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RECEIVED 03 December 2024

ACCEPTED 19 March 2025

PUBLISHED 16 April 2025

CITATION

Ediger VŞ (2025) Leaving no one behind: just energy transition of fossil fuel-producing countries.
Front. Polit. Sci. 7:1536594.
doi: 10.3389/fpos.2025.1536594

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Leaving no one behind: just energy transition of fossil fuel-producing countries

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The dual challenges of mitigating climate change and safeguarding our planet, alongside eradicating inequality and poverty to ensure prosperity for all humanity, represent the defining issues of the Anthropocene. Addressing these interconnected global crises requires inclusive, equitable, and fair actions, leaving no one behind. A just and equitable energy transition from fossil fuels to renewables is thus indispensable. To date, efforts have focused mainly on reducing fossil fuel consumption, particularly in fossil fuel-importing nations, often neglecting the unique circumstances of fossil fuel-exporting countries. This study hypothesizes “achieving energy transition goals necessitates the comprehensive recognition, integration, and addressing of the specific needs and challenges faced by fossil fuel-exporting nations, ensuring their full and equitable participation in the transition process.” Through a critical analysis of the rights and responsibilities of fossil fuel-exporting countries within the energy law framework, the study concludes that a successful phase-out of fossil fuels will remain unattainable unless mechanisms are established to safeguard these nations’ economic and social welfare. Moreover, the incentives and support to reduce fossil fuel consumption must be extended to producing and transit countries to ensure a truly inclusive and sustainable global transition.

KEYWORDS

energy transition, energy law, justice and equality, fossil fuel, producing countries

Introduction

The Anthropocene Era represents the geological epoch, defined by an unprecedented human impact on the Earth’s geology and ecosystems (Crutzen and Stoermer, 2000). This period signifies a marked transformation in the human-environment relationship, initiated by the widespread combustion of fossil fuels, which laid the groundwork for the Industrial Revolution. In response, two international agreements, the 2030 Agenda for Sustainable Development (a comprehensive plan of action to end poverty, protect the planet, and ensure prosperity for all) and the Paris Agreement (a landmark international treaty that aims to limit global warming to well below 2°C, preferably to 1.5°C, compared to pre-industrial levels) were signed to tackle climate change and to preserve our environment, while providing a shared blueprint for peace and prosperity for all countries, rich and poor, now and into the future (UN, 2015a, 2015b). Regardless of the approach proposed by Löwbrand et al. (2020, pp. 3–5)—whether the “endangered world,” the “entangled world,” or the “extractivist world”—to address the pressing challenges of the Anthropocene, it is evident that the problem is global and collectively shared by all.

The necessity of solving common global problems, such as climate change, in a way that includes everyone, both in responsibility and impact, has been emphasized for at least three decades. The United Nations Framework Convention on Climate Change (UNFCCC), which was signed in Rio de Janeiro in June 1992, was the first international treaty to introduce definitions and obligations about “equity” and “responsibility” in Articles 3, 4, and 12 (UN,

1992, pp. 9–15, 23–25). Twenty years later, the fifth UN World Future Energy Summit (WFES), which was met in Abu Dhabi in January 2012, officially declared 2012 as “The UN 2012 International Year of Sustainable Energy for All” (IISD, 2012). Ban Ki-moon, UN Secretary-General, described the Rio + 20 meetings as “the beginning of a multi-year mission to achieve sustainable energy for all” (IISD, 2012, p. 2).

Today, the “human rights-based approach” and “leaving no one behind” are two universal values that all strategies and policies must comply with to achieve the goals of the 2030 Agenda for Sustainable Development (UN, 2024a; UN, 2015a). The agenda puts “equality and non-discrimination at the center” to protect “the most vulnerable” and “those that are furthest behind.” Article 1 of the Universal Declaration of Human Rights affirms that “[all] human beings are born free and equal in dignity and rights” (UN, 2024b). It has also been clearly stated as “meeting climate goals by ensuring the whole of society – all communities, all workers, all social groups – are brought along in the pivot to a net-zero future” by UNDP (n.d.) and “greening the economy in a way that is as fair and inclusive as possible to everyone concerned, creating decent work opportunities and leaving no one behind” by ILO (2024).

On the other hand, the only known way to achieve net-zero emissions by 2050 is to stop the production and consumption of fossil fuels, a primary driver of climate change (Bouckaert et al., 2021; Foster et al., 2024). Although this fact has been known for years and various solutions have been implemented, the issue is new to be addressed in the United Nations climate change conferences. At COP26 in Glasgow (November 2021), for the first time, countries were urged to accelerate efforts towards “the phasedown of unabated coal power and phase-out of inefficient fossil fuel subsidies” [UNFCCC (United Nations Climate Change), 2021]. While the conference underscored the need to reduce coal reliance and gradually eliminate fossil fuel subsidies, the term “phase down” was used rather than “phase out” in official documents. At COP27 in Sharm El-Sheikh (November 2022), this decision was reaffirmed, though a proposal from India—a significant coal producer—to include oil and gas in addition to coal was not adopted (Green and van Asselt, 2022). Most recently, COP28 in Dubai (December 2023) marked a historic milestone with an agreement signaling the “beginning of the end of the fossil fuel era,” actively promoting a transition away from fossil fuels (UNCCC, 2023). The conference formally included fossil fuel reduction as a primary agenda item for the first time, though it encouraged rather than mandated countries to act.

Therefore, the 2030 Agenda for Sustainable Development and the Paris Agreement must go hand in hand to address our planet’s most significant challenges. The urgency of these agreements must be aligned, mutually reinforcing a just and equitable transition from fossil fuels to renewable energy sources—inclusive and ensuring that no individual or community is left behind. Especially in the last decade, energy justice has emerged as a new field of research for applying justice principles to energy issues (Jenkins et al., 2016), and although some progress has been made in this regard, the developments are not very promising.

The current progress of energy transition shows that we are not successful enough, and it will be very difficult—if not impossible—to achieve the goals set (IEA, 2024; IEA et al., 2024; WEC, 2024; Sachs et al., 2024; WEF, 2024). This situation is primarily based on hereditary reasons arising from the genetic characteristics of human beings at the point where our civilization level has reached. In a recent book called

Nexus, Harari (2024) explains this situation from a historical perspective, stating that although our species has successfully produced knowledge and information throughout history, we failed to take the necessary steps to solve our common problems. In addition, today’s energy transition is costly, faces more significant engineering challenges, and requires global collaborations between businesses and governments, making it difficult to achieve the targets by leading the energy transition to a zero-sum game, with losers and winners (e.g., Ennos, 2021; Hernández, 2022; WRI, 2024).

One of the primary factors contributing to the challenges in achieving a successful energy transition is the predominant focus of strategies and policies on the demand side, emphasizing the reduction and eventual elimination of fossil fuel consumption. However, these approaches often insufficiently address the supply side, particularly the transformation required in the fossil fuel production area. This imbalance limits the effectiveness of current policies in meeting transition targets comprehensively.

While there is no binding international legal framework governing the energy transition to limit or phase out fossil fuel production, particularly for fossil fuel-exporting countries, several key global initiatives and mechanisms are creating pressures to reduce production. For example, the Paris Agreement compels signatory states to lower carbon emissions, necessitating that a significant portion of fossil fuel reserves remain unexploited to limit global warming to 1.5°C (UN, 2015b). It also mandates the submission of Nationally Determined Contributions (NDCs), which includes commitments to transition away from fossil fuels (UNFCCC, 2016). ILO Just Transition Guidelines provide binding obligations where ratified, requiring states to ensure a just transition for workers affected by energy sector shifts, balancing economic transitions with labor protections (ILO, 2015). The European Union’s Carbon Border Adjustment Mechanism (CBAM) introduces tariffs on high-carbon imports to incentivize lower emissions in trade (EC, 2025). The Global Methane Pledge, spearheaded by the US and EU, aims to reduce methane emissions by 30% by 2030, directly impacting fossil fuel producers (US and EU, 2022; GMP, n.d.). Additionally, the G7 has discontinued international fossil fuel financing as of 2022, while the G20 has committed to phasing out inefficient fossil fuel subsidies since 2009 (OECD and IEA, 2021; Skovgaard, 2021; G7, 2023; Laan and Geddes, 2023; Skovgaard et al., 2024). The Beyond Oil & Gas Alliance seeks to terminate new oil and gas exploration licenses and gradually phase out existing production (BOGA, 2022). The Fossil Fuel Non-Proliferation Treaty, though not yet legally binding, has garnered support from the European Parliament and various states in its objective to cease new fossil fuel production (FFNPT, n.d.; Newell and Simms, 2018). Furthermore, the Powering Past Coal Alliance advocates eliminating coal in electricity generation, intensifying financial restrictions on new coal projects (PPCA, 2017; ECCC, 2022).

In addition, several international legal instruments require developed nations to provide financial and technological assistance and support for developing countries, particularly fossil fuel-producing countries, to ensure a smooth and just energy transition. For example, Articles 4.3, 4.5, and 4.7 of the UNFCCC require developed countries to promote, facilitate, and provide new and additional financial resources and technological support to assist developing nations in meeting climate-related obligations, including clean energy transitions (UN, 1992). Similarly, in the Energy Charter Treaty (ECT), Article 8 encourages member states to facilitate access to clean energy

technologies, particularly for developing countries (ECT, 2015). Article 10(c) of the Kyoto Protocol encourages technology transfer to developing countries to help reduce greenhouse gas emissions, and Article 11.2 requires developed countries to provide financial resources to assist in capacity-building and clean energy projects (UN, 1998). In the Sustainable Development Goals (SDGs), SDG 7 (Affordable and Clean Energy) calls for international cooperation to facilitate clean energy research, investment, and technology transfer, and SDG 13 (Climate Action) encourages the mobilization of climate finance from developed to developing countries (UN, 2015c). Finally, Articles 9, 10, and 11 of the Paris Agreement require developed countries to provide support through knowledge sharing and institutional strengthening to the developing countries with mitigation and adaptation efforts, including energy transition on climate finance, technology development and transfer, and capacity building, respectively (UN, 2015b; UNFCCC, 2016).

Progress is being made on the divestment of fossil fuels on the supply side, and the practice of not granting loans to new oil and gas fields has even become widespread (Share Action, 2022; Olawuyi et al., 2024a). However, despite all the practices and commitments, it will not be possible to phase out fossil fuels entirely by 2050, and cleaner fuels, especially natural gas, will need to be used as a transition fuel to support renewable energy until the energy transition is completed (e.g., Ediger and Berk, 2023 and references therein).

US President Joe Biden gave one of the best examples of the fact that fossil fuels cannot be easily given up in his words after Israel attacked Iran on October 5, 2024, by saying, “If I were in their shoes, I would be thinking about other alternatives than striking oilfields” (Bose and Singh, 2024). Donald Trump, on the other hand, took it a step further and appointed Chris Wright, the founder and CEO of Liberty Energy, to the US Energy Department after winning the presidential election. Wright, a key figure in the American Shale Revolution, was seen as instrumental in delivering on Trump’s campaign promise to boost fossil fuels under the slogan “drill, baby, drill” (Vock, 2024). These policies of American presidents beautifully demonstrate the approach of the USA, which is the world’s hegemonic power today, to energy transformation. The US economy is dependent on oil and gas, the dominant energy source of the period, and does not want to abandon this power. Fossil fuel phase-out will be much more effective in underdeveloped and developing countries that meet most of their income from fossil fuel exports.

This study examines the position of fossil fuel-exporting countries within the context of the global energy transition, arguing that the energy transition goals cannot be met without adequately considering the needs and challenges of these nations and, therefore, without fully incorporating them. In other words, a just and equitable energy transition is essential—one that is inclusive and leaves no individual or community behind. A global transformation will not be possible without finding a solution to the adverse conditions arising during and after the fossil fuel phase-out, especially in low- and middle-income fossil fuel-producing countries. The problem is global, and as Jenkins et al. (2014, p. 74) said, a holistic, system-wide approach to assessing the impacts of energy systems on justice should be applied, addressing each phase, from resource extraction to waste disposal. A just energy transition is not just a means to meet net-zero targets but a necessary step to address the implications for critical issues such as energy security, decent employment, zero poverty, gender justice, resource efficiency, economic diversification, and human rights.

To substantiate the hypothesis of this study, “The achievement of energy transition goals is contingent upon the comprehensive recognition, integration, and address of the fossil fuel exporting nations’ specific needs and challenges, necessitating their full and equitable inclusion in the process” a critical investigation has been carried out on fossil fuel-exporting countries’ just and equitable energy transition within the framework of energy law. First, the details of fossil fuel exports of significant fossil fuel-exporting countries are examined to show their importance, especially to developing countries’ economies. This section analyzes fossil fuel export capacities, calculated using EI (2024) data, by their reserves, production, and consumption metrics. Subsequently, the rights and duties of fossil fuel-exporting nations are analyzed across four primary dimensions: sovereignty, justice, environmental considerations, and security within the energy law framework, which was established as a distinct academic discipline by Bradbrook (1996). The analysis in this section is carried out with a focus on ensuring a fair transition in energy practices. The study also delved into the historical evolution of these concepts, analyzing how they have been shaped within fossil fuel-exporting countries considering energy transformation. By exploring the drivers and consequences of recent paradigm shifts in energy security, the research highlights the essential need to secure energy stability for these nations to achieve a successful net-zero transition. This study underscores the importance of establishing a just energy transition that equitably includes all stakeholders, including energy producers and transiters, alongside consumers.

Although research on energy justice related to energy production and the supply side of the energy transition has recently been carried out by several authors (e.g., Zhang et al., 2023; Achakulwisut et al., 2023; Ickler, 2023; Rekker et al., 2023; Sonter et al., 2023; Heffron and de Fontenelle, 2023; Qin and Yong, 2024; Jones and Parra, 2024; Amin et al., 2024; Foster et al., 2024), the number of those who deal with the subject in this context is very small. In this sense, this study will contribute to the literature. This study does not focus on proposing solutions to the challenges that fossil fuel-exporting countries may encounter in the energy transition. Instead, it seeks to underscore the critical importance of these challenges, emphasizing that the energy transition’s success is contingent on the inclusion of these countries. By doing so, the study aims to stimulate increased academic research and discourse on this essential topic.

Assessment of the fossil fuel-exporting countries

The world has 42,508.6 EJ of economically recoverable proven fossil fuel reserves, including coal, oil, and natural gas, which refers to the estimated amount that can be extracted with current technology and prices (EI, 2024).¹ Of these reserves, 60.0% is coal, 24.1% is oil, and 15.9% is natural gas. On the other hand, total fossil fuel production is 514.4 EJ, of which 36.7% consists of oil, 34.8% of coal, and 28.4% of gas. If these reserve and production values remain constant, the

1 Unconventional resources such as Canadian oil sands and the Venezuelan Orinoco Belt amounting to around 2984.0 EJ (EI, 2024) are not included in reserve calculations in this study.

reserves-to-production (R/P) ratio used to obtain information about the life of the reserves can be calculated as 82.6 years for total fossil fuels, while 54.1 years for oil, 46.3 years for natural gas, and 142.3 for coal. These figures show that coal was replaced by oil and gas after the Second World War, and many coal reserves remained stranded assets. In the 2050 net-zero emission process, whether all fossil fuels will suffer the fate of coal, or even whether they will be completely phased out, will vary depending on the climate policies to be implemented.

There is a high concentration of fossil fuels among five countries: the US, RF, China, Australia, and India, accounting for 51.2% of reserves, 55.2% of production, and 52.7% of consumption. These countries also have the largest coal reserves in the world, varying from 2221.0 EJ in India to 4978.8 EJ in the US. The five countries with the most oil reserves are Venezuela, Saudi Arabia, Canada, Iran, and Iraq, respectively in size, with reserves ranging from 819.4 EJ to 2011.1 EJ. On the other hand, countries RF, Iran, Qatar, Turkmenistan, and the US have the largest natural gas reserves, ranging from 454.4 EJ to 1346.3 EJ. As can be seen from these figures, only three countries, the US and RF in coal and natural gas and Iran in oil and natural gas have significant reserves of two fossil fuels. The remaining nine countries could enter the Top 5 list due to only one source.

The best way to understand the amount of fossil fuel production in the country after meeting the domestic consumption, that is, the country's export capacity, is to calculate the difference between total production and consumption (Prod-Cons). According to EI (2024) data, fossil fuel production exceeds consumption in 44 countries, including the EU, where production and consumption values are available in 100 countries. Conversely, consumption surpasses production in 56 countries, highlighting the importance of this balance in the global energy trade. The amounts and percentages of reserve, production, and consumption of the top ten countries with the highest fossil fuel Prod-Cons values are given in Table 1.

The reasons why countries are in the top ten Prod-Cons lists are quite different from each other. Of the ten countries with the highest Prod-Cons values, only 4, such as RF, Saudi Arabia, Canada, and the USA, are among the top 10 countries with the highest reserves, production, and consumption. These countries are among the top players in all three categories. On the other hand, Australia has limited

consumption despite its high reserves and production; Indonesia and Qatar are only among the top 10 producers, while UAE, Norway, and Iraq are not on any top 10 lists.

This is more evident in the top five countries with fossil fuel Prod-Cons of more than 10 EJ, such as RF (25.63 EJ), Saudi Arabia (14.82 EJ), Australia (12.66 EJ), Canada (10.65 EJ), and Indonesia (10.30 EJ). For instance, RF has 13.5% of the world's reserves, its production share is 10.3%, and consumption is only 5.4%. This country, which has the highest export capacity in the world, produces less compared to its reserves and, therefore, can increase its production even more. It has 30.1 years of reserves to meet its production and 65.9 years of reserves to meet its consumption. Saudi Arabia implements a balanced production policy compared to its reserves, having approximately a similar percentage of around 5% in terms of reserves and production. Its share in world consumption is also equal to about half of the production rate, as in the case of RF. Australia has a share of 8.1% in reserves, only 3.5% in production, and only 1% in consumption, so it can also quickly increase its production. Canada has a reasonably balanced production, with a share of 3.5% in reserves and 3.8% in production. Its share in consumption is only 1.8%. Finally, Indonesia is among the countries that consume its reserves quickly, with a share of 2.0% in reserves and 3.8% in production.

The types of fossil fuels with the highest reserve, production, and consumption in these countries also differ considerably (Table 2). Saudi Arabia is an oil and natural gas country; 88.8% of its fossil fuel reserves consist of oil and 11.2% of natural gas, whereas 84.4% of its production is oil, 15.6% is natural gas, and 88.8% of its consumption is oil and 11.2% is natural gas. Similarly, Australia and Indonesia are coal-based, and Canada is an oil-based country. On the other hand, although RF's fossil fuel reserves are dominated by coal (62.3%), production consists of 42.8% oil, 39.8% gas, and only 17.4% coal, and consumption consists of 59.6% natural gas, 26.4% oil, and 14.0% coal.

The most common aspect of the top five Prod-Cons countries, which differ in reserves, production, and consumption, is that fossil fuels are essential in the countries' economies. Based on the World Bank classification, Australia, Canada, and Saudi Arabia are high-income, whereas RF and Indonesia are upper-middle-income countries (World Bank, 2024; Metreau et al., 2024) (Table 3). Of these

TABLE 1 Top ten reserve, production, consumption, and production-consumption (Prod-Cons) countries.

Rank	Prod-Cons		Reserve			Production				Consumption			
	Country	EJ	Country	EJ	%	Country	EJ	%	R/P, Year	Country	EJ	%	R/C, Year
1	RF	25.6	US	5776.5	15.0	China	110.3	21.4	69.0	China	139.2	27.6	76.0
2	S. Arabia	14.8	RF	5207.7	13.5	US	83.7	16.3	98.3	US	76.0	15.0	190.3
3	Australia	12.7	China	3314.6	8.6	RF	53.0	10.3	30.1	EU	38.4	7.6	23.8
4	Canada	10.7	Australia	3101.6	8.1	S. Arabia	26.4	5.1	174.4	India	34.8	6.9	605.8
5	Indonesia	10.3	India	2293.8	6.0	Canada	19.7	3.8	119.2	RF	27.4	5.4	65.9
6	UAE	9.4	Venezuela	2251.1	5.8	Indonesia	19.3	3.8	771.5	Japan	14.5	2.9	1172.4
7	US	7.8	Iran	2063.2	5.4	India	19.2	3.7	114.4	Iran	12.4	2.5	166.1
8	Norway	7.6	S. Arabia	1927.8	5.0	Iran	18.0	3.5	73.1	S. Arabia	11.5	2.3	167.0
9	Qatar	7.4	EU	1601.3	4.2	Australia	17.8	3.5	307.2	S. Korea	10.2	2.0	41.7
10	Iraq	6.8	Canada	1349.3	3.5	Qatar	9.6	1.9	68.4	Canada	9.1	1.8	148.8

Data: EI (2024).

TABLE 2 Fossil fuel types in reserve, production, and consumption in the top five Prod-Cons countries.

Country	Reserve			Production			Consumption		
	Oil	N. Gas	Coal	Oil	N. Gas	Coal	Oil	N. Gas	Coal
RF	11.9	25.8	62.3	42.8	39.8	17.4	26.4	59.6	14.0
S.Arabia	88.8	11.2	0.0	84.4	15.6		88.8	11.2	0.0
Australia	0.4	2.8	96.9	3.7	30.7	65.6	0.4	2.8	96.9
Canada	84.0	6.3	9.8	59.0	34.7	6.3	84.0	6.3	9.8
Indonesia	1.9	6.0	92.2	6.7	12.0	81.3	1.9	6.0	92.2

The shares of more than about 60% are marked.

Data: EI (2024).

TABLE 3 Economic characteristics of top five Prod-Cons countries.

Country	GDP (US\$)	GDP per capita (US\$)	Income level
RF	20,21,421.5	13,817.0	Upper-middle
S.Arabia	10,67,582.9	28,895.0	High
Australia	20,21,421.5	13,817.0	High
Canada	21,40,085.6	53,371.7	High
Indonesia	13,71,171.2	4,940.5	Upper-middle

Data: World Bank (2024).

countries, Saudi Arabia's and RF's revenues are primarily derived from fossil fuel exports, and it is almost impossible for these countries to give up these revenues. The share of fossil fuels in Saudi Arabia's revenues remains high, reaching about 70%–80% of the country's budget (Albassam, 2015; DEIK, 2024). According to Mohammed Al-Jaadan, the country's finance minister, 63% of the country's GDP comes from oil in May 2024 (Dutton, 2024). In Russia, oil and gas revenues accounted for about 45% of Russia's federal budget revenues in 2021, and these resources provided nearly 60% of export revenues in 2022 (IEA, 2022b; ONB, 2022; OIES, 2024).

Although the ratio of fossil fuel exports to GDP is around 10–15% in Australia and Canada, two high-income countries, energy sectors are significant for their economies. According to the Ministry for Resources of Australia, after a record \$467 billion in 2022–23, energy export values decreased to \$400 billion in 2023–2024 and \$352 billion in 2024–2025 (MRA, 2023; EFA, 2023; DOI, 2023). Canada's energy sector accounted for approximately 11.8% (\$ 309 billion) of the GDP and approximately 3.5% of total employment in 2022 [CER (Canada Energy Regulator), 2024]. Finally, in Indonesia, which is the poorest of these countries, fossil fuel revenues historically comprised around 7% of GDP in the early 2000s and decreased to approximately 1% recently (Ministry of Finance of Indonesia, 2017; Braithwaite and Gerasimchuk, 2019; Erickson, 2024). Due to the low contribution of fossil fuels to the country's economy, this country is one of the few developing countries that aims to reduce fiscal dependence on revenues from fossil fuel production (Braithwaite and Gerasimchuk, 2019).

On the other hand, the bottom ten countries, which are all fossil fuel-importing, have a Prod-Cons value less than −4.2 EJ (Table 4). Countries such as France, Malaysia, Italy, Turkey, Germany, S. Korea, and Japan do not produce appreciable fossil fuels. Only China (110.3 EJ), India (19.2 EJ), and the EU (5.2 EJ) produce significant amounts of fossil fuels. However, despite their production, they cannot meet

TABLE 4 The bottom ten prod-cons countries.

Rank	Country	Production	Consumption	Prod-Cons
		EJ	EJ	EJ
91	France		4.2	−4.2
92	Malaysia		4.4	−4.4
93	Italy	0.3	4.8	−4.5
94	Turkey	0.6	5.7	−5.1
95	Germany	1.1	8.6	−7.5
96	S. Korea		10.2	−10.2
97	Japan		14.5	−14.5
98	India	19.2	34.8	−15.6
99	China	110.3	139.2	−29.0
100	EU	5.2	38.4	−33.2

Countries with significant production are marked.

Data: EI (2024).

their large consumption. Also, coal occupies an essential place in their energy systems. 84.4% of China's production and 66.0% of its consumption, 87.0% of India's production and 63.1% of its consumption consist of coal. In the EU, 63.5% of its production consists of coal, 23.8% of natural gas, 12.8% of petroleum, 55.8% of its consumption is petroleum, 29.9% is natural gas and 14.3% is coal. It is inevitable for countries to continue coal production to meet their domestic energy needs.

In summary, it will be challenging for the fossil fuel-exporting countries to give up fossil fuel production since they derive a significant part of their income from these exports, and the importing countries must provide high consumption from local sources. The fossil fuel policies of these countries are determined in a way that guarantees their energy security.

Energy-producing countries in energy law

Energy law, which started as an academic discipline with Bradbrook's (1996, p. 194) seminal paper, is "the allocation of rights and duties concerning the exploitation of all energy resources between individuals, between individuals and the government, between governments and between states." Natural resource law, a version of energy law, is defined as "strategies, rules,

and procedures to regulate the safe, orderly, and sustainable exploration, exploitation, or commercialization of natural resources in international law, domestic legislation, judicial decisions, and scholarly publications” (Olawuyi et al., 2024a, p. 2). This and other similar terms are accepted as synonymous and evaluated under the energy law in this study.

Achieving a just, inclusive, and orderly global energy transition will only be possible if the energy law’s nature, scope, and guiding principles are adequately understood and implemented (Huhta and Romppanen, 2022; Olawuyi et al., 2024a, 2024b). According to Olawuyi et al. (2024a, p. 6), these principles are related to “permanent sovereignty and jurisdiction over natural resources, intergenerational equity principle, energy solidarity, energy security, and energy justice.” Four of the seven fundamental principles of the energy law put forward by Heffron et al. (2018, p. 40) are directly related to energy-producing countries: (1) national resource sovereignty, (2) energy justice, (3) energy security and reliability, and (4) protecting the environment and human health. Although the rights and responsibilities of fossil fuel producer countries within the energy law framework are intertwined in these principles, the principles of sovereignty, justice, and security are among the fundamental rights of fossil fuel-exporting countries. Each of these are discussed in detail below.

National resource sovereignty

According to the principle of national resource sovereignty, one of the most basic rules of the natural resources law, states have full rights to use their natural resources in their national interests (Heffron et al., 2018) and to freely dispose of their control, ownership, and exploitation (Miranda, 2012; Gilbert, 2013). In other words, it means “the protection from actions by external actors” or “quest for energy independence,” and countries use military, political, economic, or technical tools to protect their energy systems (Cherp et al., 2012, p. 331). Energy law was initially concerned with allocating natural resources in an interstate context, but now it plays a distributive role in an intrastate context, becoming a cornerstone of international law (Miranda, 2012; Lucas and Thompson, 2018).

Within the energy transition scope, it is unclear how the limits of the sovereign rights of the countries will be determined and how they will use these rights. The Paris Agreement is not “a global rulebook on emissions,” and “there is no formal enforcement mechanism for the voluntary national targets set by each of the countries themselves” (Lucas and Thompson, 2018, p. 41). While countries have the right to exploit and use their natural resources as they wish, how will it be possible to phase out fossil fuels required by the energy transition? Would it be fair to deprive these countries, which derive most of their income from producing and exporting energy resources and using them to solve their local problems, for a global reason? Olawuyi et al. (2024a, p. 7) comprehensively pose this problem as follows: “The phase-down of fossil fuel production and their stranded assets brings questions of how to reconcile and balance net zero ambitions with the quest for resource sovereignty, economic subsistence, and social development by resource-dependent states.”

Foster et al. (2024) argue that the heterogeneity among fossil fuel-producing low and lower-middle-income countries significantly affects their trajectories toward low-carbon development. The authors

emphasize the need for “a re-orientation of international support along principles of global solidarity” to address these diverse pathways effectively (p. 242). For instance, most African national authorities do not find it fair to borrow from developed countries to develop renewable energy while leaving the hydrocarbon resources they have just found and desperately need for their countries stranded (Moore, 2021). They know they need to take action against climate change, but they think that since Africa’s problems are different, their path must differ from that of developed countries (Zubairu, 2021). If forced to achieve net-zero emissions, they think they will become a “sacrificial lamb for net-zero,” and therefore, the principles of “differentiated responsibility” and “polluters pay the most for the cost” should be applied (Moore, 2021). Oil and gas-producing countries in the Middle East are also making significant efforts toward energy transition; however, they have achieved limited success due to their heavy dependence on revenue from fossil fuels (Olawuyi, 2018).

Energy justice

The principle of energy justice is the application of human rights across the energy system, balancing risk, reward, and responsibility (Heffron et al., 2018; Heffron, 2024). Initially, McCauley et al. (2013) divided energy justice into three main elements such as “distributional justice,” which concerns the distribution of benefits and responsibilities; “procedural justice,” which is related to engaging all stakeholders in a non-discriminatory way; and “recognition justice,” which involves not devaluing some people and not differentiating the identities of others from others. Later, two more elements were added, such as “cosmopolitanism justice,” which considers the effects beyond our borders and from a global context, and “restorative justice,” which considers rectification of any injustice caused by the energy sector to be part of preventive and forward-looking action (Sovacool et al., 2014; Heffron et al., 2015; Heffron and McCauley, 2017; Hazrati and Heffron, 2021). Finally, Sovacool et al. (2014, pp. 42–48) proposed two more elements such as the “prohibitive principle,” which states that “energy systems must be designed and constructed in such a way that they do not unduly interfere with the ability of any person to acquire those basic goods to which he or she is justly entitled” and the “affirmative justice,” which states that “if any of the basic goods to which every person is justly entitled can only be secured through energy services, then in that case there is also a derivative right to the energy service.”

All these elements, especially distributive, procedural, and cosmopolitan justices, are essential to ensure that rights and freedoms are applied throughout the life cycle of energy activities from exploration and production to consumption (Sovacool et al., 2014; Sovacool and Dworkin, 2014; Hazrati and Heffron, 2021; Gao, 2024; Fontenelle, 2024).

Energy security and reliability

The principle of energy security and reliability, which requires secure and reliable energy, is one of the fundamental principles of energy law (Heffron et al., 2018; Olawuyi et al., 2024a). No matter what position the countries are in, the over-dependence of the global

energy system on fossil fuels causes global climate change and threatens energy security by affecting geopolitics due to the limited and unequal distribution of resources on Earth (MacKay, 2009).

Energy systems are vital because the services provided by these systems are critical for the functioning and stability of a society and, therefore, should have minimum or no vulnerabilities (Johansson et al., 2012; Cherp and Jewell, 2013). Energy security is closely related to the economy, policy, sovereignty, and geopolitics, focusing on the risks posed by foreign control over domestic energy systems (Rosas-Casals et al., 2014). It is also closely linked to energy justice because it profoundly impacts society (Goldthau and Sovacool, 2012; Heffron and McCauley, 2014). While ensuring energy security, it is essential to protect the interests of all social groups without making any distinction between individuals and to discriminate between the strong and the weak, the poor and the rich, and to distribute the burdens required by energy security in a balanced manner (Stirling, 2008; Sovacool, 2012; Knox-Hayes et al., 2013; Demski et al., 2014; Sovacool et al., 2014; Genys, 2020; Jakstas, 2020).

There is, however, no single definition of energy security due to its complex nature with implications in various spheres: political, economic, environmental, social, and technical (Jakstas, 2020). It means different things for different countries. Whereas industrial countries are primarily concerned with import dependency and aging infrastructure, developing and low-income countries, in addition to these, are dealing with high energy intensity, rapid demand growth, and other vulnerabilities (Cherp et al., 2012, p. 327). Therefore, energy security closely affects how countries view energy transition and energy transition will have several critical implications for energy security, especially in resource-rich countries (Banet, 2018; Thaler and Hofmann, 2022; CEC, 2022; Olawuyi et al., 2024a).

The original definition of energy security, first proposed by Willrich (1976, pp. 746–747, 751–752); Willrich (1978, p. 67), emphasized that it differed for energy-importing and energy-exporting countries. However, this distinction has been forgotten for years and has only been used to secure the energy supply of developed countries. The most common definition of energy supply security in this period was “the uninterrupted availability of energy sources at an affordable price” by the IEA (2019, 2022a). Later, in the new conditions that emerged after the collapse of the Soviet Union in 1991, the need to reconsider the concept of energy security arose (Yergin, 2006; Victor and Yueh, 2010; Sovacool, 2012; Milina, 2013; Jakstas, 2020; Ediger et al., 2021a, 2021b). Yergin (2006, pp. 69–71) proposed the term “demand security” for energy-exporting countries, which pursue to guarantee product demand because energy exports generate a vast amount of government revenues. Later, authors such as Kruyt et al. (2009), Sovacool et al. (2011), Cherp and Jewell (2014), and Kühne (2015) added new dimensions related to sustainability to energy security, which mainly consist of three dimensions such as “availability,” “accessibility” and “affordability.” The natural gas dispute between Russia and Ukraine, first in 2006, then more prominently in 2009, again in 2012, and ongoing since 2014, opened a new era in energy security studies. Evaluating all the changing paradigms, Ediger et al. (2020, p. 90) proposed “energy-transit security,” which was defined as “maintaining a continuous flow of contracted amount of energy from producing to consuming countries in a reliable and sustainable manner.” They (p. 90), within this framework, defined energy security as “uninterruptedly maintaining energy supply, demand, and transit in adequate quantity and quality at reasonable

costs/prices in an environmentally friendly manner for sustainable energy production, consumption, and transportation” (see also Ediger, 2011a, 2011b). Jakstas (2020) also discussed different aspects of energy security for energy importers, exporters, and transit countries.

Therefore, energy security, which is initially understood as the “security of energy supply” for developed nations reliant on foreign energy sources, has evolved to encompass the “security of energy demand” for fossil fuel-exporting countries and the “security of energy transit” for nations geographically situated between producers and consumers. Particularly in the context of energy transition, it is crucial to acknowledge that achieving these three dimensions of energy security is an integral aspect of national sovereignty, shaped by the unique conditions of each country.

Protecting the environment and human health

The principle of protecting the environment and human health and combatting climate change is that using energy and natural resources should comply with protecting the environment, public health, and climate change mitigation (Heffron et al., 2018). Although this principle seems more related to energy consumption, it is also closely related to energy production. Although countries have the right to use their natural resources as they wish, they must carry out their activities following the sustainable development goals and the principles of the Paris Agreement during their production. As with energy consumption, energy production and distribution should not harm the environment or contribute to climate change. The energy transition in extractive territories must prevent new injustices in energy production and be reparative to compensate for damages (Righetti, 2024).

Discussion and conclusion

Many countries have already integrated international legal principles into their national legal frameworks through constitutional provisions, national legislation, and policy strategies governing natural resources, including coal. While resource sovereignty remains key, sustainability, social justice, and environmental accountability also shape their governance in modern legal frameworks. For example, the principle of permanent sovereignty over natural resources, as established in international instruments such as UN General Assembly Resolution 1803 (UN, 1962) and the International Covenant on Civil and Political Rights (UN, 1966), has been integrated into the national legal systems. For instance, Indonesia's Constitution (Article 33.3) (RoI, 1945), Venezuela's Constitution (Article 12) (RoV, 1999), and South Africa's Mineral and Petroleum Resources Development Act of 2002 (Chapter 2) (RoSA, 2002) explicitly enshrine state ownership of natural resources, including coal.

Furthermore, principles outlined in the Rio Declaration, particularly those concerning environmental sustainability (Principles 2 and 4) (UN, 1993), alongside commitments established in the Paris Agreement regarding the phase-out of fossil fuels (Articles 4 and 6) (UN, 2015b; UNFCCC, 2016), have been incorporated into contemporary policy frameworks. These principles have notably influenced the European Union's Green Deal (EC, 2021) and

Germany's Act to Reduce and End Coal-Fired Power Generation (Coal Phase-Out Act) (GoG, 2020; Agora Energiwende, 2024), both of which aim to facilitate a transition away from coal in alignment with sustainability objectives. Similarly, India's National Action Plan on Climate Change integrates coal management strategies with renewable energy targets (MHFWGI, 2018). Additionally, the Rio Declaration's principle that industries utilizing finite resources like coal should bear the cost of environmental damage (Principles 15 & 16) (UN, 1993) has been reflected in the EU Industrial Emissions Directive (2010/75/EU), which mandates coal companies to mitigate pollution (EU, 2010), and in China's Environmental Protection Law (2015), which imposes strict liability for pollution resulting from coal mining (RoC, 2015).

The Just Transition Framework, as advocated by the International Labour Organization (ILO) (ILO, 2015; Olsen and La Hovary, 2021) and reinforced by the Paris Agreement (Article 4.15) (UN, 2015b) underscores the importance of equitable treatment for workers affected by the transition away from coal. This principle has been incorporated into South Africa's Just Transition Framework, which provides social support for coal workers during the country's transition to renewable energy (PCC, 2022), as well as in Canada's Just Transition Task Force, which ensures financial and employment assistance for coal-dependent communities (GoC, 2019).

Additionally, some countries directly embed international legal principles into their constitutions. For example, Indonesia's Constitution (Article 33) mandates state control over coal resources and requires their sustainable use (RoI, 1945), while Ecuador's Constitution (Article 74) recognizes the rights of nature and restricts over-extraction (RoE, 2008). Other nations incorporate these principles into energy and climate legislation. For instance, Indonesia's Mineral and Coal Mining Law (Law No. 3/2020) integrates sustainability into mining governance (GoI, 2020), Australia's Environment Protection and Biodiversity Conservation Act (1999) mandates environmental assessments for coal projects (GoA, 1999), the United States' Surface Mining Control and Reclamation Act (1977) ensures land restoration after coal extraction (GoUS, 1977), and Germany's Act to Reduce and End Coal-Fired Power Generation (2020) mandates the phasing out of coal by 2038 in alignment with the Paris Agreement (GoG, 2020).

In conclusion, integrating international legal principles into national legal frameworks reflects a broader commitment to balancing resource sovereignty with sustainability, social justice, and environmental responsibility. Adopting these principles in constitutional provisions, legislative measures, and policy frameworks underscores the evolving nature of coal governance in the context of international environmental and human rights law.

However, the inclusion of some international legal principles in national legal regulations by some governments is insufficient to achieve climate change and sustainability goals in a fair and equal manner. Implementing safeguards in just energy transition projects is crucial to ensure that communities and workers dependent on fossil fuel industries are not left behind. The Environmental Defense Fund (EDF) has developed a comprehensive Just Transition and Safeguards Framework to guide countries and stakeholders through a fair energy transition (EDF, 2024). This framework emphasizes inclusivity and equity, ensuring that all affected parties are considered, including workers transitioning from fossil fuel sectors and decommissioned fossil fuel sites. Fossil fuel-exporting countries are adopting these

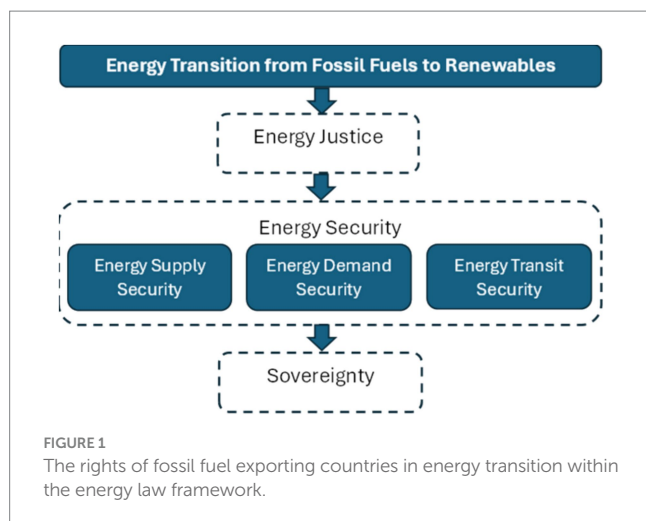
frameworks to facilitate this transition equitably. For example, South Africa's Just Energy Transition Partnership (JETP) aims to shift towards renewable energy while safeguarding its workforce and communities. The partnership includes safeguards in financial support, worker retraining programs, and community engagement, aiming to ensure that the transition is equitable and that no one is left behind (Wemanya and Adow, 2022; BMZ, 2024).

Investigating why an important agreement such as the Kyoto Protocol of 1997 failed, Frei (2004) conceptualized the energy needs pyramid after Maslow's (1943) hierarchy of needs by building categories such as "access to commercial energy," "security of supply," "cost efficiency," "natural resource efficiency," and "social acceptability." According to him, the Kyoto Protocol was ultimately compromised in favor of energy supply security. This framework implies that countries grappling with foundational issues lower on the pyramid, like energy access and supply security, tend to prioritize these concerns over more abstract, global issues positioned higher up, such as climate change. Consequently, global climate change may not receive adequate attention from nations focused on fulfilling their immediate energy needs. Ediger (2017, and the references therein) also states that the most important reasons why the protocol was not successful are: (1) the intensification of energy geopolitics worldwide, (2) countries have different energy needs and different domestic energy sources, and (3) the role of the state and the private sector in practice is not clear enough. In other words, the main reason was the problem of energy supply security, which arose due to the increasing geopolitical tension and was affected by the different conditions of countries. Even though climate change is a global problem, energy supply security is a national concern, and energy access is a local concern (Cherp et al., 2012; Zillman et al., 2018).

Similar arguments would probably apply to the Paris Agreement of 2015. This time, energy demand security comes to the fore instead of energy supply security. Adopting a fully statistically grounded probabilistic methodology, Liu and Raftery (2021) concluded that the likelihood of major emitters achieving their nationally determined contributions (NDCs) is notably low, estimated at 2% for the USA and France, 10% for Japan, 13% for Germany, and 16% for China. Furthermore, the global probability of limiting warming to below 2°C remains critically low at only 5%. Therefore, the biggest challenge in front of this agreement is to ensure a fair and equal energy transition in a way that does not leave anyone out, including fossil fuel-exporting countries. For these countries to exercise their rights under the energy law, the efforts and incentives offered for fossil fuel consumption should also be shown internationally to countries that export fossil fuels and contribute to their transportation.

The rights of fossil fuel-exporting countries in the energy transition within the energy law framework are shown in Figure 1. Energy justice covers all stakeholders, and the fairness and equality of energy transition covers all countries. This should include all countries with different energy security concepts, such as supply, demand, and transit security. The right of these countries to ensure their energy security is one of the fundamental rights of every sovereign country.

While the rights of fossil fuel-exporting countries are emphasized, it is equally critical to recognize their corresponding responsibilities. These countries bear substantial obligations in safeguarding environmental and public health, mainly through their involvement in fossil fuel upstream, midstream, and downstream phases. Therefore, these nations must adhere rigorously to sustainability



principles across all operational activities in resource exploitation. Furthermore, reducing fossil fuel consumption represents a pivotal concern. Irrespective of reserve availability, production levels, or consumption patterns, decreasing fossil fuel dependency will not only aid in addressing global environmental challenges but also align with the broader interests of all nations.

Many authors have emphasized the need to reconsider energy security in line with the new paradigm shifts such as climate change, sustainability, globalization, and the future of fossil fuels in a much broader and interdisciplinary manner in the new era (e.g., Barton and Campion, 2018; Jakstas, 2020). Due to the energy transition, the energy security concerns of countries will change as some of them may disappear or become irrelevant, and new vulnerabilities may emerge (Sovacool, 2012; Cherp et al., 2012; Scholl and Westphal, 2017). According to Sovacool (2012, p. 52 and the references therein), because of the energy transition, most countries will be more energy-insecure than ever before, and the question remains: “Can the world have secure, reliable, and affordable supplies of energy while also transitioning to a low-carbon energy system?” “How will energy-exporting countries give up their export values, which are very important for them, to realize the energy transformation, which is a global problem?” should be added to this question.

In this context, the efforts and incentives offered to reduce fossil fuel consumption should also be provided to producers and transit countries. It would be naïve to wait for countries whose economies depend heavily on fossil fuel production and exports to be easily deprived of this opportunity. Unless methods are developed to sustain

these countries’ economic and social welfare, fossil fuel phase-out will not be possible.

Data availability statement

Publicly available datasets were analyzed in this study. This data can be found here: <https://www.energyinst.org/statistical-review/home>.

Author contributions

VE: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing.

Funding

The author(s) declare that no financial support was received for the research and/or publication of this article.

Conflict of interest

The author declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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References

- Achakulwisut, P., Erickson, P., Guivarch, C., Schaeffer, R., Brutschin, E., and Pye, S. (2023). Global fossil fuel reduction pathways under different climate mitigation strategies and ambitions. *Nat. Commun.* 14, 1–15. doi: 10.1038/s41467-023-41105-z
- Agora Energiwende. (2024). Coal phase-out in Germany the multi-stakeholder commission as a policy tool. Available online at: https://www.agora-energiwende.org/fileadmin/Projekte/2022-2022-06_INT_Multi_Stakeholder_Engagement/A-EW_275_Coal-Phase-Out-Germany_WEB.pdf (Accessed February 22, 2025).
- Albassam, B. A. (2015). Economic diversification in Saudi Arabia: myth or reality? *Resour. Policy* 44, 112–117. doi: 10.1016/j.resourpol.2015.02.005
- Amin, A., Yusma, N., Yusoff, M., Peng, S., Işık, C., Ullah, A., et al. (2024). The influence of energy transition, and natural resources on carbon emissions in China: an augmented ARDL application. *Environ. Dev. Sustain.* doi: 10.1007/s10668-023-04398-0
- Banet, C. (2018). “Techno-nationalism in the context of energy transition regulating technology innovation transfer in offshore wind technologies” in *Innovation in energy law and technology dynamic solutions for energy transitions*. eds. D. Zillman, M. Roggenkamp, L. Paddock and L. Godden (Oxford: Oxford University Press), 74–98.
- Barton, B., and Campion, J. (2018). “Climate change legislation law for sound climate policy making” in *Innovation in energy law and technology dynamic solutions for energy transitions*. eds. D. Zillman, L. Roggenkamp, L. Paddock and L. Godden (Oxford: Oxford University Press), 23–37.
- BMZ. (2024). Just Energy Transition Partnership (JETP) with South Africa. Available online at: <https://www.bmz.de/resource/blob/246476/factsheet-jetp-southafrica-en.pdf> (Accessed February 26, 2025).

- BOGA. (2022). BOGA announces support fund for fossil phase out, 16 November 2022. Available online at: https://beyondoilandgasalliance.org/wp-content/uploads/2022/12/BOGA_COP27_Press_Release_updated.pdf (Accessed February 26, 2025).
- Bose, N., and Singh, K. (2024). Biden says he would weigh alternatives to striking Iranian oil if he were in Israel's shoes, Reuters 5, 2024. Available online at: <https://www.reuters.com/world/middle-east/biden-says-he-would-weigh-alternatives-striking-iranian-oil-if-he-were-israels-2024-10-04/> (Accessed November 27, 2024).
- Bouckaert, S., Fernandez Pales, A., McGlade, C., Remme, U., Wanner, B., D'Ambrosio, D., et al. (2021). Net zero by 2050—A roadmap for the global energy sector. Paris Cedex: International Energy Agency.
- Bradbrook, A. (1996). Energy law as an academic discipline. *J. Energy Nat. Resour. Law* 14, 193–217. doi: 10.1080/02646811.1996.11433062
- Braithwaite, D., and Gerasimchuk, I. (2019). Beyond fossil fuels: Indonesia's fiscal transition. International Institute for Sustainable Development. Available online at: www.iisd.org (Accessed November 15, 2024).
- CER (Canada Energy Regulator). (2024). 2023-24 Annual Report of the Canada Energy Regulator - What the CER regulates: Energy in Canada. Available at: https://www.cer-rec.gc.ca/en/about/publications-reports/annual-report/2023/board-report/what-cer-regulates-energy-canada.html?utm_source=chatgpt.com (Accessed November 2, 2024).
- Cherp, A., Adenikinju, A., Goldthau, A., Hernandez, F., Hughes, L., Jansen, J., et al. (2012). Global energy assessment: Toward a sustainable future. Cambridge: Cambridge University Press.
- Cherp, A., and Jewell, J. (2013). "Energy security assessment framework and three case studies" in International energy security handbook. eds. H. Dryer and M. J. Trombetta (Cheltenham: Edward Elgar Publishing), 146–173.
- Cherp, A., and Jewell, J. (2014). The concept of energy security: beyond four A's. *Energy Policy* 75, 415–421. doi: 10.1016/j.enpol.2014.09.005
- Crutzen, P., and Stoermer, E. (2000). The "Anthropocene". *Global Change Newsletter* 41, 17–18.
- CEC. (2022). Addressing modern slavery in the clean energy sector. Available online at: <https://assets.cleanenergycouncil.org.au/documents/resources/reports/Addressing-Modern-Slavery-in-the-Clean-Energy-Sector.pdf> (Accessed November 27, 2024).
- DEIK (2024). Suudi Arabistan information note. Available online at: <https://www.deik.org.tr/uploads/suudi-arabistan-bilgi-notu-temmuz-23.pdf> (Accessed September 15, 2024).
- Demski, C., Poortinga, W., and Pidgeon, N. (2014). Exploring public perceptions of energy security risks in the UK. *Energy Policy* 66, 369–378. doi: 10.1016/j.enpol.2013.10.079
- DOI. (2023). Resources and energy quarterly, September 2023. Available online at: www.industry.gov.au/occe (Accessed November 2, 2024).
- Dutton, J. (2024). Saudi Arabia 'conservative' on oil revenue as it pares back Vision 2030 plans, Al-Monitor, May 14, 2024. Available online at: <https://www.al-monitor.com/originals/2024/05/saudi-arabia-conservative-oil-revenue-it-pares-back-vision-2030-plans> (Accessed September 5, 2024).
- Ediger, V. Ş. (2017). Enerji jeopolitiğinin uluslararası iklim değişikliği girişimleri üzerindeki etkisi (The effect of energy geopolitics on international climate change initiatives). *Uluslararası İlişkiler* 14, 45–70. doi: 10.33458/uidergisi.513227
- Ediger, V. Ş., Bowlus, J. V., and Aydın, M. (2020). "Geopolitics and security of gas-transit through pipelines" in Regulations in the energy industry: Financial, economic and legal implications. eds. A. Dorsman, A. Bastiaan, O. Arslan-Ayaydin and J. Thewissen (Cham: Springer International Publishing), 85–106.
- Ediger, V. Ş. (2011a). Enerjiye Yeni Dünya Düzeni ve Türkiye (New World Order in Energy and Turkey). Akademi Forumu No. 67. Ankara: TÜBA Publications.
- Ediger, V. Ş. (2011b). "Energy transition periods: lessons learnt from the past" in The oil era: Emerging challenges (Abu Dhabi: The Emirates Center for Strategic Studies and Research Publications), 175–202.
- Ediger, V. Ş., and Berk, İ. (2023). Future availability of natural gas: can it support sustainable energy transition? *Resour. Policy* 85:103824. doi: 10.1016/j.resourpol.2023.103824
- Ediger, V. Ş., Bowlus, J. V., and Dursun, A. F. (2021a). "China's energy-supply security in the multi-energy transition period from fossil fuels to renewable energy" in China's energy security: Analysis, assessment and improvement. ed. J. Ren (Singapore: World Scientific Publishing), 201–217.
- Ediger, V. Ş., Bowlus, J. V., and Dursun, A. F. (2021b). State capitalism and hydrocarbon security in China and Russia. *Energ. Strat. Rev.* 38. doi: 10.1016/j.esr.2021.100725
- EFA. (2023). Australia—Climate goals lift base metals and critical minerals exports. Available online at: <https://www.exportfinance.gov.au/resources/world-risk-developments/2023/april/australia-climate-goals-lift-base-metals-and-critical-minerals-exports/> (Accessed October 13, 2024).
- EI. (2024). 2024 Energy Institute Statistical Review of World Energy, EI Statistical Review of World Energy. Available online at: <https://www.energyinst.org/statistical-review> (Accessed October 3, 2024).
- Ennos, R. (2021) 16th-century energy revolution can help fossil fuels exit. Bangkokpost.com. Available online at: <https://www.bangkokpost.com/opinion/opinion/2082987/16th-century-energy-revolution-can-help-fossil-fuels-exit> (Accessed September 12, 2024).
- Erickson, G. (2024). Indonesia's fossil fuel subsidies threaten its energy transition. Diplomat 16:2024. Available online at: <https://thediplomat.com/2024/02/indonesias-fossil-fuel-subsidies-threaten-its-energy-transition/>
- EC. (2021). European Green deal: Delivering Our Targets. Available online at: https://ec.europa.eu/commission/presscorner/api/files/attachment/869807/EGD_brochure_EN.pdf (Accessed February 23, 2025).
- EC. (2025). Carbon Border Adjustment Mechanism. Available online at: https://taxation-customs.ec.europa.eu/carbon-border-adjustment-mechanism_en#:~:text=Why%20CBAM%3F-,CBAM,production%20in%20non%20DEU%20countries (Accessed February 23, 2025).
- ECCC. (2022). Compendium of Canada's Engagement in International Environmental Agreements and Instruments. Available online at: <https://www.canada.ca/content/dam/eccc/documents/pdf/international-affairs/compendium/2022/b-9/powering-past-coal-alliance.pdf> (Accessed February 23, 2025).
- ECT. (2015). The International Energy Charter Consolidated Energy Charter Treaty with Related Documents, Energy Charter Secretariat. Available online at: <https://www.energycharter.org/fileadmin/DocumentsMedia/Legal/ECTC-en.pdf> (Accessed February 23, 2025).
- EDE. (2024). Just Transition and Safeguards Framework. Available online at: <https://library.edf.org/AssetLink/18kw3kd8k7vjmygy4ek16m827xs0j2gw.pdf> (Accessed February 23, 2025).
- EU. (2010). Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions (integrated pollution prevention and control), Official Journal of the European Union, L 334/17 dated 17.12.2010. Available online at: <https://eur-lex.europa.eu/eli/dir/2010/75/oj/eng> (Accessed February 23, 2025).
- FFNPT. (n.d.). The fossil fuel non-proliferation treaty: an Initiative to phase-out fossil fuels and fast-track solutions, climate network. Available online at: https://climatenetwork.org/wp-content/uploads/2020/11/fossil_fuel_non-proliferation_treaty-2.pdf (Accessed February 23, 2025).
- Fontenelle, L. (2024). "Energy justice and the social contract theory," in The power of energy justice and the social contract, eds. R. J. Heffron and Fontenelle, L. de (London: Palgrave MacMillan), 9–13.
- Foster, V., Trotter, P. A. S., Werner, S., Niedermayer, M., Mulugetta, Y., Achakulwisut, P., et al. (2024). Development transitions for fossil fuel-producing low and lower-middle-income countries in a carbon-constrained world. *Nat. Energy* 9, 242–250. doi: 10.1038/s41560-023-01440-3
- Frei, C. W. (2004). The Kyoto protocol-a victim of supply security? Or: if Maslow were in energy politics. *Energy Policy* 32, 1253–1256. doi: 10.1016/j.enpol.2003.12.012
- G7. (2023). G7 Climate, Energy and Environment Ministers' Communiqué. Available online at: <https://g7.utoronto.ca/environment/2023-000127536.pdf> (Accessed February 22, 2025).
- Gao, A. M. Z. (2024). "Energy justice concerns of nuclear power in the 2025 energy transition vision of Taiwan and net zero roadmap of 2050," in The power of energy justice and the social contract, eds. R. J. Heffron and Fontenelle, L. de (London: Palgrave MacMillan), 77–82.
- Genys, D. (2020). "Energy consumption and income distribution. International policies for mitigating social exclusion" in Energy transformation towards sustainability. eds. M. Tvaronavičienė and B. Ślusarczyk (Amsterdam: Elsevier), 85–97.
- Gilbert, J. (2013). The right to freely dispose of natural resources: utopia or forgotten right? *Neth. Q. Hum. Rights* 31, 314–341. doi: 10.1177/016934411303100305
- GMP (n.d.). Global Methane Pledge. Available online at: <https://www.globalmethanepledge.org/sites/default/files/documents/2023-11/Global%20Methane%20Pledge.pdf> (Accessed February 22, 2025).
- Goldthau, A., and Sovacool, B. K. (2012). The uniqueness of the energy security, justice, and governance problem. *Energy Policy* 41, 232–240. doi: 10.1016/j.enpol.2011.10.042
- GoA. (1999). Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act). Available online at: <https://www.dceew.gov.au/environment/epbc> (Accessed February 22, 2025).
- GoC. (2019). Task force on Just Transition for Canadian Coal Power Workers and Communities. Available online at: <https://www.canada.ca/en/environment-climate-change/services/climate-change/task-force-just-transition/final-report.html> (Accessed February 22, 2025).
- GoG. (2020). Act to Reduce and End Coal-Fired Power Generation (KVVBG), Bundesregierung. Available online at: <https://www.bundesregierung.de/breg-en/service/archive/kohleausstiegsgesetz-1717014> (Accessed February 23, 2025).
- GoI. (2020). Law of the Republic of Indonesia No. 3 of 2020 About Amendment to the Law no. 4 of 2009 Concerning Minerals and Coal Mining. Available online at: <https://www.fao.org/faolex/results/details/en/c/LEX-FAOC222086/> (Accessed February 23, 2025).
- GoUS. (1977). The Surface Mining Control and Reclamation Act of 1977 (SMCRA). Available online at: <https://www.congress.gov/bill/95th-congress/house-bill/2> (Accessed February 23, 2025).
- Green, F., and van Asselt, H. (2022). COP27 flinched on phasing out 'all fossil fuels.' What's next for the fight to keep them in the ground? The Conversation, 21 November 2022. Available online at: <https://theconversation.com/cop27-flinched-on-phasing-out-all-fossil-fuels-whats-next-for-the-fight-to-keep-them-in-the-ground-194941> (Accessed October 4, 2024).
- Harari, Y. N. (2024). Nexus: A brief history of information networks from the stone age to AI. London: Fern Press.

- Hazrati, M., and Heffron, R. J. (2021). Conceptualizing restorative justice in the energy transition: changing the perspectives of fossil fuels. *Energy Res. Soc. Sci.* 78:102115. doi: 10.1016/j.erss.2021.102115
- Heffron, R. J. (2024). "Energy justice—the first step in an energy decision today," in *The power of energy justice & the social contract*, eds. R. J. Heffron and Fontenelle, L. de (London: Palgrave MacMillan), 3–8.
- Heffron, R. J., and McCauley, D. (2014). Achieving sustainable supply chains through energy justice. *Appl. Energy* 123, 435–437. doi: 10.1016/j.apenergy.2013.12.034
- Heffron, R. J., McCauley, D., and Sovacool, B. K. (2015). Resolving society's energy dilemma through the energy justice metric. *Energy Policy* 87, 168–176. doi: 10.1016/j.enpol.2015.08.033
- Heffron, R. J., and McCauley, D. (2017). The concept of energy justice across the disciplines. *Energy Policy* 105, 658–667. doi: 10.1016/j.enpol.2017.03.018
- Heffron, R. J., Rønne, A., Tomain, J. P., Bradbrook, A., and Talus, K. (2018). A treatise for energy law. *J. World Energy Law Bus* 11, 34–48. doi: 10.1093/jwelb/jwx039
- Heffron, R. J., and de Fontenelle, L. (2023). *The power of energy justice & the social contract*. London: Palgrave Macmillan.
- Hernández, A. R. (2022). Geopolitics of the energy transition: Energy security, new dependencies, and critical raw materials. Department of European Political and Governance Studies, Bruges Political Research Papers 87/2022.
- Huhta, K., and Romppanen, S. (2022). Why is energy law resistant to changes required by climate policies? *Energy Climate Change* 4:100096. doi: 10.1016/j.egycc.2023.100096
- Ickler, J. (2023). Green energy transitions and the temptation of natural resource rents: experiences from Ecuador. *S. Afr. J. Int. Aff.* 30, 279–295. doi: 10.1080/10220461.2023.2221219
- ILO. (2015). Guidelines for a just transition towards environmentally sustainable economies and societies for all. Available online at: https://www.ilo.org/sites/default/files/wcmsp5/groups/public/%40ed_emp/%40emp_ent/documents/publication/wcms_432859.pdf (Accessed February 22, 2025).
- ILO. (2024). Climate change and financing a just transition. Available online at: <https://www.ilo.org/resource/other/climate-change-and-financing-just-transition> (Accessed November 22, 2024).
- IEA (2019). Energy security. Paris: IEA.
- IEA (2022a). World energy outlook 2022. Paris: IEA.
- IEA. (2022b). Energy fact sheet: Why does Russian oil and gas matter? 21 March 2022. Available online at: <https://www.iea.org/articles/energy-fact-sheet-why-does-russian-oil-and-gas-matter> (Accessed November 11, 2024).
- IEA (2024). World energy outlook 2023. Paris: IEA.
- IEA, IRENA, UNSD, World Bank, WHO (2024). Tracking SDG 7: The energy Progress report. Washington DC: World Bank.
- IISD. (2012). A daily report of the world future energy summit (WFES) 2012. World Future Energy Summit Bulletin (WFES), 187(8), 1–4.
- Jakstas, T. (2020). "What does energy security mean?" in *Energy transformation towards sustainability*. eds. M. Tvaronavičienė and B. Ślusarczyk (Amsterdam: Elsevier), 99–112.
- Jenkins, K., McCauley, D., Heffron, R., and Stephan, H. (2014). Energy justice: a whole systems approach. *Queen's Polit. Rev.* 2, 74–87.
- Jenkins, K., McCauley, D., Heffron, R., Stephan, H., and Rehner, R. (2016). Energy justice: a conceptual review. *Energy Res. Soc. Sci.* 11, 174–182. doi: 10.1016/j.erss.2015.10.004
- Johansson, T. B., Nakicenovic, N., Patwardhan, A., and Gomez-Echeverri, L. (2012). Global energy assessment—toward a sustainable future. Cambridge, UK and New York, NY, USA and Laxenburg, Austria: Cambridge University Press and the International Institute for Applied Systems Analysis.
- Jones, N., and Parra, P. Y. (2024). How the transition away from fossil fuel production can be included in new climate commitments and plans. IISD (International Institute for Sustainable Development) Report, June 2024. Available online at: <https://www.iisd.org/system/files/2024-06/fossil-fuel-transition-new-climate-commitments.pdf> (Accessed September 5, 2024).
- Knox-Hayes, J., Brown, A. M., Sovacool, K. B., and Wang, Y. (2013). Understanding attitudes toward energy security: results of a cross-national survey. *Glob. Environ. Chang.* 23, 609–622. doi: 10.1016/j.gloenvcha.2013.02.003
- Kruij, B., van Vuuren, D. P., de Vries, H. J. M., and Groeneweg, H. (2009). Indicators for energy security. *Energy Policy* 37, 2166–2181. doi: 10.1016/j.enpol.2009.02.006
- Kühne, K. (2015). Redefining energy security in the 21st century, Leave it in the Ground Initiative (LINGO). Available online at: <https://leave-it-in-the-ground.org/wp-content/uploads/2014/05/21st-Century-Energy-Security.pdf> (Accessed November 19, 2024).
- Laan, T., and Geddes, A. (2023). Fanning the flames: G20 provides record financial support for fossil fuels methodology note and reference list, International Institute for Sustainable Development. Available online at: <https://www.iisd.org/system/files/2023-08/g20-fossil-fuel-support-methodology.pdf> (Accessed February 24, 2025).
- Liu, P. R., and Raftery, A. E. (2021). Country-based rate of emissions reductions should increase by 80% beyond nationally determined contributions to meet the 2 °C target. *Commun. Earth Environ.* 2:29. doi: 10.1038/s43247-021-00097-8
- Lövbrand, E., Mobjörk, M., and Söder, R. (2020). The Anthropocene and the geopolitical imagination: re-writing earth as political space. *Earth Syst. Governance* 4:100051. doi: 10.1016/j.esg.2020.100051
- Lucas, A. R., and Thompson, C. B. (2018). "Transition to a low-carbon energy economy: the legal agenda" in *Innovation in energy law and technology dynamic solutions for energy transitions*. eds. D. Zillman, M. Roggenkamp, L. Paddock and L. Godden (Oxford: Oxford University Press), 38–54.
- MacKay, D. J. C. (2009). Sustainable energy—without the hot air. Cambridge: UIT.
- Maslow, A. (1943). A theory of human motivation. *Psychol. Rev.* 50, 370–396. doi: 10.1037/h0054346
- McCauley, D., Heffron, R. J., Stephan, H., and Jenkins, K. (2013). Advancing energy justice: the triumvirate of tenets. *Int. Energy Law Rev.* 32, 107–110.
- Metreau, E., Young, K. E., and Eapen, S. G. (2024). World Bank country classifications by income level for 2024–2025. World Bank Blogs. Available online at: <https://blogs.worldbank.org/en/opendata/world-bank-country-classifications-by-income-level-for-2024-2025> (Accessed October 17, 2024).
- MHFWGI. (2018). National Action Plan for Climate Change and Human Health (NAPCC). Available online at: <https://ncdc.mohfw.gov.in/wp-content/uploads/2024/04/27505481411548674558.pdf> (Accessed February 23, 2025).
- Milina, V. (2013). Energy security: a paradigm shift. *Connections* 2, 75–97. doi: 10.11610/Connections.12.4.04
- Ministry of Finance of Indonesia. (2017). Central Government Financial Report 2017. Available online at: <https://www.kemenkeu.go.id/publikasi/laporan/laporan-keuangan-pemerintah-pusat/> (Accessed November 4, 2024).
- Miranda, L. (2012). The role of international law in intrastate natural resource allocation: sovereignty, human rights, and peoples-based development. *Vanderbilt J. Transnatl Law* 45, 785–840.
- Moore, G. (2021). Africa must not be the West's sacrificial lamb for net zero at COP26. African business, October 27th, 2021. Available online at: <https://african.business/2021/10/energy-resources/africa-must-not-be-the-west-s-sacrificial-lamb-for-net-zero-at-cop26> (Accessed November 11, 2024).
- MRA. (2023). Resources and energy export values to ease on lower world prices, 3 October 2023. Available online at: <https://www.minister.industry.gov.au/ministers/king/media-releases/resources-and-energy-export-values-ease-lower-world-prices> (Accessed November 24, 2024).
- Newell, P., and Simms, A. (2018). A fossil fuel non-proliferation treaty, The Rapid Transition Alliance. Available online at: https://unfccc.int/sites/default/files/resource/371_Talanoa%20dialogue%20submission%202029-10-18.pdf (Accessed February 24, 2025).
- OECD and IEA. (2021). Update on Recent Progress in Reform of Inefficient Fossil-fuel Subsidies That Encourage Wasteful Consumption 2021, Climate and Energy Joint Ministerial Meeting, Naples, 23 July 2021. Available online at: http://www.g20italy.org/wp-content/uploads/2021/07/OECD-IEA-G20-Fossil-Fuel-Subsidies-Reform-Update-2021_final.pdf (Accessed February 24, 2025).
- OIES. (2024). Follow the Money: Understanding Russia's oil and gas revenues, March 2024. Available online at: <https://www.oxfordenergy.org/publications/follow-the-money-understanding-russias-oil-and-gas-revenues/> (Accessed November 11, 2024).
- Olawuyi, D. S. (2018). "Advancing innovations in renewable energy technologies as alternatives to fossil fuel use in the Middle East: trends, limitations, and ways forward" in *Innovation in energy law and technology dynamic solutions for energy transitions*. eds. D. Zillman, M. Roggenkamp, L. Paddock and L. Godden (Oxford: Oxford University Press), 354–370.
- Olawuyi, D. S., González, J. J., Mostert, H., Montoya, M. F., and Banet, C. (2024a). "Introduction" in *Net zero and natural resources law*. eds. D. S. Olawuyi, J. J. González, H. Mostert, M. F. Montoya and C. Banet (Oxford: Oxford University Press), 1–17.
- Olawuyi, D. S., González, J. J., Mostert, H., Montoya, M. F., and Banet, C. (2024b). "Conclusion: net zero and the future of natural resources law" in *Net zero and natural resources law*. eds. D. S. Olawuyi, J. J. González, H. Mostert, M. F. Montoya and C. Banet (Oxford: Oxford University Press), 352–368.
- Olsen, L., and La Hovary, C. (2021). User's manual to the ILO's guidelines for a just transition towards environmentally sustainable economies and societies for all, ILO. Available online at: https://www.ilo.org/sites/default/files/wcmsp5/groups/public/@ed_dialogue/@actrav/documents/publication/wcms_826060.pdf (Accessed February 24, 2025).
- ONB. (2022). The Russian economy and world trade in energy: Dependence of Russia larger than dependence on Russia, 15 April 2022. Available online at: <https://www.onb.at/dam/jcr:c7d95c7b-c469-4834-ac94-98554c5e6f5f/2022-04-15-russian-economy-and-world-trade-in-energy.pdf> (Accessed September 24, 2024).
- PCC. (2022). A Framework for a Just Transition in South Africa. Available online at: <https://www.oneplanetnetwork.org/sites/default/files/from-crm/A-Just-TransitionFramework-for-South-Africa-2022.pdf> (Accessed February 22, 2025).
- PPCA. (2017). PPCA Declaration. Available online at: https://poweringpastcoal.org/wp-content/uploads/PPCA-Declaration_Text-1.pdf (Accessed September 24, 2024).

- Qin, X., and Yong, Y. (2024). Fostering the efficiency of the natural resource market for a comprehensive, long-term energy transition. *Econ. Chang. Restruct.* 57:114. doi: 10.1007/s10644-024-09681-2
- Rekker, S., Chen, G., Heede, R., Ives, M., Wade, B., and Greig, C. (2023). Evaluating fossil fuel companies' alignment with 1.5°C climate pathways. INET Oxford Working Paper No. 2023–03.
- RoC. (2015). Environmental Protection Law of the People's Republic of China (2014 Revision) [Effective] (2015). Available online at: <https://greenaccess.law.osaka-u.ac.jp/wpcontent/uploads/2019/03/Environmental-Protection-Law-of-the-Peoples-Republic-of-China-2014-Revision.pdf> (Accessed February 25, 2025).
- RoE. (2008). Constitution of the Republic of Ecuador. Available online at: <https://pdba.georgetown.edu/Constitutions/Ecuador/english08.html> (Accessed February 25, 2025).
- RoI. (1945). The 1945 Constitution of the Republic of Indonesia, Jaringan Dokumentasi Dan Informasi Hukum. Available online at: <https://jdih.bapeten.go.id/unggah/dokumen/peraturan/116-full.pdf> (Accessed February 25, 2025).
- RoSA. (2002). Mineral and Petroleum Resources Development Act 28 of 2002, South African Legal Information Institute. Available online at: https://www.saflii.org/za/legis/consol_act/maprda2002452.pdf (Accessed February 25, 2025).
- RoV. (1999). Constitution of the Bolivarian Republic of Venezuela, Venezuelanalysis. Available online at: <https://venezuelanalysis.com/constitution/> (Accessed February 25, 2025).
- Righetti, T. (2024). "Just transitions in extractive territories," in *The power of energy justice & the social contract*, eds. R. J. Heffron and Fontenelle L. de (London: Palgrave MacMillan), 227–234.
- Rosas-Casals, M., Marzo, M., and Salas-Prat, P. (2014). Sovereignty, robustness and short-term energy security levels: the Catalonia case study. *Front. Energy Res.* 2, 1–10. doi: 10.3389/fenrg.2014.00016
- Sachs, J. D., Lafortune, G., and Fuller, G. (2024). The SDGs and the UN summit of the future. Sustainable Development Report 2024. Available online at: <https://dashboards.sdgindex.org/> (Accessed September 24, 2024).
- Scholl, E., and Westphal, K. (2017). European energy security reimagined: Mapping the risks, challenges and opportunities of changing energy geographies. SWP Research Paper. Berlin: Stiftung Wissenschaft und Politik.
- Share Action. (2022). HSBC announces it will no longer finance new oil and gas fields –ShareAction response. 14th December. Available online at: <https://shareaction.org/news/hsbc-announces-it-will-no-longer-finance-new-oil-and-gas-fields-shareaction-response?token=IcQ5WS9t8-TEEQvxuWEDe-2weKKnYd&s=09> (Accessed October 10, 2024).
- Skovgaard, J. (2021). The economisation of climate change; how the G20, the OECD and the IMF address fossil fuel subsidies and climate finance. Cambridge: Cambridge University Press, 87–104.
- Skovgaard, J., van Asselt, H., Beaton, C., Drake, E., Jones, N., McCulloch, N., et al. (2024). Revitalizing international fossil fuel subsidy phase-out commitments through roadmaps, closing loopholes, and support. *NPJ Climate Action* 3, 1–3. doi: 10.1038/s44168-024-00149-7
- Sonter, L. J., Maron, M., Bull, J. W., Giljum, S., Luckeneder, S., Maus, V., et al. (2023). How to fuel an energy transition with ecologically responsible mining. *PNAS* 120:e2307006120. doi: 10.1073/pnas.2307006120
- Sovacool, B. K., Mukherjee, I., Drupady, I. M., and D'Agostino, A. L. (2011). Evaluating energy security performance from 1990 to 2010 for eighteen countries. *Energy* 36, 5846–5853. doi: 10.1016/j.energy.2011.08.040
- Sovacool, B. K. (2012). Energy security: challenges and needs. *WIREs Energy Environ.* 1, 51–59. doi: 10.1002/wene.13
- Sovacool, B. K., Sidortsov, B. V., and Jones, B. R. (2014). Energy security, equality and justice. London: Routledge.
- Sovacool, B. K., and Dworkin, M. (2014). Global energy justice: Problems, principles, and practices. Cambridge: Cambridge University Press.
- Stirling, A. (2008). Opening up and "closing down": power, participation, and pluralism in the social appraisal of technology. *Sci. Technol. Hum. Values* 33, 262–294. doi: 10.1177/0162243907311265
- Thaler, P., and Hofmann, B. (2022). The impossible energy trinity: energy security, sustainability, and sovereignty in cross-border electricity systems. *Polit. Geogr.* 94:102579. doi: 10.1016/j.polgeo.2021.102579
- UN. (1962). General Assembly Resolution 1803 (XVII) of 14 December 1962, "Permanent sovereignty over natural resources". Available online at: <https://www.ohchr.org/en/instruments-mechanisms/instruments/general-assembly-resolution-1803-xvii-14-december-1962-permanent> (Accessed February 23, 2025).
- UN. (1966). International Covenant on Civil and Political Rights, General Assembly Resolution 2200A (XXI) of 16 December 1966. Available online at: <https://www.ohchr.org/sites/default/files/ccpr.pdf> (Accessed February 23, 2025).
- UN. (1992). United Nations Framework Convention on Climate Change. Available online at: https://unfccc.int/files/essential_background/background_publications_htmlpdf/application/pdf/conveng.pdf (Accessed August 15, 2024).
- UN. (1993). Report of the United Nations Conference on Environment and Development, United Nations. New York, 1993. Available online at: [https://docs.un.org/en/A/CONF.151/26/Rev.1\(vol.II\)](https://docs.un.org/en/A/CONF.151/26/Rev.1(vol.II)) (Accessed February 24, 2025).
- UN. (1998). Kyoto Protocol to the United Nations Framework Convention on Climate Change. Available online at: <https://unfccc.int/resource/docs/convkp/kpeng.pdf> (Accessed February 24, 2025).
- UN. (2015a). Transforming Our World: The 2030 Agenda for Sustainable Development, A/RES/70/1. Available online at: <https://sustainabledevelopment.un.org/content/documents/21252030%20Agenda%20for%20Sustainable%20Development%20web.pdf> (Accessed September 26, 2024).
- UN. (2015b). Paris Agreement. Available online at: https://unfccc.int/sites/default/files/english_paris_agreement.pdf (Accessed October 11, 2024).
- UN. (2015c). Transforming our world: the 2030 Agenda for Sustainable Development, Resolution adopted by the General Assembly on 25 September 2015, A/RES/70/1. Available online at: <https://docs.un.org/en/A/RES/70/1> (Accessed February 24, 2025).
- UN. (2024a). Universal Values. Available online at: <https://unsdg.un.org/2030-agenda/universal-values> (Accessed November 15, 2024).
- UN. (2024b). The Universal Declaration of Human Rights, Article 1. Available online at: <http://www.un.org/en/documents/udhr> (Accessed November 16, 2024).
- UNCC. (2023). COP28 Agreement Signals "Beginning of the End" of the Fossil Fuel Era. Available online at: <https://unfccc.int/news/cop28-agreement-signals-beginning-of-the-end-of-the-fossil-fuel-era> (Accessed November 11, 2024).
- UNDP. (n.d.). Global Climate Promise. Available online at: <https://climatepromise.undp.org/news-and-stories/what-just-transition-and-why-it-important> (Accessed November 15, 2024).
- UNFCCC. (2016). The Paris Agreement. Available online at: https://unfccc.int/sites/default/files/resource/parisagreement_publication.pdf (Accessed February 25, 2025).
- UNFCCC (United Nations Climate Change). (2021). Glasgow Climate Change Conference, 31 Oct-12 Nov 2021. Available at: <https://unfccc.int/conference/glasgow-climate-change-conference-october-november-2021> (Accessed September 29, 2024).
- US and EU. (2022). Global Methane Pledge: From moment to momentum. Available online at: <https://energy.ec.europa.eu/system/files/2022-11/GMP%20COP27%20Joint%20Factsheet.pdf>
- Victor, D. G., and Yueh, L. (2010). The new energy order: managing insecurities in the twenty-first century. *Foreign Aff.* 89, 61–73.
- Vock, I. (2024). Trump names fracking executive Chris Wright energy secretary, BBC News, 17 November 2024. Available online at: <https://www.bbc.com/news/articles/c93qjdjwnxko> (Accessed November 11, 2024).
- WEC. (2024). World energy trilemma 2024: evolving with resilience and justice. World Energy Council. Available online at: <https://www.worldenergy.org/publications/entry/world-energy-trilemma-report-2024>.
- WEF. (2024). The global risks report 2024, world. Economic Forum. Available online at: <https://www.weforum.org/publications/global-risks-report-2024/>
- Wemanya, A., and Adow, M. (2022). Implementation of the just energy transition Partnership in South Africa. Power Shift Africa and Germanwatch. Available online at: https://www.germanwatch.org/sites/default/files/g7g20_track-2_just_energy_africa_policy_brief_rev-1_met-1.pdf
- Willrich, M. (1976). International energy issues and options. *Annu. Rev. Energy* 1, 743–772. doi: 10.1146/annurev.eg.01.110176.003523
- Willrich, M. (1978). Energy and world politics. New York City: Simon and Schuster.
- World Bank. (2024). GDP (current US\$). Available online at: <https://data.worldbank.org/indicator/NY.GDP.MKTP.CD> (Accessed September 13, 2024).
- WRI. (2024). Bigger and better in Baku: scaling up climate finance for developing nations. Webinar on October 23, 2024. Available online at: <https://www.wri.org/events/2024/10/bigger-and-better-baku-scaling-climate-finance-developing-nations> (Accessed September 3, 2024).
- Yergin, D. (2006). Ensuring energy security. *Foreign Aff.* 85, 69–82. doi: 10.2307/20031912
- Zhang, S., Shinwari Zhao, S., and Dagestani, A. A. (2023). Energy transition, geopolitical risk, and natural resources extraction: a novel perspective of energy transition and resources extraction. *Resour. Policy* 83:103608. doi: 10.1016/j.resourpol.2023.103608
- Zillman, D., Roggenkamp, M., Paddock, L., and Godden, L. (2018). "How technological and legal innovations are transforming energy law" in *Innovation in energy law and technology dynamic solutions for energy transitions*, eds. D. Zillman, M. Roggenkamp, L. Paddock and L. Godden (Oxford: Oxford University Press), 1–19.
- Zubairu, S. (2021). COP26: Africa charts a complex road to net zero, African Business, October 31st, 2021. Available online at: <https://african.business/2021/10/energy-resources/africas-complex-road-to-net-zero> (Accessed November 11, 2024).