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Fossil fuel interests in Puerto Rico: Perceptions of incumbent power and discourses of delay

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ABSTRACT

This study explores perceptions of fossil fuel interests and the role narratives of fossil fuel obstruction play in slowing down the renewable energy transition in Puerto Rico. We analyzed interviews conducted with 56 "energy actors" engaged in Puerto Rico's energy system about their visions of the system's future and perceptions of the influence of different actors in promoting change or reinforcing the status-quo. The analysis also examined the use of discourses of delay in participant interviews using a framework proposed by Lamb et al. (2020). Our interviews revealed that a wide range of energy actors perceived obstruction by fossil fuel interests as shaping Puerto Rico's energy transition, and used discourses of delay to describe Puerto Rico's energy transition, but also employed narratives that countered this obstruction and resisted fossil fuel interests. The results depict the conflicted nature of Puerto Rico's energy transition: on the one hand there was widespread agreement across a wide range of actors that the future of Puerto Rico's energy system would eventually be renewable based, and at the same time, there were significant doubts that a renewable transition could or would occur. The complex interplay among perceptions of the influence of fossil fuel interests, discourses of delay, and narratives of resistance and community power offers insights into why renewable energy deployment has been slow in Puerto Rico, despite the possibility of a rapid transition after Hurricane Maria devastated the energy system in 2017 and ambitious energy policies were passed.

1. Introduction

Energy system transformation requires not only an increase in renewable energy generation, but also a parallel phaseout of fossil fuel extraction and use [1,2]. While the past decade has seen a rapid increase in renewable energy generation [3], global phaseout of fossil fuel supply is still elusive. Powerful incumbents, including those profiting from continued fossil fuel reliance, have strategically invested in perpetuating fossil fuel dependence and delaying a transition away from fossil fuels [4,5]. Despite growing research and policy advocacy for a fossil fuel phaseout and global coordination on a Fossil Fuel Non-Proliferation Treaty [6], detailed analysis of perceptions of the influence of fossil fuel interests in slowing down energy transitions in specific contexts is minimal. While recent research on climate obstruction reveals how fossil fuel interests leverage narratives and discourse to delay climate action and slow down the transition to renewable energy [7–9], to date there is not much research exploring discourses of delay in specific places, or the resistance to these discourses [10].

Puerto Rico is a specific context in which understanding the perceptions of the influence of fossil fuel interests and use of discourses of delay is particularly important. Puerto Rico is a Caribbean archipelago with a highly contested political landscape characterized by coloniality. Puerto Rico, which has been a territory of the United States since Spain ceded it in 1898 [11], is reliant on fossil fuels, despite needing to import

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all fossil fuels and having high potential for renewable energy [12].

After Hurricane Maria decimated the electric grid in 2017, leaving some communities without power for almost a year, there was a distinct window of opportunity for an accelerated renewables transition. In *Battle for Paradise*, Naomi Klein documented how multiple competing interests sought to take advantage of this window of opportunity to promote vastly different visions of the future [13].

In 2019 Puerto Rico passed ambitious climate targets including a plan to transition to 100 % renewable energy by 2050. However, more than six years later, only 3 % of Puerto Rico's energy currently comes from renewables [12], suggesting that despite the potential for a rapid transition, the fossil fuel regime has remained stable. While the path dependency of energy systems partially explains this stability, scholars also point to the importance of the legitimacy (or loss of legitimacy) of key actors in maintaining (or destabilizing) regimes [14–16]. Narratives play a key role in creating and maintaining the legitimacy of energy systems [17]. Analysis that explores the narratives that reinforce fossil fuel reliance can reveal and expose mechanisms through which fossil fuel interests seek to retain their legitimacy.

This study explores perceptions of fossil fuel interests and their role in the renewable energy transition in Puerto Rico to better understand how the fossil fuel regime has remained stable after Hurricane Maria and the collapse of the energy system. We analyze interviews with 56 people engaged in Puerto Rico's energy system about their visions of the future of Puerto Rico's energy infrastructure and perceptions of the influence of different actors in promoting and obstructing change. Conducted in the summer of 2021, interviews took place during a critical moment in Puerto Rico's energy transition. Five years after Hurricane Maria, participants reflected on their initial visions of transformation and how these visions have or have not been realized. Interviewees were also asked to map key actors on a diagram indicating their perceptions of which actors had more or less influence, and whether those actors were focused on transformation or maintaining the status-quo fossil fuel regime.

This analysis explores perceptions of the power and influence of fossil fuel interests in slowing a renewable transition and identifies the use of discourses of delay in the narratives of participants using a framework proposed by Lamb et al. [9]. By studying perceptions of fossil fuel interests, this paper connects the growing literature on climate obstruction to literature on sustainable transitions and the role of powerful incumbents in stabilizing the status quo regime. By analyzing perceptions of key actors in Puerto Rico's energy system, we uncover how discourses of delay are leveraged in a colonial context to perpetuate the power and influence of incumbents as well as the contestation and resistance that emerges to counter this power.

2. Theoretical framing

2.1. Sustainable transitions, the politics of transition and the stability of regimes

The literature on sustainable transitions highlights that the strength of existing socio-technical regimes tends to be reinforced by the power of incumbent actors who invest heavily in resisting change [15]. While the conditions that enable expansion of niche innovations are well-documented, less studied are the strategies that maintain incumbency even when there is growing policy and economic support for the intended transition [16].

The literature on energy transitions recognizes the tension between the interests of the existing fossil fuel regime to maintain the status quo and the interests of niche actors trying to promote more distributed renewable energy [16]. Because renewable energy transitions represent a fundamental threat to the legitimacy of fossil fuel actors and those benefiting from continued fossil fuel reliance, responses to the potential of transition can include obstruction of climate action (both climate policy and public support for climate action) in attempt to block change and maintain relevance in the face of change.

Transitions research also describes how disruptive events can destabilize the mainstream regime [16]. Under certain conditions, the status quo stability can be abruptly threatened [18]. The devastation of Puerto Rico's energy system by Hurricane Maria in 2017 represents one possible example of this sudden destabilization of a previously stable system. In the aftermath of Hurricane Maria, the mainstream discourse shifted to highlight the window of opportunity for rebuilding the island's energy systems with renewable energy instead of fossil fuels [19,20].

2.2. Climate obstruction

Despite the growing global urgency to transition away from fossil fuels towards renewable energy [21], energy system change has been slow [22]. Recent social science research demonstrates how powerful interests have used multiple tactics to strategically delay renewable energy deployment and perpetuate fossil fuel reliance [8,10,23–26]. This intentional denying, slowing, or blocking of policy or action on climate change is collectively known as "climate obstruction" [27].

This research reveals decades of strategic investment in climate denial and efforts to obstruct climate action and policy [27–30]. To date, most research has focused on the United States [7,31], but climate denial and delay are occurring globally [10,32]. Many powerful individuals and organizations strategically influence energy policy to ensure the continued exploration and extraction of fossil fuels [2], and most fossil fuel producers have no plans to phaseout production [3]. Additionally, the financial influence of fossil fuel interests in politics contributes to elected officials sustaining the policy and regulatory regime that perpetuates fossil fuels [25,33] and continuing the subsidization of fossil fuels [34–36].

Given the increasing public awareness of climate change and interest in renewable energy, obstruction strategies have necessarily grown more sophisticated. While the more frequent and intense impacts of climate disruptions have made it more challenging for fossil fuel interests to outright deny the climate crisis, delay strategies are an increasingly effective form of climate obstruction [8]. As part of this strategy, fossil fuel interests have invested in coordinated efforts to promote alternative narratives about why the transition is slow and why continued fossil fuel use is essential [4,5]. Large multinational fossil fuel energy companies acknowledge the positive potential of renewable energy and sometimes publicly showcase their own investments in renewable energy [4] while remaining focused on sustaining the exploration and extraction of fossil fuels.

Specific delay tactics are numerous, multi-faceted, politically complicated, and analytically difficult to characterize, but it is equally important to identify discursive strategies of delay – these are the narratives that are repeated and perpetuated to justify delay. Lamb et al. [9] has identified four distinct discourses of delay (with associated subcategories). These discourses negate the responsibility, necessity, desirability, or possibility of ambitious climate action. Importantly, they contain partial truths and may (but not necessarily) be put forward in good faith, and so the identification of these narratives does not necessarily mean that underlying motives are malicious. For this reason, these discourses can be highly effective, particularly in contexts where policy goals and priorities are highly contested. In the absence of high-quality public discourse, discourses of delay can "disorient and discourage" ambition ([9], pg 3). Fossil fuel actors alone do not create and maintain discourses of delay. Many actors, including professionals working in the energy sector, internalize these discourses and legitimize them by focusing on the risks and challenges of transitioning from fossil fuels to renewables [26,37].

Lamb et al.'s typology describes four primary discourses: 1) redirect responsibility, 2) push non-transformative solutions, 3) emphasize the downsides, and 4) surrender [9]. A key strategy of redirecting responsibility is individualism, which redirects responsibility from

systemic change towards individual action and personal responsibility. Other strategies under redirect responsibility include "whataboutism," which raises concerns that this is not the place where the problem is the worst, and attention should focus elsewhere, and the free-rider excuse that raises concerns that others will benefit if action is taken. Narratives pushing non-transformative solutions promote ineffective solutions and draw attention away from more substantial and effective options. A goal of these narratives is to avoid options that are threatening to existing power structures. A key strategy is technological optimism, which places unrealistic expectations on (future) technologies to address the problem. "Fossil fuel solutionism" in which the fossil fuel industry is promoted as part of the solution, often drawing on arguments of cleaner fossil fuels, is another common strategy for pushing non-transformative strategies. Others include attention to targets without corresponding action and measures that provide carrots but no sticks. Narratives that emphasize the downsides imply that climate action carries more risk than climate change impacts. One particularly effective strategy is to appeal to social justice, focusing on the unjust burdens that can emerge from climate action. It is of critical importance to consider these injustices, but when injustices are only considered for climate action, and not for the status quo, or potential benefits are ignored, these narratives can constitute delay. Surrender narratives focus on how change is impossible or that it is already too late to make a difference.

3. Background

3.1. Energy in Puerto Rico

Puerto Rico is representative of island nations that rely heavily on fossil fuels for electric power, are highly vulnerable to climate disruptions, and have rich solar resources well-suited for renewable energy generation [38,39]. Puerto Rico does not have any domestic methane gas, petroleum, or coal resources: all fossil fuels are imported. Nonetheless, like the US Virgin Islands and Guam [40,41], it remains heavily dependent on fossil fuels and has struggled to incorporate renewable energy.

Energy policy in Puerto Rico must be analyzed in the context of Puerto Rico's territorial relationship with the United States. Historically, Puerto Rico's energy system received significant investments as part of the United States' post-WWII project of modernization and industrialization known as "Operation Bootstrap" [19,20,42]. Operation Bootstrap included the adoption of government policies designed to actively recruit private investment through tax breaks and special loans, build facilities for manufacturing, and take advantage of a cheap labor force on the southern coast, all of which required reliable centralized energy [42]. Production is located primarily on the southern coast, where poor and marginalized communities bear the brunt of the associated direct health and environmental costs [19,43–45].

Hurricane Maria in 2017 triggered a system-wide collapse of the energy system, leaving more than three million people in the dark, some for as long as 329 days, —-the longest blackout in US history [46]. While Hurricane Maria was the proximate driver of the loss of electricity in 2017, the extent and length of the blackout were predictable outcomes resulting from a long history of lack of investment and poor management of the energy system connected to the territory's debt and lack of decision-making authority [47,48]. Preferential tax codes encouraged investments that benefitted the interests of U.S. manufacturing and pharmaceutical industries, but left Puerto Rico with increasingly unsustainable debt. As a territory, Puerto Rico has not had the option to declare bankruptcy [49]. In 2016, the Puerto Rico Oversight, Management, and Economic Stability Act (PROMESA) empowered a newly-formed fiscal control board to oversee and approve budgetary decisions for the territory [20]. As a result of the prioritization of debt repayment over other potential funding priorities, Puerto Rican public services have been increasingly hollowed out to service the debt, leading activists to describe the debt as "odious"—a term that calls into question the legality of the debt on humanitarian and human rights bases [50]. While once held up as a model energy system, decades of significant underinvestment and neglect resulted in a fragile system characterized by frequent blackouts, high costs to consumers, and lack of reliability [44]. These conditions laid the foundation for the disaster experienced after Hurricane Maria.

After Hurricane Maria, the potential to rebuild and reconstruct with a renewable-based energy system was discussed widely among energy actors [13,19,51,52]. Major investments in recovery could have enabled Puerto Rico to end its reliance on expensive imported fossil fuels ([51]; Queremos [20,53]). In 2019 the Puerto Rican government passed the Puerto Rico Energy Public Policy Act (Act 17) which mandated that Puerto Rico obtain 40 % of its electricity from renewable resources by 2025, 60 % by 2040, and 100 % by 2050. The law also mandated the phasing out coal-fired generation by 2028. However, in 2022, 43 % of Puerto Rico's electricity generation came from methane gas, 37 % from petroleum, and 17 % from coal [12]. It appears unlikely that Puerto Rico will achieve either the outlined near-term or and long-term targets [54,55].

3.2. Key actors in Puerto Rico's energy sector

A small number of private companies control the generation of electricity in Puerto Rico: Landfill Gas Technologies (gas), Horizon Energy (oil and gas), Gasna 18P (gas), EcoEléctrica (gas and oil), and AES Puerto Rico (coal, oil, and gas) [56]. There are also numerous small renewable energy companies focused on solar and wind (Table 1). In 2021, the distribution and transmission of electric power in Puerto Rico was privatized. LUMA Energy, a new private company, replaced the long-standing public provider, Puerto Rico Electric Power Authority (PREPA) for the distribution of electricity [57]. Neither LUMA nor PREPA have prioritized investments in renewable energy; in fact, since Hurricane Maria, there have been increased investments in LNG [58–60].

In addition to energy producers (both fossil fuels and renewables) and the institutions responsible for transmission and regulation, Puerto Rico's energy landscape includes community organizations and NGOs. This is a diverse group: some represent large mainstream US-based environmental groups, while others are local grassroots organizations, often motivated by public health and environmental justice concerns.

Table 1
Generation of electricity in Puerto Rico.

Name	Public/ private	Source of electricity	Production
Fossil fuel-based			97 %
AES Puerto Rico, LP	Private	Coal, oil, gas	
Autoridad de Energía Eléctrica de Puerto Rico	Public	Coal, oil, gas	
EcoEléctrica, L.P.	Private	Gas	
Gasna 18P, LLC	Private	Gas	
Horizon Energy, LLC	Private	Oil, gas	
Landfill Gas Technologies	Private	Gas	
Renewable-based			3 %
AES Ilumina, LLC	Private	Solar	
Coto Laurel Solar Farm, Inc.	Private	Solar	
DG Solar Lessee, LLC	Private	Solar	
Humacao Solar Project, LLC	Private	Solar	
Maximo Solar Industries	Private	Solar	
Oriana Energy, LLC	Private	Solar, wind	
Pattern Santa Isabel, LLC	Private	Solar, wind	
Punta Lima Wind Farm, LLC	Private	Wind	
PV Properties, Inc.	Private	Solar	
San Fermín Solar Farm, LLC	Private	Solar	
SunE W-PR1 and WMT PR2, LLC	Private	Solar	
SunEdison Puerto Rico, LLC	Private	Solar	
Sunnova Energy Corporation	Private	Solar	
Windmar Renewable Energy, Inc.	Private	Wind	

Source: PR Energy Bureau (https://energia.pr.gov/directorio/).

4. Methodology

We conducted semi-structured interviews with 56 "energy actors" during the summer of 2021. Interview participants were selected through a non-probability approach, following a combination of purposive (targeted experts) and snowball sampling that aimed for a diverse set of actors within the Puerto Rican energy sector. These actors were identified based on preliminary research identifying the main agencies and organizations involved in Puerto Rico's energy system and its transformation in the context of post-Hurricane Maria. The sample is not intended to be comprehensive, but rather provide insights into the perspectives of key actors. Small n qualitative interviews offer the opportunity for granularity and in-depth consideration of complex themes that other methods can miss. Based on their current or most recent professional position related to the energy sector, interview participants included fourteen government officials who held positions in the US federal government, Puerto Rican government, or local municipal government, twelve private sector professionals from fossil fuel or renewable energy companies, who were engaged in energy generation, transmission or distribution, ten representatives from NGOs who worked for organizations based both in Puerto Rico and in the mainland US, ten community leaders who held leadership roles in community organizations as well as individual climate and environmental advocates, eight academics who were university professors or graduate students, and two union workers from the Union of Electric Workers of Puerto Rico (UTIER) (See Table 2). We recognize that perspectives on energy transitions in Puerto Rico are correlated with political affiliation, and particularly for local government representatives, this shapes the way that actors may envision energy futures. Our sample does not contain sufficient representatives of local government to be able to reflect on this dynamic in the responses to our questions.

Two members of the research team, both native Spanish speakers, but not Puerto Rican, conducted all interviews. Most interviews were conducted in Spanish, with the exception of interviews with US-based policymakers who elected to conduct the interviews in English. Several members of the research-team are Puerto Rican and have been active participants in Puerto Rico's energy system. Their local knowledge, expertise, and contacts were critical for identifying and enrolling key actors. The study was approved by Northeastern University's human subjects review board, and all participants gave informed consent to participate in the study. Given the prominent roles some participant's hold within Puerto Rico's energy landscape, there is a risk that through the identification of their role, individuals could be identified. Most participants agreed to have their responses be attributable. When requested, we have maintained anonymity of responses.

Interviews discussed participants' perceptions of the current status of the energy system; how recent crises have affected the system, who they saw as the key actors influencing the energy system, visions of potential future energy systems, and what they believed the barriers are to achieving those visions (see Appendix for the full set of questions). Thirty-two interviews were conducted in person in Puerto Rico, and 24 were conducted remotely via Zoom. Each interview was recorded, transcribed, translated, and coded by the research team in the qualitative coding software NVivo.

A codebook was developed to guide analysis of when and how fossil fuels were mentioned in the interviews (See Appendix). Direct mentions of oil, gas, coal, and fossil fuels were identified, and then the context and key themes of those mentions were characterized. The codebook also identified key actors mentioned and barriers to change. These results were tabulated and key themes identified. Next, we analyzed our interview data for evidence of discourses of delay, using the framework proposed by Lamb et al. [9]. Interviews were coded for the four primary discourses and their sub-components to identify narratives that aligned with each discourse. Some text aligned with multiple discourses; text could be coded with multiple discourses. Quotes were selected to be representative of narratives found across multiple interviews. Finally, we identified narratives of resistance to obstruction and alternatives to the discourses of delay present in the interviews. Interviews were coded for resistance and key themes identified. Quotes were selected to be representative of key themes.

Table 2
Roles of interview participants.

Role	Number of interviews
Government	14
Private sector	12
NGO	10
Community leaders	10
Academics	8
Union workers	2
Total	56

At the end of the interviews, participants were asked to map key actors in Puerto Rico's energy system on a diagram that included four quadrants representing a vertical spectrum ranging from actors with a high level of influence to a low level of influence and a horizontal spectrum ranging from actors supporting transformation to actors reinforcing the status quo. Thirty-five (63 %) of participants completed the diagram. Participants listed between 3 and 22 actors (mean = 10.3). Respondents were free to add actors as they felt appropriate; some listed broad categories of actors such as NGO, government, etc., while others listed specific individuals or organizations. We synthesized the responses into groups of actors (i.e. University of Puerto Rico and academia were grouped together), and tabulated aggregate responses to produce a synthesis chart documenting the perceptions on the role of different actors in Puerto Rico's energy system (Fig. 2). When there were divergent responses on the influence or direction of an actor (i.e. some respondents identified an actor as supportive of the status quo and other as pushing for transformational change), the actor is included in multiple quadrants of the aggregate diagram.

5. Results

Our interviews reveal recognition of the power and influence of fossil fuel interests in Puerto Rico. The interview transcripts also include narratives that utilize discourses of delay to describe Puerto Rico's energy transition. At times, the interviews demonstrate the prevalence of narratives that were explicitly resisting fossil fuel interests by promoting local, community-based grassroots activism.

In addition to fossil fuel interests, participants also identified other barriers to a renewable energy transition. One of the other main barriers that participants included was the political "crisis" in Puerto Rico. Respondents described party politics leading to non-ambitious public policies, "vested interests," cronyism, and colonialism as barriers. The US Congress and the fiscal control board were described as barriers, often linked to the "colonial regime" in which "everything is going to work in the light of the interests of the United States", and many interviewees highlighted the extractive, exploitative, colonial relationship that Puerto Rico has with the United States. One interviewee explained that "*for the United States, the most convenient thing at the moment is the perpetuation of the colony in order to retain some benefits*." Beyond the disempowering coloniality of the political realities of Puerto Rico, other barriers that were mentioned included social barriers, such as communication and socialization of a plan to transition, or a social "resistance to change."

5.1. Perceptions of the role of fossil fuel actors

Fossil fuel companies were frequently mentioned as key actors in Puerto Rico's energy system. Across our sample, 83 % of respondents discussed fossil fuels or specific fossil fuel companies, despite not having any interview questions that explicitly asked about fossil fuels. The frequency of mentions varied by the positionality of the participant. 100

% of community leaders and union members addressed fossil fuels in their interviews. Private sector respondents were the least likely to explicitly mention fossil fuels, but even among this group, 75 % of respondents mentioned fossil fuels. Twenty-four respondents discussed coal, 29 discussed oil and 37 of the 56 interviews discussed gas.[1] Specific mentions of particular fossil fuels by different actors are described in Fig. 1.

The interview transcripts reveal competing narratives about the role of fossil fuel interests in Puerto Rico's energy transition. While there was broad acknowledgement in the interview data that fossil fuel interests were slowing down the pace of transition and limiting investments in renewables, some key actors reinforced the narrative that continued fossil fuel reliance was a necessary part of the gradual transition.

For some participants, the idea that reliance on fossil fuels was a key source of vulnerability was a key theme. As this NGO member stated: *"María showed the number of people who depend on these large fossil fuel-based plants. María showed that this dependence, in line with our centralized system, denotes vulnerability"* (July 19, 2021). Similarly, a community leader connected reliance on fossil fuels and lack of control over energy to the perpetuation of this vulnerability: "*Our dependence on oil is insane from the point of view that we do not have control over how to buy that fuel, we have follow what the big interests decide, those who have it available for use"* (July 9, 2021).

The language used by participants to describe fossil fuel interests emphasized their strong political power. Participants spoke of "the oil cartel" and "the gasoline mafia," and connected the economic power of fossil fuel interests with political influence. As one community leader described:

> *For me (the biggest problem that PREPA and Puerto Rico's public electricity system had) is that it responded to a fossil fuel agenda. This (agenda) was put together and perpetuated, and a system of resistance to change was imposed by this model of dependence on fossil fuels, of burning (fuel). I mean, and that economic power dictated the political power and the dynamics (of the electric system), and there was no Governor who could do anything about it.* (June 21, 2021)

In this account, even the governor was deemed powerless in the face of fossil fuel interests. This and other interviews highlighted the disparity in power that participants observed between fossil fuel interests and other actors.

Participants identified the lobbying power of specific fossil fuel companies as a barrier to renewable energy transformation. This lobbying was not viewed as an abstract strategy: participants pointed to specific individuals and their lobbying efforts. For example, several participants discussed the fact that the current Governor of Puerto Rico, Pedro Pierluisi, was formerly a lobbyist in the Puerto Rican Congress for one of the major US fossil fuel companies operating in Puerto Rico. One government official and community leader stated,

> *Pedro Pierluisi was a lobbyist for the AES company, for the coal company, here in the Senate and the House. So, you have a person that comes directly from the fossil companies in Puerto Rico and that, as everyone knows, works for this company that uses methane gas. Therefore, they do not have much hope in the governor.* (June 9, 2021)

Respondents reflected on the revolving door between the fossil fuel industry and the government. Many participants identified political corruption as a barrier to transitions. Participants linked political corruption, obstruction by political actors, and fossil fuel interests. For example, when asked about their expectations of LUMA and the future that LUMA could facilitate, respondents said that they did not think renewable energy would be prioritized because of the interests of fossil fuel companies and the fossil fuel lobby. A government official commented:

> *I do not see them moving very much to do a transition to renewable energy because LUMA's hands are tied by their partnered companies, which have interests in natural gas. So that's why I think that those people are going to create some corporation here in Puerto Rico to sell fuel and they are going to act against our interests.* (June 28, 2021)

Many interviews singled out gas companies as the most influential actors in slowing down an energy transition. Participants identified not only the promotion of fossil fuel sources as a barrier to a transition to renewable energy, but also raised concerns that the infrastructure system associated with gas production in particular created lock-in for the future, as this community leader and NGO member described:

> *The barrier is the natural gas methane industry, the companies like LUMA and its affiliates. I already commented that they want to rebuild the system in the image of the 20th century… Gentlemen, in the image of the 20th century! They want to go back to rebuilding centralized long-distance transmission until the supposed transition with new gas plants in this country… the fact that they control to some extent the governmental decisions, that is the problem that we have. That the economic strength and the power that these corporations like LUMA Energy or AES have that sell oil to the people (*June 26, 2021)

Respondents saw this obstruction as politically-motivated, and articulated this as a motivation across governance scales, from local to federal, as this NGO leader described:

> *The model that the government was trying to promote is one that supports the current model of fossil fuels in centralized plants, and this is reflected in the plans that the legislature and the federal government have already presented to make a transition to natural gas (*July 19, 2021)

Related to the theme of the political motivation for fossil fuel reliance was the theme of promoting privatization over public control of the energy system. A lawyer and activist described the deterioration of the existing system as a purposeful strategy intended to lead to privatization.

> *The generation component of the plants is private—there is the coal plant in Guayama, there is Ecoelectrica, and there are already some small windmills, etcetera, and renewable energy producers. But the transmission and distribution system, along with most of the plants, is managed by a public corporation, and it was in a state of deterioration that had been denounced for almost a decade. But this was a deliberate and voluntary deterioration by the political class that unfortunately has controlled PREPA for a long time. When we say it is on purpose, it was on purpose because it was abandoned and not maintained…This makes those who depend on the electric system, and the population, get angry with the distributor, which is only one and public, PREPA, the public corporation. And then they come up with this magic solution that we are going to privatize.* (August 27, 2021)

Participants drew connections between the promotion of fossil fuel interests, political power, and privatization, pointing out the importance of energy systems for promoting multiple political and economic goals.

Alignment of fossil fuel interests with the power and influence of the Puerto Rican government, PREPA, LUMA and the colonial, capital-dependent, extractive relationships these public and private entities have with the United States also emerged when participants were asked to map key actors in the energy system on a quadrant that represented their level of influence (from high to low) and how transformative they were (reinforcing the status quo or pushing for change). Different participants reported diverse perceptions of which actors have the most power and which actors are more or less transformative (Fig. 2).

PREPA was consistently mentioned as being influential but not transformative, and community organizations were consistently described as transformative (but with divergent views regarding their

[1] We use the terms "methane gas" or simply "gas" but refrain from using the term "natural gas," although this was a term used by interview participants. The term "natural gas" is associated with discourses of delay [4].

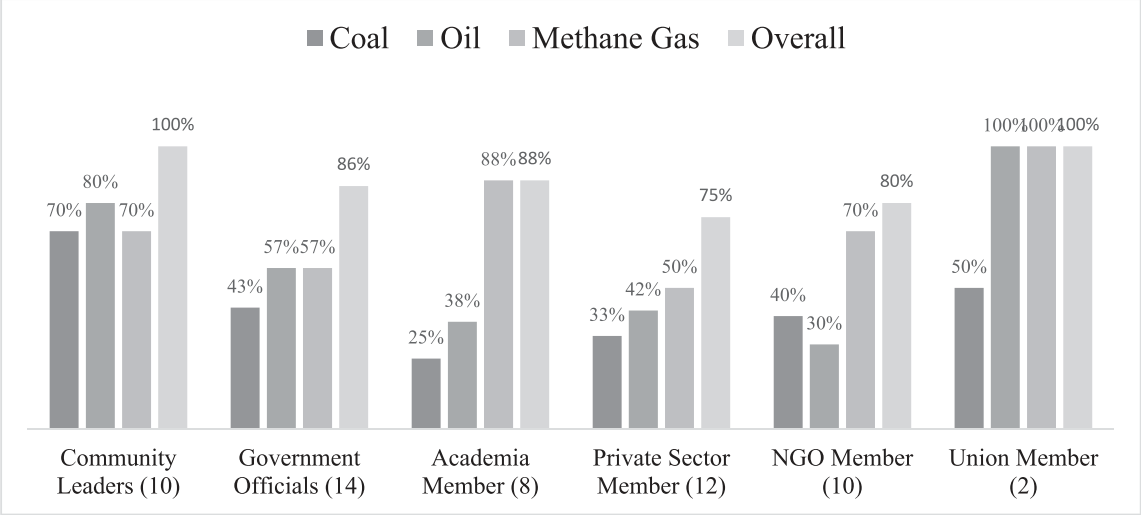

Fig. 1. Mentions of fossil fuels by different actors.

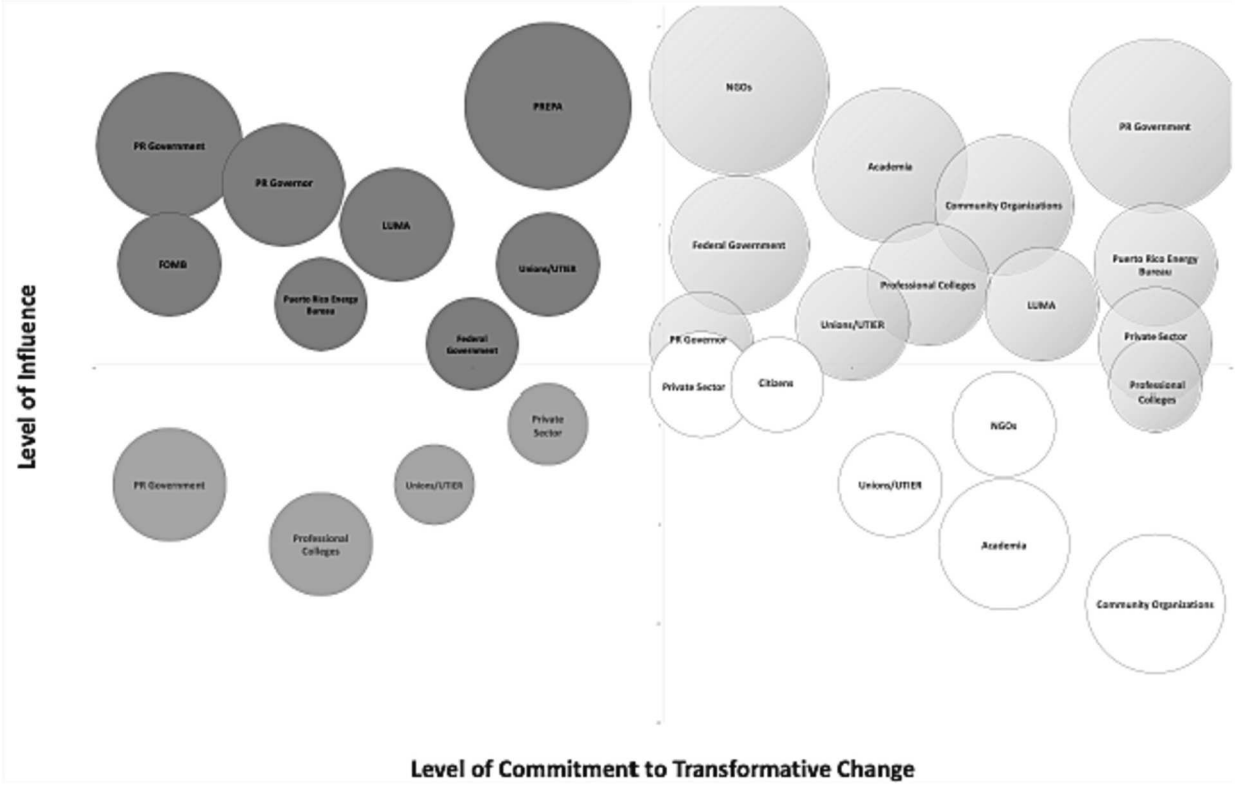

Fig. 2. Perceptions of key actors' level of influence (top quadrants represent perceptions of high level of influence and lower quadrants depict perceptions of low-levels of influence) and level of commitment to transformative change (right quadrants represent perceptions of high commitment to transformative change and left-side quadrants depict perceptions of reinforcing the status quo and low-levels of commitment to transformation). The size of the circle represents the comparative number of interviewees who mentioned each category of actor.

level of influence). The Puerto Rican government was viewed by most (but not all) as influential, but some thought the government was transformative while others thought the government reinforced the status quo. Despite being mentioned frequently in the full interview transcripts, in this exercise mapping key actors, fossil fuel companies were only explicitly mentioned in a few interviews.

Given that the current make-up of the Puerto Rican energy system is predominantly fossil fuel-based, where actors landed on the spectrum of how transformative they are can be interpreted as whether they are perceived as reinforcing or resisting fossil fuel interests. From this lens, the results show a complex landscape where some respondents see the Puerto Rican government and other powerful actors as transformative and others perceived them as endorsing the status quo.

While the incumbent power of fossil fuels is visible in this diagram, the transformative commitments of community organizations who are resisting and countering fossil fuel interests also emerged strongly. Overall, respondents identified more actors as promoting transformative change compared to the status quo but held differing perspectives as to

the relative influence of these actors.

Finally, the divergent perspectives on the role of numerous key actors indicates that there is no consensus on the positions of key actors. This finding is perhaps not surprising, given that interviews were conducted at a pivotal moment in Puerto Rico's energy transition. The entrance of LUMA as a key actor was a prominent event reshaping the landscape of energy actors, and disrupting the established roles and influence held by other actors. The divergent perspectives represented in this diagram are indicative of the potential instability of incumbent actors and the uncertainty regarding the future of Puerto Rico's energy system at this moment in time.

5.2. Discourses of delay

While participants identified ways that they saw explicit obstruction by fossil fuel interests as playing a role in delaying Puerto Rico's energy transition, more broadly, interviews contained multiple examples of discourses of delay. A wide range of actors, from government officials and the private sector to community leaders and activists included explanations consistent with discourses of delay, suggesting that these discourses are not limited to specific actors. Despite widespread agreement among participants that a renewable transition was eventually likely, many interviews also contained evidence of discourses of delay. While all four discourses of delay were present, certain narratives appeared to resonate most strongly in the Puerto Rican context.

5.2.1. Redirect responsibility

The delay strategy of redirecting responsibility by pointing to others who are not taking action was not a strong theme in these interviews. One example where this narrative was present, however, was when a representative of LUMA explained the lack of progress by arguing that corruption and the Puerto Rican people's resistance to the elimination of corruption (which she argued was part of the change that LUMA offered) slowed down progress.

> *Right now I think it's an issue of general resistance to change. The way that both the government and the consumer had been accustomed to receiving electric service is very different from the LUMA proposal. So we're seeing resistance from many, including the classic example, no, from the legislature. Public legislators who were used to accessing the information they needed to keep their constituents informed in an informal way.... Now there are rigorous processes and there are established channels of contact … once this format is stabilized and once the public gets used to it and learns to relate in this new way with the company that provides the electric service, I think everyone will be better off* (June 23, 2021)

Here it was not that responsibility for a renewable transition is being shifted to individuals, but this narrative still deflected responsibility for a successful transition from the private sector. Instead, the private sectors was presented as improving systems so that everyone will be better off, and individuals (and the legislature) were blamed for resisting progress.

There was some evidence of the second common strategy to redirect responsibility—whataboutism. This approach raises arguments that it is more important to take action elsewhere. This narrative is particularly effective in the context of developing countries, where appeals to climate justice draw attention to historical responsibility for emissions of industrialized countries and per capita emissions are used to promote delay. Puerto Rico's unique position as a part of—but also apart from—the United States, complicates these narratives. Interviews connected Puerto Rico's colonial status to delay. As one community leader articulated, this relationship lowered expectations for a renewable transition and enabled delay:

> *We are a colony, we are oppressed by an oppressor who throws crumbs at us, and we believe that it is the greatest thing because we believe that there are other people on the planet more screwed up than us. (*July 9, 2021)

This strategy functions like whataboutism, but in reverse. This respondent argued that Puerto Ricans accepted delays not because they believe those more responsible should act first, but because they accepted not being prioritized for a rapid transition.

Others also argued that the colonial relationship between Puerto Rico and the United States promoted fossil fuels but for other reasons. Unlike the delay strategy described as "whataboutism" where the strategy is to argue that action should be taken elsewhere, this participant argued that that action elsewhere was the driver of delays in Puerto Rico.

> *More and more electric utility generating plants are closed in the United States, while the public policy in place in Puerto Rico is trying to bring more natural gas. In the US it is decreasing and here it is increasing. That very important colonial issue must be brought up. I'm personally excited that Biden is taking a stand against Trump to change policies that benefited fossil fuels. This brings some hope, but the relative one is that they close there and more fossil fuel companies open here.* (August 16, 2021)

This comment serves as an important reminder of the cross-scalar and interconnected nature of energy transitions, and the potential interplay between progress in one place and delay in others.

5.2.2. Push non-transformative solutions

Narratives pushing non-transformative solutions were widespread across interviews, most notably narratives regarding the role of gas as a bridge fuel, a narrative in line with the strategy of fossil fuel solutionism. Part of this fossil fuel solutionism involved acknowledging the benefits that fossil fuels have provided in the past, as this quote from an NGO activist illustrates:

> *By the end of the 80s it was possible for everyone to have electricity…Its service purpose has been achieved by fossil fuels. I believe that this universal service is something positive because we know that many people in the world do not have that network.* (July 6, 2021)

Such narratives point to the positive social contributions of fossil fuels.

Many stakeholders discussed the ways fossil fuel companies would lose out in a renewable transition, while also describing a transition to renewables as inevitable. A common narrative was that fossil fuel companies would be able to transition their business models to profit in a renewable future.

> *Of course, those who sell fuel will be harmed. Everyone who has a business selling fuel, well the big oil companies have already invested in renewables… They will have to change their business, they will have to adapt to provide maintenance to solar farms, solar parks, rooftop parks, parking lots. They have to move a little more, but the work will be there; it is a matter of adapting.* (June 28, 2021)

Although this narrative does not immediately look like a discourse of delay, it presents a vision of the future in which a renewable transition occurs without disrupting the power dynamics of the fossil fuel industry.

A wide range of actors reflected these narratives in their interviews, as illustrated by the following two quotes, from a NGO member: *"We need renewable energy and those are the goals, but first we have to make the transition to natural gas"* (August 16, 2021) and a representative from a fossil fuel company: *"Renewable energy alone is not going to solve all the problems or be the solution for all the issues that are needed"* (August 16, 2021). Both quotes are exemplary models of discourses of delay; they support a transition to renewables, but argue that it cannot be done quickly. These examples also illustrate the complexity of discourses of delay: while Lamb et al. [9] present a typology of discourses, they acknowledge that in reality, narratives can reflect multiple discourses.

These examples combine pushing non-transformative solutions with discourses of surrender.

In this quote, a member of the federal government discredited a strategy based on renewable energy over concerns regarding diversification and avoiding silver bullets, glossing over the fact that a renewable energy strategy does not necessarily rely on a single technology or type of generation.

> *I think [Act 17, calling for 100% renewable energy] should be given more thought and look for alternatives like natural gas. I go back and push on natural gas as one of those economic, clean alternatives to generate energy and not just put all the.... we are an island, so being an island, we cannot think in only one type of technology, only one type of generation. We have to diversify our portfolio and not necessarily by what is fashionable at the moment or what is ideal for a state, for a jurisdiction to establish. (*August 25, 2021)

Although not explicitly stated, implicit in this narrative was an appeal to concerns regarding a lack of reliability of renewable energy, a concern that resonated particularly strongly in Puerto Rico given the extensive experience with unreliable electricity. Consistent with discourses of delay and overlapping with strategies that emphasize the downsides of climate action, however, this concern for reliability, was only raised for renewables, despite the history of a lack of reliable electricity in a fossil fuel-based system.

Another important strategy for pushing non-transformative strategies is technological optimism, suggesting that it will be easier to make these changes in the future. In the Puerto Rican context, we did not observe this strategy manifesting as pure optimism for the future. Instead, narratives that justified lack of action based on the poor state of technology today were juxtaposed with technological optimism about the future.

> *We do not have a world-class system, not only the transmission and distribution part, but in the renewable energy injected system is not available, but we have a blank slate that we have now to draw what we really want as an emerging technology. So I think we can play with innovation and move there—Puerto Rico is definitely going to be a world laboratory for this type of transition, but it takes more time and I think we are going to see important changes in that direction in the next 15 years.* (August 19, 2021)

As this quote illustrates, many participants saw an opening for innovation, but at the same time, such narratives also justified delayed action.

A quote from a representative from LUMA also illustrates how complex discourses of delay can be. This representative positioned LUMA as a proponent of a renewable transition, consistent with fossil fuel solutionism, a narrative sharply in contrast to the way most other participants in our sample perceived LUMA. In response to the question of how to overcome the barriers to Puerto Rico's energy transition, this participant responded:

> *By creating a resilient, clean energy system, by ceasing to depend on crude oil, and avoiding the political ups and downs that determine the future of the electric system in Puerto Rico. We cannot, we cannot continue as it happened before where the political administrations, whichever they were, were basically the ones that determined what was done in PREPA or what was done in the electric system. That ended with the entry of LUMA, a private company that does not come with political ties, and my vision and my confidence that it will continue that way.* (July 23, 2021)

Consistent with the narratives presented by other participants when discussing LUMA, privatization, political corruption and renewable transitions are deeply interwoven in Puerto Rico, as this government official made explicit:

> *I believe that this is one of the biggest obstacles for us to move towards renewable energy in the long term is the way PREPA has relied on a centralized fossil fuels model. I also have my hopes focused on the fact that maybe LUMA will also change that mentality and will have another vision in that sense, so we will also be supervising that this happens.* (June 28, 2021).

This optimism in the capacity of the private sector to facilitate a renewable transition fails to confront how deeply embedded fossil fuel interests are in Puerto Rico's political economy.

5.2.3. Emphasize the downsides

As Lamb et al. [9] highlight, appeals to social justice can be particularly powerful as a delay strategy because it is important to acknowledge the justice implications of energy transitions. For Puerto Rico, the most common concerns raised regarding social justice were energy costs and reliability and resilience of the system. Frequently, calls for reliability and resilience were used to explain why it was not desirable to transition quickly to a renewable system. These narratives posited reliability and resilience as priorities that were in tension with renewable production, without acknowledging that the current system, which is 97 % fossil fuel based, is not reliable or resilient. Such concerns constitute a discourse of delay because they present potential downsides of climate action without a comparative analysis of the potential downsides of a lack of action.

Concerns about fossil fuel interests were minimized by focusing not on how electricity is generated but on making sure the people of Puerto Rico have access to reliable and resilient energy. For example, a worker of LUMA energy stated that their goal is to modernize and to make the energy system *"reliable, resilient, safe and one that allows a reasonable cost for the user"* (July 2, 2021). Despite the importance of these narratives, some participants recognized this emphasis as consistent with discourses of delay, as this community leader articulated:

> *I think that perhaps the thing that shocks me the most, what I find most incredible, is that absolutely nothing has been done to improve the system with renewable energy. What the government has done is to say, let's go to a non-renewable energy that is cheaper than oil or less polluting than oil. But the reality is that gas also continues to be polluting and coal makes absolutely no sense and even garbage has also been considered.* (July 6, 2021)

His outrage lays bare that reliability is being used to delay action, and that the solutions being presented do not effectively address the problem.

Another concern that contains elements of both emphasizing the downsides and surrender discourses related to the workforce. Concerns about workers are central to just transition discourses. However, presenting the lack of preparation of workers as a rationale to not move forward with promoting renewable energy, as this government official argued, constitutes a delay strategy.

> *Before moving to renewable energy, we have other important priorities. We need to develop a workforce capable of meeting the needs we have for the reconstruction and creation of a new energy system in Puerto Rico.* (August 25, 2021)

Alternatively, a union leader, made a similar argument regarding the importance of protecting workers, but presented an argument that FEMA funds should be distributed to workers to ensure that nobody gets left behind (June 30, 2021) rather than arguing that the transition should wait for workforce development. This is an example of how subtle delay discourses can be. Although these two participants raised similar concerns, one argued for delay while the other did not.

5.2.4. Surrender

Despite the lack of progress on an energy transition in Puerto Rico, with very low penetration of renewables even more than five years after Hurricane Maria, discourses of surrender, arguing that change is impossible or that it is too late, were not explicitly present. There were many examples, however, of narratives that argued that the current policy goals cannot be achieved in the timeframe proposed. These discourses usually referred to Act 17: the law that mandates that Puerto Rico achieve 100 % renewable energy production by 2050. Participants

raised doubts about the economic, political, and technical feasibility of these targets, as these reflections from representatives from fossil fuel companies described:

> *To be able to achieve a renewable future we need more time, and the law has to be complied with, and it is not going to be possible to do it with such aggressive measures. And from the technological point of view, I think it is the cost and the difficulty of the battery storage technology, the fact that it is still expensive in relation to other components of the system."* (July 2, 2021*)*

> *I don't think the ambitious transition goals that are being imposed… are achievable due of all these layers in the current renewable auctions. …I think that we do not have the financial or the technical resources to maintain that pace (established by the policy), but we can achieve a portion of that inclusion of renewable sources in the next 10 years.* (June 21,2021)

In Puerto Rico, the discourses regarding the transition were less about whether it was desirable to transition or not, but rather the process and speed for this transition. As a result, surrender narratives manifested as calls to abandon ambitious targets, effectively serving to delay progress.

5.3. Resistance to obstruction and discourses of delay

Although discourses of delay were strong in the ways participants' described Puerto Rico's energy transitions, alternative discourses that resisted these narratives and presented a different vision of Puerto Rico's energy system were also present. NGO leaders and activists, in particular, articulated these alternative visions. Academics also articulated alternative visions to a fossil-fuel based future, as this simple statement illustrates: *"We now depend on natural gas, and that natural gas does not come from here…We need to depend on natural resources that we have on our island to be on the right track*" (June 28, 2021). The contrast between the complexity in discourses of delay and the clarity in these alternative visions is notable.

Participants were opposed to models that "perpetuated" dependence on fossil fuels. Community leaders, in particular, questioned this gradual transition using gas as a bridge not only for the environmental and public health consequences that it entailed but also for the economic consequences. They presented an alternative narrative, arguing that it is more economically efficient to invest in a renewable model because Puerto Rico has endogenous natural sources of energy that could make it fully energy independent and 100 % renewable. This narrative emphasized how fossil fuels must be imported and are quite costly. It argued that Puerto Ricans could be self-sufficient if they had a system based on solar and wind power. As the founder of the Queremos Sol initiative articulated, this alternative narrative linked the promotion of renewable resources to political empowerment:

> *First, (The Puerto Rican electric system) should be public and, secondly, it should be a system that enhances the renewable resources available in Puerto Rico, particularly the sun. They are resources that we have available to ensure independence from fossil fuels and update a system where renewable resources are promoted, providing opportunities for participation to all citizens.* (July 19, 2021)

Resistance to fossil fuel obstruction, from this perspective, is about more than resisting fossil fuel interests; it is also about resisting political systems that some, especially community activists, characterized as oppressive.

Many participants identified resistance as a source of inspiration and hope for the future. As one environmental activist and member of the Puerto Rican Independence Party articulated, resistance is growing, especially among the youth.

> *The momentum of [grassroots] organizations is very important… I think that 15 or 20 years from now this is going to be very different… Many of them [youth] have a correct vision of the values of things and in spite of everything that is happening, they are still fighting in Puerto Rico. Many young people are leading these organizations and they are trying to help us to unite all the organizations that deal with environmental issues. Young people are the key to change and I am optimistic to see them involved in their communities and in Puerto Rico.* (June 15, 2021)

Understanding the role of youth in resisting fossil fuels and overcoming discourses of delay is an important area for future research as it was clear that youth were viewed by many participants as key to Puerto Rico's energy transition.

6. Discussion

Respondents clearly perceived climate obstruction at play in Puerto Rico, but in addition to maintaining fossil fuel interests, they understood this obstruction to be closely tied to the maintenance of political power and control by government actors and others in positions of power. At the same time, participants had diverse views on the interests of key stakeholders in maintaining the current fossil-fuel based status quo. While fossil fuel interests may well, as participants observed, be a powerful obstructing force, community-level resistance is also strong. The power of fossil fuel interests is not absolute and a transition, however difficult, is possible. Puerto Rico's energy future is still very much in flux, and the questions of how the complex power dynamics and political tensions will play out is not clear.

While this research does not explicitly assess the strategies of climate obstruction being undertaken by fossil fuel interests in Puerto Rico, analyzing perceptions of influence provides insights on how the power of incumbent actors is distributed and allocated. The study of power dynamics in any place or context is fraught with complexity and nuance. This exploration reveals a complicated set of narratives reinforced by different key actors. The results depict a deep tension and the conflicted nature of Puerto Rico's energy transition: on the one hand there is widespread agreement across a wide range of actors that the future of Puerto Rico's energy system will eventually be renewable-based, and at the same time, there are serious doubts about how and when a renewable transition will occur.

Despite the literature on climate obstruction that posits that many of the strategies used by fossil fuel interests to obstruct climate action are hidden and not visible to the public, these interviews suggest that in the Puerto Rican context, such obstruction is widely acknowledged and visible to many. This analysis also points to the importance of grassroots, community-level resistance to fossil fuel interests and how that resistance shapes public discourse on the possibilities of a renewable transition and the role of incumbent actors.

In the Puerto Rican context, the discourses of delay framework is helpful to understand narratives that reinforce the stability of incumbent actors, but this research also highlights limitations of this framework. Further research is needed to continue to refine and expand this framework in contexts outside of North America and Europe, particularly where the power dynamics associated with fossil fuel interests are deeply intertwined with other dimensions of power, including colonial relationships that complicate decision-making. For example, rather than promoting individualism as a discourse of delay as the framework posits, in Puerto Rico fossil fuel interests and others in power may have resisted this narrative because of the desire to maintain centralized control of the energy system. This finding suggests that while individualism may be used as a discourse of delay in some contexts, it can also be used as a discourse of resistance to promote renewable alternatives.

Puerto Rican perspectives offer several insights into the stability of fossil fuel regimes. First, while obstruction is often discussed as a hidden, discreet action, actors in Puerto Rico were aware of and openly acknowledged the role of fossil fuel interests in obstructing change and slowing down the pace of a transition. This acknowledgement was coupled with a widespread assumption that eventually a renewable

future will come to Puerto Rico. Second, while obstruction literature typically focuses on obstruction as motivated by fossil fuel interests, our analysis suggests that obstruction may occur at least as much to maintain political power dynamics (or political structures) rather than to promote fossil fuel interests themselves. Our analysis emphasizes the deep interconnections between political power and fossil fuels in the Puerto Rican context, and illustrates the wide range of actors with vested interests in maintaining fossil fuel energy systems for a multitude of reasons.

Finally, our interviews also point to uniquely important role that gas plays in discourses of delay. 37 of the 56 interviews explicitly discussed gas, which was higher than for oil or coal, and gas was particularly salient in the discourses of delay. Many participants described gas a transition fuel, and arguments for the need for gas to provide stability and resilience to the grid resonated strongly in a context where people have experienced regular and prolonged grid disruption. The significant investments in gas expansion that have occurred in Puerto Rico since Hurricane Maria also indicate the effectiveness of strategies to promote gas and maintain reliance on fossil fuels in Puerto Rico's energy system. This experience and the perceived legitimacy of gas suggests that a particular focus on gas in delaying energy transitions may be warranted in other contexts as well.

7. Conclusion

The power and influence of fossil fuel interests in slowing down energy transitions globally is becoming clearer. This analysis of perceptions of fossil fuel interests in Puerto Rico reveals the complex interplay between overt obstruction by fossil fuel interests and less overt discourses of delay. This study offers insights into why renewable energy deployment has been so slow in Puerto Rico, even after the devastation of the energy system in 2017, when it appeared that a rapid transition may have been possible.

We find that Lamb et al. [9]'s typology of discourses of delay serves as a useful framework for analyzing delay strategies and gaining insight into the slow pace of renewable transition. Our study contributes to the call by Lamb et al. [9] for empirical evidence of the discourses of delay. While we found evidence of narratives that employed all four discourses of delay, our analysis also revealed the many ways that the typology does not directly apply in the Puerto Rican context. By applying the typology in specific contexts like we have here, researchers can gain a deeper understanding of the ways that discourses of delay are adapted and deployed. We can also see how unique cultural, historical, and socio-political contexts (in addition to energy contexts) shape the salience of different discourses in different places.

Our analysis also suggests that at least in contexts like Puerto Rico, discourses of delay can manifest in ways that do not fit neatly into the typology. The colonial relationship between Puerto Rico and the United States, political corruption, and the experience of Hurricane Maria were particularly important themes that shape discourses of delay in Puerto Rico.

Finally, while there was strong evidence of obstruction and use of discourses of delay, there were also many narratives of resistance and ways that actors in Puerto Rico were working to overcome discourses of delay and present alternative visions of the future of the energy system. The future of Puerto Rico's energy system is still contested; attention to both obstruction and strategies to overcome delay are important to understand to support a renewable energy transition.

CRediT authorship contribution statement

Laura Kuhl: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Supervision, Writing – original draft, Writing – review & editing. **Jennie C. Stephens:** Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Supervision, Writing – original draft, Writing – review & editing. **Carlos Arriaga Serrano:** Data curation, Formal analysis, Investigation, Methodology, Visualization, Writing – original draft, Writing – review & editing. **Marla Perez-Lugo:** Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Writing – review & editing. **Cecilio Ortiz-Garcia:** Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Writing – review & editing. **Ryan Ellis:** Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Writing – review & editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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Appendices. Supplementary data

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