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Collapse and Transformation? Cuba, Puerto Rico and the Energy Crisis of "Showcase" Peripheries in World-Ecological Perspective

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Abstract

The rise of oil-fueled accumulation in the global North produced an energy regime that by the mid-twentieth century was being extended to the semiperipheral and peripheral zones of the world-system. There it took the form of petroleum-driven development. This is especially the case for peripheral "showcases" in the Caribbean region. In the context of the Cold War, these two islands became opposing models of global South development—Puerto Rico's industrialization program functioning as the American empire's "showcase" to the Third World and Cuba emerging as an example of successful antisystemic developmentalism allied with the USSR. At least since the 1990s, both countries have experienced a long period of recurrent crises. Proposing a world-ecological and world-historical explanation, this article argues that while these islands represented different politico-economic regimes, both were nonetheless dependent on the oil-fueled accumulation dynamics of the capitalist world-ecology. Puerto Rico's export-led industrialization and Cuba's agrarian-based state socialism were underpinned by decades-long access to cheap oil. Thus, the crises—which have had the energy sector at its core—are in part the product of the unsustainability of their oil-fueled developmentalist regimes. Lastly, the article reflects on the ways in which the ongoing crises—and the respective responses taking place in Puerto Rico and Cuba—might prefigure some of the dilemmas that will characterize future world-ecological trajectories.

Keywords: Puerto Rico, Cuba, Developmentalism, Oil, World-System, World-Ecology

During the turn of the twentieth century, Cuba and Puerto Rico were firmly within the domain of American power. Both were invaded by the United States in 1898 during the Spanish-American War.[1] After decades of colonial and neocolonial domination and dependence on U.S. capital, the start of the Cold War and, more importantly, the Cuban Revolution of 1959 brought a new context. The two islands became contending models of Third World development. In the aftermath of Puerto Rico's 1940s–1950s export-led industrialization project under American hegemony, the island became the United States' "showcase" to the Third World (Pantojas García 1990). It presented the kind of foreign-financed, export-based manufacturing-led growth with rising per capita income, and improving living standards, possible within the parameters of American imperialism (Pantojas García 1990; Grosfoguel 2003). While not a "showcase" by design, the Cuban Revolution was, in practice, something like it: its radical path suggested the potential of development with social justice and economic equality that could be achieved by aligning with the Soviet bloc. Leaders in both countries proclaimed to be following distinctive paths and in terms of property relations, class dynamics, and ideological tendencies, of course they were. Nonetheless, both were *developmentalist projects* underpinned by an unsustainable energy infrastructure fueled and fed by imported cheap oil.[2] This is most evident in electricity infrastructure. For decades, both countries' economic progress rested on electricity generated by oil-fired power plants—a notable difference from other key Latin American developmental cases where hydroelectric plants played a central role in power generation during the period of state-led economic growth (Miller 2007).

By the 1970s the first signs of exhaustion of what one might call Puerto Rico's "showcasing golden age" (*c.* 1940s–1970s) appeared. The U.S. territory lost its preferential access to foreign cheap oil when it was trying to become an important petrochemical player in the U.S. market (Ayala and Bernabe 2009). Thirty years after those first signs of trouble the island was thrown deeper into crisis by the convergence of deindustrialization and climate change-driven events (Caraballo-Cueto and Lara 2018; Ayala 2022). In the case of Cuba, while the 1980s "Rectification" campaign signaled the existence of economic and political problems, the crisis exploded in the 1990s. The end of Soviet subsides brought by the USSR's collapse coincided with what came to be known as "A Special Period in Times of Peace" (Espina, et al. 2011) Thus, the 1990s was a period of economic emergency characterized by shortages in, among others, industrial inputs, fuel, food, and medicine. Since that moment, changing world-systemic conditions have forced the island to adapt to a lower carbon-intensive way of life while trying to innovate sustainable (both ecologically and economically) solutions to the crisis (Yaffe 2020).

[1] While Cuba became formally independent in 1902, Puerto Rico remains to this day a U.S. colonial possession.

[2] Here and throughout, I use McMichael's (2004) historically-grounded concept of developmentalism: a response—mostly led by global North institutions—to the decolonization wave of the post-World War II world-system. This project was ultimately instituted as a form of state-led economic growth with the goal of increasing per capita incomes and living standards via industrialization. For critical world-systems discussions of the historical limits of developmentalism, or of the developmentalist illusion, see, among others, Arrighi (1990) and Ortiz (2016). For a sophisticated analysis of Cold War developmentalism, see (Hussain 2025).

Today both countries are still in crisis management mode, especially in their energy sector: climate change, mismanagement, and economic decline have decimated the islands' capacity to maintain stable power supply for their populations.

A critical analysis of these Caribbean trajectories from positive examples of Third World development to sites of socio-ecological crisis makes an important contribution to the field of critical energy studies, especially to the political economy and ecology of fossil fuels. While there is a rich literature on the dynamics of carbon politics and fossil capitalism either across the Global North or on the scale of the world-system as a whole (e.g., Michell 2011; Huber 2013; Malm 2016; Ortiz 2020; Hanieh 2024), much less has been written about the role of fossil energy in the rise and fall of developmentalism and its aftermath in the periphery of the world-system—especially in comparative-historical perspective (see, however, Watts 2001; Hammond 2011; Kingsbury 2020). Likewise, there exists a tradition of political economy scholarship examining the advances and limits of Puerto Rico's capitalist model and Cuba's state socialist regime (e.g., Guevara 1972; Tablada Pérez 1987; Dietz 1989; Pantojas García 1990; Pérez Villanueva 2010; Muñiz Varela 2013). Most of these accounts focus on the economics or politics of these processes, with significant less attention paid to the role of nature—in particular energy—in the two islands' development projects (some exceptions are Berman Santana 1998; Muriente Pérez 2007; Funes Monzote 2019; de Onís 2021; Morejón Ramos 2023). Considering this, my account brings together these various literatures to examine the role of oil in the rise and fall of Caribbean Cold War developmentalism.

I approach this question from a perspective that reconceptualizes "historical capitalism" (Wallerstein 1995) as not only a world-economy but also as a "capitalist world-ecology" (Moore 2015). In this view, global capital accumulation is understood as dialectically combining the exploitation of human labor via proletarianization and the appropriation of extra-human nature via the expansion of commodity frontiers. In both instances, the main structuring principle of the system is capital's drive—always contested and resisted by workers, peasants, and nature itself—to acquire cheaper inputs to fuel long-term profitability (Moore 2015; Patel and Moore 2017). This analysis logically fits an instance such as Puerto Rico, a peripheral capitalist economy where foreign and local capitalists increase their wealth by exploiting low-wage labor and appropriating local natural resources on the cheap (Berman Santana 1998; Muriente Pérez 2007). On the other hand, while Cuba is not a capitalist economy, its planned economy has existed for decades under global capitalism. Even at the height of its incorporation into the Soviet trading bloc, Cuba still traded part of its output—between 20 and 40 percent in the 1970s (Eckstein 1982)—with the capitalist west. Since the 1980s, moreover, the government has encouraged foreign direct investment in the island. These relations with the capitalist world have important implications for the internal functioning of the socialist state, for example, reinforcing its specialization in sugar in the past and in tourism and medical services in the present. Lastly, while the effects of its dependence on imported fuel were minimized by Soviet energy subsidies, the USSR's collapse reintroduced the impact of world market dynamics to the Cuban oil sector. The island must compete now for its supply in a world-market where energy is a valuable input

for capital accumulation. In short, the trajectory of both islands has been shaped by the dynamics of a capitalist world-system predicated on the appropriation of low-cost natural inputs to fuel endless accumulation of wealth.

In the following sections I expand on these points to offer a comparative-historical analysis of the role of oil in Puerto Rico's and Cuba's trajectories during the Cold War era and after. In the first and second sections, I argue that imported fossil fuels were central in shaping their respective economic projects, especially because of the two small countries' relations to the main oil powers in the world. During their respective periods of peak developmentalism—in Puerto Rico from the 1940s to the 1970s and in Cuba from the 1960s to the 1980s—the two islands could count on historically lower oil prices. As I noted above and will expand in the second and third sections, this stopped being the case for Puerto Rico in the 1970s and for Cuba in the early 1990s. After briefly sketching these trajectories, in the third section I discuss also how the socio-ecological crises triggered by the decline of oil-fueled developmentalism has opened the door for potential alternatives to fossil capitalism. While I highlight some positive aspects in the two islands' responses to the decline of oil-fueled development, I also note the important obstacles and limitations both peripheral countries confront in their difficult transitions to post-carbon energy regimes.

Oil and Anti-Systemic Developmentalism in the Capitalist World-Ecology

The rise of oil-fueled development in the capitalist world-ecology was the result of a series of world-historical transformations that have roots in the emergence of commercial fossil fuels during the long sixteenth century (*c.* 1450s–1640s). During that era, Dutch capital drew upon cheap peat and British capital on coal-based energy to fuel accumulation of wealth in the emerging European core of the world-system (Moore 2015). This historical trend toward fossil capital was cemented in the nineteenth century, when British industrial capitalists systematically embraced coal-powered steam engines to overcome the double limit to accumulation represented by water-powered mills: adapting to nature's rhythms and worker insubordination in labor-scarce areas (Malm 2016). While these earlier moments introduced fossil fuels to capitalist dynamics, the rise of petroleum came with what Mandel (1975) called "the second industrial revolution" of the late nineteenth century. This technological leap forward produced, among other things, the modern internal combustion engine. While commercial oil was originally used mainly in the production of kerosene for illumination, the internal combustion engine cemented the trend toward oil dominance in the twentieth century.

The internal combustion engine—to which one might add the gas turbine—transformed global commodity production and transportation systems. It made the automobile the iconic consumer good of the twentieth century, and diesel engines the most important method of transportation of goods across global spaces (Smil 2010). Oil's technological innovations, moreover, provided impetus to the expansion of vertically-integrated American corporations—at the top was Standard Oil—which in the early twentieth century dominated the new global

petroleum market (Hanieh 2024). These uneven developments ultimately coalesced in the post-World War II creation of an expanding global demand for oil that coincided with the long upturn of the 1945–1973 period. Peacetime rearmament after World War II, the Marshall Plan, and the transformation of America and Western Europe into petroleum-fueled landscapes created the *definitive* link between oil and late capitalism (Huber 2013; Ortiz 2020; Hanieh 2024). Since the 1940s, then, capitalism has been completely dependent on the constant expansion of the extraction frontier to feed and fuel its productive infrastructure with cheap oil. This is demonstrated by the fact that throughout the post-World War era and up to the present periods of high profitability across the North have corresponded with low and stable carbon energy prices. On the flip side, accumulation crises have always corresponded with rising energy prices (Ortiz 2020). The economic, socio-cultural, economic, and geopolitical implications of the rise and dominance of oil (or, often more important, oil *money*) have been examined by many authors (Bina 1985; Coronil 1997; Podobnik 2008; Mitchell 2011; Huber 2013; Ortiz 2020; Vitalis 2020; Hanieh 2024). Here I want to highlight the implications of this world-ecological transformation in the energy regime for Cold War competition in the Caribbean region.

After it consolidated in the global North, elements of oil-fueled accumulation and oil-based development were extended to areas beyond the North Atlantic core. U.S.-Soviet tension and competition was a key factor. While the United States became the dominant economic and military power after World War II, this dominance appeared to be challenged by an emerging Soviet empire. Under the banner of socialism, the Soviet model represented an alternative to U.S.-style capitalism that, notwithstanding real variations among its adopters, boiled down to a developmentalist regime characterized by the nationalization of most means of production and centralized economic planning under the leadership of the Communist Party. In short, the Soviets where the founders of what Derluguian (2005) calls "antisystemic developmentalism" (see also Wallerstein 1990). While it was organized along a different set of production and property relations, throughout its existence the Soviet Union had its own version of oil-fueled development. During the 1930s, when the Soviet Union seemed as delinked as ever from the capitalist world-economy, Soviet leadership adopted American Fordism as a model for socialist mass production (Link 2020). On the basis of this emulation, the USSR inaugurated its largest automobile production plants and geared its planning to accommodate mass automobile use. In addition, it expanded its oil output to fuel its increasingly mechanized agriculture and emergent oil-based transportation system. In short order, the USSR became an oil-fueled developmentalist regime with the large-scale pollution and long-run socio-ecological degradation that this implies (Josephson, et al. 2013).

During the post-World War II years, the Soviet Union expanded its trade with the West as an energy exporter. Between two thirds and three quarters of its trade was still with countries of the communist bloc in the 1960s and 1970s (Sanchez-Sibony 2014). But by the latter decade the USSR was a leading oil exporter. In the decades between 1930 and 1970, the world's largest socialist state went from a challenger to the capitalist world-economy to a subordinate industrial and military power—an "empire of the periphery" in Kagarlitsky's (2007) view—incorporated to

global commodity circuits as supplier of cheap oil to the world market.[3] This incorporation as cheap energy supplier means that the USSR never became a truly parallel and, more importantly, *self-contained* socialist world-system. Rather, the Soviet Union became a successful semiperipheral developmental state increasingly dependent on its energy exports to maintain the social and economic guarantees that legitimized Communist Party rule (Kagarlitsky 2007). From the perspective of 1970, however, when the USSR was the second military power of the world with a massive industrial, energy, and agricultural base, the Soviet model offered a viable alternative developmental path for global South peoples wanting to break from centuries of peripheralization and immiseration of their countries under the existing capitalist world-system.

In this Cold War context of U.S. dominance and Soviet antisystemic developmentalism, the world periphery became a site of competition. Because of its strategic location in terms of military and economic affairs *and* unexpected historical developments like the Cuban Revolution, the Caribbean basin was one of the most important instances of this competition. Both the U.S. government and the USSR invested significant economic and symbolic capital in the region to increase their prestige and appeal to the Third World. On the American side, Puerto Rico saw its economic performance surpass that of most of the global South. On the Soviet side, Cuba, which was a neocolonial protectorate of the American empire in the early decades of the twentieth century, became, albeit less intentionally, a celebrated example for state socialism after it consolidated its alliance with the USSR.[4] While the United States used blockade and sabotage in an attempt to turn it into a "negative showcase" for Soviet developmentalism (Grosfoguel 2003), it is without question that revolutionary Cuba had great appeal for the Third World (Pantojas García 2023). This appeal derived from its achievements in education, health, science, sports, culture, environmental policy, and foreign policy all the while it challenged the most powerful state in history (Chomsky 2011; Yaffe 2020). For decades, then, the two islands represented opposing examples of successful developmental states with living standards significantly above those of the periphery of the world-system. Three simple but fundamental indicators should suffice for our purposes: while the gap is narrowing, for decades Puerto Ricans and Cubans attained higher literacy rates, had higher levels of access to electricity, and lived longer lives than most Latin Americans and global South inhabitants (see Table 1).

As I outline below, this success rested, among other important factors, on the precarious foundation of a carbon-intensive regime. In line with the dominant trend of the post-World War II capitalist world-ecology, material expansion and development were underwritten by cheap oil

[3] In fact, some argued that Soviet oil exports were a significant factor in the price drops that preceded the creation of the Organization of Petroleum Exporting Countries in 1960 (e.g., Goldman 1980). "Soviet dumping" pulled oil prices downward, indicating one of the ways in which Soviet oil shaped the dynamics of the capitalist world-economy.

[4] This alliance with the Soviets that did not emerge naturally from the 1959 Revolution but from U.S. foreign policy intransigence with respect to Cuba's new progressive regime and its challenging of foreign control of the island's resources. Foreign control of oil refineries was a key point of contention during the early years (Batista Reyes 1980).

(Patel and Moore 2017). In fact, the global oil market saw an extraordinary period of low and stable prices between the late 1940s and the early 1970s (Ortiz 2020).

Table 1. Select Development Indicators

	***c.* 1985**	***c.* 1995**	***c.* 2005**	***c.* 2015**
Life Expectancy				
Cuba	74	75	77	78
Puerto Rico	73	74	77	80
Latin America	66	70	73	75
Low & Middle Income Countries	61	64	67	70
Literacy Rate (%)				
Cuba	98	99	99	99
Puerto Rico	87	90	92	92
Latin America	83	87	91	93
Low & Middle Income Countries	65	72	79	83
Access to Electricity (% of population)				
Cuba	-	-	97	99
Puerto Rico	-	100	100	100
Latin America	-	86	94	97
Low & Middle Income Countries	-	-	77	84

Source: World Bank's World Development Indicators.

Note: Considering how recurrent energy crises have affected generation, Puerto Rico's and Cuba's electricity data are probably overestimated. Unless the data for the other regions is completely devoid of errors (making only Puerto Rico's and Cuba's numbers suspect), this indicator can still offer a comparative perspective. All in all, the absolute numbers should be interpreted with caution.

This period coincided with Puerto Rico's export-led industrialization program. In the case of Cuba, the era of cheap oil was further extended into the 1980s because of its imports rested on guaranteed prices that were partially protected from world-market volatility. In short, the two islands' access to different forms of imported cheap oil cemented their carbon-intensive dependent path.

Legacies Colonialism, Cold War and Developmentalism in the Caribbean

To this day, both islands generate most of their electricity supply with a small number of large and aging oil- and gas fired power plants (see Figure 1). This fossil developmentalism is now coming undone. First, small islands like these, face specific challenges on the energy front since they either lack fossil sources (Puerto Rico has basically none) or, when they have it, it is not

enough (which is the case of Cuba). Moreover, as islands, cross-border grid-sharing is more technically difficult and expensive. Second, the effects of the climate crisis, a result of fossil capital, are in full swing in the Caribbean. The region is experiencing stronger hurricanes with increasing devastation and recurrent heatwaves. In short, we are witnessing the world-ecological limits of fossil developmentalism. Below I unpack these trajectories to explain the role energy had in the rise and fall of these Caribbean showcases. I also discuss the ways in which the ongoing world-ecological crisis is imposing the need to look for alternatives. This situation has the potential (without any certainty) to produce more just and sustainable regimes.

Figure 1. Oil-Fired Power Plants in the Greater Antilles (2024)

Source: World Bank's Maps Toolkit

Puerto Rico: Petroleum-Fueled Developmentalism in a Colonial Showcase

Puerto Rico's modern energy regime has its origins in the late Spanish colonial era when early regulations and state promotion for electrification under colonial rule were implemented (Latimer Torres 1997). During this period, several private companies—combining local and foreign capital—were the main suppliers of energy. Foreign and local investors created these companies to electrify the rudimentary illumination systems of public areas—formerly done by gas lamps—in some of the largest cities. While this early infrastructure survived into the early twentieth century, it was ultimately superseded by the energy system built under American power. After the U.S. invasion of 1898, the colonial state built several hydroelectric plants that quickly came to dominate electricity generation on the island up to the 1950s. The first decades of the twentieth century thus saw a mixed system that combined electrification of cities by privately-owned companies subsidized by the state with a parallel government-run water-powered system focused on electrifying rural areas (Santos Ramos 1986; Autoridad de Energia Electrica 1992; Latimer Torres 1997).

The shift to a system disproportionately based on *imported* fossil fuels was a key element of the 1940s and 1950s epoch-making program known in English as "Operation Bootstrap" (Santos

Ramos 1986; Latimer Torres 1997; Muriente Pérez 2007). This development program—a capital-importing, export-led industrialization project predicated on exploiting Puerto Rico's cheap labor and appropriating its nature—was one of the original blueprints for export-led industrialization in the global South (Pantojas Garcia 1990; Grosfoguel 2003; Ortiz 2025). Now seen as a failed model relegated to the dustbin of history, for thirty years this program achieved rapid economic growth and a rise in living standards underpinned by increasing educational levels and health indicators—in short, it constituted the U.S. State Department's showcase to the Third World during the Cold War era (Pantojas García 1990; Grosfoguel 2003). Puerto Rico's emergence as a showcase of American hegemony and the islands' shift to "fossil colonialism" were part of the same historical process (de Onís 2021).[5]

Of course, the United States used Puerto Rico's relative success to promote the superiority of "free-market" capitalism. Interestingly, when it came to its Caribbean showcase, these principles were relaxed, and a degree of ownership and planning was accepted. The State Department's goal of presenting a positive capitalist example in the Caribbean—one that gained more significance after the Cuban Revolution—at times contradicted the short-term interests of American capitalists (Grosfoguel 2003). On the other hand, this goal coincided with the interests of a fraction of the local bourgeoisie that saw its power and legitimacy rooted in a strategy of state-led development and populist discourse (Baldrich 1981; Pantojas García 1990). The energy sector is a key example of this contradictory strategy.

As noted above, by the 1930s, private suppliers using carbon sources existed alongside a state sector drawing on water-power. This mixed regime created tensions between private suppliers and the growing state sector—especially since the public sector could sell electricity at around half the price of the private companies (Santos Ramos 1986; Latimer Torres 1997). Moreover, this disjointed system made it more difficult to plan for large-scale, long-term energy infrastructure thus potentially limiting Puerto Rico's economic growth. Considering this situation, Puerto Rican developmentalist elites and engineers advocated in Washington in favor of the nationalization of private energy providers in order to create a more centralized, comprehensive and economic system that could incorporate the costs of rural electrification and subsidized electricity for manufacturing. This proposal was initially resisted by the private companies and fractions of the bourgeoisie that considered it a form of creeping socialism (Latimer Torres 1997). As a strategic security move in the context of World War II, President Franklin D. Roosevelt approved the nationalization of the private energy producers to put all energy in the island under government management and thus economize on its use (Santos Ramos 1986; Dietz 1989). Formal nationalization, moreover, coincided with the shift to oil which at the time was a comparatively low-cost energy source, especially when hydroelectric

[5] An additional negative effect of Puerto Rico's showcasing strategy was the creation of a food system completely dependent on imports. Depending on the year and the estimate, between 75 and 90 percent of food consumed in Puerto Rico is imported (López Marrero and Villanueva Colón 2006; Klein 2018). Agriculture in the island is heavily export-oriented and, moreover, significant land area, especially in the southern part of the island, is used for experimental crops.

power capacity in the island appeared to be exhausted (Autoridad de Energia Electrica 1992; Latimer Torres 1997).[6] This world-systemic conjuncture of U.S. wartime policy flexibility, strategic interests, global oil price trends, and local energy and political dynamics coalesced in creating a state-run, fossil-fueled energy monopoly.

Figure 2. Oil-Fired Power Plant in Salinas, Puerto Rico, 2018

Source: Photograph by the author

Starting with the first large plant built in the late 1940s, in the 1950–1975 period Puerto Rico saw the building of four oil-fired power plants—located in San Juan, Toa Baja, Guayanilla and Salinas—that still today produce more than half of the island's electricity supply (Latimer Torres 1997). Although some of these plants have switched to natural gas, the fact remains that the system is still anchored in fossil fuels. Apart from the recently (and partially) privatized state sector, the rest of the generation is done mostly by privately-owned plants using coal and natural gas (López Marrero and Villanueva Colón 2006; Franco Cardona 2012). This move to a fossil-fueled energy regime was part of the transition from an agrarian economy to industrial development celebrated in modernization and developmentalist discourses. In the southern part of the island this change was literal. During Operation Bootstrap, southern municipalities formerly devoted to mass production of sugar cane were quickly transformed into capital-intensive energy production combined with some continuation of capital-intensive plantation

[6] I say formal nationalization because, as labor leader Ricardo Santos (1986) showed decades ago and others have more recently confirmed, Puerto Rico's state-run energy monopoly, since it is functionally a public corporation with autonomous financing, is structurally dependent on U.S. capital to fund its operations. For decades, it has debt-financed its activities via U.S. banks. Thus, at a certain level of abstraction, most of the power resides in the bondholders, the local elites that have managed the industry for decades, and the intermediaries that link both (Santos Ramos 1986). This contrasts with Cuba's full nationalization of its energy system in 1960. The industry is a part of Cuba's central planning system (Altshuler 1998).

agriculture of new crops that displaced sugar (Berman Santana 1998; de Onís 2021). The region includes one of the largest power plants on the island which, inaugurated in the 1970s and in visible decay today, can produce 800 megawatts of electricity with two boilers that burn fuel oil (see Figure 2). Because of this, the region is central in the development of the country. This area is also one of the poorest and most polluted. These energy industries have been mostly capital intensive and of an enclave type. In recent decades, the economic, health, and environmental costs of this strategy have reached critical levels leading to the rise of important environmental mobilization in southern municipalities of the country, especially in Salinas, Guayama, and Peñuelas (Berman Santana 1998; de Onís 2021).

In the 1960s, rather than changing course when it was still practical, the colonial bourgeoisie instead doubled down on the capital-intensive regime by attempting to transform the island into an oil-refining and exporting region. Access to cheap oil was key in this strategy. Because of lobbying by pro-U.S. colonial elites, in the mid-1960s Puerto Rico was granted special presidential exemptions from oil import quotas that were not available to other oil-importing regions in the United States (Chapman 1982; Pantojas García 1990). Thus, U.S.-owned refineries were able to use local cheap labor *and* import cheap oil directly from Venezuela and Saudi Arabia and, after processing it, export its products to the American market at lower prices than most U.S.-based competitors (Chapman 1982; Pantojas Garcia 1990). The 1970s oil crisis, however, eliminated these advantages as petroleum prices exploded and the U.S. government eliminated import quotas that, up to that point, limited the amount of cheap foreign oil entering the American market (Pantojas Garía 1990). Puerto Rico's transformation into an oil-refining powerhouse was thus short lived.

It was in this context of increasing input costs, moreover, that the local bourgeoisie began its decades-long attack on public-run power generation and, more specifically, on its leading labor union, UTIER (*Unión de Trabajadores de la Industria Eléctrica y Riego*). In the past, this union led electric utility workers to achieve some of the most important gains by labor in modern Puerto Rican history (for example, high wages, job security, generous pensions, and robust health plans). Proposing the control of labor costs in generation by buying electricity from privately-owned power plants, Puerto Rico's elite began to trace its path toward neoliberalism in the aftermath of the 1970s crisis. During this decade and after, some of the largest and longest strikes by energy workers took place (the 1977 strike, for example, lasted 118 days; while the 1981 strike lasted 81 days). Workers in the sector fought for higher wages, job security, health benefits and, significantly, for the defense of the public-owned power grid against privatization plans (Santos Ramos 1986; Fanco Cardona 2012). While in the long-run workers were not able to prevent privatization and the undermining of labor in the industry, their militancy did delay, for decades, the implementation of a radical neoliberal path in Puerto Rico's energy sector.

Contradictions like these led to the abandonment of the *expanded* oil-intensive accumulation path. The colonial bourgeoisie opted instead for pharmaceutical industries and high finance while maintaining fossil fuels as the main source of power generation. The real costs of the cheap oil strategy were deferred for some decades via debt-financing and utility rate hikes

passed onto the population (Smith-Nonini 2020). A key moment in this path toward crisis was the phasing out—over a period of ten years between 1996 to 2006—of Section 936 of the U.S. tax code.[7] Originally implemented during the 1970s to renew Puerto Rico's tax haven status in the context of that decade's accumulation crisis, this section provided special benefits to U.S. corporations investing in colonial territories like Puerto Rico (for example, it facilitated tax-free profit repatriation and profit shifting). As this change unfolded, many foreign corporations relocated to other lower-cost areas, erasing a significant source of income in the island. In time, Puerto Rico's government and its core public corporation, the Puerto Rico Electric Power Authority, began to rely more and more on debt to finance their activities (Caraballo-Cueto and Lara 2018). By the 2000s, with the convergence of recession and historic hurricanes, the recurrent deferral of the crisis via debt became untenable (Ayala 2022).

Because of colonial nature of the Puerto Rican showcase, none of the programs and initiatives implemented in the post-World War II era and into the neoliberal decades were geared toward energy sovereignty. As we will see in the final section below, this subordination to American capital and its dynamics has had severe consequences for the island. Puerto Ricans live under one of the least reliable and most expensive energy regimes existing within U.S. sovereignty (Puerto Ricans pay one of the highest electricity rates in the United States). In short, the combination of colonial showcasing and developmentalist strategies to increase Puerto Rico's standing within U.S. accumulation dynamics led to the creation of a vulnerable energy regime dependent on sources not available in the island and that, in their use, fuel the climate crisis that Puerto Ricans are experiencing every day. Hurricane Maria, which made landfall in 2017, constitutes a key world-ecological turning point in this trajectory. By causing the longest power outage in U.S. history, the hurricane imposed a search for alternatives. It revealed the tragedies that the climate crisis can bring while also making clear that a fossil-fueled energy system is not only unreliable but deadly. As I will discuss below—after a brief account of Cuba's own energy path—the island confronts at least two possible alternative paths. It could move into a more progressive regime rooted in principles of ecological and energy justice, or it could continue its uneven path toward a variant of green neoliberalism rooted in a combination of decaying fossil-fueled plants and privatized solar power.

Cuba: Petroleum Dependency and Antisystemic Developmentalism

If Puerto Rico emerged in the 1940s as a showcase that the rising hegemon presented to the world, Cuba, shortly after the Revolution, became, simultaneously, a "negative showcase" (Grosfoguel 2003) from the standpoint of American capitalist interests and a positive example for state socialism. The Cuban Revolution in fact represented a new hope even for the global North's left. As Hobsbawm (1996: 440) noted in his history of the twentieth century, "no

[7] The timing of not only this policy change but of an overall change of attitude toward Puerto Rico is significant. As Caban (2021) suggests, the collapse of the USSR and the end of the Cold War, because of its impact on Cuba's prospects, had an indirect role in diminishing the importance of Puerto Rico in the eyes of U.S. policymakers.

revolution could have been better designed to appeal to the Left of the western hemisphere and the developed countries[.] [I]t could be hailed by all Left revolutionaries." The appeal of the Revolution resided in part on a romantic view created by prominent foreign sympathizers but also, of course, on the real and laudable achievements it attained, especially during the 1959–1989 period. For decades the island ranked among the top global South countries in key indicators like life expectancy, educational attainment, and doctors per capita. Moreover, it has shown extraordinary capacity to mobilize its population for important national and international tasks, including its role in African anti-colonial struggles or its medical missions in the Third World (Chomsky 2011; Yaffe 2020). The contradictory counterpart to these advances on the social justice and anti-imperialist front was the implementation, especially after the institutionalization of the Soviet model in the 1970s, of a highly centralized political structure and top-down economic management system where popular consultation is common and practiced but where core decisions are reserved for the Communist Party vanguard (Eckstein 1982; Chomsky 2005). This tendency toward vanguardism is common among all revolutions that adopted Soviet-type politico-economic structures (Lebowitz 2012). One could argue that in the case of Cuba, moreover, omnipresent U.S. aggression and threat of military intervention has been an important factor in this tendency toward internal centralization and militarization.[8] This dynamic is the subject of many critiques of the Cuban Revolution.

What has been less examined is how most of the achievements of the Revolution, especially those directly linked to productive infrastructure, rested on what, in hindsight, proved to be an unsustainable antisystemic developmentalism that combined the adoption of Soviet-type planning, environmentally-problematic levels of oil-fueled electrification, and large-scale agricultural industrialization in order to push forward socialist construction (two exceptions are Diaz-Briquets and Pérez-López 2000 and Funes Monzote 2019). On the energy front, Cuba's antisystemic developmentalism sped up a process that predated it.

The country's oil infrastructure emerged during the late nineteenth century. In the 1890s, the island's sugar regime already achieved a certain level of energy self-sufficiency by drawing upon the country's biomass, sugar bagasse in particular. In fact, because of the lack of significant water sources, Cuba's early energy regime was based primarily on biomass, coal and, starting in the late nineteenth century, a rudimentary oil infrastructure (Castro 1984; Altshuler 1997, 1998). In 1892, the first oil refinery was built, and, in 1916, the first oil extraction site was established in the country (Gómez Jiménez 2010). These events kickstarted a decades-long rise in petroleum refining and consumption led by foreign capital. By the time of the 1959 Revolution, the new leadership encountered an economy that was, in Che Guevara's (1972: 417) words, "moved by oil." The new state nationalized energy infrastructure and achieved a six-fold increase in electricity generation by the mid-1980s (Castro 1984; Altshuler 1998). Sugar bagasse now constituted the most important *domestic* source of electricity, since most of the energy consumed

[8] U.S. involvement in the coups that toppled progressive regimes in Guatemala in 1954 and in Chile in 1973 should suffice as a sort of counterfactual here. The short-lived coup that almost ended Chavez's Bolivarian Revolution in 2002 is another case in point.

came from imported fossil fuels (Castro 1984). Socialist bloc help was fundamental in this process. The USSR and Czechoslovakia supported Cuba in the expansion of existing plants and in the construction of at least four oil-fired power plants located in Mariel, Santiago de Cuba, Nuevitas, and Cienfuegos (Oramas 1980). Still today, eight oil-fired plants—including the one with the most generating capacity located in Matanzas—represent the largest contribution to the island's total electricity supply.

Although their energy starting points differ, Puerto Rico starting from a water-powered regime and Cuba with a rudimentary fossil one combined with biomass, there is a significant world-historical parallel in the trajectory toward oil dominance in energy generation. The colonial relationship between Puerto Rico and the United States determined the former's turn to fossil fuels. In the case of Cuba, its alliance with the USSR shaped this dependent development process as the early revolutionary period saw the emergence of the trade pattern—whereby sugar (and to an extent nickel) was exchanged for oil and industrial commodities—that characterized Cuba-Soviet relations for decades (*New York Times* 1971; Eckstein 1982; Sanchez-Sibony 2014). Cuba's formal incorporation into the Council for Mutual Economic Assistance (COMECON) in 1972 cemented its intensive use of imported fossil fuels in agricultural production and electricity generation. From the perspective of the Communist government, this new reliance on fuel imports was a sign of international solidarity among socialist states. As part of its incorporation into the "socialist division of labor," COMECON countries received 60 percent of Cuba's exports and, in return, the island received oil and other goods on the basis of guaranteed prices. In these deals, especially when credit was involved, Cuba received preferential treatment (Eckstein 1982; Díaz Vázquez 2010). Moreover, this trade arrangement minimized the swings of world oil prices that became a norm after the 1973 energy crisis. As Fidel Castro (1984) noted, in the quarter century that passed between 1960 and the mid-1980s, Cuba never had an energy crisis because there was never any significant shortfall in supply—thanks to what Fidel described as the Soviet Union's fair trade with Cuba. This was atypical in a Third World context where the 1970s were marked by energy price shocks caused by world-market volatility (Castro 1984).

While it deepened its reliance on oil imports during roughly the same period as Puerto Rico, in Cuba this shift to the intensive use of oil did not coincide with an industrialization process based on manufacturing. While the Cuban leadership promoted industrialization and strategically allocated resources in this direction, the country's antisystemic developmentalism was rooted in *agricultural* industrialization (Guevara 1972; Funes Monzote 2019).[9] Mechanization via the introduction of tractors and the large-scale use of petroleum-derived pesticides and fertilizers took off dramatically during the post-1959 period. In fact, this capital-intensive path led to a 77 percent decline in professional sugarcane cutters between the late 1950s and early 1970s (Funes Monzote 2019). Contradictorily, important sustainability programs co-existed with this tendency towards agrarian industrialization. For example, a massive reforestation program in the area of

[9] Another key difference to this day, moreover, is the fact that Cuba has its own oil reserves which, although not sufficient to supply its total demand, can cover around half of its electricity generation (González Castillo 2010; Suárez et al. 2012).

Las Terrazas, in Artemisa Province, is an important achievement that took place during the era of large-scale agrarian intensification and is today an example of Cuba's new ecotourism strategy. This notwithstanding, the post-1959 period saw the area cultivated increase and landscapes transformed as agrarian specialization reached its symbolic peak with the unsuccessful 10-million-ton sugar harvest campaign of 1970 (Díaz, Díaz Vázquez, and Valdés Paz 2012; Funes Monzote 2019).[10] Because output growth was now predicated on an increasingly petroleum-based infrastructure, campaigns such as the 10-million ton sugar harvest deepened the country's dependence on imported Soviet oil.

By the 1980s, top officials showed concern regarding these trends. In 1984, during the country's first national symposium on energy, Fidel (1984) spent a significant part of his intervention on the matter of the island's reliance on petroleum. He highlighted the need to reduce waste, conserve energy and, furthermore, expressed his wishes that the three oil-fired plants that were being built at the time would be the last ones to be erected in Cuba. In addition to the energy sector narrowly understood, experimentation with ecologically sustainable practices in agriculture were also emphasized in the 1980s (Castro 1992; Yaffe 2020). In fact, the low input *organopónico* method of organic urban farming associated with the Special Period was innovated in the 1980s (Yaffe 2020). Nonetheless, by that point dependence on Soviet imports had set in because the socialist state had constructed an agrarian and energy regime deeply reliant on fossil fuels. In 1991, the vulnerabilities implied in this configuration exploded into a massive economic crisis. In the thirty-plus years since the end of the Soviet era, Cuba has had to improvise more sustainable practices that might prefigure elements of a future socialist world-ecology. For example, some scholars have praised its innovations in organic farming and its capacity to maintain a reasonable level of human development amid an unexpected and dramatic drop in the use of fossil energy (Levins 2005; Miller 2007; Li 2010; Yaffe 2020; Engel Di-Mauro 2021). Thus, the post-Soviet period in Cuba can be examined in terms of its *potential* combination of a reformed (and hopefully more participatory) planning system and ecological sustainability. I unpack this argument in the next and final sections, contrasting the Cuban path with that of Puerto Rico, the other former Caribbean showcase that has since the 2000s fallen into its own long-term crisis. In both instances the energy sector has a central role.

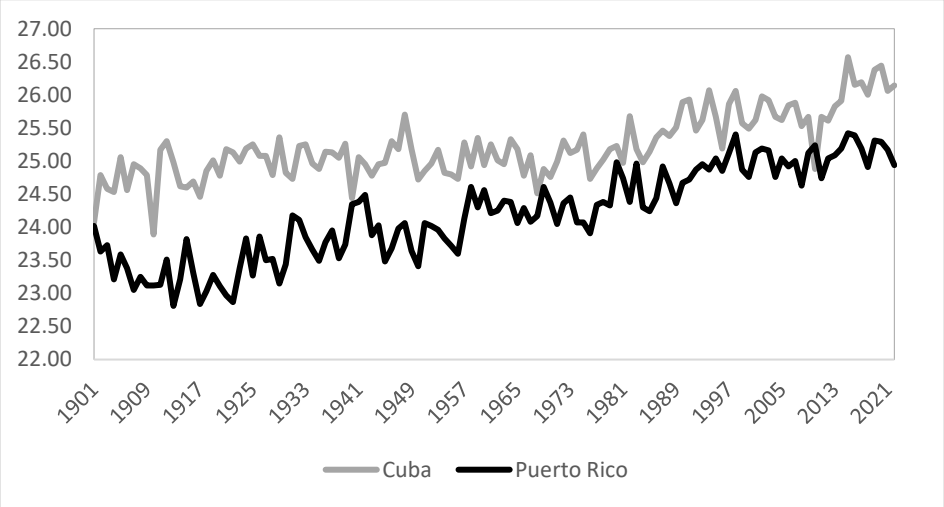
Cuba and Puerto Rico in the Eye of the World-Ecological Storm

Climate science shows that just as oil joined coal in fueling and feeding the material expansion of the post-World War II capitalist world-ecology, the clouds of global warming were darkening. CO_2 concentration in the atmosphere advanced relentlessly in this era of fossil-fueled accumulation. Since the 1970s, warming trends have accelerated (Hansen, et al. 2006). Like in previous climate-related disasters in the history of global capitalism, the peripheral zone of the world-system is experiencing the worst effects of the climate crisis (Roberts and Parks 2007).

[10] The harvest that year was 8.5 million tons, still the largest in Cuba's history.

The Caribbean experience is illustrative. While Latin America and the Caribbean contribute around 4 percent of world CO_2 emissions (in 2020), the Caribbean in particular is one of the world regions most impacted by climate events, especially tropical storms. It is also witnessing recurrent heatwaves as temperatures increased by more than 1 degree Celsius in the past century in Puerto Rico and by 2 degrees in Cuba (see Figure 3).

Figure 3. Mean Annual Temperature (Celsius Scale)



Source: World Bank's Climate Change Knowledge Portal

These higher temperatures put more stress on already degraded energy grids. In addition, the global oil economy on which these two countries depend is reaching its world-ecological limits. Petroleum's price floor registers a long-term upward trajectory since the 2000s as extraction becomes costlier and less profitable at the systemic scale (Moore 2015; Ortiz 2020). All these indicators are expressions of the limits of oil-fueled developmentalism.

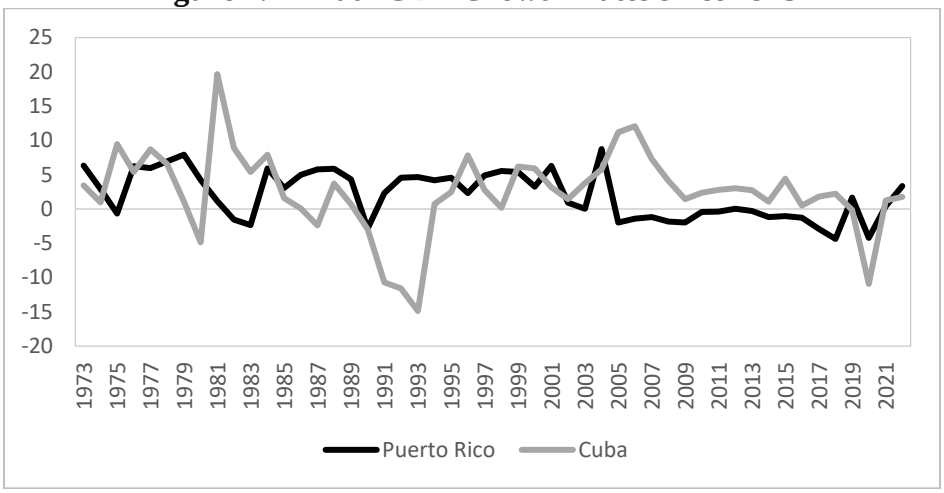
Under these new conditions, in fact, Cuba's and Puerto Rico's economic performance in the past few decades has been marred by recurring periods of slow and even negative growth (see Figure 4). Can this transition from peripheral showcases to sites of socio-ecological crisis and transformation be in part prefigurative of future trajectories in the capitalist world-ecology? In other words, are these islands undergoing changes—economic, ecological *and* political—that suggest what may come in the near future, especially in oil-importing economies of the Global South? While Cuba's case might make sense for this argument, Puerto Rico might not. Thus, let us start the discussion there.

Tropical Neoliberalism Challenged: Hurricane Maria and Potential Left Alternatives

Starting in the 1980s, the post-World War II gains that made Puerto Rico into a showcase have been undermined by the realities of peripheralized neoliberal accumulation: declining growth rates, population decline in part via emigration, racialized inequality, ever present social violence

and intensifying environmental degradation embedded in the island's peripheral industrialization project and its financialized successor (Muñiz Varela 2013; Pantojas García 2019; de Onís 2021).

Figure 4. Annual GDP Growth Rates since 1973



Source: World Bank's World Development Indicators

In the two decades that have passed since 2005 the country has had positive GDP annual growth of more than two percent only once, in 2022 (see Figure 4). In addition, Puerto Rico has been experiencing increasingly devastating hurricanes in recent decades. Hurricane Hugo in 1989, Hurricane Marilyn in 1995, and Hurricane George in 1998, for example, all caused varying levels of devastation and fatalities. In September 2017, however, the big one hit: Hurricane Maria brought sustained winds of more than 157 miles per hour (225 km/h); dropped a whopping 40 inches (100 cm) of rain leading to massive flooding; left almost the whole island under months-long blackout as the fossil-based electricity system collapsed; and tragically resulted in the death of thousands (between 1,000 and more than 4,000 depending on the estimate). The impact of the hurricane led to a general realization that the island needs to move beyond fossil fuels, not only because of its role in climate change but also because of the irony that fossil-fueled energy regimes are themselves vulnerable to climate change. As Carmona Báez (2018) and Klein (2018) have suggested, hurricane Maria constitutes a historical turning point that has opened the space for more radical proposals that seek to move beyond fossil colonialism. In fact, Klein (2018) and de Onís (2021) show that there is a vibrant environmental movement—one seeking ecological and energy justice—that has gained traction since the hurricane. At this point, of course, this new path remains a possibility and not a certainty. This possibility is the result of the failures of Puerto Rico's neoliberal elites.

The fate of the neoliberal administration in power when the hurricane hit suggests this appreciation is reasonable. At first, the government took advantage of the crisis to push for the

privatization of the state-run fossil-fueled power plants. Applying neoliberal talking points, it argued that the blackout and general chaos in the electricity system resulted from the simple fact that state-run industries don't work (they are costly, slow, wasteful, inefficient, etc.). The government passed a series of executive orders toward privatization while also drawing on recent laws, passed in the late 2000s and early 2010s, to attract U.S. capital to the island with new offers of low taxes and opportunities for investments on the cheap (Quiñones and Irrizary-Seda 2020). The same administration, moreover, had proposed plans to transform Puerto Rico's electricity generation regime into one completely fueled by green sources (solar, air, etc.). Nonetheless, its proposed path was that of green neoliberalism: achieving sustainability via privatization and financialization.[11] This neoliberal government, however, did not survive the crisis. Scandals associated with the government's response to the emergency—including the corrupt contracting of dubious U.S.-based companies to rebuild the energy grid—ultimately led to massive mobilizations and protests. By the summer of 2019, less than two years after the hurricane hit, Puerto Rico's governor, Ricardo Roselló, saw himself confronted by days-long protests and almost universal calls for his resignation. Ultimately, Roselló resigned in August 2019. This was the first time such popular-led resignation happened in the country's history.

In 2020, another neoliberal technocrat from the same political party replaced the defeated Roselló administration. While not a complete and final privatization, one of the "achievements" of the successor administration was the partial privatization of the energy grid. The state still owns the assets but private companies from the United States and Canada—LUMA Energy and Genera PR—manage this infrastructure to generate and deliver electricity for profit. Since then, prices have increased, and power outages have gotten worse. Discontent with the ways the energy system works is at its highest. Moreover, an additional form of *de facto* privatization is already emerging. By 2024, around 100,000 consumers had some form of solar power installed (Gómez 2024; Serrano 2024). Aside from businesses that can incorporate this cost, the major share of the consumers (in this case, households) accessing solar power is basically renting (or financing sometimes under detrimental conditions) the equipment. Those who own their solar panels belong mostly to the upper middle-class and bourgeois sectors of the country. From this angle, the demise of fossil colonialism on the island might be replaced by a new energy inequality based on the combination of a decaying fossil-fueled grid with privatized solar power (Santiago, Lloréns, and de Onís 2022).[12]

[11] This potential path is, of course, found in other global South places (see, for example, Ferrando et al. 2021 and Deb 2024).

[12] In addition, as Santiago et al. (2022) argue, even the ongoing plans for utility-scale solar power—via "solar farms"—in Puerto Rico's south has its own socio-ecological contradictions. It competes with agricultural land, adding to Puerto Rico's already critical lack of food self-sufficiency.

Nonetheless, important political changes are taking place that suggest a potentially more progressive direction in the country's politics. Puerto Rico's 2020 elections, the first elections *after* the 2017 hurricane, were arguably exceptional and might hint at changes to come. Because of centuries of colonialism and a century-long work of U.S. political, cultural, and economic domination over Puerto Rico (a domination in which a significant share of the local bourgeoisie participates), people on the island are still culturally and politically amenable to pro-capitalist, pro-U.S. establishment discourses. But the cultural legitimacy of capitalism and colonialism seems to be, to some extent, beginning to decline. Considering this, anti-establishment political parties (some with some significant left tendencies) and organizations overperformed at the polls in recent elections. In 2020, Puerto Rican anti-establishment parties—when counted together—gathered almost 30 percent of the vote, something unheard of in the country's contemporary history. In the 2024 elections, an even more atypical outcome took place: an alliance led by Puerto Rico's largest pro-independence party (*Partido Independentista Puertorriqueño* or PIP) came in second place after getting 30 percent of the votes. The PIP had come in second place only once in the past, in the 1952 elections (in 2016, for example, it had received only two percent of the vote). It would be wrong to interpret this result—30 percent of the vote for an avowedly anti-colonial party—as a clear-cut vote against Puerto Rico's continuing relationship with the United States. However, considering the ways parties in the island align with different policies on the economic and energy front, the new centrality of left-leaning and progressive political parties implies a reopening for forces advocating in favor of ecological justice and a post-carbon energy regime like, for example, those described by Klein (2018) and de Onís (2021). It is unreasonable to argue that Hurricane Maria was *the* cause of all these changes. But this historic storm did unmask the accumulating dangers of fossil-fueled capital accumulation, the neoliberal elite's arrogance toward the working class and the urgent need for alternative modes of food and energy production and of norms of consumption.

Today this socio-ecological transformation is still in its nascent stage, and it represents mostly the potential that an island like Puerto Rico becomes an example of a more just world-ecology. The post-Hurricane period has to some extent *imposed* the search for alternatives. There is in the southern part of the island a vibrant environmental activism that opposes the continuing expansion of carbon energy (while also fighting against green neoliberalism). These southern movements have similarities with older movements that exist in the center-west of the island where the organization Casa Pueblo has been leading anti-mining, pro-renewable energy mobilizations for decades. These mostly local organizations see energy justice as part of a larger anti-colonial struggle (Massol González 2019; de Onís 2021). Both types of movements, which can function as a bottom-up counterpart to progressive parties seeking state-power (such as the

PIP noted above), gained a new legitimacy and popularity in the aftermath of the hurricane (Klein 2018).

Of course, progressive forces—both those from below and those seeking power at the top—confront immense obstacles, especially the combined power of fossil colonialism and its local representatives. Thus, while a left-progressive way out of the crisis is possible more than it was 20 or even 10 years ago, it is far from certain. What is clear, however, is that oil-fueled developmentalism is in ruins. The question is what will replace it: either a left-progressive alternative or a fully privatized system of electricity generation that combines the decrepit fossil-fueled plants (now run for profit) with hundreds of thousands of middle and upper middle-class households using private solar panels. Here a counterpoint with Cuba, whose moment of truth preceded Puerto Rico's by a decade and where attempts in the direction of ecological justice have gone further, provides another instance of the ongoing demise of oil-fueled developmentalism in the Caribbean.

Saving the Revolution? Cuba's Special Period as Forced and Incomplete Shift

Cuba's post-Cold War performance has been the basis for important reflections that consider what a regime that puts social and economic justice first can achieve even under the most unfavorable conditions (see, for example, Carmona Baez 2004; Espina, et al. 2011; Morris 2014; Yaffe 2020; Engel Di-Mauro 2021). This type of analysis has the merit to provide some balance to a left discourse overwhelmingly obsessed with the critique of capital without paying too much attention to what anti-capitalist forces that are already in power can teach us. Here I draw on these analyses, placing them in a world-systemic and world-ecological framework that emphasizes the role of petroleum dependence on Cuba's incomplete shift to a post-carbon regime.

As described above, Cuba's pre-1991 socialist achievements, especially those tied to sugar growing, industrial output and electricity generation, were oil-fueled. In 1991, when the USSR collapsed, Cuba's socialist state had to confront its unsustainability almost overnight. In light of the disappearance of Soviet inputs, between 1991 and 1994, the country experienced the worst crisis of its revolutionary era. As Figure 4 shows, GDP growth simply collapsed in the early 1990s (see also Espina, et al. 2011; Morris 2014). The rapid economic decline brought shortages of fuel, food, medicines and other consumer goods. By 1994 the crisis led to protests (such as the so-called Maleconazo) and a wave of migration unlike anything seen during the previous 30 years of the Cuban Revolution.

Fidel Castro called this new era a "Special Period in Times of Pace"—a title indicating the need for wartime-like mass mobilization to confront the anticipated shortages and overall

economic slowdown that would follow the end of Soviet support.[13] The goal was to save the socialist regime and, if needed, to transform Cuba into the last defense of world socialism (Castro 2000). In short order, Cuban officials pivoted to a strategy that combined socialist planning with market reforms, increasing openness to foreign capital, and epoch-making experimentation and innovations in energy and agriculture (some of which were already in some stage of development in the 1980s).

On the energy front, since the 1990s the Cuban government, drawing on foreign investment, increased its local oil extraction efforts leading to important growth in nationally sourced fuel (Pichs Madruga 1996). Thus, while in 1990 local oil accounted for only 10 percent of national electric energy consumption, this proportion increased to almost 50 percent by 2007 (González Castillo 2010). This expanded local extraction was complemented by a significant increase in oil imports during the 2000s. These now arrived from Bolivarian Venezuela which replaced the Soviet Union as Cuba's main economic partner during those years (Morris 2014). This new relationship with Venezuela helped improve not only energy but overall performance. As Figure 4 shows, Cuba's GDP saw a significant upswing in the 2003–2006 period and then maintained a comparatively positive performance until around 2016. The short-term success of the combination of local reforms and Venezuelan partnership was evident in the decline in blackouts throughout the 2000s.[14] Ironically, Venezuela's energy solidarity might have deferred Cuba's transition to sustainable energy.

In any case, Cuban intellectuals and part of the leadership are aware of the contradiction inherent in this strategy. Oil is a key driver of turbulent geopolitical and economic dynamics in the capitalist world-ecology, Cuba does not have enough of it and, more importantly, its use is a leading cause of climate change. Thus, in the mid-2000s, after various hurricanes and blackouts impacted oil-fueled generation, Fidel Castro announced a program for an "energy revolution." Since then, politicians, scholars, activists and communities have sought to increase energy production, efficiency and conservation. There is also a new emphasis on the need to transition to a post-carbon energy regime based on renewable sources, most importantly, solar and wind power. The most visible impact of the energy revolution was the installation of more than a thousand small generators throughout the island to make the system less centralized and less vulnerable to weather events or foreign attacks (Yaffe 2020). But these seem to run mostly on fossil fuels (Suárez, et al. 2012). In addition to this, scholars have noted the difficulty the country

[13] I say "anticipated" because, as Yaffe (2020) notes, this new period was officially declared in 1990, before the actual collapse of the USSR. In fact, in speeches from 1989, Fidel had already hinted at the real possibility that the socialist bloc and the Soviet Union could disappear.

[14] Unfortunately, these have become increasingly worse in the past few years, but they are comparable to those witnessed in Puerto Rico after 2017. I have been in the two countries in the past few years—since 2019 I have visited each country twice (Puerto Rico in 2019 and in 2023; Cuba in 2023 and in 2024). In both cases I spent time mainly in urban areas which, of course, have better service overall. I experienced longer lasting blackouts in Puerto Rico. Since then, I have been in contact with family (in Puerto Rico) and friends (in Cuba) and, not surprisingly, both islands are experiencing blackouts—something which can be unbearable and dangerous in the context of the hot and humid Caribbean climate. Now, however, Cuba's situation is much worse than that of Puerto Rico.

faces in growing what is potentially its principal green energy goal, solar power. The direct and indirect labor and land requirements implicit in achieving significant solar-based electricity go beyond what the Cuban state can accomplish given its financial (and other resource) constraints and the context of a global system that is still ruled by capitalist forces (Hornborg, Cederlof, and Roos 2019).

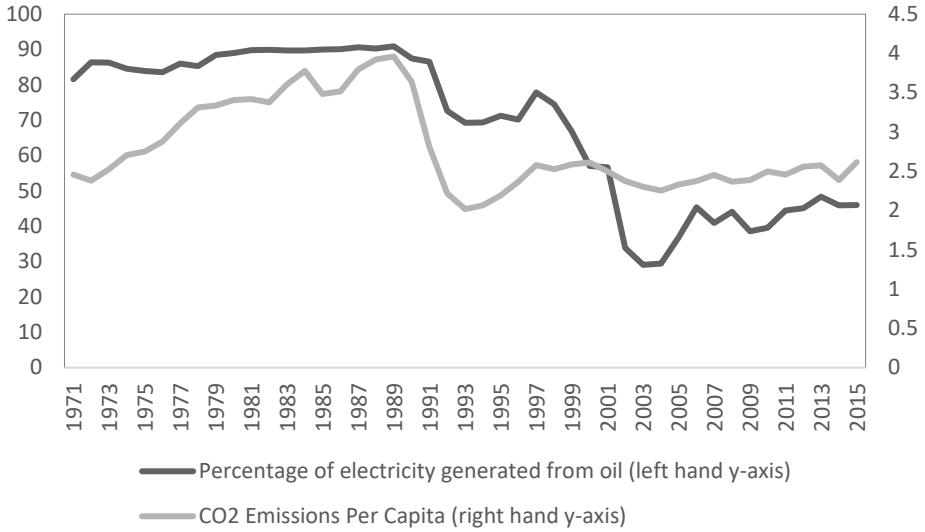
The energy revolution in power generation is still an incomplete project. Sustainability efforts are more visible in the transportation sector. In Cuban streets today, one sees the coexistence of its well-known fleet of inefficient and emission-intensive classic cars loved by tourists with a boom in the number of electric vehicles. What is even more important from an ecological impact perspective, most Cuban electric vehicles are micromobility ones: namely, electric bicycles and electric motorcycles.[15] The origin of this change was the sudden and forced degrowth in carbon-intensive transport triggered by the Soviet crisis. In addition to forced degrowth, the continuing lower emissions are also the result of state regulations that pushed energy conservation, the use of renewables and that have made micromobility electric vehicles cheaper than gasoline-powered alternatives. These new vehicles put more pressure on the electric grid, but they do so at lower levels than what a U.S.-style push for larger electric cars would. In short, even if in the context of a push for local oil extraction and an inflow of Venezuelan oil, countervailing tendencies have produced a real reduction in carbon intensity probably unmatched in the rest of the world. The country saw both its oil consumption and its CO_2 emissions decline dramatically in 1991 and have never increased back to its 1990 level (see Figure 5).

Agriculture, another sector that first collapsed and then temporarily reemerged following the end of Soviet deliveries of petroleum, has moved even further in this new direction toward a more ecologically sustainable regime (Altieri and Funes Monzote 2008). In the aftermath of the Soviet terminal crisis, the Cuban government began transferring state-managed agricultural land to peasants and small farmers. In the cities, it encouraged and supported the growth of urban agroecological farming, something visible today as urban farms are commonly found throughout cities (Morejón Ramos, Sotolongo Gutiérrez, and Carbonell Hernández 2022). All of this required immense effort, especially since it took place in the context of a rapid adjustment to lower input organic agriculture. The conventional Green Revolution resources and machinery that underpinned pre-crisis farming had stopped arriving or functioning for lack of inputs or replacement parts. As Altieri and Funes Monzote (2008) reported, by 2006 Cuban peasants using low input agroecological farming supplied more than half of the country's food albeit using only 25 percent of the land. By 2007, moreover, Cuba's food system, combining expanded local production and imports, was able to feed its population at higher levels that most of the rest of Latin America (Altieri and Funes Monzote 2008). This uptick took place, of course, amid the

[15] Interestingly, this development has been reported by U.S. commercial publications that specialize in motorcycles and electric vehicles. Outlets like *Electrek.com* and *Revzilla.com*, for example, have published pieces praising Cuba's transportation revolution. Unfortunately, this has gone mostly unnoticed in US progressive circles which are not immune to a culture obsessed with the "comfort" and "safety" offered by ridiculously large pickup trucks and "sport utility vehicles."

mid-2000s recovery noted above, one in which the new alliance with Venezuela played a critical role.

Figure 5. Cuba's Oil-Based Electricity and CO_2 Emissions



Source: World Bank's World Development Indicators

Since the first Trump administration in the United States—which brought a tightening of the blockade and, indirectly via its sanctions on Venezuela, a new decline in oil imports—and the COVID pandemic, Cuba has reentered a period of crisis. Like in the Special Period, blackouts and shortages of fuel and food are again an everyday reality, something I witnessed during my stays in the island in 2023 and 2024. Prices were skyrocketing as economic activity slowed down.[16] Lines at gas stations could take tens of hours to wind down, a result of the fuel shortage. In my view, even under these conditions, Cuba's socio-ecological transformations of the 1990s and 2000s exist as examples of what could be achieved under a regime where market forces and capital accumulation are constrained by the mechanisms of planning and public control of the main means of production. At least until the early 2010s—before continuing internal shortcomings were joined by new U.S. sanctions, the Venezuelan crisis, and the pandemic to produce the current situation—the country was able to maintain its impressive achievements in health, education, security, and equality while dramatically reducing its carbon emissions and overall impact on ecosystems. Because of this, various scholars still see Cuba as a kind of model for some form of ecologically sustainable socialism (Li 2010; Yaffe 2020; Engel Di-Mauro 2021).

[16] One case in point: during my 2024 stay in El Vedado neighborhood of Havana, a tray of 30 eggs could go for 3,000 Cuban pesos while a diner for two at a restaurant could be even more than that. This in a context were monthly salaries for, for example, educators or other professionals employed by the state could be around 4,000 and 5,000 pesos a month at that time.

This does not mean that Cuba is free from internal contradictions. The legacy of Soviet socialism and its police state tendencies still exist, albeit in much milder form than in the period of alliance with the USSR. The inefficiencies inherent in an over-extended planning system that is not matched by actual resources to allocate or by the capacity to successfully implement plans adds another layer of difficulties. In addition to this, the recent setbacks caused by the reluctance to deepen popular control of the economy (which exacerbate the problems brought by the pandemic crisis and the tightening U.S. blockade) has created a sense of dissatisfaction and disillusion even among many Cubans sympathetic to the Revolution's goals. Recent protests in reaction to price increases and recurring power outages are an indication of this dissatisfaction. In this context, a young generation of left-wing intellectuals and activists is calling on the state to renew its socialist project. These advocate for more democratic and participatory approaches to the crisis, particularly those that defend the critical legacies of the Cuban Revolution's historic leaders while incorporating more popular involvement in economic management and political decision-making to resist both neoliberal privatizations and bureaucratic corruption (e.g., Solar Cabrales 2020; Teuma 2024).

In short, left critiques of Cuba's missteps are understandable. Notwithstanding this, I believe that the primary goal of the international left with respect to Cuba should still be the ending of the U.S. economic blockade and its regime change policy against the island. One possible outcome of an end to the blockade would be that things remain the same and in time the failure of Cuban socialism could be declared. Another possible outcome, however, is that under those more favorable conditions, Cuban socialism could show its full potential (even the democratic potential that remains stunted in part because of the ever-present menace of U.S. intervention). Under more favorable conditions it could trace a path toward a more ecologically just and sustainable socialist regime led by popular forces, prefiguring what a future socialist world-ecology could look like. Both scenarios are possible, but the U.S. political establishment's refusal to risk the possibility of a successful socialist example in the Caribbean suggests that, in a world where the blockade did not exist, the failure of Cuban socialism would be far from guaranteed. In any case, the Cuban people do not have the luxury to wait for these favorable conditions. They continue to navigate a difficult transition to a less carbon-intensive and lower input economy under increasingly unfavorable conditions.

Conclusion

Today we are witnessing the crisis of oil-fueled growth in two islands that for decades represented successful examples of peripheral development by the standards of Western Cold War capitalism. The shift to cheap petroleum during the Cold War era contributed to some of the most impressive achievements in the global South in terms of incomes and industrialization (in Puerto Rico) and in terms of socio-economic guarantees and international solidarity (in Cuba). But it is now evident that oil-fueled accumulation and oil-fueled antisystemic developmentalism cannot be part of a path forward. Fossil fuels are no longer completely compatible with sustained

profitability, as the various recent global accumulation crises show (Ortiz 2020). Moreover, for peripheral capitalist states like Puerto Rico, oil-based growth has reinforced subordination to imperial power while degrading local socio-ecological conditions. This has led to the rise of alternative projects in the Caribbean island. As of today, these are still only nascent but suggest an important potential for a combination of bottom-up mobilization with a progressive movement at the top in the direction of a more sustainable regime rooted in ecological justice and self-determination. Since the late 2010s, books by authors like Naomi Klein (2018) and Catalina de Onís (2021) have suggested this potential. Future research could take these contributions into account and expand this field by providing more detailed comparative and world-historical perspectives than the one briefly sketched here. This would help clarify the specific structural obstacles to ecological justice found in peripheral areas of the capitalist system.

On the other hand, for socialist forces, oil-fueled antisystemic developmentalism has resulted in difficult dilemmas, since revolutionaries want to succeed in the impossible task of building socialism while incorporating into the global capitalist fossil-fueled regime. This tactic proved to be a dead end for the former Soviet Union and moved China into a partial restoration of capitalism. In this context, Cuba, as arguably the only remaining state socialist regime in the world, presents an important instance that should be examined and debated. For now, I would argue that Cuba's current difficulties show that any future socialist world-ecology needs to draw on the best aspects of the socialist tradition, for example, a fully democratized planning process (which implies a deeper updating of the Soviet-type planning apparatus that still functions in the island) combined with an emphasis on anti-imperialism and global working-class solidarity (which have been, and are still, central in Cuba's revolutionary process). But these elements need to converge with a genuine commitment to build a socio-ecological regime that moves beyond the appropriation of nature on the cheap to fuel endless production growth.

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