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Understanding the material dimensions of the uneven deployment of renewable energy in two Italian regions

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ABSTRACT

Drawing on empirical material from two Italian regions, we show how various material dimensions have affected the spatial distribution and deployment of renewable energy (RE), in particular solar and wind energy. The paper draws on an approach to the analysis of materiality originally developed in the extractive industries literature, including fossil fuels. The paper acknowledges that RE forms have significantly fewer material components compared with coal, oil and gas and the other extractive industries. Nevertheless, the deployment of RE, the process of turning renewable 'natural resources' into productive use as viable forms of energy through stages of energy conversion, storage, transmission and distribution has material aspects like those involved in the deployment of fossil fuels. This paper aims to show how understanding these aspects of renewable energy offers an opportunity to unpack and explain how particular RE paths come to be favoured or hampered, and yields useful insights into the spatial unevenness and variation of RE deployment at the regional level. Italy has introduced a system of renewable energy incentives and between 2010 and 2012 experienced impressive growth in the renewable energy sector. The paper shows how the significant spatial variation in renewable energy deployment in the regions of Apulia and Tuscany can be explained in terms of the influence that the material dimensions exercised in relation to renewable energy deployment processes. The paper suggests that understanding the material dimensions of renewable energy offers useful insights into how and why RE realises – and quite often fails to realise – its potential in specific forms, spaces and places.

1. Introduction

The deployment of renewable energy (RE) resources presents spatial variations that are not only influenced by the resources' characteristics but also by differing infrastructure endowments and other factors, including geographical, techno-economic, institutional and cultural factors [1]. Flows of renewable resources are thought to be immense in comparison with global human energy use [2], yet their deployment is widely and unevenly dispersed, because of the influence of such factors and their appraisal [3]. This spatial unevenness matters, has clear implications for social and spatial justice, and is integrally related to aggregate trajectories of energy decarbonisation.

Drawing on empirical material from two Italian regions, we show how various material dimensions have affected the spatial distribution and deployment of RE, in particular solar and wind energy. The paper draws on an approach to the analysis of materiality originally developed in the extractive industries literature, including fossil fuels. RE forms have significantly fewer material components compared with coal, oil and gas and the other extractive industries. Nevertheless, the deployment of RE, the process of turning renewable 'natural resources' into productive use as viable forms of energy through stages of energy conversion, storage, transmission and distribution through pipes, wires or other form of transport, has material aspects like those involved in the deployment of fossil fuels. This paper aims to show how understanding these aspects of RE offers an opportunity to unpack and explain how particular RE paths come to be favoured or hampered, and yields useful insights into the spatial unevenness and variation of RE deployment at the regional level. Addressing the material dimensions of the deployment of RE is an area that is under-researched (for exceptions see Refs. [4–6] in their discussion of the low carbon economy).

The importance of the material dimensions that influence RE are investigated and demonstrated here, drawing on empirical evidence from research conducted on two Italian regions, Apulia and Tuscany (in the southern and central area of Italy, respectively). Italy, following pressures from European and international regulation, has introduced RE deployment incentives in the form of subsidies and investment

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assistance. Generous incentives led Italy to experience impressive RE growth, especially in the PV and wind energy sectors. Italy ranked top worldwide in 2014, alongside Denmark, Spain and Germany, with the largest share of renewable electricity, due to unprecedented increases in PV installation and capacity.[1] Italian regions vary in terms of solar radiation, orography, climate, population, area and economic conditions and share responsibility for energy policies and RE with the Italian central government. Although regions have little influence on the nation-wide level of economic incentives applied to RE,[2] the distribution of installed RE capacity has varied significantly across regions. We argue that much of these differences can be explained by the direct or indirect influence of the material dimensions of RE on the deployment processes.

The aim of this paper is to show, with evidence from two Italian regions, how understanding the material dimensions of RE deployment can help analyse and explain the spatially uneven processes of RE deployment. The paper, therefore, has two objectives. Firstly, to explain how consideration of some of the material dimensions addressed by Bakker and Bridge [7], Bridge [8,9], Kaup [10,11] and others, and originally applied in the geographic resource extraction and fossil fuels literature, can help us identify and focus on those material dimensions that particularly influence RE deployment. Secondly, providing empirical evidence from Apulia and Tuscany, the paper demonstrates the importance of understanding the material dimensions of the deployment of RE and how this helps explain the spatial difference in the uptake of RE in Italy.

The paper proceeds as follows. In Section 2, we discuss arguments that address how the literatures on resource geographies and non-renewable resources, especially on mineral, oil and gas exploitation, have acknowledged the role of materiality in energy development. From this brief review, we suggest a number of material dimensions that also influence RE deployment and discuss how this occurs (Section 3). In Section 4, we introduce the empirical material and the research method adopted for the research. Section 5 discusses the results of the analysis, stressing how engaging with the different material dimensions can unpack how RE resources are- socially and materially- produced in geographically uneven ways. The paper concludes by suggesting that considering the socio-material characteristics of RE deployment is a valuable addition to research that focuses on the organisational and institutional issues of RE diffusion and deployment, helping explain its spatial unevenness at the regional but also potentially at other scales.

2. Material dimensions of non-renewable energy resource deployment

Before illustrating the material dimensions of RE deployment, we draw on some selected contributions from the literatures on resource geographies and non-renewable resources,[3] especially on mineral, oil and gas exploitation, that have addressed the complex material dimensions of non-renewable resources. This offers an opportunity to point towards some important material dimensions that, we argue, fossil fuels share with RE resource deployment.

As stated, fossil fuels present much broader material aspects than forms of RE. Nevertheless, bioenergy, which requires biomass feedstocks, and large hydropower and geothermal energy, for instance, all share some materialities with fossil fuels, which largely relate to the material extraction and/or processing of the resource. Yet, even solar and wind energy, while lacking such materialities, also present material dimensions, in particular those associated with processes of energy capture, conversion, transmission and distribution, including the physical infrastructures that support them. These material dimensions not only directly influence RE deployment potential but also interact with the ways in which these physical entities are socially constructed as exploitable energy resources through political-economic and cultural processes (cf. [12]). Our argument is that through such processes these material dimensions can and do influence the geographical deployment and dispersion of RE.

Resource and environmental geographers have mostly conceptualised nature in physical terms, traditionally focussing on improving the flow of resources ‘from’ nature ‘to’ society through the design of institutional and territorial frameworks for procuring and managing environmental goods and services [7,9].[4] Yet Bakker and Bridge [7] suggest that what counts as a resource depends on the interaction between its physical quality and condition (e.g. the variable grade/quality of mineral resources, for example) and social institutions. Referencing the material, they contend, is to acknowledge that ‘things other than humans make a difference in the way social relations unfold’ [7: 18]. In this sense, they continue ‘materiality matters because of the way its heterogeneity differentially enables, constrains and/or disrupts the social practices through which resource regulation is achieved’ [7: 21]. In other words, they acknowledge resources in dialectical terms as a combination of physical and discursive practices- a socio-natural phenomenon- that takes shape through interaction between the material/physical world and individual activities, institutional agendas and industrial forms of organisation.

Zimmerman’s dynamic concept of natural resources that vary over time and space is useful here. [13: 15] argues that ‘resources are not, they become: they are not static but expand and contract in response to human wants and human action’. Bridge [8: 416], in his account of the geography of mining investments, argues, for instance, that the size, location and value of mineral reserves are dynamic phenomena, products of both geological and mineralogical processes and a continual socio-economic re-appraisal of utility and value [9]. Changes in societal demands, in market prices and/or cost of extraction, exploration activity and/or the introduction of new technologies can create new reserves in places where, to all practical purposes, none previously existed [8].

Moreover, Bridge [14] (see also Ref. [15]) has also drawn attention to the materiality of production networks. Using the example of the oil industry, Bridge highlights the influence that materiality exerts on industrial organisations within it. He argues that the production chain of extractive industries is territorially embedded at different points. The industries’ materiality emphasises that the dependency on natural production, the location relative to markets, and the existing infrastructure limit the spatial flexibility of the network. Kaup [10: 1736] arrives at a similar conclusion, indicating that the ‘material difficulties of natural gas extraction and transport have shaped the structure of Bolivia’s natural gas industry’. The extraction and transport of natural gas requires much fixed capital and technological innovation in extraction and separation processes, pipeline construction and conversion. The requirement of capital, Kaup [10: 1737] argues, ‘has shaped the relationships between transnational extraction firms and the people and places in which natural gas is extracted’. Moreover, looking at the changing regulations and tensions surrounding Bolivia’s natural gas, Kaup [10] shows the importance of recognising how nature can be both materially manipulated and discursively constructed by a diversity of actors to disrupt and secure regimes of accumulation. He reinforces this in Kaup [11], arguing for attention to be paid on how actors’ positions

[1] The installed PV power in Italy was negligible until 2007. A series of feed-in-tariffs and good solar radiation favoured rapid growth.

[2] Solar feed-in tariffs were high enough to make a PV plant economically feasible even in the least insolated areas of northern Italy (cf. [48]).

[3] For reasons of space, we do not explore these debates in detail here. Hence, this discussion acknowledges but does not include important contributions such as those of political ecologists such as [16] and discussion around material politics (see for instance Refs. [54–56]) that have all discussed aspects of energy and materiality.

[4] This stands in contrast with much work in political ecology (e.g. see Refs. [57–59]) and the production of nature thesis, in which the mutual production of ‘society- nature’ relations has been central to research and analysis.

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