Sustainable Energy Access in Urban Areas

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In particular, the present paper has contributed to Chapter 7 on 'Re-naturing', which focuses on the governance and planning of sustainability, with specific emphasis on decoupling economic development and resource use, the transition to net zero carbon systems, risk reduction and urban resilience. Through the lens of 're-naturing', the chapter explores how local and regional governments can promote approaches that advance these goals, placing the needs and priorities of structurally discriminated social groups at the core of their actions, and contribute to urban and territorial equality.

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Introduction

Energy access plays a vital role in facilitating sustainable development. The link between energy access and sustainability is the primary concern embedded in Goal 7 of the Sustainable Development Goals (SDG7), which calls for "ensuring access to affordable, reliable, sustainable and modern energy for all." However, achieving this goal will not be an easy task considering that more than 789 million people still lack access to electricity, and nearly 3 billion people rely on polluting and unhealthy fuels (such as dung, firewood, or charcoal) for cooking and thermal comfort.[1] The number of residents dependent on such fuels has increased during the COVID-19 pandemic, increasing their vulnerability and exposure to pollution. Lack of energy access is a factor in COVID-19 comorbidity.

SDG7 calls for a shift away from an economy and infrastructure reliant on fossil fuel to address these massive energy needs. It aims to make clean and efficient energy accessible and affordable for all. This transition to clean energy will deliver critical environmental and economic benefits, reduce carbon emissions and pollution, and improve health and consumer convenience. Simultaneously, decarbonizing projects can support local businesses and improve livelihoods.[2] For example, access to electricity can facilitate industrialization, promote gender inequality, enhance living conditions and subsequently improve well-being.[3]

Achieving the energy targets of the SDG7 will be a struggle, despite the achievements of the last decade. The number of people lacking access to electricity globally reduced from 1.2 billion to 789 million between 2010 and 2018, according to data from the International Renewable Energy Agency.[4] These figures are far from the targets to achieve SDG7. Energy access lags, particularly in Sub-Saharan Africa and South Asia, compared with other world regions that have seen rapid advances, such as Southeast Asia. Moreover, fossil fuels continue to dominate the supply of urban energy. In 2019, only 16 per cent of the global primary energy came from low carbon sources- and this data includes both renewable and nuclear as 'low carbon sources'.[5] In urban areas where – models suggest– production-based emissions will decrease, consumption-based emissions will grow.[6] Even in countries with relatively well-resourced to facilitate an energy transition, such as in Europe, most cities remain stubbornly dependent on fossil fuels.[7] Cities with significant gaps in access to electricity and fuels remain dependent on fossil fuels.[8]

The supply-demand gap continues to widen due to rapid population growth, which has not been matched by a parallel expansion of electricity networks and clean fuel supply chains. Both in lower-middle-income countries, such as Ghana, and in least developed countries, such as Uganda, urban populations remain dependent on firewood or charcoal.[9] The highest urban energy deficit in the world can be placed in rapidly urbanizing Nigeria, where over 85 million people (43 per cent of the country's population) still lack access to electricity.

Achieving the SDG7 may also help to achieve the targets of other SDGs. **Energy systems lay the foundations for social and economic development, and without energy access, it is practically impossible to eliminate poverty.[10]** The importance of energy access for health care services and thermal comfort has also been brought to bear more recently during the COVID-19 crisis because lack of access to energy constraints the possibilities to provide adequate healthcare and to deal with the difficulties of the lockdown.[11] The low carbon transition goes hand in hand with the need to rethink the role of energy in building urban resilience.

Cities, especially rapidly urbanizing small and medium cities, offer opportunities for interventions towards achieving the targets of the SDG7 goal. Given existing urban infrastructure gaps, new designs for energy infrastructures can explicitly reflect the objectives of building inclusive, safe, sustainable, and resilient cities.[12] Renewable energy, for example, may provide energy access for displaced populations in humanitarian contexts.[13] However, many energy policies accept the idea that urbanization automatically leads to improved energy access. While urbanization may create

1. UN, 2019. *The Sustainable Development Goals Report* 2019. New York.

2. N.S. Ouedraogo, 2013. *Energy consumption and human* development: Evidence from a panel cointegration and error correction model. *Energy* 63, 28–41.

3. Y. Mulugetta and V. Castán Broto, 2018. Harnessing deep mitigation opportunities of urbanisation patterns in LDCs. *Current opinion in environmental sustainability*, 30, pp.82-88; G. Bridge et al, 2018. *Energy and Ssociety a critical perspective.* Routledge, Oxford, UK; D. Chirambo, 2018. Towards the achievement of SDG 7 in sub-Saharan Africa: Creating synergies between Power Africa, Sustainable Energy for All and climate finance in-order to achieve universal energy access before 2030. *Renewable and Sustainable Energy Reviews*, 94, pp.600-608.

4. IRENA, 2020, *Tracking* SDG 7: T*he Energy Progress Report*.

5. Our world in data, 2021, *Energy Mix,* Online Dataset.

6. S. Harris et al, 2020, Low carbon cities in 2050? GHG emissions of European cities using production-based and consumption-based emission accounting methods. *Journal of Cleaner Production,* 248, p.119206.

7. E. Villamor et al, 2020. European Cities in the Energy Transition: A Preliminary Analysis of 27 Cities. *Energies*, 13(6), p.1315.

8. G. Alova, P.A. Trotter and A. Money, 2021, A machine-learning approach to predicting Africa's electricity mix based on planned power plants and their chances of success. *Nature Energy,* 6(2), 158-166.

9. S. Bawakyillenuo, M. Olweny, M. Anderson, M. and M. Borchers, 2018, Sustainable energy transitions in Sub-Saharan African cities: the role of local government. In *Urban Energy Transition* (pp. 529-551). Elsevier.

10. F.F. Nerini et al, 2018. Mapping synergies and trade-offs between energy and the Sustainable Development Goals. Nature Energy, 3(1), 10-15.

11. V. Castán Broto and J. Kirshner, 2020. Energy access is needed to maintain health during pandemics. *Nature Energy,* 5(6), 419-421.

12. V. Castán Broto et al, 2017. A research agenda for a people-centred approach to energy access in the urbanizing global south. *Nature Energy,* 2(10): 776-779.; P. Romero-Lankao and D. Dodman, 2011. Cities in transition: Transforming urban centers from hotbeds of GHG emissions and vulnerability to seedbeds of sustainability and resilience, *Current Opinion in Environmental Sustainability* 3(3): 113-120; P. Romero-Lankao et al, 2014b. A critical knowledge pathway to low-carbon, sustainable futures: integrated understanding of urbanization, urban areas and carbon. *Earth's Future.*

13. Safe Access to Fuel and Energy (SAFE). *What Energy Deprivation Really Means in Refugee Camps.*

opportunities to access the electricity network, this access is by no means uniform. It is common to find people lacking access to electricity, for example, while living under the grid in informal settlements. There is a disconnect between investment in large energy projects and who has access to electricity, as it is visible, for example, in the large investments in hydropower in countries as different as Mozambique or Brazil, that often have bypassed local populations. Moreover, many people living in urban areas connected to on-grid electricity experience intermittent power supply, and energy is not always affordable.

Energy access and the benefits of the clean energy transition are not also distributed equally amongst men, women, and gender diverse people, nor among populations in urban, suburban, and rural areas. Data from the International Renewable Energy Agency demonstrates that the transition away from fossil fuel has created many jobs, and women make up 35 per cent of the renewable energy workforce.[14] Although this is higher than the percentage of women in the traditional fossil fuel energy sector, few women still occupy management and technical positions in this area. Moreover, many of them are paid less than their male counterparts in similar jobs. In addition, existing structural inequalities undermine women's energy access in households. Although women are major consumers of household energy, men often make decisions about household expenditure, and they may not always prioritize the needs of their wives and families, leading to more frequent experiences of energy poverty amongst women.[15] Factors like insecure land tenure, inadequate infrastructure, and exclusionary institutional systems further undermine energy access in rural and urban areas. The relationship between energy and inequalities is related to the price of the land. For example, the development of land-intensive renewable projects, including biofuels and large solar, generates processes of displacement and 'rural gentrification,' whereby rural communities struggle to maintain access to land.

Dominant discourses about renewable energy suggest that the energy transition will be an inclusive project that will benefit all members of society. Yet, on the ground, renewable energy projects are increasingly causing environmental disasters in many parts of the world, raising questions of environmental justice. For example, in Myanmar and Cambodia, energy projects have led to land grabbing: they have enriched the elites while impoverishing and displacing the rural poor.[16] In India, land acquisition for large dam projects and solar projects in places like Charanka Village has come under intense criticism because they have undermined the livelihoods of vulnerable communities and caused the dispossession of communal land.[17]

Simultaneously, improving access to electricity does not resolve all the energy access challenges in urban areas. In many informal urban contexts, charcoal, biomass, and agricultural waste remain the primary energy sources for cooking and thermal comfort. A case in point is Mozambique, where more than three-quarters of the urban population rely on charcoal as a residential fuel.[18] In many Latin American cities, low-income and informal neighbourhoods have precarious electricity connections, which, together with precarious housing, increase the risk of fires.[19] Affordability alone does not explain the reliance on charcoal in many urban cities. Many elite households in Mozambique's urban areas continue to use charcoal for cooking despite alternatives, although the reasons are not entirely understood.[20] Energy access in urban environments depends on the nature of the built environment and its associated infrastructure.[21]

The limited success of energy access policies and the increasing impact of current energy systems on the most vulnerable populations have given rise to justice-centered approaches to understanding just energy transitions. Justice-centered approaches relate energy access to broader issues of urban inequality, infrastructure development, and the historical development of cultural relations around energy. **Energy justice is a lens that planners, policymakers, and researchers can mobilize to address the injustices inherent in energy systems.** Such lens examines justice in terms of outcomes, recognition, and who participates in decision-making—highlighting justice as recognition foreground the differential vulnerabilities and capacities among people, depending on structural, historical processes of oppression and

14. IRENA, 2017, *Renewable Energy and Jobs Annual Review* 2017.

15. E. Fingleton-Smith, 2018. The lights are on but no (men) are home. The effect of traditional gender roles on perceptions of energy in Kenya. *Energy research & social science*, 40, 211-219.

16. C. Hunsberger et al, 2017. Climate change mitigation, land grabbing and conflict: towards a landscape-based and collaborative action research agenda. *Canadian Journal of Development Studies/ Revue canadienne d'études du développement,* 38(3), 305-324.

17. Arundhati Roy, 1999, *The Greater Common Good;* M. Levien, 2013. Regimes of dispossession: from steel towns to special economic zones. *Development and Change* 44 (2), 381–407; K. Yenneti et al., 2016. Spatial justice and the land politics of renewables: Dispossessing vulnerable communities through solar energy mega-projects. *Geoforum*, 76, 90-99.)

18. C.A. Cuvilas et al, 2010. Energy situation in Mozambique: A review. *Renewable and Sustainable Energy Reviews*, 14(7), 2139-2146.

19. P. Romero-Lankao et al, 2014a, Scale, urban risk and adaptation capacity in neighborhoods of Latin American cities. *Habitat International*, 42, 224-235.

20. V. Castán Broto et al, 2020. Energy profiles among urban elite households in Mozambique: Explaining the persistence of charcoal in urban areas. *Energy Research & Social Science*, 65, p.101478.

21. V. Castán Broto, 2019. *Urban energy landscapes.* Cambridge University Press.

exclusion.[22] Energy justice lenses will be used in the subsequent sessions to analyze topics such as: urban equality related to energy access; energy policy and planning responses; energy challenges, and the role of local government, and will guide recommendations and ways forward.

Theories of energy justice are seeking to reframe the purpose and operation of energy systems. Justice-centered perspectives have their roots in environmental justice debates. By emphasizing distribution, representation, and recognition, justice-centered approaches place people and their needs right at the heart of energy debates.[23] Research suggests that addressing energy access effectively in urban contexts requires understanding how energy is used in everyday life and addressing inequalities made visible through access to energy resources and infrastructure.[24] **Notions of energy poverty and energy vulnerability attempt to interrogate these concerns by emphasizing how energy access shapes people's everyday lives.** Similarly, the idea of energy sovereignty, inspired by food sovereignty, calls for giving people and local communities the right to control energy resources' production and consumption within socio-ecological limits.[25] These debates put the notion of autonomy at the core of energy access: the idea that people themselves should be allowed to use shared energy resources and control their access to energy resources and technologies.[26]

However, energy justice also has profound implications depending on the countries and locations it is applied. For example, in the European Union, the European Green Deal has emerged closely linked to debates on just transitions to think about how decarbonization is related to economic restructuring processes and rising unemployment in disadvantaged regions.[27] Similarly, in the United States, the Biden administration has pledged that 40 per cent of investments in climate, energy, and economic opportunity policies that recognize that the impacts of climate change ¨are far more acute on communities of color, tribal lands, and low-income communities".[28] Similar discourses are emerging elsewhere, such as, for example, in Costa Rica and other pan-American initiatives such as *'Nuestra America Verde'*.[29] Vulnerable populations with precarious energy access tend to be overlooked in the areas that boast full electricity coverage, but where many children go to sleep in a cold room.[30] In contrast, nations with significant gaps in electricity coverage and fuel access may prioritize network development at the expense of decarbonization or supporting local initiatives that directly help disadvantaged populations.

What is less clear is how energy justice can inform local governance. Local governments are increasingly recognized to play a crucial role in promoting a more just and equitable energy transition, but their role is constrained.[31] Thus, this paper concludes with a reflection on the role that local governments can play in advancing a just energy transition.

Climate and energy justice are often framed at the international level, for example, pointing towards the historical responsibility of industrialized nations on cumulative carbon emissions. Moreover, those populations who are most vulnerable to climate change tend to be those who also show the most significant gaps in energy access and face significant institutional challenges to implement a just transition. These debates reveal the lack of integration that exists between urban development and energy planning. The discussion is bleak, and there are few alternatives to change the current state of affairs. Two options dominate to respond to these questions in urban environments. On the one hand, several attempts to deliver solutions can be managed and controlled locally, such as solid clean cooking or improved cookstoves programs. On the other hand, there are numerous advocates of off-grid solutions to link renewable energy with the needs of the most disadvantaged populations. Analyses of how off-grid renewable technologies can facilitate energy sovereignty in urban contexts are scarce, although a few cases of municipal ownership of energy facilities exist.[32] In both cases, positive examples are few and far between.

In the following sections, we explore these debates in detail. First, we develop a justice-based approach to urban equality and energy access. Second, we examine existing dominant responses in urban environments, looking into urban electrification and fuel-switching measures. Third we look at urban planning and local government responses.

22. B.K. Sovacool and M.H. Dworkin, 2015. Energy justice: Conceptual insights and practical applications. *Applied Energy*, 142, 435-444; S. Bouzarovski and N. Simcock, 2017. Spatializing energy justice. *Energy Policy*, 107, pp.640-648.

23. K. Jenkins et al, 2016. Energy justice: a conceptual review. *Energy Research & Social Science*, 11, 174-182.

24. Castán Broto, 2019, *Urban energy landscapes.*

25. V. Castán Broto, 2017. Energy sovereignty and development planning: the case of Maputo, Mozambique. *International Development Planning Review*, 39(3): 229-249.

26. V. Castán Broto et al, 2019. Transformative capacity and local action for urban sustainability. *Ambio,* 48(5), 449-462.

27. Abdullah, H., 2021. *Towards a European Green Deal with Cities. The urban dimension of the EU's sustainable growth strategy.* Barcelona, CIDOB.

28. Biden-Harris Campaign, 2020. *9 Key Elements of Joe Biden's Plan for a Clean Energy Revolution.*

29. Mideplan, 2021. E*strategia Económica Territorial para una Economía Inclusiva y Descarbonizada 2020-2050 en Costa Rica.* Ministerio de Planificación Nacional y Política Económica; nuestraamericaverde.org

30. Marmot Review Team, 2011. *The Health Impacts of Cold Homes and Fuel Poverty.* London, Friends of the Earth.

31. M. van Staden, 2017. Sustainable Energy Transition: local governments as key actors. In *Towards 100% Renewable Energy* (pp. 17-25). Springer, Cham; M. Borchers, M., 2015. *Sustainable Energy in Urban Africa–the role of local government.* Africities Summit 2015: Background paper; N. Smedby and M.B. Quitzau, 2016. Municipal governance and sustainability: The role of local governments in promoting transitions. *Environmental Policy and Governance,* 26(5), 323-336.

32. S. Lenhart and K. Araújo, 2021. Microgrid decision-making by public power utilities in the United States: A critical assessment of adoption and technological profiles. *Renewable and Sustainable Energy Reviews,* 139, p.110692.

1.Justice-based Approaches to Urban Equality and Energy Access

Energy justice is a valuable framework for interrogating the disparities within energy systems and framing their solutions.[33] It recognizes the socio-political and economic imbalances in energy systems and summons academics and practitioners to investigate where injustices occur in the energy system, which groups of the society are excluded from energy access, and how such inequities can be addressed.[34] The energy justice framework has its foundations in environmental and climate justice literature which emerged from environmental justice movements. However, unlike environmental and climate justice, energy justice is not rooted in anti-establishment social movements. Instead, drawing upon and enriching the literature on climate and energy justice, **scholarship within energy justice emphasizes three dominant tenets for achieving universal energy access: distributional, procedural, and recognition.**[35] Understanding these three dimensions and applying them to energy policies means advancing fairness in delivering energy in local areas.

Distributional energy justice highlights the inequalities in the distribution of energy infrastructure and risks, and it also shows how these inequalities affect energy access. As an inherently spatial concept, distributive justice highlights how the allocation of energy technologies becomes entangled with place-based issues. Thus, it calls for justice in how energy infrastructure - not just the physical components but also the whole institutional and social infrastructure that supports energy services - and its risks are distributed amongst different social groups. Research shows that poorer and less powerful social groups have limited access to energy services and infrastructure.[36] Consequently, achieving distributive justice within energy systems requires equal rights to reliable and affordable access to modern energy services and fairness in distributing the benefits and burdens of modern energy systems.[37] Distributive energy justice also has a temporal dimension: it requires looking beyond the present and consider what impact current energy policies and practices would have on future generations. Energy justice requires incorporating public participation as a central concern for energy policy. First, it requires all stakeholders' meaningful participation, without discrimination, when making decisions about the energy system. This means to explicitly include women and gender-diverse individuals, the young and the elderly, the working class, and underrepresented racial or ethnic groups to frame the energy needs and actions to address those needs. Second, it requires that the government and the private sector, and all energy service providers, make full information disclosure to the public to fully assess the impact of energy projects and understand the intention behind energy policies. Public participation in energy projects should happen through the whole energy life cycle.[38]

Energy justice as recognition highlights how political and social factors privilege particular identities and places and exclude others in energy policy. Race, ethnic, and gender differences influence access to energy infrastructure. Existing socio-economic exclusion also makes energy access particularly difficult for poorer groups.[39] Thus, energy justice requires that any excluded group within the energy systems is given equal and full political rights to protest and be heard.

Recognition injustices within energy systems manifest as failure to recognize the population's diverse needs. Injustices of recognition also include experiences of misrecognition where there is a deliberate distortion of the views of others. It also means to develop policies and solutions that address historic and ongoing inequalities—e.g., that target historically underrepresented groups who have been more at risk from the economic, livelihood, and health impacts of energy projects. For example, the label *not-in-my-backyard* (NIMBY) is often applied to communities that opposed renewable energy developments. Powerful individuals may use local opposition to public interest

33. D.A. McCauley et al, 2013. Advancing energy justice: the triumvirate of tenets. *International Energy Law Review*, 32(3), 107-110.

34. Jenkins et al, 2016. *Energy justice.*

35. D. McCauley et al, 2019. Energy justice in the transition to low carbon energy systems: Exploring key themes in interdisciplinary research. *Applied Energy*, 233–234, 916–921.

36. D.M Kammen, 2020, Defeating Energy Poverty: Invest in Scalable Solutions for the Poor. In: Al-Delaimy W., Ramanathan V., Sánchez Sorondo M. (eds) *Health of People, Health of Planet and Our Responsibility.* Springer, Cham

37. Y. Malakar et al, 2019. The temporalities of energy justice: Examining India's energy policy paradox using non-western philosophy. *Energy Research & Social Science*, 49, 16-25.

38. Fortier et al, 2019. Introduction to evaluating energy justice across the life cycle: A social life cycle assessment approach. Appl. *Energy* 236, 211–219.

39. McCauley et al, 2019. "Energy justice in the transition to low carbon energy systems."

projects to protect their privileges. However, this critique has also been deployed against communities that opposed renewable projects, without recognizing the social histories that lead to a project being opposed as an external imposition.[40] As such, local resistance to energy projects can arise due to value-based disagreement rather than selfish reasons to protect 'one's backyard.' Understanding the histories around energy-related conflict is central to know why people oppose particular infrastructure and service delivery projects. Energy justice as recognition calls for a cosmopolitan approach to energy policy, including recognizing and respecting different people's divergent views and how different experiences of energy access shape understandings of what would be an appropriate course for action. It also entails recognizing how energy access is shaped by structural drivers of discrimination rooted, for example, in differences of gender, ethnicity, race, sexual orientation, or ability.

Given that energy justice as recognition accounts for the intersection between socio-economic inequalities and energy access, it becomes a valuable concept for examining how energy access plays out in urban areas. Access to energy services is often divided between poor and wealthy urban neighbourhoods.[41] Energy services are often saturated in affluent urban areas, while many urban poor neigbourhoods lack affordable, reliable energy. Current estimations suggest that near a billion people live in informal settlements in urban areas. The absolute number of people living in sub-service conditions does not show a sign of abating in the context of rapid urbanization. Energy access may seem like a further barrier to improved well-being for people facing multiple deprivations in the urban environment and insecure land tenure. For example, a study showed that poor households in Kibera, Nairobi, rely on charcoal and kerosene for cooking despite their associated health and environmental impacts.[42] Other study makes similar observations in Dhaka's informal settlements.[43] Poor illegal occupants are excluded from state-owned utilities, leading them to subscribe to informal utility providers who may charge exorbitant prices for unreliable, unsafe electrical connections.

More recent work has advanced scholarship in this area and added new dimensions to the energy justice framework. This includes the principle-based approach proposed by Sovacool et al., which offers ten principles for achieving energy justice, including availability, resistance, and intergenerational equity, amongst others.[44] Sareen and Haarstad propose a model which combines the energy justice framework with the low carbon transition literature to show how social structures enable just and unjust outcomes in the energy systems.[45] In a similar light, research by Heffron et al. has characterized what they call the energy policy trilemma emanating from tensions between economics, politics, and the environment.[46] Economic concerns often dominate energy policies. Hence, Heffron and colleagues counterbalance economic discourses by showing how energy justice reveals the competing concerns for economic, environmental, and political concerns in energy law and policy. A study covering several C40 member cities found that due to the lack of integration of knowledge across sectors and groups of the population, local plans tend to prioritize techno-economic concerns over the concerns and needs of underrepresented populations.[47]

40. MJ Pasqualetti, 2011. Opposing wind energy landscapes: a search for common cause. *Annals of the Association of American Geographers, 101*(4), 907-917.

41. V. Castán Broto and M. Sanzana Calvet, 2020. Sacrifice zones and the construction of urban energy landscapes in Concepción, Chile. *Journal of Political Ecology,* 27(1), 279-299.

42. S. Karekezi et al, 2008. Energy access among the urban poor in Kenya. *Energy for Sustainable Development,* 12(4), 38-48.

43. M.L.G. Jones, 2021. *Energy Justice in Dhaka's Slums* (Doctoral dissertation, UCL (University College London).

44. B.K. Sovacool et al, 2019. Temporality, vulnerability, and energy justice in household low carbon innovations. *Energy Policy 128,* 495–504.

45. S. Sareen and H. Haarstad, 2018. Bridging socio-technical and justice aspects of sustainable energy transitions. *Appl. Energy 228*, 624–632.

46. R.J. Heffron et al, 2015. Resolving society's energy trilemma through the Energy Justice Metric. *Energy Policy* 87, 168–176.

47. P. Romero-Lankao and D. Gnatz 2019. Risk Inequality and the Food-Energy-Water (FEW) Nexus: A Study of 43 City Adaptation Plans. *Frontiers in Sociology,* 4, 31.

Bangalore (Photography: Vanesa Castón Broto)

Despite being a new field, energy justice has helped integrate justice concerns within energy policy. However, energy justice debates have been dominated by theoretical perspectives from the Global North. There are doubts that these perspectives can be uncritically exported to the countries that face the highest gaps in energy access. Castán Broto et al. explain that the energy justice framework aims to achieve universality, but this may be inappropriate for understanding the contextual specificities of energy justice issues in the Global South.[48] More research is needed on what energy justice means in the context of such pressing challenges.

Most energy justice analysis focuses on large-scale processes at the national and global levels. Relatively few studies explain the crucial influence of infrastructural investments –or their lack of– on how energy access is experienced at the household or individual level.[49] This is even though household-level analysis is crucial for understanding how affordability impacts energy access and understanding the link between energy access and poverty.[50] The dominance of techno-economic perspectives on energy and the relatively slow uptake of multidisciplinary understandings of energy access has limited more creative approaches to address the challenging questions raised by energy justice. More recently, there has been a rapid interest in social sciences approaches to energy, in a process that is likely to change the policy landscape rapidly.

Increasingly, social scientists are adopting energy poverty as a valuable concept to examine energy access issues at the household level. **Put simply, energy poverty means the lack of reliable, safe, affordable, and clean energy to support well-being.[51] It emerges from three interlinked factors: low incomes, high energy prices, and energy inefficient buildings, leading to domestic energy deprivations**. While energy poverty generally refers to the problems of domestic energy consumption, the meaning of energy poverty is specific to particular contexts. It often reflects the various forms of energy deprivation encountered by households in that context. In the United Kingdom, discussions around energy poverty focus heavily on the inability of households to provide adequate warmth in their homes at an affordable cost. Households who need to spend more than 10 per cent of their total income before they can heat their homes to the standard recommended by the World Health Organisation –that is 18ºC for bedrooms and 20-21º C for living rooms– are considered to be energy poor in the United Kingdom.[52] However, in recent years, there have been calls to revise this definition so that energy-poor households are defined as households whose required fuel costs are more than the median level of the entire population.[53] This approach has been heavily challenged, however, with many critics pointing out that it excludes a significant number of energy-poor populations in the United Kingdom who continue to face domestic energy deprivation due to reduced government support. These divergencies reveal that energy poverty is framed differently not just within policies but also in academia.

Access to energy is at the heart of social and economic development.[54] Rural households that lack access to reliable electricity spend as much as 25 per cent of their household budget on purchasing fuel, keeping them longer in poverty by depleting their household income.[55] Similarly, the high cost of energy services lessens household income in poor urban households where income is already low, which decreases the money available for investment in other basic needs. Also, access to renewable technologies like rooftop PV and EVs is limited for renters and owners with limited investment opportunities who cannot benefit from the life-cycle financial benefits because they can't support the initial higher financial investment.

Power relations and the political economy have a determining impact on energy poverty.[56] However, a focus on energy supply has strongly shaped analysis and policies to address energy poverty. In countries with significant access gaps, the bulk of efforts have concentrated on providing electricity in rural areas and rethinking the fuel supply. In addition, policies have focused on identifying the economic, technical, and social factors that hinder energy access, including the absence of developed institutional infrastructure and lack of finance. More recent work

48. V. Castán Broto et al, 2018. Energy justice and sustainability transitions in Mozambique. *Applied Energy*, 228: 645-655.

49. Romero-Lankao et al, 2014b, "A critical knowledge pathway to low-carbon, sustainable futures"

50. C. Damgaard et al, 2017. Assessing the energy justice implications of bioenergy development in Nepal. Energy Sustain. Soc. 7, 8; R.P. Medeiros and C. Bermann, 2020, Challenges and Opportunities Due to Energy Access in Traditional Populations: The Quilombo Ivaporunduva Case, Eldorado—SP. In: Leal Filho W., Borges de Brito P., Frankenberger F. (eds) *International Business, Trade and Institutional Sustainability.* World Sustainability Series. Springer, Cham.

51. S. Bouzarovski and S. Petrova, 2015. A global perspective on domestic energy deprivation: Overcoming the energy poverty–fuel poverty binary. *Energy Research & Social Science,* 10: 31-40.

52. B. Boardman, 2010. Fixing Fuel Poverty: *Challenges and Solutions.* London: Earthscan

53. J. Hills, 2012. *Getting the Measure of Fuel Poverty: Final Report of the Fuel Poverty Review.* Centre for Analysis of Social Exclusion, London School of Economics and Political Science: London.

54. World Bank, 2018, *Access to Energy is at the Heart of Development*.

55. R. Peon et al, 2005, Solid state lighting for the developing world: the only solution. In *Fifth International Conference on Solid State Lighting* (Vol. 5941, p. 59410N). International Society for Optics and Photonics.

56. B.K. Sovacool, 2012, The political economy of energy poverty: A review of key challenges. *Energy for Sustainable Development,* 16(3), 272-282.

has demonstrated the link between energy access and poverty alleviation and small-scale industries, highlighting the viability of renewable energy to provide reliable energy access to households without reliable grid access. However, work exploring that relationship in urban areas has been scarce.

Critical work has emerged in urban areas explaining consumption choices among urban households. For example, some work has looked at the influence of concrete policies, such as subsidy policies, on household choices.[57] Others have linked household choices with structural social factors such as gender.[58] The link between energy access, clean cooking, and well-being improvements is particularly salient in urban areas.[59] **An emerging conclusion is that energy practices are varied and context-dependent, questioning fundamental assumptions about how people access energy and how.**

Until recently, the problem of energy poverty and vulnerability was not recognized in the academic, political, and policy arena. However, in the last decade, these two areas have gained significant attention. Energy access is now framed in many policies as a human right necessary to live a decent life in a modern world. For example, the EU Electricity Directive and the EU Pillar of Social Rights recognize the right to access energy as a human right and extend energy access to the energy-poor. However, the different ways these policies are implemented undermine their effectiveness.[60] In the light of this limitation, many civil society groups and anti-poverty networks, such as Greenpeace and Friends of the Earth, are demanding the legalization of affordable modern energy as a fundamental human right in EU legislation.[61]

The concept of energy vulnerability reveals the driving forces behind energy poverty in households. It has links with the broader literature on vulnerability, which seeks to understand threats to people's integrity and how people address those vulnerabilities within their everyday routines. While multiple definitions of energy vulnerability coexist in the literature, they all relate to an attempt to describe how different exposure, sensitivity, and adaptive capacity shape vulnerabilities to energy poverty.[62] Analysis within the field of energy vulnerability looks beyond the affordability-access binary as determinants of energy poverty, opening up the door to understanding the variety of social, material, and cultural factors that influence energy access.

One key area of study has been a review of the nature and structure of the built environment, social practices, and energy needs as determinants of energy poverty. The structural dimensions of buildings are essential determinants of energy poverty. People who live in buildings with an unsuitable heating or cooling system may suffer energy deprivation and may not access energy services that match their needs even when they can afford it. House's design may determine where cooking occurs and how pollution from cooking spreads across the house. Having a charging option may facilitate the adoption of electric vehicles. However, relatively fewer analyses of energy access consider the architectural and spatial factors that may influence it.

"While affordability is not the sole determinant of energy vulnerability, it is an important determinant."

The concept of energy vulnerability also foregrounds a needs perspective to explain how energy poverty relates to different needs. For example, certain groups in society who spend more time at home (such as the elderly, the disable, the unemployed, and, after COVID-19 specially, teleworkers) may depend on their houses' heating systems, hence being more vulnerable to their energy access restrictions. This may be particularly important for people who depend on automated systems for communication and mobility. Households oriented towards providing care to children or vulnerable adults are likely to be exposed to the negative consequences of lacking energy access. Energy vulnerability as a needs-oriented concept challenges the dominant explanations for energy poverty in developing countries. Of particular importance here is the idea that increased income will likely increase household access to modern energy services. Wealth is not the only factor shaping energy poverty in developed and developing countries alike.

57. I. Dube, 2003. Impact of energy subsidies on energy consumption and supply in Zimbabwe. Do the urban poor really benefit? *Energy Policy,* 31(15), 1635-1645.

58. R. Sehjpal et al, 2014. Going beyond incomes: Dimensions of cooking energy transitions in rural India. *Energy,* 68, 470-477.

59. L.C. Zulu and R.B. Richardson, 2013. Charcoal, livelihoods, and poverty reduction: Evidence from sub-Saharan Africa. *Energy for Sustainable Development*, 17(2), 127-137; Ouedraogo, 2013, "Energy consumption and human development."

60. M. Hesselman et al, 2019, European Energy Poverty: Agenda Co-Creation and Knowledge Innovation (Engager 2017-2021). Policy Brief No. 2, June 2019. The Right to Energy in the European Union.

61. European Public Service Union (EPSU) 2021. *Civil Society Organisations Mobilise to Defend the Right to Energy for all!*

62. L. Middlemiss and R. Gillard, 2015. Fuel poverty from the bottom-up: Characterising household energy vulnerability through the lived experience of the fuel poor. *Energy Research & Social Science,* 6, 146-154.

While affordability is not the sole determinant of energy vulnerability, it is an important determinant. Energy poverty programs that aim to assist the urban poor can privilege particular groups and reproduce exclusions amongst the group it is trying to assist. Energy costs and the availability of government subsidies significantly impact whether poor households with low purchasing power can access energy. Fiscal policies that target particular fuel types, especially electricity, increase energy deprivation. Low-income families who bear the brunt of these impacts are also less likely to be aware of energy access support programs when they exist. An emphasis on vulnerability considers technical and economic factors alongside socially-mediated household needs to address energy poverty comprehensively.

Researchers have argued that debates on energy vulnerability are dominated by political, technical, and economic concerns, with little considerations for local people's agency.[63] Energy sovereignty emphasizes a bottom-up approach to energy policies–one that recognizes local people's rights, creativity to avail themselves of electricity, charcoal, and other energy sources, and their institutions when making decisions about their energy systems.[64] Specifically, energy sovereignty ideas support any policies that seek to strengthen individuals' and communities' ability to exercise choice in all energy planning stages.

Proponents of energy sovereignty view the problem of energy poverty through the lens of local people's needs and preferences. They consider issues ranging from, but not limited to local rights, local institutions, technological capacities, and cultural preferences when addressing energy needs to ensure that energy systems meet the needs and lifestyle of local people.

Castan Broto et al. highlight three dimensions of energy sovereignty for delivering energy access in a socially just manner, especially in urban contexts.[65] **First, energy sovereignty requires a responsible relationship between society and local ecological systems.** This requires that energy projects consider the socio-ecological relationships within communities. Such harmony is lacking in Mozambique and other countries, where energy development has transformed the local landscape, with little accountability to residents whose livelihood practices are embedded within local ecological systems. **Second, energy sovereignty requires self-determination concerning business models and technologies.** This entails scrutinizing energy business models to examine whether it is the best alternative for local communities and investigate the extent to which structural inequalities and other living conditions determine consumer choices. **Lastly, energy sovereignty requires that diverse groups within a particular neighbourhood participate meaningfully in the planning, managing, and delivering of energy services, something directly related to delivering procedural justice.** Achieving energy sovereignty involves collaboration and partnership between various stakeholders, including the government, private sector, and local communities, to ensure that energy policies meet local needs and preferences. As a discipline, development planning is concerned with public participation in planning decisions. Scholars in this field can deliver innovative research that emphasizes collaboration and partnership with local communities to enable the provision of locally relevant energy services.

Bangalore (Photography: Vanesa Castón Broto)

63. M. Laldjebaev et al, 2015. 7 Energy security, poverty, and sovereignty. *International Energy and Poverty: The Emerging Contours,* 97.

64. Castán Broto, 2017. "Energy sovereignty and development planning."

65. Castán Broto et al, 2018. "Energy justice and sustainability transitions in Mozambique."

2. Policy and Planning Responses

Urban electrification is an important area for consideration. First, electrification can play a vital role in just sustainability transitions, and urban areas are crucial for enabling this transition.[66] **Electrification supports and enables decarbonization. It can help meet climate mitigation targets and also improve local pollution and health issues associated with energy.** Cities offer great opportunities for taking transformative actions to address climate change, given the sheer size of urban population and its rapid growth. Urban development requires investments in energy, housing, transportation infrastructure. Low carbon technological and institutional innovations can be incorporated within these infrastructures to foster low carbon transitions. In terms of Policy and Planning Responses, the energy transition could be the 'front door' to integrate several SDGs actions.

Second, over a billion people who lack access to electricity live in urban areas. Thus, urban electrification projects are crucial to meet universal electricity access by 2030. Third, significant opportunities for achieving universal energy access through investment in low carbon infrastructure exist in rapidly growing cities in Africa, the Middle East, South Asia, and Southeast Asia, where infrastructure is largely lacking. This infrastructure gap opens up opportunities to leapfrog towards efficient and low-carbon carbon energy systems, including clean and affordable energy from renewable energy sources.

Low carbon-electrification can deliver significant benefits to all citizens. Renewable energy sources can promote energy sovereignty by democratizing electricity provision and shifting energy systems control to local communities.[67] The role of low-carbon electrification in improving air and health quality, accelerating economic growth, and the resilience of cities is also widely recognized.[68] Nonetheless, the challenges of urban electrification are also numerous. Informal settlements where electricity needs are high are difficult to reach. Access to urban electrification advantages depends on solving structural issues related to connections to the grid, from addressing the initial installation costs, facilitating the development of storage technologies to addressing technical challenges such as the intermittency of solar irradiations in renewable energy. Without addressing these challenges, the gap between those who can afford low-carbon technologies and those who are excluded will continue to widen. Such urban inequalities will limit urban electrification's full potential for achieving sustainable transitions.[69]

Leveraging the benefits of electrification requires considering the constraints of the built environment, how electricity-powered technologies interact with building design, and people's use of urban space. Besides, equity issues raised by transitions can be addressed by adopting a justice-oriented approach to ensure fair innovation processes. Electrification projects may have unintended negative impacts on disadvantaged populations that must be avoided. As explained above, realizing urban electrification benefits also requires considering the built environment's constraints and how electricity-powered technologies interact with building design and culturally inscribed energy uses within urban space.

If progress towards electrification has been slow, the progress made in terms of expanding access to clean cooking is more disappointing. As explained above, approximately three billion people, many of whom live in Asia, Africa, and Latin America, still rely heavily on inefficient, polluting fuels such as wood, charcoal, kerosene, and agricultural waste for daily cooking purposes.[70] In Nepal, for example, 69 per cent of the country's population relies on solid biomass for cooking.[71] In Mozambique, firewood and charcoal account for 77% of the total energy use.[72]

Polluting cooking systems impact on health negatively. They generate household air pollution, which kills 4.3 million people yearly, according to data by the World Health Organisation.[73] This is higher than the deaths caused by malaria, HIV,

66. E. Pihl et ak, 2021. 10 New Insights in Climate Science 2020-a Horizon Scan. *Global Sustainability*: 1-65.

67. M.J. Burke and J.C. Stephens, 2018. Political power and renewable energy futures: A critical review. *Energy Research & Social Science*, 35, 78-93.

68. D. Antrobus, 2011, Smart green cities: from modernization to resilience?. *Urban Research & Practice,* 4(2), 207-214; IEA (International Energy Agency), 2014, Energy Technology Perspectives 2014: Harnessing Electricity's Potentia; P. Romero Lankao, et al, 2019. Urban Electrification: Knowledge Pathway Toward an Integrated Research and Development Agenda.

69. A. Korkovelos et al, 2019, The role of open access data in geospatial electrification planning and the achievement of SDG7. An OnSSET-based case study for Malawi. *Energies,* 12(7):1395.

70. J. Langbein et al, 2017, Outdoor cooking prevalence in developing countries and its implication for clean cooking policies. *Environmental Research Letters,* 12(11): 115008.

71. D. Paudel et al, 2021. Cooking-energy transition in Nepal: trend review. *Clean Energy*, 5(1), 1-9.

72. V. Castán Broto et al, 2017, Maputo's residents can now use gas. But dropping charcoal is proving hard. *The Conversation*.

73. World Health Organisations (WHO) 2021. *Air Pollution.*

and tuberculosis combined, making polluting cooking fuels a major environmental health issue.[74] In addition, reliance on biomass for cooking leads to forest extraction, which negatively impacts climate change mitigation. Clean fuels-such as liquid petroleum gas (LPG), biogas, cookstoves, ethanol gel, and electricity are considered better fuel options because they are more efficient and not associated with exposure to household air pollution. However, in implementing cleaner fuels programs, we need to consider whether they provide a workable alternative in a transition to sustainable energy. The promotion of fossil fuels such as LPG, for example, may further entrench a polluting fuel and foreclosing opportunities for innovation with renewables.

Cost is not the only factor driving the use of traditional energy sources in developing countries. Research in this area shows that local practices of energy use, access considerations, lack of awareness, and underdeveloped supply infrastructure greatly determine cooking energy choices.[75] In Nigeria, many households rely on biomass for cooking despite its health risks because smoke is believed to have preservation value and is considered effective for killing mosquitoes. Furthermore, the majority of households in rural Africa cook outdoors. Smoke exposure is worse where cooking happens indoors because the concentration of soot is higher. Natural ventilation lowers particulate matter concentration significantly, which means that the potential impact of cookstoves for outdoor cooking is lower.[76] Although clean cookstoves remain a better fuel choice, providing improved biomass stoves could be a second-best policy option in places with limited domestic funds where outdoor cooking is dominant.

Regarding Policy and Planning Responses, **Energy justice also requires incorporating public participation without discrimination paying specific attention to those who may be marginalized or discriminated against because of their gender, race, class, age, or ability level.** This means open spaces for social participation with active citizenship establish the citizen as a bearer of rights and duties and opens new arenas for political participation.

Bangalore (Photography: Vanesa Castón Broto)

74. W.J. Martin et al, 2011. A major environmental cause of death. *Science*, 334(6053), 180-181.

75. Castán Broto, 2017. "Energy sovereignty and development planning;" S. Jewitt et al, 2020, "We cannot stop cooking": Stove stacking, seasonality and the risky practices of household cookstove transitions in Nigeria, *Energy Research & Social Science* 61: 101340.

76. Langbein et al, 2017. "Outdoor cooking prevalence in developing countries and its implication for clean cooking policies."

3. Energy Challenges: What is the role of Local Government?

As questions over who benefits from energy services continue to grow, attention is shifting to the local government's role in enabling sustainable energy access. **The core rationale to involve local or municipal governments in energy services delivery is that municipal utilities can help achieve energy sovereignty and engage local communities.**

First, energy services managed by local government bring the control of energy services closer to the local people than central governments or for-profit electric utilities. Municipally managed utilities leverage existing local structures to elect board members responsible for managing energy utilities. This is a means for the democratization of the energy system. The intervention of local governments may facilitate that local communities have a voice in making utility decisions. Democratizing energy systems will ensure that energy services are culturally significant and respond to that community's specific needs. This may have further positive impacts if it addresses the misrecognition of energy needs for individuals and households.

Second, locally managed energy services are significantly more affordable. According to the American Public Power Association data, municipally managed energy supply sometimes charges up to 13 per cent lower than private utilities.[77] Communities also have the right to participate in the definition of the cost of energy services. Often municipal services are provided at cheaper rates to lower-income households. A case in point is Austin, Texas, where lower-income houses are charged lower for electricity, and richer families who live in larger homes are charged higher rates. However, these kinds of municipal-owned energy systems are infrequent in those countries with the biggest gaps in energy access and where energy access depends on large, vertically integrated utilities.

Third, **local governments can play a vital role in facilitating low carbon action, even when they have limited competencies to deliver energy services.** Local government can bring stakeholders together, and foster interventions in the built environment that improve energy access, through actions as diverse as supporting local generation projects, facilitating local innovation, or retrofitting projects to improve energy efficiency, which can have a direct impact on the well-being of their citizens. A survey in Australia found that renewable generation projects are widespread among local governments.[78] However, they also observed a limited recognition of the broad social benefits associated with developing renewable projects together with communities.

Affordable energy services help low-income households to access clean energy. Besides, municipally powered energy services are more reliable and help boost the local economy through job creation. Unlike private utilities, where the focus is often to balance shareholder interest, locally managed power projects invest significant revenues back into the community through taxes and other payments. Municipal power systems are also greener. In the United States, for example, over 40 per cent of the power generated by municipal-owned utilities came from clean sources.

One rapidly growing area is community energy. Community Energy Systems (CESs) refer to a range of collective, cooperative, or municipally managed systems of energy generation and distribution, such as, for example, small-hydro and wind community projects, or locally-managed microgrids. Research evidence suggests that CESs provide feasible options to deliver energy access for low-income communities.[79] In addition, CESs promote radical social and technological innovations needed to foster a transition to sustainable energy.[80] Hence, there are heightened hopes that CESs can increase energy access rapidly while also reducing carbon emissions, in line with the aspirations of the Sustainable Development Goals.[81]

Calls for locally managed energy systems are growing. Still, energy access remains a complex issue requiring collaborations with other actors. Sub-Saharan countries where

77. American Public Power Association, 2021, *Public Power.*

78. F. Mey et al, 2016. Can local government play a greater role for community renewable energy? A case study from Australia. *Energy Research & Social Science,* 21, 33-43.

79. J. Tomei and D. Gent, 2015. *Equity and the energy trilemma: delivering sustainable energy access in low-income communities.* International Institute for Environment and Development.

80. T. Hargreaves et al, 2013. Grassroots innovations in community energy: The role of intermediaries in niche development. *Global environmental change* 23, 868-880; J. Hicks and N. Ison, 2018, An exploration of the boundaries of 'community' in community renewable energy projects: Navigating between motivations and context. *Energy Policy* 113, 523-534; G. Seyfang and A. Haxeltine, 2012. *Growing grassroots innovations: exploring the role of community-based initiatives in governing sustainable energy transitions.* SAGE Publications Sage UK: London, England; G. Seyfang et al, 2014. A grassroots sustainable energy niche? Reflections on community energy in the UK. *Environmental Innovation and Societal Transitions* 13, 21-44.

81. P. Alstone et al, 2015. Decentralized energy systems for clean electricity access. *Nature Climate Change* 5, 305.

energy access has been stagnant lack sufficient domestic funds to meet their growing electricity needs. Thus, without financial collaborations with the private sector, foreign investors, and international organizations, expanding electricity access at the national level will be hard. Working with different civil society groups such as women groups, NGOs, rural cooperatives, and other consumers will improve partnerships' effectiveness because a more extensive collaboration base will facilitate its integration in people's lives. Successful partnerships entail sharing energy access across diverse stakeholders and an equally fair distribution of its harms. Negotiating the distribution of benefits and impacts is essential for effective energy access policies. **Local governments are strategically situated to broker those negotiations in collaborative processes.**

Furthermore, addressing energy access challenges requires that future research engage with the knowledge gaps in this area. Three areas require analytical attention. First, research in this area needs to examine user's energy needs in a particular context. Achieving the SDGs necessitates that we understand people's needs and aspirations and how structural factors constrain these. As such, this research will be significant to identify local needs. Second, there is a chronic lack of data about energy use and demand, particularly amongst the urban poor living in rapidly urbanizing areas. Interdisciplinary research that combines quantitative methods with in-depth analyses from qualitative studies will provide disaggregated data that will reveal the different types of action needed to advance energy access in the urban area and for whom. Because urban planning remains an important mechanism to integrate the poor's energy needs into the development agenda, researchers need to investigate whether planning systems address noticeable deficiencies in energy service delivery. These research areas show that adopting socially just practices and institutional participation in energy planning is critical to expanding energy access in urban areas.

Bangalore (Photography: Vanesa Castón Broto)

5. Recommendations

Bangalore (Photography: Vanesa Castón Broto)

Our analysis suggests that progress towards sustainable energy access for all has been slow, especially in rapidly growing poor urban neighbourhoods in lower income countries. The gap in energy access is increasing between the Global South and North, but also the gap in the capacity to develop a renewable energy industry. This observation reinforces the choice of the energy justice framework as a means to rethink the disparities in access to energy in the territory in its procedural, distributional, and recognition dimensions. Following this analysis, we offer a few recommendations.

First, facilitating opportunities for experimentation with off-grid technologies (e.g., rooftop PV couple to energy storage) is essential. Second, there is a need to integrate energy access concerns within urban development planning. One of the consequences of not integrating them is that deprived areas lacking electricity access will continue to be left behind in the planning process. Since most people who lack energy access in the urban areas are the urban poor who also suffer other exclusions, such integration would need to consider their multiple vulnerabilities and financial limitations in investing in advanced technologies, even if financial savings are experienced over the equipment lifetime.

Creating participatory processes that bring together people and experts to openly discuss services will play a critical role in achieving sustainable energy access. A participatory approach can disrupt the dominance of technocentric approaches in energy policy by understanding how local energy practices influence energy access. Simultaneously, participatory approaches will advance procedural, distributive and recognition aspects of energy justice. Poor urban households often lack electricity access, and the structure of the built environment determines access to modern energy. Thus, energy access depends on interventions to upgrade the built environment.

Finally, given the link between energy access and employment, and considering that the provision of many urban services–including water and waste management–depends on energy consumption, **a holistic approach to planning which addresses how these aspects are connected will significantly improve urban well-being.** In the post-COVID-19 context, there is a need to link any recovery efforts with the Sustainable Development Goals, and the SDG7, seeking for opportunities to implement energy justice.

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References

Abdullah, H., 2021. *Towards a European Green Deal with Cities. The urban dimension of the EU's sustainable growth strategy.* Barcelona, CIDOB (Barcelona Centre for International Affairs).

Alova, G., Trotter, P.A. and Money, A., 2021. A machine-learning approach to predicting Africa's electricity mix based on planned power plants and their chances of success. *Nature Energy,* 6(2), pp.158-166.

Alstone, P., Gershenson, D., Kammen, D.M., 2015. Decentralized energy systems for clean electricity access. *Nature Climate Change* 5, 305.

American Public Power Association (2021). Public Power. Online: Available at: https://www.publicpower.org/public-power. Accessed 25/3/21.

Antrobus, D., 2011. Smart green cities: from modernization to resilience?. *Urban Research & Practice,* 4(2), pp.207-214.

Bawakyillenuo, S. , Olweny, M., Anderson, M., and Borchers, M., 2018. Sustainable energy transitions in Sub-Saharan African cities: the role of local government. In Droege, P. (Ed) *Urban Energy Transition* (pp. 529-551). Elsevier.

Biden-Harris Campaign, 2020. 9 Key Elements of Joe Biden's Plan for a Clean Energy Revolution. Non paged. Available at: https://joebiden.com/9-key-elements-of-joe-bidens-plan-for-a-clean-energy-revolution/

Boardman B., 2010. *Fixing Fuel Poverty*: Challenges and Solutions. London: Earthscan

Bouzarovski, S. and Petrova, S., 2015. A global perspective on domestic energy deprivation: Overcoming the energy poverty–fuel poverty binary. *Energy Research & Social Science,* 10: 31-40.

Bouzarovski, S. and Simcock, N., 2017. Spatializing energy justice. *Energy Policy*, 107, pp.640-648.

Bridge, G., Barr, S., Bouzarovski, S., Bradshaw, M., Brown, E., Bulkeley, H., Walker, G., 2018. Energy and Ssociety a critical perspective. Routledge, Oxford, UK.

Borchers, M., 2015. Sustainable Energy in Urban Africa–the role of local government. Africities Summit 2015: Background paper. (Available at: https://www.sustainable.org.za/uploads/files/file127.pdf. Accessed 5/6/21)

Burke, M.J. and Stephens, J.C., 2018. Political power and renewable energy futures: A critical review. *Energy Research & Social Science*, 35, pp.78-93.

Castán Broto, V., 2017. Energy sovereignty and development planning: the case of Maputo, Mozambique. *International Development Planning Review*, 39(3): 229-249.

Castán Broto, V., 2019. *Urban energy landscapes*. Cambridge, Cambridge University Press.

Castán Broto, V., Baptista, I., Kirshner, J., Smith, S. and Alves, S.N., 2018. Energy justice and sustainability transitions in Mozambique. *Applied Energy,* 228: 645-655.

Castán Broto, V. and Kirshner, J., 2020. Energy access is needed to maintain health during pandemics. *Nature Energy,* 5(6), pp.419-421.

Castán Broto, V., Maria de Fátima, S.R. and Guibrunet, L., 2020. Energy profiles among urban elite households in Mozambique: Explaining the persistence of charcoal in urban areas. *Energy Research & Social Science*, 65, p.101478.

Castán Broto, V, Macucule, D. and Smith, S., 2017. Maputo's residents can now use gas. But dropping charcoal is proving hard. The Conversation. Available at: https://theconversation.com/maputos-residents-can-now-use-gas-but-dropping-charcoal-is-proving-hard-80762.

Castán Broto, V. and Sanzana Calvet, M., 2020. Sacrifice zones and the construction of urban energy landscapes in Concepción, Chile. *Journal of Political Ecology,* 27(1), pp.279-299.

Castán Broto, V., Stevens, L., Ackom, E., Tomei, J., Parikh, P., Bisaga, I., To, L.S., Kirshner, J. and Mulugetta, Y., 2017. A research agenda for a people-centred approach to energy access in the urbanizing global south. *Nature Energy,* 2(10): 776-779.

Castán Broto, V., Trencher, G., Iwaszuk, E. and Westman, L., 2019. Transformative capacity and local action for urban sustainability. *Ambio,* 48(5), pp.449-462.

Chirambo, D., 2018. Towards the achievement of SDG 7 in sub-Saharan Africa: Creating synergies between Power Africa, Sustainable Energy for All and climate finance in-order to achieve universal energy access before 2030. *Renewable and Sustainable Energy Reviews,* 94, pp.600-608.

Cuvilas, C.A., Jirjis, R. and Lucas, C., 2010. Energy situation in Mozambique: A review. *Renewable and Sustainable Energy Reviews,* 14(7), pp.2139-2146.

Damgaard, C., McCauley, D., Long, J., 2017. Assessing the energy justice implications of bioenergy development in Nepal. *Energy Sustain.* Soc. 7, 8. https://doi.org/10.1186/s13705-017-0111-6.

Dube, I., 2003. Impact of energy subsidies on energy consumption and supply in Zimbabwe. Do the urban poor really benefit?. *Energy Policy*, 31(15), pp.1635-1645.

European Public Service Union (EPSU) 2021. Civil Society Organisations Mobilise to Defend the Right to Energy for all!. Online Available at : https://www.epsu.org/sites/default/files/article/files/letter%20to%20MEPs-%20Right%20to%20Energy%20for%20all%20Europeans-%20Final_0.pdf. Accessed 26/3/21

Fortier, M.-O.P., Teron, L., Reames, T.G., Munardy, D.T., Sullivan, B.M., 2019. Introduction to evaluating energy justice across the life cycle: A social life cycle assessment approach. Appl. *Energy* 236, 211–219. https://doi.org/10.1016/j.apenergy.2018.11.022.

References

Fingleton-Smith, E., 2018. The lights are on but no (men) are home. The effect of traditional gender roles on perceptions of energy in Kenya. *Energy research & social science*, 40, pp.211-219.

Harris, S., Weinzettel, J., Bigano, A. and Källmén, A., 2020. Low carbon cities in 2050? GHG emissions of European cities using production-based and consumption-based emission accounting methods. *Journal of Cleaner Production*, 248, p.119206.

Hargreaves, T., Hielscher, S., Seyfang, G., Smith, A., 2013. Grassroots innovations in community energy: The role of intermediaries in niche development. *Global environmental change* 23, 868-880.

Heffron, R.J., McCauley, D., Sovacool, B.K., 2015. Resolving society's energy trilemma through the Energy Justice Metric. *Energy Policy* 87, 168–176. https://doi.org/10.1016/j.enpol.2015.08.033.

Hesselman, M, Anais Varo, Senja Laakso, 2019, European Energy Poverty: Agenda Co-Creation and Knowledge Innovation (Engager 2017-2021). Policy Brief No. 2, June 2019. The Right to Energy in the European Union.

Hicks, J., Ison, N., 2018. An exploration of the boundaries of 'community' in community renewable energy projects: Navigating between motivations and context. *Energy Policy* 113, 523-534.

Hills J. 2012. *Getting the Measure of Fuel Poverty: Final Report of the Fuel Poverty Review.* Centre for Analysis of Social Exclusion, London School of Economics and Political Science: London.

Hunsberger, C., Corbera, E., Borras Jr, S.M., Franco, J.C., Woods, K., Work, C., de la Rosa, R., Eang, V., Herre, R., Kham, S.S. and Park, C., 2017. Climate change mitigation, land grabbing and conflict: towards a landscape-based and collaborative action research agenda. *Canadian Journal of Development Studies/Revue canadienne d'études du développement, 38*(3), pp.305-324.

IEA (International Energy Agency), Energy Technology Perspectives 2014: Harnessing Electricity's Potential. IEA: Paris. http://www.iea.org/Textbase/npsum/ETP2014SUM.pdf.

IRENA (International Renewable Energy Agency), 2020, Tracking SDG 7: The Energy Progress Report. Available at: https://www.irena.org/publications/2020/May/Tracking-SDG7-The-Energy-Progress-Report-2020 [Accessed June 8, 2021].

IRENA (International Renewable Energy Agency), 2017, *Renewable Energy and Jobs Annual Review 2017*, https://www.irena.org/DocumentDownloads/Publications/

IRENA_RE_Jobs_Annual_Review_2017.pdf; 2017 [accessed on June 8, 2021].

Jenkins, K., McCauley, D., Heffron, R., Stephan, H. and Rehner, R., 2016. Energy justice: a conceptual review. *Energy Research & Social Science*, 11, pp.174-182.

Jewitt, S., Peter Atagher, and Mike Clifford, 2020. "We cannot stop cooking": Stove stacking, seasonality and the risky practices of household cookstove transitions in Nigeria. *Energy Research & Social Science* 61 (2020): 101340.

Jones, M.L.G., 2021. *Energy Justice in Dhaka's Slums* (Doctoral dissertation, UCL (University College London)).

Kammen DM (2020) Defeating Energy Poverty: Invest in Scalable Solutions for the Poor. In: Al-Delaimy W., Ramanathan V., Sánchez Sorondo M. (eds) *Health of People, Health of Planet and Our Responsibility.* Springer, Cham. https://doi.org/10.1007/978-3-030-31125-4_26

Karekezi, S., Kimani, J. and Onguru, O., 2008. Energy access among the urban poor in Kenya. *Energy for Sustainable Development*, 12(4), pp.38-48.

Korkovelos, A., Khavari, B., Sahlberg, A., Howells, M. and Arderne, C., 2019. The role of open access data in geospatial electrification planning and the achievement of SDG7. an OnSSET-based case study for Malawi. *Energies*, 12(7), p.1395.

Laldjebaev, M., Sovacool, B.K. and Kassam, K.A.S., 2015. 7 Energy security, poverty, and sovereignty. *International Energy and Poverty: The Emerging Contours*, 97.

Langbein, J., Peters, J. and Vance, C., 2017. Outdoor cooking prevalence in developing countries and its implication for clean cooking policies. *Environmental Research Letters,* 12(11): 115008.

Lenhart, S. and Araújo, K., 2021. Microgrid decision-making by public power utilities in the United States: A critical assessment of adoption and technological profiles. *Renewable and Sustainable Energy Reviews,* 139, p.110692.

Levien, M., 2013. Regimes of dispossession: from steel towns to special economic zones. *Development and Change* 44 (2), 381–407.

Malakar, Y., Herington, M.J. and Sharma, V., 2019. The temporalities of energy justice: Examining India's energy policy paradox using non-western philosophy. *Energy Research & Social Science*, 49, pp.16-25.

Marmot Review Team, 2011. *The Health Impacts of Cold Homes and Fuel Poverty*. London, Friends of the Earth.

Martin, W.J., Glass, R.I., Balbus, J.M. and Collins, F.S., 2011. A major environmental cause of death. *Science*, 334(6053), pp.180-181.

McCauley, D., Ramasar, V., Heffron, R.J., Sovacool, B.K., Mebratu, D., Mundaca, L., 2019. Energy justice in the transition to low carbon energy systems: Exploring key themes in interdisciplinary research. *Applied Energy,* 233–234, 916–921. https://doi.org/10.1016/j.apenergy.2018.10.00.

McCauley, D.A., Heffron, R.J., Stephan, H. and Jenkins, K., 2013. Advancing energy justice: the triumvirate of tenets. *International Energy Law Review,* 32(3), pp.107-110.

References

Medeiros R.P., Bermann C. (2020) Challenges and Opportunities Due to Energy Access in Traditional Populations: The Quilombo Ivaporunduva Case, Eldorado—SP. In: Leal Filho W., Borges de Brito P., Frankenberger F. (eds) *International Business, Trade and Institutional Sustainability.* World Sustainability Series. Springer, Cham. https://doi.org/10.1007/978-3-030-26759-9_40

Mey, F., Diesendorf, M. and MacGill, I., 2016. Can local government play a greater role for community renewable energy? A case study from Australia. *Energy Research & Social Science,* 21, pp.33-43.

Middlemiss, L. and Gillard, R., 2015. Fuel poverty from the bottom-up: Characterising household energy vulnerability through the lived experience of the fuel poor. *Energy Research & Social Science,* 6, pp.146-154.

Mideplan, 2021. *Estrategia Económica Territorial para una Economía Inclusiva y Descarbonizada 2020-2050 en Costa Rica.* Ministerio de Planificación Nacional y Política Económica.

Mulugetta, Y. and Castán Broto, V., 2018. Harnessing deep mitigation opportunities of urbanisation patterns in LDCs. *Current opinion in environmental sustainability*, 30, pp.82-88.

Nerini, F.F., Tomei, J., To, L.S., Bisaga, I., Parikh, P., Black, M., Borrion, A., Spataru, C., Broto, V.C., Anandarajah, G. and Milligan, B., 2018. Mapping synergies and trade-offs between energy and the Sustainable Development Goals. *Nature Energy,* 3(1), pp.10-15.

Ouedraogo, NS, 2013. Energy consumption and human development: Evidence from a panel cointegration and error correction model. Energy 63, 28–41. https://doi.org/10.1016/j.energy.2013.09.067

Our world in data (2021) Energy Mix, Online Dataset. Available at https://ourworldindata.org/energy-mix [last accessed 8 June 2021].

Pasqualetti, MJ, 2011. Opposing wind energy landscapes: a search for common cause. *Annals of the Association of American Geographers*, 101(4), pp.907-917.

Paudel, D., Jeuland, M. and Lohani, S.P., 2021. Cooking-energy transition in Nepal: trend review. *Clean Energy*, 5(1), pp.1-9.

Peon, R., Doluweera, G., Platonova, I., Irvine-Halliday, D. and Irvine-Halliday, G., 2005, September. Solid state lighting for the developing world: the only solution. In *Fifth International Conference on Solid State Lighting* (Vol. 5941, p. 59410N). International Society for Optics and Photonics.

Pihl, E., Alfredsson, E., Bengtsson, M., Bowen, K.J., Broto, V.C., Chou, K.T., Cleugh, H., Ebi, K., Edwards, C.M. and Fisher, E., 2021. 10 New Insights in Climate Science 2020-a Horizon Scan. *Global Sustainability*: 1-65.

Romero-Lankao, P., Dodman, D., 2011. Cities in transition: Transforming urban centers from hotbeds of GHG emissions and vulnerability to seedbeds of sustainability and resilience, *Current Opinion in Environmental Sustainability* 3(3): 113-120.

Romero-Lankao, P., Hughes, S., Qin, H., Hardoy, J., Rosas-Huerta, A., Borquez, R., & Lampis, A., 2014a. Scale, urban risk and adaptation capacity in neighborhoods of Latin American cities. *Habitat International*, 42, 224-235.

Romero-Lankao, P., Gurney, K., Seto, K., Chester, M., Duren, R. M., Hughes, S., ... & Stokes, E., 2014b. A critical knowledge pathway to low-carbon, sustainable futures: integrated understanding of urbanization, urban areas and carbon. *Earth's Future.* DOI: 10.1002/2014EF000258

Romero-Lankao, P. and Gnatz, D., 2019. Risk Inequality and the Food-Energy-Water (FEW) Nexus: A Study of 43 City Adaptation Plans. *Frontiers in Sociology*, 4, p.31.

Romero Lankao, P., Wilson, A., Sperling, J., Miller, C., Zimny-Schmitt, D., Bettencourt, L., Wood, E., Young, S., Muratori, M. and Arent, D., 2019. *Urban Electrification: Knowledge Pathway Toward an Integrated Research and Development Agenda.* Boulder, Co, NREL.

Roy, A., 1999, *The Greater Common Good. Delhi,* IndiaBook.

Safe Access to Fuel and Energy (SAFE). What Energy Deprivation Really Means in Refugee Camps. Online. Available at: https://www.safefuelandenergy.org/index.cfm. Accessed 25/3/21

Sareen, S., Haarstad, H., 2018. Bridging socio-technical and justice aspects of sustainable energy transitions. *Appl. Energy* 228, 624–632. https://doi.org/10.1016/j.apenergy.2018.06.104.

Sehjpal, R., Ramji, A., Soni, A. and Kumar, A., 2014. Going beyond incomes: Dimensions of cooking energy transitions in rural India. *Energy*, 68, pp.470-477.

Seyfang, G., Haxeltine, A., 2012. *Growing grassroots innovations: exploring the role of community-based initiatives in governing sustainable energy transitions.* SAGE Publications Sage UK: London, England.

Seyfang, G., Hielscher, S., Hargreaves, T., Martiskainen, M., Smith, A., 2014. A grassroots sustainable energy niche? Reflections on community energy in the UK. *Environmental Innovation and Societal Transitions* 13, 21-44.

Smedby, N. and Quitzau, M.B., 2016. Municipal governance and sustainability: The role of local governments in promoting transitions. *Environmental Policy and Governance,* 26(5), pp.323-336.

Sovacool, B. K., 2012. The political economy of energy poverty: A review of key challenges. *Energy for Sustainable Development*, 16(3), 272-282.

Sovacool, B.K., Lipson, M.M., Chard, R., 2019. Temporality, vulnerability, and energy justice in household low carbon innovations. *Energy Policy* 128, 495–504. https://doi.org/10.1016/j.enpol.2019.01.010.

References

Sovacool, B.K. and Dworkin, M.H., 2015. Energy justice: Conceptual insights and practical applications. *Applied Energy*, 142, pp.435-444.

Tomei, J. and Gent, D., 2015. *Equity and the energy trilemma: delivering sustainable energy access in low-income communities.* London, International Institute for Environment and Development.

UN, 2019. *The Sustainable Development Goals Report 2019.* New York. UN General Assembly.

Villamor, E., Akizu-Gardoki, O., Azurza, O., Urkidi, L., Campos-Celador, A., Basurko, I. and Hinojal, I.B., 2020. European Cities in the Energy Transition: A Preliminary Analysis of 27 *Cities. Energies*, 13(6), p.1315.

World Health Organisations (WHO) 2021. Air Pollution. Online. Available at : https://www.who.int/health-topics/air-pollution#tab=tab_1. Accessed 25/3/2021

van Staden, M., 2017. Sustainable Energy Transition: local governments as key actors. In Uyar, T.S. (Ed.) *Towards 100% Renewable Energy* (pp. 17-25). Springer, Cham.

World Bank 2018. Access to Energy is at the Heart of Development. Online. Available at: https://www.worldbank.org/en/news/feature/2018/04/18/access-energy-sustainable-development-goal-7. Accessed 27/3/21.

Yenneti, K., Day, R. and Golubchikov, O., 2016. Spatial justice and the land politics of renewables: Dispossessing vulnerable communities through solar energy mega-projects. *Geoforum*, 76, pp.90-99.

Zulu, L.C. and Richardson, R.B., 2013. Charcoal, livelihoods, and poverty reduction: Evidence from sub-Saharan Africa. *Energy for Sustainable Development,* 17(2), pp.127-137

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