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Sustainable Patent Governance of Artificial Intelligence: Recalibrating the European Patent System to Foster Innovation (SDG 9)

Guido Noto La Diega, Gabriele Cifrodelli, and Artha Dermawan*

Abstract: *This chapter reflects on what a sustainable patent governance looks like in the age of the rise of inventive AI. To do so, we critically evaluate the relationship between Artificial Intelligence, European patent law, and sustainability with a focus on the Sustainable Development Goal 9, i.e. to build resilient infrastructure, to promote inclusive and sustainable industrialisation, and to foster innovation. In particular, we consider SDG targets 9.1, 9.2, and 9.5 for their emphasis on equitable access to innovation, inclusive industrialisation, and an imperative to consider the national circumstances of developing countries. While the contribution of patent law to SDG 9 may prima facie appear as straightforward – both are all about promoting innovation – we problematise this relationship by shedding light on the unsustainability of patents. In Section 1, we analyse patent data related to climate change mitigation technologies to discover that, under the European Patent Convention, there has been a significant growth in AI-related patenting, but that developing countries are being left behind. In Section 2, to overcome the decreased access to innovation stemming from an inventive step requirement that does not match the reality of AI-powered ingenuity, we focus on AI datasets and suggest a recalibration that revolves around the concept of Therapeutics Data Commons. In Section 3, we suggest a more nuanced understanding of AI inventorship to include Global South perspectives.*

* While this chapter is a collaborative endeavour, Noto La Diega is primarily responsible for the introduction, section 1 and conclusion; Dermawan for section 2 (and relevant subsections); and Cifrodelli for section 3. We are grateful to the editors for this opportunity, and to Péter Mezei and Rosa Maria Ballardini for helpful suggestions and comments on a previous draft. We thank the anonymous peer reviewers for their helpful input. The responsibility for the content of this chapter and any errors herein remains ours.

Keywords: sustainable AI, climate change mitigation technologies, European patent law, inventive step, AI inventorship, sustainable patent governance, SDG 9

INTRODUCTION

This chapter advances a critical reflection on the relationship between artificial intelligence (AI), intellectual property (IP) and sustainability by exploring how a carefully calibrated European patent law can adequately support the use of AI to make progress towards UN Sustainable Development Goal (SDG) 9, ie to build resilient infrastructure, to promote inclusive and sustainable industrialisation, and to foster innovation.

The institutional design of the patent system makes inventors focus on the novelty and profitability of their inventions, rather than on their potential to tackle societal problems (eg 'green' patents).[1] This notwithstanding, inventions that further the interests of sustainability abound, to the point that the European Patent Office (EPO) established a new classification scheme for technical attributes of climate change mitigation technologies (CCMT).[2] This

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1 Mu-Yen Hsu, 'Green Patent: Promoting Innovation for Environment by Patent System', *PICMET '07 – 2007 Portland International Conference on Management of Engineering & Technology*, Portland: PICMET, 2007, 2491–2497. It has also been convincingly argued that, even though IP rights (IPRs) can provide an incentive to move in the direction of a circular economy, 'IP entitlements and their interpretations, as they currently stand, do not suffice to provide the proper incentives needed to trigger the transition' (Rosa Maria Ballardini and Taina Pihlajarinne, 'Incentivising Circular and Sustainable Innovations through Patent Law' in Eduardo Jacob-Lopes, Leila Queiroz Zepka and Mariany Costa Deprá (eds), *Handbook of Waste Biorefinery: Circular Economy of Renewable Energy*, New York: Springer Cham, 2022, 933–945, 933).

2 The new classification was created in 2012, building on a collaboration between the EPO, the United Nations Environmental Program (UNEP), and the International Centre on Trade and Sustainable Development (ICTSD). It has been revised, most notably in 2019 with the addition of class Y04W and further subclasses in Y02; indeed, initially there were only two subclasses: Y02C (greenhouse gas capture and storage) and Y02E

ostensible contradiction correlates to the fact that changes in policy and practice have been quicker to react to societal needs; eg after the UK introduced a fast-track programme for eco-friendly patent applications, many countries followed suit.[3]

As AI has moved from being a simple tool for climate change projections to developing or being embedded in solutions that tackle the sustainability goals,[4] the contribution of patents to sustainability can be gauged by how they incentivise such AI-related inventions.[5] For example, AI has proved to be able to support climate change adaptation by leveraging 'precise, real-time information in data-scarce settings',[6] thus supporting complex adaptation choices and implementation. While there is a consensus that AI already plays a significant role in achieving the SDGs, there is little empirical research to support this, especially about SDG 9.[7] Section 1 will address this gap by analysing CCMT patent data in Europe.

(energy generation, transmission or distribution). See Victor Veefkind et al, 'A New EPO Classification Scheme for Climate Change Mitigation Technologies' (2012) 34 *World Patent Information* 106–111.

3 Eric L Lane, 'Building the Global Green Patent Highway: A Proposal for International Harmonization of Green Technology Fast Track Programs' (2012) 27(2) *Berkeley Technology Law Journal* 1119–1170. See also the 'WIPO Green' programme, a technology transfer platform where businesses and public bodies can register their needs and their green technologies that they are willing to transfer.

4 So-Min Cheong, Kris Sankaran and Hamsa Bastani, 'Artificial Intelligence for Climate Change Adaptation' (2022) 12 WIREs Data Mining and Knowledge Discovery 1–7.

5 AI-related invention is an umbrella term to encompass inventions whose subject matter includes some form of AI ('AI inventions' are discussed in section 1) as well as AI-assisted and AI-generated inventions (analysed in section 2 and section 3 respectively).

6 So-Min Cheong, Kris Sankaran and Hamsa Bastani, 'Artificial Intelligence for Climate Change Adaptation' (2022) 12 WIREs Data Mining and Knowledge Discovery 1–7.

7 See eg the large-scale empirical study by Vilhelm Verendel, 'Tracking Artificial Intelligence in Climate Inventions with Patent Data' (2023) 13 *Nature Climate Change* 40–47. See also Ricardo Vinuesa et al,

The consensus around the positive role of AI in sustainability should not obscure the fact that AI can also hinder progress towards the SDGs as it can exacerbate existing socio-economic, racial, and environmental injustices, as well as creating new ones.[8] Similarly, patent law abuses or imbalanced patent protection can fail to adequately and sustainably incentivise AI innovation.[9] As a study of the international landscape of the inventive activity

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'The Role of Artificial Intelligence in Achieving the Sustainable Development Goals' (2020) 11(233) *Nature Communications* 1–10; Jaron Porciello, Maryia Ivanina, Maidul Islam and Haym Hirsh, 'Accelerating Evidence-Informed Decision-Making for the Sustainable Development Goals Using Machine Learning' (2020) 2(10) *Nature Machine Intelligence* 559–565.

8 For example, a recent book sheds lights on the fact that machine learning can both offer useful insights into racism, and provide examples of scientific racism (Ramon Amaro, *The Black Technical Object: On Machine Learning and the Aspiration of Black Being*, London: Sternberg Press, 2023). According to Ricardo Vinuesa et al, 'The Role of Artificial Intelligence in Achieving the Sustainable Development Goals' (2020) 11(233) *Nature Communications* 1–10, 2, AI can facilitate the achievement of 134 targets across all SDGs, but it can also prevent the achievement of 59 targets. For a focus on social and environmental injustice see Aimee van Wynsberghe, Tijs Vandemeulebroucke, Larissa Bolte and Jamila Nachid, Special Issue 'Towards the Sustainability of AI; Multi-Disciplinary Approaches to Investigate the Hidden Costs of AI' (2022) 14 *Sustainability* 16352, 1–4.

9 IP abuses (eg patent hold-up) predate AI, but they are more frequently observed in AI-dominated contexts, especially when coupled with quantum computing. For instance, it has been said that the strategic use of a mix of overlapping IPRs leads to overprotection and even IP protection in perpetuity, which in turn causes market barriers, hinders healthy competition and industry-specific innovation, and hampers the potential of emerging technologies to meet societal needs. See Mauritz Kop, 'Regulating Transformative Technology in the Quantum Age: Intellectual Property, Standardization & Sustainable Innovation' (2020) 2 *Stanford – Vienna Transatlantic Technology Law Forum, Transatlantic Antitrust and IPR Developments, Stanford University*.

has shown, only the 'major international economies are increasingly producing inventions'[10] that tackle climate change and related sustainability goals. Our study is in line with existing data showing that the Global North's patent dominance across technologies extends to CCMT, and is to the detriment of developing countries, thus ultimately frustrating the sustainability agenda. It is crucial that developing countries are fully supported to become leaders in the 'AI for sustainability' space, if we want to achieve climate justice and, more generally, meet the sustainability goals.[11] To some extent, the slowing down of patenting connected to the refusal to recognise AI systems as inventors may contribute to narrow the gap, as will be put forward later in the chapter.

While the currently slower contribution of developing countries to the patenting of AI innovation raises obvious concerns about the sustainability of patent governance, patent law's unsustainability can also be seen through the prism of limited access to patented technologies in developing countries (eg access to medicines) as well the dominant discourse around AI inventorship that rests on the Western-centric tenet that AI innovation does not require additional incentives. This will be the focus of sections 2 and 3.

[10] Francesco Pasimeni, Alessandro Fiorini and Aliki Georgakaki, 'International Landscape of the Inventive Activity on Climate Change Mitigation Technologies. A Patent Analysis' (2021) 36 *Energy Strategy Reviews* 100677, 1–14.

[11] The required changes should include among other things the replacement of bilateral agreements with 'a broader framework that permits developing economies to overcome negotiation deficiencies, thereby facilitating [patent licensing and knowledge transfer] to these countries' (Francesco Pasimeni, Alessandro Fiorini and Aliki Georgakaki, 'International Landscape of the Inventive Activity on Climate Change Mitigation Technologies. A Patent Analysis' (2021) 36 *Energy Strategy Reviews* 100677, 1–14, 10).

Against this backdrop, we will use a combination of patent data analysis[12] and doctrinal methods, infused with comparative insights,[13] to answer the following overarching research question: what does sustainable patent governance of AI innovation look like? To this end, we will critically evaluate the relationship between AI, IP and sustainability by focusing on three targets of SDG 9:

- 9.1: To develop quality, reliable, sustainable and resilient infrastructure, including regional and transborder infrastructure, to support economic development and human well-being, with a focus on affordable and equitable access for all;
- 9.2: To promote inclusive and sustainable industrialisation and, by 2030, significantly raise the industry's share of employment and gross domestic product, in line with national circumstances, and double its share in least developed countries;
- 9.5: To enhance scientific research and upgrade the technological capabilities of industrial sectors in all countries, in particular developing countries, including, by 2030, encouraging innovation.

Section 2 will focus on target 9.1 and, in particular, it will question how European patent law can ensure equitable access to AI-generated and AI-assisted innovation. While there is a growing body of literature that deals with the recalibration of the inventive step for AI-generated and AI-assisted inventions, this chapter recentres the debate in terms of sustainability and generalises lessons from the field of pharmaceuticals to AI innovation

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[12] Patent application data was extracted from the Espacenet database of the European Patent Office on 28 February 2023 and the analysis has been limited to European patents, specifically those in the CPC subclasses Y02 and Y04.

[13] While we do not claim that the chapter as a whole is a comparative endeavour, we have compared and contrasted European patent law with some foreign systems (notably, US and South Africa) where it has proved useful to answer our research question.

through the original proposal of a 'therapeutics data commons'. Section 3 will examine targets 9.2 and 9.5 by questioning whether the current approach to AI inventorship – with all countries except South Africa denying that AI can be an inventor – can be said to encourage innovation and promote sustainable industrialisation in a way that recognises the national circumstances of developing countries. Or rather, is it another example of the Global North ignoring the specific needs of the Global South, and obfuscating the fact that the latter's slower pace of innovation is rooted in a history of exploitation by the former?[14] By looking at AI inventorship through the lens of sustainability, we aim to contribute to overcoming the polarisation of the debate, thus promoting a more nuanced understanding of the world of artificial inventors, and their impact on society.

1 SUSTAINABLE AI AND EUROPEAN PATENT LAW: ADEQUATELY INCENTIVISING AI TO MAKE PROGRESS TOWARDS SDG 9

The relationship between IP and sustainability can be observed through manifold lenses. A comprehensive mapping of the literature is beyond the scope of this chapter; therefore we will limit ourselves to a few salient examples. Some scholars have called for a more robust IP framework in Africa to achieve the level of innovation that is required by SDG 9.[15] Other studies underline how IP national policies would benefit from including development considerations, given that '[d]evelopment intersects with IP policies as creativity and

[14] Cf Bawa Singh et al, 'COVID-19 and Global Distributive Justice: "Health Diplomacy" of India and South Africa for the TRIPS Waiver' (2022) *Journal of Asian and African Studies* 1–19.

[15] Kujo E McDave and Alexander Hackman-Aidoo, 'Africa and SDG 9: Toward a Framework for Development through Intellectual Property' (2021) 18 *US-China L. Rev.* 12–29. See also the examination of the debate about IP barriers to technology transfer to developing countries in Dalindyebo Shabalala, 'Intellectual Property, Climate Change and Development' (2016) 8(1) *WIPO Journal* 64–74.

innovation are either fostered or frustrated by an economy's chosen development policy'.[16] A recent monographic work[17] endeavours to align patent law and green technology with the SDGs and examines the effects of patent protection, technology transfer and compulsory licensing on the diffusion of green technologies.[18] The majority of studies focus on the *Agreement on Trade-Related Aspects of Intellectual Property Rights* (*TRIPS*) flexibilities and their use to improve access to medicines,[19] which led to the TRIPS waiver during the pandemic, although the latter has been regarded as a Pyrrhic victory.[20] There is a growing awareness that a commons-oriented approach to IP is more conducive to the SDGs.[21]

The literature about the triptych AI, IP and sustainability is still in its infancy.[22] For example, a forthcoming edited collection promoting multidisciplinary perspectives to

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16 Marsha Simone Cadogan, 'Using SDGs to Leverage National Intellectual Property Strategies' (2019) *New Thinking on SDGs and International Law—Policy Brief No. 2*, 1–6.

17 Ankit Singh and Yogendra Kumar Srivastava, *Patent Law, Green Technology and Innovation*, Abingdon and New York: Routledge, 2022.

18 There are also some older, albeit isolated, pioneering contributions, such as Ricardo Meléndez-Ortiz and Pedro Roffe (eds), *Intellectual Property and Sustainable Development: Development Agendas in a Changing World*, Cheltenham and Northampton (MA.): Edward Elgar Publishing, 2009.

19 See eg Duncan Matthews, 'TRIPS Flexibilities and Access to Medicines in Developing Countries: The Problem with Technical Assistance and Free Trade Agreements' (2005) 27 *European Intellectual Property Review* 420–427; Hakeem O Yusuf and Kamil Omoteso, 'Access to Medicine in Developing Countries: Elevating State Obligations over Corporate Profit' (2022) 29 *Ind. J. Global Legal Stud.* 131–161.

20 'TRIPS Waiver: An Insufficient Multilateral Response. TRIPS-Consistent National Actions are Called for', South Centre, 21 June 2022, https://www.southcentre.int/sc-statement-trips-waiver-21-june-2022/.

21 This is a common thread in Blake Hudson, Jonathan D Rosenbloom and Daniel H Cole (eds), *Routledge Handbook of the Study of the Commons*, Abingdon and New York: Routledge, 2020.

22 This is a strong argument in favour of the need for an edited collection such as this one. For a literature review, see Francesca Mazzi, 'The Intersections between Artificial Intelligence, Intellectual Property, and the

encourage the circular economy and sustainability sheds light on digital dispossession practices carried out by the big players of the Fourth Industrial Revolution through a combination of IP rights (IPRs), technological protection measures and contracts to prevent sustainability-friendly access to and reuse of data.[23] Another illustration is provided by a recent empirical study that has assessed the environmental and social impact of the increasing use of AI to create art.[24] The World Intellectual Property Organization (WIPO) has been leading the way in the development of AI for IP administration and service delivery, and sees this as pivotal to its contribution to developmental objectives.[25] Another noteworthy event is the creation in December 2022 of an IP research centre that is expressly devoted to sustainability studies, the NOVA Knowledge Centre on Intellectual Property & Sustainable Innovation (IPSI), in Lisbon.[26]

Sustainable Development Goals' in Francesca Mazzi (ed.), *The 2022 Yearbook of the Digital Governance Research Group*, New York: Springer Cham, 2023. [forthcoming. Cannot find page numbers. Guido: it will be published in June, I've asked Francesca for the page range now]

[23] Guido Noto La Diega and Estelle Derclaye, 'Opening up Big Data for Sustainability: What Role for Database Rights in the Fourth Industrial Revolution?' in Ole-Andreas Rognstad, Taina Pihlajarinne and Jukka Mähönen (eds), *Promoting Sustainable Innovation and the Circular Economy: Legal and Economic Aspects*, Abingdon and New York: Routledge, 2023. [forthcoming - Cannot find page numbers. Guido: the preprint is already available online as Stirling has paid for OA to this chapter, maybe we can refer to the preprint? https://ssrn.com/abstract=4220534]

[24] André Holzapfel, Petra Jääskeläinen and Anna-Kaisa Kaila, 'Environmental and Social Sustainability of Creative-Ai' (2022) *arXiv*:2209.12879 [cs.HC].

[25] WIPO, 'The Impact of Innovation. WIPO and the Sustainable Development Goals', https://www.wipo.int/sdgs/en/story.html.

[26] 'NOVA Knowledge Centre on Intellectual Property & Sustainable Innovation (IPSI)', 2022, https://novalaw.unl.pt/en/nova-knowledge-centre-on-intellectual-property-sustainable-innovation-ipsi/.

A more intense focus on the SDG by IP scholars would greatly benefit IP studies because it would show that innovation is not an end in and of itself: innovation is an instrumental good.[27] It is no accident that the WIPO policy paper on the SDGs opens with the statement that '*[w]e need innovation to help us rethink* how to overcome poverty, hunger and premature mortality, how to combat climate change and preserve our natural world, *how to optimize the use of artificial intelligence*, and how to shape the future of work'.[28] This is a useful reminder for those scholars who see maximum IP protection as the ideal status and who criticise any form of regulation of emerging technologies on the ground that it would stifle innovation.[29]

Zooming in on SDG 9, it is to a large extent self-explanatory that patent law is pivotal to it. Indeed, SDG 9 is regarded as '*the most central* to, and the *most closely aligned* with,

[27] Similarly, it has been noted that '[s]ustainable innovation deems welfare an intrinsic value and income generation an instrumental value' (António Abreu, *Innovation Ecosystems: A Sustainability Perspective*, Basel: MDPI, 2021, 257).

[28] WIPO, *Innovation Driving Human Progress. WIPO and the Sustainable Development Goals*, Geneva: WIPO, 2021, 1 (emphasis added).

[29] These stances are often rooted in neoliberal ideologies and have already been challenged. Most notably, the former has led to an abundance of studies on the negative space of IP, ie sectors where innovation thrive despite little or no IP protection (see eg Enrico Bonadio and Nicola Lucchi (eds), *Non-Conventional Copyright: Do New and Atypical Works Deserve Protection?*, Cheltenham and Northampton (MA.): Edward Elgar Publishing, 2018). As to the latter, many studies have convincingly argued that regulation fosters technological innovation; see eg Oliver Mallett, Robert Wapshott and Tim Vorley, 'How Do Regulations Affect SMEs? A Review of the Qualitative Evidence and a Research Agenda' (2019) 21(3) *International Journal of Management Reviews* 294–316.

[WIPO]'s mandate'[30] and the aforementioned policy paper notes that the 'link between innovation and economic and social progress is well established, and is expressly recognized in SDG 9'.[31] By contrast, the role of the patent governance of AI inventions in the context of SDG 9 deserves further elucidation.

At a basic level, the governance of AI by means of IP has a crucial role to play in making progress towards SDG 9 because IP is the legal mechanism whose function is to incentivise innovation and creativity. If AI models and systems can be used to tackle the societal problems that lie at the core of SDG 9, it follows that the combination of IP and AI has great potential to reach the SDG 9 targets. To expand on this, we will first examine patent data to assess the role of AI in sustainability-focused inventions, and then we will embrace a broader notion of AI sustainability to critically reflect on whether the current IP governance of AI is conducive to SDG 9.

We have examined patent data related to European patents and applications falling under the Y02 subclasses. These refer to new Cooperative Patent Classification (CPC) codes[32] introduced to account for the growth of technologies that can be loosely referred to as

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30 Committee on Development and Intellectual Property (CDIP), 'Report on WIPO's Contribution to the Implementation of the Sustainable Development Goals and Its Associated Targets', CDIP/26/3, 2021, 2, https://www.wipo.int/meetings/en/doc_details.jsp?doc_id=538971.

31 WIPO, *Innovation Driving Human Progress. WIPO and the Sustainable Development Goals*, Geneva: WIPO, 2021, 4.

32 Launched in January 2013, CPC is a harmonised patent classification scheme that is managed by the EPO and the United States Patent and Trademark Office; it is divided into sections, classes, subclasses and subgroups. Section Y includes: (i) general tagging of new technological developments; (ii) general tagging of cross-sectional technologies spanning over several sections of the International Patent Classification (IPC); (iii) technical subjects covered by former US Patent Classification (USPC) cross-reference art collections and digests. Codes are updated regularly, most recently in December 2021.

climate change mitigation technologies.[33] CCMTs are currently categorised under the following headings: adaptation to climate change (Y02A), buildings (Y02B), capture and storage of greenhouse gases (Y02C), ICT aiming at the reduction of own energy use (Y02D), production, distribution and transport of energy (Y02E), industry and agriculture (Y02P), transportation (Y02T), waste and wastewater (Y02W).[34]

A recent analysis of European patent applications falling under the code Y02 has noted that there are approximately 200 European (and UK) such applications mentioning AI either in the title, the abstract or the claims.[35] This may appear a relatively low number, compared to the overall 324,932 applications included in the relevant subclasses. However, we have widened the search beyond the generic reference to 'artificial intelligence' (returning 161 results)[36] to include the main AI techniques[37] and found a significant number of CCMT

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33 Unlike in the US, in European patent law and policy there is no dichotomy between climate change mitigation technologies and climate change adaptation technologies. Cf Kerstin Hötte and Su Jung Jee, 'Knowledge for a Warmer World: A Patent Analysis of Climate Change Adaptation Technologies' (2022) 183 *Technological Forecasting and Social Change* 121879, 1–19.

34 Subclass Y04S (smart grids) is relevant too but we have left it out of the scope for comparability purposes (the only study that has analysed AI-related sustainability-focused European patent applications, cited in the following footnote, has ignored Y04S).

35 Connor Crickmore and Julie Richardson, 'Artificial Intelligence Patent Applications Seeking to Combat Climate Change', *Reddie & Grose*, 31 May 2022, https://www.reddie.co.uk/2022/05/31/artificial-intelligence-patent-applications-seeking-to-combat-climate-change/, who note that AI-related sustainability-focused patent applications have to be drafted carefully to prove that the contribution is technical in nature.

36 The previous study refers to approximately 200 patents as it also includes UK patent applications, which we have excluded.

37 The identification of these techniques resulted from a combination of the draft AI Act ontology (Annex I) and a review of the literature analysing AI techniques used for sustainability, eg So-Min Cheong, Kris

applications using automation methods (4,639), machine learning (1,449), neural networks (762), robotics (422), data mining (234), logic-based approaches (196), knowledge-based approaches (166), and natural language processing (85). This means that approximately 2.5%[38] of all the patents in Y02 use some AI technique to make progress towards climate change adaptation and mitigation. The top application domains are industry and agriculture; ICT aiming at the reduction of its own energy use; and production, distribution and transport of energy. Examples of these AI-related CCMT inventions include among others methods to reduce power consumption (and, consequently, pollution) in AI processors,[39] neural network sewage treatment systems,[40] and computer-implemented inventions that use machine learning to predict electric car charging point use.[41] It may come as a surprise that only two of the top applicants – based on the number of applications – are based in Europe, whereas US and Asian companies lead the way (see Table 1 below). This confirms wider concerns of European innovation still lagging.[42]

Sankaran and Hamsa Bastani, 'Artificial Intelligence for Climate Change Adaptation' (2022) 12 *WIREs Data Mining and Knowledge Discovery* 1–7.

[38] The limitations of this number are that some inventions will employ more than one technique, that we may have overlooked some techniques in use, and that there is still contention as to what qualifies as AI.

[39] EP3895076A1 'Power Optimization in an Artificial Intelligence Processor' by Groq Inc.

[40] EP1376276A1 'An AI based control system and method for treating sewage/waste water by means of a neural network and a back-propagation algorithm' by H2L Co, Ltd.

[41] EP4135358 'Method, apparatus, and computer program product for predicting electric vehicle charge point utilization' by Here Global BV.

[42] Of all European patent applications, 25% are from applicants in the US, 14% Germany, 11% Japan, 9% People's Republic of China, and 5% from South Korea. Data: EPO Patent Index 2021, based on European patent applications as of 1 February 2022.

Table 1. Top 10 applicants – European and British patent applications referring to 'Artificial Intelligence' in the CPC code Y02

Applicants	**Count of Applicants**
Rockwell Automation Tech Inc [US]	16
Siemens AG [Germany]	11
LG Electronics Inc [Republic of Korea]	9
Huawei Tech Co Ltd [China]	9
Gen Electric [US]	5
Samsung Electronics Co Ltd [Republic of Korea]	3
Beijing Baidu Netcom Sci & Tech Co Ltd [China]	3
Boeing Co [US]	3
Qualcomm Inc [US]	2
Guangdong Oppo Mobile Telecomms Corp Ltd [China]	2

With the exception of the rising role of Korea, this data is in line with a larger-scale study of over 250,000 CCMT patents that shows that the US, Japan and Germany are leading the way and that '[e]xcept for inventors in China, most middle-income economies have not caught up and remain less specialized in low-carbon technologies than high-income economies'.[43] The relatively minor role of countries from the Global South in AI-for-sustainability patenting is at odds with their role as protagonists in the context of the SDGs. If SDG 9 is about the equitable access to (and not just the encouragement of) innovation, the system must be recalibrated to make sure that developing countries are not left out.

43 Benedict Probst et al, 'Global Trends in the Invention and Diffusion of Climate Change Mitigation Technologies' (2021) 6 *Nature Energy* 1077–1086.

With a considerable number of AI-related inventions designed to tackle climate change, and with 69% of them filed since 2016,[44] patents are fostering AI innovation at a growing pace. This growth can be regarded as conducive to SDG 9. At the same time, it can be regarded as hampering SDG9. SDGs are universal while access to these technologies is confined to a handful of wealthy countries. It would be in line with SDGs if development and transfer of AI technologies is ensured across the globe. The study of patent data itself is of little help when it comes to understanding whether inclusive and sustainable industrialisation is also being promoted. Indeed, the phrase 'sustainable patent law' cannot be limited to measuring the effectivity of the patent incentive by looking at how many AI-related MCCTs exist. We must embrace a wider concept of AI sustainability. Adopting a recently proposed analytical framework, sustainable AI is framed as 'a movement to foster change in the entire lifecycle of AI products towards greater ecological integrity and social justice'.[45] Sustainable AI goes beyond the innovations that apply AI to sustainability. Rather, 'it is about how to develop AI that is compatible with sustaining environmental resources for current and future generations; economic models for societies; and societal values that are fundamental to a given society'.[46] With this in mind – and to answer the overarching research question 'what does a sustainable patent governance of AI innovation look like?' – we will dedicate the following sections to the recalibration of the inventive step to ensure equitable access to AI-aided innovation, and to the rethinking of the AI inventorship debate to reflect on how we can

[44] Connor Crickmore and Julie Richardson, 'Artificial Intelligence Patent Applications Seeking to Combat Climate Change', *Reddie & Grose*, 31 May 2022, https://www.reddie.co.uk/2022/05/31/artificial-intelligence-patent-applications-seeking-to-combat-climate-change/.

[45] Aimee van Wynsberghe, 'Sustainable AI: AI for Sustainability and the Sustainability of AI' (2021) 1 *AI and Ethics* 213–218, 217.

[46] Ibid.

promote inclusive and sustainable industrialisation, in a way that reflects the needs of developing countries, as required by SDG 9.

2 RECALIBRATING THE INVENTIVE STEP TO ENSURE EQUITABLE ACCESS TO A QUALITY, RELIABLE, SUSTAINABLE AND RESILIENT INFRASTRUCTURE THROUGH DATA COMMONS: LESSONS FROM THE PHARMACEUTICAL INDUSTRY

This section takes the role of AI in the pharmaceutical industry as an example of how patenting can contribute to achieving a sustainable and resilient health system to support human well-being, and affordable and equitable access for all, pursuant to target 9.1 of SDG 9.[47] AI has the potential to address some of the biggest challenges that society faces in the healthcare industry, including drug discovery and access to affordable medicines.[48] Drug discovery is the most challenging aspect of drug research and development (R&D).[49] As developing new drugs necessitates expertise in a wide range of biological and chemical

[47] A recent study found 'a new dimension emphasizing the possibility of tailoring the pharmaceutical industry's activities under the sustainability agenda to strengthen global health security while remaining consistent with the One Health approach. See Kanika Saxena, Sunita Balani and Pallavi Srivastava, 'The Role of Pharmaceuticals Industry in Building Resilient Health System' (2022) 10 *Frontiers in Public Health* 1–16, https://www.frontiersin.org/articles/10.3389/fpubh.2022.964899/full.

[48] Kutoma Wakunuma, Tilimbe Jiya and Suleiman Aliyu, 'Socio-Ethical Implications of Using AI in Accelerating SDG3 in Least Developed Countries' (2020) 4 *Journal of Responsible Technology* 100006. See Sezen Vatansever et al, 'Artificial Intelligence and Machine Learning-Aided Drug Discovery in Central Nervous System Diseases: State-of-the-arts and Future Directions' (2021) 41(3) *Medical Research Reviews* 1427–1473, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8043990/.

[49] Also largely considered as a difficult and expensive task. Kit-Kay Mak and Mallikarjuna Rao Pichika, 'Artificial Intelligence in Drug Development: Present Status and Future Prospects' (2019) 24 *Drug Discovery Today* 773–780, 775.

fields,[50] as well as in several subtasks such as drug repositioning,[51] disease target identification,[52] drug target interaction,[53] drug combinations[54] and drug toxicity predictions.[55] Despite these challenges, AI-generated and AI-assisted inventions (with an increasing role played by machine learning) have been shown to accelerate R&D and clinical trials of the drug discovery pipeline[56] and have been capable of 'screening compounds 100 times faster

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50 Stephen Bonner et al, 'A Review of Biomedical Datasets Relating to Drug Discovery: A Knowledge Graph Perspective' (2022) 23(6) *Briefings in Bioinformatics* 1–19.

51 Drug repositioning or drug repurposing 'involves exploring new medical uses for existing drugs, including approved, discontinued, shelved and investigational therapeutics'. Alan Talevi, 'Drug Repurposing' in Terry Kenakin (ed.), *Comprehensive Pharmacology*, North Carolina and New York: Elsevier, 2022, 813–824.

52 Assessing which molecular entities, including genes and proteins, are implicated in causing or maintaining a disease, as noted by Stephen Bonner, et al, 'A Review of Biomedical Datasets Relating to Drug Discovery: A Knowledge Graph Perspective' (2022) 23(6) *Briefings in Bioinformatics* 1–19, 4.

53 Drug target interaction refers to 'the recognition of interactions between chemical compounds and the protein targets in the human body' (Kanica Sachdev and Manoj Kumar Gupta, 'A Comprehensive Review of Feature-Based Methods for Drug Target Interaction Prediction' (2019) 93 *Journal of Biomedical Informatics* 103159, 1–19, https://www.sciencedirect.com/science/article/pii/S1532046419300772).

54 The purpose of this subtask is to assess the benefit, or toxicity consequences of more than one drug being present and interacting with the biological system. See Stephen Bonner, et al, 'A Review of Biomedical Datasets Relating to Drug Discovery: A Knowledge Graph Perspective' (2022) 23(1) *Briefings in Bioinformatics* 1–19.

55 According to Jiarui Chen et al, 'Chemical Toxicity Prediction Based on Semi-Supervised Learning and Graph Convolutional Neural Network' (2021) 13(93) *Journal of Cheminformatics* 1–16, 1, 'the fundamental strategy in modern drug discovery and development is to identify chemical compounds that potently and selectively modulate the functions of the target molecules to elicit a desired biological response'.

56 Bowen Lou and Lynn Wu, 'AI on Drugs: Can Artificial Intelligence Accelerate Drug Development? Evidence from a Large-scale Examination of Bio-pharma Firms' (2021) *MIS Quarterly* 1451–1482.

than humans using conventional approaches'.[57] The COVID-19 pandemic has been a prominent example of how AI-generated and AI-powered reverse vaccinology[58] can find novel and effective antiviral vaccine candidates by using different AI datasets[59] to identify several potential existing drugs that can work as inhibitors of human coronaviruses.

Moreover, AI has proven beneficial in accelerating the drug discovery subtasks such as in drug toxicity predictions, where the Graph Convolution Neural Network was able to predict chemical toxicity by training the network with the Mean Teacher Semi-Supervised Learning algorithm.[60] AI has the potential to make medicines more affordable by accelerating the R&D timeline; indeed, 'implementing AI can reduce the time of the clinical research

57 Matthew Hashemi, 'Inventing the Right Drug: Artificial Intelligence May Just be the Cure for an Antiquated Patent System' (2022) *30 Journal of Intellectual Property Law* 169, 182.

58 As Ashwani Sharma et al note, '[r]everse vaccinology (RV) was introduced in the early 1990s as a genome-based vaccine design approach and attributed to the reason that bacterial culturing was no longer needed for selecting vaccine targets' (Ashwani Sharma et al, 'Artificial Intelligence-Based Data-Driven Strategy to Accelerate Research, Development, and Clinical Trials of COVID Vaccine' (2022) *Biomed Research International* 7205241, 1–16, 2, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9279074/).

59 Previous research shows that AI tools and computational approaches have led to speedy research and the development of a vaccine to fight against the coronavirus. See AS Ahuja, VP Reddy, and O Marques, 'Artificial Intelligence and COVID-19: A Multidisciplinary Approach' (2020) 9(3) *Integrative Medicine Research* 100434.

60 With the Semi-Supervised Learning-Graph Convolution Neural Network model, scientists were able to predict the 12 toxicological endpoints and achieved 'an average ROC-AUC score of 0.757 in the test set, which is a 6% improvement over GCN models trained by supervised learning and conventional [machine learning] methods' (Jiarui Chen et al, 'Chemical Toxicity Prediction Based on Semi-Supervised Learning and Graph Convolutional Neural Network' (2021) 13(93) *Journal of Cheminformatics* 1–16, 1. ROC-AUC (Area Under the Curve-Receiver Operating Characteristics) is a performance measurement curve that has widespread use as an evaluation metric tool for machine learning models.

phase by 40% to 50% and reduce costs for U.S. pharmaceutical companies by as much as $54 billion in R&D costs annually'.[61]

However, the use of AI in the industry is not without its problems. The ensuing accelerated invention process, combined with the vertical decrease in the cost of the relevant AI tools, 'may lead to an increase of patenting activity, which might in turn lead to low quality of patents'.[62] Legal scholars have also expressed the concern that pharmaceutical companies could use AI to abuse the patent system,[63] Against this backdrop, the inventive

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61 Matthew Hashemi, 'Inventing the Right Drug: Artificial Intelligence May Just Be the Cure for an Antiquated Patent System' (2022) 30 *Journal of Intellectual Property Law* 169–188, 183. See Kevin Gawora, 'Fact of the Week: Artificial Intelligence Can Save Pharmaceutical Companies Almost $54 Billion in R&D Costs Each Year', *Information Technology & Innovation Foundation*, 7 December 2020, https://itif.org/publications/2020/12/07/fact-week-artificial-intelligence-can-save-pharmaceutical-companies-almost/.

62 Ana Ramalho, 'Patentability of AI-Generated Inventions: Is a Reform of the Patent System Needed?' (2018) *IIP* 1. Prior to the use of AI, several empirical studies have shown the relationship between increase of patenting activities and low quality of patents. See inter alia Janet Freilich, 'The Replicability Crisis in Patent Law' (2022) 95 *Indiana Law Journal* 431. This study examined 500 patents and found that 'experiments in patents have very poor methodological quality, which means that they are likely irreplicable at rates at least as high as experiments in scientific journals'; Shawn Miller, 'Where's the Innovation? An Analysis of the Quantity and Qualities of Anticipated and Obvious Patents' (2012) https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2029263.

63 The concern is not without merit, recent study from I-MAK finds that 'on average, across the top 12 grossing drugs in America [US]: (1) there are 125 patent applications filed and 71 granted patents per drug; (2) branded drug prices have increased by 68 percent since 2012, and only one of the top 12 drugs has actually decreased in price; (3) there are 38 years of attempted patent protection blocking generic competition sought by drugmakers for each of these top grossing drugs – or nearly double the 20-year monopoly intended under U.S. patent law; (4) these top-grossing drugs have already been on the U.S. market for 15 years; and (5) over half of the top 12 drugs in America have more than 100 attempted patents per drug. I-MAK, 'Overpatented,

step, one of the most important patentability requirements in European patent law (equivalent to non-obviousness under US patent law), might need to be recalibrated if we want to achieve equitable access to innovation under SDG 9. This requirement plays a crucial role[64] especially in the context of AI-generated inventions, as there is a mismatch between the standards used by patent examiners – moulded on the romantic paradigm of the individual inventor surrounded by mountains of old books – and the reality of AI-fuelled inventiveness.[65] With this in mind, the following subsection will address the question of how to recalibrate the inventive step to achieve affordable and equitable access to AI-generated inventions for all. Much attention has already been paid to the algorithms of AI.[66] Unlike the existing literature, this section focuses on the role of AI datasets and how

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Overpriced: How Excessive Pharmaceutical Patenting is Extending Monopolies and Driving up Drug Prices’ (2018) http://www.i-mak.org/wp-content/uploads/2018/08/I-MAK-Overpatented-Overpriced-Report.pdf. See several legal scholars who expressed their concerns inter alia Holger Hestermeyer, *Human Rights and the WTO: The Case of Patents and Access to Medicines*, Oxford: Oxford Academic, 2009, 137; Olga Gurgula, ‘AI-Assisted Inventions in the Field of Drug Discovery: Readjusting the Inventive Step Analysis’ (2020) 2(8) *International Journal of Social Science and Public Policy* 7–21; Guido Noto La Diega, ‘Can Artificial Intelligence and the Internet of Things Be Governed to Achieve the UN Sustainable Development Goals? An Intellectual Property Law Perspective’, *WTO Public Forum*, AIPPI’s Working Session ‘New Digital Technologies: The protagonists of a change in perspective in the Global Supply Chain’, 9 October 2019, https://ssrn.com/abstract=3505247.

[64] Because ’the inventive step requirement is intended to prevent exclusive rights forming barriers to normal and routine development.‘ European Patent Office, ’European Patent Guide’, Chapter 3, 3.4.

[65] Ana Ramalho, ‘Patentability of AI-Generated Inventions: Is a Reform of the Patent System Needed?’ (2018) *IIP* 1.

[66] See among others, ibid; Matthew Hashemi, ‘Inventing the Right Drug: Artificial Intelligence May Just Be the Cure for an Antiquated Patent System’ (2022) *30 Journal of Intellectual Property Law* 169–188; Noam Shemtov and Garry Gabison, ‘The Inventive Step Requirement and the Rise of the AI Machines’ in Ryan

these data cause problems for the application of the inventive step under the European Patent Convention (EPC).[67]

2.1 Inventive step, PSITA and approaches to (non-)obviousness

Under article 56 of the EPC, 'an invention shall be considered as involving an inventive step if, having regard to the state of the art, it is not obvious to a person skilled in the art'.[68] This definition warrants a closer inspection of the most prominent legal fiction in European patent law: the person skilled in the art (PSITA). According to the Guidelines for Examination of the European Patent Office, a PSITA is 'presumed to be a skilled practitioner in the relevant field of technology who is possessed of average knowledge and ability (average skilled person)'.[69] While it is assumed that the PSITA has access to all the state of the art at the

Abbott (ed.), *Research Handbook on Intellectual Property and Artificial Intelligence,* Cheltenham and Northampton (MA.): Edward Elgar Publishing, 2022, 423; Ryan Abbott, 'Everything is Obvious' (2019) 66 *UCLA Law Review* 2–52.

[67] See Maurice Schellekens, 'Artificial Intelligence and Re-Imagination of Inventive Step' (2022) 13(2) *Journal of Intellectual Property, Information Technology and E-Commerce Law* 89–98.

[68] According to the Guidelines for Examination, 'obvious' 'means that which does not go beyond the normal progress of technology but merely follows plainly or logically from the prior art, i.e., something which does not involve the exercise of any skill or ability beyond that to be expected of the person skilled in the art' (European Patent Office, 'Guidelines for Examination', Part G, Chapter VII, 4). See for further analysis on the inventive step, Richard Davis, Thomas St Quintin and Guy Tritton, *Tritton on Intellectual Property in Europe*, London: Sweet & Maxwell, 5th ed, 2018, 103.

[69] European Patent Office, 'Guidelines for Examination', Part G, Chapter VII, 3. The German Federal Court of Justice (Bundesgerichtshof or BGH) defines a PSITA as the person who is often tasked with solving a problem who is knowledgeable in the invention's technological sector (BGH, 24 March 1998 – X ZR 39/95 – *Leuchtstoff* (fluorescent substance) [1998] *GRUR* 1003, 1004). The German Federal Court of Justice additionally emphasised that 'a PSITA is neither the user nor prospective customer nor purchaser nor contractor of the claimed subject matter' (BGH, 17 November 2009 – X ZR 49/08 – *Hundefutterbeutel* (dog food bag).

relevant date,[70] 'access' does not equate to 'knowledge'. Indeed, a PSITA is not expected to know everything; for example, a single publication (eg, a technical journal) will not in principle be considered common general knowledge.[71] The PSITA does not exhibit inventive ingenuity and cannot think laterally.[72]

To better understand the role of the PSITA, the example of a patent application on drug discovery comprising applications of machine learning with differential geometric modelling is a good start.[73] Machine learning is used to seek to predict the characteristics of biomolecular complexes using the combination of geometric modelling trained with element

Moreover, the PSITA working in the inventive sector is a hypothetical regular expert with typical knowledge, experience and abilities who is specified for each definite case. German Patent and Trademark Office, 'Information on Inventive Step.' https://www.wipo.int/export/sites/www/scp/en/meetings/session_22/comments_received/germany.pdf.

70 Ibid. European Patent Office, 'Guidelines for Examination', Part G, Chapter VII, 3.

71 European Patent Office, Boards of Appeals, T 0475/88 of 23 November 1989, EP:BA:1989:T047588.19891123.

72 This is particularly clear in national jurisprudence eg, the English case *Rockwater Ltd v Technip France SA* [2004] EWCA Civ 381 and the Italian case Tribunale di Milano 12 February 2014 [2016] *Commentario Ubertazzi* 380. This is along the same line as the Australian concept of 'scintilla of inventiveness' (see *Cronk v Commissioner of Patents* [2014] FCA 37). See more generally Massimo Scuffi, Mario Franzosi and Aldo Fittante, *Il codice della proprietà industriale*, Padua: CEDAM, 2005, 262 ff.

73 This section will use a patent application in the US, as examples of applications of AI-generated inventions in the pharmaceutical industry in the EU are very difficult to find. See USPTO, Patent Application Number US20210027862A1, https://patents.google.com/patent/US20210027862A1/en?q=(drug+and+machine+learning)&oq=drug+and+machine+learning.

interactive curvature.[74] When the claimed invention modifies a previously disclosed machine learning model for geometric modelling, the patent office will assess whether the concept of using the method was well known to a PSITA.[75] Moreover, to analyse the inventive step in an 'objective and predictable manner'[76] in the above patent application, the problem-solution approach is applied. This consists of three main stages: assessing the closest prior art, solving the objective technical problem, and evaluating whether the claimed invention would have been obvious to a PSITA given the closest prior art and the objective technical problem on the priority date.[77]

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74 An important issue in molecular biophysics, element interactive curvature is the smoothness and curvedness of a given biomolecular surface. See Duc Duc Nguyen and Guo-Wei Wei, 'DG-GL: Differential Geometry Based Geometric Learning of Molecular Datasets' (2018) *arXiv*, https://arxiv.org/pdf/1806.03765.pdf.

75 As this is a US patent application, the US PSITA requirements would apply, but the substance remains the same. The patent office will find out whether a PSITA would be likely to think of making the applied invention. See also the analysis of the inventive step in Raphael Zingg, 'Foundational Patents in Artificial Intelligence' in Jyh-An Lee, Reto Hilty and Kung-Chung Liu (eds), *Artificial Intelligence and Intellectual Property*, Oxford: Oxford University Press, 2021, 75–98, 91.

76 European Patent Office, 'Guidelines for Examination, Part G, Chapter VII, 5.

77 European Patent Office, 'Guidelines for Examination, Part G, Chapter VII, 5. The three basic tests stipulated by the German court in assessing obviousness are a good comparison. The court developed the following guidelines based on the EPO's problem-solution approach: '(i) Which steps would an average person skilled in the art have to carry out to arrive at the teaching of the application or patent? (ii) Would the average person skilled in the art have cause to direct his or her thinking in this direction? (iii) What in the present case at hand argues for or against the average person skilled in the art carrying out these considerations and arriving at the solution claimed in the application or patent?' See BGH 16 December 2008 – X ZR 89/07 [2009] *GRUR* 382. See also Paul England, 'Inventive Step in Europe and the UPC' (2018) 13 *Journal of Intellectual Property and Practice* 534–541, 537. The reason the court decided on the above test was that the EPO's problem-solution approach was considered too narrow.

2.2 MSITA and AI datasets: The missing link in the inventive process?

The application of the inventive step requirement as currently centred on the PSITA is cause for concern, especially in the context of AI-generated inventions. There is a clear divergence between a PSITA's capabilities and AI capabilities: AI-generated inventions lacking genuine inventiveness would be non-obvious – hence, patentable – to a PSITA, thus potentially causing patent flooding and an unwarranted propertisation of knowledge, to the detriment of those wanting to access it,[78] especially in the Global South. The more knowledgeable and capable of ingenuity this hypothetical person is, the harder it will be for the applicant to meet the 'inventive step' requirement, because it will be likely that such a person will consider the invention obvious and thus not patentable. And the opposite is also true, a PSITA that is considerably less skilled than the actual average inventor will make it easier to patent inventions that add little to the existing stock of knowledge, with ensuing risks of unwarranted monopolies and bottlenecks in the access to innovation. The unsustainability of restricting access to innovation is particularly evident in the pharmaceutical field (where insufficient access to medicines is causing health crises in developing countries) and it is exacerbated by the increasing use of AI as a tool to invent.[79]

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[78] Ana Ramalho, 'Patentability of AI-Generated Inventions: Is a Reform of the Patent System Needed?' (2018) *IIP* 1. See also Olga Gurgula, 'AI-Assisted Inventions in the Field of Drug Discovery: Readjusting the Inventive Step Analysis' (2020) *International Journal of Social Science and Public Policy* 7–21, 13 discussing the same problem.

[79] Recent study concludes that 'the inability of the current health innovation and access ecosystem to provide equitable access to lifesaving technologies has never been so clear.' Gaëlle Krikorian and Els Torreele, 'We Cannot Win the Access to Medicines Struggle Using the Same Thinking That Causes the Chronic Access Crisis' (2021) *Health Hum Rights* 119-127.

We believe that, as part of a more sustainable governance of patent law, the inventive step should be recalibrated, and that AI makes this move urgent. To corroborate this claim, it is useful to go back to expand on the concept of a PSITA. The latter is presumed to have ’the means and capacity for routine work and experimentation which are normal for the field of technology in question’.[80] This begs the question of whether AI has become a normal tool for routine work and experimentation in the industry.[81] Although AI is already widely used, currently it is unlikely that AI becomes a normal tool for routine work in the industry on a global scale.[82] While an invention is assisted by AI, the use of AI in the invention may not be considered during the examination, as the PSITA is not familiar with its use. There are several solutions offered to elevate the patent standards in the age of AI. Most of them can be regarded as incremental or non-radical: (i) the definition of PSITA should take AI knowledge and skills into account;[83] and (ii) a PSITA should be equipped with or have access to AI.[84] A more radical proposal argues for the establishment of the machine skilled-in-the-art (MSITA) standard.[85] MSITA is a concept where machines augment PSITA’s capabilities and could

[80] European Patent Office, ‘Guidelines for Examination, Part G, Chapter VII, 3.

[81] Olga Gurgula, ‘AI-Assisted Inventions in the Field of Drug Discovery: Readjusting the Inventive Step Analysis’ (2020) *International Journal of Social Science and Public Policy* 7–21, 13.

[82] Cf Maurice Schellekens, ‘Artificial Intelligence and Re-Imagination of Inventive Step’ (2022) 13(2) *Journal of Intellectual Property, Information Technology and E-Commerce Law* 89–98.

[83] Daria Kim et al, ‘Clarifying Assumptions about Artificial Intelligence before Revolutionising Patent Law’ (2022) 71(4) *GRUR International* 295–321, 300.

[84] Olga Gurgula, ‘AI-Assisted Inventions in the Field of Drug Discovery: Readjusting the Inventive Step Analysis’ (2020) *International Journal of Social Science and Public Policy* 7–21.

[85] See among others, Daniele Fabris, ‘From the PHOSITA to the MOSITA: Will “Secondary Considerations” Save Pharmaceutical Patents from Artificial Intelligence?’ (2020) 51 *IIC* 685–708, 690; Ryan Abbott, ‘Everything is Obvious’ (2018) 66 *UCLA L. Rev*. 2–52, 37; Liza Vertinsky and Todd M Rice, ‘Thinking

standardise research in their respective fields.[86] The subsequent analysis will focus on the latter proposal.

In general, there are two important components of AI-based drug discovery that lead to invention and would be part of the inventive process, namely the algorithms and the datasets. As Figure 1 shows, the algorithms and datasets are inseparable because 'AI thrives on datasets as necessary inputs for training algorithms'.[87]

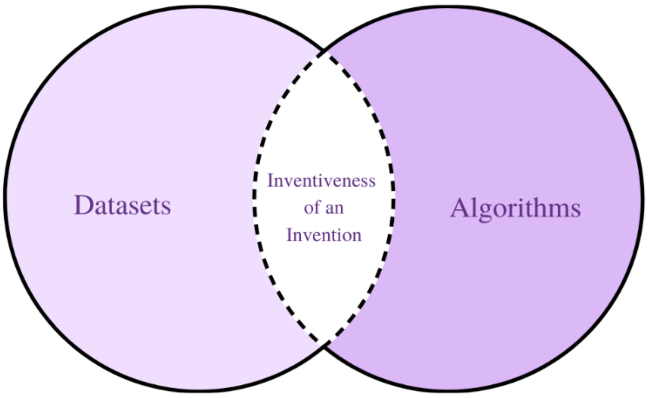

Figure 1. The relationship between AI dataset, algorithms, and inventiveness.

Moreover, the choice of the datasets both by the patent applicant and the MSITA could raise several issues as follows. First, by letting the MSITA run on the same datasets as the patent applicant, the patent examination processes filter out the effects of the process of choosing the right datasets. This would allow the examiner to focus the assessment of the inventiveness

About Thinking Machines: Implications of Machine Inventors for Patent Law' (2002) 8(2) *B. U. J. Sci. & Tech. L.* 574–613, 586; Ryan Abbott, 'I Think, Therefore I Invent: Creative Computers and the Future of Patent Law' (2016) 57(4) *B.C.L. Rev.* 1079–1126, 1081.

86 Daniele Fabris, 'From the PHOSITA to the MOSITA: Will "Secondary Considerations" Save Pharmaceutical Patents from Artificial Intelligence?' (2020) 51 *IIC* 685–708.

87 Bertin Martens, 'The Impact of Data Access Regimes on Artificial Intelligence and Machine Learning' *JRC Digital Economy Working Paper No. 2018-09*, European Commission, Joint Research Centre (JRC), 2018, https://www.econstor.eu/bitstream/10419/202237/1/jrc-dewp201809.pdf. This does not mean that datasets are used only for training purposes (eg, validation and testing).

on the training algorithms. Moreover, if MSITA takes the place of the PSITA, the examination process would show what is within the capabilities of MSITA and what is beyond its capabilities, and this could lead to inventiveness.[88] This brings us to the second issue: determining if inventiveness derives from the AI datasets is important since only AI algorithms trained with 'rich' datasets could deliver innovative solutions.

In the case of MSITA using the same big and 'rich' datasets as the patent applicant, MSITA would have arrived at the invention that would have been regarded as obvious.[89]

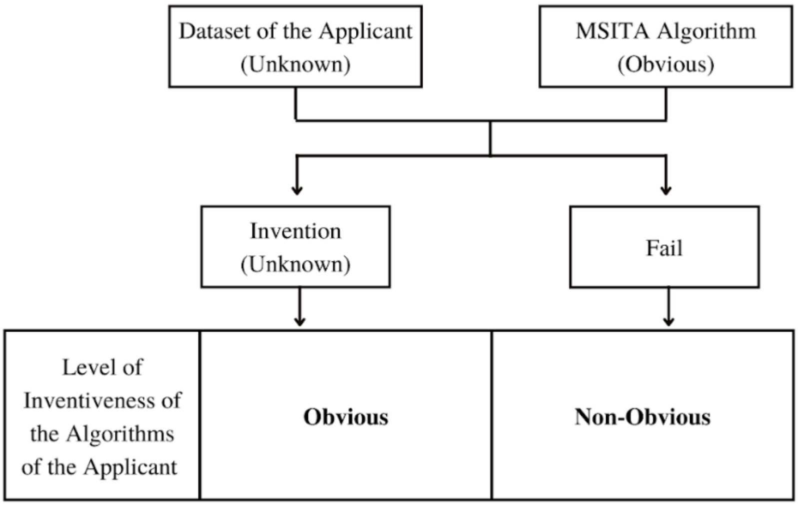

Figure 2. The inventiveness of the algorithms of the patent applicant.

The reasoning assumes that patent applicants disclose the AI datasets being used during the examination process. However, if the patent applicant, were to disclose their AI datasets during the assessment, patent law would become less desirable for protecting AI-generated inventions, especially 'when datasets are used that are non-public and where their non-public

88 Maurice Schellekens, 'Artificial Intelligence and Re-Imagination of Inventive Step' (2022) 13(2) *Journal of Intellectual Property, Information Technology and E-Commerce Law* 89–98, 94.

89 This only occurs because the rich (non-public) medical dataset is treated as if it belongs to MSITA, as noted ibid, 94.

nature contributes to the value of the dataset’.[90] The use of the same datasets by applicants and MSITAs is feared to raise issues related to confidentiality, transparency of the patent examination, and efficiency. Therefore, we suggest that the EPO could use different AI datasets to rebalance patent standards and simultaneously promote innovation to all fields of AI-generated inventions. The use of different AI datasets is briefly discussed in the next section.

2.3 Public AI datasets: Introducing therapeutics data commons

This chapter considers two policy options to raise the inventive step standards in the patent system to prevent overprotection of AI-generated innovation. First, the European Patent Office could equip PSITA with large publicly available AI datasets. Second, if in the future it is deemed necessary to establish MSITA – based on a deeper understanding of AI trends in the relevant industry – MSITA could use different datasets to the patent applicants. In this scenario, the database would consist of large datasets for AI, as ‘a large dataset has the effect of heightening the bar of inventiveness’.[91] This section presents AI medical datasets as an example; however, the overall analysis in this chapter can be applied to all AI-generated inventions, considering the growing importance of datasets to any AI algorithms. Most AI developers use medical datasets that can be obtained online.[92] Unfortunately, not all datasets are free, which is problematic from the perspective of SDG 9 given its emphasis on equitable

90 Ibid.

91 Ibid, 95. According to the European Patent Guide, ’Inventive step is usually evaluated on the basis of the "problem/solution" approach, in other words whether the solution presented to the problem in the patent application is obvious or not to the person skilled in the art.’ European Patent Office, ’European Patent Guide’, Chapter 3, 3.4.002.

92 Altexsoft, ‘Medical Datasets for Machine Learning: Aims, Types, and Common Use Cases’, 2022, https://www.altexsoft.com/blog/medical-datasets/.

access. Table 2 provides a non-exhaustive list of freely available medical datasets that can be used for training AI algorithms for drug discovery purposes.

Table 2. Five worldwide free public datasets for AI.[93]

Datasets	Size	Focus	Application program interface
The Cancer Imaging Archive (TCIA)	39 million images	Cancer imaging archive with 21 types of cancer	Accessible for machine learning developer
Musculoskeletal Radiographs (MURA)	40,561 radiographs	Dataset of musculoskeletal radiographs (bone X-Ray)	Accessible for machine learning developers
Medical Information Mart for Intensive Care (MIMIC)	53,423 data of adult hospital admissions	Deidentified health-related data of over 40,000 patients in intensive care	Accessible for machine learning developers with PhysioNet Credentialed Health Data License 1.5.0
Global Health Observatory (GHO)	Data from 194 WHO members	WHO's gateway to health-related statistics for its 194 Member States	Accessible for machine learning developers
The Cancer	20,000 datasets	33 types of cancer	Accessible for machine

[93] Compiled from multiple sources. See The Cancer Imaging Archive (TCIA), https://imaging.cancer.gov/informatics/cancer_imaging_archive.htm; Pranav Rajpurkar et al, 'MURA: Large Dataset for Abnormality Detection in Musculoskeletal Radiographs' (2017) *arXiv*, https://arxiv.org/abs/1712.06957; Alistair Johnson et al, 'MIMIC-III, a Freely Accessible Critical Care Database', (2016) 3 *Scientific Data*, https://www.nature.com/articles/sdata201635#citeas; Global Health Observatory (GHO), https://www.who.int/data/gho; The Cancer Genome Atlas Program (TCGA), https://www.cancer.gov/about-nci/organization/ccg/research/structural-genomics/tcga; Altexsoft, 'Medical Datasets for Machine Learning: Aims, Types, and Common Use Cases', 2022, https://www.altexsoft.com/blog/medical-datasets/.

Genome Atlas Program (TCGA)	of cancer		learning developers

Based on the data above, AI developers are struggling due to the limited number of datasets that can be used.[94] For drug discovery and inventive steps, the European Patent Office requires varied datasets that cover many diseases in a single database to achieve a high-level of efficiency in evaluating the inventive step.[95] This is within reach as such a single database already exists, namely the Therapeutics Data Commons. This is 'the first unifying platform to systematically access and evaluate machine learning across the entire range of therapeutics'.[96] According to the official website, Therapeutics Data Commons 'includes 66 AI-ready datasets spread across 22 learning tasks and provides an ecosystem of tools and community resources, including 33 data functions and diverse types of data splits, 23 strategies for systematic model evaluation, 17 molecule generation oracles, and 29 public leaderboards'.[97] In addition to providing AI-ready datasets, the Therapeutics Data Commons also plays a role in facilitating 'algorithmic and scientific advances and accelerat[ing] AI method development, validation and transition into biomedical and clinical implementation'.[98] We suggest that Therapeutics Data Commons is a suitable candidate to equip a PSITA or MSITA

[94] David Wild, 'Solving the Data Problem for AI in Drug Discovery', *In Vivo Pharma Intelligence*, 25 October 2022, https://invivo.pharmaintelligence.informa.com/IV146743/Solving-The-Data-Problem-For-AI-In-Drug-Discovery.

[95] Maurice Schellekens, 'Artificial Intelligence and Re-Imagination of Inventive Step' (2022) 13(2) *Journal of Intellectual Property, Information Technology and E-Commerce Law* 89–98.

[96] Kexin Huang et al, 'Therapeutics Data Commons: Machine Learning Datasets and Tasks for Drug Discovery and Development' (2021) *arXiv*, https://arxiv.org/abs/2102.09548. According to the National Cancer Institute, 'therapeutic' is 'having to do with treating disease and helping healing take place'. See the National Cancer Institute, https://www.cancer.gov/publications/dictionaries/cancer-terms/def/therapeutic.

[97] Therapeutics Data Commons, https://tdcommons.ai/overview/.

[98] Ibid.

in assessing inventive steps for any AI-generated inventions in the field of drug discovery, and that similar initiatives should be deployed cross-industry.

3 AI AS AN INVENTOR IN THE CONTEXT OF INCLUSIVE AND SUSTAINABLE INDUSTRIES: THE SOUTH AFRICAN CASE AND A TAILORED APPROACH TOWARDS PATENTABILITY

The debate about AI inventorship, which sheds light especially on targets 9.2 and 9.5 of SDG 9, provides another entry point to understand the unsustainability of patent law in an increasingly automated world.

Our reflection rests on two premises. First, AI is automatic and not autonomous, in the sense that while the performance of a machine learning model is not predefined *ex ante* by the human scientist/designer, it is dictated by the training data that are in turn set up by the human.[99] Therefore, the computer does not autonomously decide computational steps, but at best it automatically performs the relevant mathematical calculations based on the prepared functions.[100] Second, the most active patent offices in the world – the EPC, United States, Japan, Korea and China (so-called IP5 jurisdictions)[101] – do not accept that AI can be regarded as an inventor under patent law.[102] This is apparent from the deluge of decisions that

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99 Daria Kim et al, 'Clarifying Assumptions about Artificial Intelligence before Revolutionising Patent Law' (2022) 71(4) *GRUR International* 295–321, 308.

100 The degree and type of human involvement – and machine autonomy – varies; eg, in unsupervised learning contexts, the AI's behaviour will be less constrained by human choices. The AI at issue in the *Thaler* cases requires a considerable amount of human intervention, see Imagination Engines 'DABUS Described', https://imagination-engines.com/dabus.html.

101 These offices represent 80% of the entire patent market: see European Patent Office (EPO), *Report from the IP5 Expert Round Table on Artificial Intelligence*, Munich, 31 October 2018.

102 Ibid. See also Noah Shemtov, 'A Study on Inventorship in Inventions Involving AI Activity', *EPO*, 2019. However, in Japan, Korea and China until now we have no evidence of cases about AI inventorship.

have resulted from litigation initiated by Stephen Thaler, the human behind the infamous 'Device for the Autonomous Bootstrapping of Unified Science' (DABUS).[103] Dr Thaler sought recognition of inventorship for his AI in the EPC,[104] the US,[105] South Africa,[106] Australia,[107] the UK,[108] and Germany.[109] Limiting ourselves to Europe, the term 'inventor' is not clearly defined,[110] but there is an abundance of elements pointing in the direction that an inventor can only be a human being. Indeed, in the EPO decision in *Thaler*[111] (subsequently upheld by the EPO Board of Appeal[112]), it was held that an AI cannot be considered an inventor since the 'name' of the inventor – which is one of the elements required in a patent application[113] – can refer only to natural persons, as the scope of the name itself is the

103 This machine has been described as a 'collection of source code or programming and a software program' and 'a particular type of connectionist artificial intelligence' called a 'Creativity Machine'. See eg EP 18 275 163 and EP 18 275 174.

104 See, for most recent decision, EPO Board of Appeal J 0008/20 decision of 21 December 2021.

105 See, for most recent decision, *Thaler* v. *Vidal*, US Court of Appeals for the Federal Circuit (2022) 2021-2347.

106 South African Patent Office (SAPO), ZA2021/03242.

107 See, for most recent decision, *Commissioner of Patents* v. *Thaler* [2022] FCAFC 62.

108 See, for most recent decision, *Thaler* v. *Comptroller General of Patents Trade Marks And Designs* [2021] EWCA Civ 1374.

109 See, for most recent decision, Federal Patent Court, Case 11 W (pat) 5/21, decision of 11 November 2021. To easily access all these decisions see 'The Artificial Inventor Project', https://artificialinventor.com/.

110 Also in relation to national legislations of EPC member states, see for instance s 7(3) of the *Patents Act 1977* (UK), which defines the inventor as 'the actual deviser of the invention', a concept which clearly needs further interpretation (mostly by courts).

111 EPO decision of 27 January 2020 on EP 18 275 163 and EP 18 275 174.

112 EPO Board of Appeal J 0008/20 decision of 21 December 2021.

113 EPC, article 81 and EPC Implementing Regulations, rule 19(1).

identification of such natural persons and the possibility to exercise their rights that form part of their personality.[114] As confirmed by the *travaux préparatoires* to the EPC 1973,[115] the EPO continues, only a natural person automatically has a legal personality as a consequence of being human.[116] Non-humans can be granted legal personality through a legal fiction, as already occurs, for instance, with companies.[117] However, this is not the case for AI, for which no legal fiction has been established yet.[118] Therefore, AI cannot be designated as inventor in the EPO patent proceedings.

Dr Thaler sought inventorship for 'his' AI also in another country, South Africa, whose Patent Office (SAPO), contrary to what had already occurred in the EPC and the US, granted a patent by recognising the machine DABUS as the inventor.[119] This decision was followed by such surprise and disbelief that some people justified the outcome by noting that SAPO does not address the substantive requirements of patentability, such as novelty or inventive step, but simply requires the patent applicant to follow a formal filing procedure to be granted a patent on their invention.[120] A number of commentators in the Global North raised concerns for the future of the patent system as a whole. For instance, some have declared that this outcome by SAPO could lead to IP abuse, as an AI can potentially generate thousands of inventions and, if one recognises it as inventor and its owner as the patent

114 EPO decision of 27 January 2020 on EP 18 275 163 and EP 18 275 174 at [22].

115 See eg document BR/169 e/72 ett/AV/prk, point 31 ('development of invention by a person').

116 EPO decision of 27 January 2020 on EP 18 275 163 and EP 18 275 174 at [27].

117 Ibid.

118 Ibid.

119 IPWatchdog, 'DABUS Gets Its First Patent in South Africa under Formalities Examination', 29 July 2021, https://www.ipwatchdog.com/2021/07/29/dabus-gets-first-patentsouth-africa-formalities-examination/id=136116/.

120 Ibid.

holder, there would be a risk of an increase in infringement proceedings. Indeed, the human patentee could bring proceedings against unwitting infringers, as it would be practically impossible to keep track of and pace with these AI-generated inventions.[121] The critics of AI inventorship continue by noting that the general increase of inexpensive AI outputs (eg Generative AI models such as DALL-E 2 or ChatGPT) would decrease the incentives and the rewards for human ingenuity and creativity.[122]

These are legitimate concerns. However, we cannot dismiss the fact that the only national stance in favour of AI inventorship comes from an African country by saying that the SAPO made a mistake, or that it was a mere oversight by the patent office.[123] Learning from some IP scholars based in the Global South,[124] we argue for a deeper engagement with the reasons for the South African decision, one that considers the wider socio-economic and cultural context, as well as the overall justification of the patent system. A useful starting point is the ruling of the Australian Federal Court setting aside the decision by the Australian Deputy Commissioner of Patents to reject Thaler's patent application.[125] Even though the former ended up being reversed on appeal by the Full Court of the Federal Court,[126] it is

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121 Pete Swabey, 'South Africa's AI Patent Approval Could Trigger Innovation and Abuse', 3 Aug 2021, *Tech Monitor*, https://techmonitor.ai/technology/ai-and-automation/south-africas-ai-patent-approval-could-trigger-innovation-and-abuse.

122 Ibid.

123 See eg Joff Wild, 'South Africa Awards World's First AI-Invented Patent, but It May Not Be That Big a Deal', 28 July 2021, *IAM*, https://www.iam-media.com/article/south-africa-ai-patent-award.

124 See eg Donrich Thaldar and Meshandren Naidoo, 'AI Inventorship: The Right Decision?' (2021) *OSF Preprints*, https://osf.io/7uctg/ and Desmond Oriakhogba, 'Dabus Gains Territory in South Africa and Australia: Revisiting the AI-Inventorship Question' (2021) 9 *South African Intellectual Property Law Journal* 87–108.

125 *Thaler* v. *Commissioner of Patents* (2021) FCA 879.

126 *Commissioner of Patents* v. *Thaler* [2022] FCAFC 62.

useful to refer to it as it appears to unequivocally derive AI inventorship from the justification of patents as innovation incentives. At the core of the ratio decidendi was the consideration that to exclude AI systems from the meaning of 'inventor' would run contrary to the object of the Australian *Patents Act 1990*, which 'promotes technological innovation and the publication and dissemination of such innovation by rewarding it, irrespective of whether the innovation is made by a human or not'.[127] If this is the objective of the patent system – and if the equitable promotion of innovation is pivotal to SDG 9 – is the patent system still able to perform this function in the context of AI-generated inventions?

The exclusive rights granted by a patent are often presented as a necessary incentive for inventors to disclose and disseminate information that can be used to further advance innovation once the patent expires, to the benefit of the public at large.[128] The so-called quid pro quo theory can only justify the patent system if the 20-year monopoly does act as an incentive to innovation and if, after that monopoly, the public could benefit from the invention.[129] Even before the advent of AI, this theory had been called into question, eg by those revealing the manifold techniques patentees deploy to extend their exclusive rights .[130] It has been stated that this patent incentive might be even less relevant in the context of AI-

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127 *Thaler* v. *Commissioner of Patents* (2021) FCA 879 at [124].

128 This tension between the rights of the patent owner and the public interest is noticeable also in the current legislation. See, for instance, with regard to issues of infringement, Protocol on the Interpretation of Art. 69 EPC, Art 1: '[Art. 69] is to be interpreted as defining a position […] which combines a fair protection for the patent proprietor with a reasonable degree of legal certainty for third parties.'

129 Kristina Lybecker, 'How to Promote Innovation: The Economics of Incentives', 21 July 2014, *IPWatchdog*, https://ipwatchdog.com/2014/07/21/promote-innovation-the-economics-of-incentives/id=50428/.

130 See for example the evergreening practices that are particularly common in the pharmaceutical industry. Cf Gaurav Dwivedi, Sharanabasava Hallihosur and Latha Rangan, 'Evergreening: A Deceptive Device in Patent Rights' (2010) 32(4) *Technology in Society* 324–330.

generated inventions for two reasons.[131] First, software developers can have non-economic incentives to foster innovation in the AI industry, since such development would increase their reputation or simply would allow them to satisfy their scientific curiosity and desire to exchange data and information with other programmers.[132] Second, since we may witness a rapid development of AI-generated inventions, the societal and commercial value of these inventions (and consequent patent grants) would decrease when there would be a general struggle to determine what the real groundbreaking technologies are.[133]

Now, these reasons can and to a large extent do justify the undesirability of recognising AI systems as inventors in western and developed countries, where the software/AI industry has grown considerably over the years. However, if we consider the scenario in the Global South, the same reasoning no longer holds true. In countries such as South Africa, private investments in the AI industry and the frequency of dataset usage to train AIs are extremely low.[134] Against this backdrop, the reasons to overcome the quid pro quo theory in the context of AI-generated inventions should be called into question. First, due to this lack of data usage, it can be inferred that in South Africa there would not be enough software developers with whom to exchange information and data within the same country,

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131 See in this regard Gabriele Cifrodelli, ‘Patent System and Artificial Intelligence: Towards a New Concept of Inventorship?’, 2021, *CREATe Working Paper Series*, https://zenodo.org/record/5720649#.Y-JrZS_P2Ul.

132 Ryan Abbott, ‘I think, Therefore I Invent: Creative computers and the future of patent law’ (2016) 57(4) *B.C.L. Rev.* 1076–1126, 1106. See also Yochai Benkler, *The Wealth of Networks*, New Haven (US): Yale University Press, 2006, which at 64–65 reports that the first example of free software was Richard Stallman’s ‘nonproprietary operating system’ called GNU (GNU’s Not Unix).

133 Scott D Anthony, ‘Innovation Gone Overboard’, 19 March 2008, *Harvard Business Review*, https://hbr.org/2008/03/innovation-gone-overboard.

134 See the Internet Health Report 2022, https://2022.internethealthreport.org/facts/.

thus satisfying that scientific curiosity that may sometimes suffice as an incentive to develop AI-generated inventions. Second, given such lack of AI-generated inventions, it is unlikely that in the Global South there would be an excessive development of such inventions and a consequent decrease of their value ,

Although the SAPO decision per se might be explained also in light of the formalities in the patent application procedure, it does entail something else. Indeed, a more pressing need for innovation by leveraging the patent system and its incentive justification can be derived from a purposive interpretation of the South African *Patents Act 1978*, as suggested by some South African IP scholars.[135] The purpose of the Act can be understood by looking at the Intellectual Property Policy of the Republic of South Africa Phase 1 (IP Policy), which defines IP as 'an important policy instrument in promoting innovation, technology transfer, research and development (R&D), creative expression, consumer protection, industrial development and more broadly, economic growth'.[136] Therefore, as a key driver of industrial policy in a context of slow industrialisation, patent law cannot play the same role as in developed countries (that have become fully industrialised at the expense of the Global South). This is in line with a 2019 white paper published by the South African government on science, technology and innovation with regard to the Fourth Industrial Revolution (4IR).[137] This document argues that South Africa needs to foster sustainable innovation – which has been considerably deficient in the past – in order to provide optimal welfare to the

135 Donrich Thaldar and Meshandren Naidoo, 'AI Inventorship: The Right Decision?' (2021) *OSF Preprints* 5, https://osf.io/7uctg/.

136 South Africa Department of Trade and Industry, 'Intellectual Property Policy of The Republic of South Africa Phase 1', 2018, 3.

137 South African Department of Science and Technology, 'White Paper on Science, Technology and Innovation', 2019, https://www.dst.gov.za/images/2019/White_paper_web_copyv1.pdf.

population, and one of the best ways to achieve this is by reforming the IP system and taking into account the impact of AI technology, which is central for the future of South Africa.[138] Therefore, in the Global South the patentability of AI-generated inventions cannot be immediately labelled as inefficient and ineffective for innovation purposes, because that protection can still constitute an incentive for the promotion of sustainable industrialisation and the upgrade of technological capabilities, as advocated by SDG 9.

We must learn the SDG 9 lesson that, in encouraging inclusive and sustainable innovation, patent law, policy and scholarship must consider 'national circumstances'[139] and lead to the 'upgrade [of] the technological capabilities of industrial sectors in all countries, in particular developing countries'.[140] Similar to the need to modulate climate change obligations based on the history and needs of the Global South, there is the need for a tailored approach that would apply to the patent system in terms of different levels of protection for different patented inventions implemented in different industries and countries.[141] This could optimise the patent function as a balance between the protection of a certain invention and the likelihood that the invention does not stifle innovation in a certain field or industry,[142] but instead reinforce such development. One of the ways to assess that balance – and thus to start implementing an effective tailored approach – is to look at the R&D costs when

138 Donrich Thaldar and Meshandren Naidoo, 'AI Inventorship: The Right Decision?' (2021) *OSF Preprints* 7, https://osf.io/7uctg/. See also Kujo E McDave and Alexander Hackman-Aidoo, 'Africa and SDG 9: Toward a Framework for Development through Intellectual Property' (2021) 18 *US-China L. Rev.* 12–29, who advocate for a stronger IP protection in light of industrial development in Africa.

139 SDG 9, target 9.2.

140 SDG 9, target 9.5.

141 Benjamin N Roin, 'The Case for Tailoring Patent Awards Based on Time-to-Market' (2014) 61 *UCLA L Rev* 672–759, 677.

142 Ibid 698.

implementing a certain invention, the technological hazard that can result from the R&D itself, and the possibility to consider other means of protection to foster innovation.[143] This complex assessment should be done not in an abstract vacuum, but in the context of each individual country where the field or industry being analysed operates. To simply ‘export’ the rationale for rejecting AI inventorship to the Global South should be regarded as a form of ‘patent colonialism’. Based on a deeper understanding of the wider industrial and socio-economic context, governments in the Global South should be able to use the patent system as both an industrial policy tool and a means for sustainability, and this may well include the acceptance of AI systems as inventors.

CONCLUSION

To make tangible progress towards SDG 9, we need ‘radical action at various levels of society’,[144] and patent law ought to be part of this movement. As our analysis of patent data in Europe shows, AI-related patents that can be used for sustainability purposes are on the rise. However, SDG 9 sees the encouragement of innovation as a way of tackling wider societal challenges, and doing so in a way that is fair, equitable, and mindful of national circumstances, especially in developing countries.

Sustainable AI requires sustainable governance of patents. This chapter elucidates three aspects of patent unsustainability. First, our study confirms existing data showing that the Global North’s patent dominance across technologies includes climate change mitigation technologies, and argues that development and transfer of AI technologies should be ensured

[143] Peter S Menell, ‘A Method for Reforming the Patent System’ (2007) 13 *Mich Telecomm & Tech L Rev* 487–508, 494.

[144] Rosa Maria Ballardini and Corinna Casi, ‘Regulating Nature in Law Following Weak Anthropocentrism: Lessons for Intellectual Property Regimes and Environmental Ethics’ (2020) 167(4), *Retfærd: nordisk juridisk tidsskrift* 17–38.

across the globe if we want to take SDG 9 seriously. Second, to critically assess the contribution of Europe patent law to target 9.1, centred on equitable access to innovation, we have made proposals to recalibrate the inventive step requirement to better accommodate AI-fuelled innovation. We recommend that the EPO reconsider the definition of PSITA, which should be equipped with a single public AI dataset to enhance the inventive step criteria, and that this dataset should be different to the one being used by the patent applicant. We also put forward that Therapeutic Data Commons is a suitable candidate to equip PSITA or MSITA in assessing inventive steps for any AI-generated inventions in the field of drug discovery. Similar initiatives should be trialled and deployed cross-industry if we want to ensure affordable and equitable access for all. Third, the contribution to targets 9.2 and 9.5 has been considered by calling for a rethinking of the AI inventorship debate. While the decline of the incentive justification may well constitute the basis for the rejection of AI inventorship in developed countries, the same reasoning cannot be simply exported to the Global South, lest we be guilty of patent colonialism. It is in line with SDG 9 to accept that, while there are very good reasons to deny AI inventorship in the Global North, the South African approach is coherent with the sustainability and industrial policies pursued by that country, and may narrow the gap in terms of pace of AI patenting.

In conclusion, AI sustainability requires a change in the patent system and re-appreciation of some of its core concepts. This should include the rethinking of innovation as an instrumental good, a recalibration of the inventive step to ensure equitable access to AI-generated innovation, and the acknowledgement that doctrines that may be groundless in developed countries (eg AI inventorship) may well be justified in the Global South. The march towards progress should be paused if we cannot ensure that innovation becomes fairer and more inclusive. Patent law should be part of this progress, lest it become just another residue of an unjust past.