

Green Technology Protection through Patents within the EU
Enhancing Climate Mitigation within the EU or Hindering from Reaching the
Goal? – Looking into the German Benchmark

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Abstract

The thesis' goal is to examine whether the European patent system is suitable to enforce climate mitigation in the EU and especially in Germany by protecting green technologies, or whether it is hindering from reaching the worldwide climate neutrality goals. Analyzing the patent features as well as the procedures within the European patent system and comparing them to the requirements needed to achieve progressive climate mitigation, is supposed to indicate whether the European patent system is the right instrument to incentivize as well as prompt green technologies.

The research material and therefore the base for the analysis consist mostly of legal framework (the UNFCCC, the Paris Agreement, and the European Green Deal) and legislation (TRIPS, European Climate Law, Federal Climate Change Act) as well as case law but also procedures within patent offices, recommendations and conferences of the WIPO, OECD, and WTO as well as further doctrinal sources and statistical material is considered.

The outcome reflects the thought of the European patent system with its existing patent features and procedures not enhancing climate mitigation. In return, it is not directly hindering climate mitigation but slowing down climate mitigation when fast actions are required. Nevertheless, it is believed that because of the positive effects the patent system has on innovation, it can protect green technologies in a manner which supports climate mitigation. Therefore, adaptations to the European patent system are proposed such as the consideration of Arts 30, 31 TRIPS, prioritized patent applications, a better consideration of the morality aspect through further institutions, boosting of green technology features through law as well as further incentives surrounding the patent system.

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List of Abbreviations

Art.	Article
Arts	Articles
bk.	book
CCAT	climate change adaptation technology
CCMT	climate change mitigation technology
CL	Compulsory Licensing
chap.	chapter
CNN	Cable News Network
Co.	company
COVID	Coronavirus Disease
CSD	Commission on Sustainable Development
DTTL	Deloitte Touche Tohmatsu Limited
EC	European Commission
ECHR	Charter of Fundamental Rights of the European Union
e.g.	for example
EIT	economic in transition
EPC	European Patent Convention
EPO	European Patent Office
etc.	et cetera
EU	European Union
GeSI	Global Enabling Sustainability Initiative
GHG	greenhouse gas
gov.	government
HIV	human immunodeficiency virus
Ibid	ibidem; in the same place
IP	Intellectual Property
IPR	Intellectual Property Rights
IPCC	Intergovernmental Panel on Climate Change
LOR	Licence of Right
MDG	Millennium Development Goal
NDC	Nationally Determined Contribution
no.	number
OECD	Organisation for Economic Co-operation and Development
org.	organization

p.	page
pp.	pages
Para.	Paragraph
PCT	Patent Cooperation Treaty
SDG	Sustainable Development Goal
Sec.	Section
Secs	Sections
TFEU	Treaty on the Functioning of the European Union
TRIPS	Agreement on Trade-Related Aspects of Intellectual Property Rights
UFZ	Zentrum für Umweltforschung
UK	United Kingdom
IPO	Intellectual Property Office
UN	United Nations
UNCTAD	United Nations Department of Economic and Social Affairs
UNCED	United Nations Conference on Environment and Development
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
U.N.T.S.	United Nations Treaty Series
US	United States
USPTO	United States Patent and Trademark Office
U.S.T.	United States Treaties
vol.	volume
vs	versus
WIPO	World Intellectual Property Organization
WMO	World Meteorological Organization
WTO	World Trade Organization
ZEW	Zentrum für Europäische Wirtschaftsforschung

1 Introduction

Climate change is advancing faster than ever before. Meltdown of glaciers in Alaska, Iceland, Switzerland, etc.,¹ shrinking ice sheets in Antarctica and Greenland, temperature rise, ocean warming, and change in weather patterns are resulting in dry seasons that evolve in loss of land, hunger, and increase of sandstorms. Additionally, severe rainfalls lead to flooding, landslides, and poverty. Another concern is that a rise in sea level endangers coastal and island populations, extinction of marine life and loss of species, among many others.² Most of the global warming occurred in the last 40 years and is speeding up twice as fast as it was from 1880 to 1980.³ This rapid increase will cause even more catastrophes and lead to drastic changes in climate if the issues remain unaddressed.

The main reasons for climate change listed by the European Commission are inter alia greenhouse gases (GHG).⁴ Whereas GHGs also occur naturally, their main sources being human-made emissions through deforestation, burning fossil fuels, gas, and oil transmission, farming, agriculture, certain types of fertilizers, improper waste treatment as well as industrial processes.⁵ However, all human actions are driven by technology – either by societal problems (illnesses, pollution in water and air, etc.), governmental policies, or market competition with the goal to boost efficiency or effectiveness.⁶ Especially companies contribute massively to carbon emissions and therefore need to actively engage in reducing their carbon footprint by not only aiming for a sustainable strategy but also by adapting their processes.⁷

To address anthropogenic climate change, political and legal measures as well as climate change action plans have been implemented worldwide and recently also within the EU.⁸

¹ Robert Kunzig, ‘Glacial Meltdown’, *National Geographic*, 2013 <<https://www.nationalgeographic.com/magazine/article/glacial-meltdown>> [accessed 13 November 2021].

² NASA, ‘Climate Change Evidence: How Do We Know?’, *Global Climate Change: Vital Signs of the Planet* <<https://climate.nasa.gov/evidence>> [accessed 13 November 2021].

³ Rebecca Lindsey and Luann Dahlman, ‘Climate Change: Global Temperature’, *Climate.Gov*, 2021 <<https://www.climate.gov/news-features/understanding-climate/climate-change-global-temperature>>.

⁴ European Commission, ‘Causes of Climate Change’, *Climate Action* <https://ec.europa.eu/clima/climate-change/causes-climate-change_en> [accessed 23 October 2021].

⁵ NASA, ‘The Causes of Climate Change’, *Global Climate Change: Vital Signs of the Planet* <<https://climate.nasa.gov/causes>> [accessed 23 October 2021]; Gabriele C Hegerl and others, ‘Causes of Climate Change over the Historical Record’, *Environmental Research Letters*, 14.12 (2019), p. 1 <<https://doi.org/10.1088/1748-9326/ab4557>>.

⁶ Edward S Rubin, ‘Innovation and Climate Change’, in *Innovation. Perspectives for the 21st Century*, p. 333.

⁷ Deloitte Touche Tohmatsu Limited (DTTL) Global Enabling Sustainability Initiative (GeSI), *Digital with Purpose: Delivering a SMARTer2030*, 17 September 2019, p. 13.

⁸ United Nations General Assembly, *United Nations Framework Convention on Climate Change*, 1992; UNFCCC, ‘Kyoto Protocol to the United Nations Framework Convention on Climate Change’, 1997; ‘The Doha Amendment | UNFCCC’ <<https://unfccc.int/process/the-kyoto-protocol/the-doha-amendment>> [accessed 27 November 2021]; United Nations Climate Change, ‘The Paris Agreement | UNFCCC’ <<https://unfccc.int/process-and-meetings/the->

However, none of these plans can be realized if appropriate measures to enforce the outlaid goals are not followed. According to the Global Sustainability Initiative (GeSI) and Deloitte (DTTL) environmentally sound technologies can help to reduce emissions as well as increase resilience by “*optimizing energy and material usage across sectors to minimize effects on climate change*”.⁹ Even though environmentally sound technologies, so-called “green technologies” could be a solution, innovation needs to be appropriately boosted and protected, so inventors start engaging in the development of such technologies.¹⁰

For this step, Intellectual Property (IP) laws that enforce the protection of inventions could be relevant and necessary. They could guarantee a profit arising from the protection of the outcome and would make research more attractive for inventors of renewable, green technologies. Especially the patent system is a popular instrument for the protection of technologies as it is the most rewarding one, and, therefore, highly prominent. In fact, patent applications for most technologies are rising constantly since 2016 and prior, with a few setbacks compared to the last year due to COVID-19.¹¹

This increase in innovation would be also profitable for green technologies. However, patents for environment-related technologies are nothing new and have been patented already since 2011 without an increase in patent applications over the past years looking at the statistic of patents granted by the European Patent Office (EPO).¹² Putting Germany with the most ambitious climate neutrality goals in the focus, but not excluding other countries within the EU, their patent applications for environment-related technologies did decrease constantly since 2011. This is especially surprising as they are overall a strong player when it comes to patent applications and innovation.¹³ Further discussed topics are the exclusivity and monopolistic

paris-agreement/the-paris-agreement> [accessed 29 November 2021]; European Commission, ‘A European Green Deal: Striving to Be the First Climate-Neutral Continent’ <https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en> [accessed 23 October 2021]; Council of the European Union, European Parliament, *Regulation (EU) 2021/1119 Establishing the Framework for Achieving Climate Neutrality and Amending Regulations (EC) No 401/2009 and (EU) 2018/1999 (‘European Climate Law’)*, 2021; Bundestag, *Bundes-Klimaschutzgesetz Vom 12. Dezember 2019 (BGBl. I S. 2513), Das Durch Artikel 1 Des Gesetzes Vom 18. August 2021 (BGBl. I S. 3905) Geändert Worden Ist*, 2019.

⁹ Deloitte Touche Tohmatsu Limited (DTTL), Global Enabling Sustainability Initiative (GeSI), *Digital with Purpose: Delivering a SMARTer2030*, 17 September 2019, p. 13.

¹⁰ Heleen de Coninck and Daniel Puig, ‘Assessing Climate Change Mitigation Technology Interventions by International Institutions’, *Climatic Change*, 131.3 (2015), p. 417 <<https://doi.org/10.1007/s10584-015-1344-z>>.

¹¹ European Patent Office (EPO), ‘Statistics and Trends’, *European Patent Office* <<https://www.epo.org/about-us/annual-reports-statistics/statistics.html>> [accessed 12 December 2021]; European Patent Office (EPO), ‘European Patent Applications’, *European Patent Office* <<https://www.epo.org/about-us/annual-reports-statistics/statistics/2020/statistics/patent-applications.html>> [accessed 12 December 2021].

¹² Organisation for Economic Co-operation and Development (OECD), ‘Patents by Technology : Patents in Environment-Related Technologies’ <<https://stats.oecd.org/index.aspx?queryid=29068#>> [accessed 10 December 2021].

¹³ In 2020, Germany contributed 14% to all patent applications granted by the EPO.

rights that are granted to the patentors which conflict with the public interest and technology diffusion.¹⁴ Moreover, the moral aspects surrounding climate change and, in that regard, green technologies, evoke an important angle when it comes to the patentability assessment and the patent granting of green inventions.¹⁵

According to statistics, the patent system is already used for green inventions but there is no visible increase in the amount of invented green technologies. Hence, this thesis examines whether the European patent system is suitable to enforce climate mitigation within the EU and especially in Germany by protecting green technologies, or whether it is hindering from reaching the worldwide climate neutrality goals.

1.1 Purpose and Research Questions

The purpose of the thesis is to explore whether the European patent system with its features and processes is able to enhance climate mitigation by incentivizing and prompting green technologies as well as their transfer or if it is rather hindering from reaching the worldwide climate goals. The thesis is not aiming to prove that green technologies are the best solution to reach climate neutrality. It rather aims to analyze whether the European patent system as an instrument for the protection of green technology is suitable for climate mitigation or whether there must be a consideration of other options to enforce green technologies. This research focuses, therefore, on the usability of the European patent system for the protection of green technologies to reach climate neutrality.

Supporting the purpose of this research, the first and main research question of this thesis is whether the current European patent system is suitable to boost green technologies and, therefore, enforce climate mitigation worldwide with a focus on the EU and Germany. The abstract, which should answer the question of the patent system`s suitability to protect green technologies, focuses on the features and processes of the European patent system. It is aimed to identify in what way the features fulfill the listed requirements within the climate mitigation documents which are needed for the decrease of climate change to reach the climate neutrality goals within the EU.

¹⁴ Bernice Lee, Ilian Iliev, and Felix Preston, *Who Owns Our Low Carbon Future? Intellectual Property and Energy Technologies* (London: Chatham House, 2009), p. 1.

¹⁵ Stephen M. Gardiner, 'Ethics and Global Climate Change', *Ethics*, 114.3 (2004), p. 556; Michael Grubb, 'Seeking Fair Weather: Ethics and the International Debate on Climate Change', *International Affairs*, 71.3 (1995), pp. 472,473.

A sub-question relating to the first main question analyzes whether there are already existing procedures within the patent systems for green technologies within the EU and if patents are already issued for green technologies. If there are no special treatments for green technologies, treatments for other technology fields resembling the characteristics and importance of green technologies should be identified and analogously suggested for green technologies. The focus should also lie on how other emergency situations were approached under the patent law. An example would be the current COVID-19 situation.

The second sub-question refers to whether adaptations to the current European patent system are necessary to optimally mitigate climate through green technologies, and if needed, suggestions on how the European patent system can be improved are made.

1.2 Structure

Beginning with the contextualization of the topic, terminologies relating to climate change and IP are defined and put into a legal and historical background. Firstly, international climate change negotiations and treaties are explained such as the United Nations Framework Convention on Climate Change (UNFCCC) which is supported by an action plan, the so-called “Kyoto Protocol”, followed by the Paris Agreement which is based on the UNFCCC. Secondly, climate change actions within the EU are analyzed including the European Green Deal which is a European action plan to the Paris Agreement. Further on, the transmission of the European Climate Law into German national law is examined in terms of the climate neutrality timeline. Moving on to IP, IPR are defined, and the patent law system as one form of protecting IPR further considered. More generally, the patent law’s purpose and historical origin is illuminated to understand certain features and the development of patents. Concluding the second chapter, touching points between climate change and patents are outlined evoking the necessary knowledge base for the following chapters of the thesis. In this regard, the topic of green technology and the protection of green technology through the European patent system is introduced.

Continuing with the third chapter, patent-granting processes and the patent features within the EU are explored. The analysis constitutes of four main aspects: the general principles behind patentability, the pre-grant, the granting, and the post-grant phase. The principles behind patentability discuss the systematic behind patent granting, what criteria an invention needs to fulfill to be considered for a patent, and what exemptions to patentability there are. Whereas the principles behind patentability are more theoretical, the further sections of the chapter cover

practical aspects of the actual patenting process and discusses its challenges. The pre-grant phase deals with questions referring to the technology enforcement as well as quality assurance, the debate over private rights granted to the patentee vs the public's interest in using the invention as well as the consideration of morality before granting a patent. The middle part of the third chapter contains the actual patent grant application and describes every single step and obstacle that may occur to achieve a patent grant issuing. Lastly, the post-grant phase covers the technology use and exclusivity of patents, the abuse of patent monopoly in contrast to free-market competition, the interference into private rights as well as instruments of the government to monitor these rights, and the dissemination of technology and its transfer to developing countries.

After looking at the patent features and patent system procedures, chapter four lists the requirements needed to achieve progressive and fast results for climate neutrality. These requirements are a reflection of existing climate change documents and address short notice actions, the representation and increase of environmentally green features within new inventions, the need for functioning market competition, the worldwide accessibility as well as usability of new green technologies, and minor but still important requirements such as the assurance of high quality and working green technologies, affordable product protection as well as the traceability of climate mitigation advances. Combining the patent features and patent system procedures with the requirements for achieving progressive climate neutrality, the European patent system will be assessed for its suitability to incentivize and protect green technologies. In this regard, advantages, and disadvantages of the patent system for climate mitigation will be weighed against each other.

In the next chapter, with regard to the outcome of the fourth chapter, adaptations to the existing European patent system for green technologies are suggested. This chapter illuminates climate change as an exception ground to exclusive rights or for other use as well as special treatments and proceedings containing a prioritized examination. Moreover, the need for an additional institution during the patentability assessment relating to morality, the enforcement of green technologies through law as well as other climate change supporting incentives surrounding the patent system are discussed.

Lastly, in the sixth chapter, the main findings are summarized, and the research questions reviewed.

1.3 Research Methodology

The thesis follows a legal dogmatic methodology based on doctrinal and legal research material that concentrates on different political and legal approaches towards climate mitigation, the protection of green technologies and the European patent system. According to *Smits*, there is no clear definition for legal doctrine but “[i]t is probably best described as research that aims to give a systematic exposition of the principles, rules and concepts governing a particular legal field or institution and analyses the relationship between these principles, rules and concepts with a view to solving unclarities and gaps in the existing law”.¹⁶ This definition highlights best what the purpose of choosing the legal dogmatic methodology for this thesis is: to identify existing patent and climate change laws, their surrounding procedures and how both fields intertwine from a legal and practical perspective. That way, the usability or potential imperfections can be analyzed and adaptations in regard to modern technologies as well as the current climate change situation made which is the aim of the thesis.

As mentioned, climate change is highly due to anthropogenic emissions and climate change technologies, in this thesis referred to as green technologies, could be one way to shrink them.¹⁷ Therefore, the thesis is focusing on how green technologies can be protected through the European patent system to incentivize the investment in and prompt the increase of green technologies. At the same time, it should be investigated whether the current European patent system with its procedures and patent features matches the requirements needed for progressive climate mitigation.

The research material and therefore the base for the analysis consist mostly of legal framework such as treaties (the UNFCCC, the Paris Agreement and the European Green Deal) and legislation (Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS), European Climate Law, Federal Climate Change Act) as well as case law but also procedures within patent offices, recommendations and conferences of the WIPO, the OECD, and the WTO as well as further doctrinal sources and statistical material is be considered.

In the first step, the climate change terminologies is defined, and the climate change history explained. The definition is based on existing international treaties whereas the historical background follows the evolution of the climate neutrality incentives and plans, resulting in the

¹⁶ Jan M. Smits, ‘What Is Legal Doctrine? On the Aims and Methods of Legal-Dogmatic Research’ (Maastricht University - Maastricht European Private Law Institute, 2015), p. 5.

¹⁷ European Commission, ‘Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions: The European Green Deal’, 2019, p. 4.

recently implemented European Climate Law and the German Federal Climate Change Act. For the climate change history, doctrinal material, as well as conference papers are used referring to existing international treaties and statutes. As for the definition of IPR and the patent law system, they follow the same approach as climate change. Mainly doctrinal research material is used to outline the definition of IPR and the historical background of patents. Referring at a later stage to legal frameworks such as the Paris Convention and the TRIPS Agreement demonstrates a harmonization of IPR and marks the starting point for technology protection under a stabilized patent law system. Further on, for the interaction between climate change and the patent law system, doctrinal material is mainly used to elaborate on the possibilities as well as challenges the patent law system can impose on climate mitigation. Listing green technologies as a possible solution for climate mitigation, statistics are used to show the current position of green technologies within the patent system.

Continuing with the next chapter, the TRIPS Agreement, EPO proceedings, the European Patent Convention (EPC), documents from the WIPO and the WTO such as consultation drafts, conference papers, and articles are used to identify the patent granting process for general patent protection within the EU as well as patent features. Throughout this chapter, the *de lege ferenda*, as well as the critical approaches are aimed as the goal is to evaluate the existing procedures and features for different technology fields but especially for green technologies.

Referring to the principles behind patentability, mainly the EPC is of use as the patentability criteria are regulated there. For the pre-grant questions, documents of the WIPO and further scholarly literature, as well as articles are considered to identify occurring thoughts before the patent grant. At the same time, the TRIPS is used to refer back to the debate between the private rights of the patentee and the public interest. When it comes to the morality exemption according to Art. 53(a) TRIPS, provisions of the TRIPS are pinpointed. Examples from biotechnology are shown to demonstrate similarities to climate change by utilizing journal articles, WTO sources as well as case law in which the morality of biotechnological inventions was prior discussed. Proceeding to the granting phase, the sources are closely tight to documents of the EPO as well as the EPC which include the documented patent application process within the EU and payable fees. The following past-grant phase covers different academic articles and literature to illustrate the diverse opinions behind the exclusivity features of the patent but also the monopolistic effect a patent has on free-market competition. In parallel, the use of international agreements and regulations continues to direct back to the origin of the discussed concepts. Further on, instruments of the government to intervene in and monitor patent rights cover diverse sources such as EPO and WIPO documents, academic literature, and legal

provisions to illustrate not only existing processes but also different opinions about their effectiveness. The same applies to the dissemination of technology.

Chapter four contains the requirements needed to achieve climate neutrality by protecting green inventions. For that purpose, sources such as the European Green Deal, the UNFCCC, the European Climate Law, and the German Federal Climate Change Act are used which mirror the guidelines for achieving climate mitigation. However, further documents of the WIPO, the OECD as well as the European Commission are used to highlight current technological and climate change trends. At the end of chapter four, the requirements to achieve progressive climate neutrality are compared to the patent processes and features within the EU. For this step, sources already used in chapters three and four are picked up and the comparative approach is used to identify the patent system's suitability for incentivizing green technologies. It is wished to find out in how far the patent system procedures and patent features match the requirements needed to achieve progressive climate neutrality. That way, potential imperfections of the patent system for protecting green technologies become visible and adaptation to them can be suggested.

Lastly, innovative ideas from existing literature as well as existing procedures either of similar technology fields or other patent offices are examined to suggest adaptations to the current European patent system. In detail, it is referred to the prioritized patent examination for COVID-19, the green technology pilot program in the US, and the green technology channel in the UK. Moreover, solutions of including climate change into existing provisions are looked for by orientating on the TRIPS and WTO papers. For considering the morality exemption more concretely, the idea of using further institutions is assessed by citing innovative academic literature and journal articles. The same applies to the further suggested adaptations to the European patent system. However, based on the findings, own thoughts, and conclusions flow into the proposed suggestions.

2 Climate change and Intellectual Property: background and definition

This chapter serves as a contextualization of the thesis topic. Beginning with the definition of climate change and its history, IP, especially patents, follow with their meaning and background. Moving on to the third section, the interaction between climate change and IPR is pointed out to further elaborate on how the mitigation of climate is through green technologies connected to the patent system.

2.1 Climate change

Under this subsection, climate change related wordings are defined, and the history of climate change displayed. The focus lies, first, broadly on international negotiations and treaties and, further, focus on climate mitigation incentives as well as regulations within the EU, specializing on Germany.

2.1.1 Definitions

Climate change according to the UNFCCC refers to “*a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods*”.¹⁸ This means that even though climate change can have natural causes,¹⁹ the economic understanding of climate change is related to an anthropogenic caused change in the climate.²⁰

Human-made emissions of GHGs (carbon dioxide, fluorinated gases, methane, nitrous oxide, etc.)²¹ alter the composition of the atmosphere which results in an increased “greenhouse effect”. A higher number of sunrays is hindered from leaving the atmosphere as they are absorbed by GHGs. The outcome is a global temperature rise and warming of the earth.²²

Climate change mitigation, therefore, means the prevention or the reduction of GHGs by utilizing “*new technologies and renewable energies, making older equipment more energy efficient, or changing management practices or consumer behavior*”.²³

With climate change mitigation measures climate neutrality can be reached. Climate neutrality which is also mentioned later on in the climate action plans is described as a state in which the GHG emissions are net zero. This means that the GHGs produced by humans equal the GHGs removed from the atmosphere by natural means so the overall level of GHGs is not increasing.²⁴

¹⁸ Art. 1 no. 2 UNFCCC.

¹⁹ Hegerl and others, p. 1.

²⁰ Edeltraud Günther, ‘Definition: Klimawandel’, *Gabler Wirtschaftslexikon* (Springer Fachmedien Wiesbaden GmbH, 2018) <<https://wirtschaftslexikon.gabler.de/definition/klimawandel-52424>> [accessed 23 November 2021].

²¹ European Commission, ‘Causes of Climate Change’.

²² Sophie Jankowski, ‘Wie funktioniert der Treibhauseffekt?’, *Umweltbundesamt*, 2021 <<https://www.umweltbundesamt.de/service/uba-fragen/wie-funktioniert-der-treibhauseffekt>> [accessed 24 November 2021]; NASA, ‘What Is the Greenhouse Effect?’, *NASA* <<https://climate.nasa.gov/faq/19/what-is-the-greenhouse-effect>> [accessed 24 November 2021].

²³ UN Environment Programme, ‘Mitigation’, *UNEP - UN Environment Programme*, 2017 <<http://www.unep.org/explore-topics/climate-action/what-we-do/mitigation>> [accessed 22 December 2021].

²⁴ United Nations Climate Change, ‘A Beginner’s Guide to Climate Neutrality | UNFCCC’ <<https://unfccc.int/blog/a-beginner-s-guide-to-climate-neutrality>> [accessed 23 December 2021].

2.1.2 Global climate negotiations & treaties – historical background

Historically, the idea of climate change and the greenhouse effect being a result of increased GHGs in the air started in the late 19th century when only a few specialized and knowledgeable people were speculating about the influence of carbon dioxide on temperature rise.²⁵ The first conference on the human environment, however, was held only in June 1972 and climate change was still not on the agenda.²⁶ Nevertheless, back then commitments were made toward protecting the environment and maintaining sustainability on a global level.²⁷ In addition, the UN Environment Programme (UNEP)²⁸ was created.

As scientific warnings relating to GHG emissions increased in the late 1980s, climate change was mentioned at the very first global “World Climate Conference”²⁹ in 1979 and later on at the “Toronto Conference”³⁰ in 1988. As consequence, the UNEP and the World “Meteorological Organization”³¹ (WMO) established the “Intergovernmental Panel on Climate Change”³² (IPCC) to assess and provide policymakers with scientific information regarding climate change. After the first IPCC assessment, it was agreed in the second World Climate Conference to address climate change jointly.

Shortly after, the first treaty relating to climate change, the “United Nations Framework Convention on Climate Change”³³ (UNFCCC), was drafted and released by the UN General Assembly. Later on, at the “Rio Conference”³⁴ (United Nations Conference on Environment

²⁵ Svante Arrhenius, ‘On the Influence of Carbonic Acid in the Air upon the Temperature of the Ground’, *Philosophical Magazine and Journal of Science*, 41.5 (1896).

²⁶ United Nations, ‘Report of the United Nations Conference on the Human Environment’ (presented at the United Nations Conference on the Human Environment, Stockholm, 1972) <https://www.un.org/ga/search/view_doc.asp?symbol=A/CONF.48/14/REV.1> [accessed 24 November 2021].

²⁷ United Nations Codification Division, Office of Legal Affairs, ‘Declaration of the United Nations Conference on the Human Environment’, *Audivisual Library of International Law* <<https://legal.un.org/avl/ha/dunche/dunche.html>> [accessed 24 November 2021].

²⁸ United Nations Environment, ‘UNEP - UN Environment Programme’, *UNEP - UN Environment Programme* <<http://www.unep.org/node>> [accessed 24 November 2021].

²⁹ ‘Proceedings of the World Climate Conference: A Conference of Experts on Climate and Mankind’, ed. by World Meteorological Organization (WMO), WMO; No. 537 (presented at the World Climate Conference, Geneva: Secretariat of the World Meteorological Organization, 1979).

³⁰ ‘The Changing Atmosphere | Implications for Global Security Conference Statement’ (Toronto: World Meteorological Organization (WMO); United Nations Environment Programme (UNEP), 1988) <https://www.academia.edu/4043227/The_Changing_Atmosphere_Implications_for_Global_Security_Conference_Statement_1988> [accessed 24 November 2021].

³¹ ‘About Us’, *World Meteorological Organization* <<https://public.wmo.int/en/about-us>> [accessed 25 November 2021].

³² ‘IPCC — Intergovernmental Panel on Climate Change’ <<https://www.ipcc.ch/>> [accessed 25 November 2021].

³³ United Nations Climate Change, ‘What Is the United Nations Framework Convention on Climate Change? | UNFCCC’ <<https://unfccc.int/process-and-meetings/the-convention/what-is-the-united-nations-framework-convention-on-climate-change>> [accessed 25 November 2021].

³⁴ United Nations, ‘United Nations Conference on Environment & Development’ (Rio de Janeiro, 1992); also known as the Earth Summit.

and Development (UNCED)) in 1992, the treaty was presented to 179 countries for signature. Nowadays, 197 member states have signed the UNFCCC.³⁵ They all noted that climate change is human-made and agreed to jointly take measures to stabilize the “*greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system*“.³⁶ Developed countries and further economic in transition (EIT) countries (named in Annex 1) were distinguished in the agreement from developing countries and are primarily responsible to combat climate change and help developing countries in doing so.³⁷ At the same time, “Agenda 21”³⁸ was adopted referring to the Rio Conference and covering a non-binding action plan for areas related to the environment which are negatively impacted by humans.³⁹ After this convening, the “Commission on Sustainable Development”⁴⁰ was founded to monitor actions taken after the Earth Summit.⁴¹

Following the Millennium Summit in 2000, the UN Millennium Declaration was passed which was the origin of the Millennium Development Goals (MDGs). 12 years later, a second Earth Summit followed, the Rio+20 Summit. There, it was decided that the framework for the Sustainable Development Goals (SDGs), of which the MDGs are part, should be developed. In 2015, the “2030 Agenda for Sustainable Development”⁴² was passed by the UN General Assembly which represents in its 17th development goal measures against climate change.⁴³

A further milestone was the “Kyoto Protocol”⁴⁴ which was created in 1997 and came into force in 2005. It functions as an action plan for implementing the principles laid down in the UNFCCC. With the Kyoto Protocol, timely goals were defined to limit and reduce GHG emissions. The implementation of the “Doha Amendment”⁴⁵ which was attached to the Kyoto

³⁵ ‘Status of Ratification of the Convention | UNFCCC’ <<https://unfccc.int/process-and-meetings/the-convention/status-of-ratification/status-of-ratification-of-the-convention>> [accessed 25 November 2021].

³⁶ Art. 2 UNFCCC.

³⁷ Art. 4(2), (3) UNFCCC.

³⁸ United Nations, ‘United Nations Conference on Environment & Development’.

³⁹ Magdalena Bexell and Kristina Jönsson, *The Politics of the Sustainable Development Goals: Legitimacy, Responsibility, and Accountability*, 2021, p. 9; United Nations, ‘Agenda 21’, p. 21 <<https://sustainabledevelopment.un.org/outcomedocuments/agenda21>> [accessed 23 December 2021].

⁴⁰ United Nations Department of Economic and Social Affairs, ‘Commission on Sustainable Development (CSD)’ <<https://sustainabledevelopment.un.org/csd.html>> [accessed 23 December 2021].

⁴¹ Forum Umwelt & Entwicklung, ‘2030-Agenda Und SDGs’ <<https://www.forumue.de/themen/nachhaltigkeit/post-2015-agenda-rio20/>> [accessed 23 December 2021].

⁴² General Assembly, ‘Transforming Our World: The 2030 Agenda for Sustainable Development’, 2015.

⁴³ Duncan French and Louis J. Kotzé, *Sustainable Development Goals: Law, Theory and Implementation* (Edward Elgar Publishing, 2018), pp. 1,2; Bexell and Jönsson, pp. 8,9.

⁴⁴ UNFCCC, ‘Kyoto Protocol to the United Nations Framework Convention on Climate Change’, 1997.

⁴⁵ United Nations, *Doha Amendment to the Kyoto Protocol* <<https://unfccc.int/process/the-kyoto-protocol/the-doha-amendment>> [accessed 25 November 2021].

Protocol aimed to further bind the signed parties to the GHG decrease targets with a timeline dated until 2020.

The newest achievement strengthening the UNFCCC, however, is the “Paris Agreement”⁴⁶ which all countries that signed the UNFCCC were working on while the Kyoto Protocol and its Doha Amendment were in place. It had the purpose of creating a timeline for countries to reach a climate reduction and climate neutrality to maintain a climate under 2.0 degrees Celsius and even limit it to 1.5 degrees Celsius.⁴⁷

2.1.3 Climate change within the EU

Important parts of the Paris Agreement are Nationally Determined Contributions (NDCs)⁴⁸ that are showing which measures the contributing parties are taking to follow the climate mitigation goals and aim for GHG reduction on a national level. The “Katowice rulebook”⁴⁹ agreed on in 2018 sets out guidelines to transfer the goals described in the Paris Agreement into reality and make them operational.⁵⁰

To fulfill the requirements of the Paris Agreement, the EU presented the first draft of the European Green Deal in 2019. The Green Deal foresees the continent Europe to be climate neutral in 2050 which would also make them the first ones aiming and reaching that goal.⁵¹ Enforcing the European Green Deal, a new Proposal for the “European Climate Law”⁵² was drafted and after revision, enabled in June 2021.⁵³ Part of the European Green Deal is the European Climate Pact which has the purpose of bringing together “*people, communities and*

⁴⁶ UNFCCC, ‘Paris Agreement to the United Nations Framework Agreement on Climate Change’, 2015.

⁴⁷ David Hirst, ‘The History of Global Climate Change Negotiations’, *UK Parliament*, 2020 <<https://commonslibrary.parliament.uk/the-history-of-global-climate-change-negotiations/>> [accessed 25 November 2021]; United Nations Climate Change, ‘The Paris Agreement | UNFCCC’ <<https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement>> [accessed 29 November 2021].

⁴⁸ United Nations Climate Change, ‘Nationally Determined Contributions (NDCs) | UNFCCC’ <<https://unfccc.int/process-and-meetings/the-paris-agreement/nationally-determined-contributions-ndcs/nationally-determined-contributions-ndcs>> [accessed 29 November 2021].

⁴⁹ ‘The Katowice Climate Package: Making The Paris Agreement Work For All | UNFCCC’ <<https://unfccc.int/process-and-meetings/the-paris-agreement/katowice-climate-package>> [accessed 29 November 2021].

⁵⁰ Hirst.

⁵¹ European Commission, ‘The European Green Deal’, *European Commission*, 2019 <https://ec.europa.eu/commission/presscorner/detail/en/ip_19_6691> [accessed 29 November 2021].

⁵² European Commission, *Proposal for a Regulation of the European Parliament and of the Council Establishing the Framework for Achieving Climate Neutrality and Amending Regulation (EU) 2018/1999 (European Climate Law)*, 2020 <<https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52020PC0080>> [accessed 29 November 2021].

⁵³ Council of the European Union, European Parliament, *Regulation (EU) 2021/1119 Establishing the Framework for Achieving Climate Neutrality and Amending Regulations (EC) No 401/2009 and (EU) 2018/1999 (‘European Climate Law’)*, 2021.

organisations” who want to jointly take action against climate change.⁵⁴ The initiative should function as a communication forum for people’s opinions and engagement in climate mitigation.⁵⁵

Striving for a climate-neutral Europe in 2050, the goal according to the “2030 Climate Target Plan”⁵⁶ is to reduce emissions by at least 55% in 2030 in comparison to 1990.⁵⁷

As EU Directives need to be transferred into national law, Germany enabled the German Federal Climate Change Act which foresees an even stricter timeline. Acting as an example, Germany wants to reduce their GHG emissions by 65% by 2030, by at least 88% in 2040, and reach climate neutrality already in 2045.⁵⁸ Not only are the goals tight to a timeline but they also require a digital transformation, so the *European Commission*.⁵⁹ Both, the Federal Climate Change Act, and the European Green Deal represent the thought of reconstruction within all kinds of technology fields to reach an emission reduction.⁶⁰

2.2 Intellectual Property Rights and Patents

According to the World Intellectual Property Organization (WIPO), “*Intellectual Property [...]* refers to creations of the mind, such as inventions; literary and artistic works; designs; and symbols, names and images used in commerce“.⁶¹ To enforce IP, different categories of protection were enabled through law. These categories are patents, trademarks, and copyright as the biggest ones but also trade secrets, industrial designs, integrated circuits, and geographical indications.⁶²

⁵⁴ European Commission, ‘The European Climate Pact: Empowering Citizens to Shape a Greener Europe’, *European Commission*, 2020 <https://ec.europa.eu/commission/presscorner/detail/en/ip_20_2323> [accessed 1 December 2021].

⁵⁵ Ibid.

⁵⁶ European Commission, ‘State of the Union: Commission Raises Climate Ambition and Proposes 55% Cut in Emissions by 2030’, *European Commission*, 2020 <https://ec.europa.eu/commission/presscorner/detail/en/ip_20_1599> [accessed 1 December 2021].

⁵⁷ European Commission, ‘A European Green Deal: Striving to Be the First Climate-Neutral Continent’ <https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en> [accessed 23 October 2021].

⁵⁸ Bundestag, *Bundes-Klimaschutzgesetz Vom 12. Dezember 2019 (BGBl. I S. 2513)*, *Das Durch Artikel 1 Des Gesetzes Vom 18. August 2021 (BGBl. I S. 3905) Geändert Worden Ist*, 2019, Para. 3.

⁵⁹ European Commission, ‘Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions: The European Green Deal’, p. 4.

⁶⁰ Ibid, p. 3; Sec. 4(1) Federal Climate Change Act.

⁶¹ WIPO, ‘What Is Intellectual Property (IP)?’, *WIPO* <<https://www.wipo.int/about-ip/en/index.html>> [accessed 1 December 2021].

⁶² G. Gregory Letterman, *Basics of International Intellectual Property Law*, 2021, pp. 165–315; World Intellectual Property Organization, *WIPO Intellectual Property Handbook: Policy, Law and Use* (WIPO, 2004), pp. 17–120.

Looking closer at patents, their history began when the first Venetian Patent Statute was established in 1474.⁶³ In the early medieval ages, workers rather kept their manuals secretly to retain innovation secrets and, therefore, secure their jobs as well as further contracts.⁶⁴ However, there are multiple examples of privileges that were granted by kings to inventors to boost progress in many ways, including industrial, commercial, etc.⁶⁵ In a similar way, Venice wanted to attract craftsmen, most likely from outside of the city, and grant them for their services of sharing their innovation and also inventing new inventions, an exclusivity right for an agreed number of years. An early invention of Filippo Brunelleschi had already received a patent in 1421 through the Statute of the Republic of Florence which included an exclusivity right of three years. It is speculated that this statute was used as a base for the later known Venetian Patent Statute.⁶⁶

The demand for patents and the emerging market lead also to the implementation of a patent regulation in the United Kingdom by the Parliament and House of Lords in 1623⁶⁷ (whereas other sources say 1624)⁶⁸ called the Statute of Monopolies.⁶⁹ This statute was similarly structured to the Statute of Venice but as patent protection evolved, requirements such as submitting a description of the invention became an additional standard procedure in the Statute of Monopolies.⁷⁰

In the transition phase between the 18th and 19th centuries, further patent systems were passed such as in France in 1791, which was later modified in 1844. The French patent law foresaw a change in approach towards the value of an invention. Instead of letting the government decide, this task was delegated to the society through a so-called ‘market test’.⁷¹ All following patent systems within Europe were basically based on the French model. Germany followed (prior Prussia) in 1815 with their patent law which changed throughout the years and gained new

⁶³ Wenwei Guan, *Intellectual Property Theory and Practice: A Critical Examination of China’s TRIPS Compliance and Beyond* (Springer, 2014), p. 3.

⁶⁴ Dominique Guellec and Bruno van Pottelsberghe de la Potterie, *The Economics of the European Patent System: IP Policy for Innovation and Competition* (Oxford: Oxford University Press, 2007), p. 15,16.

⁶⁵ Philippe Braunstein, ‘À l’origine Des Privilèges d’invention Aux XIVE et XVe Siècles’, in *Les Brevets. Leur Utilisation En Histoire Des Techniques et de l’économie*, Paris, Centre de Recherche En Histoire de l’innovation (Paris: Centre de recherche en histoire de l’innovation, 1984).

⁶⁶ Michael J. Harbers, ‘International Patent Cooperation Recent Development’, *Stanford Law Review*, 20.5 (1967), p. 1001.

⁶⁷ William Weston Fisher, ‘Patent | Law | Britannica’, 1998 <<https://www.britannica.com/topic/patent>> [accessed 1 December 2021].

⁶⁸ Chris Dent, ‘“Generally Inconvenient”: The 1624 Statue of Monopolies as Political Compromise’, *Melbourne University Law Review*, 33.2 (2009), p. 438.

⁶⁹ ‘History and Architecture of the Patent System’, in *The Laws of Patent*, ed. by Craig Nard, 2nd edn (Aspen Publishers, 2010), pp. 9–11.

⁷⁰ W. Cornish, D. Llewelyn, and T. Alpin, *Intellectual Property: Patents, Copyright, Trademarks and Allied Rights*, 8th edn (London: Sweet & Maxwell, 2013), p. 125.

⁷¹ Beltran, Chauveau, and Galvez-Behar.

features such as first to invent instead of first to file, publication and public opposition before patent grant, and compulsory licences.⁷²

Even though patents became an integrated component in some countries, others either did not accept or only later implemented the patent as a system or abolished the one they had implemented before. For example, the Dutch patent law which was enabled in 1817 became ineffective in 1869.⁷³ As for Switzerland, the country did not have a patent system until 1888 and even then, it was very restrictive until its expansion in 1907. All in all, most countries had either a lack of patent regulations or a different approach toward granting patents. Moreover, their scope of protection and the duration of the patent grant differed which split the countries in their legal harmonization and made it difficult to regulate transnational patents.⁷⁴ Following the Industrial Property Congress in which discrimination and the lack of a unitarian system were discussed, an international treaty,⁷⁵ the “Paris Convention”⁷⁶ was signed by eleven member states in 1883. This treaty was revised multiple times until its last revision in 1967.⁷⁷

A further milestone was the implementation of all IPR into the TRIPS Agreement which made them part of an international trade agreement. Setting minimum standards for IP protection through the World Trade Organization (WTO) made the TRIPS Agreement a more powerful instrument for the enforcement of them at a national level. Under the TRIPS, there is no restriction for patents regarding the technology field or invention place,⁷⁸ all patents have the same minimum duration of 20 years with a possibility of extending it and an invention does not necessarily have to prove its functioning except in special cases.⁷⁹

⁷² Zorina Khan, ‘An Economic History of Patent Institutions’, *EH.Net*, 2006 <<https://eh.net/encyclopedia/an-economic-history-of-patent-institutions/>> [accessed 3 December 2021].

⁷³ Ministry of Economic Affairs and Climate Policy, ‘A Short History of Patents in the Netherlands and Europe’, *Netherlands Enterprise Agency*, 2021 <<https://english.rvo.nl/information/patents-intellectual-property/general-information-patents/history-patents-netherlands-europe>> [accessed 4 December 2021].

⁷⁴ Petra Moser, ‘Patents and Innovation: Evidence from Economic History’, *Journal of Economic Perspectives*, 27.1 (2013), pp. 25,26.

⁷⁵ Gabriel Galvez-Behar, ‘The 1883 Paris Convention and the Impossible Unification of Industrial Property’, in *Diversity and Harmonization in Historical Perspective*, ed. by Graeme Gooday and Steven Wilf, Cambridge Intellectual Property and Information Law (Cambridge: Cambridge University Press, 2020), pp. 55–59.

⁷⁶ *Paris Convention for the Protection of Industrial Property, Mar. 20, 1883, as Revised at Stockholm on July 14, 1967, 21 U.S.T. 1630, 828 U.N.T.S. 305.*

⁷⁷ Daniel Gervais, ‘The Internationalization of Intellectual Property: New Challenges from the Very Old and the Very New’, 12.4 (2002), p. 930.

⁷⁸ Art. 27(1)(1) TRIPS.

⁷⁹ Art. 33 TRIPS; Khan (2006).

2.3 Interaction between climate change and IPR

The heart of the climate change discussions is technology.⁸⁰ It is not only the cause of temperature rise but might also be an important aspect of climate mitigation.⁸¹ Even relevant international and transnational agreements for climate mitigation are highlighting the role green technology will play in climate mitigation as stated in chapter 2.2 following. For reaching the goals laid out in the European Green Deal and the German Federal Climate Change Act, the economy needs to grow in line with the climate neutrality goals which means that new technologies need to cover green features to support climate mitigation and stop GHG emissions. Such technologies could relate to other sources of producing energy, storing energy more efficiently, and finding environmentally friendly ways of transportation, land, and forest cultivation. This is where IPR gains in importance. IPR is protecting technologies and has also the main purpose of increasing innovation. The increase of environmentally sound technologies in combination with a global technology transfer is what it takes to reach climate mitigation.⁸² However, there are also limitations to IPR which might lead to bigger challenges when it comes to the dissemination of technology.⁸³ This is discussed more deeply in the following chapters.

2.3.1 Green technology

In the context of this paper, green technology is used to describe technology that is meant to positively affect climate change.

Even though there is no definition for green technology, the WIPO uses green technology as a synonym for environmentally sound technologies.⁸⁴ At the same time, technology should in the context of this thesis and in relation to the patent system refer to processes or products. According to the UN Conference in 1992 in Rio, the description of green technologies is that it refers to all technologies that “*protect the environment, are less polluting, use all resources in a more sustainable manner, recycle more of their wastes and products, and handle residual waste in a more acceptable manner than the technologies for which they were substitutes*”.⁸⁵

⁸⁰World Intellectual Property Organization (WIPO), ‘Climate Change and the Intellectual Property System: What Challenges, What Options, What Solutions? An Outline of the Issues: Informal Consultation Draft Only.’, 2008, p. 5.

⁸¹ de Coninck and Puig, p. 417.

⁸² World Intellectual Property Organization (WIPO), ‘Climate Change and Intellectual Property’, *WIPO* <https://www.wipo.int/policy/en/climate_change/index.html> [accessed 6 December 2021].

⁸³ Fabian Klein, ‘GREEN IP - A Look at How Sustainability Influences IP and How IP Can Help in Achieving Sustainability’, 2020 <<https://www.ashurst.com/en/news-and-insights/legal-updates/a-look-at-how-sustainability-influences-ip-and-how-ip-can-help-in-achieving-sustainability/>> [accessed 7 November 2021].

⁸⁴ World Intellectual Property Organization (WIPO), ‘WIPO GREEN: The Global Marketplace for Sustainable Technology’ <<https://www3.wipo.int/wipogreen/>> [accessed 7 November 2021].

⁸⁵ United Nations, ‘United Nations Conference on Environment & Development’, 1992, chap. 34 of Agenda 21.

Green technology is, therefore, not connected to a specific field of technology but is rather covering all areas. It is, however, difficult to categorize a technology as ‘green’ as there are no measurable values of what is green and what not, so *Klein*.⁸⁶

An existing initiative relating to green technologies was already started by the WIPO, called ‘WIPO Green’. It is supposed to be an exchange platform for green technologies. Users can register and upload their invention no matter what stage of process it is in. The marketplace should support innovation relating to climate change and stimulate new inventions.⁸⁷

2.3.2 Patent system as a source of protection for green technologies

Even though there is a range of IP, patents were addressed the most by policy makers and in literature in connection to the climate change combat.⁸⁸ All kinds of technologies can be protected through patents in areas such as energy and water procurement, farming and forestry, transportation, environmentally friendly pollution and waste treatment, product manufacturing, material use, and construction, which in return can, if invented environment-focused, positively influence climate mitigation.⁸⁹

Under the existing patent systems, granted patents are already protecting all kinds of technologies, so why does the protection of green technologies need more consideration under the patent system, one could ask. In fact, the number of patents granted by the EPO is rising constantly since 2016 with a slight decrease of 0,7% due to Covid-19 compared to the previous year. Even in direct comparison to 2011 with 142.822 patents granted, in 2020 180.250 patents were granted, Germany concluding 14% of all patent applications, which is an indicator of increased innovative development.⁹⁰ However, the OECD database shows that the patent offices worldwide, especially pointing out the European Patent Office (EPO), granted progressively fewer environment-related patents since 2011, Germany being not an exception.⁹¹

Moreover, the climate neutrality goals represented in the UNFCCC, the Kyoto Protocol but more specifically and recently, in the European Green Deal and the Federal Climate Change Act, are following a strict timeline.⁹² Reaching these goals is tied to time that is running out and

⁸⁶ Klein.

⁸⁷ World Intellectual Property Organization (WIPO), ‘WIPO GREEN’.

⁸⁸ Ofer Tur-Sinai, ‘Patents and Climate Change: A Skeptic’s View’, *Environmental Law*, 48.1 (2018), p 211.

⁸⁹ World Intellectual Property Organization (WIPO), ‘Wipogreen Database’ <<https://wipogreen.wipo.int/wipogreen-database/database>> [accessed 8 December 2021].

⁹⁰ European Patent Office (EPO), ‘Statistics and Trends’; European Patent Office (EPO), ‘European Patent Applications’.

⁹¹ Organisation for Economic Co-operation and Development (OECD).

⁹² See chap. 2.3.

overstepping a certain level of degree rise could cause irreversible damages. Surprising is that all these goals striving for climate neutrality are relying on a technological change either through renewable energy or environmentally friendly technology, even though the patent statistics clearly show that there is a decrease in patent applications for environment-related technologies.⁹³

Therefore, within chapters three to five of this thesis, the European patent system together with its features and processes is analyzed in more detail to examine whether the protection through patents for green technology is or is not the right instrument for reaching climate neutrality. Not only is it necessary to consider questions faced in the pre and post-grant phases such as the scope of protection, the suitability of a technology to be protected, the exclusivity of the technology but also the debate between the public and the investor's interest, supportive incentives within the patent system boosting the invention of environmental-related technologies, and the technology dissemination.⁹⁴

3 The patent – its granting process and features within the EU

In this chapter, principles behind patentability, pre, post-patent grant phase, as well as the granting process within the EU, are analyzed and discussed. As part of it, pre-grant questions referring to technology enforcement and quality assurance, public interest vs private rights, the morality exemption according to 53(a) TRIPS, the exclusivity feature, abuses of patent monopoly, the monitoring and intervention into patent rights as well as the dissemination of technology and transfer to developing countries are taken into focus. This chapter constitutes the base for the comparison and evaluation of the patent system for its suitability for protecting and boosting green technologies conducted in the second half of chapter four.

3.1 Principles behind patentability

The basic principle underlying the patent granting is the patentability of an invention. When applying for a patent at the EPO, the invention is assessed for its qualification for patent eligibility which takes place already during stage three of the patent application process but then more extensively during stage five.⁹⁵ In general, the rule applies that “*European patents shall be granted for any inventions, in all fields of technology, provided that they are new,*

⁹³ Organisation for Economic Co-operation and Development (OECD).

⁹⁴ World Intellectual Property Organization (WIPO), ‘Climate Change and the Intellectual Property System: What Challenges, What Options, What Solutions? An Outline of the Issues: Informal Consultation Draft Only.’, pp. 6–15.

⁹⁵ The stages of the patent granting process are further defined in chap. 3.3.

involve an inventive step, and are susceptible to industrial application” according to Art. 52(1) EPC.⁹⁶ This means that inventions should be, firstly, novel which is further defined in Art. 54 EPC. They should not be ‘state of the art’.⁹⁷ In other words, for inventions to get a patent, they have to not already exist or be part of any former art. However, new does not mean that the invention has to be based on completely new technologies – it has to be either used in a way that is new, even though it combines existing technologies or includes any new part making the invention significantly distinguishable.⁹⁸ Secondly, as further laid down in Art. 56 EPC, inventions have to be done through inventive steps which signifies that an invention should not be apparently visible to anyone having knowledge in the same field of studies.⁹⁹ Hence, inventions have to be generated through a process. At the same time, the inventive step signifies that the invention has to be a non-obvious solution to an existing problem.¹⁰⁰ Thirdly and lastly, inventions have to be “*considered as susceptible of industrial application*”,¹⁰¹ meaning, they are suitable for every industry, as well as they may be used in agriculture.¹⁰² In consequence, every invention fulfilling these requirements would be eligible for receiving a patent as long as it does not fall under Art. 52(2) EPC or under the category of exceptions stated in Art. 53 EPC, meaning it’s against morality or ordre public.¹⁰³ With regard to the listed criteria, inventions can be newly established products, processes, or solutions developed for predominant problems often related to technology.¹⁰⁴

3.2 Pre-grant phase

The pre-grant phase involves questions that arise before the actual patent grant takes place or during the patentability assessment. In this regard, the debate between the public interest in the invention and the issuing of exclusive rights to the patentee is discussed in first place. Right after, the exemption to the patentability of an invention according to Art. 53(a) TRIPS, as well as the aims to maintain high-quality inventions and ensure the technology enforcement are addressed.

⁹⁶ Art. 52(1) *Convention on the Grant of European Patents (European Patent Convention) of 5 October 1973 as Revised by the Act Revising Article 63 EPC of 17 December 1991 and the Act Revising the EPC of 29 November 2000.*

⁹⁷ Art. 54(1) EPC.

⁹⁸ Nicolas Lalyre, ‘WIPO - Technology and Innovation Support Center Seminar on the Effective Use of Technical and Scientific Information’, 2014.

⁹⁹ Art. 56 EPC.

¹⁰⁰ Government of the Netherlands, ‘What Are the Criteria for Patenting My Invention?’, *Government.NL* <<https://www.government.nl/topics/intellectual-property/question-and-answer/what-are-the-criteria-for-patenting-my-invention>> [accessed 4 February 2022].

¹⁰¹ Art. 57 EPC.

¹⁰² *Ibid.*

¹⁰³ Arts 52(2), 53 EPC. The exception of morality is further addressed in 3.2.3.

¹⁰⁴ World Intellectual Property Organization (WIPO), ‘Patents’ <<https://www.wipo.int/patents/en/index.html>> [accessed 1 January 2022].

3.2.1 Pre-grant questions referring to technology enforcement and quality assurance

The elementary base surrounding the pre-grant phase consists of the main questions of whether patents should be granted for certain technologies or not, under which criteria they should be granted, and what the implications are if patents are or are not granted. Especially in the field of environment and green technologies, it is under consideration whether patents should be granted for green technologies and whether patents supporting climate change mitigation or adapting existing technologies to climate change should be granted at all. The reason, therefore, is the restricting character of a patent hindering the invention's limitless use and the technology diffusion. It should be questioned whether the patent system is the right incentive for boosting technologies and how the investment into research and development of new technologies, especially relating to climate change mitigation and adaption can be increased.¹⁰⁵

Another question that arises during an invention's review stage is whether its impactful implications can be examined already at this early stage to its fullest. The patent examination's initial aim is to ensure a high patent quality, which positively influences society with the invention's new and beneficial character. Therefore, during the research and review phase of patent claims, a better exchange of patent offices would lead to a patent claim which approaches the patent law in its content to its closest. Another measure would be the open contribution of the public in the research and examination phase to accelerate the search for existing similar inventions. Furthermore, a special dataset is gathering all inventions.¹⁰⁶

Despite the questions surrounding the patent system as an instrument for the enforcement of public policies,¹⁰⁷ a further topic addressed in the pre-grant phase is the debate between the public interest in the invention and the issuing of exclusive rights to the patentee.

3.2.2 public interest vs private rights

Reflecting the pre-grant questions, a widely discussed feature of patents is their exclusivity granted to the patent owner in return for sharing their invention according to Art. 28 TRIPS Agreement.¹⁰⁸ Even though the invention falls into the public domain after 20 years of

¹⁰⁵ World Intellectual Property Organization (WIPO), 'Climate Change and the Intellectual Property System: What Challenges, What Options, What Solutions? An Outline of the Issues: Informal Consultation Draft Only.', p. 26.

¹⁰⁶ Ibid.

¹⁰⁷ Ibid, p. 6.

¹⁰⁸ Rebecca Tushnet, 'Intellectual Property as a Public Interest Mechanism', in *The Oxford Handbook of Intellectual Property Law*, 2018, p. 96.

protection which starts after the filing date,¹⁰⁹ the use of the newly invented technology can be restricted completely by the patent owner until the end of the 20 years.¹¹⁰

Ever since the TRIPS Agreement came into force, the coexistence of public interests in the invention and the patentee's exclusivity rights in the invention were a widely controversial topic.¹¹¹ On the one hand, the inventors want a reward for their investment in the research and development of the invention. On the other hand, the public wants to access the invention without restrictions to profit from the new technology which might be valuable for public health or the environment. This particular conflict was already considered in the TRIPS Agreement in its Arts 7 and 8. Both, the rights of the public and these of the IP owner should be weight against each other whereas the innovation should be promoted, and the technology diffusion enabled.¹¹² At the same time, the public interest should be taken into account and if necessary, measures taken to maintain the public interest in areas depending on the development in technology as long as they are consistent with the provisions of the TRIPS Agreement.¹¹³

Even though in theory, there should be a functioning mechanism to balance private rights and the public interest, the TRIPS Agreement makes no distinction between developing and developed countries. Whereas developing countries are financially stable and do not rely on limitless and cost-effective access to certain information, developing countries do. According to *Picciotto*, the system behind the TRIPS Agreement is aggravating access to knowledge and its diffusion for developing countries,¹¹⁴ whereas countries with appropriate resources are profiting from inventions.¹¹⁵ Even though some provisions enable exceptions to exclusive rights (such as compulsory licences),¹¹⁶ the claim can be denied by the government.¹¹⁷ To further elaborate, States can decide freely on which grounds to allow or deny compulsory licences, provided that their national law foresees compulsory licences and they comply with Arts 30 and 31 TRIPS.¹¹⁸ Furthermore, *Picciotto* claims that ever since the conclusion of the Agreement between the WTO and WIPO as well as the WIPO's implementation into the TRIPS

¹⁰⁹ Art. 33 TRIPS.

¹¹⁰ Art. 28 (1) TRIPS.

¹¹¹ World Trade Organization, 'Intellectual Property and the Public Interest', *Wto.Org* <https://www.wto.org/english/news_e/news19_e/ddgaw_05dec19_e.htm> [accessed 12 January 2022].

¹¹² Art. 7 TRIPS.

¹¹³ Art. 8 TRIPS.

¹¹⁴ See chapters 3.4.1 and 3.4.4 for further information about technology use and dissemination.

¹¹⁵ Sol Picciotto, 'Private Rights vs. Public Interests in the TRIPS Agreement', *Proceedings of the Annual Meeting (American Society of International Law)*, 97 (2003), p. 167.

¹¹⁶ Arts 30, 31, 31bis TRIPS.

¹¹⁷ Picciotto, p. 168.

¹¹⁸ 'WTO | Intellectual Property (TRIPS) - TRIPS and Public Health: Compulsory Licensing of Pharmaceuticals and TRIPS', *World Trade Organization* <https://www.wto.org/english/tratop_e/trips_e/public_health_faq_e.htm> [accessed 17 November 2021].

Agreement, there is a debate about the WIPO being the right body to ensure the balance between the public interest and private rights. As the WIPO is in favor of IP protection, it strengthens IPRs and might disregard the value of the public interest which might be especially crucial for developing countries.¹¹⁹

3.2.3 *Morality question*

As briefly mentioned in the chapter about principles of patentability, patents are not granted if their exploitation would be against morality or “ordre public”.¹²⁰ However, there is no entity commissioned with the assessment of the exemptions according to Art. 53(a) TRIPS Agreement.¹²¹ The same applies to the “*interpretation of the concept of morality [which] should be a matter for European institutions*”,¹²² says the *Working Party on the EPC*. Even though no European definition of morality exists and no regulations within existing patent laws are found which decide whether and when an invention falls under the exception of morality according to Art. 53(a) EPC,¹²³ assigning a concrete competent party with these tasks was left out. Therefore, in theory, morality is foreseen in law, the execution of it, nevertheless poses difficulties. Due to no existing standards, judgmental decisions are unpredictable as well which creates legal uncertainty.¹²⁴

The morality aspect is currently most discussed in Biotech Medicine and concerns morally controversial biotechnological inventions as well as their ethical boundaries.¹²⁵ More specifically, patents are not granted if the inventions are against human dignity which is measured by their moral value to Europeans according to Art. 1 ECHR,¹²⁶ displayed in *Brüstle v. Greenpeace eV*¹²⁷ and *Use of Embryos/WARF*¹²⁸. As scientists are already capable of altering human genomes so far that, in 2018, the genomes of two Chinese newborns were modified to increase their resistance to HIV, the question of what should be allowed and what not becomes more and more relevant. Thinking further and putting aside the facts that all procedures bear risks, experimenting with human genomes can go massively wrong, and wrongly modified

¹¹⁹ Picciotto, p. 168.

¹²⁰ Art. 53(a) EPC.

¹²¹ Maureen O’Sullivan, *Biotechnology, Patents and Morality: A Deliberative and Participatory Paradigm for Reform* (New York and Abingdon: Routledge, 2019), p. 14.

¹²² Travaux Préparatoires (EPC 1973), ‘Meeting on 18 April 1961, IV/2767/61-E’, p. 7.

¹²³ T-0356/93 Plant cells ECLI:EP:BA:1995:T035693.19950221 (OJ, 21 February 1995) <<https://www.epo.org/law-practice/case-law-appeals/recent/t930356ex1.html>> [accessed 16 March 2022].

¹²⁴ Maureen O’Sullivan, p. 52.

¹²⁵ Ed Silverman, ‘The 5 Most Pressing Ethical Issues in Biotech Medicine’, *Biotechnology Healthcare*, 1.6 (2004), pp. 41–46.

¹²⁶ Art. 1 *Charter of Fundamental Rights of the European Union (ECHR)*, OJ C 326/391 (2000).

¹²⁷ C-34/10 *Brüstle v. Greenpeace eV* [2011] ECR I-09821 (Grand Chamber, 18 October 2011).

¹²⁸ G2/06 *Use of Embryos/WARF* ECLI:EP:BA:2008:G000206.20081125 (Enlarged Bd App., 25 November 2008).

genomes are passed through generations, the inventor of such a creation might want to apply for a patent. Doing so, they would obtain patent rights either over the modified embryo or over the processes that were used to modify the human genomes. In general and also applying to biotechnological inventions, these exclusive rights would grant the inventor, then referred to as patent owner or right holder, the right to prevent others from „*making, using, offering for sale, selling, or importing*“ the product or process.¹²⁹ At the same time, the patentee would have the right to consent to the commercial exploitation of the invention by third parties.¹³⁰ That way, human lives, as well as the decision about human influenceable inventions, would lie in the hand of one person only, the patentee.¹³¹

Likewise, the existence of ethical aspects within climate change is posited. Even though climate change is highly scientific, and economic,¹³² it also covers ethics profoundly. Moreover, it is law-related and border-crossing which is why it is rich in complexity. As climate change impacts not only the world for the time being but has a huge influence on the development and habitability of the earth, it primarily will affect future generations.¹³³ Furthermore, climate change is seen as a “prisoner`s dilemma” as the actions of every country, independent of the country`s location, have an impact worldwide. Whereas the reduction of climate change risks and therefore climate mitigation is wished by every country, at the time, everyone still desires to operate unrestrictedly.¹³⁴ In consequence of the wide-reaching and long-term ramifications of climate change, especially the impact awareness of climate change includes ethical characteristics.¹³⁵

Similar to the morality discussion in the field of biotechnology, climate change bears, as mentioned, ethical aspects which are critical for human survival. For that reason, it should be questioned, analogously to biotechnological inventions, whether patent rights for climate change inventions should be granted to a right holder only whose decision over the invention could affect the whole world. In the same way, it should be decided whether and what kind of climate change inventions are permitted to receive patent protection. As green inventions are

¹²⁹ Art. 28(1) TRIPS.

¹³⁰ Ibid.

¹³¹ Shannon Patrick, ‘Can We Learn to Incentivize Morality?: A Discussion of Biotechnology on an International Level’, *Emory International Law Review*, 34.3 (2020), pp. 859–861.

¹³² Stephen M. Gardiner, p. 556.

¹³³ Grubb, pp. 472,473.

¹³⁴ Dieter Helm, ‘Climate-Change Policy: Why Has so Little Been Achieved?’, *Oxford Review of Economic Policy*, 24.2 (2008), 211–238 (p. 234); see also Marvin S. Soroos, *The Endangered Atmosphere: Preserving a Global Commons* (Columbia, S.C.: University of South Carolina Pres, 1997).

¹³⁵ Stephen M. Gardiner and Lauren Hartzell-Nichols, ‘Ethics and Global Climate Change’, *Nature Educational Knowledge*, 3.10 (2012) <<https://www.nature.com/scitable/knowledge/library/ethics-and-global-climate-change-84226631/>> [accessed 18 March 2022].

novel and constantly evolving, the dimension of them is unknown but all of them are affecting the environment and the atmosphere to some extent.¹³⁶ That is why it should be assessed in advance to granting a patent whether the invention affects the environment positively or whether it bears potential risks or negative implications on the environment. It is also thinkable that inventions might benefit the environment and restrict human being at the same time. In such cases, the rights of the public and the rights of the single individual should be balanced. At the same time, it can be speculated that inventions not including green features can anyways be morally controversial in relation to climate change (e.g. when the production of the invention emits an enormous amount of GHGs or the invention itself is contributing to huge GHGs emissions).

In contrast to inventions that are morally controversial in respect of climate change, there could be also inventions that could positively contribute to solving ethical issues (which, inter alia, climate change belongs to). It should be assessed whether such inventions should receive special treatment but, firstly, the benefit of such inventions for resolving ethical issues needs to be recognized by a knowledgeable and assigned board.

However, the issue, as pointed out by *O`Sullivan*, still exists. Not only is the term “morality” not defined, but the morality bar is also examined by officials at the EPO with an education in law or technology without knowledge of how to apply the morality bar from an ethical point of view which is why a patent is granted when the requirements in Art. 52(1) EPC are fulfilled rather than considering the moral aspect of Art. 53(a) EPC in addition.¹³⁷

3.3 Granting phase

The patent granting process follows strict systematic procedures and consists of nine stages.¹³⁸ In stage one, the request for the grant of a European patent needs to be filed and documents covering the invention`s description including the designated inventor or inventors, claims, drawings if referred to in the claims or description of the invention, and an abstract provided.¹³⁹ In addition, a fee applies and needs to be paid.¹⁴⁰

¹³⁶ As technologies can either contribute to a climate neutral world or one that worsens the climate situation.

¹³⁷ Maureen O`Sullivan, p. 52.

¹³⁸ European Patent Office, ‘The Patenting Process’ <<https://www.epo.org/learning/materials/inventors-handbook/protection/patents.html>> [accessed 2 January 2022].

¹³⁹ Art. 78(1) EPC.

¹⁴⁰ Art. 2(1)(1)(i) European Patent Organisation, *Rules Relating to Fees of 20 October 1977 as Adopted by Decision of the Administrative Council of the European Patent Organisation of 7 December 2006 and as Last Amended by Decision of the Administrative Council of 27 March 2020 (RFees EPC)*.

The next stage ensures the correctness of the documents handed in for the invention. If so, the application receives a filing date.¹⁴¹ During 12 months after receiving the filing date, the patent protection can be applied for in other countries as well as other applications for the same group of inventions filed allowing to apply the so-called priority date to later applications.¹⁴² In such a case the filing date of the first application would equal the priority date.¹⁴³

In stage three, the European search report is conducted. All existing patents are examined on prior art resembling the invention filed for.¹⁴⁴ Through this process, the novelty of the invention but also the description of the invention and its attached drawings, if any, are assessed which takes on average five months after filing the application. The finalized report is sent to the applicant and gives a first impression of the invention's possible patentability and its fulfillment with EPC requirements.¹⁴⁵ If the application is not consistent with the requirement of unity of invention according to Art. 82 EPC, the EPO can decide to only conduct a partial report covering the invention or inventions which were mentioned as the first ones in the claims by the applicant. For all inventions not falling under the same group of inventions, a further fee must be paid to conduct a search report within two months after the notification of the applicant about the lack of unity.¹⁴⁶

Stage four includes the publication of the patent application into a public database 18 months passing the filing date,¹⁴⁷ and the information transmission of the publication to the applicant.¹⁴⁸ The publication includes all documents handed in by the applicant which are required for the application process according to Art. 78(1) EPC. The European Search report is either published directly with the publication as Annex 1 or if not available at that time, it will be published later as a separate Annex. If the application was not filed in one of the languages required by the EPO¹⁴⁹ a translation of the application is published as well.¹⁵⁰ It serves already as provisional protection as it is at that stage already registered as an already existing invention and, therefore,

¹⁴¹ Arts 80, 90(1) EPC.

¹⁴² Arts 87(1)(b), 88 EPC; Art. 4(C)(1) Paris Convention.

¹⁴³ Art. 4(A)-(C) Paris Convention.

¹⁴⁴ Art. 92 EPC.

¹⁴⁵ European Patent Office, *European Patent Guide: How to Get a European Patent*, 21st edn, 2021, p. 50; European Patent Office, *Implementing Regulations to the Convention on the Grant of European Patents of 5 October 1973 as Adopted by Decision of the Administrative Council of the European Patent Organisation of 7 December 2006 and as Last Amended by Decision of the Administrative Council of the European Patent Organisation of 15 December 2020*, R.61-66.

¹⁴⁶ R. 64(1) EPC; Art. 2(1), item 2, RFees EPC.

¹⁴⁷ Art. 93(1) EPC.

¹⁴⁸ R. 69 EPC.

¹⁴⁹ English, French or German.

¹⁵⁰ European Patent Office, *European Patent Guide: How to Get a European Patent*, p. 52.

forbids companies and private entities to invent the same kind of invention.¹⁵¹ Within six months after the publication, the applicant needs to decide whether they want to proceed with the patent granting and which countries the patent protection should cover.¹⁵² Accordingly, a further fee must be paid.¹⁵³

If a proceeding with the application is wished, a substantive examination takes place in stage five, in which the final decision is drawn about the patentability of the inventions and their fulfillment of all requirements according to the EPC.¹⁵⁴ More so, the extensive examination is based on the preliminary opinion and research report made in stage three as well as the applicant's replies to the documents.¹⁵⁵ In this stage, a defense of the invention and changes to the application might be necessary and are allowed.¹⁵⁶

In case the invention is eligible for a patent, the grant stage follows in stage six.¹⁵⁷ Within the document provided to the applicant about the implication to grant the patent, the applicant is asked to pay all due fees.¹⁵⁸ The payment of the fees is seen as approval of the written patent text for the patent grant.¹⁵⁹ After all fees are paid, the patent will be granted.¹⁶⁰ The next step is the publishing of the patent granting decision in the European Patent Bulletin from which day onwards the patent will be effective.¹⁶¹

Continuing with stage seven, a validation of the patent needs to follow in every single state in which the protection was applied for. This needs to happen during six months after the publication of the search report in the European Patent Bulletin.¹⁶² It might be required to apply for and afterward pay for either a translated version of the patent or single claims.¹⁶³

In stage eight, the patent will be open for a public opposition for nine months during which period every person can oppose the patent based on the grounds according to Art. 100 EPC.¹⁶⁴ After a possible claim by third parties, the oppositions will be reviewed by the EPO for their

¹⁵¹ Art. 67 EPC.

¹⁵² R. 70(1) EPC.

¹⁵³ Art. 2(1), item 6, RFees EPC.

¹⁵⁴ Art. 94(1) EPC.

¹⁵⁵ European Patent Office, *European Patent Guide: How to Get a European Patent*, pp. 54,55.

¹⁵⁶ R. 70a, 137(2), (3) EPC.

¹⁵⁷ Art. 97(1) EPC.

¹⁵⁸ R. 71(3)-(7) EPC.

¹⁵⁹ R. 71(3), (7) EPC.

¹⁶⁰ R. 71a(1) EPC.

¹⁶¹ Art. 97(3) EPC.

¹⁶² Arts 79(2), 94(1), R. 39 EPC.

¹⁶³ Art. 65(1), (2) EPC.

¹⁶⁴ Arts 99(1), 100 EPC.

formal correctness.¹⁶⁵ The opposition will be sent to the patent owner, so they can adopt necessary changes to the patent documents.¹⁶⁶ After the preliminary sorting of the oppositions, the Opposition Division will examine all accepted oppositions thoroughly.¹⁶⁷ If at least one ground according to Art. 100 EPC prejudices the patent, the Division shall revoke the patent.¹⁶⁸ However, it can be decided that the patent can be maintained if certain amendments are made by the patent owner.¹⁶⁹

If the patent was not or not successfully opposed during that stage, the patent can be challenged, in stage nine, in court.¹⁷⁰ All stages are also illustratively shown in the “Overview of the procedure for the grant of a European patent” by the *EPO*.¹⁷¹

All in all, the process of granting a patent takes about three to four years and might be costly in terms of application fees, translations, all necessary amendments during the oppositions phase, and expenses for a patent attorney who accompanies the applicant through the whole patent application process. It also applies a renewal fee each year for every country the invention is protected in. There is always a risk of financial losses due to the invention’s loss of worth until the patent is finally granted and the potential lack of revenue.¹⁷²

3.4 post-grant phase

After the patent application was approved for the filed invention, the post-grant phase begins. It deals with the main questions of usability of the technology (especially licensing options), the monitoring and regulation of patent rights, and possible restrictions to it.¹⁷³ Furthermore, the dissemination of technology and the technology transfer to developing countries is mentioned. During this abstract, particularly the features of exclusivity play an important role.

¹⁶⁵ R. 77(1) EPC.

¹⁶⁶ Art. 79(1) EPC.

¹⁶⁷ Art.101, R. 81 EPC.

¹⁶⁸ Art. 101(2) EPC.

¹⁶⁹ Art. 101(3)(a) EPC.

¹⁷⁰ Art. 106 EPC.

¹⁷¹ European Patent Office, ‘European Patent Guide: Annex 1 – Overview of the procedure for the grant of a European patent’ <https://www.epo.org/applying/european/Guide-for-applicants/html/e/ga_ai.html> [accessed 1 May 2022].

¹⁷² European Patent Office, ‘The Patenting Process’.

¹⁷³ World Intellectual Property Organization (WIPO), ‘Climate Change and the Intellectual Property System: What Challenges, What Options, What Solutions? An Outline of the Issues: Informal Consultation Draft Only.’, p. 6.

3.4.1 Technology use and exclusivity

As already pointed out in the history of the patent system, the patent system is based on the reward theory which grants 20 years of exclusivity to the patent seeker.¹⁷⁴ Being granted these exclusive rights enables the patent owner to protect their inventions and to recoup the cost of investment in the research and development of the technology.¹⁷⁵ In addition, the right holder also receives the right to restrain others from “*making, using, offering for sale, selling, or importing*”¹⁷⁶ a product or process without the right holder’s permission.¹⁷⁷

The overall belief of economists like *La Mana*, *Maurer* and *Scotchmer*, *Kultti* and *Takalo*, *Shapiro*, and *Henry* is that the patent system, as it is, is ineffective in the sense that it only grants a patent to the first inventor of a technology of its kind even though it is possible that many individuals are researching and developing, in some cases, a similar technology at the same time.¹⁷⁸ The patent system as such does not only to some extent hinder the promotion of innovation as it restrains others to build a technology slightly different to the one invented (except for when it clearly demonstrates an improvement through an inventive step) but it also leaves inventors that invested in the research and development of a technology with empty hands if they are not the first ones to file for a patent.¹⁷⁹

However, the patent owner has the possibility to share his invention with other individuals by licensing it.¹⁸⁰ The licence does not only represent the permission to use someone else’s invention but it is also referring to the licence agreement in which the permission is regulated.¹⁸¹ It enables the licensee to use the invention for a period of time and only for the use and scope agreed upon in the licence agreement. Any further use is not permitted and the limitations, as well as remedies for the contract breach, should be specified further in the licence agreement.¹⁸²

¹⁷⁴ Art. 33 TRIPS.

¹⁷⁵ See chap. 2.2 for the origin of exclusive rights.

¹⁷⁶ Art. 28(1) TRIPS.

¹⁷⁷ Sec. 10(1) *Patent Act as Published on 16 December 1980 (Federal Law Gazette 1981 I p. 1), as Last Amended by Article 4 of the Act of 8 October 2017 (Federal Law Gazette I p. 3546) (German Patent Act/Patentgesetz)*.

¹⁷⁸ Stephen M. Maurer and Suzanne Scotchmer, ‘The Independent Invention Defence in Intellectual Property’, *Economica*, 69 (2002), pp. 535–547; Manfredi La Manna, Ross Mangleod, and David de Meza, ‘The Case for Permissive Patents’, *European Economic Review*, 33 (1989), pp. 1427–1443; Carl Shapiro, ‘Prior User Rights’, *American Economic Review*, 96.2 (2006), pp. 92–96; Klaus Kultti and Tuomas Takalo, ‘Optimal Fragmentation of Intellectual Property Rights’, *International Journal of Industrial Organization*, 26.1 (2008), pp. 137–149; Emeric Henry, ‘Strategic Disclosure of Research Results: The Cost of Proving Your Honesty’, *The Economic Journal*, 119.539 (2009), pp. 1036–1064.

¹⁷⁹ *Ibid*; Vincenzo Denicolò and Luigi A. Franzoni, ‘On the Winner-Take-All Principle in Innovation Races’, *Journal of the European Economic Association*, 8.5 (2010), pp. 1135,1136.

¹⁸⁰ Art. 28(2) TRIPS.

¹⁸¹ Christian Fortmann, *Revenue Models* (London: Kogan Page Ltd, 2009), p. 175.

¹⁸² Christian Fortmann, pp. 177–179.

Another option is that the right holder makes the patent accessible to the public. Choosing this option, many countries allow the patent owner a reduction in the annual renewal fees.¹⁸³ The same applies in the case of Germany where the patent owner receives a reduction of up to 50%.¹⁸⁴

3.4.2 *Abuses of patent monopoly vs free market competition*

Already two centuries ago, the positive effect of the patent system on the economy was highly questioned. *Jean-Baptiste Say*, among other economists, suspected that it would negatively influence the rise in prices as well as the market competition.¹⁸⁵ Later writings show agreement with the impact of patents on competition or more anti-competition.¹⁸⁶ Whereas some proposed a weakening or even the abolition of the patent system,¹⁸⁷ others pointed out its long-term existence and argued with irresponsibility of destroying a concept in place for so long.¹⁸⁸

The basic concept behind patents is that they grant the invention owner exclusive rights which entitle them to prevent others from the use or reproduction of the technology except for when the patent owner decides to provide a possibility to make use of it (e.g. licences, etc.) as already mentioned in 3.4.1. For this very reason, the patent owner is the only person that can sell the product or process and decide about its pricing. It may appear obvious that a patent owner falls under the category of a monopolist according to the definition of monopoly in the 'Glossary of Industrial Organisation Economics and Competition Law': "*Monopoly is a situation where there is a single seller in the market*".¹⁸⁹ The terms monopoly and market power are, moreover, often used in combination with patents or patent rights ("[...] *exclusive patent rights last for 20*

¹⁸³ Catherine Jewell and Charlotte Tilbury, 'Licences of Right in European Patent Convention (EPC) Territories and with Respect to European Unitary Patents | Beck Greener', *BeckGreener*, 2017 <<https://www.beck-greener.com/licences-right-european-patent-convention-epc-territories-and-respect-european-unitary-patents>> [accessed 2 February 2022].

¹⁸⁴ Sec. 23(1) German Patent Act.

¹⁸⁵ Jean-Baptiste Say, *A Treatise on Political Economy; or the Production, Distribution, and Consumption of Wealth*, 1803, bk. I, chap. XVII.

¹⁸⁶ Frederic M. Scherer, *Innovation and Growth: Schumpeterian Perspectives*, 1984; Suzanne Scotchmer, 'Standing on the Shoulders of Giants: Cumulative Research and the Patent Law', *Journal of Economic Perspectives*, 5.1 (1991), p. 29; Edward H. Chamberlin, *The Theory of Monopolistic Competition*, 1937.

¹⁸⁷ Stephen M. Maurer and Suzanne Scotchmer, 'The Independent Invention Defence in Intellectual Property', *Economica*, 69 (2002), pp. 535–547; Manfredi La Manna, Ross Manleod, and David de Meza, 'The Case for Permissive Patents', *European Economic Review*, 33 (1989), pp. 1427–1443; Carl Shapiro, 'Prior User Rights', *American Economic Review*, 96.2 (2006), pp. 92–96; Klaus Kultti and Tuomas Takalo, 'Optimal Fragmentation of Intellectual Property Rights', *International Journal of Industrial Organization*, 26.1 (2008), pp. 137–149; Emeric Henry, 'Strategic Disclosure of Research Results: The Cost of Proving Your Honesty', *The Economic Journal*, 119.539 (2009), pp. 1036–1064.

¹⁸⁸ Fritz Machlup, 'An Economic Review of the Patent System: Study of the Subcommittee on Patents, Trademarks, and Copyrights of the Committee on the Judiciary', 1958, p. 76.

¹⁸⁹ R. S. Khemani and D. M. Shapiro, 'Glossary of Industrial Organisation Economics and Competition Law' (OECD, 1993), p. 59.

years. The idea is to provide monopoly power [...],¹⁹⁰ “a medicine is protected by a patent which confers a temporary monopoly on its holder”,¹⁹¹ “[...] the surge in the strategic use of patents that confer market power to their holders”,¹⁹² “[...] the patent system is designed to create market power as the reward for invention”).¹⁹³

However, controversial sources confirm that the terminology is misused and has no connection to monopoly, also called the “patent=monopoly theorem”.¹⁹⁴ The problem behind it leads back to Art. 102 “Treaty on the Functioning of the European Union”¹⁹⁵ (TFEU) which prohibits abusive behavior within the international market by a party with market dominance. Referring to a patent as a monopoly right would, therefore, provoke the violation of the named regulation and question the whole concept behind the patent system.¹⁹⁶

Disregarding the correct terminology behind the patent, a natural monopoly is often confirmed.¹⁹⁷ Past issued patents demonstrate that granted patents were commercially misused and are still hindering free competition.

3.4.3 Monitoring and intervening into patent rights

Another question that arises once the patent is granted is to what far the government is allowed to or even has the power to intervene in the exclusion rights of the patent owner.¹⁹⁸

Intervention instruments are used to weaken the rights of the patent owner that allow them to exclude others from its use. Instead, which is at least the case for the two instruments following

¹⁹⁰ Steven A. Greenlaw and David Shapiro, ‘How Monopolies Form: Barriers to Entry’, in *Principles of Microeconomics 2e* (OpenStax).

¹⁹¹ C-468/06 to C-478/06, Sot. Léloukas and Others v GlaxoSmithKline ABE, [2008] ECR I-7139 (Grand Chamber, 16 September 2008), §64.

¹⁹² Joaquín Almunia Vice President of the European Commission responsible for Competition Policy, Speech at *Industrial Policy and Competition Policy: Quo Vadis Europa? New Frontiers of Antitrust 2012 – Revue Concurrances Paris, 10 February 2012* <https://ec.europa.eu/commission/presscorner/detail/en/SPEECH_12_83> [accessed 22 March 2022].

¹⁹³ Michael Baye and others, ‘The Digital Economy - 2012’, *OECD*, 2012, p. 55.

¹⁹⁴ Arnold B. Silverman, ‘Is a Patent a Monopoly? - Antitrust Considerations’, *JOM*, 56.4 (2004), p. 80; Sven Bostyn and Nicolas Petit, *Patent=Monopoly: A Legal Fiction* (Rochester, NY: Social Science Research Network, 31 December 2013), p. 3 <<https://doi.org/10.2139/ssrn.2373471>>.

¹⁹⁵ *Consolidated Versions of the Treaty on the Functioning of the European Union (TFEU) 2012/C 326/01 Signed on 13 December 2007*.

¹⁹⁶ Bostyn and Petit, p. 3.

¹⁹⁷ John F. Duffy, *Intellectual Property as Natural Monopoly: Toward a General Theory of Partial Property Rights*, 2005, p. 19.

¹⁹⁸ World Intellectual Property Organization (WIPO), ‘Climate Change and the Intellectual Property System: What Challenges, What Options, What Solutions? An Outline of the Issues: Informal Consultation Draft Only.’, pp. 28,29.

in this chapter, the exclusion rights are transformed into “*a right to reasonable remuneration*”,¹⁹⁹ in this case, revenues from licences.²⁰⁰

An existing instrument for the intervention into patent rights is compulsory licencing (CL). According to the WTO “[c]ompulsory licensing is when a government allows someone else to produce a patented product or process without the consent of the patent owner or plans to use the patent-protected invention itself”.²⁰¹ Even though CL is represented with inconsistent frequency throughout Europe, it still is used on special occasions in which the invention might be crucial for the public interest such as live-saving events.²⁰²

CL is already an existent part of international agreements such as the Paris Convention and the TRIPS Agreement,²⁰³ and is regulated further on a regional and national level.²⁰⁴ An example of an EU regulation including CL is the Biotech Directive.²⁰⁵ As for the national level, on the example of Germany, compulsory licences are a component of the patent law and are mentioned in Sec. 13 and 24 of the German Patent Act.²⁰⁶ These regulations enable to prevent abusive use of exclusion rights by allowing the government to take legislative measures in form of CL against patents.²⁰⁷

At the same time, as mentioned in Art. 12 Biotech Directive, CL can be used in favor of the patent seeker or patent owner of a biotechnological invention. Insofar, CL can also be applied for by either the patent seeker who wants to “*acquire or exploit a plant variety right*”²⁰⁸ or by a patent owner who is not able to exploit a biotechnological invention “*without infringing a prior plant variety right*”.²⁰⁹ In these cases, a compulsory licence can be granted “*for non-exclusive use of the plant variety that is protected by that right*”,²¹⁰ and insofar as it is needed “*for the exploitation of the plant variety to be protected*”.²¹¹

¹⁹⁹ Ilja Rudyk, ‘The License of Right, Compulsory Licensing and the Value of Exclusivity’, *Universitätsbibliothek Der Ludwig-Maximilians-Universität München*, 2012, p. 2.

²⁰⁰ Rudyk, pp. 1,2.

²⁰¹ World Trade Organization, ‘Compulsory Licensing of Pharmaceuticals and TRIPS’, *Wto.Org* <https://www.wto.org/english/tratop_e/trips_e/public_health_faq_e.htm> [accessed 3 April 2022].

²⁰² European Patent Office, *Compulsory Licensing in Europe A Country-by-Country Overview.*, 2019, p. 3.

²⁰³ Art. 5(A) Paris Convention; Art. 31bis TRIPS.

²⁰⁴ European Patent Office, *Compulsory Licensing in Europe A Country-by-Country Overview.*, 2019, p. 3.

²⁰⁵ European Parliament and Council of European Union, *DIRECTIVE 98/44/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 6 July 1998 on the Legal Protection of Biotechnological Inventions* (Biotech Directive).

²⁰⁶ Secs 13, 24 German Patent Act.

²⁰⁷ Art. 5(A)(2) Paris Convention.

²⁰⁸ Art. 12(1) Biotech Directive.

²⁰⁹ Art. 12(2) Biotech Directive.

²¹⁰ Ibid.

²¹¹ Art. 12(1) Biotech Directive.

However, according to Art. 31 TRIPS, every single authorization request by a possible user has to be considered individually but all of them have the requirement of prior sought unsuccessful attempts for permission from the patent owner.²¹² In cases of an emergency situation or other extreme circumstances, the requirement for sought authorization can be waived by the government.²¹³ In addition, the TRIPS Agreement does not foresee which exemptions should be implemented by the member states but it does regulate requirements for doing so. The exemptions have to be limited, should “*not unreasonably conflict with a normal exploitation of the patent and do not unreasonably conflict with a normal exploitation of the patent and do not unreasonably prejudice the legitimate interest of the patent owner*”.²¹⁴ Nevertheless, compulsory licences in general are only granted with limitations and only in compliance with legal regulations.²¹⁵

As already shortly mentioned in 3.1.2.1, another instrument for intervening in exclusion rights is the license of rights (LOR).²¹⁶ The mechanism behind the LOR is that the patent owner willingly shares their patent with everyone by declaring it to the Patent Office.²¹⁷

This regulation was included in the German law already in 1936 and is mentioned in Sec. 23 of the German Patent Act. In return for sharing the invention with anyone for a reasonable remuneration the patent owner receives a reduction on the annual renewal fees which varies from country to country.²¹⁸ For Germany, the annual fees will “*be reduced to one half*”.²¹⁹

However, the rates for patents with declared LOR are low and make up only 6% of all patents that are granted. Furthermore, the percentage is unequally distributed within different technology areas. Whereas areas such as electrical engineering constitute almost 11%, in other fields such as biotechnology only around 1% of all patents LOR are declared after their expiration. Notable is also the discrepancy between the declaring groups behind the LOR. Big companies are six times more represented than small bodies.²²⁰

The explanation behind the low representation of LOR is that the expected revenue out of the full patent protection minus the whole amount of renewal fees that need to be paid is seen, in

²¹² Art. 31(b) TRIPS.

²¹³ Art. 31(a), (b) TRIPS.

²¹⁴ Art. 30 TRIPS.

²¹⁵ European Patent Office, *Compulsory Licensing in Europe A Country-by-Country Overview.*, p. 3.

²¹⁶ Catherine Jewell and Charlotte Tilbury.

²¹⁷ Rudyk, p. 2.

²¹⁸ Catherine Jewell and Charlotte Tilbury.

²¹⁹ Sec. 23 German Patent Act.

²²⁰ Rudyk, p. 2.

most cases, as more rewarding than the revenue the patent owner would get from the compensation of declaring LOR plus the savings for the reduction of patent maintenance fees.²²¹ Reversely, this would mean that the revenues for declaring LOR need to increase for the patent owners to decide to rather share their invention than insist on full patent protection.

3.4.4 Dissemination of technology and transfer to less developed countries

An aspect which is for a long time under discussion is whether the dissemination of technology but also the transfer of technology to developing countries is possible once a patent is granted. In addition, it is also questioned what the effect on the patentee as well as other parties is if the dissemination and technology transfer do not happen fast enough or are not possible at all.

In an era where everything is evolving, technology is no longer limited to certain geographics, or at least there is a possibility of distributing technology.²²² Technology dissemination signifies the spread of an invention to other technological areas outside of the one it was invented for,²²³ as well as the internationalization and distribution of the invention across country borders.²²⁴

In general, according to the *WIPO*, it is not the patent itself that is hindering technology dissemination or transfer, but rather multiple factors and their constellation play a role in the execution of technology dissemination. In the same way, a non-existing patent system or non-existing exclusion rights do not provide for a working technology transfer mechanism.²²⁵

For the patent owner, a successful technology dissemination, as well as patent transfer to other countries, indicate an increase in revenues. Voluntary licensing guarantees the patentee high commercialization if the technology spread happens fast enough and surpasses country borders. On the contrary, a slow technology diffusion as well as only little or no distribution of the technology internationally, can lower the profit and harm the patentee.²²⁶ More importantly, even though a harmonization of the minimum standard of protection through the implementation of the TRIPS exists, patent laws can vary among different countries and provide higher protection in some and less protection in other countries. Whereas some national laws

²²¹ Rudyk, pp. 2,3.

²²² Wei Yang and others, 'Mapping the Landscape of International Technology Diffusion (1994–2017): Network Analysis of Transnational Patents', *The Journal of Technology Transfer*, 46.1 (2021), p. 139.

²²³ Petros Gkotsis and Antonio Vezzani, 'Technological Diffusion as a Recombinant Process: Evidence from Patent Data', *OECD Blue Sky Forum 'Towards the next Generation of Data and Indicators'*, 2016, p. 2.

²²⁴ Yang and others, p. 140.

²²⁵ World Intellectual Property Organization (WIPO), 'Climate Change and the Intellectual Property System: What Challenges, What Options, What Solutions? An Outline of the Issues: Informal Consultation Draft Only.', p. 30.

²²⁶ Secretariat WIPO, 'Transfer of Technology' (presented at the Standing Committee on the Law of Patents, Geneva, 2010), XIV, p. 35.

have fewer exclusions to the patentee's exclusive rights, others might have wider provisions and therefore might allow a certain use of the technology which would be regarded as an infringement in another country.²²⁷

Looking at third parties, especially developing countries seem to have difficulties profiting from transnational patents and globalization, says *Peri*. Even though the patent would underly a technology transfer agreement in their country which allows them theoretically to access the information relating to the manufacture of that product or process, low developed countries with a lack of financial mediums and the absence of or far distance from educational facilities do not have the means to improve their technological status.²²⁸ On the other hand, *Xu* and *Chiang* claim the opposite by saying that countries with a low or middle income seem to benefit from transnational patents the most as they do not have enough domestic technological inventions.²²⁹ Taken this thought further, it can be speculated that there is a dependency of developing countries on developed countries' technological research and development. However, as *Peri* stated, further indicators need to be considered to successfully enable countries without their own resources to profit from transnational patents such as know-how and financial support. Moreover, the *WIPO* claims that to perform a technology transfer a patent can be used in different forms and should be adjusted to the receiving market.²³⁰

Another facet of this topic leads back to the technology use which is highly influenced by the decisions of the patent owner.²³¹ Whereas patents, in general, contribute to innovation, they at the same time hinder technology diffusion if the patent owner exercises its exclusion rights to their fullest.²³² Reversely, this means that technology dissemination and transfer are dependent on the patentee's willingness to share the technology through licences or the government's interventions through compulsory licences.

²²⁷ Secretariat WIPO, XIV, pp. 39–41.

²²⁸ Giovanni Peri, 'Knowledge Flows, R&D Spillovers and Innovation' (presented at the ZEW Discussion Papers, Zentrum für Europäische Wirtschaftsforschung (ZEW), 2003).

²²⁹ Bin Xu and Eric P Chiang, 'Trade, Patents and International Technology Diffusion', *The Journal of International Trade & Economic Development*, 14.1 (2005), p. 131.

²³⁰ World Intellectual Property Organization (WIPO), 'Climate Change and the Intellectual Property System: What Challenges, What Options, What Solutions? An Outline of the Issues: Informal Consultation Draft Only.', p. 31.

²³¹ See chap. 3.4.1.

²³² OECD, 'Patents and Innovation: Trends and Policy Challenges' (OECD, 2004), p. 9.

4 Achieving climate neutrality by protecting green inventions through patents

Within this chapter requirements needed for achieving progressive climate neutrality are determined. To identify what necessary requirements are, the climate neutrality goals described under 2.1.3, the UNFCCC, the European Green Deal which serves as a Climate Neutrality Action Plan within the EU as well as the European Climate Law and the German Federal Climate Change Act is used and the requirements for climate neutrality derived from. The focus is not only on Europe in general but also on Germany as a specific European country. Once the requirements are ascertained, the next step focuses on the comparison of the requirements for progressive climate neutrality to patent processes and features within the EU. By doing this, the suitability of the patent system, its processes, and features as such for achieving climate neutrality can be evaluated.

4.1 Requirements for achieving progressive climate neutrality

Orientating closely on the European Green Deal, which represents the NDCs of Europe demanded by the Paris Agreement, and the corresponding European as well as German legal regulations, which are based on the goals within the European Green Deal, requirements for progressive climate neutrality are identified. Such requirements are short notice actions, a functioning market competition, the representation, and increase of environmentally green features in new inventions, the worldwide accessibility of green technologies, the assurance of high quality and working green technologies, affordable product protection as well as the traceability of climate mitigation advances.

4.1.1 Short notice actions

All underlying documents, the European Green Deal, the European Climate Law, and the German Federal Climate Change Act are stating fixed goals. These goals do not only reflect a climate-neutral Europe but also a timeline manifesting the date the goals should be reached.²³³

As for the European Green Deal, the estimated climate neutrality should be reached in 2050. The European Climate Law is the representation of the European Green Deal and the legal

²³³ European Commission, ‘Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions: The European Green Deal’; Council of the European Union, European Parliament; *Federal Climate Change Act of 12 December 2019 (Federal Law Gazette I, p. 2513)*, as Last Amended by Article 1 of the Act of 18 August 2021 (*Federal Climate Change Act*), 2021.

enforcement of the goals within it.²³⁴ Therefore, the European Climate Law aims at the same goal of Europe being climate neutral until 2050. The German Federal Climate Change Act, however, is the transcription of the European Climate Law into national law. Here, the German Federal government targets climate neutrality by 2045 which is an even stricter goal than foreseen in the European Climate Law. A similarity between all documents is that they aim for their first milestone in 2030. Whereas the European Green Deal but more explicitly the European Climate Law intend to reduce GHG emissions by 55% until then,²³⁵ the German Federal Climate Change Act targets an emission reduction by at least 65%.²³⁶ The Federal Climate Change Act indicates another due date which is in 2040. Until then, Germany plans to reduce GHG emissions by at least 88%.²³⁷ In the European Climate Law, the goals for 2040 are still under discussion and will be recorded in the Union 2040 climate target.²³⁸

To reach the goals for 2030 and 2040 as well as 2045 or 2050, climate-positive measures need to be taken. The European Green Deal proposes, inter alia, an increase in renewable energy, a clean economy, and a change in construction, the food system as well as in the mobility section to more environmentally sound procedures and products.²³⁹ The Federal Climate Change Act suggests an emission reduction in the same sectors.²⁴⁰ All these goals should be reached through a transformation of the economy within the EU.²⁴¹ Even though other factors such as the restructuring of the values as well as beliefs towards climate mitigation and adaptations to policies are contributing to the success of the transformation, the European Commission does mention that there is a need for investment into “*digital transformation and tools*”.²⁴²

This is where CCMT as well as climate change adaptation technologies (CCAT) play an important role.²⁴³ They not only need to be developed as soon as possible but also require time to be implemented by all European countries and, further on, worldwide. However, the duration for research, investment, and development of new technologies differs in all technology fields.

²³⁴ European Commission, ‘Climate Action: European Climate Law’ <https://ec.europa.eu/clima/eu-action/european-green-deal/european-climate-law_en> [accessed 6 November 2021].

²³⁵ Art. 2(1) European Climate Law.

²³⁶ Sec. 3(1)(1) Federal Climate Change Act.

²³⁷ Sec. 3(1)(2) Federal Climate Change Act.

²³⁸ Art. 4(3) European Climate Law.

²³⁹ European Commission, ‘Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions: The European Green Deal’, p. 3.

²⁴⁰ Sec. 4(1) Federal Climate Change Act.

²⁴¹ European Commission, ‘Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions: The European Green Deal’, p. 4.

²⁴² Ibid.

²⁴³ Further defined in chap. 4.1.2.

²⁴⁴ That is also why there is an IPR system in place, to support and reward the researcher for the time and financial means invested into the research and development of new technology. The same applies to the implementation of these technologies which depends on the company size and the implementation area. However, what is certain is that impact assessments and environmental studies take between 51 days to 18.4 years which makes up an average of 3.4 years per assessment/study.²⁴⁵ After the research phase follows the product development and the implementation of the product which again takes some time. The duration of the product development depends on the product that is developed. If the design of an existing product is slightly changed, the development may be around 3 months. The development of greenfield products or the execution of major technological changes in existing technologies can, however, take up to 12 months.²⁴⁶ Product complexity, product compilation and parts, internal company communication, technology novelty, and team efficiency or efficiency of subcontractors are decisive and can add up additional product development duration.²⁴⁷ Therefore, short-notice and fast actions are necessary to reach the climate mitigation commitments. These short-notice actions can be reached through a flexible patent system, adopting its patent application process duration to certain pressing situations or even whole technology fields, while boosting technology at the same time. Additional incentives outside of the patent system might be, however, necessary as well, which is mentioned in more detail in chapter five.

4.1.2 Representation and increase of environmentally sound features in new inventions

As described under 4.1.1, the earliest estimated goal for 2030 is to have a reduction of GHG emissions by a minimum of 55% according to the European Climate law and by 65% according to the Federal Climate Change Act.²⁴⁸ From a timely perspective, this can take up to several years, depending on the product or process.

To reach the timely goals new technologies need to, in addition to being developed as soon as possible, represent green features.²⁴⁹ As mentioned in previous chapters, green technologies can

²⁴⁴ Piet deWitt and Carole A. deWitt, ‘Research Article: How Long Does It Take to Prepare an Environmental Impact Statement?’, *Environmental Practice*, 10.4 (2008), 164–74 (p. 164).

²⁴⁵ Ibid.

²⁴⁶ Mario, ‘How Long Does It Take to Develop a New Product? | Cad Crowd’, *Cadcrowd.Com*, 2019 <<https://www.cadcrowd.com/blog/how-long-does-it-take-to-develop-a-new-product/>>.

²⁴⁷ Michael Edwin Ayre, ‘How Long Does It Take to Develop a New Product?’, *CrucibleDesign.Co.Uk*, 2019 <<https://www.crucibleDesign.co.uk/blog/how-long-does-it-take-to-develop-a-new-product-2.php>> [accessed 13 March 2022].

²⁴⁸ Art. 2(1) European Climate Law; Sec. 3(1)(1) Federal Climate Change Act.

²⁴⁹ European Commission, ‘Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions: The European Green Deal’, p. 3.

be distinguished in CCMT and CCAT.²⁵⁰ Green technologies, also referred to as environmental technologies can have two purposes. The first one is to contribute to climate mitigation and the second one to prepare for climate change consequences.²⁵¹ As Tompkins states, CCAT can lower the risks against climate changes and, therefore, stabilize as well as secure human capital and goods.²⁵²

Not only is it crucial that new technologies represent green features so the environment can be protected and the GHG emissions cut but also an active increase in environmentally sound features within new technologies should be aimed. It is substantial to understand the main issues that are hindering a fast increase in sustainable technologies. The risks following new environmentally sound technologies are unclear as no historical data sets exist. Thus, companies investing in green technologies may need to bear risky investments without receiving appropriate security from the capital market.²⁵³ Private investors, on the other hand, usually do not have sufficient encouragement and knowledge compared to bigger entities to invest in extensive development which leads to a higher risk.²⁵⁴ Another point are existing substitutes for green technology products. Regular non-green products and technologies have been in place a long time before regulations supporting the environment existed. Their present market advantage as well as their interweaving into existing infrastructure makes it more difficult for green technologies to gain a high market reputation.²⁵⁵ Therefore, governmental and further supportive incentives are necessary to boost green technology inventions and enable investment willingness, addressed thoroughly in chapter five.

4.1.3 Functioning market competition

Especially end-consumers profit from free competition.²⁵⁶ As they have the opportunity to decide between multiple market players, they choose products that have the highest price-

²⁵⁰ See chapters 2.3, 4.1.1.

²⁵¹ Kerstin Hötte, Su Jung Jee, and Sugandha Srivastav, 'Knowledge for a Warmer World: A Patent Analysis of Climate Change Adaptation Technologies', *ArXiv:2108.03722 [Econ, q-Fin]*, 2021, p. 3 <<http://arxiv.org/abs/2108.03722>> [accessed 13 March 2022].

²⁵² Emma L. Tompkins and others, 'Adapting to Change: People and Policies', in *Deltas in the Anthropocene* (Palgrave Macmillan, Cham, 2020), pp. 206,207.

²⁵³ Patrik Söderholm, 'The Green Economy Transition: The Challenges of Technological Change for Sustainability', *Sustainable Earth*, 3.1 (2020), p. 4; see also Peter Newell, *Globalization and the Environment: Capitalism, Ecology and Power* (Cambridge: Cambridge University Press, 2012).

²⁵⁴ Paul Lehmann and Patrik Söderholm, *Can Technology-Specific Deployment Policies Be Cost- Effective? The Case of Renewable Energy Support Schemes* (Leipzig: Helmholtz-Zentrum für Umweltforschung (UFZ), 2016), pp. 10–18.

²⁵⁵ W. Brian Arthur, 'Competing Technologies, Increasing Returns, and Lock-In by Historical Events', *The Economic Journal*, 99.394 (1989), pp. 116,117.

²⁵⁶ Federal Ministry for Economics Affairs and Climate Action, 'Protecting Free Competition', *Bmwi.De* <<https://www.bmwi.de/Redaktion/EN/Dossier/competition-policy.html>> [accessed 12 March 2022].

performance. That way, competing companies are not only animated to offer high-quality products but are forced to provide fair pricing as well as reasonable or lower prices than the competitors. In particular, competition policies prevent arrangements between companies as well as agreements on fixed prices.²⁵⁷

However, not only the customer takes advantage of functioning market competition, but it also contributes to technological progress. Due to existing competition, enterprises are automatically encouraged to improve their services and product. This often results in technological advances which benefit economic growth and employment.²⁵⁸

Monopolies and anti-competition, on the contrary, would lead to a rise in prices which would not only pressure consumers to buy from one particular supplier but would also hinder affordable access and therefore dissemination of technology. Peculiarly for the development and diffusion of green technologies, it would mean that it would harm the increase in innovation and the adaptation of existing technologies to climate mitigation.

Therefore, to ensure constant research and development of green technologies, free market competition must be secured and is inevitable. In addition, natural monopolies, as they prevail within the patent system, must be balanced as well as intervening measures, such as compulsory licences,²⁵⁹ taken, if necessary.

4.1.4 Worldwide accessibility and usability of new green technologies

In the last centuries since the industrial revolution began, technical advances happened in some parts of the world whereas other geographical destinations did not succeed in adapting to the technological changes due to their location or cultural circumstances. Countries which successfully applied the technological knowledge were able to stand out from other countries that could not. Not only did their average salary per person increase but also the overall living standard did noticeably expand.²⁶⁰ This could further be an obstacle when it comes to the implementation of climate change measures.

²⁵⁷ European Commission, 'Competition Policy: Antitrust', *Ec.Europa.Eu* <https://ec.europa.eu/competition-policy/antitrust_en> [accessed 12 March 2022].

²⁵⁸ Federal Ministry for Economics Affairs and Climate Action, 'Protecting Free Competition', *Bmwi.De* <<https://www.bmwi.de/Redaktion/EN/Dossier/competition-policy.html>> [accessed 12 March 2022].

²⁵⁹ Art. 31 TRIPS already foresees CL but the implementation of CL into national law and the execution of it must be promoted within the individual member states; see more detailed in chap. 5.

²⁶⁰ UNCTAD Secretariat, UN Department of Economic and Social Affairs, and WIPO International Bureau, *The Role of the Patent System in the Transfer of Technology to Developing Countries: Report / Prepared Jointly by the United Nations Department of Economic and Social Affairs, the UNCTAD Secretariat and the International Bureau of the World Intellectual Property Organization* (New York: UN, 1975), p. 31.

This was also recognized by the UNFCCC, which is the origin of all further climate change documents and action plans. It is mentioned that there exists a common responsibility of all committed parties to engage in and reach climate mitigation but, at the same time, a differentiation in roles is made. The main responsibility, however, is imposed on OECD members that joined in 1992, also represented as developed countries. Together with EIT countries, as mentioned in Annex 1 UNFCCC, they have to actively develop their own national climate change policies and shrink their GHG emissions.²⁶¹ At the same time, developing countries should be involved in the process of transforming climate mitigation measures through financial support from developed countries parties of the UNFCCC (mentioned in Annex 2).²⁶² In addition, Annex 2 countries should give financial aid to developing countries to implement CCAT.²⁶³ Furthermore, especially the transfer to and the access by developing countries need to be ensured. The UNFCCC foresees developed countries to offer financial means, existing know-how as well as transfer facilitation procedures if countries possess the ability and mediums for doing so.²⁶⁴

It is not mentioned who should develop climate change technologies but as developing countries do not have the financial resources or educational institutions to implement technologies, they consequently also do not have the required financial position for investments into research and development of CCAT or CCMT.²⁶⁵ The report by the UN about the role of the patent system in the transfer of technology to developing countries confirms that developing countries only hold 1% of all patents granted for technologies which demonstrates their reliance and dependence on the technological development of more developed countries.²⁶⁶ In addition, the UNFCCC mentions that the successful implementation of climate change measures in developing countries depends on the realization of the commitments according to the UNFCCC by developed countries.²⁶⁷

It is undeniable that reaching climate net-zero requires the participation and implementation of climate mitigation commitments by all countries. With the help of more developed countries, developing countries can be supported by transferring climate change technologies. However, in some countries such as Iran, Indonesia, and Venezuela, subsidies imposed on fossil fuel

²⁶¹ Art. 4(2) UNFCCC.

²⁶² Art. 4(3) UNFCCC.

²⁶³ Art. 4(4) UNFCCC.

²⁶⁴ Art. 4(5) UNFCCC.

²⁶⁵ See also Giovanni Peri.

²⁶⁶ UNCTAD Secretariat, UN Department of Economic and Social Affairs, and WIPO International Bureau, pp. 33–42.

²⁶⁷ Art. 4(7) UNFCCC.

usage may cause a higher burden for the realization of climate mitigation,²⁶⁸ say *Copenhagen Economics* and *The IPR Company* - thus, require special consideration.²⁶⁹

4.1.5 Further requirements

Besides the main requirements for climate mitigation mentioned in the previous subchapters, additional minor but evident requirements might be of high importance to facilitate the process of achieving progress in climate mitigation. Such requirements are the assurance of high quality and working green technologies, affordable product protection, as well as the traceability of climate mitigation advances, to ideally tighten up, loosen or change climate mitigation measures. These requirements play, inter alia, a role in chapter five.

4.2 Comparison of requirements for achieving progressive climate neutrality to the patent processes and features within the EU

This section provides the worked-toward outcome of the thesis by taking the findings of previous chapters and subsuming them in this comparison. This chapter takes up the topic of the patent, its granting process, and features within the EU as well as parts of its history to contrast them with the requirements needed to achieve progressive climate neutrality according to the EU and German climate mitigation documents as well as the UNFCCC climate neutrality plan. The aim is to find out whether the patent system is suitable to promote and protect green technologies effectively, what the patent system's advantages are but also which imperfections it bears specifically for climate mitigation. It also constitutes the base for chapter five in which adaptations to the patent system are proposed.

Starting with the positive aspects of patents, their main goal is to enhance innovation. Therefore, the patent system provides inventors with a “suitable”²⁷⁰ reward for their investment in the research and development of new processes or products.²⁷¹ In the same way as the European patent system is seen as a boost amplifier for technologies in each technology field,²⁷² it could

²⁶⁸ Copenhagen Economics and The IPR Company, *Are IPR a Barrier to the Transfer of Climate Change Technology?* (European Commission (DG Trade), 19 January 2019), pp. 32,33.

²⁶⁹ Bronwyn Hall and Christian Helmers, ‘The Role of Patent Protection in (Clean/Green) Technology Transfer’, *Voxeu.Org*, 2010 <<https://voxeu.org/article/intellectual-property-and-climate-change>> [accessed 27 March 2022].

²⁷⁰ Suitable in that regard that the reward of the patent exclusivity and the expected earnings are higher than the expenditures for the research, development and patent application process.

²⁷¹ Philippe Braunstein, ‘À l’origine Des Privilèges d’invention Aux XIVe et XVe Siècles’, in *Les Brevets. Leur Utilisation En Histoire Des Techniques et de l’économie*, Paris, Centre de Recherche En Histoire de l’innovation (Paris: Centre de recherche en histoire de l’innovation, 1984); World Intellectual Property Organization (WIPO), ‘Climate Change and Intellectual Property’, *WIPO* <https://www.wipo.int/policy/en/climate_change/index.html> [accessed 6 December 2021].

²⁷² Especially in the fields of biotechnology and Information and Communications Technology an enormous increase can be seen since 1995. Particularly in the countries Sweden, Finland and Germany were highlighted as

be used for climate mitigation measures to guarantee new green technologies. Such green technologies are needed for the climate neutrality goals to function and would, through the patent's reward function, stimulate to some extent the representation of green technologies.²⁷³

Moreover, the patentability assessment of new inventions ensures that only high-quality technologies which are beneficial to society are granted a patent. As mentioned in chapter 3.1, the new invention has to at least fulfill three basic criteria for being patentable, inter alia the inclusion of an inventive step.²⁷⁴ This also means that the invention must present a solution to an existing problem that is not obvious to someone skilled in the same art.²⁷⁵ To improve an existing product or provide a solution, the functionality of the product or process is presupposed as well.²⁷⁶ The patentability criteria have the purpose of guaranteeing that only significant inventions and technologies of value are qualified enough to receive a patent. This feature of the patent process might be very helpful for green technologies to ensure their performance in achieving climate mitigation which is why it is one of the requirements for achieving progressive climate neutrality as stated in chapter 4.1.5.

A further benefit that the patent system presents is its transparency. Even though it is not a direct requirement for achieving progressive climate neutrality, tracking the progress of new green technologies might influence the achievement of the climate goals positively.²⁷⁷ As all inventions are uploaded into a public database 18 months after their patent application passes its filing date, the government can trace the current development status of green technologies.²⁷⁸ This leads to a better overview of the advancement of the climate mitigation commitments. Later on, if the inventor decides to proceed with the application and receives a patent for their invention, the granting decision is published in the European Patent Bulletin.²⁷⁹ The publication enables further interested inventors or the populace, in general, to be informed about the innovative ongoings and even be inspired to improve the published inventions or develop something completely new.

those with the most increase in ICT; OECD, 'Patents and Innovation: Trends and Policy Challenges' (OECD, 2004), pp. 12,13.

²⁷³ World Intellectual Property Organization (WIPO), 'Climate Change and Intellectual Property', *WIPO* <https://www.wipo.int/policy/en/climate_change/index.html> [accessed 6 December 2021].

²⁷⁴ Art. 52(1) EPC.

²⁷⁵ Art. 56 EPC.

²⁷⁶ Government of the Netherlands, 'What Are the Criteria for Patenting My Invention?', *Government.NL* <<https://www.government.nl/topics/intellectual-property/question-and-answer/what-are-the-criteria-for-patenting-my-invention>> [accessed 4 February 2022].

²⁷⁷ See chap. 4.1.5.

²⁷⁸ Art. 93(1) EPC.

²⁷⁹ Art. 97(3) EPC.

Despite the prevailing benefits of the patent system for climate mitigation, it also has its imperfections. As stated before, the patent system can boost technologies and might influence the representation of green technologies positively.²⁸⁰ However, it remains questionable whether the patent system is even the right instrument to assess green technologies and therefore, should boost them. Even though generally, there is a functioning mechanism to assess the patentability of inventions and, therefore, ensure the technology's added value to the society,²⁸¹ the question arises whether the criteria within the patentability assessment are enough for all kinds of inventions.²⁸² Focusing on the exceptions to patentability mentioned in Art. 53 EPC, especially the morality aspect seems to receive insufficient recognition.²⁸³ Whereas morality is often discussed in connection with morally controversial biotechnological inventions, climate change technologies touch on the aspect of morality as well.²⁸⁴ Their existence or non-existence, functionality, and proper execution influence the survival of existing and future generations.²⁸⁵ However, whether an invention is morally controversial or not is not assessed within the scope of the patentability assessment.²⁸⁶ As a matter of fact, a patent is granted if the criteria of novelty, inventive step, and susceptibility of all industries are fulfilled paying little attention to the applicability of the patentability exceptions. Even though morality is mentioned as an exception to the patentability of inventions,²⁸⁷ it is not executed in practice.²⁸⁸ In this respect, the patent system, as it is, might not be the ideal instrument for respecting the climate mitigation technologies' special characteristics.

Furthermore, regardless of the innovation promotive purpose of the patent system, some features connected to the patent are hindering, even if unintentionally, innovation. One of these features is the naturally formed monopoly caused by patents.²⁸⁹ It does not only allow patentees to dictate prices but also hinders free competition as only the patent owner possesses the

²⁸⁰ OECD, 'Patents and Innovation: Trends and Policy Challenges' (OECD, 2004), pp. 12,13.

²⁸¹ Through novelty, the inventive step and susceptibility of all industries; see chap. 3.1.

²⁸² Regarding the exception to patentability mentioned in Art. 53(a) TRIPS.

²⁸³ Travaux Préparatoires (EPC 1973), 'Meeting on 18 April 1961, IV/2767/61-E', p. 7, Maureen O'Sullivan, *Biotechnology, Patents and Morality: A Deliberative and Participatory Paradigm for Reform* (New York and Abingdon: Routledge, 2019), pp. 14,52.

²⁸⁴ Ed Silverman, 'The 5 Most Pressing Ethical Issues in Biotech Medicine', *Biotechnology Healthcare*, 1.6 (2004), pp. 41–46; Stephen M. Gardiner, 'Ethics and Global Climate Change', *Ethics*, 114.3 (2004), p. 556; Grubb, 'Seeking Fair Weather: Ethics and the International Debate on Climate Change', *International Affairs*, 71.3 (1995), pp. 472,473.

²⁸⁵ Grubb, pp. 472,473.

²⁸⁶ Art. 52(1) EPC.

²⁸⁷ Art. 53(a) EPC.

²⁸⁸ Maureen O'Sullivan, *Biotechnology, Patents and Morality: A Deliberative and Participatory Paradigm for Reform* (New York and Abingdon: Routledge, 2019), p. 14; Travaux Préparatoires (EPC 1973), 'Meeting on 18 April 1961, IV/2767/61-E', p. 7.

²⁸⁹ See chap. 3.4.2.

decision right about the invention's disposal.²⁹⁰ This leads to the second aspect, the exclusivity of the patent rights.²⁹¹ Exclusive patent rights give the right holder of the invention the possibility to exclude others from using or reproducing the invention.²⁹² However, some instruments such as CL are already used by the government for reasons concerning public interest, are providing a mechanism to restrain the patent owner's exclusive rights.²⁹³ Nevertheless, these are often only used in cases where the invention might be necessary for medical health reasons of the population.²⁹⁴ Moreover, the natural monopoly might be a burden for climate mitigation as one of the requirements for achieving progressive climate mitigation is functioning and free market competition.²⁹⁵ Whenever there is the possibility of competition, motivation exists to keep up with competitors, offer affordable pricing, improve the invention in place, or even produce new and better products. Only a functioning market competition can ensure constant growth and development of green technologies.²⁹⁶

Another challenge constitutes the duration of the patent application process. All in all, the length of the process from the very beginning until the patent grant takes between three and four years with the possibility of delay due to patentability examination remarks, the right holder's defense, following changes to the invention as well as public oppositions, followed by required amendments to the invention.²⁹⁷ However, in the end, it can be decided that the invention is not eligible for a patent which would be a huge financial loss and would cause the technology not to have any protection in the end.²⁹⁸ An important requirement for achieving climate neutrality, however, is short notice actions for the development and use of green technologies.²⁹⁹ All previously discussed mitigation documents, hereunder the UNFCCC, the European Green Deal together with the European Climate Law and the German Federal Climate Law, have timely set

²⁹⁰ Jean-Baptiste Say, *A Treatise on Political Economy; or the Production, Distribution, and Consumption of Wealth*, 1803, bk. I, chap. XVII; Frederic M. Scherer, *Innovation and Growth: Schumpeterian Perspectives*, 1984; Suzanne Scotchmer, 'Standing on the Shoulders of Giants: Cumulative Research and the Patent Law', *Journal of Economic Perspectives*, 5.1 (1991), p. 29; Edward H. Chamberlin, *The Theory of Monopolistic Competition*, 1937.

²⁹¹ See chap. 3.4.1.

²⁹² Art. 28(1) TRIPS; Sec. 10(1) Federal Patent Act.

²⁹³ See chap. 3.4.3.

²⁹⁴ European Patent Office, *Compulsory Licensing in Europe A Country-by-Country Overview.*, 2019, p. 3.

²⁹⁵ See chap. 4.1.3;

²⁹⁶ Federal Ministry for Economics Affairs and Climate Action, 'Protecting Free Competition', *Bmwi.De* <<https://www.bmwi.de/Redaktion/EN/Dossier/competition-policy.html>> [accessed 12 March 2022].

²⁹⁷ See chap. 3.3; European Patent Office, 'The Patenting Process' <<https://www.epo.org/learning/materials/inventors-hand-book/protection/patents.html>> [accessed 2 January 2022].

²⁹⁸ Ibid.

²⁹⁹ See chap. 4.1.1.

goals.³⁰⁰ More specifically, the majority aims to record the first milestone in 2030, even though some are more ambitious than others.³⁰¹ The average time of 3.4 years that it takes for impact assessments and environmental studies added up with the product development which can take up to a year, depending on the product complexity, leaves already little time to implement the climate mitigation goals.³⁰² Another three to four years for the patent application process would only delay the progress in achieving climate neutrality instead of facilitating it.

In addition, it can be confirmed that the patent system with its reward system enhances innovation and with it, to some extent the representation of new, maybe even green technologies.³⁰³ However, the patent system might not be a suitable instrument for boosting the increase of green features within new technologies. This is simply because the patent system has no such feature which dictates which inventions to develop. Another problem that cannot necessarily be influenced by the patent system, except patenting fees,³⁰⁴ is high costs for the research & development of new green technologies. Added up with the uncertainty of green technologies, this makes an investment in such technologies rather unattractive because of their unpredictable risk.³⁰⁵ It is, however, conceivable that new regulations are passed which require to invent technologies that include green features and permit exceptional, faster, as well as cheaper access to patent rights.³⁰⁶

Lastly, the worldwide dissemination of green technologies and the transfer of them to developing countries are further requirements for achieving progressive climate neutrality.³⁰⁷ The UNFCCC explicitly differentiates between developed and developing countries and foresees a responsibility of developed countries to support less developed ones.³⁰⁸ At the same

³⁰⁰ See chapters 2.1.3 & 4.1.1; European Commission, ‘Climate Action: European Climate Law’ <https://ec.europa.eu/clima/eu-action/european-green-deal/european-climate-law_en> [accessed 6 November 2021].

³⁰¹ Art. 2(1) European Climate Law; Sec. 3(1)(1) Federal Climate Change Act.

³⁰² Piet deWitt and Carole A. deWitt, ‘Research Article: How Long Does It Take to Prepare an Environmental Impact Statement?’, *Environmental Practice*, 10.4 (2008), p. 164; Mario, ‘How Long Does It Take to Develop a New Product? | Cad Crowd’, *Cadcrowd.Com*, 2019 <<https://www.cadcrowd.com/blog/how-long-does-it-take-to-develop-a-new-product/>>.

³⁰³ Philippe Braunstein, ‘À l’origine Des Privilèges d’invention Aux XIVE et XVe Siècles’, in *Les Brevets. Leur Utilisation En Histoire Des Techniques et de l’économie*, Paris, Centre de Recherche En Histoire de l’innovation (Paris: Centre de recherche en histoire de l’innovation, 1984); World Intellectual Property Organization (WIPO), ‘Climate Change and Intellectual Property’, *WIPO* <https://www.wipo.int/policy/en/climate_change/index.html> [accessed 6 December 2021]; OECD, ‘Patents and Innovation: Trends and Policy Challenges’ (OECD, 2004), pp. 12,13; World Intellectual Property Organization (WIPO), ‘Climate Change and Intellectual Property’, *WIPO* <https://www.wipo.int/policy/en/climate_change/index.html> [accessed 6 December 2021].

³⁰⁴ As they are regulated in the EPC.

³⁰⁵ Patrick Gattari, ‘The Role of Patent Law in Incentivizing Green Technology’, *Northwestern Journal of Technology and Intellectual Property*, 11.2 (2013), p. 43.

³⁰⁶ *Ibid*, pp. 41,42.

³⁰⁷ See chap. 4.1.4.

³⁰⁸ Art. 4 UNFCCC.

time, all signing parties recognize that it takes the commitment of all countries to achieve climate neutrality.³⁰⁹ Developing countries seem to verifiably struggle to improve their technological level even though there might be a possibility to access the new technology.³¹⁰ Their low financial status and the absence of knowledge or educational institutions simply hinder them to develop.³¹¹ The WIPO states that it is not the deficiencies of the patent system or its absence in some countries that is hindering a successful technology transfer but rather multiple other factors such as financial means and learning opportunities.³¹² Therefore, in this regard, the patent system cannot be evaluated or titled as suitable or not to pursue a worldwide knowledge or technology transfer. In fact, it is the obligation of more developed countries to financially support less developed ones and the task of the government to enable the financial stability of developed countries as well as guide developed countries through the commitments.³¹³

The patent system possesses many helpful features such as the purpose to increase innovation, the reward function, and the quality assurance due to the patentability assessment. However, these features are only helpful for some technology fields. To combat climate change by boosting and protecting green technologies, the patent system, as it is, is not the right instrument. This is, on one side, because its patentability assessment does not consider the green technologies' special morality-influential characteristics. On the other side, the patent application process' duration, as well as its costs, hinder from taking short notice actions and investing in new green technologies which are needed for reaching progressive climate mitigation. In addition, the natural monopoly which patents form prevents free market competition. Therefore, adaptations to the patent system are suggested in chapter five. Further supporting incentives surrounding the patent system are inevitable. At the same time, the increase and the investment in green technologies is not only depending on governmental measures and supporting regulations but governmental-independent capital and engagement as well.

³⁰⁹ Art. 4 UNFCCC

³¹⁰ Giovanni Peri, 'Knowledge Flows, R&D Spillovers and Innovation' (presented at the ZEW Discussion Papers, Zentrum für Europäische Wirtschaftsforschung (ZEW), 2003).

³¹¹ Ibid.

³¹² World Intellectual Property Organization (WIPO), 'Climate Change and the Intellectual Property System: What Challenges, What Options, What Solutions? An Outline of the Issues: Informal Consultation Draft Only.', p. 30.

³¹³ Art. 4(4), (5) UNFCCC.

5 Proposed adaptations of the patent system and its surroundings to green technologies

As seen in chapter four, the patent system is a great instrument to protect and boost technologies in some technology fields.³¹⁴ For other technology fields, inter alia green technologies, the patent system, however, demonstrates shortcomings within its processes and features. These shortcomings, which were discussed in detail in the final part of chapter four, are addressed shortly again in this chapter to propose adaptations to the imperfections of the patent system's features and processes. In addition, further supporting incentives are suggested which would supplement the climate mitigation commitments beyond the patent system. For the suggestion of changes to the patent systems, parallels are drawn to biotechnological inventions as emergency situations are foreseen and have been executed in this specific technology field as well.

5.1 Climate change as exception ground to exclusive rights or as reason for other use

One of the listed complications of the patent system for green technologies is the patent's natural monopoly. At the same time, monopoly leads to price dictation and implies high licence purchase costs from a third-party perspective.³¹⁵ A suggested solution is for member states to consider climate change as a ground for exceptions to conferred rights under Art. 30 TRIPS or to declare climate change an emergency situation under Art. 31(b) TRIPS.

Even though it is in the interest of the European Patent Convention to sustain the interests of the patent owner and balance the rights of the patentee and further third parties,³¹⁶ member states of the TRIPS Agreement can independently decide about exemptions to restrict the exclusive rights of the patent. Even though the TRIPS Agreement does not foresee which exemptions to implement, it does, however, regulate further requirements for doing so. The exemptions have to be limited, should “*not unreasonably conflict with a normal exploitation of the patent and do not unreasonably conflict with a normal exploitation of the patent and do not unreasonably prejudice the legitimate interest of the patent owner*”.³¹⁷

³¹⁴ Especially ICT and biotechnology, OECD, ‘Patents and Innovation: Trends and Policy Challenges’ (OECD, 2004), pp. 12,13.

³¹⁵ Jean-Baptiste Say, *A Treatise on Political Economy; or the Production, Distribution, and Consumption of Wealth*, 1803, bk. I, chap. XVII; Federal Ministry for Economics Affairs and Climate Action, ‘Protecting Free Competition’, *Bmwi.De* <<https://www.bmwi.de/Redaktion/EN/Dossier/competition-policy.html>> [accessed 12 March 2022].

³¹⁶ Arts 28, 30 TRIPS.

³¹⁷ Art. 30 TRIPS.

Thinking further, member states could consider climate change a ground for such exemptions of exclusive rights. That way, it could be decided that inventions that help in combatting climate change could be used by third parties without prior authorization of the patent owner for this very and only reason.³¹⁸ However additional research on the terms and scope of such exemption requires further research and are be considered further within this thesis.

In addition to the provided exceptions in national laws according to Art. 30 TRIPS, Art. 31 TRIPS allows for further use of the patent without the authorization of the right holder. Instead, national competent courts decide whether a compulsory licence should be granted to a third party, or an invention should be used because of public interest.³¹⁹ As already stated in chapter three, compulsory licensing is a measure of the government to intervene in the exclusive rights of the patent owner. More concretely, in the process of compulsory licensing, the “*government allows someone else to produce a patented product or process without the consent of the patent owner or plans to use the patent-protected invention itself*”.³²⁰ Such occasions are exceptional, underly several requirements, and are restricted in their issuing and duration.³²¹ Not only should the authorization for the use of a patent be considered individually for every case but prior attempts by the third party should have been made unsuccessfully to receive the permission from the patent owner to use the invention “*on reasonable commercial terms and conditions*”^{322, 323} However, the requirement of prior sought authorization by the possible user can be waived by the government in emergency situations “*or other circumstances of extreme urgency*”.³²⁴

Compulsory licensing has been mainly used for pharmaceuticals - especially in countries with low public health standards or with the need for certain pharmaceuticals are profiting from the medicines export to their country.³²⁵ Its legal grounds can be found outside of the TRIPS for Germany in Section 24 of the German Patent Act which is the implementation of the TRIPS

³¹⁸ World Trade Organization, ‘The WTO TRIPS Agreement - A Practical Overview for Climate Change Policymakers*’ (wto.org, 2010), pp. 7,8 <https://www.wto.org/english/tratop_e/trips_e/ta_docs_e/8_3_overviewclimatechange_e.pdf> [accessed 20 April 2022].

³¹⁹ Art. 31(a), (b) TRIPS.

³²⁰ World Trade Organization, ‘Compulsory Licensing of Pharmaceuticals and TRIPS’, *Wto.Org* <https://www.wto.org/english/tratop_e/trips_e/public_health_faq_e.htm> [accessed 3 April 2022].

³²¹ Art. 31(c) TRIPS; European Patent Office, *Compulsory Licensing in Europe A Country-by-Country Overview*, 2019, p. 3; Ilja Rudyk, ‘The License of Right, Compulsory Licensing and the Value of Exclusivity’, *Universitätsbibliothek Der Ludwig-Maximilians-Universität München*, 2012, pp. 1,2.

³²² Art. 31(b) TRIPS.

³²³ Art. 31(a), (b) TRIPS.

³²⁴ Art. 31(b) TRIPS.

³²⁵ ‘WTO | Intellectual Property (TRIPS) - TRIPS and Public Health: Compulsory Licensing of Pharmaceuticals and TRIPS’.

Agreement as well as the Directive on the Legal Protection of Biotechnological Inventions (Directive 98/44/EC).³²⁶ In addition, compulsory licences can result from competition laws and the “regulation on compulsory licensing of patents relating to the manufacture of pharmaceutical products for export to countries with public health problems”³²⁷.³²⁸ An example of a compulsory licence can be found in Germany - in 2017 a compulsory licence was issued e.g. for the drug raltegravir which is used for HIV treatment. The Supreme Court and the Federal Patent Court decided that it was in the public’s interest for the pharma company Merck & Co to sell the HIV drug on the German market even though a European patent was held for raltegravir by the Japanese pharma company Shionogi since 2012.³²⁹ Moreover, Covid-19 was seen as an emergency situation that could allow issuing compulsory licences. For the special case of epidemic situations, the “German Infection Protection Act” was amended in November 2020. Its section 5 grants the Federal Ministry of Health the right to issue compulsory licences without prior consultation of the German Bundesrat for the duration of a declared national emergency situation.³³⁰

However, currently, this instrument is only used in special occasions in which live threatening situations occur. In these cases, the interest of the public to use the invention is higher than protecting the private rights of the right holder.

It is likely that climate change can constitute an emergency as well. According to *Robert Fair*, compulsory licensing should be applied to green technologies in cases where pollution destroys the environment.³³¹ This is the case especially in developing countries - 16 cities within China appear on the scale of the twenty most polluted cities worldwide.³³² Despite the grave influence of air pollution on the climate, it also leads to the death of 1.5 million people per year caused by respiratory infections related to the environment, solid fuel use alone being the reason for

³²⁶ Liat Sanz Martinez, ‘Compulsory Licensing Germany’, *Kluwer Patent Blog* <<http://patentblog.kluweriplaw.com/2021/05/10/compulsory-licensing-germany/>>.

³²⁷ *Regulation (EC) No 816/2006 of the European Parliament and of the Council of 17 May 2006 on Compulsory Licensing of Patents Relating to the Manufacture of Pharmaceutical Products for Export to Countries with Public Health Problems*.

³²⁸ Liat Sanz Martinez.

³²⁹ T-1150/15, Raltegravir [2017] X ZB 2/17, GRUR 2017, 1017 (German Federal Court of Justice, 16 October 2017); 3 LiQ 1/16, Raltegravir [2017] GRUR 2017, 373 (German Federal Patent Court, 31 August 2016).

³³⁰ Jenny Gesley, ‘Germany: Amendments to Infectious Diseases Protection Act Enter into Force’, *Library of Congress*, 2020 <<https://www.loc.gov/item/global-legal-monitor/2020-11-24/germany-amendments-to-infectious-diseases-protection-act-enter-into-force/>> [accessed 20 April 2022].

³³¹ Robert Fair, ‘Does Climate Change Justify Compulsory Licensing of Green Technology?’, *Brigham Young University International Law & Management Review*, 6.1 (2010), pp. 29, 30.

³³² Rachel Oliver, ‘All About: Developing Cities and Pollution’, *CNN*, 3 November 2008 <<http://www.cnn.com/2008/WORLD/asiapcf/03/09/eco.cities/index.html>> [accessed 21 April 2022].

36% of all lower respiratory infections.³³³ Therefore, while it appears that Art. 31 TRIPS is primarily used for pharmaceuticals,³³⁴ there is no obstacle that would hinder profiting from this provision within an environmental context.³³⁵

Nevertheless, it should be pointed out that both provisions, Arts 30 and 31 TRIPS, provide for exemptions on a national level as it is up to each individual member state of the TRIPS to apply them and implement them into their national law. That is why this solution cannot be used wholesale for every country but rather every single member state of the TRIPS needs to act upon it.

5.2 Prioritized Patent Application Examination

Another challenge for green technologies is the long duration of the patent application process. A possible adaptation to the patent's application process could be a prioritized treatment procedure for green technologies which already exists for COVID-19 inventions. This could cause a reduction in the patent application examination duration. In this regard, a more flexible patent system is advised.

A system that was implemented by the United States Patent and Trademark Office (USPTO) enables a prioritized consideration of COVID-19 inventions. The Program started as a Pilot and would enable inventions that meet certain requirements a faster patent examination without demanding extra fees. The invention needs to be invented by a “*small or micro entity*”, meaning a small entity is a “*nonprofit organization [or] does not [...] have 500 or more employees*” and “*has not assigned, licensed or otherwise conveyed an interest in the invention to a non-small entity*”.³³⁶ A micro entity, on the contrary, is a natural person or group who was not mentioned as an inventor or co-inventor “*on more than 4 prior patent applications*”, does not earn more than 3 times the amount a medium household receives (according to the reported U.S. standards), “*has not licensed or otherwise granted an interest in the invention to an entity who has more gross income than the amount listed above (unless the entity is an institution of higher*

³³³ World Health Organization, *Analysis of Estimates of the Environmental Attributable Fraction, by Disease*, 2004, p. 33 <https://cdn.who.int/media/docs/default-source/environmental-health-impacts/ebd/preventingdisease5.pdf?sfvrsn=5e6c7211_13> [accessed 21 April 2022].

³³⁴ World Trade Organization, ‘Compulsory Licensing of Pharmaceuticals and TRIPS’, *Wto.Org* <https://www.wto.org/english/tratop_e/trips_e/public_health_faq_e.htm> [accessed 3 April 2022].

³³⁵ Jason Weiner, ‘Sharing Potential and the Potential for Sharing: Open Source Licensing as a Legal and Economic Modality for the Dissemination of Renewable Energy Technology’, *Geo. Int’l Envtl. L. Rev.*, 18 (2006), p. 274.

³³⁶ James Singer, ‘Large Entity, Small Entity Or Micro-Entity: Which Type Of Patent Applicant Are You?’, *Jdsupra.Com*, 2020 <<https://www.jdsupra.com/legalnews/large-entity-small-entity-or-micro-43016/>> [accessed 22 April 2022].

education)”) and does additionally fulfill all the requirements of a small entity.³³⁷ The second requirement for being eligible for the prioritized examination program is to possess at least one product within the application which is proven by the FDA to prevent or treat COVID-19. Lastly, the invention is not allowed to underly more than one prior “*U.S. non-provisional or PCT application*”.³³⁸

Through this program, the application process can be reduced to on average six months if the applicant is responding to all inquiries quickly, says the *USPTO*.³³⁹

Another fast-track program was considered by the US for green technologies. In December 2009, the first green technology pilot program was started by the USPTO.³⁴⁰ However, after the first pilot, the program was closed and not reopened.³⁴¹ Earlier the same year, the UK IPO launched a green technology-based process called “Green Channel”. Contrary to the program by the USPTO which was not continued, the Green Channel Program is still ongoing. According to *Dechezleprêtre* and *Lane*, the fast-track program has provenly shown to reduce the application time by 42-75%, whereas the patent office within the UK demonstrates to be the fastest one to grant a patent.³⁴² However, the UK IPO only accepts UK patent applications.³⁴³ This seems not to be the only burden to the prioritized patent granting program. Even though such programs seem to be beneficial, only a few apply for the program as the program might be in some cases more expensive due to its reduced examination duration. Moreover, another reason the authors highlight is the diversity in rules between different fast-track programs regarding not only the formal requirements but also the invention’s or applicant’s eligibility. The research is often not only attached to higher costs but also time consumption. Additionally, it might not always be of the inventor’s interest to seek an application right away even though they might in general want to receive a patent grant sooner than other competitors.

³³⁷ Singer.

³³⁸ Peter Corless, ‘COVID-19: Prioritized Patent Application Examination and Patents 4 Partnerships’, *Mintz.Com*, 2020 <<https://www.mintz.com/insights-center/viewpoints/2231/2020-05-15-covid-19-prioritized-patent-application-examination-and>> [accessed 24 April 2022].

³³⁹ Peter Corless.

³⁴⁰ Hee-Eun Kim, ‘Role of the Patent System’, in *The Role of the Patent System in Stimulating Innovation and Technology Transfer for Climate Change*, Including Aspects of Licensing and Competition Law, 1st edn (Nomos Verlagsgesellschaft mbH, 2011), pp. 33–56 (pp. 44, 45) <<https://www.jstor.org/stable/j.ctv941r23.7>> [accessed 16 November 2021].

³⁴¹ United States Patent and Trademark Office, ‘Green Technology Pilot Program - CLOSED’, *Uspto.Gov*, 2012 <<https://www.uspto.gov/patents/initiatives/green-technology-pilot-program-closed>> [accessed 24 April 2022].

³⁴² Antoine Dechezleprêtre and Eric Lane, ‘Fast-Tracking Green Patent Applications’, *WIPO Magazine*, 2013.

³⁴³ Nicole Cordy, ‘The Green Channel – a Faster Way to Patent Green Technologies’, *Murgitroyd Blog*, 2018 <<https://www.murgitroyd.com/blog/a-faster-way-to-patent-green-technologies/>> [accessed 24 April 2022].

A similar prioritized examination could be considered within the EU driven by the EPO for technologies that could help to mitigate climate change. The requirements would need to be e.g. broader than those used for the COVID-19 prioritized examination as bigger and more experienced companies with a certain amount of granted patents would, according to the requirements of the USPTO, not fall under the eligibility of the prioritized patent examination.³⁴⁴ It is necessary to highlight the time pressure the world is facing with the current climate change situation and put certain criteria such as the size or experience of the applicant as not relevant when considering an invention as suitable for the prioritized examination. At the same time, participation in the program needs to be accompanied by reduced application costs and reasonable benefits for the inventors, so more applications are filed and inventors attracted.

5.3 Further institutions during patentability assessment (morality focused)

To consider the special morality-touching characteristics of climate change technologies, the inclusion of further institutions during the patentability assessment is proposed for green technologies.³⁴⁵ Therefore, in terms of the patent content assessment, a stricter patent system is sought.

Resolving this issue, O`Sullivan leads through multiple options in her book “Biotechnology, Patents and Morality: A Deliberative and Participatory Paradigm for Reform”. As the legislature seems not to clarify morality in law, the author suggests that European specialized courts could adjudicate morality as it can be done in the US through precedents.³⁴⁶ This way a law can be built and with precedents and the morality aspect could gain in consistency. However, in the European legal system, there is no such thing as precedent as everything is based on civil law, a written constitution based on specific codes decided by the legislature in long-lasting procedures. The codification of law results in stiffness of legislation which is unsuitable for the fast-developing green technology industry.³⁴⁷

Further on, O`Sullivan speaks of patent officials as the closest body between the patent applicant and the patent grant which is why patent officials could have a significant impact on

³⁴⁴ James Singer, ‘Large Entity, Small Entity Or Micro-Entity: Which Type Of Patent Applicant Are You?’, *Jdsupra.Com*, 2020 <<https://www.jdsupra.com/legalnews/large-entity-small-entity-or-micro-43016/>> [accessed 22 April 2022]; Peter Corless, ‘COVID-19: Prioritized Patent Application Examination and Patents 4 Partnerships’, *Mintz.Com*, 2020 <<https://www.mintz.com/insights-center/viewpoints/2231/2020-05-15-covid-19-prioritized-patent-application-examination-and>> [accessed 24 April 2022].

³⁴⁵ Maureen O`Sullivan, *Biotechnology, Patents and Morality*, 2019, pp. 64-83.

³⁴⁶ *Ibid*, pp. 64-72.

³⁴⁷ *Ibid*, pp. 68.

morality interpretation.³⁴⁸ However, due to multiple reasons as stated by the author, “*lack of transparency, bias, funding, collaboration among different patent offices, lobbying, internationalization of patent law, [misunderstanding of the invention] and a discomfort in applying the morality provisions*”,³⁴⁹ the patent office fails in acknowledging the morality bar’s value.³⁵⁰ Moreover, patent offices are financed through patents, through applications themselves, and, later on, when it comes to renewing a patent, through their fees.³⁵¹ This is why patent officials are more likely to grant patents to new technologies without thoroughly considering exceptions to the rule, especially when it comes to vague formulations of terms or no clear definitions as is the case with morality.³⁵²

A further solution toward a better understanding of morality including the consideration of the public opinions could be ethic committees, says *O’Sullivan*.³⁵³ Ethics committees could serve as advisors to identify cases that would require the consideration of the morality bar. However, there is no obligation that is forcing them to consult, and it also cannot be guaranteed that diverse opinions are regarded by the patent offices which again leads to uncertainty in the ethic committees’ actions.³⁵⁴ Further on, ethic committees are not represented in all countries and would again just add other bodies to the patent law system not able to decide extensively about the morality aspect.³⁵⁵

Other than postponing the task of clarifying the morality term to other entities, *Pila* suggests building a clear mechanism among the EPO which divides technologies into two categories, emerging and non-emerging technologies. Emerging technologies should cover technologies that are ethically problematic and might need special regulation. This could be done through a risk assessment which would scan all new applications that fall under the category of emerging technologies for possible threats.³⁵⁶ More clarity and structure would be brought into the patent granting process of morally controversial applications as it could be ensured that morally controversial technologies are controlled equally. This would help in identifying morally controversial inventions but depending on the risk assessment probably not the question of

³⁴⁸ O’Sullivan, pp. 72-76.

³⁴⁹ Ibid, p. 72.

³⁵⁰ Ibid.

³⁵¹ Ibid, pp. 73,73.

³⁵² Charlotte Waelde et al., *Contemporary Intellectual Property: Law and Policy*, 2016, p. 507.

³⁵³ Maureen O’Sullivan, *Biotechnology, Patents and Morality*, 2019, pp. 76-83.

³⁵⁴ Ibid, pp. 76,78.

³⁵⁵ Ibid, pp. 82,83.

³⁵⁶ Justine Pila, ‘Adapting the ordre public and morality exclusion of European patent law to accommodate emerging technologies’, *Nature biotechnology*, 38.5 (2020) p. 556.

when exactly an invention is already considered morally controversial and therefore a patent should not be granted.³⁵⁷

Clarifying, an entity is needed that, first of all, defines the morality term. Further on, this same entity or another body whose presence must be obligatory in all countries has to decide about the occurrence of morality in inventions and their consequential special treatment. Additionally, it is necessary that the body has an authoritarian position, so its decisions are no simple consultations but rather something that needs to be acted upon.

5.4 Boosting green features within new technologies through law

To achieve a boost in green technologies, it is further suggested that the existence of green features within green technologies is prescribed by law. Even though the WIPO only refers to the IP mechanisms not mentioning the goals written in the UNFCCC and Kyoto Protocol enough,³⁵⁸ it is only logical that manifesting climate change goals in law binds to exercise them. In the same way, the necessity of green features within new technologies can be explicitly desired by law.

Not only does it take functioning processes within the patent system and adequate patent features to meet the requirements necessary for an increase in the invention of green technologies but also further supporting incentives allowing green technologies to bloom within the patent system. Despite investing in research and development of green technologies, lending money to manufacturers of green technology products, and imposing regulations in favor of green technologies, the government can further support the increase of green technologies by contributing to a solid and well-functioning patent system. They can do so by enabling adequate private rights which are adapted to the current climate change situation. Thinkable are regulations for some categories of technologies that enable to gain access to patent rights much faster as well as cheaper.³⁵⁹

5.5 Further supporting incentives surrounding the patent system

However, besides governmental investments, further government-independent capital is indispensable and needed for significant progress in the field of green technologies and further

³⁵⁷ Pila, p. 556.

³⁵⁸ World Intellectual Property Organization (WIPO), 'Climate Change and the Intellectual Property System: What Challenges, What Options, What Solutions? An Outline of the Issues: Informal Consultation Draft Only.', pp. 12,13.

³⁵⁹ Patrick Gattari, 'The Role of Patent Law in Incentivizing Green Technology', *Northwestern Journal of Technology and Intellectual Property*, 11.2 (2013), pp. 41,42.

boost of climate change inventions. Depending on the maturity level of the market the green technology is in, the risk as well as the likelihood to invest in companies as well as the form of capital needed in these segments varies. It can be distinguished between the venture stage, emerging market stage, and mature market stage.³⁶⁰

In the venture stage, rather new established companies are investing in researching green technologies, eager to construe their own IP, likely highly diverse and spread. These companies are embodied through characteristics such as “*large intangible assets, negative cash flow, technological uncertainty, and low liquidation value*”.³⁶¹ As startups at this early stage most likely do not have their own capital, they rely on borrowed capital. Investors, on the other hand, seek companies that are striving for filing a patent. That way, the investor can be assured that their investment in the technology is secured by exclusive rights once the application goes through.³⁶² However, early stage investments are always intertwined with high risk due to the failure rate.³⁶³

As for the emerging market stage, creating value, acquiring, and expanding market share as well as gaining potential customers through spread patents are goals that companies in a further progressed stage are aiming for. Existing patents` exclusive rights are valuable assets for retrieving further investors but are also useful to gain market dominance. Once the technology has dispersed and was implemented by a particular amount of people, it enables the patentee, here the company, to increase charge prices and therefore higher the technology`s value.³⁶⁴

The mature market stage is characterized by companies already possessing a large number of market shares. In this stage, the goal is to secure the existing shares while reaching further an increase in market shares. Not only can the existing patent rights be protected through litigation, but also can competitors be deterred by menacing legal procedures or penalties for misuse of intellectual property rights.³⁶⁵

Non-withstanding the stage, it can be said, the higher the uncertainty of the technology, the higher the risk. According to *Relander*, new technologies in general bear risks which is not

³⁶⁰ Gattari, p. 43.

³⁶¹ Ibid

³⁶² Ibid.

³⁶³ Simon Bennett et al., ‘Ten years of clean energy startups’, *iea.org*, 2021 <<https://www.iea.org/articles/ten-years-of-clean-energy-start-ups>> [accessed 5 May 2022].

³⁶⁴ Gattari, p. 43

³⁶⁵ Ibid.

different for green technologies.³⁶⁶ Therefore, to compensate for the existing high risk, a higher reward for investors is needed.³⁶⁷ At the same time, diversification of investments should be considered.³⁶⁸ Consequently, as there is a high risk in the venture stage, it can be more difficult to find investors if the start-up is not willing to pay appropriate compensation. On the other hand, in the emerging market stage with a moderate as well as in the mature market stage with low risk, it might be easier and less expensive to encourage investors.

6 Conclusion

Looking back at the purpose of the thesis, its goal was to examine whether the European patent system is suitable to enforce climate mitigation within the EU and especially in Germany by protecting green technologies, or whether it is hindering from reaching the worldwide climate neutrality goals. Analyzing the patent features as well as the procedures within the European patent system and comparing them to the requirements needed to achieve progressive climate mitigation, was supposed to indicate whether the European patent system is the right instrument to incentivize as well as prompt green technologies. At the same time, it should ensure the transfer and dissemination of green technologies.

Recalling the patent features and patent system procedures, the principles behind patentability, and the pre-grant phase including technology enforcement, quality assurance, the debate between the public interest in the invention and the exclusive rights of the patentee, and the morality question were observed. This was followed by the patent granting process consisting of the patent application process, and, lastly, the post-grant phase containing the technology use as well as exclusivity, the patent monopoly, instruments to intervene into patent rights, and the dissemination of technology and transfer to developing countries.

For the climate mitigation requirements, the following requirements were considered necessary to achieve progressive climate neutrality: short notice actions as the climate mitigation commitments follow strict timelines, the representation and increase of green features in new inventions, a functioning market competition to ensure the increase in green technologies, and the worldwide accessibility as well as usability of new green technologies including technology

³⁶⁶ Brett Relander, 'Investing in Green Technology', *Investopedia.com*, 2022
<<https://www.investopedia.com/articles/investing/040915/investing-green-technologythe-future-now.asp>>
[accessed 5 May 2022].

³⁶⁷ Gattari, p. 44.

³⁶⁸ Brett Relander, 'Investing in Green Technology', *Investopedia.com*, 2022
<<https://www.investopedia.com/articles/investing/040915/investing-green-technologythe-future-now.asp>>
[accessed 5 May 2022].

transfer. Further minor requirements were identified such as the assurance of high quality and working green technologies, affordable product protection as well as the traceability of climate mitigation advances to ideally tighten up, loosen, or change climate mitigation measures.

The first sub-question raised relating to the main research question was aimed to explore the existing procedures within the patent system for green technologies within the EU but also to find out whether patents are already issued for green technologies by the EPO. If there were no special treatments for green technologies within the EU, treatments for other technology fields resembling the characteristics and importance of green technologies should be identified and analogously suggested for green technologies. The focus was supposed to lie on how other emergency situations were approached under the patent law, e.g. the current COVID-19 situation.

It was found that there are existing special treatments for green technologies. Within the US, a pilot program was started for green technologies but discontinued after it. Contrary to that, in the UK, a program called Green Channel exists until now and provenly reduces the patent application period by 42-75%. A different program that was discussed is used in the US for COVID-19 inventions. As the characteristics and the importance of biotechnological inventions resemble green inventions, the program can be considered and analogously applied to green technologies. However, no such programs exist within the EU. An implementation of such a program by the EPO is proposed. Nevertheless, fast-track programs bear downsides that need to be considered and eventually adapted before considering their implementation. The application for such a program might be more expensive than a normal application due to the duration reduction which leads to a decline in filed applications. A cost-effective solution must, therefore, be found. Another downside to a fast-track program is the diversity of the rules applied to such programs. The inconsistency in the application procedures and the requirements relating to the eligibility of an invention are often linked to higher costs and time consumption. A uniform or coordinated program, applicable in all countries, could be a possible solution. Moreover, the inventor might not be interested in seeking an application right away. Motivating incentives might be of use to attract inventors to file a prioritized patent examination.

The second sub-question dealt with the adaptations to the current European patent system. It was questioned whether the patent system as it is, is sufficient to protect green technologies in that manner that it enhances climate mitigation through a rise in green technologies.

The comparison of the patent features and the procedures of the European patent system to the requirements needed to achieve progressive climate neutrality exposed that the patent system does have useful features and might be suitable for inventions of other technology fields but has its imperfection when it comes to the protection of green technologies. This is, on one side, because its patentability assessment does not consider the green technologies' special morality-influential characteristics. Green technologies do touch on the morality aspect as their existence or non-existence, functionality, and proper execution influence the survival of existing and future generations. However, the morality exemption according to Art. 53(a) TRIPS is not assessed enough during the patent granting process and is not directly included in the patentability assessment. On the other side, the patent application process' duration, as well as its costs, hinder short notice actions and investments in new green technologies which are needed for reaching progressive climate neutrality. A normal patent application process takes up to 4 years which signifies in regard of the aimed climate neutrality goals and the timeline for them a difficult task that most likely will delay the whole process. In addition, the natural monopoly which patents form prevents free market competition. Competition ensures constant growth, affordable prices, improvement of existing and, most importantly, more new products which are beneficial for the increase in green technologies.

Therefore, answering the question, adaptations to the patent system are needed which is why the following adaptations to the European patent system were suggested. To overcome the patent's natural imposed monopoly, prevent price dictation through high licence prices, and enable the use of green inventions, the first suggestion was to consider climate change an exception ground to exclusive rights under Art. 30 TRIPS or allow third parties to make use of green inventions without prior authorization of the patentee according to Art. 31 TRIPS. As every member state can decide according to Art. 30 TRIPS individually about limitations to the exclusive rights of patentees, climate change could be chosen as such ground for exemption which would enable the use of inventions supporting climate mitigation by third parties without prior authorization of the patent owner. In parallel, Art. 31 TRIPS can enable the issue of compulsory licences by the government. While CL is rarely used, but appears often in the context of pharmaceuticals, there is no obstacle that would hinder profiting from this provision within the climate change environment by e.g. declaring climate mitigation an emergency. Another adaptation suggestion to overcome the long duration of the patent application process was the consideration of prioritized examinations of green technologies. Even though fast-track programs were used for COVID-19 inventions within the US and are still in use for green technologies within the UK, no such program exists within the EU. Therefore, implementing a

prioritized patent application examination for green technologies was advised for the patent system to become more flexible. However, downsides to such programs need to be regarded – application costs balanced and reasonable benefits for the inventors included, so more applications are filed and inventors attracted. Furthermore, to consider the special morality-touching characteristics of climate change technologies, the inclusion of further institutions during the patentability assessment is proposed for green technologies. Therefore, in terms of the patent content assessment, a stricter patent system is sought. An entity is needed to define the morality term and decide about the occurrence of morality in inventions as well as their consequential special treatment. Additionally, it was suggested to achieve a boost in green technologies by enforcing the existence of green features within green technologies through law as manifesting climate change goals in law binds to exercise them. The government can, at the same time, contribute to more adequate private rights. Thinkable are regulations that enable access to patent rights much faster as well as cheaper. Lastly, further supportive incentives surrounding the patent system are envisioned. As governmental investments are often not enough, further investors are needed to finance the research and development of green technologies. However, green technologies are categorized by a lower market maturity level which is why also a high reward for investors needs to be foreseen.

This outcome also directs back to the main research question and the thesis topic – is the European patent system suitable to enforce climate mitigation within the EU and especially in Germany by protecting green technologies, or is it hindering from reaching the worldwide climate neutrality goals? The European patent system as it is does not enhance climate mitigation by incentivizing green technologies. It also does not directly hinder climate mitigation. The patent system is used as an adequate tool for protecting technologies of other technology fields which is why it can also protect green technologies in theory. However, setting aside the positive effects of the patent system, the patent features and procedures within the patent system do slower the overall patenting process which is why in reverse they could slower climate mitigation when fast actions are required. Nevertheless, it should be questioned if foregoing the patent system is an option at all because of the reward function it entails and the influence it has on innovation and investment into new technologies. Therefore, it is proposed to use the European patent system for green technologies but tailor some characteristics of it as described above. As a result, the European patent system becomes more flexible when it comes to the patent application duration and stricter when it comes to the patentability assessment by considering the morality aspect thoroughly. Moreover, the adequate

adaptation and legal regulation of private rights lead o a well-functioning and solid patent system that can optimally support climate mitigation and incentivize green technologies.

7 References

Legislation & Treaties

- Bundestag, *Bundes-Klimaschutzgesetz Vom 12. Dezember 2019 (BGBl. I S. 2513), Das Durch Artikel 1 Des Gesetzes Vom 18. August 2021 (BGBl. I S. 3905) Geändert Worden Ist*, 2019
- Charter of Fundamental Rights of the European Union (ECHR), OJ C 326/391 (2000)*
- Consolidated Versions of the Treaty on the Functioning of the European Union (TFEU) 2012/C 326/01 Signed on 13 December 2007*
- Convention on the Grant of European Patents (European Patent Convention) of 5 October 1973 as Revised by the Act Revising Article 63 EPC of 17 December 1991 and the Act Revising the EPC of 29 November 2000*
- Council Decision (EU) 2015/1339 of 13 July 2015 on the conclusion, on behalf of the European Union, of the Doha Amendment to the Kyoto Protocol to the United Nations Framework Convention on Climate Change and the joint fulfilment of commitments thereunder*
- Council of the European Union, European Parliament, Regulation (EU) 2021/1119 Establishing the Framework for Achieving Climate Neutrality and Amending Regulations (EC) No 401/2009 and (EU) 2018/1999 ('European Climate Law'), 2021*
- European Commission, Proposal for a Regulation of the European Parliament and of the Council Establishing the Framework for Achieving Climate Neutrality and Amending Regulation (EU) 2018/1999 (European Climate Law), 2020*
- European Patent Office, Implementing Regulations to the Convention on the Grant of European Patents of 5 October 1973 as Adopted by Decision of the Administrative Council of the European Patent Organisation of 7 December 2006 and as Last Amended by Decision of the Administrative Council of the European Patent Organisation of 15 December 2020*
- European Parliament and Council of European Union, DIRECTIVE 98/44/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 6 July 1998 on the Legal Protection of Biotechnological Inventions*
- European Patent Organisation, Rules Relating to Fees of 20 October 1977 as Adopted by Decision of the Administrative Council of the European Patent Organisation of 7 December 2006 and as Last Amended by Decision of the Administrative Council of 27 March 2020*
- Federal Climate Change Act of 12 December 2019 (Federal Law Gazette I, p. 2513), as Last Amended by Article 1 of the Act of 18 August 2021*
- Paris Convention for the Protection of Industrial Property, Mar. 20, 1883, as Revised at Stockholm on July 14, 1967, 21 U.S.T. 1630, 828 U.N.T.S. 305*
- Patent Act as Published on 16 December 1980 (Federal Law Gazette 1981 I p. 1), as Last Amended by Article 4 of the Act of 8 October 2017 (Federal Law Gazette I p. 3546) (German Patent Act/Patentgesetz)*

Regulation (EC) No 816/2006 of the European Parliament and of the Council of 17 May 2006 on Compulsory Licensing of Patents Relating to the Manufacture of Pharmaceutical Products for Export to Countries with Public Health Problems

UN General Assembly, *United Nations Framework Convention on Climate Change: resolution / adopted by the General Assembly, 20 January 1994, A/RES/48/189*

UNFCCC, ‘Kyoto Protocol to the United Nations Framework Convention on Climate Change’, 1997

UNFCCC, ‘Paris Agreement to the United Nations Framework Agreement on Climate Change’, 2015

Legal Cases

C-34/10 *Brüstle v. Greenpeace eV* [2011] ECR I-09821 (Grand Chamber, 18 October 2011)

C-468/06 to C-478/06, *Sot. Lélos kai Sia EE and Others v GlaxoSmithKline AEEV*, [2008] ECR I-7139 (Grand Chamber, 16 September 2008)

G2/06 *Use of Embryos/WARF* ECLI:EP:BA:2008:G000206.20081125 (Enlarged Bd App., 25 November 2008)

T-0356/93 *Plant cells* ECLI:EP:BA:1995:T035693.19950221 (OJ, 21 February 1995) <<https://www.epo.org/law-practice/case-law-appeals/recent/t930356ex1.html>> [accessed 16 March 2022]

T-1150/15, *Raltegravir* [2017] X ZB 2/17, GRUR 2017, 1017 (German Federal Court of Justice, 16 October 2017)

3 LiQ 1/16, *Raltegravir* [2017] GRUR 2017, 373 (German Federal Patent Court, 31 August 2016)

Articles, Books, Reports, Submissions & Web pages

‘About Us’, *World Meteorological Organization* <<https://public.wmo.int/en/about-us>> [accessed 25 November 2021]

Almunia, Joaquín, Vice President of the European Commission responsible for Competition Policy, *Speech at Industrial Policy and Competition Policy: Quo Vadis Europa? New Frontiers of Antitrust 2012 – Revue Concurrences Paris, 10 February 2012* <https://ec.europa.eu/commission/presscorner/detail/en/SPEECH_12_83> [accessed 22 March 2022]

Arrhenius, Svante, ‘On the Influence of Carbonic Acid in the Air upon the Temperature of the Ground’, *Philosophical Magazine and Journal of Science*, 41.5 (1896)

Arthur, W. Brian, ‘Competing Technologies, Increasing Returns, and Lock-In by Historical Events’, *The Economic Journal*, 99.394 (1989)

- Ayre, Michael E., ‘How Long Does It Take to Develop a New Product?’, *CrucibleDesign.Co.Uk*, 2019 <<https://www.crucibleDesign.co.uk/blog/how-long-does-it-take-to-develop-a-new-product-2.php>> [accessed 13 March 2022]
- Baye, Michael; Brousseau, Eric; Heiner, David; and Wu, Tim, ‘The Digital Economy - 2012’, *OECD*, 2012
- Beltran, Alain; Chauveau, Sophie; and Galvez-Behar, Gabriel, *Des brevets et des marques. Une histoire de la propriété industrielle* (Fayard, 2001)
- Bennett, Simon; Le Marois, Jean-Baptiste; Orgland, Nikolai, ‘Ten years of clean energy startups’, *iea.org*, 2021 <<https://www.iea.org/articles/ten-years-of-clean-energy-startups>> [accessed 5 May 2022]
- Bexell, Magdalena; and Jönsson, Kristina, *The Politics of the Sustainable Development Goals: Legitimacy, Responsibility, and Accountability*, 2021
- Bostyn, Sven; and Petit, Nicolas, *Patent=Monopoly: A Legal Fiction* (Rochester, NY: Social Science Research Network, 31 December 2013) <<https://doi.org/10.2139/ssrn.2373471>>
- Braunstein, Philippe, ‘À l’origine Des Privilèges d’invention Aux XIVE et XVe Siècles’, in *Les Brevets. Leur Utilisation En Histoire Des Techniques et de l’économie*, Paris, Centre de Recherche En Histoire de l’innovation (Paris: Centre de recherche en histoire de l’innovation, 1984)
- Chamberlin, Edward H., *The Theory of Monopolistic Competition*, 1937
- Codification Division, Office of Legal Affairs, United Nations, ‘Declaration of the United Nations Conference on the Human Environment’, *Audivisual Library of International Law* <<https://legal.un.org/avl/ha/dunche/dunche.html>> [accessed 24 November 2021]
- Cordy, Nicole, ‘The Green Channel – a Faster Way to Patent Green Technologies’, *Murgitroyd Blog*, 2018 <<https://www.murgitroyd.com/blog/a-faster-way-to-patent-green-technologies/>> [accessed 24 April 2022]
- Corless, Peter, ‘COVID-19: Prioritized Patent Application Examination and Patents 4 Partnerships’, *Mintz.Com*, 2020 <<https://www.mintz.com/insights-center/viewpoints/2231/2020-05-15-covid-19-prioritized-patent-application-examination-and>> [accessed 24 April 2022]
- de Coninck, Heleen; and Puig, Daniel, ‘Assessing Climate Change Mitigation Technology Interventions by International Institutions’, *Climatic Change*, 131.3 (2015) <<https://doi.org/10.1007/s10584-015-1344-z>>
- Copenhagen Economics, and The IPR Company, *Are IPR a Barrier to the Tansfer of Climate Change Technology?* (European Commission (DG Trade), 19 January 2019)
- Cornish, W., Llewelyn, D., and Alpin, T., *Intellectual Property: Patents, Copyright, Trademarks and Allied Rights*, 8th edn (London: Sweet & Maxwell, 2013)
- Dechezleprêtre, Antoine and Lane, Eric, ‘Fast-Tracking Green Patent Applications’, *WIPO Magazine*, 2013

- Denicolò, Vincenzo; and Franzoni, Luigi A., ‘On the Winner-Take-All Principle in Innovation Races’, *Journal of the European Economic Association*, 8.5 (2010)
- Dent, Chris, ‘Generally Inconvenient’: The 1624 Statue of Monopolies as Political Compromise’, *Melbourne University Law Review*, 33.2 (2009)
- deWitt, Piet; and deWitt, Carole A., ‘Research Article: How Long Does It Take to Prepare an Environmental Impact Statement?’, *Environmental Practice*, 10.4 (2008), 164–74
- Duffy, John F., *Intellectual Property as Natural Monopoly: Toward a General Theory of Partial Property Rights*, 2005
- Environment Programme, UN, ‘Mitigation’, *UNEP - UN Environment Programme*, 2017 <<http://www.unep.org/explore-topics/climate-action/what-we-do/mitigation>> [accessed 22 December 2021]
- Environment, United Nations, ‘UNEP - UN Environment Programme’, *UNEP - UN Environment Programme* <<http://www.unep.org/node>> [accessed 24 November 2021]
- European Commission, ‘A European Green Deal: Striving to Be the First Climate-Neutral Continent’ <https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en> [accessed 23 October 2021]
- , ‘Causes of Climate Change’, *Climate Action* <https://ec.europa.eu/clima/climate-change/causes-climate-change_en> [accessed 23 October 2021]
- , ‘Climate Action: European Climate Law’ <https://ec.europa.eu/clima/eu-action/european-green-deal/european-climate-law_en> [accessed 6 November 2021]
- , ‘Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions: The European Green Deal’, 2019
- , ‘Competition Policy: Antitrust’, *Ec.Europa.Eu* <https://ec.europa.eu/competition-policy/antitrust_en> [accessed 12 March 2022]
- , ‘State of the Union: Commission Raises Climate Ambition and Proposes 55% Cut in Emissions by 2030’, *European Commission*, 2020 <https://ec.europa.eu/commission/presscorner/detail/en/ip_20_1599> [accessed 1 December 2021]
- , ‘The European Climate Pact: Empowering Citizens to Shape a Greener Europe’, *European Commission*, 2020 <https://ec.europa.eu/commission/presscorner/detail/en/ip_20_2323> [accessed 1 December 2021]
- , ‘The European Green Deal’, *European Commission*, 2019 <https://ec.europa.eu/commission/presscorner/detail/en/ip_19_6691> [accessed 29 November 2021]
- European Patent Office, *Compulsory Licensing in Europe A Country-by-Country Overview.*, 2019

- , ‘European Patent Applications’, *European Patent Office* <<https://www.epo.org/about-us/annual-reports-statistics/statistics/2020/statistics/patent-applications.html>> [accessed 12 December 2021]
- , ‘European Patent Guide: Annex 1 – Overview of the procedure for the grant of a European patent’ <https://www.epo.org/applying/european/Guide-for-applicants/html/e/ga_ai.html> [accessed 1 May 2022]
- , *European Patent Guide: How to Get a European Patent*, 21st edn, 2021
- , ‘Statistics and Trends’, *European Patent Office* <<https://www.epo.org/about-us/annual-reports-statistics/statistics.html>> [accessed 12 December 2021]
- , ‘The Patenting Process’, *Epo.Org* <<https://www.epo.org/learning/materials/inventors-handbook/protection/patents.html>> [accessed 2 January 2022]
- Fair, Robert, ‘Does Climate Change Justify Compulsory Licensing of Green Technology?’, *Brigham Young University International Law & Management Review*, 6.1 (2010)
- Federal Ministry for Economics Affairs and Climate Action, ‘Protecting Free Competition’, *Bmwi.De* <<https://www.bmwi.de/Redaktion/EN/Dossier/competition-policy.html>> [accessed 12 March 2022]
- Fisher, William Weston, ‘Patent | Law | Britannica’, 1998 <<https://www.britannica.com/topic/patent>> [accessed 1 December 2021]
- Fortmann, Christian, *Revenue Models* (London: Kogan Page Ltd, 2009)
- Forum Umwelt & Entwicklung, ‘2030-Agenda Und SDGs’ <<https://www.forumue.de/themen/nachhaltigkeit/post-2015-agenda-rio20/>> [accessed 23 December 2021]
- French, Duncan; and Kotzé, Louis J., *Sustainable Development Goals: Law, Theory and Implementation* (Edward Elgar Publishing, 2018)
- Galvez-Behar, Gabriel, ‘The 1883 Paris Convention and the Impossible Unification of Industrial Property’, in *Diversity and Harmonization in Historical Perspective*, ed. by Graeme Gooday and Steven Wilf, Cambridge Intellectual Property and Information Law (Cambridge: Cambridge University Press, 2020)
- Gardiner, Stephen M., ‘Ethics and Global Climate Change’, *Ethics*, 114.3 (2004)
- Gardiner, Stephen M.; and Hartzell-Nichols, Lauren, ‘Ethics and Global Climate Change’, *Nature Educational Knowledge*, 3.10 (2012) <<https://www.nature.com/scitable/knowledge/library/ethics-and-global-climate-change-84226631/>> [accessed 18 March 2022]
- Gattari, Patrick, ‘The Role of Patent Law in Incentivizing Green Technology’, *Northwestern Journal of Technology and Intellectual Property*, 11.2 (2013)
- General Assembly, ‘Transforming Our World: The 2030 Agenda for Sustainable Development’, 2015

- Gervais, Daniel, 'The Internationalization of Intellectual Property: New Challenges from the Very Old and the Very New', 12.4 (2002)
- Gesley, Jenny, 'Germany: Amendments to Infectious Diseases Protection Act Enter into Force', *Library of Congress*, 2020 <<https://www.loc.gov/item/global-legal-monitor/2020-11-24/germany-amendments-to-infectious-diseases-protection-act-enter-into-force/>> [accessed 20 April 2022]
- Ghosh, Tuhin; Tompkins, Emma L; Vincent, Katharine; Suckall, Natalie; Rahman, Rezaur; Mensah, Adelina; and others, 'Adapting to Change: People and Policies', in *Deltas in the Anthropocene* (Palgrave Macmillan, Cham, 2020)
- Gkotsis, Petros; and Vezzani, Antonio, 'Technological Diffusion as a Recombinant Process: Evidence from Patent Data', *OECD Blue Sky Forum 'Towards the next Generation of Data and Indicators'*, 2016
- Global Enabling Sustainability Initiative (GeSI), Deloitte Touche Tohmatsu Limited (DTTL), *Digital with Purpose: Delivering a SMARTer2030*, 17 September 2019
- Government of the Netherlands, 'What Are the Criteria for Patenting My Invention?', *Government.Nl* <<https://www.government.nl/topics/intellectual-property/question-and-answer/what-are-the-criteria-for-patenting-my-invention>> [accessed 4 February 2022]
- Greenlaw, Steven A.; and Shapiro, David, 'How Monopolies Form: Barriers to Entry', in *Principles of Microeconomics 2e* (OpenStax)
- Grubb, Michael, 'Seeking Fair Weather: Ethics and the International Debate on Climate Change', *International Affairs*, 71.3 (1995)
- Guan, Wenwei, *Intellectual Property Theory and Practice: A Critical Examination of China's TRIPS Compliance and Beyond* (Springer, 2014)
- Guellec, Dominique; and van Pottelsberghe de la Potterie, Bruno, *The Economics of the European Patent System: IP Policy for Innovation and Competition* (Oxford: Oxford University Press, 2007)
- Günther, Edeltraud, 'Definition: Klimawandel', *Gabler Wirtschaftslexikon* (Springer Fachmedien Wiesbaden GmbH, 2018) <<https://wirtschaftslexikon.gabler.de/definition/klimawandel-52424>> [accessed 23 November 2021]
- Hall, Bronwyn; and Helmers, Christian, 'The Role of Patent Protection in (Clean/Green) Technology Transfer', *Voxeu.Org*, 2010 <<https://voxeu.org/article/intellectual-property-and-climate-change>> [accessed 27 March 2022]
- Harbers, Michael J., 'International Patent Cooperation Recent Development', *Stanford Law Review*, 20.5 (1967)
- Hegerl, Gabriele C.; Brönnimann, Stefan; Cowan, Tim; Friedman, Andrew R.; Hawkins, Ed; Iles, Carley; and others, 'Causes of Climate Change over the Historical Record', *Environmental Research Letters*, 14.12 (2019) <<https://doi.org/10.1088/1748-9326/ab4557>>

- Helm, Dieter, ‘Climate-Change Policy: Why Has so Little Been Achieved?’, *Oxford Review of Economic Policy*, 24.2 (2008), 211–38
- Henry, Emeric, ‘Strategic Disclosure of Research Results: The Cost of Proving Your Honesty’, *The Economic Journal*, 119.539 (2009)
- Hirst, David, ‘The History of Global Climate Change Negotiations’, *UK Parliament*, 2020 <<https://commonslibrary.parliament.uk/the-history-of-global-climate-change-negotiations/>> [accessed 25 November 2021]
- Hötte, Kerstin; Jung Jee, Su; and Srivastav, Sugandha, ‘Knowledge for a Warmer World: A Patent Analysis of Climate Change Adaptation Technologies’, *ArXiv:2108.03722 [Econ, q-Fin]*, 2021 <<http://arxiv.org/abs/2108.03722>> [accessed 13 March 2022]
- ‘IPCC — Intergovernmental Panel on Climate Change’ <<https://www.ipcc.ch/>> [accessed 25 November 2021]
- Jankowski, Sophie, ‘Wie funktioniert der Treibhauseffekt?’, *Umweltbundesamt*, 2021 <<https://www.umweltbundesamt.de/service/uba-fragen/wie-funktioniert-der-treibhauseffekt>> [accessed 24 November 2021]
- Jewell, Catherine; and Tilbury, Charlotte, ‘Licences of Right in European Patent Convention (EPC) Territories and with Respect to European Unitary Patents | Beck Greener’, *BeckGreener*, 2017 <<https://www.beckgreener.com/licences-right-european-patent-convention-epc-territories-and-respect-european-unitary-patents>> [accessed 2 February 2022]
- Khan, Zorina, ‘An Economic History of Patent Institutions’, *EH.Net*, 2006 <<https://eh.net/encyclopedia/an-economic-history-of-patent-institutions/>> [accessed 3 December 2021]
- Khemani, R. S., and Shapiro, D. M., ‘Glossary of Industrial Organisation Economics and Competition Law’ (OECD, 1993)
- Kim, Hee-Eun, ‘Role of the Patent System’, in *The Role of the Patent System in Stimulating Innovation and Technology Transfer for Climate Change*, Including Aspects of Licensing and Competition Law, 1st edn (Nomos Verlagsgesellschaft mbH, 2011), pp. 33–56 <<https://www.jstor.org/stable/j.ctv941r23.7>> [accessed 16 November 2021]
- Klein, Fabian, ‘GREEN IP - A Look at How Sustainability Influences IP and How IP Can Help in Achieving Sustainability’, 2020 <<https://www.ashurst.com/en/news-and-insights/legal-updates/a-look-at-how-sustainability-influences-ip-and-how-ip-can-help-in-achieving-sustainability/>> [accessed 7 November 2021]
- Kultti, Klaus; and Takalo, Tuomas, ‘Optimal Fragmentation of Intellectual Property Rights’, *International Journal of Industrial Organization*, 26.1 (2008)
- Kunzig, Robert, ‘Glacial Meltdown’, *National Geographic*, 2013 <<https://www.nationalgeographic.com/magazine/article/glacial-meltdown>> [accessed 13 November 2021]
- La Manna, Manfredi; Manleod, Ross; and de Meza, David, ‘The Case for Permissive Patents’, *European Economic Review*, 33 (1989)

- Lalyre, Nicolas, 'WIPO - Technology and Innovation Support Center Seminar on the Effective Use of Technical and Scientific Information', 2014
- Lee, Bernice, Iliev, Ilian; and Preston, Felix; *Who Owns Our Low Carbon Future? Intellectual Property and Energy Technologies* (London: Chatham House, 2009)
- Lehmann, Paul; and Söderholm, Patrik, *Can Technology-Specific Deployment Policies Be Cost-Effective? The Case of Renewable Energy Support Schemes* (Leipzig: Helmholtz-Zentrum für Umweltforschung (UFZ), 2016)
- Letterman, G. Gregory, *Basics of International Intellectual Property Law*, 2021
- Lindsey, Rebecca, and Luann Dahlman, 'Climate Change: Global Temperature', *Climate.Gov*, 2021 <<https://www.climate.gov/news-features/understanding-climate/climate-change-global-temperature>>
- Machlup, Fritz, 'An Economic Review of the Patent System: Study of the Subcommittee on Patents, Trademarks, and Copyrights of the Committee on the Judiciary', 1958
- Mario, 'How Long Does It Take to Develop a New Product? | Cad Crowd', *Cadcrowd.Com*, 2019 <<https://www.cadcrowd.com/blog/how-long-does-it-take-to-develop-a-new-product/>>
- Martinez, Liat S., 'Compulsory Licensing Germany', *Kluwer Patent Blog* <<http://patentblog.kluweriplaw.com/2021/05/10/compulsory-licensing-germany/>>
- Maurer, Stephen M; and Scotchmer, Suzanne, 'The Independent Invention Defence in Intellectual Property', *Economica*, 69 (2002)
- Ministry of Economic Affairs and Climate Policy, 'A Short History of Patents in the Netherlands and Europe', *Netherlands Enterprise Agency*, 2021 <<https://english.rvo.nl/information/patents-intellectual-property/general-information-patents/history-patents-netherlands-europe>> [accessed 4 December 2021]
- Moser, Petra, 'Patents and Innovation: Evidence from Economic History', *Journal of Economic Perspectives*, 27.1 (2013)
- Nard, Craig, ed., 'History and Architecture of the Patent System', in *The Laws of Patent*, 2nd edn (Aspen Publishers, 2010)
- NASA, 'Climate Change Evidence: How Do We Know?', *Global Climate Change: Vital Signs of the Planet* <<https://climate.nasa.gov/evidence>> [accessed 13 November 2021]
- , 'The Causes of Climate Change', *Global Climate Change: Vital Signs of the Planet* <<https://climate.nasa.gov/causes>> [accessed 23 October 2021]
- , 'What Is the Greenhouse Effect?', *NASA* <<https://climate.nasa.gov/faq/19/what-is-the-greenhouse-effect>> [accessed 24 November 2021]
- Newell, Peter, *Globalization and the Environment: Capitalism, Ecology and Power* (Cambridge: Cambridge University Press, 2012)
- OECD, 'Patents and Innovation: Trends and Policy Challenges' (OECD, 2004)

- Oliver, Rachel, 'All About: Developing Cities and Pollution', *CNN*, 3 November 2008 <<http://www.cnn.com/2008/WORLD/asiapcf/03/09/eco.cities/index.html>> [accessed 21 April 2022]
- Organisation for Economic Co-operation and Development (OECD), 'Patents by Technology : Patents in Environment-Related Technologies' <<https://stats.oecd.org/index.aspx?queryid=29068#>> [accessed 10 December 2021]
- O'Sullivan, Maureen, *Biotechnology, Patents and Morality: A Deliberative and Participatory Paradigm for Reform* (New York and Abingdon: Routledge, 2019)
- Patrick, Shannon, 'Can We Learn to Incentivize Morality?: A Discussion of Biotechnology on an International Level', *Emory International Law Review*, 34.3 (2020)
- Peri, Giovanni, 'Knowledge Flows, R&D Spillovers and Innovation' (presented at the ZEW Discussion Papers, Zentrum für Europäische Wirtschaftsforschung (ZEW), 2003)
- Picciotto, Sol, 'Private Rights vs. Public Interests in the TRIPS Agreement', *Proceedings of the Annual Meeting (American Society of International Law)*, 97 (2003)
- Pila, Justine, 'Adapting the ordre public and morality exclusion of European patent law to accommodate emerging technologies', *Nature biotechnology*, 38.5 (2020)
- Relander, Brett, 'Investing in Green Technology', *Investopedia.com*, 2022 <<https://www.investopedia.com/articles/investing/040915/investing-green-technologythe-future-now.asp>> [accessed 5 May 2022].
- Rubin, Edward S, 'Innovation and Climate Change', in *Innovation. Perspectives for the 21st Century*
- Rudyk, Ilja, 'The License of Right, Compulsory Licensing and the Value of Exclusivity', *Universitätsbibliothek Der Ludwig-Maximilians-Universität München*, 2012
- Say, Jean-Baptiste, *A Treatise on Political Economy; or the Production, Distribution, and Consumption of Wealth*, 1803
- Scherer, Frederic M., *Innovation and Growth : Schumpeterian Perspectives*, 1984
- Scotchmer, Suzanne, 'Standing on the Shoulders of Giants: Cumulative Research and the Patent Law', *Journal of Economic Perspectives*, 5.1 (1991)
- Secretariat WIPO, 'Transfer of Technology' (presented at the Standing Committee on the Law of Patents, Geneva, 2010), XIV
- Shapiro, Carl, 'Prior User Rights', *American Economic Review*, 96.2 (2006)
- Silverman, Arnold B., 'Is a Patent a Monopoly?-Antitrust Considerations', *JOM*, 56.4 (2004)
- Silverman, Ed, 'The 5 Most Pressing Ethical Issues in Biotech Medicine', *Biotechnology Healthcare*, 1.6 (2004), 41–46
- Singer, James, 'Large Entity, Small Entity Or Micro-Entity: Which Type Of Patent Applicant Are You?', *Jdsupra.Com*, 2020 <<https://www.jdsupra.com/legalnews/large-entity-small-entity-or-micro-43016/>> [accessed 22 April 2022]

- Smits, Jan M., ‘What Is Legal Doctrine? On the Aims and Methods of Legal-Dogmatic Research’ (Maastricht University - Maastricht European Private Law Institute, 2015)
- Söderholm, Patrik, ‘The Green Economy Transition: The Challenges of Technological Change for Sustainability’, *Sustainable Earth*, 3.1 (2020)
- Soroos, Marvin S., *The Endangered Atmosphere: Preserving a Global Commons* (Columbia, S.C.: University of South Carolina Pres, 1997)
- ‘Status of Ratification of the Convention | UNFCCC’ <<https://unfccc.int/process-and-meetings/the-convention/status-of-ratification/status-of-ratification-of-the-convention>> [accessed 25 November 2021]
- ‘The Changing Atmosphere | Implications for Global Security Conference Statement’ (Toronto: World Meteorological Organization (WMO); United Nations Environment Programme (UNEP), 1988) <https://www.academia.edu/4043227/The_Changing_Atmosphere_Implications_for_Global_Security_Conference_Statement_1988> [accessed 24 November 2021]
- ‘The Katowice Climate Package: Making The Paris Agreement Work For All | UNFCCC’ <<https://unfccc.int/process-and-meetings/the-paris-agreement/katowice-climate-package>> [accessed 29 November 2021]
- Travaux Préparatoires (EPC 1973), ‘Meeting on 18 April 1961, IV/2767/61-E’
- Tur-Sinai, Ofer, ‘Patents and Climate Change: A Skeptic’s View’, *Environmental Law*, 48.1 (2018)
- Tushnet, Rebecca, ‘Intellectual Property as a Public Interest Mechanism’, in *The Oxford Handbook of Intellectual Property Law*, 2018
- UNCTAD Secretariat, UN Department of Economic and Social Affairs, and WIPO International Bureau, *The Role of the Patent System in the Transfer of Technology to Developing Countries: Report / Prepared Jointly by the United Nations Department of Economic and Social Affairs, the UNCTAD Secretariat and the International Bureau of the World Intellectual Property Organization* (New York: UN, 1975)
- United Nations, ‘Agenda 21’ <<https://sustainabledevelopment.un.org/outcomedocuments/agenda21>> [accessed 23 December 2021]
- , *Doha Amendment to the Kyoto Protocol* <<https://unfccc.int/process/the-kyoto-protocol/the-doha-amendment>> [accessed 25 November 2021]
- , ‘Report of the United Nations Conference on the Human Environment’ (presented at the United Nations Conference on the Human Environment, Stockholm, 1972) <https://www.un.org/ga/search/view_doc.asp?symbol=A/CONF.48/14/REV.1> [accessed 24 November 2021]
- , ‘United Nations Conference on Environment & Development’ (Rio de Janeiro, 1992)
- United Nations Climate Change, ‘A Beginner’s Guide to Climate Neutrality | UNFCCC’ <<https://unfccc.int/blog/a-beginner-s-guide-to-climate-neutrality>> [accessed 23 December 2021]

- , ‘Nationally Determined Contributions (NDCs) | UNFCCC’ <<https://unfccc.int/process-and-meetings/the-paris-agreement/nationally-determined-contributions-ndcs/nationally-determined-contributions-ndcs>> [accessed 29 November 2021]
- , ‘The Paris Agreement | UNFCCC’ <<https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement>> [accessed 29 November 2021]
- , ‘What Is the United Nations Framework Convention on Climate Change? | UNFCCC’ <<https://unfccc.int/process-and-meetings/the-convention/what-is-the-united-nations-framework-convention-on-climate-change>> [accessed 25 November 2021]
- United Nations Department of Economic and Social Affairs, ‘Commission on Sustainable Development (CSD)’ <<https://sustainabledevelopment.un.org/csd.html>> [accessed 23 December 2021]
- United States Patent and Trademark Office, ‘Green Technology Pilot Program - CLOSED’, *Uspto.Gov*, 2012 <<https://www.uspto.gov/patents/initiatives/green-technology-pilot-program-closed>> [accessed 24 April 2022]
- Waelde, Charlotte; Brown, Abbe; Kheria, Smita; and Cornwell, Jane, *Contemporary Intellectual Property: Law and Policy* (OUP 2016)
- Weiner, Jason, ‘Sharing Potential and the Potential for Sharing: Open Source Licensing as a Legal and Economic Modality for the Dissemination of Renewable Energy Technology’, *Geo. Int’l Envtl. L. Rev.*, 18 (2006)
- WIPO, ‘What Is Intellectual Property (IP)?’, *WIPO* <<https://www.wipo.int/about-ip/en/index.html>> [accessed 1 December 2021]
- World Health Organization, *Analysis of Estimates of the Environmental Attributable Fraction, by Disease*, 2004 <https://cdn.who.int/media/docs/default-source/environmental-health-impacts/ebd/preventingdisease5.pdf?sfvrsn=5e6c7211_13> [accessed 21 April 2022]
- World Intellectual Property Organization, *WIPO Intellectual Property Handbook: Policy, Law and Use* (WIPO, 2004)
- World Intellectual Property Organization (WIPO), ‘Climate Change and Intellectual Property’, *WIPO* <https://www.wipo.int/policy/en/climate_change/index.html> [accessed 6 December 2021]
- , ‘Climate Change and the Intellectual Property System: What Challenges, What Options, What Solutions? An Outline of the Issues: Informal Consultation Draft Only.’, 2008
- , ‘Patents’ <<https://www.wipo.int/patents/en/index.html>> [accessed 1 January 2022]
- , ‘WIPO GREEN: The Global Marketplace for Sustainable Technology’ <<https://www3.wipo.int/wipogreen>> [accessed 7 November 2021]
- , ‘Wipogreen Database’ <<https://wipogreen.wipo.int/wipogreen-database/database>> [accessed 8 December 2021]

- World Meteorological Organization (WMO), ed., 'Proceedings of the World Climate Conference: A Conference of Experts on Climate and Mankind', WMO; No. 537 (presented at the World Climate Conference, Geneva: Secretariat of the World Meteorological Organization, 1979)
- World Trade Organization, 'Compulsory Licensing of Pharmaceuticals and TRIPS', *Wto.Org* <https://www.wto.org/english/tratop_e/trips_e/public_health_faq_e.htm>
- , 'Intellectual Property and the Public Interest', *Wto.Org* <https://www.wto.org/english/news_e/news19_e/ddgaw_05dec19_e.htm> [accessed 12 January 2022]
- , 'The WTO TRIPS Agreement - A Practical Overview for Climate Change Policymakers*' (wto.org, 2010) <https://www.wto.org/english/tratop_e/trips_e/ta_docs_e/8_3_overviewclimatechange_e.pdf> [accessed 20 April 2022]
- 'WTO | Intellectual Property (TRIPS) - TRIPS and Public Health: Compulsory Licensing of Pharmaceuticals and TRIPS', *World Trade Organization* <https://www.wto.org/english/tratop_e/trips_e/public_health_faq_e.htm> [accessed 17 November 2021]
- Xu, Bin, and Eric P Chiang, 'Trade, Patents and International Technology Diffusion', *The Journal of International Trade & Economic Development*, 14.1 (2005)
- Yang, Wei, Xiang Yu, Ben Zhang, and Ziyang Huang, 'Mapping the Landscape of International Technology Diffusion (1994–2017): Network Analysis of Transnational Patents', *The Journal of Technology Transfer*, 46.1 (2021)