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Finance and justice in low-carbon energy transitions

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HIGHLIGHTS

- Energy policy increasingly takes account of the needs of commercial finance.
- The multi-billion mobilisation of energy finance has significant justice impacts.
- There are 6 principles of 'just' energy finance.
- Energy policy focusses only on affordability, missing five remaining principles.

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ABSTRACT

Up to $61trillion of power systems investment is needed to fulfil the Paris Agreement. The mobilisation of so much capital is a huge challenge. As such, energy policy is changing to meet the needs of commercial finance. However, very little has been done to question the justice implications of this capital mobilisation, and what alternatives there are to commercially-oriented finance for low carbon energy systems. This paper uses a comparative analysis of two developed economies to explore how 'alternative' forms of finance operate in each nation's energy investment landscape. We find alternative finance is often set in opposition to commercial capital. Alternative finance in both nations is motivated by financial justice outcomes that are poorly understood in current energy policy. Our findings suggest that 6 principles are key to 'just' energy finance: affordability, good governance, due process, intra-generational equity, spatial equity, and financial resilience. Energy policy that seeks to mobilise capital, should take account of all six principles.

1. Introduction

The scale of the low-carbon energy challenge is illustrated by global investment costs. The total investment needed for the global energy system, is up to $61 trillion if the sector is to decarbonise rapidly enough to limit planetary warming to less than 2 degrees Celsius; this requires a tripling of 2015 investment levels [1]. These sums clearly surpass state funding possibilities [2], and will need to enrol diverse forms of private capital. This research identifies the justice implications of these forms of capital, by analysing the finance landscape of two nations. The aim is to explore how finance shapes the justice outcomes of energy transitions, and how energy policy could shape these justice outcomes.

In this paper we are referring to 'capital' in its money form, intended to generate a surplus through investment and transformation into fixed assets seeking a return. For finance, or 'forms' of finance, we mean the vehicles through which money capital is transformed into fixed assets. This can be as debt or equity; applied via loans, shares, bonds etc. 'Institutions' of finance can here be taken as the types of organisations orchestrating this activity. These could be pension, insurance and wealth funds (also referred to as institutional investment), commercial banks, development banks, forms of crowdfunding (i.e. peer to business equity), venture capital etc. We also must be clear on how we are defining 'justice'. Here we use Sovacool et al's [3] eight principles of energy justice; availability, affordability, due process, transparency, sustainability, inter-generational equity, intra-generational equity, and responsibility. These principles are the indicators of 'just' energy futures which we apply to energy finance using two questions: 1, what are the implications of the current finance system on just energy transitions? And 2, what principles of justice could energy finance satisfy?

Prior research has shown that states now design energy policy to mobilise new institutions of finance. They target new sources of capital

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for energy transitions [4–5]. Taking account of the justice implications of this capital mobilisation in the energy sector is critical, because in other sectors, agnostic assumptions about the influence of capital have led to poor justice outcomes [6]. Recent analyses of the financialisation phenomenon in energy, water, and rail, have exposed how the needs of international financial institutions, are increasingly prioritised over the continued operation, development, and maintenance of these systems[1]. Financialisation results in private returns to investors being prioritised above possible social and environmental benefits [7,8]. Failures in this respect endanger social acceptance and legitimacy [9].

Energy system investment of up to $61 trillion by 2060 implies an urgent need to mobilise far greater and more diverse forms of capital, yet little has been done to explore how energy finance can secure both low-carbon transitions, and avoid poor justice outcomes and social damage. To address this gap, our research investigates the justice dimensions of different forms of energy finance, using eight principles of energy justice [3].

The paper is structured as follows. Section 2 explores existing research on energy finance. We then explore how 'alternative' finance broadly defined, is growing substantially across various markets. We use Hall and Soskice's varieties of capitalism work to analyse the background conditions giving rise to particular forms of financial actors in each nation. Section 3 summarises the methods used. Section 4 presents the UK and German case summaries, detailing the justice implications of different energy finance trends. Section 5 analyses the case data to propose 6 principles of just energy finance.

2. Energy finance

2.1. Accelerating low-carbon energy investment

There is a clear gap between the volume of capital needed to enable low-carbon transitions, and the current level of investment [1]. To meet climate change commitments, capital allocation to low-carbon investments must accelerate [2]. The majority of research by energy finance scholars focusses upon this acceleration falls into three fields: 1) state-facing policy prescription, 2) investor-facing risk perception and de-risking research, and 3) sociology and political economy analyses of finance in energy transitions. Each field has different theoretical starting points and economic assumptions about the behaviour of energy investors and therefore how and where capital is allocated. [10,11].

Direct policy advice to nation states on low carbon energy investment demonstrates the importance of investor heterogeneity in the innovation chain [12–14]. The research on policy measures has focussed on better Research, Development, and Demonstration (RD&D) partnerships, advocacy coalitions with financiers, mission driven public investments, demand stimulus[2], and (RD&D) tax system reform [15] p.531].

The second field presents the risk-return profile of investments as the key enabler for private finance [16,17] and addresses two main problems. The first deals with investor risk perception [18,19], behavioural responses to risk across investor types [20,21], and capacity to assess risk across different energy assets using various tools [22,23]. The second strand investigates either specific de-risking mechanisms such as state backed guarantees, loan concessions, or grants [24,25], subsidy and energy policy approaches to risk management using deeper market reforms [5], and investor mobilisation to challenge state decisions on subsidy reform, in order to establish a precedent for ex-post subsidy risk management through arbitration [26].

In both policy-centred and de-risking fields, the needs of finance capital and investors are foregrounded. There is an implicit (or sometimes explicit) argument that the needs of finance capital must shape energy policy, if it is to achieve the desired levels of investment at least cost. The basic premise being that, a lower cost of capital for low-carbon generation will translate into more affordable low carbon energy for households and business [27]. Both fields have substantially improved our understanding of the needs of private capital and how energy policy can meet those needs. However, energy finance research so far has had very little to say about the ethical or justice dimensions of energy finance. It adopts either a 'more is better' stance, or works on matchmaking between risk profiles, investor preferences and fund structures.

The final category of existing research, the sociology and political economy of energy finance, *has* started to question whether different forms of finance and sources of capital can have wider distributional impacts than the final cost of low-carbon energy. For example, Baker claims that the interests of international finance capital in the South African energy transition subordinate socio-economic and environmental developments [28]. There is also growing understanding that energy finance is part of much wider systems of accumulation that have far reaching consequences across labour, gender, and nature/space relations [29]. This connects with literatures on financialisation, which show how various systems are subject to "the increasing dominance of financial actors, markets, practices, measurements, and narratives" [30]p. 3], with detrimental effects on wider business and societal objectives in both developed and developing contexts [31].

The investment needs of energy transitions are increasingly used as an enabler of financialisation of energy policy [5]. Polzin et al. [32] argue that a financial monoculture has emerged, which is not resilient to crises, and that designing energy policy to serve this monoculture only further exposes energy transitions to boom and bust investment cycles in the wider financialised economy. The nexus of work on sociology and political economy of energy finance deals with values, motivations, systemic effects and distributional outcomes of financialisation and explores what alternatives there might be [4,29,33,34]. However this work has hitherto lacked a coherent framework of analysis to integrate these concerns. In what follows we explore whether energy justice principles can help generate this framework. The challenge is to find a series of principles through which investigations of the sociology and political economy of finance, can make meaningful qualitative judgements about something more than the effect of various policies or tools on the cost of capital.

2.2. Energy justice and energy finance, introducing the 8 principles

Energy justice can be described as "a global energy system that fairly disseminates both the benefits and costs of energy services, and one that has representative and impartial energy decision-making" [9p.436]. Three forms of justice are considered; distributional - the distribution of environmental benefits and ills and their associated responsibilities; procedural – access to decision-making procedures that ensure equitable outcomes; and recognition – the fair representation of individuals, who are free from physical threats, and offered complete and equal political rights [35,36]. Sovacool et al. [37] add cosmopolitan justice as a further form, which argues that all human beings have equal moral worth and are deserving of energy justice.

Energy justice can be a conceptual tool, an analytical tool or a decision making tool [3]. The three (or four) forms are appropriate for a conceptual discussion. However, they provide insufficient detail for supporting specific decisions, for example; how could the finance sector be shaped to enable just energy transitions? Therefore further work [37] developed an energy justice framework based on eight principles that can be applied to real-world problems: (1) availability, (2)

[1] The process by which financial institutions and markets grow in importance, size and influence within a national economy. The Financialisation of basic urban and infrastructural systems including housing, water, and other systems is explored by the FESSUD programme (http://fessud.eu/)

[2] Demand stimulus here refers to investment demand and not energy demand. It is used to show how different subsidy schemes affect investors 'demand' for energy projects in their portfolios.

affordability, (3) due process, (4) transparency and accountability, (5) sustainability, (6) ***inter***-generational equity, (7) ***intra***-generational equity, and (8) responsibility.

Energy justice has been successful in the conceptual and academic spheres, but Heffron et al. call for a more direct link with policy [38]. Recent work on energy justice has explored how these principles can be embedded in business model innovations for energy [39], showed how the challenge of affordability and fuel poverty cuts across all tenets of energy justice [40], and highlighted the impact that the concept of energy justice can have on policy decisions [38]. It has taken up the "spatial turn" in energy research [41,42] and discussed geographical dimensions of inequality and inequity under the label of "spatial justice" [43,44]. In this attempt, it went beyond mere geographical location, and analysed the social construction of spaces and its justice implications – e.g. unjust *distribution* and mis*recognition* of certain locations [45], or negative impacts of large-scale solar energy finance via disposition of land rights [46].

However, as yet the mobilisation of capital, be it state, commercial, or citizen finance, has received no systematic analysis from a justice perspective. Doing so now allows us to connect our understanding of energy finance research, and its turn toward the broader financialisation phenomenon, with the literatures on energy justice. To do so we explore two further fields before returning to our research questions. First, what alternatives there are to strictly financialised sources of capital for energy transitions i.e. 'alternative finance'; and second, how we can usefully conceptualise the various political economies of finance that differ across nations.

2.3. Alternative finance

Beyond mainstream commercial lending and equity relationships, structured almost exclusively by the risk return calculus identified above, there is an 'alternative finance' sector which seeks multiple outcomes [47]. The capacity of alternative financial innovations to deliver justice outcomes remains under-researched. This is curious given the current growth of alternative finance, both in Europe and around the world, with significant markets maturing in the Americas [48][3], Africa and the Middle East [49][4], China and the Asia-Pacific [50][5]as well as those across Europe [51][6] and within the UK [52].

'Alternative finance' includes those financial instruments that emerge outside of the traditional channels of capital raising and financial intermediation [53,54]. Online alternative finance[7] is now: supplying credit to small and medium enterprises (SMEs), raising venture capital to start-ups, funding the creative industries, and creating new ways for individuals and institutions to choose how and to whom money is lent and invested. This definition includes those 'mission oriented' platforms that match capital to social and environmental causes [50,55]. The sector strives to facilitate productive investment in the 'real economy', disintermediating elite banking institutions and so drawing capital away from the financial speculations that played a devastating role in the global financial crisis [56].

[3] Total market volume across the USA, Canada, Latin America and the Caribbean of US $35.2 billion

[4] Total of US$242 m in online alternative finance funds raised across both Africa and the Middle East in 2015

[5] China is the world's largest online alternative finance market by transaction volume, registering RMB 638.79 billion in 2015 (circa US$101.7 billion allowing for currency fluctuations)

[6] In Europe, the total online alternative finance market grew by 92% in 2015 to reach €5431m (circa US$6467m allowing for currency fluctuations) with German market valued at €249 m (circa US$296m) in the same year

[7] In this definition of online alternative finance, we follow Zhang et al. [50] in understanding the provision of finance to individuals and businesses through alternative channels via online marketplaces outside of the banking system. This definition therefore excludes activities such as peer-to-peer insurance, online money market funds or third-party payments.

Alternative finance companies typically operate online and share a similar business model, in which an individual or collective actor providing money ("funder") passes it to another individual or collective actor seeking money ("fundraiser") through a website or smartphone app ("platform") that is managed by the company that then takes a percentage commission on the funds raised [56]. These platforms facilitate all manner of financial transaction: from "peer to peer" (P2P) money lending, either to consumers (P2C) or to businesses (P2B), to selling shares ("equity crowdfunding"), or simple gifted money in 'reward' or 'donation' crowdfunding.

The global alternative finance sector uses these online channels to move money into a wide range of activities, including general business finance, property development, community projects, and renewable energy infrastructure. Indeed, the market connections between alternative finance and alternative energy systems are very strong, as new forms of finance, with more or less explicit social and environmental justice aims, provide for renewable energy schemes that could otherwise not raise capital through traditional routes [4,57]. Vasileiadou et al. ([58] p. 150) argue: "*the field of sustainability transitions can benefit from turning to the financial mechanisms that can facilitate the spread of renewable energy*". Given the claims on socio-environmental outcomes and economic development often made by the alternative finance sector [59,60] our research targets these actors to explore the justice implications of financing low carbon transitions via alternative means of raising capital.

2.4. Varieties of capitalism

In an UK/Germany comparison it is important to stress that we are not comparing economies with identical financial institutions [61]. Important differences exist between the two cases. Primary amongst these is the character, or 'variety', of capitalism present within each country. Drawing upon Hall and Soskice (2001) [62], we can state that all variants of capitalism function within market economies, and share some common institutions and practices, but that these operate in very different ways and so deliver a significant variety of outcomes [63].

Hall and Soskice (2001) demonstrate that the circulation of capital in national [capitalist] economies is mediated and shaped by historically specific institutions that in turn shape productivity outcomes across sectors [62]. Utilising the 'varieties of capitalism' approach with respect to our chosen case studies, we can state that the UK has a *liberal market economy* (LME) heavily reliant upon competitive markets and with highly developed capital markets motivated by the maximization of share price in the short term. As such, the UK's 'neoliberal' economy is reliant upon the success of its banking and finance sectors with investment typically facilitated by equity or debt instruments traded in liquid securities [4]. Germany, on the other hand, has instead a *coordinated market economy* (CME) with a distinctive set of institutions that appear to be more stable over time, and less reliant than the UK on short term share prices, with banking and finance sectors facilitating long-term investment in companies and infrastructure because of a broader "corporatist industrial structure" [64] and 'ordoliberal/social democracy hybrid [65].

Comparing energy finance in these two cases is thus more complex than might appear. Despite the apparent advantages of its CME structure for enabling longer-term sustainable investment, in Germany public authorities still lack the necessary capital from private institutional investors, who are typically more averse to restraints such as high transaction costs and risk-return-concerns [66]. Indeed, it is for this very reason that Yildiz [66] suggests that alternative financing innovations must be better researched and developed if the wider energy transition is to be successful.

It is partly for these reasons that we stop short of Baumol et al. [67] by not dividing these 'varieties of capitalism' into classifications of either "good" or "bad". Given the varieties of capitalism within which energy finance evolves, we are interested here in how energy finance

providers are affecting justice outcomes.

2.5. Summary and research question

This section demonstrates that the majority of research on energy finance focusses on policy advice or the risk return calculus. Recent work on the sociology and political economy of finance shows promise in unpicking the ethical, distributional, or justice implications of this capital mobilisation, but has hitherto lacked clear categories of analysis. The 8 principles of energy justice are emerging as an organising concept for broader explorations of energy justice. We explore data on energy finance in two nations and question whether the 8 principles of energy justice are sufficient to investigate the justice outcomes of mobilising large volumes of finance capital. Our question is:

1. What are the implications of the current finance system on just energy transitions?
2. What principles of justice could energy finance satisfy?

3. Methods

The research team undertook a synthesis of 64 elite semi structured interviews conducted by the team between 2012 and 2017 across the UK and German energy finance sectors. The interviews were the result of four purposive samples by the authors covering renewable energy finance, alternative finance sector growth, and civil/civic energy sector development.

The UK sample comprised: 10 institutional or utility investors, 17 alternative finance providers or experts, 2 civil servants, and 1 project developer. The German sample comprised 1 alternative finance platform, 8 institutions of public or mutual banking pillars, 1 academic, 2 NGOs, 7 co-operative developers or representatives, 5 private developers or manufacturers, 3 transmission system operators, 1 civil servant, 5 utilities, 1 law firm, and 1 regional public agency. Interviewees were selected with professional knowledge of renewable energy (RE) development and financing in each nation.

The full interview list is available as a supplementary document in [68]

The interviews were re-coded against the 8 principles of energy justice identified by [37] and against emergent justice criteria beyond the 8 principles. The interviews were used to construct comparative case reports [69] which were developed for each nation. The question set was developed iteratively around four sub themes: who participates in energy finance and how, the effect of energy policy on investment attractiveness, the multiple values pursued by different stakeholders, and the justice and equity effects of different financial vehicles. These themes were interpreted for justice outcomes by the authorial team.

4. Results

The results section is structured as follows. Sections 4.1 and 4.2 present case study summaries for the UK and Germany which present three things: (1) the institutional context for each nation, (2) the evolution of energy policy and energy finance, and (3) how these factors affect justice outcomes in energy transitions. In Section 4.3 we compare the case studies and reflect on the wider role of finance in energy justice, as described by the 8 principles and introduce two additional aspects of justice that emerge from case study findings.

Supplementary materials 2&3 [70,71] present full case reports from each nation. Readers with a particular interest in the empirical foundations of the case summaries below are referred to the full case reports.

4.1. UK case summary

4.1.1. Institutional context

Prior to the 2008 financial crisis, low carbon energy finance in the United Kingdom was predominantly composed of project finance from banks and balance sheet financing by utilities. Post financial crisis, banks required lower ratio of debt to equity which meant that they were less likely to finance renewable energy projects. The reduction of commercial bank lending invited other financial market participants into the energy space, not least institutional investment by insurance, pension and wealth funds.

In parallel there has been a surge in alternative finance with a focus on renewable and local energy. This surge aims to address a broader range of outcomes than financial return. Some of these outcomes relate specifically to the energy system (for example, the focus on 'productive' investment that has benefits for society as well as delivering returns to investors), others relate to the finance system more generally (for example increasing engagement and reducing the control of a small number of large institutions). The United Kingdom is now the largest alternative finance market in the European Union by a considerable margin and generally considered to be the most mature. It has a total online market size of £3.2 billion in 2015 (circa US$4.5 billion allowing for currency fluctuations).

4.1.2. Evolution of energy policy and energy finance

One of the most significant changes to UK energy policy during the study period was the Electricity Market Reform package. One of the principal drivers for this package was the scale of investment in low carbon technologies that was needed to respond to Climate Change Act (2008) targets. Investment needs analysis showed the requirements of the power sector were beyond the capacity of post-crisis utility balance sheets [72]. It was identified that additional sources of finance would be needed to support the necessary transformation of the energy sector, and that new energy policy was required to stimulate this investment in a way that did not affect the price and affordability of energy. Affordability, i.e. keeping costs of capital low in order to reduce final costs of energy, was the primary justice principle identified by the market based UK sample.

Electricity Market Reform and the enabling Energy Act 2013 [73] developed a new subsidy system; feed in tariff type arrangements with contracts for difference (CfDs), designed to crowd in institutional investors (pension, wealth, insurance funds etc) on the basis of easily calculable cash flows, an outcome it largely achieved between 2014 and 2017 [5]. This level of financialisation of energy policy in the UK meant that by 2014 the access to capital problem was being solved via a change in the investor base, away from a simple bank/equity relationship to a more mixed landscape, in which large insurance, pension and wealth funds are targeted as sources of capital, somewhat to the neglect of alternative forms of finance.

4.1.3. Finance and justice outcomes in energy transitions

Reliance on (indeed encouragement of) institutional finance to fill the energy finance shortfall has significant implications for energy justice. Our UK case report shows this form of finance is highly intermediated which makes it very hard to connect funding to finance and therefore trace who is making decisions about investments in energy, what their aims and goals might be, and how these might affect energy system transformation or justice outcomes. It also tends to be very exclusive because of the scale of investment needed. This means that decisions about what to invest in are not transparent, and negative inter-generational equity impacts are experienced because it is impossible to benefit from direct energy investment without holding individual money capital of several hundred thousand pounds. The case data shows UK energy policy has attended almost exclusively to the affordability principle of energy justice, elevating the minimum possible cost of capital above other justice concerns. However, beyond this,

the UK case report [70] shows market based and institutional finance is poorly aligned with other justice outcomes.

By contrast, alternative finance is currently more transparent; the link between money capital and the projects it supports is made explicit, and transparency is a key selling point for investors and projects alike. This transparency criterion fulfilled by alternative finance platforms is the first and strongest of the 8 original principles of energy justice [37]. Alternative finance also has a clear contribution to make to intra-generational equity. This is because of the low capital barriers to entry. For example some UK platforms invite investment from as little as £5, where in market based finance the minimum amount needed to invest directly in schemes can often be over £25,000. These low barriers to entry are often cited by those who use the term 'democratic' finance [56]. This lowering of access thresholds is a key enabler of intra-generational equity as it opens up opportunities to invest in low-carbon transitions in a more direct and meaningful way than any UK financial institution was able to achieve pre-crisis.

A further feature of alternative finance identified in the case data relates to 'due process' specifically regarding those procedures of constructing bid and offer documents that enable engagement and accountability of stakeholders in individual projects. As barriers to investment are low, so are barriers to information around the performance of the asset, predicted revenues, scheme timescales and profits. As such the citizen engagement activities of alternative finance contribute to the justice principles of 'due process'. By offering local residents and medium-low income investors access to information and new ways of investing in low-carbon energy projects, due process indicators such as stakeholder decision-making and participation are enabled. While the lines between due process and transparency are not always clear, the data clearly shows a procedural element of scheme building and stakeholder involvement which goes beyond simple information sharing.

The case data also shows a strong association of the alternative finance sector to financial system resilience. A clear narrative emerged that alternative finance providers see themselves somewhat insulated from the volatility of financial markets. They see alternative finance as contributing to system resilience through building diversity, and standing at a remove from more globally connected flows of capital which they argue are more exposed to systemic crises. Building diversity as a means of resilience would hold to logical argument, particularly in a relatively homogeneous market, but causal links are yet to be proven between the growth of alternative finance and systemic resilience [60].

Our sample identified challenges with scaling up the niche alternative finance market and whether it is possible to retain the same level of transparency and equity when the sector becomes more mature and consolidated. The mission of some alternative finance providers extends to specific sustainability or justice goals, for example, some specialise in renewable energy projects, but this is not universal.

The UK case report shows that the justice outcomes of energy finance are very dependent on the form of finance deployed, which is in turn strongly driven by contemporary energy policy. This case showed energy policy in the UK was explicitly designed to meet the needs of market based finance, largely due to this form of finance being dominant in the UK. However, the alternative finance sector did benefit from energy investment opportunities created by energy policy. The justice principles served by market based finance relate almost exclusively to the cost of capital and its effects on the affordability of energy. Beyond this commercial market based finance has some negative justice outcomes, particularly around transparency and intra-generational equity. The alternative finance sector addresses these principles to some degree by providing low cost opportunities to invest directly in low-carbon energy schemes. The alternative finance sector goes further by necessitating new stakeholder engagement processes which relate to the due process principle. Lastly, the alternative finance sector argues that it contributes to system resilience by diversifying the UK economy away from "too big to fail" [Interview #28] banks and contributing to what the International Monetary Fund (IMF) have called a global public good of financial system stability [74]. Therefore from the UK case, our justice implications from within the 8 principles are:

- Affordability
- Due Process
- Transparency [good governance]
- Intra-generational Equity

And from beyond the 8 principles we add:

- Financial system resilience

4.2. Germany case summary

4.2.1. Institutional context

Germany traditionally has a decentralised, universal bank-based financial system, and banks form a dominant share of energy financing. The banking system includes three types of banks:

- For-profit private banks including four large banks, smaller regional banks and branches of foreign banks;
- The public banking sector, including (a) "Sparkassen", i.e. municipally-owned savings banks and (b) "Landesbanken", i.e. banks owned by federal states ("Länder") and regional savings banks associations, which are less profit-oriented.
- Cooperative banks, including credit cooperatives, the cooperative central bank DZ Bank AG and specialised institutions

Additionally, the state provides low interest refinancing through the national development bank KfW and through Rentenbank, which is the development bank for the agricultural and food sector. Many local banks, i.e. Sparkassen and credit unions, are highly involved in the renewable energy sector due to these favourable refinancing conditions and easily calculable cash flows. A relatively dense branch network and close ties to the local economy, especially SMEs, enabled local banks to build a strong renewable energy credit portfolio.

As has been argued elsewhere [4], this conducive institutional environment led to a co-evolution of citizen renewable energy projects and a socially motivated, small-medium scale bank based financing system. It reduced the financing 'problem' to the question of how much equity the projects needed and where to source it from. As a result of a more diversified banking system, there is a much less active alternative finance sector in Germany. While still a niche market, interviewees do see a role for it in case of non-standard types of projects, giving equity like returns to citizen capital and providing a new avenue for financing less bankable projects in new markets such as storage, or aiding more traditional projects in reaching financial close.

4.2.2. Evolution of energy policy and energy finance

The renewable energy transition in Germany emerged from the anti-nuclear movement and small-scale, community or farmer owned projects played a large part from the beginning. A feed-in law was introduced in 1991 to ease negotiations with grid operators and to improve the economic feasibility of projects. In combination with the strong support from the public banking system for investment in small-scale projects[8] this has resulted in a high proportion of investment from local residents and communities. Empirical insight from Germany on ownership structures of existing renewable energy infrastructures (excluding offshore wind, geothermal energy and pumped storage hydro power stations) reveals that citizen participation schemes defined in a broad sense account for approximately 47% of the installed renewable

[8] Particularly refinancing options from the federal development bank KfW

energy capacity in Germany in 2012 [66]. The introduction of the Renewable Energy Act in 2000 aimed to broaden the investor base, to professionalise the sector and to mainstream renewable energy financing. As a result a greater proportion of institutional investors have entered the energy finance market in Germany. In 2014, the German government gradually changed the support scheme from a feed-in premium to an auction-based system in order to comply with the EU Environment and Energy State Aid Guidelines (EEAG) and to limit the costs of the support scheme. Some market players feared that this move could endanger a main characteristic of the German renewable energy system: its high "diversity of actors". Specific measures have been put in place to support community energy projects, but there are fears that these do not go far enough to overcome challenges for the standard project finance approach. Nevertheless, there is currently a strong representation of local residents in energy sector investment.

4.2.3. Finance and justice outcomes in energy transitions

The justice themes that came through strongly from the German data were transparency, due process, intra-generational equity and spatial development. Transparency, due process, and intra-generational equity are within the existing 8 principles framework while spatial equity/local economic development is an emergent theme. A further theme on financial sector resilience was also indicated, but remained under-developed in the empirical sample.

Interviewees stressed the importance of transparency and accountability as a procedural dimension of the investment process, particularly for community energy. Financial sector interviewees often referred to transparency as an explicit aim, i.e. transparency on the assets in which the clients' money is invested in. The way in which transparency is achieved for RE schemes was the way equity vehicles of community energy communicated the financial performance of investments to the wider community.

In common with the alternative finance sector in the UK, community equity stakes often enabled better due process outcomes by enrolling communities in discussions over the timing, rollout and benefit sharing of schemes. Thus, the financial vehicles of the citizen equity stake often led to improved scheme acceptance as a function of improved due process. The equity vehicles commonly raised for German RE schemes require staged stakeholder engagement. Equity in this case offers a strong route to a procedural as well as distributional justice outcome because it necessitates clear communication and engagement with stakeholders and citizens close to proposed RE developments.

The third strong theme from within the 8 principles was intra-generational equity. From an energy finance perspective this was expressed by the sample as clear discussions about who is in and out of different investment offers. These intra-generational equity issues concern whether the benefits of energy investment were available to all citizens, could be equitably distributed, and whether any purposive exclusions were fair. There was an implicit assumption that those closest to the disbenefits of energy projects should be offered the first ability to share rewards but financial regulations do not allow for spatial discrimination in many cases, which can work against stated justice outcomes.

While spatial distributional benefits are related to intra-generational equity, we also found a strong spatial justice element which runs through the entire public and co-operative banking sector, which transcends energy only projects. Two of the three pillars of the German model voice explicit spatial development and economic resilience goals. Both the Sparkassen/Landesbanken and the Volksbank networks are operationalising these goals through renewable energy investments. The local circulation of capital and the diverse effects this can have on local economic resilience is bound up with questions about the effectiveness of import substitution vs more open trade policies that are beyond the scope of this paper to address. However it is clear that there is a strong narrative of local provisioning of both energy and energy finance as a route toward more systemic resilience of regions.

In the German interviews, we find little coverage of two of the 8 original principles of energy justice: availability, and affordability. Issues of three more; sustainability, inter-generational equity, and responsibility, were not absent, but were often assumed as 'given' since our interviews largely explored the mobilisation of finance around low-carbon energy transitions.

To summarise the principles of justice that relate to energy finance in Germany are:

From within the 8 principles:

- Due process
- Transparency [good governance]
- Intra-generational Equity

And from beyond the 8 principles we add:

- Spatial equity/local economic development
- Financial sector resilience [to a lesser extent in the empirical data but to a greater extent from secondary sources]

5. Discussion: Energy finance and principles of justice

In both cases examined there is a significant representation of finance types that are well aligned with some of the 8 principles of energy justice and beyond (i.e. the banking system in Germany and alternative finance in the UK) but which have evolved differently as a result of the institutional structure and varieties of capitalism of each location. Looking across both case studies at the potential of finance to enable or constrain energy justice, we find that this potential is unevenly distributed between principles.

5.1. Energy justice principles strongly associated with finance

The case data demonstrate a close relationship between different forms of finance and 4 of the 8 principles of energy justice articulated by Sovacool et al. [37]: affordability, due process, transparency, and intra-generational equity. Due process and transparency, principles are closely tied to procedural justice as they enable meaningful involvement in decisions about the energy system; and intra-generational equity and affordability, relate to distributional justice categories as they concern the distribution of benefits between communities in the present [3].

New forms of finance are emerging that improve due process by allowing a far broader range of citizens to participate in meaningful decisions on the energy system; firstly by providing opportunities to invest in projects, allowing citizens to express preferences in terms of what should be built; secondly by broadening the range of actors who are able to engage directly in the energy system; and thirdly by regulating the financial information shared with communities and potential shareholders about particular developments.

Finance can also affect the transparency of decision-making. Institutional investors frequently have interests (such as the need for shareholder return) which shape decisions (for example to prioritise short-term revenue over long-term value such as emissions reductions) but which are not transparently declared. Institutional finance is also heavily mediated so it is difficult to trace decision-making processes which have a significant effect on investments in the energy system. As such, accountability to funders and to citizens is poor. The normalised citizen equity stake in Germany and alternative finance platforms in the UK, can increase transparency and accountability by providing a much clearer link between funding, investment (projects) and revenues (income from investments). This transparency is supported by a greater emphasis on reporting about where funding comes from and where it is invested, increasing the accountability of decision-making.

One of the principal driving forces cited by many providers of alternative forms of finance was to broaden the engagement of citizens

regardless of the financial resource they have available to them. This is also promoted by the local banking systems in Germany, both public and mutual. When directed to energy finance, this can mean that more people *"have a stake in a sustainable energy mix"* (Source #28: Alternative Finance Platform Provider, UK 2015); investment provides a means of engagement in the energy system. The barriers to entry are very low at present, partly as a function of the mission of the organisations involved in these forms of finance, but there is fear that consolidation of the alternative finance sector in the UK will increase the barriers to entry. Therefore, intra-generational equity is driven in-part by the *mission* of finance, not just the *form* of finance.

There was some evidence that alternative finance in the UK could increase the availability of high quality (low carbon) energy, through investing in crucial aspects of the system which are traditionally harder to fund, such as demand management. They can also have a significant effect on the *affordability* of energy; the rate of return demanded on funding can increase the cost of new technology and infrastructure [75], but by providing competition to commercial finance there is the potential for lowering or benchmarking finance costs. It was also clear that investor risk perception, and management of regulatory risk through mechanisms such as arbitration and state guarantees, was a fundamental constituent of the price of capital and that work to reduce the risk premium was welcome. However, there was little or no discussion of the justice implications of risk reduction from our sample. This was surprising given the current debates around investor arbitration [26] and the investor state dispute settlement clauses that have become a key site of dispute in wider international trade negotiations [76].

5.2. Energy justice principles weakly associated with finance

The link between finance and the justice principles of availability, sustainability, *inter*-generational equity and responsibility were less clear in the data. Sustainability was mentioned as a mission of some specific financial organisations but not of the form of finance itself. Inter-generational equity was addressed only once, when an interviewee recognised the relationship between debt and future generations:

> "*Debt is a claim on future revenues, a claim on someone's future, their wealth, their future wealth, and the reason why Islamic finance bans it* [sic]*, is it's usually an unfair sharing of the risk"*.
>
> Source #26: Alternative Finance Platform Provider UK, 2015

There was no substantive discussion of responsibility for the energy justice implications of finance decisions.

5.3. Emergent energy justice and finance themes

The case data shows two strong and significant emergent themes relating to justice, which were not adequately captured by Sovacool et al's 8 principles. These were related to: (i) the spatial dimensions of justice; (ii) the role of finance in building resilience. Finance is an important medium through which the burdens and benefits of energy system transformation are distributed. This distribution not only happens across income groups but can also cluster in particular geographies or be absent in others. Much of this 'place-based' finance is due to the financial vehicles adopted by projects and the ownership of debt participating in projects. For a UK solar development funded by developer equity and debt from a commercial bank, the retention of local value is minimal. In contrast, the same kind of project in Germany may have multiple equity stakes from the local community and draw on debt from locally rooted institutions. The distribution of the financial interest from an energy project in this case will mean positive value retention for the local community. This is a characterisation of a general rule. Clearly purely commercial or citizen led projects can exist in each nation. However, the deep involvement of citizen equity, and debt from the public or mutual banking pillars in Germany is clearly more common than in the UK.

Inter-country or inter-regional distribution of burdens and benefits was also discussed at length. For example, 'foreign' energy companies who would use profits from activities in the UK to invest in energy systems transformation in their 'home' country:

> "*and I think we can't expect there to be an asymmetric flow of investment between different countries all of whom are trying to suck as much capital into their energy systems as possible and all of whom want their consumers to pay as little for their energy as possible"*.
>
> Source #5: Institutional Investor, UK 2013

> *"Wind farms are often purchased or sold as investment objects; with the negative consequence that there is no local contact person anymore and thus no local rootedness and acceptance for decentralised energy decreases;"*.
>
> Source #55: Developer/Service company for community wind DE, 2017

Beyond mitigating international flows of energy investment and return, some forms of finance are able to take a more spatially explicit approach and build resilience not just locally but in the wider finance system:

> *"What it can do is that it can prevent the economic decline from going below a certain level. It can stabilise…… And the savings bank, because it is anchored within that local area and also bound to only operate in that local area, will have to live off the profits that it can make in that local area."*.
>
> Source #19: Banking institution [Savings bank] DE, 2014

Perhaps more subtly, energy finance was also seen as a way of engaging citizens with their locality and as a means through which they could generate and retain social and environmental, as well as financial value, giving them more control over their localities and their livelihoods:

> *"So a good example is somewhere like Frome*[9]*, where a lot of economic resilience in Frome is coming from community investment. They've done energy, they've done land, they've got their football club"*.
>
> Source #36: Alternative Finance Enabler, UK

> *"But this is really something where civil society, where communities where municipalities where people from outside the authorities get together and try to create something and try to be independent and take some responsibility for their lives and that is something that is very close to the founding mission of the savings banks. So we want to enable people to take responsibility for their own lives and do something about it."*
>
> Source #19: Banking institution [Savings bank] DE, 2014

We argue that the case data supports a consideration of 'place-based' finance and spatial equity as a key form of energy justice, particularly important at the interface of energy transitions and finance. In this, we go beyond existing studies of energy poverty [45] or social investments [46] in several ways: First, finance may not only instigate or be entwined in vicious circles producing unjust results, but can also produce virtuous circles of local development. Second, the interviewee responses regarding inter-regional or inter-country distributional effects, indicate that there are different domains (governance, control, and financial returns) and processes (social acceptance) to be taken into account. Third, finance is part of spatial processes of recognition and empowerment (or the lack thereof).

The second additional category proposed is financial system resilience, and specifically whether investment in energy assets by

[9] Frome is a small town in the UK which has pioneered local resilience and sustainability initiatives, including decentralised energy developments. See http://transitionfrome.org.uk/9

alternative finance can make a given financial system more or less crisis prone. The role of energy finance in building system resilience was identified strongly by the UK alternative finance sector and energy investing was one productive avenue they had found to operationalise that wider goal:

> *"one other thing that's been healthy in the finance industry is all the challenger banks. I think everybody, I mean the Govermnent, and a lot of the general public, are pretty desperate to see the big four banks having much much less control over the country's finances."*
>
> Source #32: Founder, alternative finance platform UK, 2015

> *"…resilience for me starts with diversity, and I know it's very trite but, this 5 banks that are too big to fail and too big to jail, that is the fundamental driver of the opportunity for crowdfunding. I don't think we'd be here if it wasn't for 2008…"*
>
> Source #28: Alternative finance platform chair UK, 2015

This theme was less well developed in the German sample though one savings bank employee stated:"

> *"…to have a structure below, something local, something decentralised something that might even be there in the longer term and not be effected by the big winds blowing on the financial markets I think that's important. And it makes you a bit more independent".*
>
> Source #19: Banking institution [Savings bank] DE, 2014

This is not to say the German banking model is immune to crisis [77], yet the lower tier of the public banks (Sparkasse) and the co-operative banking network did not suffer in the same way as other financial institutions more dependent on international financial markets. Indeed the Sparkassen and cooperative models have been repeatedly analysed as a potential model to provide basic banking and SME business lending both as a long term solution to UK productivity problems and as a potential counter cyclical agent [78–81]. In addition, the goal of "preserving the diversity of actors" in the energy sector, which is at the heart of current discussions about institutional reforms, can be linked to the idea of resilience, even if this is normally not done by stakeholders and is only marginally touched on in our interviews.

We argue for financial system resilience to be included as a principle of energy justice when researching the interface of energy and finance. We concur with Polzin et al. [32] in arguing that a financial monoculture has the potential to expose energy investment to global boom and bust cycles. We propose that energy has the potential to play the opposite role. By linking energy policy to non-cyclical financial institutions such as savings banks or alternative finance platforms it could very well play a stabilising role as opposed to exacerbating future crises. We argue for this as a justice category in the same terms as the IMF [74], that financial sector stability can be seen as a global public good, or with the United Nations who see access to stable domestic finance as key to Sustainable Development Goal (SDG) 8 [82].

6. Conclusion

Trillions of dollars of international capital are unlikely to be sourced from one form of finance alone. It is likely that various mixes of state, commercial, and 'alternative' money capital will be required for low-carbon energy transitions. In this paper we have detailed these interrelations for two nations in order to understand which principles of justice are important to the interface of energy and finance. We asked: w*hat are the implications of the current finance system on just energy transitions?* And *what principles of justice could energy finance satisfy?*

We found that depending on the form of energy finance and its organising institutions that it can positively or negatively affect affordability, due-process, good governance, inter-generational equity, spatial equity, and financial system resilience. These are the 6 categories of justice most relevant to financing energy transitions.

This analysis shows that taking account of the variety of capitalism in each nation, and its attendant financial institutions can illuminate several ways in which these principles can be operationalised, from pursuing financial innovation through alternative platforms to expanding public or mutual banking provisions. Further work should explore how energy policy can be assessed against each principle, whether risk reduction clauses and mechanisms such as investment arbitration can be better theorised within energy justice, and how future energy policy which aims to attract new capital, can use these 6 categories to pro-actively pursue explicitly just outcomes.

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Appendix A. Supplementary material

Supplementary data associated with this article can be found, in the online version, at http://dx.doi.org/10.1016/j.apenergy.2018.04.007.

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