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Resistance as climate change mitigation: Contested emissions from Japan's anti-coal movement

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ABSTRACT

Grassroots resistance increasingly shapes sustainability transformations, yet its implications for climate change mitigation remain difficult to identify and quantify. This paper introduces the concept of 'contested emissions' to make visible the climate significance of such struggles and develops an operational framework for estimating the emissions associated with carbon-intensive projects subject to social contestation. Contested emissions refer to the projected greenhouse gas emissions from projects opposed by local communities, activists, or social movements, including struggles that are not primarily framed around climate change. We distinguish four types of contested emissions: those associated with project cancellations, delays in operation, shortened operational lifespans, and constraints on fossil-fuel markets. We apply the framework to coal-related conflicts in Japan using data from the Environmental Justice Atlas, Global Energy Monitor, and local environmental organisations. We estimate that the opposition has been associated with the cancellation of projects representing approximately 49 million tonnes (Mt) of annual CO₂ emissions, while projects representing a further 2.4 Mt. have been delayed and 2.4 Mt. are associated with reduced operational lifespans. In addition, projects representing approximately 258 Mt. of annual CO₂ emissions have been subject to continuing contestation associated with market constraints. Taken together, these resistances are associated with projects representing emissions equivalent to 26.5% of Japan's 2021 annual greenhouse gas emissions. The contested emissions framework therefore broadens conventional understandings of climate action by showing how struggles over pollution, health, livelihoods, and environmental justice can also shape carbon-intensive development and emissions trajectories.

1. Introduction: Grassroots climate actions and contested emissions

On August 6, 2024, sixteen youths from across Japan filed a civil lawsuit at the Nagoya District Court against ten major thermal power companies, including JERA (Japan's Energy for a New Era), Japan's largest energy producer. They demanded a 48% reduction in GHG emissions by 2030 and a 65% reduction by 2035 compared to 2019 levels, arguing that the government's current target, equivalent to a 37% reduction by 2030 from 2019 levels, is insufficient to meet the Intergovernmental Panel on Climate Change (IPCC) recommendations [1]. This case reflects a growing wave of climate activism in which civil society organisations (CSOs) and local communities mobilise legal,

political, and social strategies to contest fossil fuel industries and their financial backers, framing greenhouse gas (GHG) emissions as a site of political and social struggle [2].

Scholars have paid increasing attention to such grassroots movements contesting carbon-intensive activities, including fossil-fuel extraction, processing, and energy infrastructure [3]–[6]. However, research on the extent to which activism contributes to effective reductions in greenhouse gas emissions remains limited. Such resistance occurs across diverse geographical and political contexts and is motivated by concerns over climate change as well as pollution, health, land, livelihoods, and environmental justice. While some of these struggles are explicitly organised around climate action, others challenge carbon-intensive development without necessarily framing their claims in

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climate terms. Nevertheless, social movements are increasingly recognised as forces that can shape climate change mitigation by contesting the expansion and operation of coal, oil, and other fossil-fuel projects [7]. Transnational climate movements and community-led initiatives can also influence energy transitions by challenging carbon-intensive development and advancing alternative pathways toward more sustainable and just energy systems [8]–[10].

While Martinez-Alier [5] made preliminary attempts to estimate emissions from coal-fired power plants opposed by local communities, comprehensive studies are still lacking. Furthermore, there is a need to further conceptualise the diverse pathways through which local opposition contributes to climate change mitigation processes. While achieving the cancellation of a carbon-emitting project is perhaps the most direct form of contributing to emission avoidance at the local scale, the implications of local opposition for climate change mitigation go well beyond this, and may include raised awareness, emission postponement, and strengthened regulations, among other outcomes [7].

This paper addresses a knowledge gap identified in IPCC WG3 Sections 4.5 and 4.2.3, which highlight the importance of justice and equity in enabling socially acceptable mitigation while noting the limited quantification of mitigation actions by non-state actors due to data constraints [11,12]. In this context, local and grassroots contestations of high-emitting facilities can be seen both as expressions of justice and as measurable contributions to mitigation [11]. The IPCC report emphasises the need for ‘stronger and more ambitious climate action’ from civil society, private sector actors, and Indigenous communities [11] but notes that quantifying their impact remains a challenge. Here, we seek to fill these gaps by proposing a novel conceptual framework for understanding the role of ‘contested emissions’ in climate action and a methodological framework for quantifying coal-related grassroots contestations, using Japan as an empirical case. Recognising the role of contested emissions for curbing emissions can help shift the focus from solely top-down approaches and market mechanisms to more synergetic and inclusive approaches that consider the transformative potential of civil society.

To illustrate how such contested emissions operate in practice, we address the following research question for Japan: how can contested emissions be understood and measured, and what role do anti-coal movements play in reducing greenhouse gas emissions? Japan presents a compelling case due to its post-Fukushima shift to coal, its position as a significant global emitter, and the rise in climate litigation and grassroots activism against this coal dependency. This article examines climate activism that emerged in response to the planned construction of new coal-fired power plants after 2012, with varying degrees of visibility within the coal phase-out movement. Empirically, this study draws on data from the Environmental Justice Atlas (EJAtlas), the Global Coal Plant Tracker (GCPT) and local environmental organisations such as Kiko Network, and Beyond Coal Japan. By doing so, the article incorporates a counter-accounting approach by using data and methodological tools from civil society organisations, academics, and think tanks, which challenge conventional frameworks that measure greenhouse gas emissions [13,14]. Specifically, we aim to account for contested emissions, i.e. CO₂ emissions from carbon-intensive projects that are actively challenged by social movements, local communities, and civil society organisations, focusing on coal-fired power plants. Conceptually, the study advances sustainability science by integrating ecological economics, political ecology, and social movement studies into an interdisciplinary framework that quantifies the influence of local civil society on climate change mitigation.

The next section introduces the contested emission conceptual framework and discusses its implications for climate change mitigation. Section 3 provides background to the Japanese case. Section 4 describes the data and methodology employed in the study, while Section 5 applies the conceptual frameworks of contested emissions in climate change mitigation to the case of Japan and presents estimates. Finally, Section 6 explores the broader implications of these findings and offers

concluding insights.

2. Contested emissions: Linking social movements to limiting emissions

This section introduces the concept of ‘contested emissions’ and examines its relevance to climate change mitigation. First, we define contested emissions by drawing on concepts from ecological economics, political ecology and social movement theory [15].

2.1. The concept of contested emissions

We define contested emissions as the projected greenhouse gas emissions from carbon-intensive projects and activities that are opposed by local communities, social movements, and other grassroots groups through protests, litigation, advocacy and other forms of resistance. These actions can interact with emission reduction processes in various ways, leading to the cancellation of projects, postponement of their operation and construction, shortening of their operational lifespans, or constraints on fossil-fuel markets. Quantifying such contested emissions further enables us to estimate the extent of their influence in climate change mitigation processes.

For example, if a coal plant is successfully opposed and subsequently cancelled, the projected CO₂ emissions from its operation are avoided (see below for a discussion of potential leakage). While this avoidance is measured at the project or local level, incorporating such outcomes into national and global climate strategies would recognise the tangible mitigation benefits of grassroots resistance. Furthermore, contested emissions often reveal underlying environmental justice issues, as marginalised communities disproportionately bear the burden of carbon-intensive projects [16–18]. By identifying contested hydrocarbon projects, accounting for the emissions associated with them, and categorising them by outcome, the framework extends analysis beyond avoided emissions to include emissions that are actively contested. This reveals not only the potential climate implications of contestation but also the scale of social mobilisation, political conflict, and collective efforts to transform carbon-intensive development pathways.

Not all forms of contestation lead to outright cancellations. Many instead contribute in more subtle ways to constraining fossil fuel-based energy systems, such as through delaying projects, reducing their scale, or influencing market conditions and operational costs [7,19]. If projects representing 10 MtCO₂ become the target of organised opposition, but only 4 MtCO₂ are ultimately avoided, the remaining 6 MtCO₂ still reflect the magnitude of ongoing mobilisation and political struggle. In this sense, contested emissions draw attention not only to realised mitigation outcomes but also the extent to which emissions have become objects of collective resistance and demand for energy transformation. However, there is a need for a systematic approach to categorising, identifying, and attributing emissions that goes beyond binary categories of emissions being avoided or not avoided.

The concept of ‘contested emissions’ is grounded in the work on ecological distribution conflicts (EDCs), understood as socio-ecological struggles arising from the unequal and unsustainable distribution of environmental benefits and burdens across social groups and territories, and generations [5]. These conflicts are often triggered by societal metabolic shifts, such as fossil-fuel-driven industrial growth that has intensified material and energy flows, increased GHG emissions, and deepened the climate crisis [20]. Opposition to fossil fuel extraction, processing, and waste disposal challenges exploitative governance and market practices, resisting further environmental and social harm [21–24]. Such conflicts can reshape resource use and the metabolic processes that sustain societies [25].

The second conceptual pillar comes from social movement theory, which examines how movements share features such as collective claims, sustained contentious action, and organised networks [26–28]. Grassroots struggles against fossil fuels, often embedded in broader

EDCs, mobilise alliances, influence public discourse, and pressure decision-makers. Movements such as Leave Fossil Fuels Underground (LFFU) and Blockadia [29,30] illustrate this dynamic [31]. Examples include opposition to the Keystone XL Pipeline (USA), *Ende Gelände* (Germany), *Limity jsme my* (Czech Republic), and *Né qui né altrove* (Italy), as well as Ecuador's Yasuni ITT campaign, which aimed to keep 850 million barrels of oil untapped, avoiding an estimated 410 million tonnes (Mt) of CO₂ emissions. These movements have also contributed to the concept of 'unburnable fossil-fuel reserves' [5,30,32,33].

While contested emissions can lead to substantial local reductions, we acknowledge the potential for emissions leakage, whereby avoided or reduced emissions in one jurisdiction are offset by increases elsewhere [34]. This can occur, for example, when energy demand is met through imported energy carriers or commodities produced in carbon-intensive systems, effectively displacing rather than eliminating emissions. Carbon leakage thus tells a different story; one situated in the systemic dynamics of how reductions in one place reshape emissions elsewhere. It is not specific to contestation; it is a logic embedded in global commodity chains and energy systems. It resonates with theories of unequal ecological exchange and cost shifting, where harms are displaced along transnational circuits of production and destructive commodities continue to flow, merely rerouted [23,35]. There is also a risk of leakage through fossil-fuel substitution, where emissions avoided from constrained coal projects are partially offset by increased reliance on other fossil fuels, including natural gas and liquefied natural gas (LNG) [36].

Although emissions from cancelled hydrocarbon projects can be counted as avoided emissions, contested emissions are not simply a measure of carbon removed from future inventories. Rather, they capture emissions associated with projects that become sites of resistance because they are perceived as harmful to land, livelihoods, health, territories, and ways of life, often independent of climate discourse. Claims of climate mitigation may emerge through these struggles as communities resist what they consider unacceptable forms of environmental and social harm.

Contested emissions, therefore, offer a distinct lens on mitigation. Rather than focusing on how carbon is optimally reduced, they make visible the scale of opposition to carbon-intensive projects and the outcomes of that contestation, including avoidance, delay, or reduction. The purpose is not to explain why projects succeed or fail, but to identify how much carbon-intensive capacity is under contestation and how contested projects are distributed across observable outcomes.

These dynamics can be addressed empirically through a counter-accounting approach. Through careful categorisation and systematic accounting of both existing and prospective carbon inventories, contested emissions can be traced across scales. Specifically, in the context of project-based energy system analysis, the challenge of leakage can be partially addressed through a multi-scalar approach that moves from local sites of opposition to national energy strategies and regional trade flows. This enables analysis of how resistance in one location interacts with energy production, project development, and potential displacement elsewhere [37]. Where a contested hydrocarbon project does not reappear elsewhere within national boundaries and is not offset through increased imports, it can be treated as cancelled and its associated emissions as avoided.

Within the framework of contested emissions, 'leakage' is treated not only as a function of energy demand and investment substitution, but also as a function of political contestability. Displaced projects do not enter an empty space; they enter new social and regulatory landscapes. The likelihood that emissions re-emerge elsewhere, therefore, depends on both the structural conditions of the energy system and the capacity of local actors to contest new fossil infrastructure. In this sense, leakage is itself politically mediated: it reflects not only where capital flows, but where it is resisted. When a similar project emerges in another location, the outcome is better understood as delayed emissions, reflecting temporal displacement rather than termination. Where no direct

continuation can be identified but a comparable project later appears, it is treated as a new development and enters the framework only if it, too, becomes contested. The usefulness of this approach depends on the scale of analysis. As the scale widens, displacement becomes more diffuse and links between cancelled and re-emerging projects become harder to establish. Rather than resolving leakage, the framework makes visible how local acts of resistance interact with broader energy systems.

A central challenge in contested emissions accounting is attribution and causality. It is rarely possible to determine whether a particular outcome can be directly attributed to social movement activity, over what timescale effects should be assessed, or how indirect and delayed impacts should be accounted for. Apparent failure is equally difficult to interpret, as the absence of observable change does not necessarily indicate weak mobilisation, particularly in contexts where repression and limited political opportunities constrain visible outcomes [38].

Power asymmetries, institutions, and political ideologies shape movement strategies and outcomes, making straightforward assessments of effectiveness problematic. Social movements are therefore best understood as relational actors whose influence emerges through interactions with broader political and social structures rather than as autonomous drivers of change [39]. Accordingly, contested emissions accounting adopts a relational approach, focusing on emissions associated with projects subject to documented contestation rather than claiming activism as the primary cause of emission reductions. Attribution is discussed further in the methodology section.

The categorisations and typologies are built on empirical case studies of resistance against fossil fuel activities, which demonstrate how grassroots mobilisations have significantly influenced processes of sustainable transformation [16]–[18,40]. Studies have examined ecological distribution conflicts on a global scale, including Temper et al. [7], which analysed 869 cases, and Thiri et al. [4], which focused on 57 cases. Building on these empirical studies, we next identify four distinct types of contested emissions. The details of the typologies will be explained in the following Section.

2.2. A typology of contested emissions for just energy transitions

This section describes the different types of contested emissions considered here. These categories are analytical constructs designed to differentiate observable project outcomes associated with documented contestation.

1) Contested emissions linked to project cancellations

Contested emissions from project cancellations are the emissions avoided when planned emissions-intensive projects, such as coal-fired power plants, are cancelled following significant opposition from social movements, activists, or environmental organisations. 'Contested' here refers to resistance on ecological, social, or health grounds, often led by local communities, climate justice networks, and NGOs. Cancelling such projects directly prevents the release of future emissions, contributing to decarbonisation. For example, cancelling a coal plant projected to emit five million tonnes of CO₂ annually avoids those emissions in that locality. Grassroots movements have been pivotal in achieving such outcomes: between 2008 and 2013, Climate Alliance Germany halted 18 of 30 planned coal-fired power plants, preventing millions of tonnes of CO₂ emissions each year [41–43]. These successes underscore the role of environmental justice organisations in curbing emissions by cancelling new projects, accelerating the closure of existing ones, and preventing prolonged operations [44].

However, the benefits of cancellations are not always visible in official emissions accounts, as these avoided emissions were never realised. The estimation of avoided emissions, therefore, relies on projected operational parameters rather than observed historical emissions. Furthermore, some developers relocate contested projects to regions with weaker regulations, causing emission leakage, where avoided

emissions in one area reappear elsewhere. This challenge has spurred climate justice networks and organisations such as Global Energy Monitor to track fossil fuel infrastructure worldwide, enabling a feasible counter-accounting approach to contested emissions [45].

2) Contested emissions linked to postponed projects

Contested emissions from postponed projects occur when emissions-intensive developments, such as coal-fired power plants or hydrocarbon infrastructure, are delayed due to legal, regulatory, or public resistance. Unlike cancellations, postponements do not guarantee a permanent halt, but they defer emissions and can create conditions for eventual abandonment. Opposition through protests, litigation, and regulatory challenges can stall projects for years, buying time for cleaner technologies to advance, renewable energy to become more competitive, and policy landscapes to shift toward stricter climate targets.

These delays are significant for climate mitigation: they prevent emissions during the postponement period and often increase the financial and political costs of proceeding. Legal battles, inflation, and shifting investor priorities can make postponed projects less attractive to developers. For example, the Keystone XL Pipeline was delayed for years through sustained activist pressure, postponing the transport of over 800,000 barrels of oil per day; it was ultimately cancelled in 2021. Similar patterns occur in the coal sector, where lawsuits, protests, and regulatory interventions disrupt project timelines, sometimes leading to their eventual cancellation.

While the emissions avoided during postponement are temporary, the disruption weakens the momentum of fossil fuel expansion and creates openings for policy change. For example, litigation against the proposed Thabametsi coal-fired power plant in South Africa delayed regulatory approvals, financing, and the start of construction [46]. Postponement, therefore, functions not only as an immediate brake on emissions but also as a leverage point in shifting markets and investment away from carbon-heavy projects.

3) Contested emissions linked to the reduced lifespan of fossil fuel infrastructures

In the context of contested emissions, ‘reduced lifespan’ refers to situations in which the operational life of an existing emissions-intensive facility, such as a coal-fired power plant, oil refinery, or gas plant, is shortened due to activism, policy interventions, and regulatory changes resulting from public pressure. Rather than operating for its intended lifetime, the facility is retired early or prevented from extending operations, thereby reducing cumulative emissions. For example, a coal plant designed to operate for 50 years but closed after 20 years avoids 30 years of emissions. Estimating such avoided emissions necessarily involves counterfactual assumptions regarding intended plant lifetimes and utilisation rates.

This category is analytically important because emissions from long-lived infrastructure are path-dependent and cumulative. Fossil fuel facilities are typically built with the expectation of decades of operation, and their continued functioning embeds carbon-intensive pathways into energy systems, labour arrangements, and regional economies. Interventions that shorten plant lifespans therefore disrupt carbon lock-ins and reconfigure future emissions trajectories, even when they do not immediately replace fossil generation with low-carbon alternatives. In this sense, reduced lifespan captures a form of mitigation that operates through temporal constraint rather than outright cancellation.

Globally, coal plants retire at an average age of 46 years, though some operate for 60–80 years [47,48]. Campaigns targeting ageing and inefficient plants, often with outdated technology and higher carbon intensities, have succeeded in securing early closures, as in the U.S. cases of Valmont, Fisk, and Redondo Beach, where shutdowns between 2012 and 2017 prevented several additional years of emissions [44]. These cases illustrate how contestation directed at existing infrastructure can

yield substantial climate-relevant effects, even in the absence of new project cancellations.

While estimating emissions from reduced lifespan involves uncertainty, particularly regarding counterfactual operating years, future utilisation rates, and replacement generation, such interventions nonetheless contract a region's remaining carbon budget and bring energy systems closer to alignment with climate targets such as those articulated under the Paris Agreement. Within a contested emissions framework, reduced lifespan therefore represents a conservative and empirically grounded category for capturing how struggles over existing infrastructure reshape long-term emissions trajectories by foreclosing future fossil fuel use.

4) Contested emissions contributing to fossil fuel market constraints

Contested emissions from market constraints refer to emissions from fossil fuel projects that are actively opposed by social movements and allied actors, thereby restricting fossil fuel markets. Market constraints arise when grassroots mobilisation, advocacy coalitions, and allied actors influence or directly trigger policy changes, financial decisions, or regulatory measures that restrict fossil fuel activities. Examples include carbon pricing (taxes, cap-and-trade), removal of subsidies, divestment campaigns, extraction bans, financial regulations (e.g., green or transition bonds), and international agreements [49–51].

These measures increase operational costs, erode investor confidence, and shift market dynamics toward renewable energy. For instance, Fossil Free Germany convinced 20 organisations to divest at least €16.33 billion from fossil fuel industries [41]. These constraints, manifesting as reduced investment, lower profitability, stricter regulations, or diminished demand, limit the development or expansion of coal, oil, and gas projects, thereby reducing future emissions potential [7]. They are best represented by ongoing contestations that have not yet reached a definitive outcome but hold the potential to cut emissions if such constraints persist or intensify. Grassroots resistance can also cause direct financial losses; oil and mining projects have faced up to \$20 million per week in losses due to delays [49]. Beyond such disruptions, activists often collaborate with policymakers and professionals to reform energy markets, deregulate renewables, and promote decentralised generation, further undermining fossil fuel viability [52]. By increasing costs and uncertainty, these pressures can accelerate decarbonisation.

Collectively, these typologies illustrate different pathways through which contestation can influence emissions trajectories and highlight how struggles often framed in terms of environmental justice, sovereignty, or the defence of land and territory have climate mitigation implications. The concept links such struggles to the emissions associated with the projects they oppose, broadening conventional understandings of climate action.

The following section presents the background of Japan's energy transition and coal contestation, detailing its relevance for estimating contested emissions.

3. Background of the case: Coal struggle and energy transition in Japan

Japan's coal industry, which grew rapidly in the early 20th century, declined sharply after WWII, accelerated by labour disputes, accidents like the fatal 1963 Mitsui Miike disaster, and a shift in the energy mix from coal to oil, then to nuclear, gas, and back to coal by 2010 [53,54]. Today, coal remains central to Japan's energy mix, fuelling about one-third of electricity generation and supplying metallurgical coal for steel production [55]. The 2011 Fukushima disaster marked a major shift: nuclear fell to 2% of supply by 2019, while coal rose to 25%, pushing fossil fuel dependence to 85% of primary energy use. The energy sector, responsible for 85–90% of Japan's emissions, produces around 280 MtCO₂ annually [56]. In 2022, fossil fuels still supplied 83%

of Japan's energy, including 183 Mt. of coal consumption, making it the world's third-largest importer [57].

Japan's 2023 Green Transformation (GX) policy aims for carbon neutrality by 2050 through a gradual coal phase-down, increased renewables, and investment in hydrogen, ammonia, and carbon capture. Yet, as in many countries, renewables have supplemented mainly rather than replaced fossil fuels [58]. In 2023, fossil fuels generated 68.6% of Japan's electricity, compared with 22.9% from renewable energy and 8.5% from nuclear power [59]. Globally, fossil fuels made up 81.5% of primary energy consumption in 2023, remaining dominant [60]. Japan's modest demand reductions have come from efficiency gains, population decline, and behavioural changes, such as Sho-Ene ('energy down-scaling'), but coal still plays a significant role.

Japan also has a well-established network of environmental organisations engaged in opposition to coal expansion. The Kiko Network, Climate Action Network Japan, Friends of the Earth Japan, Greenpeace Japan, and other organisations have supported anti-coal mobilisation through policy advocacy, litigation, divestment and shareholder campaigns, public awareness activities, and coordination with local movements [61,62]. These modes of action can be observed in several contested coal projects. Legal mobilisation accompanied opposition to the Sendai Power Station, with residents filing Japan's first lawsuit in 2017 seeking the suspension of a single coal-fired power plant. In Tokyo Bay, local opposition to proposed coal plants in Soga, Ichihara, and Sodegaura was reinforced by environmental organisations through public campaigning, information sharing, and advocacy; all three projects were subsequently cancelled. More recently, opposition to J-POWER's proposed modification of the Matsushima plant combined public consultation, campaigning, and advocacy by environmental organisations, while shareholder activism and engagement with financial institutions have extended contestation beyond individual project sites.

The Network has connected otherwise dispersed local struggles to broader challenges to coal expansion and finance. Its advocacy has also unfolded alongside significant shifts in national coal policy, including Prime Minister Kishida's 2023 pledge to end the construction of new unabated coal-fired power plants. Campaigns have also challenged LNG infrastructure expansion, biomass and ammonia co-firing, and the continued role of nuclear power. More recently, activists have raised concerns regarding LNG oversupply and surplus import capacity, advocating constraints on further gas development [63].

It is nevertheless important to situate contested emissions in Japan within a political context where climate mobilisation remains limited. Coal is not opposed on the scale that nuclear power has historically been, and climate change has not led to mass protest. National surveys consistently show that climate change does not rank among the public's most urgent concerns, making the language of 'public opposition' potentially misleading. Environmental NGOs, while increasingly active, remain institutionally and socially constrained, and their mobilisation capacity is modest in comparison to movements elsewhere [64]. These limits form the structural conditions under which contestation unfolds. Contested emissions in Japan thus arise not from a broad societal climate politics, but from targeted, uneven, and often fragile forms of organised resistance operating within a largely fossil-normalised society [65].

The following cases were selected to illustrate different forms of coal contestation in Japan across distinct geographical, historical, and political contexts. Together, they show how coal opposition is shaped by local experiences and concerns that extend beyond carbon emissions to include public health, environmental justice, and care for future generations.

3.1. Kushiro: Peripheral coal and local limits

In 2015, a 112 MW coal-fired power plant was proposed in Kushiro, Hokkaido, alongside efforts to revive Japan's last operating coal mine. Local residents formed the Kushiro Thermal Power Plant Study Group to

examine environmental, health, and climate impacts. They criticised the project as an "assessment-escape" scheme, designed to fall just below the national EIA threshold, and exposed pollution standards that were far weaker than those at comparable plants elsewhere. Opposition linked coal expansion to Kushiro's ecological vulnerability, including wetlands, fisheries, and climate-related risks such as fog acidification and storm surges. Despite petitions and public statements calling for suspension, the plant began operation in 2020, supported by substantial public subsidies. The case illustrates how peripheral regions become testing grounds for marginal coal projects, and how resistance emerges from lived exposure to cumulative harm rather than from climate politics alone [66].

3.2. Sendai: Litigation and disaster injustice

The 112 MW Sendai coal plant similarly avoided national EIA requirements. In response, residents formed Anti-Coal Sendai and, in 2017, launched Japan's first lawsuit against a single coal-fired power plant. Opponents raised concerns regarding public health, air pollution, impacts on nearby ecosystems, and the compatibility of the project with climate goals. The movement also framed the plant as a form of post-disaster injustice, given its location in a tsunami-affected district while supplying electricity primarily to metropolitan areas. Although the injunction was unsuccessful, the case increased national scrutiny of small-scale coal projects and established litigation as a tool of anti-coal mobilisation [66].

3.3. Tokyo Bay: Clustered resistance and regional spillover

Following Fukushima, coal expansion concentrated along Tokyo Bay, with proposals in Soga, Ichihara, Sodegaura, and Yokosuka. In Soga, residents revived pollution-era activism rooted in the Aozora Trials, framing a 1070 MW project as a renewed threat to public health. Regional coordination and transnational alliances intensified pressure. In 2017, the large Ichihara project was cancelled, the first major coal cancellation in Japan, followed by Sodegaura. These outcomes demonstrated how local struggles could potentially reshape investment decisions in Japan's industrial core. In contrast, the 1.3 GW Yokosuka project proceeded under regulatory shortcuts, prompting coordinated litigation across the bay. Together, these cases show how site-specific pollution struggles scale into regional governance challenges, producing both cancellation and displacement within the same infrastructural corridor [66,67].

Beyond site-specific campaigns, the Kiko Network has played an important coordinating role in Japan's anti-coal movement, linking frontline struggles with national and transnational advocacy through a multifaceted repertoire of contention. The significance and impacts of this work received international recognition through the Goldman Environmental Prize, which acknowledged the Network's role in a nationwide campaign that contributed to the cancellation of planned coal-fired power plants in Japan.

Taken together, the cases illustrate how coal contestation in Japan emerges through targeted and place-based forms of mobilisation rather than large-scale climate protest. Opposition was rooted in locally specific concerns, while environmental NGOs played an important role in connecting these issues to broader energy and climate debates. The cases also demonstrate how contestation can operate through multiple pathways, including community organising, litigation, and coalition-building, producing varied outcomes ranging from project cancellation to ongoing resistance. As such, they provide insight into how contested emissions emerge within a context where climate mobilisation remains relatively limited and organised resistance operates under significant institutional and social constraints.

The following section will outline the methods and data sources used in this analysis, providing the foundation for examining coal-related conflicts and their impact on carbon emissions.

4. Quantifying contested emissions in Japan: A methodological framework

We used a multi-source framework to analyse contested coal-fired power plants in Japan, combining multiple data sources into a single dataset. We used data from the EJAtlas, the Global Coal Plant Tracker (GCPT), maintained by Global Energy Monitor (GEM), and local activist organisations (Kiko Network, Japan Beyond Coal) to identify contested projects and estimate their associated CO₂ emissions. We analyse coal-related conflicts in Japan that emerged after the Fukushima Nuclear Accident in 2011. Therefore, the timeline of the conflicts, their outcomes, and the estimated emissions resulting from the contestation span 2012–2024. Methodologically, we draw on counter-accounting, an alternative accounting approach used by activists and researchers to challenge official data and sustainability claims by producing independent assessments that identify gaps and inconsistencies in conventional reporting [13,14]. The concept emerged in response to corporations' superficial sustainability reporting, which fails to ensure adequate accountability. The counter-accounts become more relevant as they provide alternative perspectives from external stakeholders that challenge official narratives and financial reports, thereby restoring an ethical dimension to accounting by speaking truth to power [9]. These accounts can offer more comprehensive information, enabling society to make better-informed decisions [68]. While counter-accounts may vary in accuracy, they provide valuable alternative representations and data sources. Here, we apply it to quantify and highlight the visible and potential impact of grassroots resistance on emissions mitigation, which is often overlooked in conventional emissions accounting. This study does not seek to determine the precise contribution of contestation to individual project outcomes. Such an undertaking would require detailed

case-specific investigation beyond the scope of the present research. Rather, the objective is to develop a framework that can be applied across different contexts to identify and quantify emissions associated with contested projects.

4.1. Methodological decision framework

The methodological flowchart (Fig. 1) explains the multi-scalar strategy and the logic used to select and evaluate coal-fired power plant (CFPP) projects to be accounted for as contested emissions, beginning at the national level to avoid selection bias. The approach is multi-scalar in the sense that it moves analytically between local sites of contestation, national energy systems, and their implications for climate change mitigation at a broader, transboundary scale. It traces how place-based struggles over specific projects are translated into changes in national infrastructure trajectories, and how these, in turn, materialise as differences in carbon futures.

Rather than starting from known cases of social contestation, which risks over-representing highly visible or well-documented movements, the analysis begins with the universe of CFPP projects at the national scale. The first step is to identify all CFPP projects and their cancellation status using the GCPT, which enables systematic identification of cancelled projects regardless of their public visibility. This approach avoids the common bias that arises when case selection is based solely on documented protest or activism, as projects with limited media attention or weaker civil society presence may otherwise be overlooked.

Cancelled projects are then cross-checked against qualitative descriptions in both the EJAtlas and the GCPT project notes to assess whether cancellation occurred in the context of documented social contestation (e.g. protests, legal action, NGO campaigns, or local

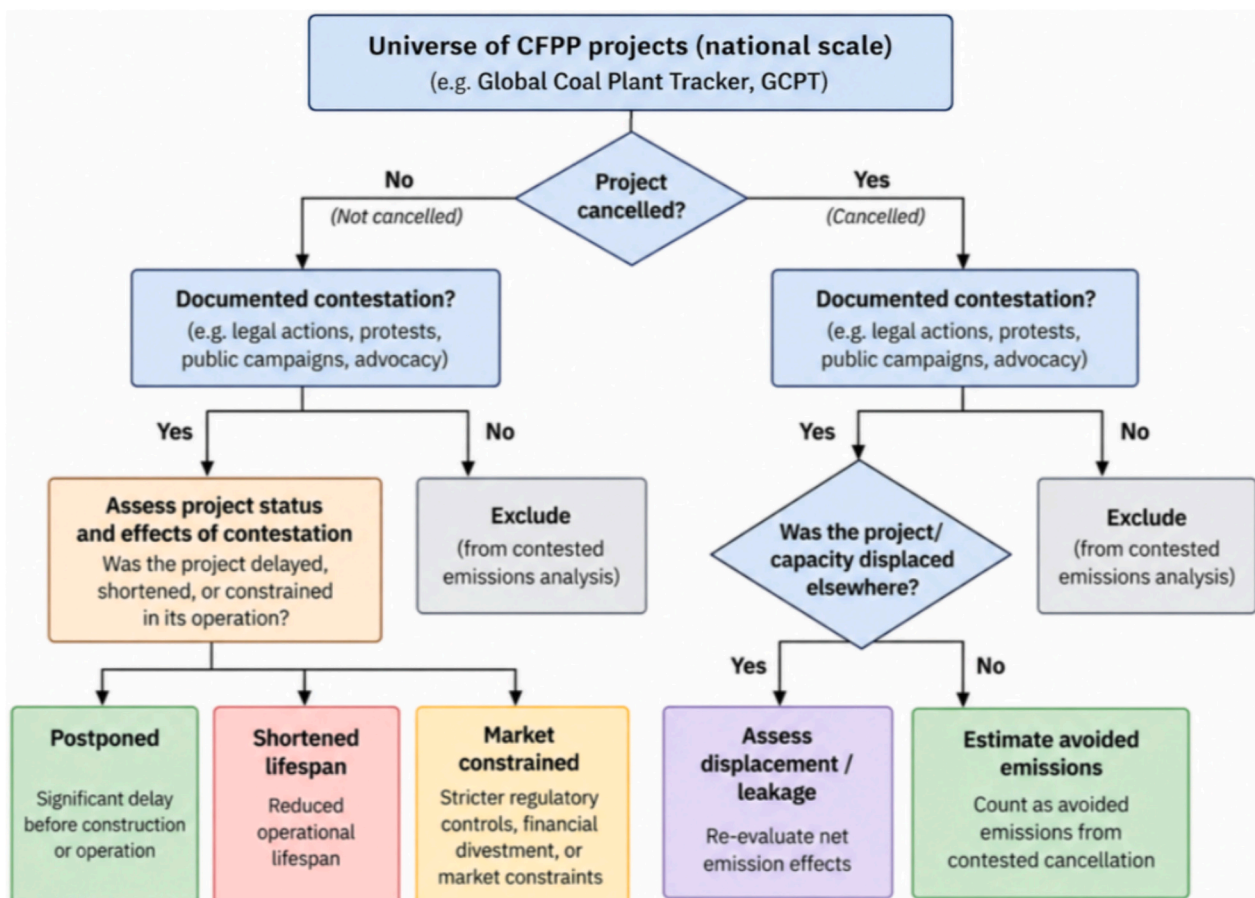


Fig. 1. Methodological decision framework for case classifications. Source: Created by authors.

resistance). Multiple sources and cross-referencing are necessary at this stage. Projects cancelled without evidence of contestation are not coded as contested emissions.

Project cancellations are not interpreted as the direct causal effects of social contestation. Instead, contestation is treated as a relational condition occurring within broader political, regulatory, and economic processes that shape infrastructure outcomes. Accordingly, contested emissions are identified where cancellation coincides with documented social mobilisation, without implying singular or linear causality.

For cancelled and contested projects, additional investigation is conducted at the national level to determine whether equivalent or substitute projects subsequently emerge elsewhere. Where new projects appear to replace cancelled ones, these cases are treated as potential leakage or displacement and are therefore re-evaluated rather than automatically counted as avoided contested emissions. In Japan, however, no new coal-fired power plant projects emerged following the post-2011 wave of coal expansion, nor was cancelled generation replaced by electricity imports. As a result, cancelled and contested projects are treated as genuinely avoided emissions, rather than displaced emissions.

The analysis then turns to CFPP projects that were not cancelled. These remaining projects are assessed to determine whether they were subject to social contestation. Where contestation is identified, projects are further classified according to the nature of the governance outcome, including delays in construction or operation, reductions in operational lifespan, or capacity and regulatory constraints. These outcomes are subsequently used to estimate delayed, reduced, or constrained emissions, rather than fully avoided emissions.

Overall, this stepwise procedure, moving from national-level project identification to case-level qualitative evaluation, ensures that contested emissions are conservatively and transparently attributed, while minimising selection bias and over-attribution of movement effects.

4.2. Data sources

For the identification and estimation of contested emissions, we utilised multiple sources that document contested projects and their technical specifications. These include the EJAtlas, GCPT and materials produced by local environmental organisations.

4.2.1. The EJAtlas and local environmental organisations

The EJAtlas is the world's largest database on ecological distribution conflicts [69,70]. The platform documents place-based, contested projects by gathering information about affected populations, involved corporations, social-environmental impacts, mobilising actors, forms of mobilisation, and conflict outcomes. Case data is crowdsourced through a global network of contributors, providing information about conflicts based on secondary data such as civil society reports, court proceedings, news articles or academic studies. Before publication, the entries are reviewed and verified by a permanent team of moderators. All authors are directly involved in the EJAtlas project and contributed to case data collection and codification following EJAtlas protocols. Here, we use EJAtlas data on Japan primarily to identify conflicts over coal-fired power plants and to gather information on project status and mobilisation forms.

The EJAtlas documents 14 cases of coal-fired power-plant conflicts in Japan. Several of these entries were produced in direct consultation with local anti-coal organisations in Japan, ensuring that case descriptions reflect situated knowledge, campaign histories, and locally perceived harms. As EJAtlas cases depend on published secondary sources, some smaller or less formally organised cases of opposition may not be captured in the dataset. More generally, as a crowdsourced database relying on secondary sources, the EJAtlas exhibits inherent limitations in geographic coverage due to potential selection biases (e.g., cases covered based on accessible information) and description biases (e.g., the accuracy of conflict descriptions). To triangulate and complement available information in the EJAtlas, the authors also conducted

additional case-level research and validated their findings with references from local organisations. Specifically, we drew on materials from organisations such as Kiko Network and Beyond Coal Japan, which provide detailed and up-to-date information on project status, mobilisation trajectories, and local dynamics. Cases are also cross-referenced between the EJAtlas, GCPT, and GEM to confirm evidence of contestation and to collect relevant project data.

4.2.2. Global Coal Plant Tracker (GCPT) and Global Energy Monitor (GEM)

The GEM database tracks fossil fuel energy projects worldwide, including coal-fired power plants. CO₂ emissions estimates are based on the GCPT (July 2024 version) from GEM. The GCPT developed by GEM is a comprehensive database that tracks the status, capacity, and emissions of coal-fired power plants worldwide, providing essential data for research, advocacy, and policy development to address climate change. This data can be requested from the GCPT through its website.² The dataset categorises the status of each coal plant as announced, pre-permitted, permitted, under construction, shelved, cancelled, operating, or retired. GEM's data validation process involves cross-referencing information from government reports, media coverage, NGO databases, and private data collections to ensure accuracy and reliability.

The GCPT includes plant-level data on location, capacity (MW), combustion technology, fuel type, operational status, year of commissioning, planned retirement, and investors. According to the GCPT, Japan has documented 201 coal plant units that have been operational since 1957. Of these, 19 units have retired in recent decades, and three are mothballed, meaning they have reached retirement age and remain non-operational, however, without an official retirement designation. As of July 2024, 151 units are documented as operating in Japan. Over the study period from 2012 to 2024, 23 proposed coal-fired power plant projects were cancelled. Coal-fired generation relies mainly on bituminous coal, with subcritical technology most common. Approximately 50 plants may retire in the next decade, but another 40 could operate for 10–20 more years, and some for up to 40 years.³

4.3. Mapping contested coal projects

Contested emissions are projected greenhouse gas emissions reduced, avoided, or delayed in the context of opposition to fossil fuel projects, infrastructure, or policies. These emissions are 'potential' in the sense that they could have occurred in the absence of such contestation. Identifying contested emissions involves two steps. First, assess the intensity and scale of hydrocarbon projects. Second, determine whether a specific project has faced contestation. The first phase of the analysis maps contested coal-fired power plant projects in Japan. Using EJAtlas mapping tools alongside data from Beyond Coal Japan and GCPT, we identify projects that have faced public opposition. Once a project is confirmed as contested, it is assigned to one of four outcome categories based on observable results: cancellation, postponement, reduced lifespan and market constraints. All contested emissions that are not categorised as cancellations, postponements, or reduced lifespans are classified as potential market constraints, reflecting the role of opposition in limiting the expansion or operation of fossil fuel markets. We then cross-referenced each case by its current status (e.g., cancelled, shelved, under construction) as reported by GCPT, and analysed patterns of mobilisation and public resistance that contributed to halting

² This data is distributed under a Creative Commons Attribution Non-Commercial Share-Alike Public License, meaning sharing and adapting the data is permissible with attribution to GEM. The data can be downloaded publicly through the following webpage: <https://globalenergymonitor.org/projects/global-coal-plant-tracker/>

³ Global Coal Plant Tracker, Global Energy Monitor, July 2024 release.

these projects between 2012 and 2024 (Appendix A).

Determining how a plant's cancellation relates to social contestation is not straightforward. This attribution gap poses a methodological challenge for measuring contested emissions. To address it, we code cancellations as 'contested' when there is documented evidence of opposition, such as protests, legal cases, NGO campaigns, or shareholder actions, occurring before or during the project's planning and development, regardless of the reasons officially stated by the company. This approach recognises that corporate narratives often understate or omit the influence of social movements, while allowing for a more conservative estimate of contested emissions by relying on verifiable contestation records. Cases without verifiable evidence are excluded.

4.4. Annual emissions estimation

For each plant, annual CO₂ emissions are estimated from capacity, heat rate (Btu/kWh), load factor, emission factor (kgCO₂/TJ), and a conversion constant. The GEM data and approach of estimating emissions are widely used by scholars in the field [47,71].

To estimate annual CO₂ emissions for each power plant, we applied the approach used by GEM, using the following formula:

$$EM_{it} = Cap_i \times HR_i \times lf_t \times ef \times \varnothing \quad (1)$$

EM_{it} = Yearly emissions of plant unit i in megatonnes of CO₂ (MtCO₂) for a specific year t .

Cap_i = capacity of plant unit i in megawatts (MW).

HR_i = Heat rate of plant unit i , representing the efficiency of converting fuel into electricity, expressed in British thermal units per kilowatt-hour (Btu/kWh).

lf_t = Load factor of the power plant in a particular year t , which is the ratio of the actual output to the theoretical maximum output.

ef = Emission factor, the amount of CO₂ emitted per unit of electricity generated, typically expressed in kg of CO₂ per TJ (kgCO₂/TJ).

$\varnothing$ = A conversion factor to end up with the correct units (MtCO₂/yr).

Eq. (1) is applied to all plant units in the dataset to establish a baseline annual emissions profile.

Lifetime emissions for plant i are calculated as:

$$Lifetime\ EM_i = \sum_S^T EM_{it} \quad (2)$$

where S is the commissioning year and T the decommissioning year. For example, a plant emitting 5 MtCO₂/year from 2000 to 2024 operates for 25 years, releasing a lifetime total of 125 MtCO₂. If the decommissioning year is unknown, we assume an average lifespan of 40 years for coal-fired plants in Japan.

4.5. Contested emissions categories

Building on GEM's plant-level emissions estimation approach, we extend the framework by developing equations to estimate contested emissions in the following steps:

The total emissions of coal-fired power plants can be estimated by using the following formula

$$TEM = C + N = \sum_{c=1}^4 EM_c + N \quad (3)$$

where C refers to contested coal-fired power plants, and N refers to coal-fired power plants that are not being contested.

Contested emissions are calculated by classifying coal-fired plants into four categories:

- 1 Project cancellation (CEM_p): plants cancelled before operation.

Table 1

Lifetime emissions calculation by contested category.

Category	Lifetime emissions calculation	Time basic
Project Cancellation	$CEM_p = \sum_{i=1}^N EM_i \times L_{planned}$	$L_{planned} = 40\ years$
Postponed	$CEM_d = \sum_{i=1}^N EM_i \times Y_{delay}$	$Y_{delay} = \#of\ years\ start\ is\ delayed$
Reduced Lifespan	$CEM_{re} = \sum_{i=1}^N EM_i \times (Y_{planned} - Y_{actual})$	$Y_{planned} - Y_{actual} > 0$
Market Constraint	$CEM_{mk} = \sum_{i=1}^N EM_i \times L_{remaining}$	Time remaining until decommissioning

- 2 Postponement (CEM_d): plants whose commissioning is delayed.

- 3 Reduced lifespan (CEM_{re}): plants retired earlier than initially planned.

- 4 Market constraint (CEM_{mk}): operating or planned plants facing demand restrictions.

For each category, annual emissions are calculated using Eq. (1), and lifetime emissions are obtained by multiplying annual emissions by the relevant operational years (Table 1).

Therefore, the formula for total contested emissions is as follows:

$$C = CEM_p + CEM_d + CEM_{re} + CEM_{mk} \quad (4)$$

where C is the total contested emissions, CEM_p are emissions avoided through cancellations, CEM_d are the delayed emissions by the postponed projects, CEM_{re} are emissions avoided through reduced lifespans, CEM_{mk} are emissions in market constraints.

Equations for annual emissions (Eq. 1) are not repeated for each category to avoid redundancy.

The aggregation presented in Eq. (4) provides an estimate of total contested emissions across all forms of contestation. However, the framework is designed to be modular, allowing each category to be calculated and analysed independently depending on the research objective. For example, researchers interested in emissions more directly associated with mitigation outcomes may focus exclusively on project cancellation and on postponed and reduced lifespans, whereas studies examining the broader influence of socio-environmental conflicts on fossil-fuel development may incorporate delays and market constraints. This flexibility enables the framework to distinguish between avoided emissions and the wider spectrum of emissions associated with contested projects.

Formulas for weighted capacity and emission leakage

The following formulas are proposed to incorporate emission leakage and weighted attribution probabilities into contested emissions accounting.

Coal-fired power plants operate at highly variable utilisation rates, and contestation often depresses load factors through regulatory constraints, reputational risk, or altered dispatch priorities. We therefore do not assume full or fixed operation. Instead, annual emissions are estimated under low-, medium-, and high-utilisation scenarios by varying the load factor within empirically observed ranges in the power sector.

To weight each plant's emission,

$$EM_{it}^{(k)} = Cap_i \times HR_i \times lf_t^{(k)} \times ef \times \varnothing, \quad k \in \{low, mid, high\} \quad (5)$$

Where:

- lf_t^{low} represents a low load factor

- lf_t^{mid} represents the observed historical average load factor
- lf_t^{high} represents the observed maximum operational load factor

In the case of Japan, the load capacity factor is relatively stable and mid-range, at 0.53; therefore, multiple simulations were not conducted. However, in other national contexts, particularly where load factors vary significantly due to seasonal heating demand or demand fluctuations, the load capacity may be more uncertain. In such cases, formula (5) can be used to illustrate a range of possible outcomes.

To weight leakage factor to the contested emissions avoided, the following formula can be used.

$$CEM_p = \sum_{i=1}^N EM_i \times L_{planned} \times (1 - \lambda) \quad (6)$$

Where:

no chances to low chance of leakage ($\lambda = 0, 0.1$).

Higher chances of leakage ($\lambda = p^{reappear} \times 1 - p^{opp}$)

$p^{reappear}$ is the structural likelihood that foregone fossil capacity is sought elsewhere (driven by demand, capital, and policy)

p^{opp} is the likelihood that new projects encounter local opposition (density of civil society, legal opportunity structures, history of successful mobilisation, diffusion of anti-fossil frames, access to courts)

By decomposing leakage into the likelihood of reappearance and the likelihood of effective opposition, the framework allows contested emissions to be parameterised in ways that are sensitive to national political contexts. Countries with dense civil societies, juridified environmental governance, and declining fossil fuel trajectories can be modelled with low leakage, whereas contexts characterised by constraints in contestation and continued fossil fuel expansion warrant higher leakage values. In the following section, we apply this method to Japan.

5. Empirical findings: Contested emissions and grassroots resistance in Japan's anti-coal movement

This section presents the results of our contested emissions estimation. We begin by outlining the results for each category, following the sequence of definition, estimation method, and relevance in the Japanese context. Table 2 summarises the estimated contested emissions for each category during the period of coal contestation from 2012 to 2024. Fig. 2 shows the geographical distribution of post-Fukushima coal-fired power plants included in the analysis, distinguishing their status and associated annual emissions.

5.1. Project cancellations

Over the past decade, mobilisation has been associated with the cancellation of 23 planned coal-fired power plants in Japan, totalling 12.18 GW of capacity (Appendix A). Halting these projects is projected to avoid 49 MtCO₂ annually, around 4% of Japan's total emissions in 2021, or 11% of annual electricity sector emissions. While companies often cite market conditions or policy alignment as reasons for withdrawal, evidence shows that these projects were actively contested through litigation, shareholder advocacy, and public campaigns [2].

Two emblematic cases illustrate these dynamics. The 1200 MW Nishikoyama project in Ube City was opposed from 2016 by the Kiko

Table 2

Estimated Contested Emissions Categories.

Contested Emissions Categories	In Capacities (GW)	Annual emissions (MtCO ₂ /year)	Lifetime emissions (GtCO ₂)
Project cancellations	12.18	49.03	1.96
Project postponements	0.50	2.4	0.004
Reduced plant lifespans	0.50	2.4	0.1
Market constraints	54.75	257.72	4.34
Total	67.93	311.55	6.40

Source: Authors' calculations based on the data from the Global coal plant tracker, Global energy monitor, July 2024 release.

Network, local residents, and allied groups who challenged its environmental assessment, exposed flawed emissions data, and mobilised shareholder activism, protests, and media campaigns. The movement drew on long-standing environmental networks in western Japan, where past struggles over industrial pollution had strengthened local organising capacity. Public backing from the local mayor and Japan's Environment Minister amplified the pressure [72]. The project was cancelled in April 2021, marking a landmark victory for Japan's coal phase-out movement [73]. The 1070 MW Soga project in Chiba City has been opposed since 2017 by the Anti-Coal Soga group, Friends of the Earth Japan, and the Kiko Network. Drawing on the legacy of the Aozora Trials, residents framed the project as a threat to health, climate, and community rights, while securing support from the environment minister. The project was cancelled in December 2018, reinforcing the strategic value of coupling local environmental justice struggles with national climate advocacy [74].

This category also includes several long-postponed coal projects that, while never officially cancelled, have disappeared from public plans and reporting. Recognising them as effectively cancelled allows for a more accurate picture of the contested emissions landscape. The following section turns to postponed projects, examining how delays contribute to the broader dynamics of contested emissions.

5.2. Postponed projects

In Japan, several coal projects have been postponed, collectively deferring millions of tonnes of CO₂ emissions and highlighting how delays can undermine the long-term viability of fossil fuel investments. Unlike in some countries, Japanese anti-coal movements rarely use direct-action tactics such as sit-ins or construction-site occupations, instead relying on sustained public campaigns, organised protests, petitions, and legal challenges. As a result, postponements often arise from a combination of advocacy, institutional processes, and market dynamics, making it difficult to isolate the impact of movement actions.

In our analysis, shelved projects that have not reappeared in public plans are treated as effectively cancelled and included in the cancellation category. The remaining postponement category is therefore limited to active but delayed projects, most notably the GENESIS Matsushima project. Planned to emit 2.4 MtCO₂ annually, its two-year delay represents a deferral of roughly 4.8 MtCO₂. Project delays should not be interpreted merely as a temporal shift in emissions. Extended delays can alter the structural conditions under which a project operates and thereby affect its overall viability. Over time, political opposition tends

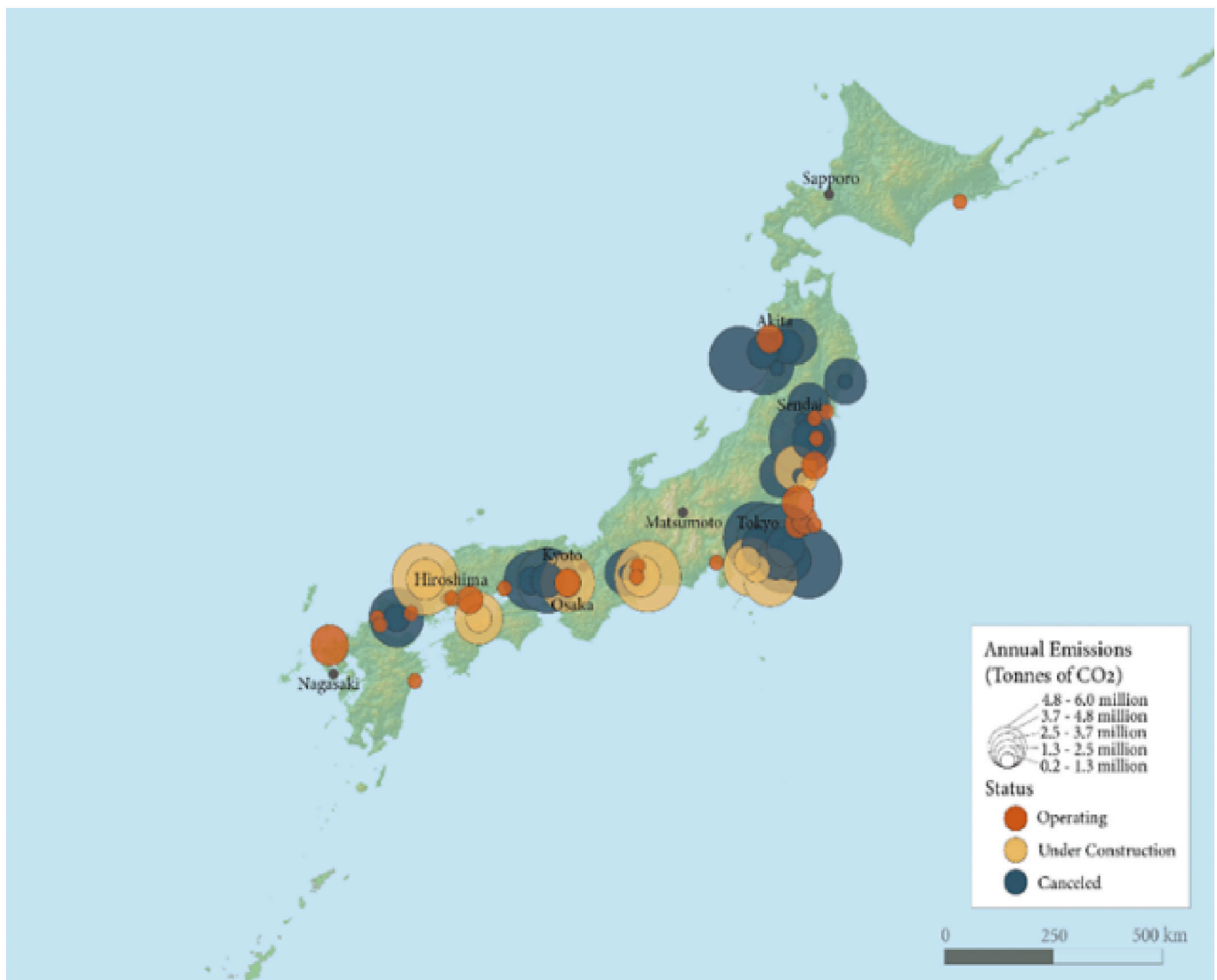


Fig. 2. Coal-fired power plants and their emission estimates.

(Source: Authors' calculation using the status of CFPPs proposed after 2011 from GCPT, 2024)

to consolidate, tightening financing conditions, and regulatory priorities often evolve [54]. These developments can raise the costs and risks associated with project completion. As a result, prolonged delays do not simply postpone emissions; they increase the likelihood that projects are ultimately abandoned.

5.3. Reduced operational lifespans

'Reduced lifespan' and 'cancellation' may appear similar when coal plants are decommissioned, or their operational lives are cut short, but the nuances lie in their context and outcomes. Reduced lifespan refers to coal plants that are shut down earlier than planned or prevented from extending their operational life. In Japan, environmental movements have increasingly called for not only stopping new coal construction but also shortening the operating periods of existing plants, particularly those slated for life-extending upgrades [75]. Civil society groups estimate that Japan's current coal fleet will emit around 4.3 GtCO₂ over its remaining lifetime, and early retirement is seen as essential to achieving national climate targets [75].

A prominent case is the Matsushima coal-fired power plant in Nagasaki, where operator J-Power proposed the 'Upcycling' plan to retrofit the facility with coal gasification and ammonia co-firing. While

presented as a decarbonisation measure, the upgrade was expected to cut CO₂ emissions by only ~10%, and critics noted that ammonia production would itself generate significant CO₂ [76]. From 2021 onward, youth activists, the ACT Matsushima coalition, Friends of the Earth Japan, and the Kiko Network organised sustained opposition to the project. Their repertoire of contention included demonstrations outside J-Power's Tokyo headquarters, public letter campaigns directed at relevant ministries and plant operators, and a coordinated social media campaign under the hashtag #SekitanZombie. The campaign generated more than 850 public comments, videos, and posts, indicating a substantial level of public engagement within the consultation process [76]. While these actions cannot be interpreted as the direct cause of the final decision, research on social movements shows that multifaceted mobilisation strategies can increase the visibility and political salience of contested projects. On 31 October 2023, J-Power announced that Unit 1 would be decommissioned and Unit 2 suspended by the end of 2024, avoiding an estimated 2.4 MtCO₂ annually from 2024 onward, while delaying the GENESIS Matsushima project until 2028. Even though the average operational lifetime of a coal-fired power plant in Japan is 40 years, some plants have been operating for more than 40 years. The decommissioning of the plant reduced its projected life expectancy by at least 20 years. Although J-Power attributed the decision to strategic and

technical considerations, it occurred in the context of several years of public mobilisation and sustained media scrutiny surrounding the project. Activists continue to call for the full cancellation of the upcycling project and the early closure of other coal-fired units nationwide, arguing that addressing the operational longevity of existing plants is as critical as preventing new builds. The following section examines the broader implications of contested emissions in Japan's energy transition, particularly those cases where outcomes remain unresolved.

5.4. Constraining fossil fuel markets

Social movements and divestment campaigns can indirectly limit coal development by raising financial, regulatory, and reputational risks, even when projects proceed. In Japan, emissions associated with coal-fired capacity subject to such market constraints amount to an estimated 258 MtCO₂ annually, despite sustained opposition.

Not all contestation ultimately prevents CO₂ emissions, but it can shape future investment decisions in coal. Some campaigns fail to halt operations, as in the cases of the Sendai Power Station and the Kobe Steel Power Plant. In Kobe City, two 650 MW units have faced organised resistance since 2018. Residents, supported by the Kiko Network, launched lawsuits, engaged in shareholder activism, and conducted public campaigns over the plant's 6.9 MtCO₂ annual emissions and health risks. While the plant remains operational, the campaign has heightened scrutiny of coal finance and contributed to national policy shifts, including Prime Minister Kishida's 2023 pledge to end approvals for new coal plants [72]. In Sendai City, the 112 MW Sendai Power Station emits about 0.67 MtCO₂ annually and was built without a complete environmental assessment. The citizen group Anti-Coal Sendai, mobilising around concerns over health, biodiversity, climate impacts, and environmental injustice, filed Japan's first lawsuit against a single coal plant in 2017. Although the injunction was dismissed in 2021, the court recognised protection of pollution control agreements, strengthening corporate accountability and inspiring similar actions nationwide [77].

These cases show how ongoing contestation has potential to reshape the coal market by weakening investor confidence, tightening regulations, and undermining the long-term viability of fossil fuel projects. Sustained activist pressure has pushed policymakers and investors to reconsider coal expansion, leading to commitments to curb new projects and expand renewables, and creating a market environment where coal's future is increasingly uncertain.

5.5. Estimates for the contested emissions: From local contestation to global climate implications

Of the 6.4 gigatonnes (Gt) of lifetime contested emissions identified in this study, approximately 2 Gt correspond to avoided emissions

associated with cancelled coal projects and shortened operational lifetimes (Table 3). These avoided emissions illustrate the combined influence of grassroots mobilisation, regulatory interventions, and broader economic changes on the development trajectories of coal infrastructure in Japan. The remaining contested emissions reflect other forms of contestation, including delays and market constraints, which do not necessarily result in immediate emissions reductions but nevertheless shape the timing, scale, and future operation of fossil-fuel projects.

Since 2012, newly constructed coal plants are expected to emit around 100 Mt. of CO₂ annually for the next 20–40 years or more. Within the avoided emissions category, cancelled projects alone would have produced an estimated 49 MtCO₂ per year had they proceeded. Adding postponed projects and reduced lifespans, which together account for about 4.8 MtCO₂ annually, brings total avoided emissions to 53.8 MtCO₂.

This represents a substantial share when compared with Japan's 2021 total greenhouse gas (GHG) emissions of 1170 MtCO₂e [57]. Our analysis estimates that contested coal plants that remain operational could emit up to 311 MtCO₂ per year, accounting for 26.5% of Japan's total annual emissions and approximately 73.6% of the country's electricity sector emissions in 2021. While these estimates do not imply equivalent mitigation outcomes across all categories of contested emissions, they underscore the scale at which socio-environmental conflicts intersect with carbon-intensive development.

In global terms, total lifetime contested emissions from Japan's coal sector correspond to 2.7% of the remaining global carbon budget of 235 Gt (as of January 2025), while avoided emissions alone account for 0.8%, a measurable contribution to global climate mitigation efforts. These figures highlight the significance of local and national struggles over fossil-fuel infrastructure within broader global decarbonisation efforts.

The contested emissions framework demonstrates that climate-relevant outcomes emerge through multiple forms of intervention in fossil-fuel development. While these forms of contestation have different implications for climate mitigation, together they reveal how social mobilisation can influence emissions trajectories and reshape the conditions under which energy transitions unfold. The cumulative effect demonstrates how local resistance can disrupt fossil fuel dependency and accelerate the shift toward sustainable energy. These findings frame contested emissions as both a climate-mitigation tool and a pathway to integrating grassroots action into national and global decarbonisation strategies.

An important implication of these findings concerns the limits of policy-led decarbonisation under contemporary “green growth” paradigms. In Japan, a country long positioned as a climate leader within the G7 and a signatory to both the Kyoto Protocol and the technocratic green transition policies, the scale of contested coal emissions, amounting to 26.5% of annual GHG emissions, suggests that a substantial share of

Table 3
Proportion of Contested Emissions to National Emissions and Global Carbon Budget.

Category	Cumulative Emissions (Annual)	Cumulative Emissions (Lifetime)	Share of Japan's 2021 Annual Emissions	Lifetime Emissions Equivalent	Share of Remaining Global Carbon Budget*	Remarks
Total Contested Emissions	311 MtCO ₂	6.4 GtCO ₂	26.5%	Approx. 5 years of Japan's annual emissions	2.7%	Emissions associated with all four forms of contestation (cancellation, delay, shortened lifespan, and market constraints)
Cumulative Avoided and Deferred Emissions *	53.8 MtCO ₂	2.0 GtCO ₂	4.6%	Approx. 1.7 years of Japan's annual emissions	0.8%	Emissions associated with cancellation, delay, and shortened operating lifespans

Notes: * For cancelled projects, cumulative emissions are estimated over the expected project lifetime. For postponed projects, they represent emissions deferred during the period of delay; for reduced-lifespan projects, they represent emissions avoided over the years of operation foregone.

Remaining global carbon budget estimated at 235 GtCO₂ as of January 2025 for limiting warming to 1.5°C. National emissions proportions are calculated using Japan's 2021 greenhouse gas emissions of 1170 MtCO₂e. Lifetime emissions assume an average coal-fired power plant operational lifetime of approximately 40 years in Japan. Source: Using data from Global Energy Monitor. Data is attached as supplementary material.

mitigation in this sector has emerged not primarily from technocratic green transition (GX) policies, but through sustained grassroots mobilisation. Notably, many of these forms of contestation predate the Paris Agreement and have contributed to shaping the policy landscape and energy corporate structures within which decarbonisation has subsequently been pursued. In this sense, civil society opposition can be understood as a prefigurative force in the energy transition rather than merely a reaction to it.

This finding does not simply demonstrate the influence of communities and civil society; it also exposes the structural limits of market-oriented and technocratic climate governance [78]. While governments and international institutions often frame existing policies as incremental progress in the “right direction,” the Japanese case indicates that such trajectories remain climate-relevant only insofar as they are actively contested and constrained from below. In this sense, resistance does not merely complement green policy, but frequently prevents it from being diluted, delayed, or reversed. Contested emissions thus suggest that what appears as progress under green capitalism may, in fact, be the sediment of prolonged struggle, underscoring that mitigation outcomes are less the result of an orderly transition than of ongoing conflict over the direction, pace, and meaning of decarbonisation.

6. Conclusions: Social movements, contested emissions, and climate actions

As of January 2026, the remaining global carbon budget for a 50% chance of limiting warming to 1.5 °C is estimated at approximately 170 Gt CO₂ [79], projected to be depleted within four years at current emission rates. Against this backdrop, the contested emissions framework offers a novel conceptual and methodological contribution to ecological economics, political ecology, and sustainability science by linking ecological distribution conflicts, energy and power asymmetries, and climate change mitigation within a transdisciplinary analytical approach. The framework provides a way to make grassroots resistance visible within climate accounting.

Applying this framework to Japan, we estimate that prevented and deferred annual emissions associated with project cancellations, delayed and shortened operating lifespans amount to approximately 4.6% of Japan's annual GHG emissions. More broadly, projects subject to contestation represent emissions equivalent to 26.5% of national emissions. This distinction highlights the difference between emissions that have already been prevented and the wider scale of carbon-intensive development that has become the object of sustained social and political challenge. In Japan, cancelled coal projects were not replaced by new coal capacity, allowing these emissions to be treated as avoided rather than displaced nationally. Although LNG is often discussed as a potential substitute for coal, recent LNG developments appear to be more closely linked to the replacement of existing thermal capacity than to cancelled coal projects [63]. Nevertheless, persistent LNG overcapacity and plans for new infrastructure indicate that contestation increasingly extends beyond coal to broader questions of energy demand, including data-centre expansion and associated resource conflicts [80]. This study does not examine how contested emissions interact with broader patterns of fossil-fuel extraction, displacement, and consumption across different geographical scales. Understanding these cross-scalar dynamics remains an important area for future research.

In Japan, many anti-coal movements reject the framing of coal phase-out as a simple trade-off with other contested energy sources, such as nuclear power, large-scale biomass, gas-fired power plants, or ammonia co-firing [75]. Such actions, whether through legal challenges, advocacy, or direct participation in energy debates, can be understood as expressions of care for land, people, and more-than-human worlds as much as they are struggles over atmospheric carbon [81–83]. From this perspective, contested emissions situate grassroots actions within broader patterns of inequality and environmental justice, operationalising ‘resistance as mitigation’. Conventional mitigation frameworks

such as carbon credits tend to abstract emissions from place, labour, and ecology, framing justice in terms of compensation or redistribution after transition decisions have already been made. Such approaches risk reproducing climate coloniality, as the social and ecological costs of extraction and pollution are displaced onto marginalised regions while mitigation benefits accrue elsewhere [84].

This framework represents a first step forward in capturing the climate significance of grassroots resistance, but substantial technical and methodological refinements remain possible. The current approach focuses on coal-fired power plants in Japan, relying on available project-level data and emission factors; future studies could develop more robust, dynamic models incorporating temporal shifts in energy demand, fuel substitution effects, and cross-sectoral spillovers [37]. Expanding the framework beyond single fuel types and national boundaries would help to assess contested emissions at regional and global scales. Recognising and integrating these contributions into national and global climate strategies is not only a matter of accounting accuracy, but also of acknowledging the diverse pathways through which a just and sustainable energy future can be realised.

CRedit authorship contribution statement

May Aye Thiri: Writing – review & editing, Writing – original draft, Validation, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Federico Demaria:** Writing – review & editing, Supervision, Project administration, Conceptualization. **Arnim Scheidel:** Writing – review & editing, Supervision, Project administration, Conceptualization.

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.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.erss.2026.104976>.

Data availability

Data will be made available on request.

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