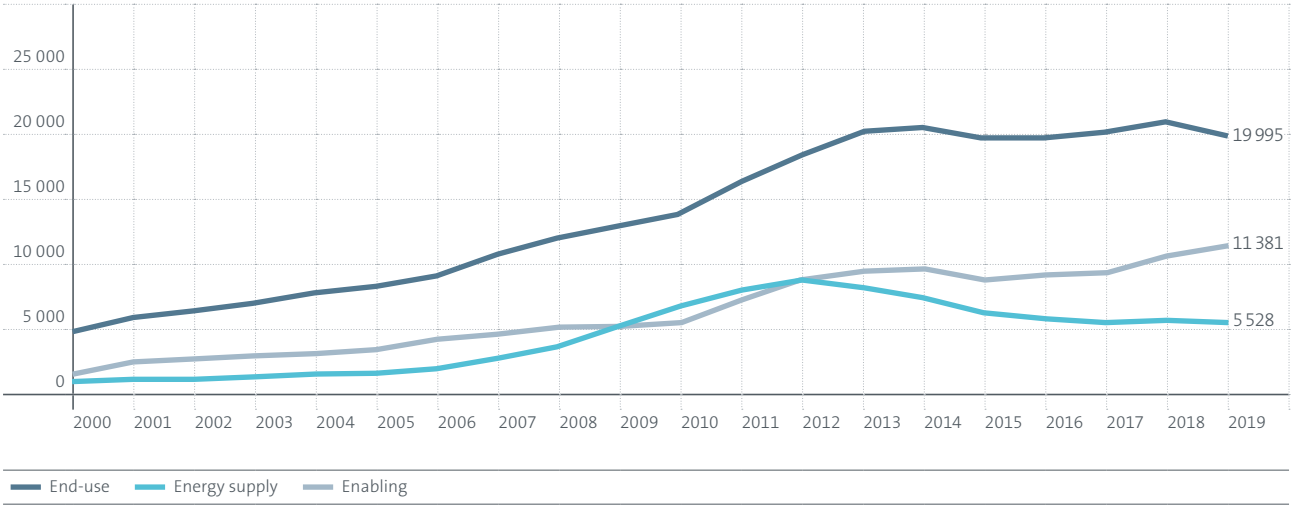
Source: European Patent Office

LCE innovation is shifting from supply to end-use and enabling technologies

Fuel-switching and energy efficiency technologies in end-use sectors represented a stable 60% of all LCE patents over the past five years, reflecting the massive challenge of reining in energy demand across the economy. However, the main driver of LCE growth since 2017 has been innovation in cross-cutting technologies such as batteries, hydrogen and smart grids as well as carbon-capture, utilisation and storage (CCUS), that serve as key enablers of the energy transition. Patenting related to renewable energy technologies (like wind, solar, geothermal or hydroelectric power) and other energy supply technologies has been falling since 2012, in contrast with the fast growth observed in the previous decade.

Figure KF2

Global growth of IPFs in clean energy supply, enabling and end-use technologies, 2000-2019



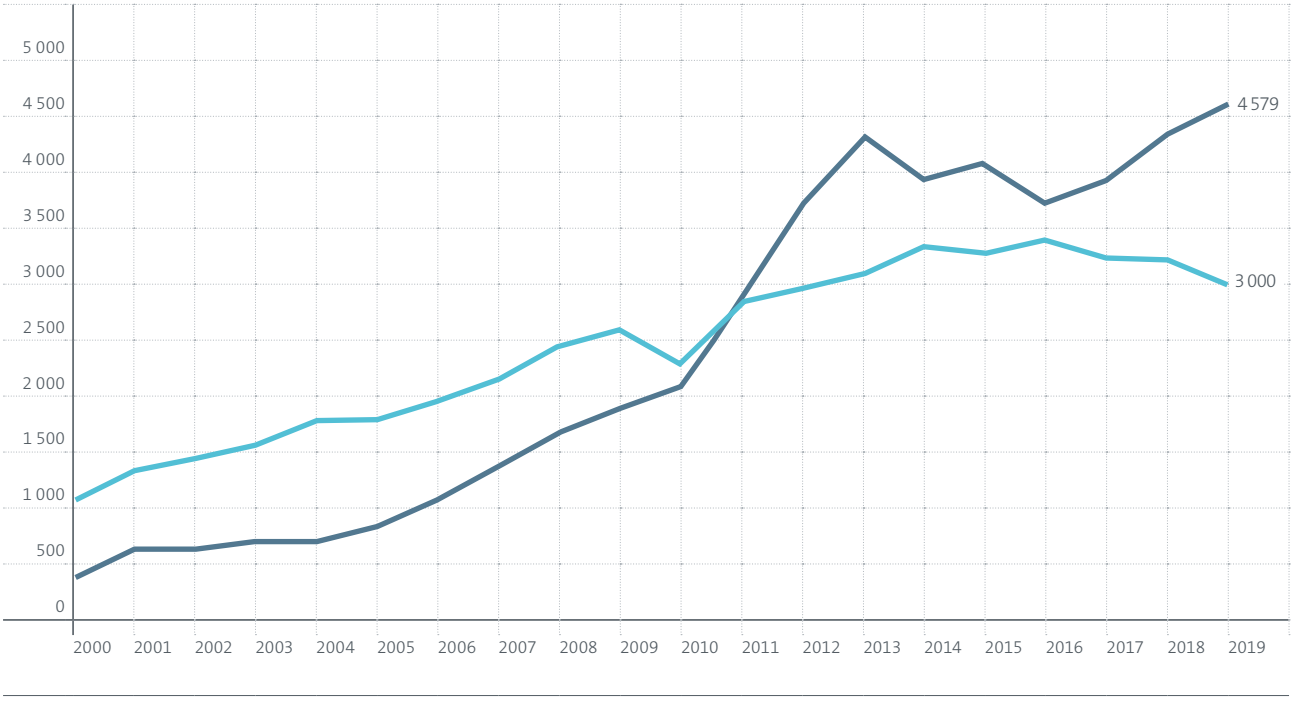
Source: European Patent Office

Electric vehicles are driving the dominance of end-use technologies in low-carbon energy patenting

In end-use sectors, the fast development of electric vehicles (EVs) and their associated infrastructure have been the most powerful driver of innovation in LCE technologies over the past decade. This is visible both in end-use technologies, where the number of IPFs in electric vehicles overtook other clean energy technologies for road vehicles [2] as of 2011, and in the fast rise of innovation in batteries as enabling technologies. In addition, there are significant patenting activities in the "hard-to-abate" sectors (e.g. metals), with innovation in both energy efficiency and direct abatement (CCUS).

Figure KF3

Global growth of IPFs in electric vehicles versus other LCE technologies for road transportation, 2000-2019



Source: European Patent Office

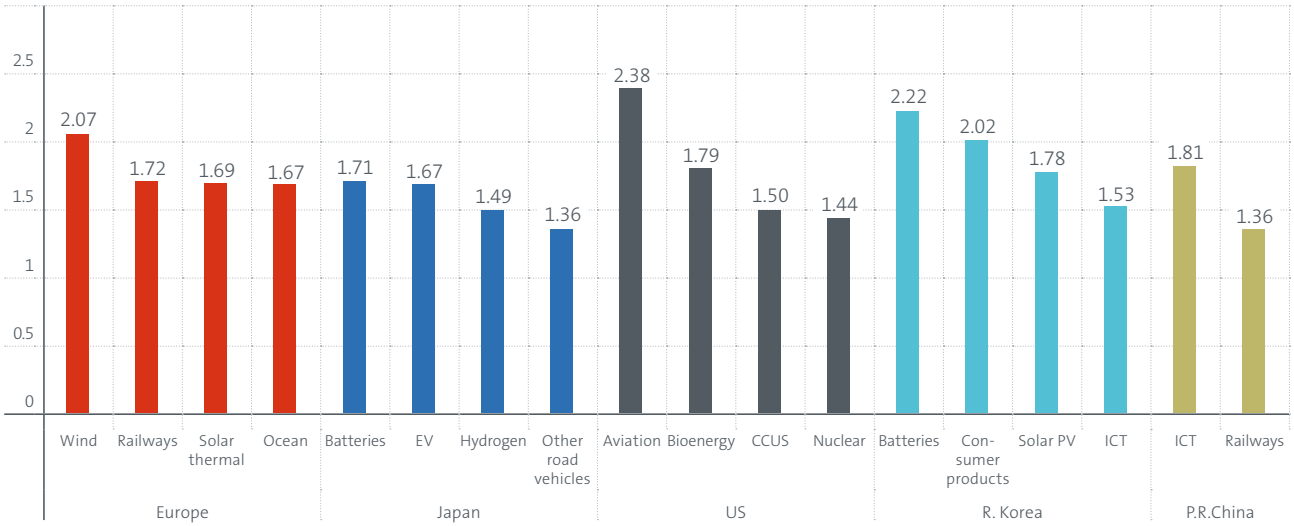
2 Including technologies aimed at more efficient combustion engines, as well as improved aerodynamics, weight reduction, or more energy-efficient components and subsystems.

Countries are specialising nationally and collaborating internationally to foster local technology advantages

Since 2000, Europe has consistently led patenting activities in LCE with 28% of all IPFs in the period 2010-2019. It ranks first in most renewable energy fields. With 25% of all IPFs since 2010, Japan remains closely behind, followed by the US (with 20% of all IPFs). Japan is a world leader in batteries and hydrogen, which translates into an advantage in EVs. Besides a strong specialisation in fossil fuel technologies, the US shows a technology advantage in low-carbon combustion and related end-use sectors such as aviation. The Republic of Korea (10% of all IPFs) and P.R. China (8% of all IPFs) are modest innovation centres in LCE technologies but have shown an increase in patenting activities in the past decade.

Figure KF4

Main revealed technology advantages (RTAs) of global innovation centres



Source: European Patent Office

Notes: The revealed technology advantage (RTA) index indicates a country's specialisation in terms of LCE technology innovation relative to its overall innovation capacity. It is defined as a country's share of IPFs in a particular field of technology divided by the country's share of IPFs in all fields of technology. An RTA above one reflects a country's specialisation in a given technology. Only the highest RTAs (approximately 1.5 or more) are reported in the chart.

The full report is available for download at:
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