Energy and the Good Life: Capabilities as the Foundation of the Right to Access Energy Services

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ABSTRACT

Access to an adequate level of uninterrupted, high quality, affordable, sufficient and useful energy services varies dramatically across countries. While some nations still experience energy poverty and struggle to fulfil basic needs, others consume well over what is considered sufficient to sustain wellbeing and human flourishing. These imbalances represent fundamental injustices that must be urgently addressed and resolved. Given current inequalities, this paper asks, in general, whether it is possible to establish a human right to energy and, more specifically, whether the Capabilities Approach (CA) can provide a solid theoretical foundation for the claim to a human right to access energy services. We argue, on the one hand, that it is possible to identify concrete ranges of individual energy consumption that, if "translated" into useful energy services, constitute the adequate (not just minimal) preconditions for achieving core capabilities in different geographical contexts. On the other hand, we use the CA as a normative framework to argue for a capability-based human right to access necessary energy services such as nutrition, cooking fuel and electricity. We support these claims in two main ways. First, by looking at how individual energy consumption impacts human development and wellbeing. Second, we offer a comparison between access to specific energy services and the Human Development Index (HDI). The human right to access necessary energy services should be understood in both moral and legal terms. It should be integrated within both the international United Nations human rights framework and international energy law.

KEYWORDS

Human rights; energy access; energy ethics; energy justice; energy services; capabilities approach (CA)

1. Introduction

The modalities and pace of current sociotechnical energy transitions vary significantly across countries (WBGU 2003; Mediavilla et al. 2013; Araújo 2014; Geels et al. 2017; Büscher, Schippl, and Sumpf 2019). Many differences depend on geographical factors (i.e. climate, latitude, altitude) and previously established path dependencies (i.e. infrastructures, technical systems, and policies).[1] Each energy

transition is also unique because it hinges on deeply-rooted "cultures of energy" (Stephenson et al. 2010; Strauss, Rupp, and Love 2013; Sheller 2014) as well as a variety of historical and socio-cultural circumstances such as lifestyles, situated experiences, ingrained behaviours and habits (Groves et al. 2017).

Despite relatively positive improvements in the access to certain energy services in many "developing" nations[2] (e.g. better cooking fuel and stoves, electrification; see UNDP and OPHI 2019), there are persistent and worrisome inequalities worldwide. For example, it is well known that some nations consume well over what is considered "sufficient" while others still experience energy poverty and struggle to fulfil basic needs, let alone sustain wellbeing and human flourishing (Nussbaumer et al. 2013). Consider, for instance, that in 2014 the United States had an annual energy consumption per capita of about 290 GJ, Germany of 157 GJ, and China of 94 GJ. While the world average stands at about 85 GJ, countries such as Haiti, Yemen, or Ethiopia had values as low as 10–20 GJ.[3] Although any ambitious energy transition has to face several challenges, the situation is especially worrisome in poor and vulnerable nations that experience most of the burdens of energy access and use inequalities which, in turn, particularly affect women (Buechler et al. 2020; Feenstra and Özerol 2021; Fathallah and Pyakurel 2020; Winther et al. 2020). All this means that, for instance, "on time scales acceptable for developing countries, both decarbonization and the needed structural changes or efficiency improvements […] are unlikely to be achieved without endangering [other] sustainable development objectives" (Steckel et al. 2013, 53). Notwithstanding these difficulties, many deprived people are demanding adequate access to energy services to improve their lives. But the requirements of such services are also important: they are considered useful insofar as they are reliable (uninterrupted), high quality, affordable, sufficient, sustainable and modern (Hesselman, Varo, and Laakso 2019; IEA et al. 2019). Therefore, access to energy services is a pressing ethical issue, geographically as well as temporally, that must be urgently addressed and resolved (Bergstrom 2004). Here, for example, we assume that nutrition, cooking fuels and electricity are necessary energy services (Walker, Simcock, and Day 2016) that can lead to ulterior, or "second-level" necessary energy services, that is what actually enhances "energy capabilities" (e.g. being well-nourished, being able to read in the dark, being able to operate a computer).[4]

The normative thesis that an "adequate energy supply" is a key prerequisite for economic, cultural and social development in complex societies is supported by most energy scholars as well as by the major Declarations and Reports by the United Nations (UN 1986; UN 1992; UN 2012).[5] In particular, Sustainable Development Goal 7 (SDG7) stresses that an increase in the availability of modern energy is directly linked to many dimensions of human development.[6] Similarly, the Index to Sustainable Development Goal Indicators that is part of the *Human Development Indices and Indicators 2018 Statistical*

Update echoes that SDG7 was envisioned to "ensure universal access to affordable, reliable, sustainable and modern energy for all" (UNDP 2018). This point that further emphasises that, from a well-being perspective, "it is energy services that are demanded rather than energy carriers [… because the focus in on] the benefits individuals derive from using energy" (Kalt et al. 2019, 51). It is worth repeating that improving access to energy services is especially crucial in all energy-poor contexts (Bazilian et al. 2012; Bazilian and Pielke 2013) including "energy peripheries" (Golubchikov and O'Sullivan 2020).

The emerging field of "energy ethics"[7] can offer a systematic ethical analysis as well as a "moral compass" (Frigo 2018b) by which to orient moral agents who act in energy projects or stakeholders who bear the consequences of energy-related decisions. Energy ethics, in general, deals with the "morality" of energy transitions (Miller 2014; Smith and High 2017; High and Smith 2019; Frigo 2021). More specifically, it can be envisioned as a type of applied ethics framework to analyse and decide the ethical merit within energy controversies and dilemmas (Bethem et al. 2020). While we agree that the energy transitions should respond to climate concerns and energy injustices among peoples, here we also suggest that a central task of energy ethics is to take a harder look at the issue of "how much" energy is used, by "whom" and especially "why" or "for what purposes". In particular, we aim at connecting the topics of energy poverty, energy consumption and access to rights theory. Our research question is the following: can the Capabilities Approach (CA)[8] provide a solid basis for (normatively) theorising a human right to access necessary energy services?

Following the introduction, the paper is organised in four parts. In Section 2 we first clarify why and how we chose the CA as the "theoretical anchor" of our article and survey the work of a few scholars who have already connected the CA with the field of energy poverty and energy justice. Section 3 illustrates current attempts to theorise "energy rights" and presents our proposal of a "human right to access necessary energy services." To support our thesis, in Section 4 we discuss studies of the correlation between energy consumption and indicators of human development and wellbeing. Moreover, we present the correlation between three specific energy services that we deem necessary and the Human Development Index (HDI). Section 5 summarises our findings and provides some practical recommendations for politicians, energy policymakers and practitioners.

2. Theoretical Frameworks and Assumptions

2.1. Why *Capabilities? The Importance of Freedom of Choice and Human Dignity*

The study of the relationship between energy consumption and quality of life has been traditionally framed through a utilitarian perspective. This means

that the (re)distribution of and then access to energy resources have typically been envisioned as a key means toward wellbeing. Most development policies of the past mirrored this assumption. An initial reason for choosing the CA instead, depends on the fact that it changes the point of view from a resource-based paradigm—the greatest amount of energy access for the greatest number—to a perspective that considers how people's individual wellbeing relates to and depends on the actual access to energy services. The CA has indeed criticised approaches to human development that focus on distributing resources and seeks instead to pay attention to the capabilities that are enhanced or diminished by certain resources. Second, as a "practical strand of normative political philosophy" (Robeyns 2016), the CA is particularly suited to address immediate, pressing questions concerning energy ethics and justice. Third, the CA allows scholars, policy makers, politician and energy practitioners to "step into the shoes" of the most vulnerable people, thus stressing a bottom-up approach in considering issue of energy access and (in)justice, as also recently proposed by Velasco-Herrejon and Bauwens (2020). A fourth, related reason for privileging the CA is that it has often been used in the context of human development studies (Nussbaum and Sen 1993; Nussbaum 2000; Comim, Qizilbash, and Alkire 2008) to stress the importance of freedom of choice and human dignity. In fact, the CA regards the type of lives that individuals are able to lead—what they are able to do and be(come)—as intrinsically valuable. As suggested by S. Alkire, "the key idea of the capability approach is that social arrangements should aim to expand people's capabilities—their freedom to promote or achieve what they value doing and being" (Alkire and Deneulin 2009, 31). "Freedom to achieve" (or freedom of choice) and "human dignity" are two key principles of the CA, and are accordingly understood to be of intrinsic worth. They precede, in a sense, what one will be capable of. Although the material conditions as well as other characteristics of a good human life may vary according to different human groups and contexts, it does indeed seem possible to determine common "preconditions" for individual flourishing that are often mirrored in the broader socio-economic and political organisation as well in infrastructural and technological development.

From an ethical standpoint, identifying the key requirements for a good life implies that, however, diverse lifestyles and experiences might be, there is some common ground when it comes to things humans generally tend to value. But *how* is this framework useful here? In the rapid evolution of energy transitions, it seems evident that neither making systems more efficient (e.g. insulating homes) nor creating smarter energy devices (e.g. digitalisation) are ends in themselves. These modifications are deemed "good", "valuable" or "effective" insofar as they make it possible to efficiently provide or improve certain energy services. These services are typically envisioned as means to achieve, maintain or improve certain "conditions" or

"states" of human life.[9] Therefore, it seems that one of the fundamental preconditions for preserving capabilities, freedom of choice and human dignity consists in being able to access sources of energy to fuel different energy services. For example, in a narrow sense, electricity is required for reading and studying at night as well as for accessing the internet (capabilities), so it can be seen as a service that constitutes also the precondition for freedom of choice and human dignity. For these reasons, we propose that the CA is particularly useful for considering energy services as "conversion factors", namely, as the preconditions for a good life.

In this article, we will privilege Nussbaum's account (2011) because she:

(a) proposes an explicit list of core capabilities that can be directly linked to energy systems, technologies (Hillerbrand and Goldammer 2018) and services (whereas A. Sen seems to intentionally leave this aspect more open for deliberation);
(b) argues for capabilities that are common and potentially "universal" across cultures;
(c) uses the CA to construct a theory of social justice, thus providing a direct link to the energy justice discourse;
(d) develops a normative framework that is centred around the notion of individual human dignity, a topic that we believe is very much interwoven with adequate access to energy services;
(e) sets the list of capabilities as both essential and ambitious goals and not merely survival ones.

Following Nussbaum, we assume that identifying shared and valuable "energy capabilities" is a matter of evaluating the requirements for not just a decent, but a "good life".[10]

The CA was first adopted in energy studies in the 2000s. There are especially two domains of energy scholarship related to capabilities that are important within the scope of this paper. The first gathers studies that employed the CA to address energy poverty, access and sustainable development studies, often with a focus on people's wellbeing. The second area deals with energy justice, typically with a stress on energy policy. The following two sections survey a few studies in these two areas.

2.2. Capabilities, Energy Poverty and Access

There are several case studies about the CA and energy poverty. For example, Pachauri and Spreng assess how access to and use of energy are related to poverty (2004), and look at how to monitor improvements in energy access using the CA (2011). Pachauri et al. (2004) evaluate different ways to measure energy poverty in Indian households, while S. Groh proposes a

study of the relationship between energy poverty, remoteness and implications for people's development opportunities in the context of rural Peru (2014). Despite a general focus on the Global South, it is also relevant to remember that although energy poverty particularly affects "developing" countries it is, in fact, a vulnerability that can also be present in the so-called developed, industrialised ones. In this direction, some authors have investigated how the CA can be used to relate energy poverty to energy services, particularly with reference to domestic heat (see the review article by Jessel, Sawyer, and Hernández 2019, or case studies such as Walker and Day 2012; Bouzarovski 2014; Xu and Chen 2019; Bartiaux et al. 2019; Middlemiss et al. 2019). Similarly, Willand and Horne (2018) and Willand et al. (2020) combine several themes such as sustainability, the CA, energy poverty, vulnerability, and policy recommendations regarding home heating and retrofitting buildings in Australia.

In this article, we will follow the widely cited capability-based definition of energy poverty proposed by R. Day et al.: "an inability to realise essential capabilities as a direct or indirect result of insufficient access to affordable, reliable and safe energy services, and taking into account available reasonable alternative means of realising these capabilities" (2016, 260). Moreover, we underline with L. Middlemiss et al. (2019) the importance of paying attention to the "recursive connection" between social relations and energy poverty because being able to establish good social relations, a core capability,[11] "can both enable access to energy services, and be a product of such access" (227).

2.3. Capabilities and Energy Justice

A decade after its emergence, energy justice has become a well-established and already influential framework in the just energy transitions debate (Shirani et al. 2013; Jones, Sovacool, and Sidortsov 2015; Finley-Brook and Holloman 2016; Jenkins, McCauley, and Forman 2017; Jenkins 2018). A few authors mention the CA while surveying theoretical frameworks (Lacey-Barnacle, Robison, and Foulds 2020) or providing overviews (Sovacool, Sidorstov, and Jones 2014). What little there is that connects directly the CA with issues of energy justice has mostly been concerned with what can be called "specific injustices" such as energy or fuel poverty (e.g. Willand and Horne 2018). For example, G. Pellegrini-Masini (2019) mostly follows the account of A. Sen to address issues of energy and "basic capability equality". Wood and Roelich (2019, 2020) propose to expand and substantiate the notion of energy justice through the pluralistic framework of the CA as a way to mitigate tensions and better understand energy dilemmas. While energy justice has traditionally been framed within the so-called triumvirate of tenets (distributional, procedural and recognition types of justice, McCauley et al. 2013), in the case of a right to energy access it is particularly important to also emphasise its cosmopolitan dimension given the transboundary geopolitics of energy resources.[12]

By linking the CA and rights theory with the interwoven topics of energy poverty and access, our goal is to contribute to the recent call for "appropriate reflexivity" in energy justice research in order to "maximize its societal impact" (Jenkins et al. 2020).

3. Energy Rights and Capabilities

3.1. Energy Rights in Theory and Practice

Our research question—whether the CA can be used to support a human right to access necessary energy services—is actually underpinned by a more general one: *is it at all possible to argue for energy rights?* Especially in the last decade, a few scholars have proposed that it is indeed time to talk about a "right to energy" (Freling 2012; Tully 2006; 2008; Walker 2015; Caney 2011; Azad and Chakraborty 2020). Interestingly, the language of this emergent energy rights debate has quickly become quite specific, probably because, as G. Walker has noted, talking about a right to energy immediately raises "basic questions about meaning, value and form" (2015). Hence, authors began to talk about a more precise "right to energy *access,*" stressing for instance the distinction between "having access" and "being able to make use of that access" (Walker 2015).[13]

However, understanding the right to energy as the "right to energy access" still remains too vague because, in reality, people do not want to "access energy" but rather the services that energy can provide to them. In this sense, the demand for energy becomes a normative matter because of what energy is used for, namely, what it can be used to achieve (Shove and Walker 2014). Since the right to energy (unlike, for instance, the "right to water"; see Sultana and Loftus 2015) cannot refer to a "key substance with a clear material definition" (Walker 2015, 30), it is essential to link it to something more tangible, namely, *energy services*. In this direction, for example, S. Tully first proposed the "access to electricity as a human right" (2006) and then, more generally, "the human right to access clean energy" (2008). In line with the ambitions set by SDG7, this focus on energy services has already spread to the realm of policy. As A. J. Bradbrook has noted, "many national electricity policies are increasingly being formulated in rights-based terminology that guarantees safe, affordable, adequate and reliable supplies of electricity available to all" (2016, 22). Moreover, in the European context, the ENGAGER 2017–2021 COST Action uses the language of "energy rights in relation to household-level energy poverty"[14] while the *Right to Energy Coalition* formed in 2017 recognises "energy as a basic human right."[15]

We suggest that the CA is a good candidate for grounding a right to access energy services theoretically because it provides a normative approach combined with a bottom-up perspective, both of which move from the concrete

needs of people and from an explicit concern for vulnerability, freedom of choice and human dignity.

3.2. A Capabilities-based Human Right to Access Necessary Energy Services

Let us now consider our research question specifically. *Can the CA provide a solid theoretical foundation for a human right to access necessary energy services?* To answer this question, we propose to briefly examine the relationship between Nussbaum's list of capabilities as they relate to both energy systems and technologies. Then, we will address the link between these latter and energy services.

Hillerbrand and Goldammer (2018) applied Nussbaum's core capabilities to energy systems and technologies, outlining a preliminary set of values or "energy capabilities" that are central to sustainable energy systems and predominantly at stake during their transformation.[16] Table 1 (See Supplementary Materials) summarises their examples of "energy capabilities" also synthesised more succinctly by de Wildt et al. (2020). Energy systems and technologies are the means through which energy services are carried out. But different types of technologies and arrangements of systems will require and consume different amounts of energy and release different amounts of wastes. This means that it is not only important to pay attention to the delivery of specific services, but also to the energy intensity and footprint of different systems and technologies.

The current state of energy transitions shows that only some people can access and afford services that derive from highly efficient and little polluting systems and technologies. Many people have to use less efficient ones or they have to make do with rudimental means. Yet, others do not have access to energy services at all. In short, different technologies and systems can provide energy services at different levels and with various characteristics. In this sense, energy systems and technologies are not "neutral": certain infrastruc-tural and technical arrangements as well as different technologies may enhance, diminish or threaten one or more capabilities.

Therefore, a capabilities-based human right to access energy services stress that energy systems and technologies should promote core capabilities or at least, should not negatively impact them. Finally, because certain capabilities are not fulfilled under certain thresholds of energy access (see below), it is relevant to argue for a human right to be recognised, protected and pro-moted by political institutions in a transboundary way, across nations of people. Hence, this right should be understood in both moral *and* legal terms. In a similar direction, A. J. Bradbrook has devoted several publi-cations to the topic of energy (access) as it relates to legal theory and systems. In 2006, for instance, together with J. G. Gardam, he suggested

that given "the need to provide universal access to modern energy services [without which] people are destined to live in poverty", such access should be understood as a human right (Bradbrook and Gardam 2006; see also Bradbrook, Gardam, and Cormier 2008; Bradbrook 2011). Similarly, the EU has recognised that "uninterrupted, high quality, affordable, and sufficient access to energy services is essential to human life" (Hesselman, Varo, and Laakso 2019). However, the recent 2019 report "Clean Energy for All Europeans" mentions only "consumer rights" related to energy and nothing more than that (European Commission 2019). These examples show that, if it is possible to conceptualise such a normative claim in a theoretical sense, it should also be possible to advocate for its legal implementation. For example, we suggest that it could and should also be integrated into the international UN human rights framework[17] and implemented in both international energy law and countries' energy policies.

3.3. What Type of Right Is the Human Right to Access Energy Services?

Although the notion of a "right" can be based on different theories, here we follow the analysis by Wacks (2006), according to whom "the springboard for any analysis of rights" is the American jurist, Wesley Hohfeld ([1919] 1966), who proposed a thorough scheme of "jural relations". According to Hohfeld framework, the right to access energy services should be understood as a "claim right" (X has a claim-right to do R and Y [or anyone else] is under a duty to allow X to do R), where the "duty" here is the correlative of a claim-right. This resonates with Walker (2015), for whom the current energy rights discussion is

> a mode of claim-making about what should be in place and protected for individuals (or groups) and, it often follows, about what duties and obligations should rest with others and in particular the State, to provide for and protect these rights (26).

We propose that such claim-right may possess additional attributes, and could be qualified also as:

(a) a *human* right: in this case, our capabilities orientation is compatible with the "orthodox view, according to which human rights are moral rights possessed by all human beings simply in virtue of their humanity" (Cruft, Matthew Liao, and Renzo 2015, 45).
(b) an *individual* right: although access to energy services benefits a larger number of people (i.e. families, ethnic, religious, and linguistic groups, and nations), the capabilities they enhance are important first and foremost at an individual level.
(c) a *passive* right, which is "signaled by statements of the form 'A has a right that B φ' (where 'φ' is an active verb)" (Wenar 2020). Here the holder of the

claim-right, the individual person, has a passive right whereas the provider of the energy service has an active duty to provide such services.

(d) a *positive* right: "the holder of a negative right is entitled to non-interference, while the holder of a positive right is entitled to provision of some good or service" (Wenar 2020), making the right to access energy services a positive one.

(e) a *socio-economic* right. As Walker (2015) states, "rights-based talk has increasingly incorporated energy into a set of 'second generation' rights that seek to demand the politically significant socio-economic or welfare needs of contemporary (global) citizenship". Thus the human right to access energy services should also be understood as a socio-economic right.

(f) an *intragenerational* right. Following Sovacool et al. (2017) a claim to equity among people living in different places at the same time may suggest that "All people have a right to fairly access energy services".

(g) an *intergenerational* right. Following Sovacool et al. (2017), a claim to equity for future generations may suggest that future people "have a right to enjoy a good life undisturbed by the damage our energy systems inflict on the world today".

To summarise, our analysis of the characteristics that may define a right to energy access suggests that it can be theorised as a human, individual, passive, positive, socio-economic, intra- and inter-generational claim right.

4. Energy and the Good Life

4.1. Empirical Studies of the Relationship Between Energy Use and Wellbeing

Arguing for a human right to access energy services is supported by robust scholarship that has investigated the relationship between energy consumption and the degree of human development[18] or wellbeing.[19] While there was interest in this area as early as the 1940s (White 1943; Cottrell 1955), more robust empirical studies on this topic began in the 1970s and were pursued primarily by social scientists (e.g. Mazur and Rosa 1974; Nader and Beckerman 1978; Olsen 1992; Steinberger and Roberts 2010), historians of energy (Adams 1975; 1977), economists (e.g. Wolvén 1991; Smil 2003; Aydemir and Soytaş 2019), engineers (Nadimi and Tokimatsu 2018) and public policy scholars (e.g. Schipper and Lichtenberg 1976; Krugmann and Goldemberg 1983; Goldemberg et al. 1985; Alam et al. 1991; Schipper and Price 1994; Alam et al. 1998; Goldemberg 2001; Spreng 2005; Dias, Mattos, and Balestieri 2006; Lambert et al. 2014). Although differing in terms of empirical and theoretical methods, most of these studies support the existence of a positive correlation between per capita energy consumption and indicators for wellbeing such as

the HDI. Moreover, they demonstrate that certain thresholds of energy use con-stitute the prerequisites for achieving human development and wellbeing. Below, Table 2 summarises various proposals of energy use thresholds while Table 3 (see Supplementary Materials) provides examples of per capita energy use and HDI in different countries for the year 2014.

4.2. How Much Is Enough? The "Saturation Phenomenon"

Although the correlation between energy use and the HDI is very important, the most impressive finding consists in what some authors have described as

Table 2. Thresholds estimated by various authors along with examples of actual energy use and HDI.

Study	Threshold	Wellbeing Criteria
Recent Proposals		
Krugmann and Goldemberg (1983)	41.26 < GJ < 56.54 (27000 < kcal/day/c < 37000)	"basic human needs"
Goldemberg et al. (1985)	36 GJ (1 Kw/capita)	"basic human needs and considerable improvement in living standards"
Olsen (1992)	209.34 GJ (5000 Kgoe) (average of 30 countries)	7.9 GNP in US $
Pasternak (2000)	14.4 GJ (4000 kWh) (EC*)	HDI > 0.9
Goldemberg (2001)	42 GJ (TPED**)	"acceptable standard of living"
WBGU (2003)	35.4 GJ (Average TPED, traditional energy consumption)	0.7 < HDI < 0.8
Smil (2003)	65 < GJ < 110 (110 GJ saturation level)	HDI > 0.8
Dias, Mattos, and Balestieri (2006)	120 GJ	Lowest HDI of OECD countries
Martínez and Ebenhack (2008)	16.7 GJ < TPED < 33.5 GJ 121.4 GJ (TPED)	"extremely low" <HDI < 0.7 HDI > 0.9
Steinberger and Roberts (2010)	60 GJ (2005)TPED dynamic function:	HDI > 0.8
Steckel et al. (2013)	100 GJ (FEC)***	"very likely" HDI > 0.8
Rao, Riahi, and Grubler (2014)	30 GJ (TPED)	"90% of the population living in 'decent conditions'"
Lambert et al. (2014)	120 GJ	HDI > 0.75
Aydemir and Soytaş (2019)	6.25–6.69 GJ/c/y residential energy consumption without heating	"fair energy consumption/use" (residential)
Azad and Chakraborty (2020)	8.52–9.49 GJ/c/y residential energy consumption at 1000 HHD**** 8,16 GJ/c/y (2268 kWh/annum, plus an annual universal travel pass of $17.9)	"Energy Right programme" for India
Future Scenarios		
Goldemberg et al. (1985)	31.5 GJ (1 kW) (FEC)	"achieving material standard of living of Europe in the 1970s"
WBGU (2003)	25.5 GJ (2020, average TPED)	0.7 < HDI < 0.8
Spreng (2005)	72 < GJ < 144 GJ (2000-4000 W/capita) (2050, upper limit of global average per capita energy consumption)	"basic needs" "stabilization of the climate"
Steinberger and Roberts (2010)	45 GJ (2030, TPED dynamic function)	HDI > 0.8

*EC: annual per capita electricity consumption.
**TPED: annual per capita total primary energy demand.
***FEC: annual per capita final energy consumption.
****HDD: Heating Degree Days (heating demand).
Source: Arto et al. (2016), Krugmann and Goldemberg (1983), Olsen (1992), Smil (2003), Spreng (2005), Lambert et al. (2014).

the "plateau" (Pasternak 2000) or "saturation" phenomenon. Consider the following key findings:

> If one does assume saturation behavior of global energy consumption, then there is justification to isolate three regions within the EA ["energy advantage" or the trend representative of most of the world]. The first, steeply rising region (HDI 0.354–0.7) represents energy-poor nations, and indicates that there is a very strong dependence of human development on increased access to energy. The second region, located near the point of inflection (HDI 0.7–0.9), represents transitioning nations, and indicates a threshold from very poor human development to very high development. The third, leveling off or "saturated" region (above 0.9) represents energy-advantaged nations residing in the industrialised world, and indicates that little improvement in human welfare can be achieved with greater energy consumption patterns at these very high HDI levels. [So] it is also certain that enhanced energy demands will not benefit the populace of these [already developed] nations as a whole. (Martínez and Ebenhack 2008, 1432)

The correlation of HDI and total energy consumption per capita (which refers to the use of primary energy) and year in GJ can be clearly derived from Figure 1.

Most "developed" countries (i.e. with HDI around 0.9) yield a total energy demand of > 90 GJ/c/y. The higher energy use of some "outliers" sometimes depends on specific contextual factors. Consider these three examples. First, there are some cases where the HDI is below 0.9 but it is associated with a very high energy use.[20] This can be explained simply by the fact that these countries use fossil fuels extensively as primary energy carriers but have comparatively low conversion efficiencies related to fossil-fueled technologies. Second, contextualisation is fundamental in order to avoid the risk that energy consumption per capita becomes a misleading indicator. Consider the case of a small country such as Trinidad and Tobago (0.79, 601.36) that is considered "developing" from an HDI perspective but has a huge energy consumption per capita. Why? Most of the energy consumed in T&T is used by its many industrial and petro-chemical plants rather than by its inhabitants. Third, it is important to pay attention to specific types of energy sources when assessing this kind of correlation. For example, while Iceland has a small population, the nation consumes a lot of energy (mostly because of its climate). However, it is important to know that most of Iceland's power comes from hydropower and geothermal sources (0.92, 750.1). But, more importantly for our reasoning here, although ten among the most energy-poor countries are still far from the global average energy use (red dot, HDI 0.72, 80.49 GJ/c/y), the correlation between individual energy consumption and HDI appears to remain consistent.

In Figure 2, the HDI is plotted against the total energy use per capita over time for selected countries. There seems to be a positive linear trend for both indicators, which themselves correlate strongly ~0.7. Interestingly, there has been only limited progress for the HDI and energy use in some countries

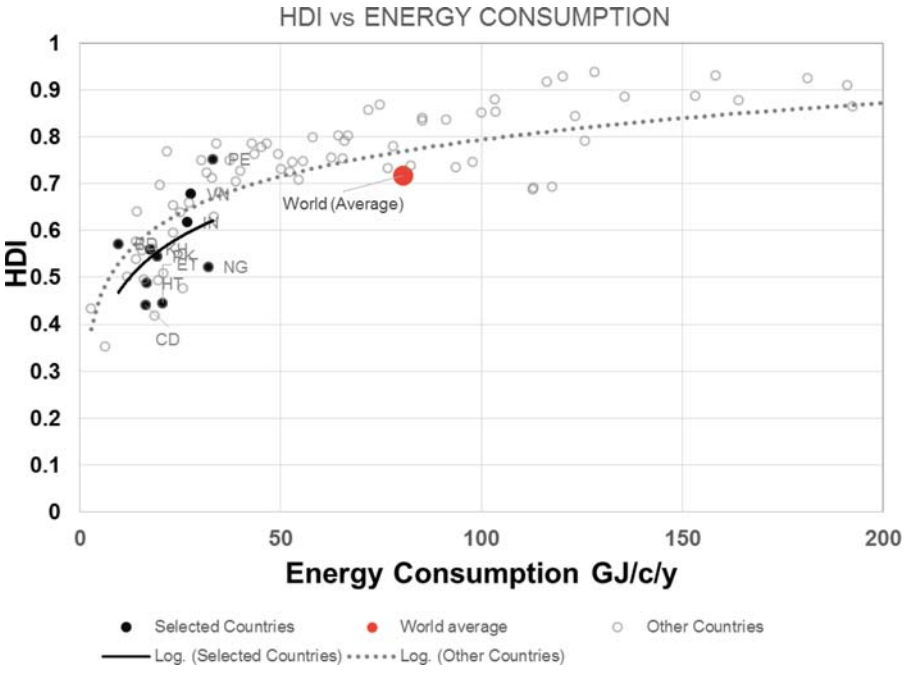

Figure 1. Comparison of energy use per capita vs. HDI highlighting the trendline of ten energy-poor countries and the world average. Data Source: World Bank and UNDP.

such as Bangladesh (BG) or Nigeria (NE). This may also depend on the fact that improvements in energy supply (e.g. electrification) do not "compensate" for (i.e. they grow slower than) the rate of population growth, an important point related to population policy also mentioned by Nussbaumer et al. (2013).

The claims about this important correlation made so far still require two points of clarification. First, as already mentioned using per capita energy use/consumption as an indicator may be problematic. For example, it depends on potentially unwarranted assumptions that have already been suitably criticised (Arto et al. 2016).[21] Second, the HDI has not been calculated uniformly over the years and its definitions have also changed over time. Nevertheless, we defend the use of both indicators as valuable and appropriate for our purposes. In particular, using per capita energy consumption is helpful because:

(a) it is a prerequisite for energy services to exist;
(b) as O'Neill et al. has noted, "a per capita approach allows us to explore what quality of life could be universally achieved if resources were distributed equally" (2018);
(c) it mirrors the CA's concern for individualistic but not subjective wellbeing.

In any case, we mentioned above that per capita energy consumption is going to be a useful indicator only if it can be linked to concrete access to

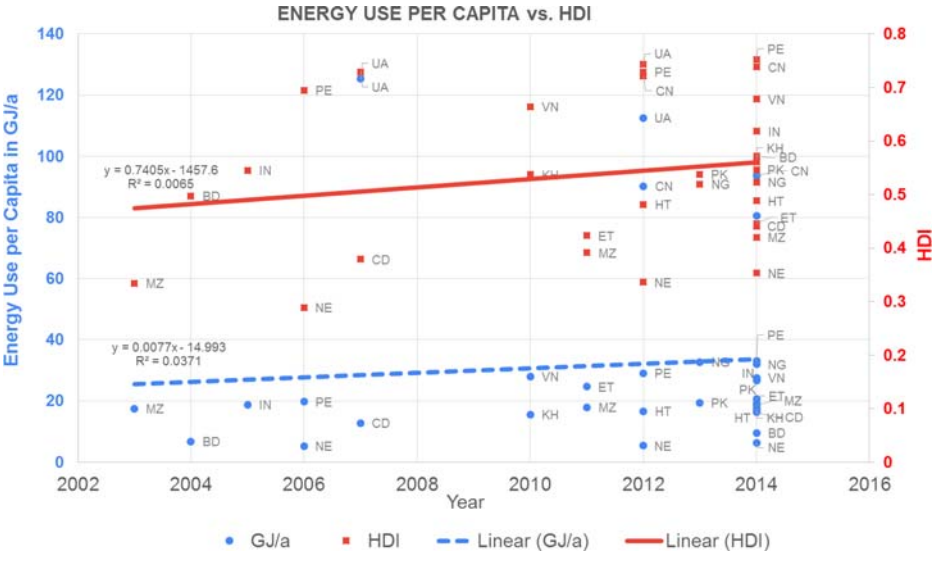

Figure 2. Comparison of energy use per capita (left y-axis) vs. HDI (right y-axis) for selected countries over time. Data Source: World Bank and UNDP.

various energy services that can directly enhance the capabilities available to individuals. In the following section, we assess this condition.[22]

4.3. The Correlation Between Energy Services and HDI

Following Walker (2015), and as explained above, we assume that the reason "energy" is really valued is because it is a "useful resource" that can provide specific "energy services":

> Energy as such is not what is important. It is rather the heat, cool, light, mobility, communication, cooking of food and other services that energy provides which contribute to wellbeing, and to being able to achieve a range of basic capabilities. (29)

While we agree that "access to energy services" is the most convincing formulation of a right to energy, it should be considered a right if and only if it refers to fundamental, essential or necessary energy services. But because even what is essential varies according to different people and contexts, Walker et al. claimed that "it is clear that the idea of the right to energy services being simply definable in universal and global terms is problematic" (Walker 2015, 30). We agree that some energy services may be considered more or less needed or valuable depending on geographical contexts, times and conditions as well as latitudes and altitudes. For example, while it would make sense to consider a "right to cooling" for countries located in the tropics, Scandinavian countries would rather prefer to concentrate on a "right to heat". However, is there any *necessary* energy services that would be valuable for enhancing capabilities generally? Our proposal here is that at least three energy services (nutrition,

cooking fuel and electricity) should be considered essential or necessary for enhancing several core capabilities and should therefore become part of a human right claim. Others (e.g. heating and cooling) might be added depending on geographical variability.

To support this claim, below we present a comparison between the HDI and some indicators of those three services drew from the *Global Multidimensional Poverty Index 2019* (UNDP and OPHI 2019) and the *Multidimensional Energy Poverty Index* (MEPI). Our use of these indices depends on the fact that they have frequently been linked to capabilities thinking because they "negatively" assess how much "less poor" people are with regard to specific material conditions. We have combined data from these indices with reports concerning twenty (energy poor) countries as they relate to nutrition (Figure 3), cooking fuel (Figure 4) and electricity (Figure 5) and plotted them against the HDI for each country in different years (as we did in Figure 2). These relationships illustrate the (expected) tendency of the HDI to moderately improve as these specific energy services become more available to people in need. Let us consider each graph separately.

(A) ***Nutrition***. The level of nutrition has been growing considerably for most countries considered in Figure 3, which is also reflected through a growing HDI. Here a strong positive correlation of 0.79 between these two indicators can be observed.

(B) ***Cooking Fuel***. In contrast, a strong negative correlation of ~0.8 can be observed between HDI and the need for (simple) cooking fuels (e.g. firewood, charcoal, crop residues) for selected countries as indicated in Figure 4. One reason for this might be that in countries like Ukraine (UA) gas and electric stoves are primarily used.

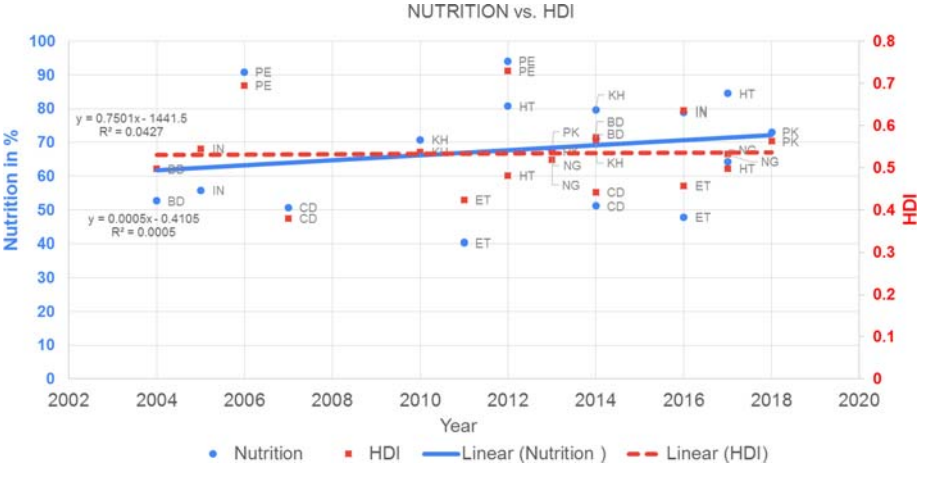

Figure 3. Nutrition in % (left y-axis) vs. HDI (right y-axis) for selected countries over time. Data Source: GMPI and UNDP.

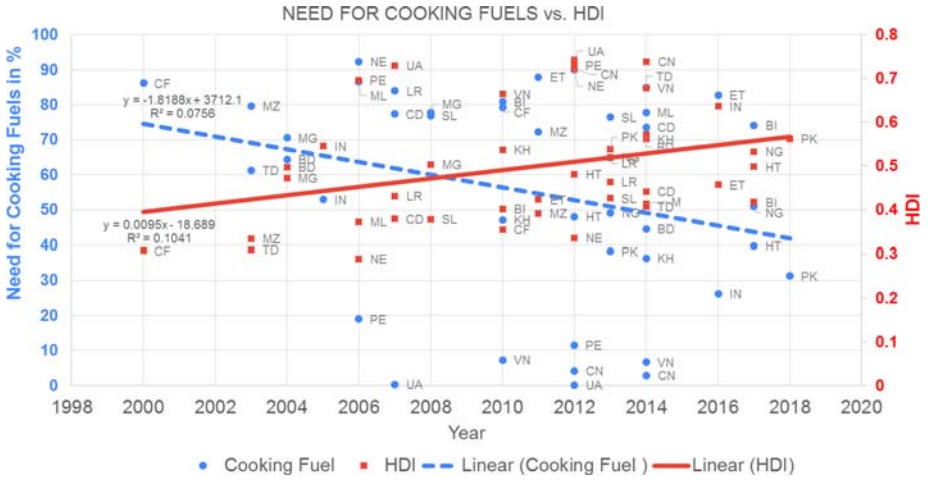

Figure 4. Need for cooking fuels % (left y-axis) vs. HDI (right y-axis) for selected countries over time. Data Source: GMPI and UNDP.

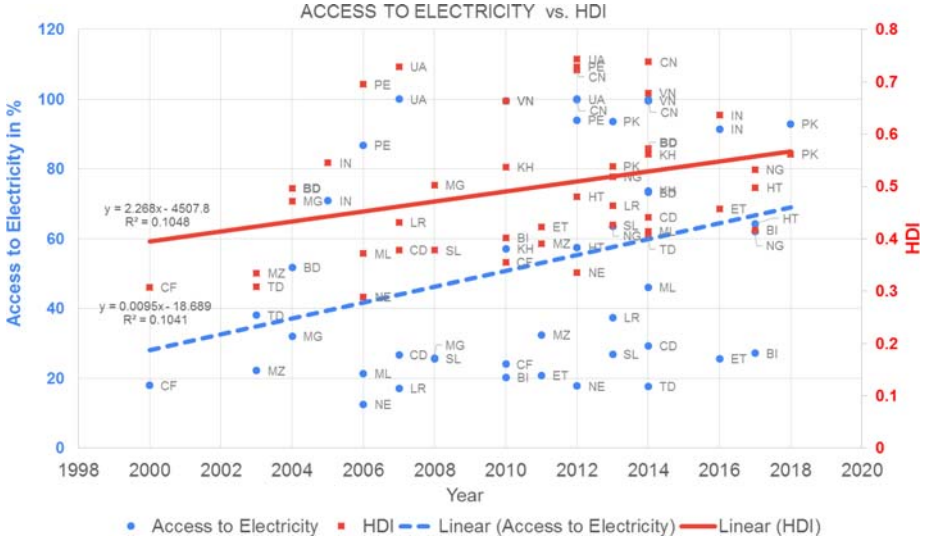

Figure 5. Access to electricity in % vs. HDI for selected countries over time. Data Source: GMPI and UNDP.

(C) ***Electricity***. Figure 5 shows a strong positive correlation of HDI and access to electricity (with ∼0.76). Electrification efforts in the countries being considered seem to pay off most of the time. In some cases, though, almost no development can be observed due to the comparably high population growth which mitigates the effects of overall electrification rates, as previously mentioned.

It is becoming increasingly relevant to understand electricity as a necessary energy service as many scholars stress that a key requirement for energy transitions is the electrification of all infrastructures and devices for all purposes.

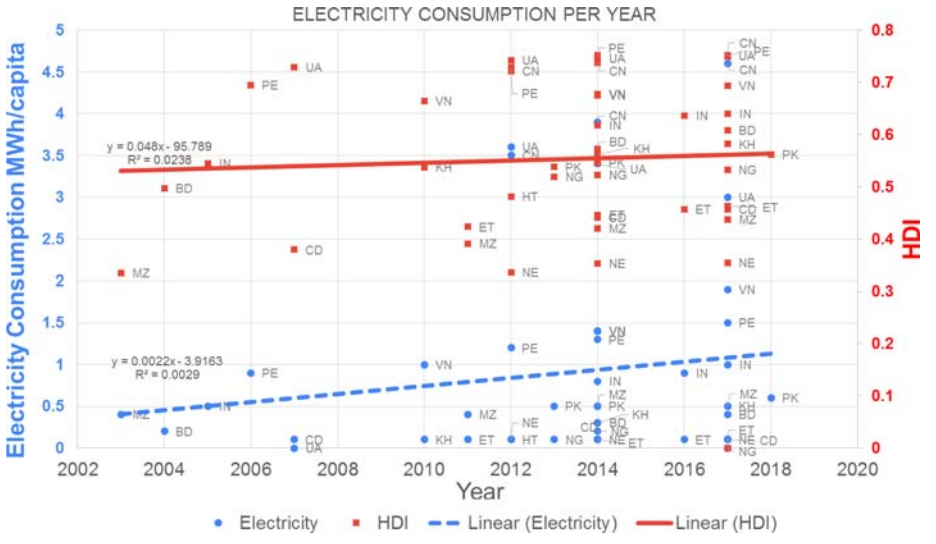

Figure 6. Electricity consumption vs. HDI for selected countries over time. Data Source: World Bank, UNDP.

While electricity obviously cannot replace nutrition, it can (and probably will) serve as a substitute for both biomass and fossil fuels as cooking fuels, thus becoming a substitute for many second-level energy services. Moreover, as Tully (2006) emphasises, "the right to food as a 'means of subsistence' engages electricity in several respects [… because …] electricity provides a safe means of cooking (through electric stoves) and food preservation (refrigeration). Electricity is therefore essential to agriculture and a prerequisite for food security" (562–563). It is also interesting to compare how electricity consumption per capita relates to the HDI in the same twenty developing countries (Figure 6). As expected, there is a correlation such that the HDI improves as electricity consumption increases, suggesting that there are important energy services already derived from an adequate access to electricity.

While we grant that nutrition might be regarded as the only energy-related service that is valuable for all people at all times, it seems fair to assume that most people who live in complex modern societies would also greatly benefit from adequate access to cooking fuel and electricity (where, again, cooking fuel could be replaced by electricity). This also seems to be a fair assumption considering that other energy services are becoming increasingly valuable for many people, and perhaps also essential, "such as computational capacity and communication enabled by electricity—[which] have a more constant relevance to quality of life" (Walker 2015, 30).

Our last graph (Figure 7) compares the MEPI provided by Nussbaumer et al. (2013) to the HDI for the same year and for ten of the most energy-poor countries. The MEPI as a poverty index is calculated also based on two of the indicators mentioned above (the access to electricity and to cooking

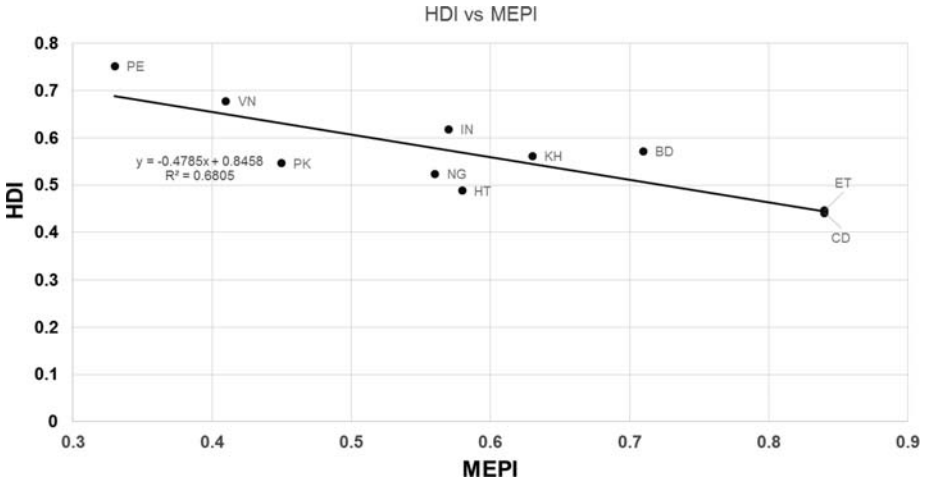

Figure 7. MEPI vs. HDI for selected countries over time. Data Source: Nussbaumer et al. (2013), UNDP.

fuels). It turns out that ten of the poorest countries show a correlation similar to that assessed when comparing energy consumption per capita and HDI (as discussed in 4.2).

In any case, here we propose that at least the three energy services mentioned in this section should be regarded as necessary and thus become part of the notion of a human right to access necessary energy services. All these services impact in one way or another all the core capabilities proposed by Nussbaum (2011) and discusses by Hillerbrand and Goldammer (2018). Nevertheless, we agree with Walker, Simcock, and Day (2016) in saying that, from a capabilities standpoint, the definition of necessities and minimum standards should be left to public deliberations according to geographical and cultural variabilities.

To summarise, the consideration of current energy injustices, the existence of the saturation phenomenon discussed, and the fact that many capabilities depend on access to what we identified as necessary energy services allow us to create the following argument for the recognition of a moral and legal human right to access necessary energy services. If,

(a) (following our introduction and Sec. 2) adequate access to types of energy services that are reliable (uninterrupted), high quality, affordable, sufficient, sustainable and modern is a fundamental prerequisite for human development in complex societies;
(b) (following 3.2) energy capabilities can be related to concrete types of energy systems and technologies which can enhance (or not) individual capabilities;
(c) (following 3.2–3.3) the notion of a "human right to access necessary energy services" appears as a rigorous formulation to connect rights, energy poverty and access;

(d) (following 4.2) several scholars have shown that there are intimate connections between the CA and issues of energy poverty and access;
(e) (following Sec. 4.1–4.2) there are certain thresholds of energy consumption/use that constitute the prerequisites for achieving certain levels of human development and wellbeing;
(f) (following this Sec. 4.3) these levels of energy use can be "translated" into adequate access to necessary energy services that, when compared to the HDI, show a positive correlation;

Then, it follows that the CA can provide a solid foundation to theorise a right to access necessary energy services understood, more thoroughly, as a human, individual, passive, positive, socio-economic, intra- and inter-generational claim right.

Is it possible to say something more about the actual levels of individual energy consumption that would guarantee such right? In other terms, would it be possible to connect the previous discussion about the relationship between energy consumption and wellbeing (4.1), or the issue of consumption thresholds and the saturation phenomenon, to access to necessary energy services? Although this question would require a much more detailed investigation, we suggest that the concrete access to certain ranges of energy use can be translated, at least in theory, to access to energy services. For instance, in the case of Central Europe (the writers' context) a range of per capita annual energy consumption between 80 and 150 GJ seems to constitute the appropriate amount of energy input required to maintain current levels of access to energy services. Assuming that in future scenarios there will be some radical transformations of energy infrastructure and devices as well as higher efficiencies in the various steps and components of energy systems, these values could be significantly lowered without affecting the type, quality and intensity of the corresponding energy services. Moreover, our adoption of the CA suggests that although such ranges of individual energy consumption should reflect the saturation phenomenon, levels of energy access should ultimately be determined by the corresponding stakeholders according to their specific needs, contexts, climates, situated experiences, lifestyles, values and preferences, all of which may vary over time as well.

5. Conclusion and Outlook

The paper provides a philosophical argument for the application of CA to energy ethics and aims to contribute to the debate about access to energy as a human right. It engages with energy poverty and justice scholarships, and discusses the correlation between energy consumption and the HDI, highlighting the relative decoupling after certain thresholds. The main thesis is supported by different premises about the appropriateness of the CA for arguing in favour of

a human right to access necessary energy services such as nutrition, cooking fuel and electricity.

In the Western world, improving efficiency and reducing nations' and economic systems' energy intensity (or ecological/energy footprint) constitute the necessary steps to respond to growing environmental and climate concerns.[23] In other parts of the world, especially where infrastructures are still underdeveloped or nonexistent, higher energy consumption levels that include fossil fuels may be temporarily granted in order to build, as sustainably and efficiently as possible, basic infrastructures and services such as schools, hospitals, transportation systems, electrification, sewerage, and so forth. Among the things that seem to be essential for human wellbeing we can list water, food and some kind of energy. C. Graham, for instance, considers electricity and water to be two main contenders of a "politics of necessity" (2007). The human right to access necessary energy services as outlined in this paper should orient and guide energy policies, especially in energy-poor contexts in order to address the cosmopolitan dimension of distributional, procedural and recognition types of justice.

A crucial development that we suggested is that from the ethical realm of theorising such right, concrete efforts will be made to implement it also in the legal sphere. For instance, we proposed that the human right to access necessary energy services such as nutrition, cooking fuel and electricity should be integrated in the international UN framework of human rights. In this sense, the human rights-based approach (HRBA) could operate to determine whether the right to access necessary energy services meets the standards of its conceptual framework for the process of human development that is normatively based on international human rights. This further step would also clarify the capacities of "duty-bearers" to meet their obligations to provide essential energy services as well as the ways in which "rights-holders" can claim their right to access them adequately. These reflections and proposals may be relevant for energy practitioners who are interested in the theorising and implementation of a right to energy access grounded in the CA. We suggest that energy policymakers and practitioners should carefully consider the saturation phenomenon and integrate the insights provided by the CA into their work on the policies governing energy transitions in order to respond more substantially to growing social, energy and climate concerns.

Notes

1. This means, for example, that unless groundbreaking technological innovations occur soon, "some inefficiencies cannot be recouped as a result of infrastructures currently employed [such as those] for ground and air transportation" (Martínez and Ebenhack 2008, 1432). Consider also that, in 2017, 86% of the world's Total Primary Energy Supply (TPES) still consisted of non-renewable sources (IEA 2017).

2. Although here we use the term "developing", we are aware of the debate concerning the use of alternative phrases such as Global South/North. We maintain that in the case of access to certain energy services, the use of "developing" is more appropriate when, for example, access to electricity is not available to all.
3. Data Source: World Bank dataset: https://data.worldbank.org/indicator/EG.USE.PCAP.KG.OE. See also IEA and World Bank (2015), UNIDO and UN Women (2015).
4. This assumption can of course be criticized. In the debate about conceptualizing and defining energy services, for instance, there is an important technical distinction between energy carriers and energy services (e.g. heating fuels vs warm living space; electricity vs illumination) that can be further elaborated, for example, through the proposal of an "Energy Service Cascade" (Kalt et al. 2019). Although we are aware of this debate and the possible nuances involved, here we assume that nutrition, cooking fuels and electricity can be considered *necessary* energy services that can lead to ulterior "second-level" energy services, that is what actually enhances capabilities (e.g. being well nourished, read in the dark, operate a computer). Our decision is consistent with energy and well-being studies and essentially depends on the necessity to avoid confusion between the notion of energy service and that of energy capabilities as they are further discussed in this paper.
5. Both *The Millennium Development Goals Report* (UN 2015) and the *Sustainable Development Goals Report* (UN 2016) addressed energy poverty, access and justice as they relate to sustainable human development.
6. The SDG7 "seeks to promote broader energy access and increased use of renewable energy, including through enhanced international cooperation and expanded infrastructure and technology for clean energy" (UN 2016). See also: https://sdgcompass.org/sdgs/sdg-7/ and https://sustainabledevelopment.un.org/sdg7. R. Hillerbrand (2018) has recently presented constructive criticism of the dichotomic formulation of SDG7 and a proposal to reframe it in light of the socio-technical nature of energy systems and the CA.
7. See for example, Frigo (2018a, 2021), Miller (2014), Sovacool (2013), Audouze (1997), Biviano et al. (2016), Biviano (2018), Cross (2019), Gardoni et al. (2014), Halsnæs (2013), Kimmins (2001), Mitcham and Smith (2013), O'Neill-Carrillo et al. (2008).
8. Throughout, we embrace the use of the plural "capabilities" because it adequately stresses the plurality of "doings and beings" a person should be able to access and achieve. This choice resonates better with the list of capabilities provided by Nussbaum and mirrors the recent attention given to the "gendered" dimension of energy poverty and access (UNIDO and UN Women 2015; Lapniewska 2019; Pueyo and Maestre 2019; Winther et al. 2020; Wiese 2020). Indeed, according to D. Gasper, Nussbaum's approach is a "more substantive Aristotelian version and attempts to apply such conceptions to women's lives" (Gasper 1997).
9. It should be noted that although individual energy consumption may affect several capabilities, some of them may be difficult (or even impossible) to measure. Thus, we are somehow forced to focus on "visible" functionings such as being well-fed, schooling, reading at night, longevity, and so forth.
10. Our attempt is in a way similar to recent scholarship that has addressed issues of energy equality and energy sufficiency (Calwell 2010; Darby and Fawcett 2018; Samadi et al. 2017; Steinberger and Roberts 2010; Thomas, Thema, and Kopatz 2017; Toulouse et al. 2017; NégaWatt 2018; Pellegrini-Masini 2019).
11. For Nussbaum, this aspect of human development should be understood in political terms and relates to at least three core capabilities, namely, "emotions", "affiliation" and "control over one's environment".

12. According to Sovacool et al. (2019), cosmopolitan justice refers to global externalities and "focuses on ensuring the wellbeing of persons, rather than communities or nations, treating every human equally" (589).
13. He asks: "Should it be just a matter of putting supply infrastructure in place (the right to have access) or should it extend to ensuring that the demand for energy that is needed to sustain basic levels of well-being can be realised by all citizens (the right to be able to use)?" (Walker 2015, 30). So, especially in energy-poor countries, it is important to remember that being able to access energy is not the same as, for example, having 100% connection of households to the electricity grid (access only).
14. See: http://www.engager-energy.net/aims-and-objectives/.
15. See: https://righttoenergy.org/a-propos/.
16. See Table 1 in the Supplementary materials.
17. On a similar note, G. Walker has noted that "the right to energy has been seen as a prime candidate for entry into the international United Nations human rights framework, taking its place alongside other 'second generation' socio-economic rights such as the right to water, shelter and food, as a basic necessity for all people" (Walker 2015, 26).
18. The Human Development Index (HDI) is the statistical measure (composite index) developed by the United Nations that has been used most frequently as it is able to grasp several variables that are widely recognized as the preconditions for human well-being, or one may say a "good life" (knowledge and understanding, a long and healthy life, and an acceptable standard of living). But there are other statistical tools such as the Social Progress Index (SPI) developed following the writings of Amartya Sen, Douglass North, and Joseph Stiglitz and available since 2014 (Social Progress Imperative 2019) or the World Happiness Report published since 2012 (Helliwell, Layard, and Sachs 2018, 2019).
19. It should be noted that, on this topic, the literature presents a myriad of terms used along with "wellbeing" (e.g., "quality of life", "social progress", "happiness", "life fulfillment", "human flourishing", "standard of living", and so forth). The meaning of these notions can be rather controversial and may change depending on the different disciplines. It is only possible to overcome these inconsistencies by assuming that the various terms refer to similar "degrees" of wellbeing that people can reach. The most important point remains the "significance of access to modern energy services in the poverty debate" (Bradbrook and Gardam 2006).
20. Our graph has intentionally omitted a few of these countries, which, although moving quickly toward more renewable energy, are still largely dependent on their abundant fossil fuel reserves (e.g., Bahrain [0.81, 443.65], Brunei Darussalam [0.85, 363.12], Kuwait [0.8, 384.29], Qatar [0.85, 750.38], or the United Arab Emirates [0.85, 320.22]).
21. For instance, energy consumption per capita does not account for diversity in energy access among different people in a nation. Moreover, it is an aggregate indicator that does not tell us what types of energy source or technology are in use. Finally, according to Arto et al., it does not measure the actual amount of energy consumed by the end users, i.e. the energy footprint (2016, 3).
22. What is the value that energy adds to human life? For Martínez and Ebenhack "real energy demands are not for quadrillion BTUs or kilograms of oil equivalent (kgoe), but for the work or services provided to the end-user" (Martínez and Ebenhack 2008). Day, Walker, and Simcock (2016) also mention that "a few researchers and organisations have started to approach the diagnosis of energy sufficiency/energy poverty from the basis of the energy services accessed or achieved, which would be

in line with the recognition discussed above that a range of energy services are crucial for eliminating poverty and realising the millennium development goals" (257). See also Modi et al. (2005). A similar point was discussed by G. Walker in his presentation at the "Right to Energy" workshop held in Groningen in January 2020.

23. A different, perhaps eco-modernist, position on this issue is offered, for instance, by Joseph A. Tainter who proposes a historical perspective and claims that, when it comes to energy transition, "problems are inevitable, requiring increasing complexity, and conservation is therefore insufficient to produce sustainability. Future sustainability will require continued high levels of energy consumption to address converging problems" (Tainter 2011).

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References

Adams, R. N. 1975. *Energy and Structure: A Theory of Social Power*. Austin: The University of Texas Press.

Adams, R. N. 1977. "Man, Energy, and Anthropology: I Can Feel the Heat, But Where's the Light?" Presidential Address Presented at the Annual Meeting of the American Anthropological Association, Houston, TX.

Alam, M. S., B. K. Bala, A. M. Z. Huq, and M. A. Matin. 1991. "A Model for the Quality of Life as a Function of Electrical Energy Consumption." *Energy* 16 (4): 739–745. doi:10.1016/0360-5442(91)90023-F.

Alam, M. S., A. Roychowdhury, K. K. Islam, and A. M. Z. Huq. 1998. "A Revisited Model for the Physical Quality of Life (PQL) as a Function of Electrical Energy Consumption." *Energy* 23 (9): 791–801. doi:10.1016/S0360-5442(98)00005-X.

Alkire, S., and S. Deneulin. 2009. "The Human Development and Capability Approach." In *An Introduction to the Human Development and Capability Approach. Freedom and Agency*, edited by Séverine Deneulin and Lila Shahani, 22–48. London: Earthscan.

Araújo, K. 2014. "The Emerging Field of Energy Transitions: Progress, Challenges, and Opportunities." *Energy Research & Social Science* 1: 112–121. doi:10.1016/j.erss.2014.03.002.

Arto, I., I. Capellán-Pérez, R. Lago, G. Bueno, and R. Bermejo. 2016. "The Energy Requirements of a Developed World." *Energy for Sustainable Development* 33: 1–13. doi:10.1016/j.esd.2016.04.001.

Audouze, J. 1997. *The Ethics of Energy*.

Aydemir, M. O., and U. Soytaş. 2019. "Quality of Life and Energy Use." In *Routledge Handbook of Energy Economics*, 1st ed., edited by Uğur Soytaş and Ramazan Sarı, 289–306. Routledge. doi:10.4324/9781315459653-19.

Azad, R., and S. Chakraborty. 2020. "Green Growth and the Right to Energy in India." *Energy Policy* 141 (June): 111456. doi:10.1016/j.enpol.2020.111456.

Bartiaux, F., M. Maretti, A. Cartone, P. Biermann, and V. Krasteva. 2019. "Sustainable Energy Transitions and Social Inequalities in Energy Access: A Relational Comparison of Capabilities in Three European Countries." *Global Transitions* 1: 226–240. doi:10.1016/j.glt.2019.11.002.

Bazilian, M., P. Nussbaumer, C. Eibs-Singer, A. Brew-Hammond, V. Modi, B. Sovacool, V. Ramana, and P.-K. Aqrawi. 2012. "Improving Access to Modern Energy Services: Insights from Case Studies." *The Electricity Journal* 25 (1): 93–114. doi:10.1016/j.tej.2012.01.007.

Bazilian, M., and R. Pielke. 2013. "Making Energy Access Meaningful." *Issues in Science and Technology* 29 (4): 74–78.

Bergstrom, P., and UNESCO Office Bangkok and Regional Bureau for Education in Asia and the Pacific. 2004. "Ethical Aspects of Access and Use of Energy." In *Ethics in Asia-Pacific*. Bangkok: UNESCO Digital Library. https://unesdoc.unesco.org/ark:/48223/pf0000135911.

Bethem, J., G. Frigo, S. Biswas, T. DesRoches, and M. J. Pasqualetti. 2020. "Energy Decisions Within an Applied Ethics Framework: Analysis of Five Recent Controversies." *Energy, Sustainability & Society* 10 (29): 1–6.

Biviano, E. L. 2018. “Catholic Energy Ethics: Commitments and Criteria.” *Relations: Beyond Anthropocentrism* 6 (1): 143–152.

Biviano, E. L., D. Cloutier, C. Z Peppard, and J. Schaefer. 2016. “Catholic Moral Traditions and Energy Ethics for the Twenty-First Century.” *Journal of Moral Theology* 5 (2): 1–36.

Bouzarovski, S. 2014. “Energy Poverty in the European Union: Landscapes of Vulnerability.” *Wiley Interdisciplinary Reviews: Energy and Environment* 3 (3): 276–289. doi:10.1002/wene.89.

Bradbrook, Adrian. 2011. “The Legal Right to Solar Access.” *Environment Design Guide* 68: 1–9.

Bradbrook, A. 2016. “Energy and Law—Searching for New Directions.” In *Imagining Law: Essays in Conversation with Judith Gardam*, edited by Dale Stephens and Paul Babie, 13–33. Adelaide: University of Adelaide Press.

Bradbrook, A. J., and J. G. Gardam. 2006. “Placing Access to Energy Services Within a Human Rights Framework.” *Human Rights Quarterly* 28 (2): 389–415. doi:10.1353/hrq.2006.0015.

Bradbrook A. J., Gardam J. G., Cormier M. 2008. “A Human Dimension to the Energy Debate: Access to Modern Energy Services.” *Journal of Energy & Natural Resources Law* 26: 526–552. doi:10.1080/02646811.2008.11435198.

Buechler, S., V. Vázquez-García, K. G. Martínez-Molina, and D. M. Sosa-Capistrán. 2020. “Patriarchy and (Electric) Power? A Feminist Political Ecology of Solar Energy Use in Mexico and the United States.” *Energy Research & Social Science* 70: 101743. doi:10.1016/j.erss.2020.101743.

Büscher, Christian, Jens Schippl, and Patrick Sumpf, eds. 2019. *Energy as a Sociotechnical Problem: An Interdisciplinary Perspective on Control, Change, and Action in Energy Transitions*. New York: Routledge.

Calwell, C. 2010. “Is Efficient Sufficient?” European Council for an Energy Efficient Economy.

Caney, S. 2011. “Climate Change, Energy Rights, and Equality.” In *The Ethics of Global Climate Change*, edited by Denis G. Arnold, 77–103. Cambridge: Cambridge University Press. doi:10.1017/CBO9780511732294.005.

Comim, F., M. Qizilbash, and S. Alkire. 2008. *The Capability Approach. Concepts, Measures and Applications*. Cambridge: Cambridge University Press.

Cottrell, F. 1955. *Energy and Society: The Relation Between Energy, Social Changes, and Economic Development*. New York: McGraw-Hill.

Cross, J. 2019. “The Solar Good: Energy Ethics in Poor Markets.” *Journal of the Royal Anthropological Institute* 25 (S1): 47–66. doi:10.1111/1467-9655.13014.

Cruft, Rowan, S. Matthew Liao, and Massimo Renzo, eds. 2015. *Philosophical Foundations of Human Rights*. 1st ed. Philosophical Foundations of Law. Oxford: Oxford University Press.

Darby, S., and T. Fawcett. 2018. “Energy Sufficiency: An Introduction—Concept Paper.” Energy Sufficiency: An Introduction—Concept Paper.

Day, R., G. Walker, and N. Simcock. 2016. “Conceptualising Energy Use and Energy Poverty Using a Capabilities Framework.” *Energy Policy* 93: 255–264. doi:10.1016/j.enpol.2016.03.019.

Dias, R. A., C. R. Mattos, and J. A. P. Balestieri. 2006. “The Limits of Human Development and the Use of Energy and Natural Resources.” *Energy Policy* 34 (9): 1026–1031. doi:10.1016/j.enpol.2004.09.008.

European Commission. 2019. *Clean Energy for All Europeans*. Luxembourg: European Union.

Fathallah, J., and P. Pyakurel. 2020. "Addressing Gender in Energy Studies." *Energy Research & Social Science* 65: 101461. doi:10.1016/j.erss.2020.101461.

Feenstra, M., and G. Özerol. 2021. "Energy Justice as a Search Light for Gender-Energy Nexus: Towards a Conceptual Framework." *Renewable and Sustainable Energy Reviews* 138: 110668. doi:10.1016/j.rser.2020.110668.

Finley-Brook, M., and E. Holloman. 2016. "Empowering Energy Justice." *International Journal of Environmental Research and Public Health* 13 (926): 1–19.

Freling, B. 2012. "Energy Is a Human Right." *Bob Freling's Solar Blog* (blog). January 17. http://www.bobfreling.com/2012/01/energy-is-a-human-right-the-hi.htm.

Frigo, G. 2018a. "Energy Ethics: Emerging Perspectives in a Time of Transition." *Relations: Beyond Anthropocentrism* 6 (1): 7–30.

Frigo, G. 2018b. "The Energy Ethics and Strong Sustainability: Outlining Key Principles for a Moral Compass." In *Strongly Sustainable Societies*, edited by K. J. Bonnedahl and H. Pasi, 77–95. London: Routledge.

Frigo, G. 2021. *Philosophical Reflections on the Energy Transition: A Normative Energy Ethics*. Routledge Focus on Energy Studies. London: Routledge.

Gardoni, P., R. Hillerbrand, C. Murphy, and B. Taebi. 2014. "Panel—The Ethics of Nuclear Energy in the Post-Fukushima Era." In 2014 *IEEE International Symposium on Ethics in Science, Technology and Engineering*, 1–2. doi:10.1109/ETHICS.2014.6893373.

Gasper, D. 1997. "Sen's Capability Approach and Nussbaum's Capabilities Ethic." *Journal of Human Development* 9 (2): 281–302.

Geels, F. W., B. K. Sovacool, T. Schwanen, and S. Sorrell. 2017. "Sociotechnical Transitions for Deep Decarbonization." *Science* 357 (6357): 1242–1244. doi:10.1126/science.aao3760.

Goldemberg, J. 2001. *Energy and Human Well-Being*. New York: United Nations Development Programme.

Goldemberg, J., T. B. Johansson, A. K. N. Reddy, and R. H. Williams. 1985. "Basic Needs and Much More with One Kilowatt per Capita." 13.

Golubchikov, O., and K. O'Sullivan. 2020. "Energy Periphery: Uneven Development and the Precarious Geographies of Low-Carbon Transition." *Energy and Buildings* 211: 109818. doi:10.1016/j.enbuild.2020.109818.

Graham, C. 2007. "The Politics of Necessity: Electricity and Water in Great Britain." *Journal of Consumer Policy* 29 (4): 435–448. doi:10.1007/s10603-006-9020-3.

Groh, S. 2014. "The Role of Energy in Development Processes—The Energy Poverty Penalty: Case Study of Arequipa (Peru)." *Energy for Sustainable Development* 18 (February): 83–99. doi:10.1016/j.esd.2013.12.002.

Groves, C., K. Henwood, F. Shirani, G. Thomas, and N. Pidgeon. 2017. "Why Mundane Energy Use Matters: Energy Biographies, Attachment and Identity." *Energy Research and Social Science* 30: 71–81. doi:10.1016/j.erss.2017.06.016.

Halsnæs, K. 2013. "Energy Ethics." In *A Companion to the Philosophy of Technology*, edited by J. K. B. Olsen, S. A. Pedersen, and V. F. Hendricks, 422–425. Blackwell Companions to Philosophy 27. Chichester: Wiley-Blackwell.

Helliwell, J. F., R. Layard, and J. Sachs. 2018. *World Happiness Report 2018*. New York: Sustainable Development Solutions Network.

Helliwell, J. F., R. Layard, and J. D. Sachs. 2019. *World Happiness Report 2019*. New York: Sustainable Development Solutions Network.

Hesselman, M., A. Varo, and S. Laakso. 2019. "The Right to Energy in the European Union." Policy Brief No. 2. Agenda Co-Creation and Knowledge Innovation (ENGAGER 2017-2021).

High, M. M., and J. M. Smith. 2019. "Introduction: The Ethical Constitution of Energy Dilemmas." *Journal of the Royal Anthropological Institute*. doi:10.1111/1467-9655.13012.

Hillerbrand, R. 2018. "Why Affordable Clean Energy Is Not Enough. A Capability Perspective on the Sustainable Development Goals." *Sustainability* 10 (2485): 1–14. doi:10.3390/su10072485.

Hillerbrand, R., and K. Goldammer. 2018. "Energy Technologies and Human Well-Being. Using Sustainable Design for the Energy Transition." In *The Future of Engineering*, edited by Albrecht Fritzsche, and Sascha Julian Oks, 151–175. Cham: Springer.

Hohfeld, W. N. (1919) 1966. *Fundamental Legal Conceptions, as Applied in Judicial Reasoning*. New Haven: Yale University Press.

IEA. 2017. *Key World Energy Statistics 2017*.

IEA, and World Bank. 2015. *Sustainable Energy for All 2015—Progress Toward Sustainable Energy*. Washington, DC: World Bank.

IEA, IRENA, UNSD, WB, and WHO. 2019. *Tracking SDG7: The Energy Progress Report 2019*. Washington, DC: International Bank for Reconstruction and Development / The World Bank.

Jenkins, K. 2018. "Setting Energy Justice Apart from the Crowd: Lessons from Environmental and Climate Justice." *Energy Research & Social Science* 39: 117–121. doi:10.1016/j.erss.2017.11.015.

Jenkins, K., D. McCauley, and A. Forman. 2017. "Energy Justice: A Policy Approach." *Energy Policy* 105: 631–634. doi:10.1016/j.enpol.2017.01.052.

Jenkins, K. E.H., J. C Stephens, T. G. Reames, and D. Hernández. 2020. "Towards Impactful Energy Justice Research: Transforming the Power of Academic Engagement." *Energy Research & Social Science* 67: 101510. doi:10.1016/j.erss.2020.101510.

Jessel, S., S. Sawyer, and D. Hernández. 2019. "Energy, Poverty, and Health in Climate Change: A Comprehensive Review of an Emerging Literature." *Frontiers in Public Health* 7: 357. doi:10.3389/fpubh.2019.00357.

Jones, B. R., B. K. Sovacool, and R. V. Sidortsov. 2015. "Making the Ethical and Philosophical Case for 'Energy Justice'." *Environmental Ethics* 37 (2): 145–168. doi:10.5840/enviroethics201537215.

Kalt, G., D. Wiedenhofer, C. Görg, and H. Haberl. 2019. "Conceptualizing Energy Services: A Review of Energy and Well-Being Along the Energy Service Cascade." *Energy Research & Social Science* 53: 47–58. doi:10.1016/j.erss.2019.02.026.

Kimmins, J. P. 2001. *The Ethics of Energy: A Framework for Action*. Vincennes: SCIPP.

Krugmann, H., and J. Goldemberg. 1983. "The Energy Cost of Satisfying Basic Human Needs." *Technological Forecasting and Social Change* 24 (1): 45–60. doi:10.1016/0040-1625(83)90062-8.

Lacey-Barnacle, M., R. Robison, and C. Foulds. 2020. "Energy Justice in the Developing World: A Review of Theoretical Frameworks, Key Research Themes and Policy Implications." *Energy for Sustainable Development* 55: 122–138. doi:10.1016/j.esd.2020.01.010.

Lambert, J. G., C. A. S. Hall, S. Balogh, A. Gupta, and M. Arnold. 2014. "Energy, EROI and Quality of Life." *Energy Policy* 64: 153–167. doi:10.1016/j.enpol.2013.07.001.

Lapniewska, Z. 2019. "Energy, Equality and Sustainability? European Electricity Cooperatives from a Gender Perspective." *Energy Research & Social Science* 57: 1–12.

Martínez, D. M., and B. W. Ebenhack. 2008. "Understanding the Role of Energy Consumption in Human Development Through the Use of Saturation Phenomena." *Energy Policy* 36 (4): 1430–1435. doi:10.1016/j.enpol.2007.12.016.

Mazur, A., and E. Rosa. 1974. "Energy and Life-Style." *Science* 186 (4164): 607–610. doi:10.1126/science.186.4164.607.

McCauley, D., R. J. Heffron, S. Hannes, and K. Jenkins. 2013. "Advancing Energy Justice: The Triumvirate of Tenets." *International Energy Law Review* 32 (3): 107–110.

Mediavilla, M., C. de Castro, I. Capellán, L. J. Miguel, I. Arto, and F. Frechoso. 2013. "The Transition Towards Renewable Energies: Physical Limits and Temporal Conditions." *Energy Policy* 52: 297–311. doi:10.1016/j.enpol.2012.09.033.

Middlemiss, L., P. Ambrosio-Albalá, N. Emmel, R. Gillard, J. Gilbertson, T. Hargreaves, C. Mullen, T. Ryan, C. Snell, and A. Tod. 2019. "Energy Poverty and Social Relations: A Capabilities Approach." *Energy Research & Social Science* 55: 227–235. doi:10.1016/j.erss.2019.05.002.

Miller, C. 2014. "The Ethics of Energy Transitions." In *2014 IEEE International Symposium on Ethics in Science, Technology and Engineering*. Chicago, IL: IEEE Press. doi:10.1109/ETHICS.2014.6893445.

Mitcham, C., and J. R. Smith. 2013. "Energy Constraints." *Science and Engineering Ethics* 19 (2): 313–319.

Modi, V., S. McDade, D. Lallement, and J. Saghir. 2005. *Energy Services for the Millennium Development Goals*. Washington, DC: World Bank.

Nader, L., and S. Beckerman. 1978. "Energy as It Relates to the Quality and Style of Life." *Annual Review of Energy* 3: 1–28. doi:10.1146/annurev.eg.03.110178.000245.

Nadimi, R., and K. Tokimatsu. 2018. "Modeling of Quality of Life in Terms of Energy and Electricity Consumption." *Applied Energy* 212: 1282–1294. doi:10.1016/j.apenergy.2018.01.006.

NégaWatt. 2018. "Energy Sufficiency."

Nussbaum, M. C. 2000. *Women and Human Development: The Capabilities Approach*. New York: Cambridge University Press.

Nussbaum, M. 2011. *Creating Capabilities: The Human Development Approach*. Cambridge: Harvard University Press.

Nussbaum, Martha Craven, and Amartya Sen, eds. 1993. *The Quality of Life*. Reprinted. Studies in Development Economics. Oxford: Clarendon Press.

Nussbaumer, P., F. Nerini, I. Onyeji, and M. Howells. 2013. "Global Insights Based on the Multidimensional Energy Poverty Index (MEPI)." *Sustainability* 5 (5): 2060–2076. doi:10.3390/su5052060.

Olsen, M. M. 1992. "The Energy Consumption Turnaround and Socioeconomic Wellbeing in Industrial Societies in the 1980s." *Advances in Human Ecology* 1: 197–234.

O'Neill-Carrillo, E., W. Frey, C. Ortiz-Garcia, A. A. Irizarry-Rivera, M. Perez-Lugo, and J. A. Colucci-Rios. 2008. "Advancing a Sustainable Energy Ethics Through Stakeholder Engagement." In 2008 *IEEE Energy 2030 Conference*, 1–6. Atlanta, GA: IEEE. doi:10.1109/ENERGY.2008.4781008.

O'Neill, D. W., A. L. Fanning, W. F. Lamb, and J. K. Steinberger. 2018. "A Good Life for All Within Planetary Boundaries." *Nature Sustainability* 1 (2): 88–95. doi:10.1038/s41893-018-0021-4.

Pachauri, S., A. Mueller, A. Kemmler, and D. Spreng. 2004. "On Measuring Energy Poverty in Indian Households." *World Development* 32 (12): 2083–2104. doi:10.1016/j.worlddev.2004.08.005.

Pachauri, S., and D. Spreng. 2011. "Measuring and Monitoring Energy Poverty." *Energy Policy* 39 (12): 7497–7504. doi:10.1016/j.enpol.2011.07.008.

Pasternak, A. D. 2000. *Global Energy Futures and Human Development: A Framework for Analysis*. UCRL-ID-140773. Lawrence Livermore National Laboratory. Livermore: US Department of Energy.

Pellegrini-Masini, D. G. 2019. "Energy Equality and Energy Sufficiency: New Policy Principles to Accelerate the Energy Transition," 7.

Pueyo, A., and M. Maestre. 2019. "Linking Energy Access, Gender and Poverty: A Review of the Literature on Productive Uses of Energy." *Energy Research & Social Science* 53: 170–181. doi:10.1016/j.erss.2019.02.019.

Rao, N. D., Riahi, K., Grubler, A. 2014. "Climate Impacts of Poverty Eradication." *Nature Climate Change* 4 (9): 749–751. [Sep].

Robeyns, I. 2016. "The Capability Approach." In *The Stanford Encyclopedia of Philosophy*, edited by Edward N. Zalta. Metaphysics Research Lab, Stanford University. https://plato.stanford.edu/archives/win2016/entries/capability-approach/.

Samadi, S., M.-C. Gröne, U. Schneidewind, H.-J. Luhmann, J. Venjakob, and B. Best. 2017. "Sufficiency in Energy Scenario Studies: Taking the Potential Benefits of Lifestyle Changes into Account." *Technological Forecasting and Social Change* 124: 126–134. doi:10.1016/j.techfore.2016.09.013.

Schipper, L., and A. J Lichtenberg. 1976. "Efficient Energy Use and Well-Being: The Swedish Example." *Science* 194 (4269): 1001–1013.

Schipper, L., and L. Price. 1994. "Efficient Energy Use and Well-Being: The Swedish Example After 20 Years." *Natural Resources Forum* 18 (2): 125–142. doi:10.1111/j.1477-8947.1994.tb00882.x.

Sheller, M. 2014. "Global Energy Cultures of Speed and Lightness: Materials, Mobilities and Transnational Power." *Theory, Culture & Society* 31 (5): 127–154. doi:10.1177/0263276414537909.

Shirani, F., C. Butler, K. Henwood, K. Parkhill, and N. Pidgeon. 2013. "Disconnected Futures: Exploring Notions of Ethical Responsibility in Energy Practices." *Local Environment* 18 (4): 455–468. doi:10.1080/13549839.2013.779236.

Shove, E., and G. Walker. 2014. "What Is Energy For? Social Practice and Energy Demand." *Theory, Culture & Society* 31 (5): 41–58. doi:10.1177/0263276414536746.

Smil, V. 2003. *Energy at the Crossroads. Global Perspectives and Uncertainties*. Cambridge: MIT Press.

Smith, J., and M. M. High. 2017. "Exploring the Anthropology of Energy: Ethnography, Energy and Ethics." *Energy Research & Social Science* 30: 1–6. doi:10.1016/j.erss.2017.06.027.

Social Progress Imperative. 2019. *2018 Social Progress Index Executive Summary*. Social Progress Imperative.

Sovacool, B. K. 2013. *Energy & Ethics. Justice and the Global Energy Challenge*. New York: The Palgrave Macmillan.

Sovacool, B. K., M. Burke, L. Baker, C. K. Kotikalapudi, and H. Wlokas. 2017. "New Frontiers and Conceptual Frameworks for Energy Justice." *Energy Policy* 105: 677–691. doi:10.1016/j.enpol.2017.03.005.

Sovacool, B. K., M. Martiskainen, A. Hook, and L. Baker. 2019. "Decarbonization and Its Discontents: A Critical Energy Justice Perspective on Four Low-Carbon Transitions." *Climatic Change* 155 (4): 581–619. doi:10.1007/s10584-019-02521-7.

Sovacool, B. K., R. V. Sidorstov, and B. R. Jones. 2014. *Energy Security, Equality, and Justice*. London/New York: Earthscan/Routledge.

Spreng, D. 2005. "Distribution of Energy Consumption and the 2000W/Capita Target." *Energy Policy* 33 (15): 1905–1911. doi:10.1016/j.enpol.2004.03.023.

Steckel, J. C., R. J. Brecha, M. Jakob, J. Strefler, and G. Luderer. 2013. "Development Without Energy? Assessing Future Scenarios of Energy Consumption in Developing Countries." *Ecological Economics* 90: 53–67. doi:10.1016/j.ecolecon.2013.02.006.

Steinberger, J. K., and J. T. Roberts. 2010. "From Constraint to Sufficiency: The Decoupling of Energy and Carbon from Human Needs, 1975–2005." *Ecological Economics* 70 (2): 425–433. doi:10.1016/j.ecolecon.2010.09.014.

Stephenson, J., B. Barton, G. Carrington, D. Gnoth, R. Lawson, and P. Thorsnes. 2010. "Energy Cultures: A Framework for Understanding Energy Behaviours." *Energy Policy* 38 (10): 6120–6129. doi:10.1016/j.enpol.2010.05.069.

Strauss, S., S. Rupp, and T. Love. 2013. *Cultures of Energy. Power, Practices, Technologies*. Walnut Creek, CA: Left Coast Press.
Sultana, F., and A. Loftus. 2015. "The Human Right to Water: Critiques and Condition of Possibility: Human Right to Water." *Wiley Interdisciplinary Reviews: Water* 2 (2): 97–105. doi:10.1002/wat2.1067.
Tainter, J. A. 2011. "Energy, Complexity, and Sustainability: A Historical Perspective." *Environmental Innovation and Societal Transitions* 1: 89–95. doi:10.1016/j.eist.2010.12.001.
Thomas, S., J. Thema, and M. Kopatz. 2017. *Energy Sufficiency Policy: How to Limit Energy Consumption and Per Capita Dwelling Size in a Decent Way*. ECEEE.
Toulouse, E., H. Gorge, M. Le Dû, and L. Semal. 2017. *Stimulating Energy Sufficiency: Barriers and Opportunities*. ECEEE.
Tully, S. 2006. "Access to Electricity as a Human Right." *Netherlands Quarterly of Human Rights* 24 (4): 557–587. doi:10.1177/016934410602400402.
Tully, S. 2008. "The Human Right to Access Clean Energy." *Journal of Engineering for Sustainable Development: Energy, Environment & Health* 2 (1): 140–148.
UN. 1986. *Declaration on the Right to Development*. 97. A/RES/41/128. New York: United Nations.
UN. 1992. *Agenda 21: Programme of Action for Sustainable Development, Rio Declaration, Forest Principles*. Rio de Janeiro. http://www.un.org/esa/sustdev/documents/agenda21/english/Agenda21.pdf.
UN. 2012. "The Future We Want: Outcome Document Adopted at Rio+20 Conference on Sustainable Development." In *United Nations Department of Economic and Social Affairs*. Rio de Janeiro: UN.
UN. 2015. *The Millennium Development Goals Report 2015*. New York: United Nations.
UN. 2016. *The Sustainable Development Goals Report 2016*. New York: United Nations.
UNDP. 2018. *Human Development Indices and Indicators 2018 Statistical Update*. New York: United Nations Development Programme.
UNDP, and OPHI. 2019. *Global Multidimensional Poverty Index 2019: Illuminating Inequalities*. New York.
UNIDO, and UN Women. 2015. *Sustainable Energy for All: The Gender Dimensions*. http://www.unido.org/fileadmin/user_media_upgrade/What_we_do/Topics/Women_and_Youth/GUIDANCENOTE_FINAL_WEB.pdf.
Velasco-Herrejon, P., and T. Bauwens. 2020. "Energy Justice from the Bottom Up: A Capability Approach to Community Acceptance of Wind Energy in Mexico." *Energy Research & Social Science* 70: 101711. doi:10.1016/j.erss.2020.101711.
Wacks, R. 2006. *Philosophy of Law: A Very Short Introduction*. Oxford: Oxford University Press.
Walker, G. 2015. "The Right to Energy: Meaning, Specification and the Politics of Definition." *L'Europe En Formation* 378 (4): 26. doi:10.3917/eufor.378.0026.
Walker, G., and R. Day. 2012. "Fuel Poverty as Injustice: Integrating Distribution, Recognition and Procedure in the Struggle for Affordable Warmth." *Energy Policy* 49: 69–75. doi:10.1016/j.enpol.2012.01.044.
Walker, G., N. Simcock, and R. Day. 2016. "Necessary Energy Uses and a Minimum Standard of Living in the United Kingdom: Energy Justice or Escalating Expectations?" *Energy Research & Social Science* 18: 129–138. doi:10.1016/j.erss.2016.02.007.
WBGU. 2003. *World in Transition 3: Towards Sustainable Energy Systems*. London: Earthscan.
Wenar, L. 2020. "Rights." In *Stanford Encyclopedia of Philosophy*. Stanford, CA: The Metaphysics Research Lab.

White, L. A. 1943. "Energy and the Evolution of Culture." *American Anthropologist* 45 (3): 335–356. doi:10.1525/aa.1943.45.3.02a00010.

Wiese, K. 2020. "Energy 4 All? Investigating Gendered Energy Justice Implications of Community-Based Micro-Hydropower Cooperatives in Ethiopia." *Innovation: The European Journal of Social Science Research*, 1–24. doi:10.1080/13511610.2020.1745059.

Wildt, T. E., E. J. L. Chappin, G. van de Kaa, P. M. Herder, and I. R. van de Poel. 2020. "Conflicted by Decarbonisation: Five Types of Conflict at the Nexus of Capabilities and Decentralised Energy Systems Identified with an Agent-Based Model." *Energy Research & Social Science* 64: 101451. doi:10.1016/j.erss.2020.101451.

Willand, N., and R. Horne. 2018. "'They Are Grinding Us Into the Ground'—The Lived Experience of Energy (In)justice Amongst Low-Income Older Households." *Applied Energy* 226: 61–70. doi:10.1016/j.apenergy.2018.05.079.

Willand, N., T. Moore, R. Horne, and S. Robertson. 2020. "Retrofit Poverty: Socioeconomic Spatial Disparities in Retrofit Subsidies Uptake." *Buildings and Cities* 1 (1): 14–35. doi:10.5334/bc.13.

Winther, T., K. Ulsrud, M. Matinga, M. Govindan, B. Gill, A. Saini, D. Brahmachari, D. Palit, and R. Murali. 2020. "In the Light of What We Cannot See: Exploring the Interconnections Between Gender and Electricity Access." *Energy Research & Social Science* 60: 101334. doi:10.1016/j.erss.2019.101334.

Wolvén, L.-E. 1991. "Lifestyles and Energy Consumption." *Energy* 16 (6): 959–963.

Wood, N., and K. Roelich. 2019. "Tensions, Capabilities, and Justice in Climate Change Mitigation of Fossil Fuels." *Energy Research & Social Science* 52: 114–122. doi:10.1016/j.erss.2019.02.014.

Wood, N., and K. Roelich. 2020. "Substantiating Energy Justice: Creating a Space to Understand Energy Dilemmas." *Sustainability* 12 (5): 1917. doi:10.3390/su12051917.

Xu, X., and C.-F. Chen. 2019. "Energy Efficiency and Energy Justice for U.S. Low-Income Households: An Analysis of Multifaceted Challenges and Potential." *Energy Policy* 128: 763–774. doi:10.1016/j.enpol.2019.01.020.