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From a fossil towards a renewable energy regime in the Americas?
Socio-ecological inequalities, contradictions and challenges for a global bioeconomy

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From a fossil towards a renewable energy regime in the Americas? Socio-ecological inequalities, contradictions, and challenges for a global bioeconomy

Abstract

Drawing on political-economic insights from Political Ecology, complemented with the global perspective of world-systems analysis, this paper sheds light on the energy landscape in the Americas. The analysis focuses on the socio-ecological inequalities and conflicts shaping past and current struggles over fossil and renewable energy projects. Given the growing importance of renewable sources, this paper discusses the extent to which the Americas' changing energy mix is a starting point for the transition away from the dominant fossil energy regime. Moreover, the paper also explores how the existing socio-ecological inequalities are being redefined or challenged in this transitional process. In contrast to fossil energy, renewable sources could enable decentralised, sustainable and just systems of energy production and consumption. However, they are not predetermined to do so. Renewable energies can also reproduce the status quo of the dominant fossil energy regime and trigger new societal conflicts. To develop this argument, the paper provides an overview of the energy mix and the unequal landscape of energy production and consumption in the Americas, while at the same time situating the region in a global context. Eight snapshots are then provided to demonstrate the historically unequal contexts in which fossil and renewable energy projects are implemented in the Americas. The analysis reveals the social relations of struggle and resistance underlying these projects as well as the crosscutting persistence of the fossil energy regime and its interconnection with regional and local socio-ecological inequalities. Understanding these issues is a prerequisite for the discussion and implementation of energy transitions in a global bioeconomy.

Biographical note

Maria Backhouse is a professor of sociology and director of the Junior Research Group Bioeconomy and Inequalities funded by the German Federal Ministry of Education and Reseach (BMBF). Her current research engages with political ecology, knowledge and technology, social-ecological inequalities, bioenergy with a regional focus on Brazil.

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Keywords: Bioeconomy, energy, fossil fuels, social inequalities, renewable energies, asymmetries, socio-ecological conflicts

Maria Backhouse, Fabricio Rodríguez, Anne Tittor

Vom fossilen zum erneuerbaren Energieregime in den Amerikas? Sozial-ökologische Ungleichheiten, Widersprüche und Herausforderungen für eine globale Bioökonomie

Abstract

Ausgehend von den politisch-ökonomischen Erkenntnissen der Politischen Ökologie und ergänzt mit der globalen Perspektive der Weltsystemanalyse, beleuchtet das vorliegende Workingpaper die Energielandschaft in den Amerikas. Die Analyse konzentriert sich auf die sozial-ökologischen Ungleichheiten und Konflikte, die die vergangenen und aktuellen Kämpfe um fossile und erneuerbare Energieprojekte prägen. Angesichts der wachsenden Bedeutung erneuerbarer Energien wird in diesem Papier diskutiert, inwieweit der sich ändernde Energiemix in den Amerikas ein Ausgangspunkt für den Übergang weg vom dominanten fossilen Energieregime ist. Außerdem wird gefragt, wie die bestehenden sozial-ökologischen Ungleichheiten in diesem Übergangsprozess neu definiert oder in Frage gestellt werden. Im Gegensatz zu fossilen Energien können erneuerbare Energien dezentrale, nachhaltige und gerechte Systeme der Energieerzeugung und -nutzung ermöglichen. Sie müssen es aber nicht. Erneuerbare Energien können auch den Status quo des vorherrschenden fossilen Energiesystems bestärken und neue gesellschaftliche Konflikte auslösen.

Um diese Fragen beantworten zu können, gibt das Papier einen Überblick über den Energiemix und die ungleiche Energieerzeugung und -nutzung in den Amerikas und stellt die Region gleichzeitig in einen globalen Kontext. Acht Momentaufnahmen zeigen dann die historisch ungleichen Zusammenhänge, in denen fossile und erneuerbare Energieprojekte in den Amerikas umgesetzt werden. Die Analyse zeigt die sozialen Beziehungen und gesellschaftlichen Auseinandersetzungen, die diesen Projekten zugrunde liegen. Dabei wird die übergreifende Beharrlichkeit des fossilen Energieregimes und dessen Verbindung mit regionalen und lokalen sozial-ökologischen Ungleichheiten deutlich. Das Verständnis dieser Fragen ist eine Voraussetzung für die Diskussion und Umsetzung von Energiewandlungsprozessen in einer globalen Bioökonomie.

Kurzbiographien

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Schlagworte: Bioökonomie, Energie, Fossile Energien, Erneuerbare Energien, Soziale Ungleichheiten, Asymmetrien, sozial-ökologische Konflikte.

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1 Energy transition in the Americas

As global warming advances, there is no doubt that a transformation of the dominant fossil energy regime is much needed. With the objective of meeting this challenge, governments and supranational institutions are making significant efforts to expand the use of renewable energies — from biofuels and wind power to hydropower. Key discourses on a global scale are the Sustainable Development Goals (SDGs), primarily goal 7 "affordable and clean energy" as well as the societal transformation narratives of the green economy in the context of the Rio Summit in 2012 and of the bioeconomy. The bioeconomy was first introduced as a political programme by the policy paper "The Bioeconomy to 2030. Designing a Policy Agenda" by the OECD (2009) and disseminated by the policy frameworks of the European Union (EU) (2012; 2018). In recent years, several think tanks, governments and supranational organisations have released strategies on the transition towards the bioeconomy.

Definitions of the bioeconomy vary — from the focus on biotechnologies (US) to the substitution of fossil fuels for biomass sources (EU). The common political goal of these strategies, however, is the promotion of green growth to mitigate the current socio-ecological crisis, with climate change being a central problem. While bioenergy — fuels, heat or power based on biomass — is treated by the OECD and the US as just one of many topics, for many national and supranational bioeconomy policies, it is a crucial pillar, as is the case in the EU, Brazil or Argentina, for example (Backhouse et al. 2017: 20; Kleinschmit et al. 2014: 403). The Biofuture Platform (BfP), which is a government-led, multi-stakeholder forum created at the 22nd Conference of the Parties (COP22) to the United Nations Framework Convention on Climate Change (UNFCCC) in Marrakesh, 2016, is a case in point. Launched on the initiative of the Brazilian Government, BfP brings together 20 different states, "which are either already leaders in the new advanced bioeconomy or interested in its development" (Biofuture Platform 2018: 13). One of the key concerns of the BfP is the question of how to expand the production of bioenergy as a way of securing the decarbonisation of the global energy mix with a particular focus on the transport sector.

In contrast to fossil energy, renewable energies *could* indeed enable decentralised, sustainable and just energy production and consumption systems, as argued by Markus Wissen (2016). However, they are not predetermined to do so; they could also reproduce the status quo of the dominant energy regime and trigger new societal conflicts (Backhouse/Lehmann 2019). In line with the work of Patrick Kupper, we conceptualise energy regimes as social configurations of energy production, distribution and consumption, which are stable for a longer period (Kupper 2017). Since the end

of the 19th century, the dominant energy regime has been based on fossil fuels, particularly oil and coal.

In fact, renewable energies are not implemented in ahistorical vacuums but rather within specific pre-existing historical contexts shaped by global, regional and local inequalities. As this paper later shows, in comparison to other world regions, the Americas show a comparatively high share of renewables in the overall energy mix. At the same time, the region is characterised by high levels of social inequality within and between countries. Despite the increasingly dynamic development of the renewable energy sector, there is limited evidence for any real transition away from the dominant energy regime and its connection with global inequalities. As this study of the Americas shows, rather than replacing the fossil basis of social reproduction, renewable energy is actually contributing to the diversification of the prevalent energy regime, if not sustaining it. At the same time, the change to renewable energy resources can also deepen social inequalities especially with regard to land access on the local and regional level.

This paper elaborates this argument based on political-economic insights from Political Ecology complemented by the global perspective of world-systems analysis (Wallerstein 2007). In Section 2, the analytical standpoint underpinning the paper is developed. Section 3 provides an overview of the current landscape of energy production and consumption while at the same time situating the Americas in a global context. With the aim of sketching past and current configurations in the energy sector in the Americas, Section 4 presents eight snapshots illustrating first, the rise and the dynamics of the conflicting and contested facets of the fossil energy regime and second, the contradictions of renewable energy projects in the Americas. Section 5 concludes by tying the main insights together and discussing the socio-ecological challenges of any political project working towards the sustainable transition of a society's energy basis in the context of the emerging bioeconomy. The article is comprehensive but not exhaustive. It is comprehensive inasmuch as it covers the full spectrum of energy sources shaping socio-ecological inequalities in the Americas. However, the scope of the argument is limited to the insights drawn from the selected snapshots and grey literature on the most iconic and controversial projects in which energy and inequalities are visibly at stake in the specific context of the Americas.

2 Energy and socio-ecological inequalities: Insights from political ecology and world-systems analysis

Etymologically the word "energy" is a Greek compound of *ev* (in) and *ergon* (work or activity), probably invented by Aristotle (Smil 2008: 2). He gave the concept *energeia*

a kinetic meaning as he stated that every object´s existence was maintained by energy. From this perspective, energy signifies motion, action, work and change. For nearly two millennia, "energy" was a philosophical generalisation, and there appeared to be no serious intention of conceptually redefining it. Yet, the energy challenges of everyday life led different societies to develop a wide range of technologies. Not only humans and animals, but also machines driven by water and wind contributed to the 'energising' of societies. The concept of energy, as it is widely understood today, originated in Europe and dates back to the 19th century. In Smil's words:

> "Energy is not a single, easily definable entity, but rather an abstract collective concept, adopted by nineteenth century physicists to cover a variety of natural and anthropogenic (generated by humans) phenomena. Its most commonly encountered forms are heat (thermal energy), motion (kinetic or mechanical energy), light (electromagnetic energy) and the chemical energy of fuels and foodstuffs" (Smil 2006: 8f.).

When we refer to Political Ecology, we are aware that this is not a single field or coherent theory but a useful perspective to study the reciprocal relations between society and nature, which are encapsulated in the adjective "socio-ecological". Drawing on different schools of theory, including Marxism and Poststructuralism among others (Escobar 2008; Robbins 2010; Leff 2015; Alimonda et al. 2017), Political Ecology seeks to politicize nature by examining the social relations undergirding environmental destruction (Peet et al. 2011: 15f.). From a political-economic perspective, within Political Ecology, the modern, rather technical definitions of the energy concept are only one part of the story. As Larry Lohmann and Nicholas Hildyard argue: "Energy … is among those ubiquitous contemporary 'keywords' that, as the British cultural critic Raymond Williams once put it, seem to be 'mere transparencies, their correct use a matter only of education'. Like many other modern abstractions such as 'resource', 'nature', 'development', … and 'education', they seem neutral …" (Lohmann/Hildyard 2014: 25). Hence, as argued in this paper, an in-depth understanding of energy must emphasise its inherent social relations, which are also embedded in global social inequalities.

The political-economic perspective of Political Ecology requires a specific understanding of materiality: In this perspective, nature is not a mere expression of social relations, and neither is society determined by nature. Consequently, natural resources such as wood or oil have a specific physical quality or materiality, which influences societal relations of energy production and distribution (Görg 1999). As Timothy Mitchell argues in his work on the intersecting histories of coal, oil and democracy, the physical materiality of energy resources were an important factor in favouring and/or impeding the development of democracy in the 20th century (Mitchell 2011). In his view, the physical qualities of oil, namely high concentration of energy, lightness and fluidity, made it feasible for it to be transported by large corporations via pipelines and ships.

In comparison to coal mining, oil requires a much smaller, globally dispersed workforce, which made transnational distribution systems less vulnerable to strikes and other forms of labour struggles (ibid.).

Nevertheless, social relations and developments are not determined by the physical materiality of natural resources; rather they are intertwined phenomena. According to political-economic insights on materiality, human beings have to appropriate nature via work in order to reproduce their conditions of existence. This process of appropriation is a societal process and, in the context of the emergence of capitalism, is structured by specific forms of labour (e.g. waged labour), a new labour market, and a new (global) division of labour. However, this societal process of appropriation of nature is contested and can be changed (ibid.). The specific societal relations of energy production and consumption are shaped but not determined by capitalist relations. This is why renewable energies *can* but do not necessarily create spaces for decentralised infrastructures as well as for non-capitalist modes of energy production and consumption (Altvater 2006; Wissen 2016).

Another advantage of working with both Political Ecology and world-systems analysis (Wallerstein 2007) is that many authors within these fields ask how current structures of inequality came into being with a particular emphasis on colonialism and how it is related to the appropriation of nature (Leff 2015; Alimonda et al. 2017 a/b; Moore 2003). The rise of capitalism reconfigured the existing unequal relations to produce a highly unequal world system (Wallerstein 1979). Industrialisation in Western Europe depended not only on the destruction of the old feudal order, the enclosure of the commons and the dispossession of the peasants, but also on the colonial exploitation of the Americas. In the words of the environmental historian Jason Moore, this process of "so called primitive accumulation" (Marx) brought about an "epochal reorganization of world ecology" on a global scale (Moore 2003: 312). Drawing on an analysis of how sugar and silver were appropriated in the Americas, Moore argues that these commodity frontiers were not only economically but also ecologically indispensable to the emergence of a modern world economy. The exploitation of sugar and silver was thus both the product and the expression of unequal interrelations between regions, histories and nature.[1]

[1] As Moore argues: "In various ways, silver and sugar enabled the emergence of far-flung divisions of labor and the consolidation of a capitalist world-economy predicated on the endless accumulation of capital. The "local'' environmental transformations precipitated by these frontiers were not simply consequences of European expansion; they were in equal measure constitutive of such expansion, condition as well as consequence. Degradation and relative exhaustion in one region after another were followed by recurrent waves of global expansion aimed at securing fresh supplies of land and labor, and hence to renewed and extended cycles of unsustainable development on a world-scale" (Moore 2003: 209).

This reciprocal and relational perspective on the shared and divided histories of the capitalist cores and (semi-)peripheries that are reproduced in durable global inequalities and power asymmetries to this day is expressed in the notion of 'entangled histories' (Conrad/Randeria 2002; Randeria 2002). The implication for the current analysis is that the paper does not see single events as separate phenomena. Instead, the paper explores these as interconnected historical processes, which are part of the dominant fossil energy regime and include the implementation of renewable energies within the Americas.

As mentioned above, this epochal process of transition towards capitalism was fuelled by a new energy regime in the 19th century. Simultaneously, capitalism reinforced the perpetuation and dominance of this very energy regime. Agrarian societies relied on a solar-based energy system and on the energy conversion provided by plant biomass (Krausmann et al 2008: 640). Only waterways allowed for long-distance transport as the energy costs of overland carriage were very high and limited the exchange of staple food, feed and fuel, which were produced at low-energy densities. In contrast, fossil fuels are characterised by a very high level of energy density. Therefore, the transition towards a fossil energy system made it possible to overcome these limitations to economic growth. Technological and social change based on coal and new types of energy conversion, especially the steam engine and railroad technology complex, expanded the inherent limits to growth. In 1850, for instance, Britain was producing coal in a quantity that was equivalent to all the wood available in the country; by 1900 this quantity was equivalent to five times the size of the entire country (Krausmann/Fischer-Kowalski 2010: 48). Energy turned from a scarce to an abundant resource, labour productivity in agriculture and industry increased, the energy cost of long-distance transport declined and the number of people who could be nourished from one unit of land multiplied, allowing for an unprecedented process of urbanisation (Krausmann et al 2008: 643). Fossil fuel-based energy subsidies for agriculture (mechanisation and fertiliser) gave way to tremendous productivity growth, but this was at the expense of the positive energy return on investment[2] that agriculture had enjoyed in the agrarian regime. As Jason Moore argues: "Nearly everything in our world depends on Cheap Energy: everything we associate with 'economic development' turns on fossil fuels" (Moore 2015: 109). Agriculture relies on energy-intensive fertilisers, which means that

[2] From an economic point of view, modern agriculture increased productivity per unit of labour and per hectare. But, from a physical point of view, it needs more energy than it produces. Several researchers who compared different agricultural systems discovered that traditional systems of corn production (for instance in Mexico and Guatemala) have a better output–input ratio than intensive corn production in the US (Martínez Alier 2012: 60). Against this backdrop, the energy return on investment (EROI) becomes an important indicator for measuring different forms of energy and agricultural production.

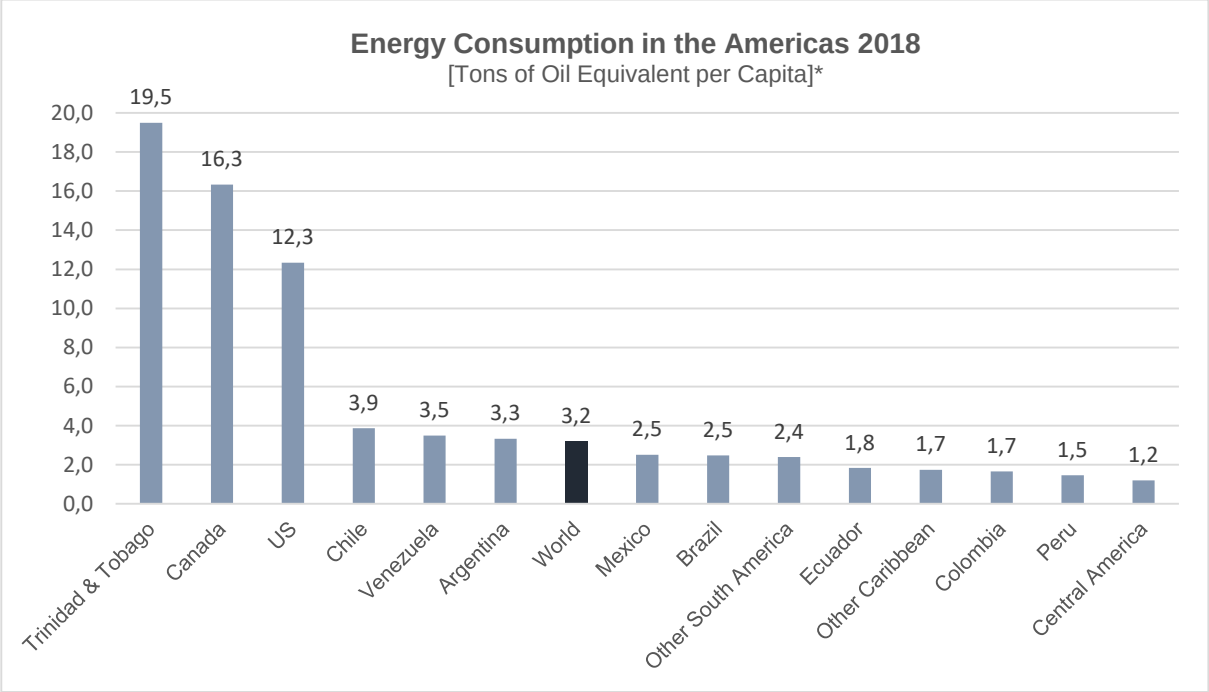
a growing part of the world´s population is 'eating' fossil fuels. In addition, capital has a tendency to dissolve the boundaries between the crucial inputs for the economy: to turn food into energy and raw materials, energy into food and into labour power (Moore 2015: 104). In sum, the dominant fossil energy regime is intertwined with the mode of production of global capitalism.

Against this backdrop, the term "socio-ecological inequalities" refers in this study to three important aspects. First, it refers to the persistence of global inequalities of energy production, distribution and consumption, which emerged with the conquest of the Americas more than 500 years ago. This aspect raises the question of how these global inequalities emerged historically as well as how they have been changed or reconfigured by state policies and incentives for the expansion of renewable energies in the Americas since the 1970s. Second, it underlines that energy regimes are not only shaped by physical laws but also by unequal and contested labour and land relations. We therefore analyse several socio-ecological conflicts emerging in different areas of energy production, which respond to different material bases. Third, and finally, the concept of global socio-ecological inequalities includes the normative goal of developing a sustainable and just transformation perspective. This includes the question of whether current changes to the dominant energy regime serve as a basis for this societal transformation.

The different snapshots illustrating the dynamics of fossil and renewable energy production and/or distribution were chosen because they are, firstly, emblematic struggles, which, secondly, occur in different parts of the Americas, and are, thirdly, based on different energy sources. The article shows that conflicts over energy transition can only be understood when accompanied by an analysis of the global and local inequalities fuelling them. These aspects cannot be ignored when discussing how to promote a just and sustainable transformation of the dominant energy regime. Before taking a closer look at these struggles and conflicts, we provide an overview of current trends in energy production and consumption in the Americas, a field that is intrinsically linked to different forms of socio-ecological inequalities.

3 Energy consumption and energy mix in the Americas

Around the world, the level of energy consumption is continuing to rise. Despite warnings about global warming caused by increasing levels of CO_2 emissions, despite local, national and global attempts to improve energy efficiency, the world continues to consume higher levels of energy every year. However, the consumption of energy is unequally distributed across the globe. In 2015, for instance, the Americas accounted for 26.6 percent of the world's total consumption of primary energy. This figure represents more than double the share of primary energy consumption in the EU (12 percent) and is slightly higher than that of China (22.9 percent), which has the largest national share in the consumption of primary energy in the world (BP 2016; Enerdata 2017). Within the Americas, energy consumption is far from homogenous, as is shown in the graph below.



Source: BP Statistical Review of World Energy 2019 * Primary energy comprises all types of renewable and non-renewable energy sources. Original Data in gigajoules per capita, converted into tons of oil equivalent (TOE), where 1 gigajoule = 0.0239 TOE.

In fact, there are remarkable structural inequalities within and between different regions. In terms of energy consumption per capita, in 2018, the average US citizen used 12.3 tons of oil equivalent and the average Canadian used 16.3 tons, whereas the average Mexican used just 2.5 tons, which is below the world's average of 3.2 tons. While Trinidad and Tobago (19.5 tons), Venezuela (3.5 tons), and Argentina (3.3 tons) are all above the world's average in terms of energy consumption per capita, Ecuador (1.8 tons), Colombia (1.7 tons) and Peru (1.5 tons), for instance, are below that average (BP 2019). However, these data only reflect general trends. In the case of Trinidad and

Tobago, for example, high-levels of per capita energy consumption are not necessarily the result of material-intensive behaviour in terms of consumption. As research points out, "it is rather a result of [a] production structure […] based on material- and energy-intensive industries, which are based on domestic energy resources and imported raw materials, but produce only for export" (Krausmann et al. 2014: 299).

Since the 1990s, the Americas have experienced a significant increase in the level of primary energy consumption per capita, but, at 30 percent, it has nevertheless remained below the global average. In terms of the total energy mix, oil is the most dominant energy source in North, Central and South America, accounting for 32.9 percent of total energy supply in 2015 (Fischer 2017: 658). In fact, some important producers (US, Mexico, Venezuela, Brazil) and consumers (US, Brazil) of oil are located in the Americas. In Latin America, in particular, oil and natural gas are the two most important sources of energy. In 2013, oil accounted for 46 percent of the region's primary energy supply (TPES), which is similar to the level exhibited by OPEC countries and higher than the world's average level of 31 percent (IRENA 2016: 12). By contrast, natural gas accounts for 23 percent of Latin America's primary energy supply and is slightly below the global average of 23.8 percent. In Latin America, the use of coal contributes five percent of TPES (ibid.), which is comparatively low, considering that coal is the second most important energy source in the world, accounting for 29.2 percent of total primary energy consumption (WEC 2016).

Within South America, the use of nuclear energy has generally been limited and concentrated in a small number of countries, such as Argentina, Brazil and Mexico. In this context, Argentina is the only country dominating in all steps of the production chain, including the mining of uranium, its processing, as well as in terms of the technical capabilities to design and build nuclear facilities. With the aim of strengthening its nuclear capacity for electricity generation, Argentina recently signed cooperation agreements with Russia and has been looking for investments from China (Clercq 2018). In North America, nuclear energy is more important. In Canada, there are 19 nuclear reactors, which generated 15 percent of the country's electricity in 2017. The US has 98 nuclear reactors, which generated 20 percent of the country's electricity, while in Mexico only six percent of the electricity generated in 2017 came from two nuclear plants. Canada is currently the world's second largest uranium producer — after ceding the first place to Kazakhstan in 2009 — while the US is the largest uranium and nuclear power importer (World Nuclear Association 2019).

Overall, fossil sources (oil, gas and coal) accounted for 74 percent of Latin America's total consumption of primary energy in 2015, which remains below the global share of 86 percent (WEC 2016). Against this backdrop, the Americas account for a comparatively high share of renewable energies. The concept of renewable energy encompasses all energy sources (including biomass, sun, wind and water) that are not derived

from fossil or nuclear sources. Renewable sources of energy have been used for thousands of years. With renewable energy accounting for 25 percent of the region's total primary energy supply (TPES) in 2013, Latin America is above the global average of 13 percent. Within Latin America, solid biofuels (such as wood, sawdust, charcoal or bagasse) (57 percent) and hydropower (31 percent) are the main sources of renewable energy in the region's primary energy mix, followed by liquid biofuels (biodiesel on the basis of vegetable oil or ethanol on the basis of vegetable starch/sugar) (eight percent), geothermal (three percent) and other renewable energy sources (IRENA 2016). In relative terms, Central America has the highest share of renewable energy (55 percent of TPES, although around half of this comprises traditional solid biofuels), followed by Brazil (39 percent of TPES, mainly for end uses and power generation).

One of the most significant trends in Latin America's energy sector is the rapidly growing importance of electricity. In fact, power generation more than quadrupled from 1980 to 2013 (ibid.: 32). The production of electricity is largely based on hydropower but natural gas and other renewable sources have become increasingly relevant. While hydropower was responsible for 67 percent of electricity generation in 1990, this share had fallen to 50 percent by 2013. Hydropower is used to different degrees in different countries. It contributes to 100 percent of power generation in Paraguay and about 75 percent in Brazil, Colombia, Venezuela and Costa Rica. In parallel, natural gas has gradually become the most important source of electricity generation in Bolivia, and the second most important in Colombia, Peru and Venezuela (ibid.: 33).

In terms of renewable energy, bioenergy and onshore wind have experienced the highest growth rate in terms of installed capacity since the year 2000 (ibid.). Across Latin America, renewable energy supplies 35 percent of heat demand, nearly one quarter of which comes from traditional biomass. Some countries in the region rely heavily on renewable sources for industrial heat, including Paraguay (90 percent renewable), Uruguay (80 percent), Costa Rica (63 percent) and Brazil (54 percent). Moreover, in 2016, several countries in the Americas experienced high levels of investment in renewables. Bolivia has the world's highest level of investment in renewable powers and fuels per unit of GDP. In terms of hydropower investment, Brazil occupies the second place, behind China, while Ecuador holds the third place. In terms of the world's total investment in solar and wind power in 2016, the United States held the second place, also behind China. Notably, the Americas take the global lead in terms of annual investment in biodiesel and fuel ethanol production, with the US taking the first and Brazil the second place (REN21 2017: 25).

These data portray the unequal distribution and diversity of the energy sources available for consumption and/or export in the Americas but it completely fails to expose the ecological burden of growing levels of energy consumption. As it becomes clear in the next chapter, the extraction, production, export and distribution of energy is

deeply entrenched in socio-ecological conflicts all over the Americas. Countries where the export of natural resources plays a dominant role typically have a high level of embodied materials, pollution and energy use per unit of economic output. In these cases, the expansion of the economy relies on the physical expansion of exports, while the production of energy creates unequally distributed social and environmental risks in each country (Muradian et al. 2012: 560; Martinez-Alier 2016).

4 Unequal historical dynamics of energy: reconfigurations and struggles

The previous chapter provided an overview of the current trends in the energy mix of the Americas. Its purpose was to provide an insight into whether renewable energies are becoming more important and to highlight the inequalities related to energy consumption and production in which local and transitional energy projects are embedded. Nevertheless, these data present different energy sources as abstract concepts, which can be compared independent of their respective material qualities. However, this analytical step does not go far enough, inasmuch as it does not unpack the historical and societal processes necessary for the production of energy. In keeping with our concept of socio-ecological inequalities, we do not see energy as a neutral and abstract concept or phenomenon of thermodynamic rules. Instead, we ask how these energy regimes are historically entangled with neocolonialism, unequal development, transnational power asymmetries and the exploitation of labour and nature. Importantly, our analysis engages with the contradictions and conflicts underpinning the implementation of renewable energy projects.

4.1 The rise of the fossil energy regime in Canada and the US and the carbon lock-in in the Americas

Before the carbon age, the direct and indirect energy flows from the Americas to Europe were based on biomass and human labour. Indirect energy flows were (and still are), for instance, vast deforestations of whole regions and exploitation of human labour for mining (Moore 2003). Sugar is an example of direct energy flow; it was the first internationally traded crop to exploit slaves and simultaneously provide the emerging urban labour force with important sources of energy in the context of industrialisation (Mintz 1986). In contrast to Latin America, the US benefited from an early emancipation from its colonial dependence on the British Empire in 1776, also

taking advantage of the mercantilist interests of Britain, France, Spain and the Netherlands, who competed to capitalise on its good soils and the Great Plains. After the dispossession of the First Nations of their land and the construction of the railroads, the land produced very high quantities of grain, which facilitated urbanisation within the country and a huge increase in exports to Europe (Krausmann/Fischer-Kowalski 2010: 49). Unlike in Britain, coal was not as crucial to the rise of the US as water (Malm 2016: 259). Waterwheels were important energy sources until the end of Civil War in 1865, and, until 1850, 90 percent of the nation's heat was generated from wood. Consequently, the intensive use of coal and oil triggered the emancipation of the energy system 'away from the surface'. Given their high levels of energy density and physical concentration in the underground, their production does not necessarily require large extensions of land.

With the discovery of large oil reserves in Texas around 1900, the global energy regime was fundamentally transformed. Until the mid-20th century, the US was the most important producer of oil. The combination of oil, internal combustion engines, aircrafts, a chemical industry with rising wages, the emergence of assembly line production and cheap energy was crucial to Fordism and US-American global hegemony (Krausmann/Fischer-Kowalski 2010; Malm 2016). Later on, the automobile, central heating and meat joined the list of key elements of an energy-intensive form of living associated with the *American way of life*. The US and Canada were host to 'the carbon lock-in', which describes the cementation of fossil fuel-based technologies within transport systems (automobiles rather than trains or bicycles). An entire infrastructure emerged comprising oil terminals, petroleum refineries, asphalt plants, road networks and gasoline stations as well as the individual transportation sector, while other systems, especially the train transportation system, lost their importance (Malm 2016). At the same time, Latin America was subordinated as North America's peripheral resource backyard. As the following sections sketch out, different countries of Latin American have been trying, unsuccessfully, to eliminate national and regional dependence on North America as well as social inequalities within their countries by nationalising their energy sources and energy companies and building up new national and regional distribution structures.

4.1.1 Nationalisation of oil companies as a reaction against US and European dominance

As a means of eradicating external dominance in the domestic hydrocarbon sector, many countries in Latin America opted to nationalise the corresponding enterprises. During the first three decades of the 20th century, a few transnational enterprises

backed by the US and other Western governments were able to secure comprehensive concessions for oil exploration and production in many parts of Latin America. From 1912 onwards, British and US investors started drilling for oil in Veracruz, Mexico, off the Atlantic Coast in Nicaragua and in different parts of Venezuela. By 1932, the Standard Oil Company of New Jersey (Standard Oil, now ExxonMobil) had become the largest foreign oil company in the region, acquiring concessions for oil exploration, refining and transportation in Bolivia, Venezuela, Mexico, Colombia and Peru (Perreault/Valdivia 2010: 694; Philip 1982: 43f.). A few years later, Royal Dutch Shell started operations in Latin America, acquiring exploration concessions in Ecuador, Guatemala, Colombia, Mexico and Venezuela, with the latter accounting for nearly one third of Shell's global production of oil in 1937 (Philip 1982: 45).

With the emergence of Import Substitution Industrialisation (ISI), different Latin American states strengthened control over the oil industry, which they regarded as a strategic pillar of *desarrollismo* or developmentalism. This led to a series of nationalisation processes. The first state-owned oil enterprise emerged in 1922 in Argentina under the name of YPF (*Yacimientos Petrolíferos Fiscales*). Following this example, Bolivia created its own state-owned oil and gas company YPBF (*Yacimientos Petrolíferos Fiscales Bolivianos*) in 1936. As part of a strong national movement to assert economic independence, Mexico nationalised its oil production and founded PEMEX (*Petróleos Mexicanosin*) 1938. Chile created the national oil company *Empresa Nacional del Petróleo* (ENAP) in 1950. After intense political struggles, Brazil then created the state-owned company Petrobrás in 1953. This regional wave of nationalisation reached Ecuador and Venezuela in the 1970s. Although the Venezuelan state had begun exerting significant tax pressure on US companies in 1943, the nationalisation of the oil industry was concluded in 1976 with the creation of PDVSA (*Petróleos de Venezuela)* (Prado/Schaposnik 2015: 100).

4.1.2 Pitfalls of rentier politics and the (re-)emergence of (neo-) extractivism

Albeit to different degrees, the nationalisation of the hydrocarbon sector led to the proliferation of rentier politics, and provided the material basis for the emergence of (neo-)extractive development models in the 2000s. Tighter state control over oil, gas and mineral 'rents' — defined as "the difference between revenues and extraction cost" (Barma et al. 2011: 11) — has since led to volatile increases in public revenue but has not automatically served as a driver of development. In fact, based on the negative economic outcomes of the 'Dutch disease', the problems of the 'resource curse', 'rent-seeking' and, more recently, '(neo-)extractivism' (see below) are prominent topics of

debate across the Americas. The 'Dutch disease' is a commonly cited argument, according to which the accelerated expansion of gas exports in the Netherlands became a 'curse' during the 1960s. This single commodity-based, export-oriented economic model induced high levels of currency appreciation and inflation, which, in turn, had a negative effect on the diversification of the manufacturing and industrial sectors (Peters 2017: 47; Ross 1999: 306).

The 'resource curse' debate also criticised the political implications of 'rent-seeking', given that oil, gas and minerals provide privileged social groups with huge incentives to compete for control over the state infrastructure so as to access the national resource base and use it mainly to their own political and economic advantage. Hence, a substantial element of the debate on rentier economies and the rentier state links resource extraction with higher levels of corruption, patronage and clientelism (Omeje 2010). In this case, the term 'rent' is used in a broader sense and refers to money transfers from oil consumers (mostly in the Global North) towards rentier states, which use these transfers to stabilise state revenues without due accountability to citizens and tax-payers. Venezuela, which currently holds 18 percent of all confirmed reserves in the world, making it the most oil-rich country on earth (Fischer 2017: 662), is an outstanding example of a rentier economy. In 2014, oil represented over 97 percent of the country´s exports, while oil rents made up 45 percent of state income and 35 percent of the country's GDP (Peters 2017: 54). Since the beginning of the 2000s, China's demand for Venezuelan oil has grown significantly, thus contributing to the 'rentier' character of the Venezuelan state and its Bolivarian developmental model (Rosales 2016).

In recent years, the term (neo-)extractivism has been widely debated in Latin America and beyond. The term is used to conceptualise a problematic developmental model through which resource-exporting states become increasingly dependent on volatile market prices and predatory practices of extraction to foster policies of redistribution (Acosta 2013; Gudynas 2015; Svampa 2015). This new wave of resource extraction is essentially nothing new as it is reminiscent of Latin America's history of subjugation, in which European countries enforced the export of raw materials as a key feature of colonial rule and oppression. However, with rapidly rising commodity prices at the beginning of the 21st century, the region experienced a boom in the adoption of extractive models of development[3]. Albeit with different social, political, economic and ecological implications, different forms of extractivism have been adopted by many states, including Bolivia, Ecuador, Peru, Colombia, Chile, Argentina and Brazil. Although extractive strategies contributed to rising budgets in some nation-states and provinces

[3] The new element of neo-extractivism (in comparison to classical extractivism) is that the Pink Tide's governments claimed (and to a certain extent also fulfilled their promise) to use the revenue from extracting resources to expand social policies, redistribution and the development of other industries.

as well as to private profits in the short run, most (neo-)extractive endeavours have contributed to the formation and/or reproduction of socio-ecological inequalities. Investment in extractive projects have negative impacts on local livelihoods because they often involve the displacement of people from their territories, the contamination of soil and water with dangerous chemicals. Such endeavours undermine every necessary condition for community-based livelihoods to pursue self-determined strategies based on subsistence agriculture or on gathering forest fruits. This regional trend has reinforced Latin America's position as a provider of raw materials for export (Svampa 2015). According to Fernando Coronil, the problems of resource extraction are thus better explained as a 'neo-colonial disease'. Because of pre-exiting relations of international subordination, he argues that postcolonial states are substantially more vulnerable to the economic and political 'traps' of expanding commodity exports than most Western countries. Additionally, extractive development models tend to reproduce the "relations of colonial dependence between these formally independent nations and metropolitan centers" (Coronil 2008: 19). Thus, the reproduction of global socio-ecological inequalities becomes evident.

4.1.3 Privatisation and the economic dominance of energy companies across the Americas

During the 1990s, many of the region's national energy companies were privatised, including Bolivia and Argentina. In many other countries, although the state formally owned the enterprises, its decisions and revenue were often subordinate to the influence and profit of international investors (as was the case in Venezuela or Mexico, for example). Since 2000, a period of high commodity prices driven substantially by China's rapidly rising energy demand has motivated different Latin American states to reassert national control of the energy sector (Rodríguez 2018). Nowadays, seven energy companies feature among the world's ten largest firms in terms of revenue (Fischer 2017: 660). Looking specifically at the ten largest energy companies, two enterprises from the Americas hold prominent positions: ExxonMobil holds the fourth and Chevron the tenth place. Both companies are privately owned, stock-market-listed enterprises with headquarters in the US. Nevertheless, national oil companies (NOCs) have progressively gained influence in the world energy market. According to the World Bank, about 90 percent of the world's oil and gas reserves and about 75 percent of their exploitation is in the control of NOCs. Moreover, in the Americas, state-owned energy companies have expanded transborder activities, leading to new interamerican relations.

4.1.4 Multilatinas and Caribbean Oil diplomacy: Contra-hegemonic instrument and/or authoritarian power base?

The emergence of the *multilatinas* is a noteworthy phenomenon. The three most important examples of state-owned enterprises pursuing deliberate strategies of internationalisation (through exports, investment and joint ventures) are PEMEX from Mexico, Petrobrás from Brazil and PDVSA from Venezuela. While PEMEX has expanded its operations mainly into the US and European markets, Petrobrás has diversified into the US, China and Latin America and has also given significant attention to African countries, including Angola, Nigeria, Mozambique and Tanzania (Satsumi et al. 2017). In fact, the nationalisation of the oil and gas industries in Bolivia and Ecuador have respectively led to considerable bilateral tensions with Brazil, as different social movements rejected Petrobrás' policies of intraregional expansion. PDVSA has engaged in overseas operations in Asia and the US but also placed a strong focus on implementing Venezuela's oil diplomacy in the Caribbean and Central America.

Between 2008 and 2016, Venezuela developed a strategy for promoting Caribbean integration, regional industrialisation and new trade flows with its oil. The most important element of the strategy was the creation of *Petrocaribe* in 2005. The Venezuelan state-owned oil company PDVSA has created 14 mixed enterprises in 11 Petrocaribe member countries (Aponte García et al. 2015: 89). PDVSA maintains between 60 and 83 percent of the shares in the respective enterprises. Under this umbrella Venezuela sold oil to companies or states at favourable prices; part of the cost has to be paid directly, part is given as a long-term credit with a low interest rate and a certain percentage goes to the ALBA Caribe Fund. The latter developed 88 projects between 2006 and 2008 in the areas of housing and habitat (32 percent), social issues (24 percent), urban services (14 percent) and productive sectors (13 percent) implemented in different Central American and Caribbean countries (Aponte García et al. 2015: 93). For several Caribbean countries, these projects have made a significant contribution to their electrical infrastructure. Oil can be partially paid in services. Cuba, for example, sends medical and educational personnel to Venezuela.

Venezuela's attempt to build up these transnational networks was driven by its interest in reducing historical dependence on external actors. In this regard, Venezuela's oil diplomacy can be understood as a contra-hegemonic instrument. Nevertheless, as the problematic developments of the last years show, the expansion of the oil frontier has by no means translated into an emancipatory project, but has instead contributed to reinforcing the power base of authoritarian leaders with a socialist façade.

For Nicaragua's president, Daniel Ortega, for example, the Petrocaribe initiative and the ALBA process were key drivers of economic growth, as, in 2012, Venezuela bought almost 50 percent of Nicaragua's beef exports, as well as a high share of milk, beans

and sugar (Martí I Puig/Baumeister 2017: 391). For Ortega's repressive authoritarian regime, this mechanism is key, as PDVSA has been extending oil loans to an FSLN[4]-owned private bank for 25 years. However, the use of this money is not transparent (Thaler 2017: 165). Venezuela has tried to reduce its exposure to price volatility on the world market, to deepen South-South relations and to adapt its own commodity chains and trade networks (Pardo/Schaposnik 2015: 97f.). In recent years, however, PDVSA has faced serious financial problems as a result of hyperinflation and mounting levels of foreign debt, which have forced Venezuela to develop an oil-backed crypto-currency called the 'petro'. The political regime turned out to be incapable of responding to the severe economic and political crisis. This situation has forced almost three million Venezuelans to leave the country due to dramatically deteriorating living conditions.

4.1.5 Contradictions of and struggles over fossil fuels in the Andean countries

Struggles around energy have usually involved resistance movements fighting against powerful national and transnational energy companies. These struggles cut across different energy sectors, including hydrocarbons, wind, biomass and the development of large-scale infrastructures related to the extraction, production and distribution of energy. In Bolivia, the struggles between those calling for national control of hydrocarbon resources and revenues, on the one hand, and those calling for regional autonomy and greater local control of oil and gas rents, on the other, have been intense (Perreault/Valdivia 2010: 690). In 2003, a conflict over the export of natural gas from Bolivia through a Chilean port to Mexico and the US triggered large-scale social mobilisation resulting in what became known as the 'Gas War', with nearly 80 people being killed in the protest. Historically, Chile–Bolivia relations have been tense since Bolivia lost its coastal border to Chile during the Pacific War in 1884. In 2005, road blockades and protests demanding the nationalisation of the country's natural gas reserves forced the president to resign (Spronk/Webber 2007). Natural gas has now become the symbol of Bolivian sovereignty and been declared a natural heritage. In fact, the Bolivian constitution (2009) and a special law (2010) entitled the *Pachamama* (Mother Earth) both contain legal mechanisms to protect it from overexploitation. Nevertheless, the Bolivian state is heavily dependent on the extraction and export of natural gas: hydrocarbons represent Bolivia's single largest source of income, with revenues increasing

[4] FSLN stands for *Frente Sandinista de Liberación Nacional* (Sandinist Front of National Liberation) and is the political party that led the Sandinist revolution 1979-1990. Since 2007, the FSLN has been back in power, with Daniel Ortega, an FSLN leader, as President of Nicaragua, transforming the country into an authoritarian state.

from US$188 million in 2001 to over US$1.5 billion in 2007 (Perreault/Valdivia 2010: 696).

A particularly interesting case is the resistance movements against Big Oil (Chevron-Texaco) in Ecuador. In 1993, more than 30,000 indigenous people joined the *Unión de Afectados por las Operaciones de Texaco* (Union of People Affected by Texaco Operations, UDAPT) to demand compensation for the irreversible damage caused by Texaco's oil-drilling activities in a sensitive area of the Ecuadorian Amazon. The oil company Texaco obtained extraction rights from the Ecuadorian government in 1963 and became a subsidiary of the California-based oil corporation Chevron in 2001. In collaboration with research organisations, activist groups and state bureaucracies, local communities gathered compelling evidence of the social and environmental damage caused by Texaco between 1964 and 1993 (Pigrau 2012: 1). Texaco dumped toxic waste into the Amazonian rivers and caused hundreds of oil leakages, which affected 1,500 km of river basin, leading to the destruction of more than 450,000 hectares of Amazonian rainforest. In 2011, an Ecuadorian court sentenced Chevron to pay a US$8.6 billion fine for the negligent actions of its subsidiary Texaco. Since then, Chevron has sued the Ecuadorian government in three international court cases. In 2017, the US Supreme Court declared that the available evidence brought against Chevron in this decade-long litigation process was fraudulent. This ruling impedes any judicial measures originating in Ecuador from being legally effective against Chevron in the US (Chevron 6/19/2017).

Over the 2000s, this and other anti-extraction movements, such as the *YASunidos*, came together to produce a paradigmatic proposal to institutionalise a national oil moratorium, internationally known as the *Yasuni-ITT* initiative. Announced in 2007, this Ecuadorian policy consisted of an international trust fund, which invited the international community to make money deposits amounting to half the price of the available oil beneath the soil. As well as preventing the extraction of oil in a highly sensitive part of the Amazon and reducing CO_2 emissions, the money collected was intended to finance Ecuador's transition towards a cleaner energy mix and a post-oil prosperity model. Fearing a lack of long-term commitment, the international community did not respond as expected. This reinforced the political position of government officials in favour of expanding Ecuador's state-led oil industry in the context of high commodity prices.

In October 2019, Ecuador's president, Lenin Moreno announced that a package of structural measures, including the elimination of fossil subsidies in place since the 1970s, had been enacted by Decree No. 833, following a closed-door agreement with the International Monetary Fund (IMF). This politically dramatic measure was adopted by the Ecuadorian government in order to fulfil the requirements of the IMF to cut public spending in exchange for a US$4.2 billion loan, which was intended to alleviate

the fiscal balance of the otherwise highly indebted Latin American state. Despite having authored the *Yasuni-ITT* initiative, one of the most prominent proposals to transition away from the fossil regime, Ecuador continues to depend on the extraction and export of oil resources. Most of Ecuador's underground reserves had in fact been previously committed to Chinese companies in exchange for expensive long-term loans during the government of Rafael Correa. For most people in the small-scale agricultural sector, cheap sources of fossil energy, mainly gasoline and diesel, are key to their survival, not only in terms of production but also in terms of sustaining their living conditions in a dollarised economy.

The sudden elimination of fossil subsidies, as part of a conditional package negotiated by the Ecuadorian government with the IMF and with little to no participation of most sectors of society, sparked a massive political protest on behalf of the politically powerful indigenous movement represented by the Confederation of Indigenous Nations (CONAIE). Cutting fossil subsidies meant a sudden and drastic increase in production and living costs (150 percent increase in the price of gasoline, 200 percent in the case of diesel). Over a ten-day period, the Ecuadorian government reacted with unprecedented levels of repression, mobilising police and military forces to combat social protests leading to a standstill at the country's most important transport hubs. The public ombudsman's office reported that, as a result of the struggle to restore fossil subsidies, seven people had died, 1,340 had been injured and 1,152 arrested, most of them on a random basis and with no prospect of a fair trial. Given the high levels of social unrest and the strong capacity of the indigenous movement to articulate its demands for social justice, President Moreno agreed to open the dialogue with the mediating support of the United Nations.

Finally, one day after the iconic evening of the 12th October (the so-called discovery of the Americas), the government of Ecuador agreed to suspend the aforementioned Decree No. 883, hence restoring fossil subsidies across the country. On the one hand, this shows how powerful the indigenous nationalities of Ecuador have become in terms of contesting key political issues in the country and thus contributing to a gradual reduction in the political and economic inequalities that have developed over history. On the other hand, the struggle to restore fossil subsidies shows the extent to which the people living in the peripheries of the Americas rely on carbon intensive sources. Paradoxically, the chances of protecting the *Pachamama* (Mother Earth) while being locked-into the fossil regime are virtually non-existent, at least for the time being.

4.2 Contradictions and conflicts surrounding renewable energy projects

All renewable energy projects once again raise the question of land access and land use, which is highly contested, especially in Latin America. In contrast to fossil fuels, dubbed as "subterranean forests" (Sieferle 1982), the production of renewable energy requires more space above ground and thus has a different impact on the dynamics of land access and use (Jepson/Caldas 2017). In other words, given the lower energy density that renewable energies have compared to fossil fuels, the materialities of the former imply that more land is needed to produce less energy. Many conflicts are therefore triggered by the displacement of rural communities and growing social inequalities in the countryside, the far-reaching restructuring of land access through land conversions or negative socio-ecological impacts of the large-scale projects on the wellbeing and health of the people living close to the operations. The contradictions of these renewable energy projects become clear when we focus on the resistance and struggles against them. In the following sections, the paper focuses on bioenergy, especially of agro-fuels, since they represent the main energy source in the emerging bioeconomy.

4.2.1 Agro-fuels in the US, Brazil and Argentina

The dominance of the fossil regime does not mean that other energy sources — considered in the context of climate change as renewables — are dispensable. Currently, the share of biomass-based energy in total global final energy consumption is about 14.1 percent (REN21 2017). Nevertheless, the transition towards a fossil regime in the 20th century did not replace but instead absorbed and integrated renewable energy sources, as illustrated by the case of biofuels. Biofuels — including animal fats, vegetable oils and methanol from wood — were humanity's first liquid fuels and powered the early stages of the industrial revolution. Around the early 20th century, biofuels were used for the combustion of engines all over the world, given concerns with regard to fuel quality and petroleum depletion (Kovarik 2013). After the emergence of the fossil regime, biofuels vanished until the oil crisis in the 1970s, which gave rise to more serious concerns over national energy security. In the 1970s, Brazil and the US, for instance, started the production of ethanol as a substitute for gasoline and simultaneously restructured their agricultural sectors through subsidies (Leopold 2015; Nitsch et al. 1985). In the Brazilian case, state incentives supported the expansion of individual transport for the urban elites, while inhibiting the development of an inclusive system of public transport. Thus, public investments in the ethanol sector were unequally distributed, not only in the countryside, but also in the rapidly growing metropolitan agglomerations and cities of Brazil (Nitsch et al. 1985).

Since then, the Brazilian sugar-ethanol complex has overcome several economic crises (e.g., because of the volatility of the oil market) thanks to state incentives and technological innovations such as the flex car. Flex cars can mix ethanol and gasoline depending on the oil price. In the context of climate change, ethanol, as with all different forms of biofuels, has been reframed as a green substitute for fossil fuels, especially within the transport sector (Wilkinson/Herrera 2010). In 2017, with a blending quota of 27 percent and a production of 26.2 billion litres, Brazil was the second biggest global consumer and producer of ethanol after the US (USDA 2017). The Brazilian National Biodiesel Production Program (PNPB) was created in 2004 to promote domestic production, reduce import dependency on oil, generate jobs and tackle poverty in the countryside. In 2017, the biodiesel mandate was set at eight percent and total biodiesel production was estimated at 4.3 billion litres (ibid.). Nowadays, Brazil is the second largest biodiesel producer after the US. 70 percent of Brazil's biodiesel is produced from soybean oil, followed by animal tallow (16 percent), while the rest comes from cottonseed oil and other oil seeds (ibid.).

In Argentina, biodiesel production has developed from a small-scale business in the 1990s to an agro-industrial complex, which today positions the country among the world's top exporters. Albeit declining, production capacity reached 2.5 billion litres in 2019 (USDA 2019: 1). This trend coincides with a massive expansion in soybean production, which developed from a marginal crop in the 1980s and now occupies 50 to 66 percent of Argentina's agricultural lands. In the early years, almost all the biodiesel produced was exported. Currently, several regulations incentivise domestic consumption as a way of stabilising Argentina's struggling biodiesel sector. Bioethanol based on sugarcane, and, more recently, on corn, has a longer history. Its use dates back to the 1920s, with production originally exclusively targeting the domestic market (Toledo López 2013: 139). The Biofuels Law, passed in 2006, regulated the sector and established an obligatory blending quota of five percent ethanol in gasoline and five percent biodiesel in diesel from 2010 onwards. In 2010, the blending mandate was raised to 12 percent in the case of ethanol and ten percent in the case of biodiesel. Most activities related to the production of biofuel have tax advantages; export taxes on biodiesel and ethanol are much lower than export taxes for raw crops, which is a governmental instrument to stimulate industrial upgrading. This was interpreted by the US and the EU as dumping and they (partially) closed their markets for Argentinian biodiesel.

However, many actors question the sustainability of biofuels. In 2007, the 'food vs. fuel' debate started with protests in Mexico ('*tortilla* crisis') and other parts of the world, which were provoked by growing food prices. The corn ethanol mandate adopted by the US government contributed to this problem as it absorbed scarce grain supplies

and pushed up food prices. Even if biofuels are only one part of the food price problem, the reputation of biofuels was damaged. Additionally, as part of a transnational agro-industrial complex, the production of biofuels is highly dependent on fossil fuels, as well as being responsible for at least one quarter of global greenhouse gases. Furthermore, the production of biofuels is not necessarily inclusive of smallholders but increases land concentration and land-grabbing processes (Borras et al. 2011; Bernardes/Aracri 2011; Backhouse 2015). Since the prefix 'bio' is misleading, critics prefer to call this biomass-based fuel 'agro'-fuel referring to the agro-industrial mode of production. NGO campaigns and social movements such as Via Campesina have successfully criticised the sustainable image of biofuels, which has led the EU to freeze blending quotas.

In the context of current bioeconomy debates, bioenergy has come to constitute a new and broader framing for agrofuels. Bioenergy refers to energy obtained through the burning or fermentation of biomass, including straw, wood, sugarcane, palm oil, corn and wastes of these crops, among others. Although bioenergy is a much less contested concept, and in European countries and Brazil, for example, it faces little resistance, many of the problems discussed in the debate on agro-fuels also apply to bioenergy. As bioenergy has a low energy density compared to fossil energy sources, the corresponding conflicts surrounding land use, dispossession and pesticides are likely to gain strength. Under the current conditions, the production of bioenergy is only profitable in large-scale settings, normally implying monocultures. As many scientists and activists have shown for the case of Argentina, monocultural production of soybean or corn reinforces the agro-business model and results in increased use of pesticides (Lapegna 2015; Gras/Hernandez 2013). Local populations suffer from the negative health effects of this form of production, but their complaints have been ignored for many years (Avila-Vazquez et al. 2018; Evia 2018). Campaigns and protests against the spraying of wide areas, including rural schools and villages, have now attracted public attention and achieved some policy changes (Arancibia 2013). At the same time, enterprises in Argentina's bioenergy sector present themselves as sustainable, environmentally aware and as smart businesses (Toledo-López/Tittor 2019).

In sum, there is a certain risk of bioeconomy policies responding mainly to the interests of enterprises sustaining the agri-business model. These companies expect rising profits because of an increasing demand for biomass connected to the emerging bioeconomy. They are therefore keen to mobilize political and financial support from the government. If bioeconomy policies follow this path, the already existing inequalities and conflicts surrounding land-use changes, access to land and pesticide use are likely to deepen and intensify.

4.2.2 Hydropower in Brazil

Another emblematic case of contested renewable energy projects is the resistance to hydropower in the context of Belo Monte. Since the 1970s, the construction of the massive Belo Monte hydroelectric power plant — the world's third largest — has threatened the Xingu River in the state of Pará, part of the Brazilian Amazon basin. Massive local resistance and transnational protests stopped the project for nearly three decades. However, in 2010, the project was relaunched with the support of the Brazilian government, despite existing laws and enduring protests. Belo Monte is part of an official plan to convert Brazil into a global energy player through the systematic expansion of hydropower. However, the technical, procedural and also political aspects of this project are highly contested. Belo Monte magnifies the risk of gigantic floods, deforestation and huge biodiversity losses, which would have vast negative effects on the livelihoods of traditional and indigenous peoples. The construction of the dam, which began in 2011 with significant governmental support and financial commitment of up to US$13 billion, resulted in the displacement of more than 20,000 people, whose livelihoods have, for centuries, depended on river navigation and fishing (Rodríguez 2017). However, Brazil does not necessarily depend on hydropower to meet its domestic demand for electricity. Instead, part of the energy surplus will either be directly exported or used by Vale (Brazil's mining company) in the extraction, production and export of aluminium for the global market. The levels of opposition to Belo Monte have thus been impressive yet costly. Since the first turbines began operations in 2016, the opposition movement has split into different groups. There are those who continue to fight the dam, those pledging to seize the opportunities provided by the financial resources the government has made available and those who see "the importance of working with local and federal government officials in order to support the needs of dam-affected people" (Klein 2015: 1153).

4.2.3 Wind parks in Mexico

The construction of large-scale wind parks is moving forward all over the world. Despite its renewable character, this type of energy production is also highly contested (Lehmann 2019, 2018). Mexico is seen as one of the world's most promising future wind markets, which explains why many different stakeholders are investing heavily in this sector (Lehmann 2018: 6). Between 2012 and 2017, the installed production capacity for the generation of renewable energy increased 11 fold compared to 2012. To date, most of Mexico's energy for electricity is produced by hydroelectric dams (20 percent); wind energy contributes just a small share of renewable energy production (4.7 percent). Nevertheless, the wind power sector has still been a source of conflict on

the Pacific coast of the Isthmus of Tehuantepec in the southern state of Oaxaca. This is where all 24 of Mexico's wind farms are located (ibid.: 7). Particularly the construction of more than 1,000 turbines in the semi-rural region of the Isthmus is highly contested by local residents. Their protests target the construction of these projects implemented by transnational companies, which generate electricity from renewable resources for consumers in other parts of the country. The main concerns are unresolved land tenure issues, socio-ecological impacts of these huge wind farms, unrealistic promises regarding jobs and the economic development of the region, as well as a lack of information and any genuine participatory process. Thus, it becomes clear that it is not the energy source itself that is contested but rather the social context of its unequal production and distribution. In addition, the implementation of wind energy projects in the Isthmus of Tehuantepec reveals that renewable energy projects are also capable of triggering and/or reinforcing social conflicts, particularly if the problematic rationale for and dynamics of large-scale infrastructural schemes are not reversed.

5 Conclusion: Energy transition and challenges for a global bioeconomy

The analysis conducted in this paper reveals that the historical rise of the fossil energy regime in the Americas was accompanied by and articulated via the formation of new global and regional inequalities. Due to the intensive use of oil in combination with technological innovations, North America became the hegemonic centre of global capitalism, spreading the use of fossil energy across the world, and consequently subordinating Latin America as its peripheral resource backyard. Since then, the *American way of life* has spread globally as the standard to follow, hence exacerbating the world's overreliance if not complete dependence on fossil energy sources. This carbon lock-in has resulted in new, environmentally problematic consumption patterns amongst the working classes in both the old and new centres of the capitalist world system, while having an almost intractable negative impact on the conditions of existence of the poorest classes in the global peripheries. This study of the Americas has shown that the emergence of the carbon lock-in has been accompanied by durable structures of inequality resulting largely from colonialism, intraregional power asymmetries and a globally unequal division of labour. These historical inequalities and extractivist practices are not limited to the fossil sector; depending on the context-specific circumstances, they affect large-scale infrastructures from the mining and agricultural to the renewable energy sector. The different attempts of Latin American countries to reduce national and regional inequalities by nationalising energy companies and their fossil resources did not create any real prospects for transformation beyond

the fossil regime. (Neo-)extractivist models using subsoil energy sources to reduce social inequalities had important distributional effects in the medium term but have proven troublesome in the long run: they have increased dependence on fossil fuels, tied the reduction of inequality to volatile commodity prices and failed to develop cleaner energy sources in the process.

The eight snapshots presented in this paper show that the attempts at expanding the renewable share of the energy mix have been implemented largely within the framework of large-scale infrastructures. They have thereby reinforced the status quo of global social inequalities and ecological crisis. Agro-fuels, for instance, were introduced in the context of the oil crisis in the US and Brazil in the 1970s. As the Brazilian case shows, state incentives for ethanol were not only intended to strengthen the crisis-ridden agro-industrial sugar cane sector but they also supported the expansion of individual transport and the lack of investment in public transport in the rapidly growing metropolitan agglomerations and cities. The winners of such reforms were not necessarily the socially vulnerable sectors of society but rather the agrarian and urban elites with the economic means to participate in the fossil regime. The history of biofuels underscores the fact that the so-called 'renewables' are not necessarily sustainable, but can in fact diversify and thereby support the dominant fossil energy regime and its intrinsic articulation with global social-ecological inequalities.

The environmental dimension of these socio-ecological inequalities becomes evident when we examine the materialities of the sources of renewable energy studied. These show much lower levels of energy density than fossil sources and also require more and more space above the ground to meet societies' growing energy needs. As the cases of large-scale hydropower plants, agro-industrial plantations and wind farms have shown, most of these renewable energy sources have triggered conflicts on land access and land use. This means that the specific quality of a resource being renewable does not automatically lead to ecological balance. Similarly, the implementation of renewable energy projects does not automatically improve the social and economic wellbeing of the human lives they affect. Therefore, a global transition towards the bioeconomy cannot be thought of a priori as a socially homogenous process of win-win relationships. If a global bioeconomy agenda is to overcome the environmental and socio-economic problems of the fossil energy regime, then a careful consideration of the social relations of inequality underpinning this transition is required.

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