UNITED NATIONS UNIVERSITY
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WIDER Working Paper 2016/51

The legal configuration of hydrocarbon infrastructure

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May 2016

In partnership with

JISEA
Joint Institute for Strategic Energy Analysis

United Nations University World Institute for Development Economics Research
wider.unu.edu

Abstract: The United States' greenhouse gas mitigation strategy decentralizes mitigation responsibility to the states and states have primary regulatory jurisdiction over electrical power utilities. Using the biophysical approach, this paper introduces the notion of hydrocarbon infrastructure. Focusing on a utility rate case from the state of Wisconsin, I argue that the law and the electrical markets which it organizes presuppose hydrocarbon infrastructure. A necessary aspect of greenhouse gas mitigation and transition to renewable energy is a state-level reconfiguration of law and legal institutions around renewable energy generation.

Keywords: electric utilities, energy returned on energy invested, law
JEL classification: K1, L94

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This study has been prepared within the UNU-WIDER project on 'The Political Economy of Clean Energy Transitions'.

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ISSN 1798-7237 ISBN 978-92-9256-094-2

Typescript prepared by Sophie Richmond.

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The Institute is funded through income from an endowment fund with additional contributions to its work programme from Denmark, Finland, Sweden, and the United Kingdom.

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1 Introduction

Through its intended nationally determined contribution (INDC), the United States (US) has committed to reducing its greenhouse gas emissions by between 26 and 28 per cent in 2025 relative to a 2005 baseline. The US' commitment is founded solely on regulations promulgated by administrative agencies under existing statutory authority, including the Clean Air Act, the Energy Policy Act, and the Energy Independence and Security Act (UNFCCC 2016). These regulations include fuel-economy standards for various classes of vehicles, energy conservation standards for appliances and some commercial buildings, and, most prominently, carbon dioxide emission standards for new and existing electrical generating units (EGUs). The regulations for new EGUs are known as New Source Performance Standards (EPA 2015b) and those for existing EGUs, as the Clean Power Plan (EPA 2015a). The Environmental Protection Agency (EPA) promulgated both under the authority of the Clean Air Act.

In accordance with the Clean Air Act's 'cooperative federalism', the Clean Power Plan decentralizes the US' mitigation effort by setting emission targets for the individual states. The individual states are then to design a state implementation plan (SIP) which meets those emission targets. At present, then, whether the US successfully eliminates greenhouse gas emissions from its electrical power sector and transitions to clean energy or whether it backslides on its mitigation commitment is heavily dependent upon state policy and politics.

Greenhouse gas abatement touches almost every aspect of policy, and in this paper, I use a recent utility rate case from the state of Wisconsin to illustrate some of the political and policy difficulties states will confront during the transition to renewables. In this rate case, the state's largest privately owned utility, WE Energies, sought tariff rates which would have severely undermined the value of distributed photovoltaic (PV) energy production to the homeowner and thus the viability of the distributed photovoltaic industry in Wisconsin. The Public Service Commission of Wisconsin (PSCW) approved the rates and advocates of the renewable energy industry sued, winning a lower court decision reversing a portion of the tariff. The case docket and ensuing litigation strongly suggest an instance of agency capture and strategic rent-seeking. However, the danger that the US might backslide on its mitigation commitment is not alleviated merely by disciplining badly behaving monopolies through either more competition or more regulation. The conflict between hydrocarbon generation and renewable generation is not merely an economic one. Viewing it as such obscures more fundamental contradictions between the two types of technologies and underestimates the scope of legal reform required to mitigate and transition.

After detailing the salient aspects of the rate case which make it appear an instance of strategic rent-seeking, I analyse the electrical power utility from the biophysical point of view. The biophysical point of view, *inter alia*, incorporates the first and second laws of thermodynamics into its analysis of socioeconomics. The concept of energy returned on invested (EROI) is a corollary of the second law of thermodynamics, and allows us to identify three contradictions between hydrocarbon infrastructure and renewable infrastructure. Using examples from the rate case, we can then see how the law, legal institutions, and the legally organized markets for electricity are configured around and support hydrocarbon infrastructure.

As a general matter, then, for the US to transition to renewables and eliminate greenhouse gas emissions, law, legal institutions, and the markets which they organize must be reconfigured from a hydrocarbon infrastructure to a renewable energy infrastructure. This is a difficult task requiring technical expertise, creativity, and the development of well-entrenched, multi-state climate coalitions.

2 Strategic rent-seeking in Wisconsin

Wisconsin is situated on the west coast of Lake Michigan and the port city of Milwaukee is its largest. The early economy of Wisconsin revolved around agriculture and the extraction of its northern pine forests, the timber from which was transported either to Milwaukee or, more likely, to Chicago, from where it was exchanged for the grains from the fertile Midwestern plains. The area between Chicago and Milwaukee became a leading developer of tractor equipment. Along with timber, the farm equipment was shipped west to the farmers who used it to build up their homesteads and crop yields. This foundation, along with a railroad system and access to navigation over the Great Lakes, led eastern Wisconsin to develop into a classic Keynesian-Fordist economy—centralized manufacturing of raw materials with unionized labour and a fairly robust welfare state. The west of the state was and is agricultural (Cronon 1992; Hurst 1964). In line with the general trend in the US, during the 1980s, the Keynesian-Fordist economy in eastern Wisconsin began to deteriorate. A few silos of Keynesian-Fordist manufacturing remain in the vicinity of Milwaukee, and a remnant of both the timber industry and the Keynesian-Fordist economy is found in the paper and pulp mills of northern Wisconsin.

The law has organized the electrical power utilities in Wisconsin under three different forms: capital owned utilities, municipally owned utilities, and rural electrical cooperatives. WE Energies, whose 2015 rate case is the object of analysis here, is a capital owned electrical power utility (officially, 'The Wisconsin Electrical Power Corporation' or WEPCO doing business as WE Energies). It is also a natural gas distribution utility (WEGO) and files rates for Wisconsin Gas LLC (WG). It is presently owned by the holding company WEC Energy Group (WEC).

Prior to July 2015, WE Energies' electrical power division held two non-contiguous load territories within Wisconsin and a third which is partially in Michigan. WE Energies originated as a traction and light company in Milwaukee, The Milwaukee Electric Railway and Light Company (TMERL), and its southern territory thus radiates from Milwaukee to Shebogan to the north and over Racine and Kenosha to the Illinois border to the south (McDonald 1957; McShane 1970). It thus includes the three of the four largest cities in Wisconsin and the centre of the old Keynesian-Fordist economy. In the north, WE Energies' load territory extends north from Appleton, where the same interests which owned TMERL also operated a traction company (McDonald 1957; McShane 1970). The eastern edge of the northern load territory passes just to the west of Green Bay. In the far north, WE Energies also controls load territory which straddles the border with Michigan's Upper Peninsula, so that the corporation also operates under the jurisdiction of the Michigan Public Service Commission (PSCW 2015 Electric Service Territory Map).

In July 2015, WE Energies' holding company, formerly called Wisconsin Energy, completed the US$9.1 billion purchase of Integry Energy Group, at which point it became the 'WEC Energy Group' (WEC). The purchase included the Wisconsin Public Service Corporation (PSC) whose load territory includes Green Bay, large portions of north-eastern Wisconsin, and a small territory in the south-eastern portion of Michigan's Upper Peninsula. The western border of PSC's load territory abuts the eastern border of WE Energies' northern load territory. The purchase also included a natural gas utility which holds territory in the northern Chicago area, Michigan, and Minnesota, as well as a compressed natural gas services and facility design ('Trillium') (Content 2015).

According to the Energy Information Agency figures from 2012, WEC Energy Group's electrical utilities held load territory covering 35 million megawatt hours (MWh) of loads per year, about 25 million of which are WE Energies' and 10 million of which are PSC's (EIA 2012).

For comparison, the next largest investor-owned electrical utility, Wisconsin Power & Light, held load territory encompassing 10 million MWh of annual loads (EIA 2012).

During the unbundling period of the late 1990s and early 2000s, the Wisconsin utilities and other stakeholders organized the American Transmission Company (ATC). In exchange for an ownership stake, the Wisconsin utilities transferred control of their transmission assets (high voltage) to the ATC. With the purchase of the Wisconsin PSC through Integry, WEC Energy Group acquired a 60 per cent ownership share (Content 2015). WEC further owns a firm which builds electrical generating plants and then leases them back to WE Energies under the Leased Generation Act of 2001 ('We Power') and a firm which engages in commercial development ('Wispark').

Much of western Wisconsin is agricultural and is organized as rural electrical cooperatives, a legal form made available under the Rural Electrification Act of 1936 (Driscoll 2001). Along with rural electrical cooperatives from south-east Minnesota, north-east Iowa, and north-west Illinois, these cooperatives have organized themselves as the Dairyland Power Cooperative. Dairyland itself owns transmission and a number of generating assets, including a wind farm, several land-fill stations, and several small coal-fired boilers (Dairyland Cooperative Webpage 2016). The member cooperatives own the distribution systems and a number are now developing their own renewable energy generating resources (Hubbuch 2014). Development is in the early stages, but anecdotal evidence suggests that the cooperatives are leading the transition to renewables within Wisconsin.

Also of note, Wisconsin Public Power Inc. (WPPI) represents 51 municipal utilities throughout Wisconsin, Michigan, and Iowa. Each of the municipals operates its own utility while WPPI provides organization capacity not otherwise available to small municipals. WPPI owns a share of the Elm Road Generating Plant (Oak Creek), natural gas plants in Fond du Lac and Kaukauna, and other plants in Iowa and Minnesota (WPPI Webpage 2016).

WE Energies owns two large coal-fired generating plants. The Pleasant Prairie Plant is located in south-east Wisconsin, about 5 miles inland from Lake Michigan and just north of the Illinois border. Each of the two boilers is 595 MW. One began operating in 1980 and the other in 1985 (WE Energies Webpage 2016). The Oak Creek Power Station consists of two complexes. The first has four units put into operation between 1959 and 1967 for a total 1,190 MW. Beginning in 2005, WE Energies expanded the old plant with two additional boilers, each 615 MW which began operation in 2010 and 2011. The new unit is called the Elm Road Generating Station (WE Energies Webpage 2016).

The Valley Power Plant is located just west of downtown Milwaukee in the Menominee Valley, which used to host the city's industrial production and is now undergoing environmental restoration. The plant primarily provides steam to downtown Milwaukee, but also has 280 MW generating capacity. WE Energies recently converted the plant from coal to natural gas (WE Energies Webpage 2016).

The Port Washington Generating Station is a 1,150 MW combined-cycle natural gas plant. Its first and second units became operational in 2005 and 2008 (WE Energies Webpage 2016). The Presque Island Power Plant is located in Michigan's Upper Peninsula on the south shore of Lake Superior. Its coal-fired units began operation in the late 1970s and have a maximum combined capacity of 431 MW (WE Energies Webpage 2016). At the time of the rate case, WE Energies also owned several wind-farms, two natural gas 'peaker' plants, a heating and chilling plant in Milwaukee County (since sold), and a 50 MW biomass plant which provides steam to a paper mill in Rothschild, Wisconsin (WE Energies Webpage 2016).

On 31 January 2014, WE Energies filed a request with the PSCW to open a rate docket for the 2015 test year. The request revised rates extensively and included new tariffs for distributed generation (PSCW Case No. 5-UR-107).

As a general matter, for nearly all customer classes WE Energies proposed shifting its revenue collection from volumetric charges (per kilowatt hour (kWh)) to facility charges. For the small customer classes WE Energies increased the facility charge from US$0.30/day to US$0.52602/day (US$16.00 month) (PSCW 2014a: 35). WE Energies then computed the volumetric charge by 'dividing the remaining costs . . . by the total forecasted energy for these classes' (PSCW 2014a: 35). This reduced the volumetric charge by about 3.3 per cent, from 13.9 cents to 13.4 cents (PSCW 2014h: Appendix B).

For distributed generation, the most contentious component and the eventual subject of litigation, WE Energies offered five tariffs. COGS-NM (net metering) and COGS-NP (non-purchase) are of most interest to distributed PV. COGS-NM is for generation of up to 300 kW and COGS-NP is for generation of any size. They apply to both renewable and non-renewable generation (PSCW 2014a: 55).

The COGS-NM required the installation of two meters because 'the values from the two meters would be netted each billing period. If the customer's consumption exceeds the generation, the net will be billed to the customer at the customer's underlying retail rate' (PSCW 2014a: 56). WE Energies' former tariffs for distributed PV paid the distributor the retail price for exported power, but under COGS-NM, WE Energies would purchase the net export 'based on the Company's forecast LMP [locational marginal price], by season and time period, plus avoid transmission costs' (PSCW 2014a: 56). The LMP is the price of electrical power in the regionally organized wholesale market, adjusted at nodes to account for reliability, congestion, and line losses. As calculated by WE Energies, the seasonally average LMP is 4.2 cents/kWh (PSCW 2014b). For comparison, the old distributed generation tariff credited PV producers at the retail rate of 13.9 cents/kWh (13.4/kWh under the new tariff).

WE Energies also proposed increasing the facilities charge for the extra meter required by the COGS-NM tariff from US$1.41 per month to US$3.42 per month. The PSCW approved an increase to US$1.81 (PSCW 2014h: 70–1). Meters can be engineered to run backwards, so the second meter is required only by the differentiation in price between purchase (retail) and sale (wholesale). Further, the tariff altered the netting of imports and exports from annually to seasonally. Hence, under the new tariff summer exports would not be credited against a winter's imports.

The COGS-NP is for customers whose generation is unlikely to exceed consumption and who therefore agree to receive no payment for exports to the grid. Under the COGS-NP owners of PV avoid the extra facilities charge on the second installed meter.

Finally, and which became the subject of litigation, WE Energies proposed a demand charge in both the COGS-NM and COGS-NP tariffs. According to WE Energies' testimony, the demand charge 'will recover distribution costs that are not recovered by the facilities charge of the underlying rate' (PSCW 2014a: 56–7). WE Energies also stated that the demand charge is supposed to 'recover the costs of stand-by generation' (2014a: 57).

WE Energies based the demand charge for COGS-NM and COGS-NP upon the name-plate capacity of the installed generation. For customer classes which already have a demand charge built into their rate, the COGS-NM demand charge was waived (PSCW 2014a: 57). For intermittent distributed generation, WE Energies proposed a proportional reduction in the

demand charge because energy consumption from such customers 'during the time that the intermittent generation is not operating will at least partially offset the costs to serve them' (2014a: 57). The WE Energies rates also discounted for the efficiency of the inverter (2014a: 58). In sum, WE Energies proposed a non-intermittent demand charge of US$8.602/kW/month and an intermittent demand charge of US$3.794/kW/month (PSCW 2014c).

The new WE Energies tariff, then, would decrease the value of distributed PV to the owner of distributed PV in five ways. First, distributed generation owners would, like all residential customers, pay the increased customer-related facilities charge. Second, distributed generation owners would pay the facilities charge from the installation of a second meter. Third, the alteration in net metering from annual to seasonal reduces the ability of solar generation to spread its surplus generation over a longer period of time. Fourth, owners of distributed generation will be paid less for the energy they export to the grid because they will be paid at the wholesale rate rather than the retail rate. Fifth, owners of distributed generation must pay the new customer-related demand charge.

RENEW Wisconsin is a non-profit which advocates for the renewable energy industry in Wisconsin. They intervened before the PSCW and along with the Alliance for Solar Choice eventually filed suit against the demand charge. Michael Vickerman, RENEW's policy director, offered testimony on the economic impacts of the new tariffs to owners of PV. Excluding the generally applicable increase in the facilities charge, Vickerman calculated that for a 5 kW PV system installed in 2013 whose total annual output is equivalent to half of the resident's annual loads, the new tariff reduces the value to the owner by 35 per cent, from US$834 per year to US$542 per year. If the PV system is sized to cover 95 per cent of loads, it becomes more likely that production will exceed loads more frequently and that the new annual netting procedure and new export price would be applicable more frequently. Under this scenario, Vickerman calculated that the value of the PV to the owner drops 47 per cent, from US$834 per year to US$389 per year (PSCW 2014d: 20–2).

In other states, such as Minnesota, Maine, New York, and California, stakeholders are having a robust discussion on how to value distributed energy resources in a manner which facilitates the transition to clean energy, expands economic opportunity, and preserves the fiscal position of capital. Because the utility made no effort to engage the renewable energy stakeholders, because the PSCW voted against the recommendation of staff, and because the one (dated) study on the value of solar concluded it to be beneficial to WE Energies, this rate case seems a classic example of the sort of strategic rent-seeking which canonical economic thought instructs us to expect from monopolies (Kaiser 2014; PSCW 2014e: 27–32). In any case, the judge presiding over the legal challenge to the demand charge thought so. While discussing the evidence for the demand charge during an oral hearing, he commented that:

> [t]he strong impression that this Court has when we look at the evidence that was presented is … these are stories, but they're not empirical, and they happen to be stories spun by a company that is facing competition from the people who are now going to be paying these higher rates. So if these were our standards in most cases, let's hear the competitor tell us what his competitor is doing but without evidence, but without empirical evidence, we would expect it to be skewed. (*Alliance for Solar Choice v. Public Service Comm. of Wisconsin* 2015: 60).

At this point of the hearing, the judge's objection to the demand charge is merely economic and founded in the thin 'neoliberal' norm of competitive markets. Within the confines of the regulatory law from which the judge made his ruling, this norm is probably sufficient grounds for remanding the demand charge back to the PSCW to develop further evidence for its fairness.

In the next section, however, I argue that the conflict between hydrocarbon infrastructure and renewables is not merely economic. Rather, it is also buried in technological differences, social attitudes, ideology, and law and legal institutions. Hence, transitioning to renewables cannot be achieved merely by 'correcting market failures'. Rather, the law and legal institutions, as well as the markets which operate within that legal framework, must be reconfigured around renewable generation.

3 The biophysical approach and hydrocarbon's legal infrastructure

The biophysical approach incorporates the first and second law of thermodynamics into the analysis of socioeconomics. Here, we are interested in the second law of thermodynamics and its relationship to the legal regime which has arisen around and supports hydrocarbon infrastructure. The second law of thermodynamics states, roughly put, that without exogenous inputs of energy, a closed system become less organized, more random. EROI is one way to measure the exogenous inputs of energy into the socioeconomic system. EROI is 'the ratio of energy returned from an energy-gathering activity compared to the energy invested in that process' (Hall and Klitgaard 2012: 310). It is derived from the ecologist's practice of analysing the transportation of energy through trophic food webs. It is an indispensable concept for analysing the organization of society's productive capacities.

EROI for all fossil fuels declines over the history of the industry. In 1930, petroleum and gas had EROIs as high as 100:1, and perhaps higher. In 1970, the EROI of petroleum and gas was down to 30:1, and the EROI from contemporary tar sands extraction is as low as 2–4:1. At best, corn-base ethanol has an EROI of 3:1. In 1930, coal had an EROI of 80:1, which had declined to 30:1 by 1970. Hydropower retains a high EROI of about 100:1, while wind turbines have an EROI of about 18:1. Solar PV presently has an EROI of about 7:1, and some analyses show as high as 15:1. The EROIs for wind and solar, however, do not include the embedded energy of whatever devices, such as storage, might be needed for a renewable grid (Hall et al. 2014).

Prieto and Hall estimate that an EROI of 3:1 is required at the well-head merely to extract, refine, and transport the petroleum to the place of use. EROIs at the well-head must be of the order of 8:1 if one wishes the workers at the well to be able to support a family and as high as 12:1 if one wishes that family to have access to health care (Prieto and Hall 2013). Declining EROI ratios make societal activities which are high on the hierarchy of 'energy needs' (such as 'art') increasing difficult to achieve.

Scholars still dispute the appropriate boundaries for determining EROI, and data for many activities is unavailable or incomplete. However, neither the orders of magnitude nor the general EROI trend are contentious. The fossil fuels extracted during the twentieth century represented extraordinary high EROIs and show a continual decline. The best first principle from ecology suggests that hydrocarbon EROIs can be expected to decline further, and can be intuitively observed in Arctic petroleum drilling endeavours and other quests for 'extreme energy'.

On the other hand, since renewable generation is in its infancy, there is an expectation that their net-energy ratios will improve. The EROIs on both wind and solar PV, for instance, already exceed that of tar sands. Whether renewables will be able to obtain ratios high enough to support their own expansion remains open, especially at the rate required to avoid disastrous global warming. Less likely still is that renewable generation will be able satisfy the consumption norm which organized the US' productive capacities during the previous century of high EROI hydrocarbons.

From EROI we may introduce the notion of hydrocarbon infrastructure, which is infrastructure which is possible and useful only when high EROI hydrocarbons are available. The electrical power utility in the US is a paradigmatic example of hydrocarbon infrastructure. The electrical power industry, however, is not only an organization of technology and human capacity. It is also a legal apparatus, which responds to and is configured by the biophysical aspects of hydrocarbons. As such, the electrical power utility has two critical relationships to the depletable reservoir of high EROI hydrocarbons. First, it is the apparatus through which that depletable store is converted from a use-value to an exchange-value. Second, it is parasitic upon that same depletable store.

First, the primary use-value of hydrocarbons is found in their chemical bonds. The bonds represent both a store of energy (heat) and an arrangement of atoms from which a substance may be made. For the hydrocarbon's use-value to be realized as an exchange-value, the use-value must be made social by bringing it to the market, as the metaphor goes. At the market, other members of society may access the hydrocarbon's use-value by exchanging it for some other use-value. The exchange is not, of course, completed by bartering use-values, but through the exchange of the money commodity, that is, currency. In the case of the electrical power utility, the use-value of the hydrocarbon (heat) is converted to a commodity (the kWh) through processing by an extensive number of technological devices. With a monthly bill, the 'customer' then exchanges that kWh for currency. The currency is thereby brought under the legal control of the utility, which then dispenses that currency to different social interests, that is, to capital in the form of dividends and coupon payments, to labour in the form of wages, to politicians in the form of campaign contributions, and so forth.

To further illustrate the utility's power over the dispensation of the use-value of high EROI hydrocarbons, consider the cost of service study (COSS) which WE Energies used in the recent rate case. Electrical power utilities serve a variety of customer types, typically residential, commercial, and industrial. The utility incurs costs in delivering electrical power to these different classes, but because all customer classes are reliant upon the same grid, a method is needed to assign those costs to the different customer classes. Once the costs are assigned, the rate paid by the different customer types can be calculated. A COSS assigns costs across customer types and a great number of methodologies are available.

The Citizens' Utility Board (CUB) submitted testimony opposed to WE Energies' requested rates. One of their objections was that while in previous rate cases, WE Energies had used various COSS methodologies and then assigned costs and rates by comparing and weighting the different outcomes of the different methodologies. In this case, however, the CUB noted that WE Energies used only a single COSS methodology known to assign costs disproportionately to residential rate payers as compared to commercial and industrial rate payers (PSCW 2014f: 11). In disproportionately assigning costs of service to residential customers, the CUB argued that WE Energies was concurrently assigning to the residential rate class a disproportionate responsibility for paying those costs as compared to the commercial and industrial rate classes. There was dispute over the CUB's testimony, but the point here is that, through the COSS, the utility exercises the power to assign the benefits and costs of hydrocarbon's use-value to different social interests.

Second, the electrical power utility could not exist or perpetuate itself in the absence of the reservoir of high EROI ancient sunlight and is, therefore, parasitic upon it. The various devices which transform the chemical bonds of the ancient sunlight into heat, steam, mechanical motion, and then an electrical current represent very large magnitudes of embodied energy. Those physical devices include not only the turbines, transformers, and conductors but also the steel rails over which the coal is transported to the plant. Without access to the high EROI reserve of

ancient sunlight, the devices which convert that sunlight into a current could not themselves have been brought into being.

In sum, the electrical power utility, then, is a legal apparatus which is both parasitic upon the depletable reserve of high EROI ancient sunlight and realizes the use-value of that ancient sunlight and channels its benefits and costs to various segments of society.

4 Three contradictions and the configuring legal apparatus

Renewable energy infrastructure and hydrocarbon infrastructures both involve a myriad of technological devices. Here, however, I focus here on the biophysical characteristics of coal-fired and distributed PV generation. These two types of generation were central to the rate case and also show distinctly the contradiction between the legal regime which has arisen around hydrocarbon infrastructure and that which must be constructed around renewable infrastructure. Other types of renewable and hydrocarbon generation, along with their attendant grid infrastructure, might have a mix of or different biophysical characteristics than those of coal and distributed PV. This overlap of characteristics means they will play an important part of the transition away from hydrocarbon generation and to renewable generation, but that role is not discussed here.

4.1 Efficiency logics and territory

The efficiency logics of coal-fired and distributed PV generation are different, which manifests in different relationships with territory.

Coal's (formerly) high EROI means that it can be combusted at a perpetual high heat, and thus produce a perpetual high voltage. To match this perpetual high voltage, hydrocarbon generation needs loads which are temporally disbursed. In this way, the turbine can be perpetually turning as near to capacity as possible. Hence, utilities developed loads by, for instance, giving away appliances and through construction projects. The amusement park, for instance, was a creature of the utilities meant to provide the turbine with an off-peak load (Nye 1992: 122–32). Recall also that the WEC holding company owns a commercial developer. These temporally dispersed loads are also physically separate from each other, so to bring them under their dominion, the utility must acquire and retain control of the territory in which those loads are located. In the US this was accomplished through the law and, during the formative years of the industry, the utilities convinced states to transfer to them certain powers of sovereignty, including exclusive franchises over territory, eminent domain, limited negligence liability, and access to premises (Hempling 2013: 15–34 [territory], 57–8 [eminent domain], 61–3 [liability]; Wisc. Statutes 1983).

In contrast, distributed PV is intermittent and produces low voltages. The perception of intermittency is conditioned by a century's access to hydrocarbon infrastructure, but nevertheless counsels confining loads to the time and wattage of generation. Since voltage deteriorates linearly over a conductor, low voltages do not travel far. Hence, the efficiency logic of distributed PV is to bring loads both physically and temporarily proximate to the generation and to minimize or eliminate all other loads. This is almost the exact opposite of the efficiency logic of hydrocarbon generation. Hence, distributed PV does not require the control of territory or the gifting of toasters. It does, however, require legal protection against shading as well as the authority to enter so as to remove that shading, or, at the least, the upper hand in negotiating over the prevention and removal of shading. Hence, in 1982 the Supreme Court of Wisconsin considered whether a homeowner had cause of action against a neighbour whose trees shaded the homeowners solar thermal water heater. Building off of the common law's Doctrine of Ancient

Lights, the Supreme Court of Wisconsin found that the homeowner could bring a nuisance suit over the shading and the Wisconsin legislature then codified the ruling (*Prah v. Maretti* 1982). Likewise, to receive an incentive payment from the state's solar incentive programme, a homeowner must show the installed PV system will have '10 percent or less obstacle shading' (Focus on Energy 2016).

4.2 Decommodification and jurisdiction

Under a hydrocarbon infrastructure, the utility is the 'producer' of a commodity, the kWh, and the homeowner is the 'consumer' of that commodity. The utility produces the kWh to maximize its exchange-value, not for its use-value, which is incidental to the utility.

In contrast, for distributed PV, the 'consumer' and the 'producer' are either the same entity or is a distinction which no longer provides a felicitous description of socioeconomic reality and should be replaced. For distributed PV, the kWh is not brought to the market as a means of realizing its exchange-value by swapping it for the money commodity. The current is generated for its use-value, and its exchange-value is incidental to the homeowner. Distributed PV, then, represents the decommodification of a critical aspect of human well-being (power, heat, and light) which the utilities had formerly commodified (Nye 1993: 234).

However, the legally organized electrical power 'markets' are configured around electrical power as a commodity which utilities generate for its exchange-value. For instance, in the wholesale electrical power markets, the unit of exchange is the MWh. From the point of view of distributed PV, this is to configure the markets around the exchange of a commodity of the wrong order of magnitude.

The law of jurisdiction, as scribed in the US Constitution itself, configures both the retail markets and the wholesale markets which have commodified electrical power. Early in the development of the electrical power industry in the US, a detente was reached between municipal ownership and capital ownership of utilities. The law acknowledged that capital owned utilities as monopolies (supposedly 'natural') in exchange for having a state public utility commission regulate rates so as to be 'just and reasonable'. Wisconsin was one of the first states to legislate this arrangement (Nord 1975).

The power industry's construction of transmission across state lines disrupted the detente. In the early 1920s, Narragansett Electric Light Company, located in Rhode Island, entered into a contract with the Attleboro Electric Steam Company, located in Massachusetts, to supply electrical current. As required by law, the Narragansett Company then filed the rate schedule contained in the contract with the Rhode Island Public Utilities Commission (PUC), which accepted it. Several years later, the Narragansett attempted to revise the contract through a proceeding before the Rhode Island PUC, claiming that, because of increased generating costs, it was suffering an operating loss. The Rhode Island PUC agreed and revised the rates accordingly. The Attleboro Electric Steam Company filed suit against the Rhode Island PUC for its approval of the new rates, and the parties appealed the case to the Supreme Court of the US. The Supreme Court found that the current crossing the state boundary separating Rhode Island from Massachusetts was interstate commerce. The Supreme Court then ruled that the commerce clause of Article I, Section 8 prohibited the Rhode Island PUC from exercising jurisdiction over the transaction between Narragansett and Attleboro. It further concluded that jurisdiction over interstate transactions of electrical power was reserved to the federal government (*Public Utilities Commission of Rhode Island et al. v. Attleboro Steam & Electric Co.* 27 U.S. 83 (1927)). In response, the Congress passed the Federal Power Act which assigned to the Federal Power Commission jurisdiction over 'the transmission of electric energy in interstate commerce and to the sale of

electric energy at wholesale in interstate commerce' (Federal Power Act § 201, codified at 16 U.S.C. §824(b)(1)).

Hence, out of the Supreme Court's interpretation of the commerce clause, there emerged a regulatory framework in which the federal government, through the Federal Power Commission (now the Federal Energy Regulatory Commission [FERC]) regulates the interstate wholesale electrical power industry while states regulate the intra-state retail side of that industry. Accordingly, during the restructuring period of the mid 1990s, through a sequence of orders, the FERC coaxed the regional wholesale markets into being and now supervises them to ensure that rates are 'just and reasonable' (see FERC Orders 888, 889, 890 [FERC 1996a, 1996b, 2007]). Those wholesale markets entrenched existing hydrocarbon infrastructure, including both generating assets and high-voltage transmission.

Recent litigation over FERC orders requiring the organized wholesale markets to allow the participation of demand response in those markets illustrates the entrenchment. Voltage and loads must be perpetually and instantaneously matched. As initially configured, the wholesale markets achieved that matching by increasing generation rather than by reducing load. In those markets, load-serving entities (LSEs, i.e. distribution utilities) submit their projected daily demand to the market, usually a day ahead and for durations of an hour, although each regional wholesale market configures its own market and there is variation among them. Generators then submit their generation bid for those same time increments. All trading takes places in dollars per MWh. Generator bids are stacked in order of price, and the next least cost bid required to meet the demand is assigned the clearing price. The clearing price is adjusted for reliability, congestion, and line losses at particular nodes in the grid, producing the LMP. The LMP is then paid by all LSEs and received by all dispatched generators.

Into this configuration of the wholesale markets, FERC Order 719 (FERC 2008) required market organizers to allow demand side management (DSM) to participate in the bidding. FERC Order 745 (FERC 2011) further established the mechanism for compensating DSM. According to a 2009 FERC study (FERC 2009: x), DSM could reduce peak load by up to 150 GW nationally, something many generators were not interested in, and the Electrical Power Supply Association (EPSA) brought a suit. EPSA claimed that Orders 719 and 745 exceeded FERC's jurisdictional authority because DSM fell on the retail side of the jurisdictional divide. The appellate court agreed: '[d]emand response—simply put—is part of the retail market. It involves *retail* customers, their decision whether to purchase *at retail*, and the levels of *retail* electricity consumption' (*EPSA v. FERC*, 753 F.3d 216, 223 (D.C. Cir. 2014), emphasis in the original).

The Supreme Court reversed the appellate court on the grounds that DSM 'directly affects wholesale rates' and has not 'regulated retail sales' (*FERC v. EPSA*, 136 S. Ct. 760, 733, 577 U.S. __, 14 (2016)). Nonetheless, esoteric matters of legal jurisdiction continue to configure the organized markets around pre-existing hydrocarbon infrastructure. As legally organized, generation of MWh which are transmitted over high-voltage conductors is the reference position for the organized wholesale markets. Other techniques for managing electrical power management have no jurisdictional home. Consider, for instance, that under the appellate court's rationale in *EPSA v. FERC*, the exported generation from distributed PV would likely be considered a retail commodity just like DSM, but that under the COGS-NM tariff, WE Energies compensates exported energy at the wholesale rate. The Supreme Court's ruling in *FERC v. EPSA* disturbs that jurisdiction configuration, but does not alter it. Especially given the mechanism by which DSM providers are to be compensated (from the LSEs in which the DSM is located), *FERC v. EPSA* likely marks an important aspect of the US' transition to renewables. It does not by itself, however, reconfigure those markets around renewables generally or distributed PV specifically.

4.3 Guaranteeing and disciplining capital

The devices which compose the electrical power utility, such as the turbine, represent large magnitudes of embedded energy. The initial financial capital required to construct those devices is therefore also large and requires long payback periods. Financial capital is subject to many risks over these long periods. To facilitate capital formation, states guarantee capital's return on investment (ROI). Indeed, in *Missouri ex rel. Southwestern Bell Telephone Co. v. Public Service Commission* (262 U.S. 276 (1923)) the Supreme Court interpreted the Fifth Amendment's Taking Clause to require financial capital's ROI to be large enough to preserve a utility's fiscal position. This primacy of capital is illustrated by WE Energies' rate case. In its final ruling, the PSCW began its decision by settling on the appropriate return on equity (ROE) which capital was to receive. In this instance, PSCW staff facilitated negotiations between WE Energies, the CUB, the Wisconsin Industrial Energy Group, and the Wisconsin Paper Council. They agreed to reduce WE Energies' proposed ROE from 10.4 per cent to 10.2 per cent. From this prioritization of ROE, WE Energies' revenue requirements were then calculated, and from that how much the utility was to collect from ratepayers (PSCW 2014g: 3, 2014h: 17–20).

In contrast, each individual distributed PV requires a small fiscal outlay and the payback period is comparatively short. As compared to hydrocarbon generation, then, risks to capital are greatly reduced. Nonetheless, relative to the pocketbook of the PV owner, the capital outlay for distributed PV might yet be substantial. Further, transitioning to a renewable energy infrastructure will require capital outlays of the same order of magnitude as a business-as-usual scenario over the coming decades. Some state-recognized financing mechanism, then, is needed to facilitate and discipline capital formation towards investments in renewables.

A third-party installer arrangement is one such mechanism. Under such an arrangement, the installer finances and installs the distributed PV system, and the installer and the homeowner then share the economic benefit of the homeowner's reduced power costs. However, the installer appears to be selling kWh to the homeowner and ambiguity exists as to whether, as a matter of law, the third-party installer should be classified as a utility subject to PSCW regulation. This legal ambiguity exists in Wisconsin, and appears to be preventing the formation of a third-party installer industry. In its rate case, WE Energies solicited a prohibition on third-party installers by seeking a requirement that distributed generators own their own equipment (PSCW 2014a: 60). The PSCW rejected WE Energies' proposal, but without resolving the ambiguity about the legal status of third-party installers (PSCW 2014h: 89). The laws of finance remain configured around hydrocarbon generation.

5 Conclusion: rents, law, and the danger of reactionary politics

From the merely economic point of view, WE Energies' rate case is an instance of strategic rent-seeking. However, when we view the electrical power utility as a paradigmatic instance of hydrocarbon infrastructure composed of technological devices, human capacities, and a supporting legal apparatus, we discover more substantive contradictions between distributed PV and coal-fired generation.

The utility's legal apparatus is configured around the biophysical characteristics of high EROI hydrocarbons, coal in particular. Hydrocarbon generation tends towards a centralized legal configuration which exercises sovereign functions over an exclusive territory, which is the 'producer' selling a commodity to a 'consumer', and which has the state secure capital's fiscal position over long periods of time. Distributed PV generation, in contrast, implies a tendency towards physically and temporally confining loads to the proximity of generation, represents the

decommodification of an important part of life (heat, light, and power), negates the distinction between 'producer' and 'consumer', and requires the state to support a different type of capital formation and discipline.

These biophysical differences, of course, are both tendencies and extreme limits. They are not 'natural' and their existence and perpetuation requires constant effort. The utility's monopoly over territory, the commodification of the kWh, and the state's preservation of capital's fiscal position were all earned by shrewd manoeuvring during the industry's formative years. The utilities, for instance, used differential rates between residential and industrial customers to undercut industries' self-generation, and installed snake lines to strategically service otherwise unprofitable communities so as to undercut the political impetus for municipal ownership in these communities (Nye 1992: 316). During the initial years, it was unclear as to what, exactly, the utility was selling and whether electrical power ought to be classified as labour, capital, a raw material, or a service (Nye 1992: 234). Hence, the legal apparatus now aggregated around hydrocarbon infrastructure is not merely a formal recognition of facts on the ground, but participated and continues to participate in bringing those facts into existence. In this regard, as in so many others, the law is performative, calling into being institutions and modes of living. To complete the transition to renewables, the law and legal institutions must similarly be configured around and bring into existence renewable generation and infrastructure, the nucleus of which is just now forming.

We can reach some ancillary conclusions. First, the task of transitioning to renewables in the US is not merely one of pricing carbon or finding the right level of subsidization of renewables. While these benefit the transition, they continue to operate under the conceit that greenhouse gas emissions are a 'market failure' which needs 'correcting'. Markets and the law which constitutes them are always and everywhere brought into being around certain assets and to the benefit of particular interests. To transition to renewables, then, law and the markets the law structures do not so much need to be 'corrected' as configured around renewables generation in the first place.

Second, such a legal reconfiguration is a large task, and we can expect uneven progress among the states. States now fortunate to have climate-conscious leadership will reconfigure their law to effect the transition, and those states presently unlucky enough to lack such leadership will find themselves trailing in the transition. Wisconsin, for instance, has not only joined with 25 other states in filing *ultra vires* suits against the Clean Power Plan, but as of April 2016 was the only state not developing an SIP. Even considering the extreme emission reductions now required to avoid catastrophic global warming, such an uneven transition might be tolerable, so long as the laggard states are unable to exercise control over the federal government.

Here, then, is a major concern as to whether the US will uphold its mitigation commitments or, as is required, enhance them. In a few states public service commissioners are elected directly, but in most states they are appointed by the governor and confirmed by the legislature. To continue to enjoy friendly decisions from commissions, utilities will need to support friendly state-elected officials. It is likely that over the coming years the 'honest climate change denier' will fade from American politics and climate denialism will become embedded solely and deeply in reactionary ideology. The danger is that in supporting candidates hostile to distributed PV, utilities will facilitate the organization of state-level reactionary power cliques. Since the Senate and the governor's house are the nursery of presidents, these reactionary power cliques could come to control the federal government. Part of the US' success in mitigating emissions and making the transition to renewables, then, is dependent upon state-level transitions which develop a bi-partisan climate-conscious coalition sufficiently entrenched to quarantine climate reactionary cliques to their own states.

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