



Original research article

Untangling the socio-political knots: A systems view on Indonesia's inclusive energy transitions

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ARTICLE INFO

Keywords:

Socio-political dynamics
 Inclusive transitions
 Developing countries
 Socio-technical energy transitions
 Systems thinking

ABSTRACT

National energy transitions face complex socio-political challenges, ranging from inertia to exacerbated inequalities. There are limited studies investigating these dimensions, especially in developing economies. This paper presents Indonesia, a country with high fossil fuel dependency, as a valuable case study to investigate the societal interplay affecting transitions. Interviews and literature analyses were conducted to assess barriers and levers to success. The findings are further analysed with systems thinking (ST), highlighting dynamic patterns and interdependencies. It is found that conflicting interests, inconsistent regulation, and low capability at the implementation level are among the most persistent barriers creating disparities between intentions and reality. These leave some groups disproportionately disadvantaged; notably, regions with fossil fuel-dependent income, informal sectors, and indigenous and local communities. Recommendations include the creation of an independent agency for the energy transition, and empowering regional participation. Addressing inclusion is imperative for social justice as well as to ensure adoptability and acceptance from all.

1. Introduction

Energy transitions often face inertia as they comprise complex socio-technological processes with power interplay between multiple actors – making a purely technological viewpoint inadequate [1–4]. This is particularly the case in Indonesia, where the advancement of both the Law and Presidential Regulation on renewables (regulatory policies signed by the House of Representatives and the President) has been impeded in the past years, failing to provide the country with an umbrella regulation for sustainable energies. For a long time, this missing legal precondition tacitly indicated an unstable political state of Indonesia's renewable energy development [5]. While a recently launched “Energy Transition Net Zero” roadmap [6] partially remedied this, the document still overlooks addressing root systems causes likely to hinder efforts towards sustainable structural change, including more focus on local capacity and on the vulnerable communities that will be impacted by the transition.

Indonesia – ranked 14th in the Global Climate Risk Index – is in a highly vulnerable position due to climate change [7]. In spite of this, the country is the 7th biggest user of coal-fired power plants in the world and 91.5 % of the national primary energy mix still relies on fossil fuels

[8,9]. Indonesia is also the largest coal exporting country by volume and possesses very significant coal reserves [10]. Therefore, the low carbon energy transition poses strong challenges to the country's economic stability and energy security. This massive dependency on fossil fuels and expectations for uninterrupted economic development is common in many developing countries [11,12], and can create fossil fuels lock-ins, path dependencies, and political pressure from incumbents that may oppose the transition [13–17]. However, the decarbonisation of the energy sector in such countries is urgent given the growing population. Indonesia struggles with an under-utilisation of renewable resources, stalled at a 2 % realisation of its 442 GW potential [18] and the transition target of 23 % renewable energy uptake by 2025 has been lagging at 11 % for the past decade [19]. Indonesia's current transition policies are also unique in their definition of ‘new energies’, which include the usage of coal and nuclear power, a terminology much debated with concerns over its influence in undermining the regulatory support towards renewables. The country has declined to propose a more ambitious energy target through its Nationally Determined Contribution (NDC).

Meanwhile, energy exploration and exploitation in Indonesia have created a long list of injustices towards local communities. This ranges

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Received 30 May 2022; Received in revised form 16 September 2022; Accepted 30 November 2022

Available online 14 December 2022

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from floods caused by mining activity, coal spill-over on public beaches, to exposed mining holes that caused multiple citizen casualties [20–23]. While some of these cases gained national coverage and public support, only minimum reparation actions were attempted, leading some community actors to denounce their powerlessness compared to large energy institutions [24]. Setyowati [23] argues that this inequality has been sustained by Indonesia's current energy policies that exclude vulnerable communities from decision-making. This concern is reflected in the global sphere, with calls for more inclusive and holistic energy transition approaches [26]. Aiming in priority for universal energy access, Indonesia's current policies indicate trade-offs between environmental sustainability and economic affordability [27]. All these factors emphasise the need for an inclusive transition that considers all the impacted groups, maximises opportunities for economic prosperity, and adheres to social justice. Inclusivity in this research therefore focuses on how the interests of vulnerable groups are represented and how the overall socio-justice principle is embedded throughout the process.

Energy transition research and studies have been largely concentrated in developed countries [4,12,28], which provide few application opportunities in developing countries [29,30]. There is also a gap in untangling socio-political factors within national energy transitions, especially one that investigates how inclusivity is being embedded in the decision-making processes. Hence, studying Indonesia is fitting as it presents a relevant case study to these two gaps. This background leads to the research question: How do societal and political dynamics affect the inclusive transition of renewable energies in Indonesia? In order to answer this, this study uses a systems thinking (ST) perspective to illustrate and bring novel insights into the country's socio-political dynamics. This research intends to present timely recommendations to the current drafting process of the national renewable energy regulations.

2. Methodology

2.1. Interviews

Several semi-structured interviews were conducted to gain actors-specific data, as recommended by Sterman [31]. Key stakeholders are defined by Stroh as the people and organisations that are affected by and able to influence the issue at stake [32]. Ialnazov and Keeley define the key stakeholders in Indonesia's energy transition as the government, state-owned energy utility companies, private investors, and international aid organisations [13], while Sunitiyoso et al. also include researchers [33]. This study also included insights from non-governmental organisations (NGOs) or civil society organisations (CSOs), intermediary organisations, and representatives from community-led projects to address McCauley et al. [34] and Bickerstaff et al. [1] suggestions to give greater agency to communities and get insights on inclusivity. Some direct perspectives which are not covered by our interviews are filled in by focused studies from the literature such as [12,25,35–38]. The specific interviewees were identified from their visible participation and contribution in national dialogues regarding energy transition. In summary, the study gathered perspectives from 17 key actors from 4 stakeholder groups (see Table 1). To preserve their anonymity this study does not assign any statement to specific interviewees.

The semi-structured interviews explored stakeholder's views on the challenges, current energy and climate policies, and key actors of Indonesia's energy transition. This was followed by open-ended questions where the interviewee could express their suggestions in making the socio-political dynamics work towards a more inclusive transition. The interview questions are listed below:

1. Opening questions

- Can you briefly describe your main role and responsibility in your current affiliation?
- How does your role allow you to contribute to energy transition discourse in Indonesia?

Table 1

List of interviewees.

Stakeholder group	Main expertise	Number of people interviewed
1. Government	Policymaking Development plan	5
2. Coal industry players	Partnership Socio-political barriers for businesses	2
3. NGO including think tank, development partner, CSO	Inclusivity Local community perspectives Stakeholder involvement Development programmes	7
4. Academics/Research groups	Research in energy transitions Systems thinking	3

2. Main discussion

- From your perspective, can you describe the decision-making process in formulating policies for renewable energy transition in Indonesia?
- What would you say the important drivers, factors, or considerations in energy transition policymaking in Indonesia?
- Would you say inclusivity is a part of the consideration? Do you consider it has been discussed in an adequate amount? What kinds of factors driving it?
- How would you see the organisational relationship between different institutions and bodies affecting the policymaking of energy transition in Indonesia?
- In your views, what are the societal and political barriers for an inclusive renewable energy transition in Indonesia?
- How would you see different motives/motivations among the main actors in energy transition policymaking?
- How do you see the pandemic drives or hinders inclusive energy transition in Indonesia?
- In your opinion, what is the biggest cause of the delay in renewable energy regulations in Indonesia and what are the possible outcomes should this continues?
- What would be the implications of the upcoming Presidential Regulation and the new energy bill to different actors involved in energy transition in Indonesia?
- Which institutions do your institution cooperate the most? Which one is the least? Are there any important stakeholders you consider need to be involved more?

2.2. Literature analysis

The literature analysis examines selected academic papers found through Scopus using systematic keyword combinations and filters. The research also included direct Google search and media monitoring to gather local and national news on key phrases, namely 'renewable energy', 'energy transition', 'renewable energy bill', and 'renewable energy presidential regulation'. Additionally, grey literature such as policy statements, conference proceedings, as well as government and other organisational reports and publications were explored and synthesised. The snowballing of bibliographies was also used and excluded documents not written in the English or Indonesian languages and those not publicly accessible. In addition, a brief analysis on the history of Indonesia's energy politics, including decentralisation and domestic politics, were conducted.

The literature review process and results are summarised in Table 2.

Table 2
Literature review process and results.

Search term	Initial hits	By titles		By paper	
		Shortlisted	By abstract Shortlisted	Shortlisted	Shortlisted
“Renewable energy” AND “policy” AND “Indonesia”	312	66	36	21	
“Energy transition” AND “policy” AND “Indonesia”	18	9	7	5	
“Just transition” AND “Indonesia”	5	3	2	1	
“Inclusive” AND “energy transition” AND “Indonesia”	0	0	0	0	
“Inclusive” AND “energy transition”	75	28	13	7	

2.3. Systems thinking

Energy transitions deal with transformation of a complex socio-technical system. Wright and Meadows [33] identify this as an intrinsically systems problem, caused by undesirable behaviours or characteristic of the system structures that produce them. In facing this complex issue, adapting a siloed, linear method of thinking does not fit. In fact, people seeking to solve this kind of problem can make the situation worse with unanticipated side effects from a counterintuitive social system behaviour [40]. Sterman [31] defines systems thinking (ST) as the ability to see the world as a complex system where everything is connected. Stroh [32] highlights that understanding these interconnections can help achieving a desired purpose. Systems thinking may also help accelerate changes by catalysing collaboration, focusing on people, and stimulating continuous learning [32].

Markard [41] and Hidayatno et al., [42] advocate for a more holistic type of thinking in advancing research and policymaking in energy transitions, as they involve many interconnected processes and various stakeholders' interests. These interconnectedness are also important in discussing inclusive transitions, as defining what is just, and for whom, requires a wide understanding of the scope [43]. Therefore, a ST approach is relevant to answer the research question as it acknowledges interdependencies, interrelationships, gaining insights on underlying behaviour, and aiming for long-term best interests [31,44,45]. This study utilises more particularly visual tools from System dynamics (SD),

a modelling methodology derived from ST, such as causal loop diagrams (CLD) and systems archetypes, which help draw out and visualise the systemic patterns in place to operationalise ST findings and elicit high-level policy interventions [31].

3. Results and analysis

3.1. Energy transition in Indonesia: an in-depth look

3.1.1. Brief history of Indonesia energy politics

To dig further into the domestic political economy of Indonesia's energy transition, it is important to see how the energy systems come to what it is like today. Historically, the fossil fuels industry has always held an important role in the country's energy mix, planning and development (Fig. 1).

The exploitation of natural resources for development is a legacy of Dutch colonialism which then became a part of Indonesia's constitutions. Article 33 Paragraph (3) of the 1945 Constitution states that the earth, water and natural resources contained in the nation are controlled by the state and to be used for the greatest prosperity of its people. The Article is often seen as blanket approval for decision-makers to manage operations with free market mechanisms as seen appropriate [47]. Oil used to be the biggest source of Indonesia's energy mix and therefore has substantially shaped Indonesia's energy politics in the process. This materialised in at least two connected ways: an important national and regional governments dependence on oil for development, reinforced by the normalization of subsidies for its industry.

The oil boom-and-bust cycle of the 80s and 90s has impacted the government's structure. During the boom in the 80s, the government was able to provide increased employment with the absolute number of civil servants quadrupled in only 10 years. It eventually stagnated when the oil prices fell in the 90s, and a zero-growth policy on civil servant numbers was instituted [48]. This is now similar with the coal industry, which, sustained by the mutual dependence between the subnational governments and the industries for local fiscal revenues, can mingle with local politics [49]. Additionally, as the provision of public infrastructure has always been one of the most important development goals of the Indonesian government, the contribution of oil, and now coal, to the public budget create a strong incentive for the national and local governments to sustain the profitability of the industry [49].

Indonesia enjoyed its surplus of oil and the status of global exporter between the 80s to the 00s [46]. This period allowed Indonesia to

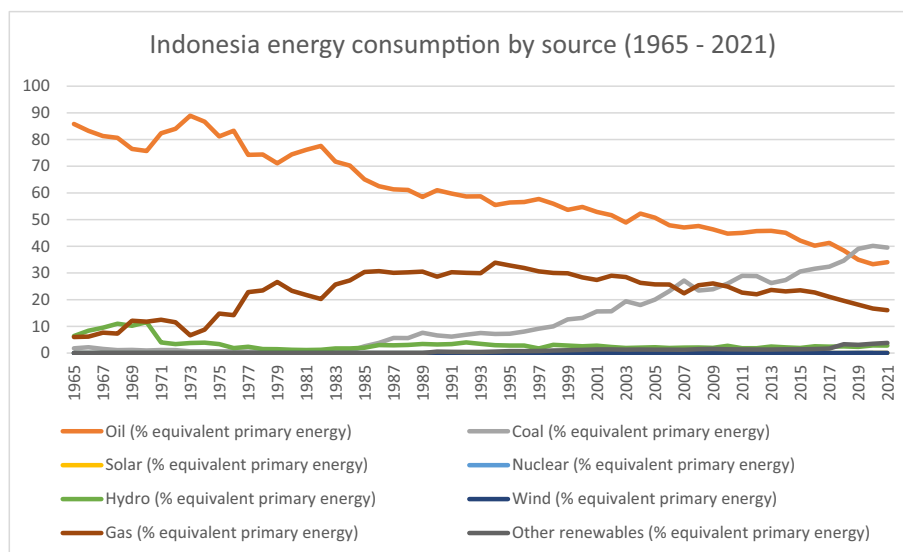


Fig. 1. Indonesia energy consumption by source over time. (Source: BP [46].)

normalize subsidies for domestic energy consumption. With such surplus, the policy at that time was largely unaffected by international energy price volatility [47]. However, the government continued to subsidise even when the country turned to become importer by 2003 as the domestic demand exceeded production. Subsidising energy consumption had already become embedded as a culture, seen as both politically and socially acceptable [50]. Indonesians therefore became dependent to ‘cheap’ energy, even though it actually consumed around 20 % of the national budget over 2011–2014 [47]. This very costly measure, which contributed significantly to global emissions, did not serve the communities who needed it the most. Only 36 % of the benefits helped low-income populations and less than 1 % supported the poorest [51–53].

3.1.2. Indonesia's energy transition actors

Dissecting Indonesia's energy transition starts from appreciating the different actors involved in this endeavour: fossil fuels and renewable energy companies, electricity providers, governments, civil societies working towards wider climate change effort, and citizens. Each possesses different jurisdictions, influence, and impact, which we divide in this study into two broad categories: policymaking and implementation. Table 3 serves as a simplified projection of the complex, sometimes overlapping or opposing existing national and institutional structure. It adapts and enhances previous frameworks by Morris et al. [54] and Lauranti and Djahhari [37]:

A further description of the key actors and their actions towards national decarbonisations is presented below:

a. Ministry of Energy and Mineral Resources (MEMR)

MEMR aims to achieve the national emission reduction target largely by increasing the usage of renewable energy. They have developed a long-term model that envisions Indonesia reaching an emission peak by 2040 and net-zero emission by 2060 [55] – which differs from the MoEF's updated NDC document. MEMR aims to reach 23 % of NRE in the energy mix by 2025. However, over the past decade, it has stalled at 11.2 %. Between 2014 and 2019, Indonesia has added less than 300 MW of renewables and 1900 MW of coal annually, increasing the risk of more lock-ins into high cost and carbon-intensive technologies. The existing retirement plans for coal power plants allow some plants to still operate until 2056. The plan also relies on gas as an intermediate transition, which, while having a lower carbon, is argued to be missing the opportunity to directly transition to renewables. MEMR has often highlighted the importance of global support, as promised in the Paris Agreement, to accelerate the phasing-out of coal. MEMR is currently developing a

presidential regulation that aims to incentivise renewable energy development through pricing mechanisms.

b. Ministry of Environment and Forestry (MoEF)

MoEF holds an important position as Indonesia's focal point in the global climate discussion. However, some interviewees pinpointed the ministry's organisational challenges, as it was, just before the signature of the Paris Agreement, merged from two different organisations: the Ministry of Environment and the Ministry of Forestry. Additionally, while the responsibility for climate change lay in the organisation, both government and non-governmental interviewees recognise it has limited room for action. This is not unique to Indonesia, as it is found to be one of the biggest global problems of climate change governance where the environment ministries usually have little power over other key departments, such as finance, trade and industry [56,57].

Having declined to increase the emission reduction target in the NDC, MoEF had proposed its own Long-term Strategy on Low Carbon and Climate Resilience 2050 (LTS-LCCR 2050). The document is expected to align the climate goals and targets with national, sub-national, and international objectives, including the UN-SDGs. However, it still contains differences with other ministries' documents, including MEMR and Bappenas. The document's most ambitious scenario initially oversaw Indonesia's emission peaking in 2030 and reaching net-zero emissions by 2070. It was then amended to the official statement “Net-zero emission: 2060 or sooner with international cooperation” without further details.

c. Ministry of Finance (MoF)

MoF publicly acknowledges the financial difficulty faced by the state-owned, vertically integrated utility company, PLN, in the electricity sector in Indonesia. Therefore, MoF agrees that stimulus is needed for the energy transition. The government's commitment to supporting climate change programmes has been realised in allocating around 4.1 % of the national budget, but many consider it inadequate. The ministry also recently submitted a carbon tax plan to the Indonesian House of Representatives (DPR-RI). This is still primarily debated by many, with the opposing parties arguing it will worsen the burden on the industry.

d. Ministry of National Development Planning (Bappenas)

Bappenas generates its own Low Carbon Development report that argues for a 6 % GDP growth per year until 2045 with a low-carbon economy [58]. The ministry is also involved in the energy transition through its roles in coordinating the UN-SDGs implementation and achievement in Indonesia. They also develop a waste-to-energy pilot project in Bali as a regional-level development programme. Bappenas also develops its own net-zero emission scenarios, looking at 2045, 2050, 2060, and 2070. The most ambitious scenario demands

Table 3
Institutional mapping of actors in Indonesia's energy transition.

	Fossil-fuels	Renewable energy	Electricity	Climate change/sustainable development
Policy-making	<ul style="list-style-type: none"> Ministry of Energy and Mineral Resources o Directorate of Mineral and Coals o Directorate of Oil and Gas Ministry of Finance Ministry of Industry Ministry of Trade National Energy Council Indonesian House of Representatives (DPR-RI) 	<ul style="list-style-type: none"> Ministry of Energy and Mineral Resources o Directorate of New and Renewable Energy and Energy Conservation National Energy Council Ministry of Finance Ministry of Industry Ministry of Public Works and Housing Indonesian House of Representatives (DPR-RI) 	<ul style="list-style-type: none"> Ministry of Energy and Mineral Resources o Directorate of Electricity Ministry of State-Owned Enterprise (SOE) Ministry of National Development Planning National Energy Council 	<ul style="list-style-type: none"> Ministry of National Development Planning Ministry of Environment and Forestry o Directorate of Climate Change Control Ministry of Finance o Financial Services Authority (OJK)
Implementation	<ul style="list-style-type: none"> Local government Private businesses State-Owned Enterprise (SOE) (Pertamina, PGN) 	<ul style="list-style-type: none"> Private businesses NGOs/CSOs Development partners e.g., IBEKA, GIZ, HiVos 	<ul style="list-style-type: none"> SOE (PLN) IPPs Development partners 	<ul style="list-style-type: none"> NGOs/CSOs Development partners

(Adapted from Morris et al. and Lauranti and Djahhari.)

the country to have an emission peak in 2027 and decline to net-zero in 2045 or 2050. All scenarios envision usage of coal to peak in 2025 and rapidly decline during the 2030s, which needs synchronisation with other ministries' documents.

e. PLN

The National Electricity Company (*Perusahaan Listrik Negara* or PLN) plays a key role in Indonesia's energy transition [12,33,42]. PLN, in coordination with MEMR, has published a commitment to achieve carbon neutrality by 2060 with a roadmap for coal-fired power plants retirement until 2056. PLN has its organisational challenge due to its responsibilities being tied to three different ministries: Ministry of State-Owned Enterprise (MSOE), MoF, and MEMR. PLN itself is a massive organisation with multiple functions across the value chain – which, many actors find, reduces the transparency of costs and make it prone to structural conflicts of interests, causing a bottleneck in the energy transition. Additionally, the enterprise is also constrained by excess capacity, debt burden, and forex exposure. PLN has a substantial fiscal dependence and relies on budget subsidies for 21 % of its operating revenues [59].

f. Foreign actors

Foreign actors can influence the speed and direction of energy transitions in Indonesia by facilitating knowledge transfer, providing technological and financial resources, addressing policy, institutional, and regulatory barriers, and creating industrial networks [60]. Programmes such as MENTARI, for example, is led by the British Embassy in collaboration with MEMR, which aims to deliver inclusive economic growth and poverty reduction in Indonesia through the development of low carbon energies. Meanwhile, a partnership between the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety of Germany with Bappenas develop the Clean, Affordable, and Secure Energy for Southeast Asia (CASE) Program to support a narrative change in the power sector towards an evidence-based national energy transition. However, historical results for international cooperation schemes are often mixed [61–63]. Many national actors interviewed also state that development support is not yet sufficient and far from the promises featured in the Paris Agreement. Foreign actors could also hinder renewable energy transition with their own investments in fossil fuels. For instance, China's resource provision has previously generated policy effects that were fastening the transition towards a coal-based electricity system [60]. This situation is predicted to massively change in the future with China's decarbonisation policies which projected to slash coal import from Indonesia [64].

g. Renewable industry players

The Indonesian renewable energy market was found to present little attractiveness to investors, due to a lack of government commitment, unconvincing regulatory conditions, price competitiveness, and difficulty in obtaining permits from multiple agencies. This problem does not go unnoticed by the central government which attempts to simplify and review approval processes centrally through the recent Job Creation Law. The president also has targeted an increase in the ease of investment by implementing online single submissions. While results from both interventions are still to be observed, there is an opportunity to involve more businesses in implementing renewable energies, as research by Eaton [65] finds that 83 % of Indonesian companies prioritise renewable energy, which is relatively higher than other countries in the Asia Pacific.

h. Coal industry

The interviews discovered that while it is clear for the industry players that renewable energy transition is happening, the signals are mixed as to when and how aggressive it will be. Many still consider coal will continuously hold a significant role due to its price competitiveness and abundant resources. Major companies have stated their intention to develop renewables; however, as some of the interviewees noted, this lacks a clear long-term plan. The government's mandate to stop new coal plants does not translate as

immediate pressure, with domestic coal consumption still expected to rise, and public statements from many government officials on the inevitability of coal usage. However, with the market volatility and highly regulated prices that limit the margin of sales, fossil fuels industry players also fear low financial capability. The private actors interviewed in this study consider this has made innovation or investment towards renewables hard to prioritise.

i. NGOs/CSOs

While they play a substantial role in proliferating off-grid renewables in remote areas and increasing community participation, only a few research contributions looked at the specific influence of NGOs/CSOs on the Indonesia's national energy transition. Coming from a politically marginalised position, most NGOs have little experience in engaging with the government and corporates [66]. Every interviewee in this group evoked the significant barriers they face in programme implementation, from permitting issues, cultural acceptance, financing, and unsustainable impact. They also regret a lack of involvement in the current policymaking process.

3.1.3. Decentralisation and domestic politics in Indonesia

Indonesia relies on decentralised and regional governments for many policies implementation. The reform movement in 1999 generated the Autonomy Act that delegated decision-making and management responsibilities to provincial and regional governments. This central-regional governance plays a significant role in defining how energy transition materialises in Indonesia. The local governments are made responsible for energy planning and development through *Rencana Umum Energi Daerah* (RUED) or General Regional Energy planning, as well as project implementation, permits and licenses issuances, and public land acquisition [38,67]. However, power and capacity remain fragmented, as institutional arrangements and regulatory frameworks stays within the scope of the national government and, when it comes to the electricity sector, the monopoly of PLN [38]. In theory, such decentralisation can increase inclusivity via public participation and some ethnic minorities saw it as opportunities to return to local forms of land tenure and resource management [68]. However, even though there is a strong political rhetoric for this, this decentralisation does not on its own lead to a higher degree of participation of non-government stakeholders [69]. Indonesia's decentralisation itself also face many institutional challenges such as corruption, lack of capacity, low transparency and good governance [70–72]; as such, inclusivity is not guaranteed. Decentralisation can even negatively affect local communities as local government might prioritise generating income through natural resources exploitation and undermine these land rights [68].

3.2. The vulnerable groups

One of the primary elements of inclusive transitions is to identify affected and marginalised stakeholders [73]. Focusing on the security and adaptability of vulnerable communities is critical to economic and social institutions stability and energy governance credibility [74]. The interviews have highlighted specific stakeholders' groups who would be disproportionately impacted but possess very little influence in the current energy transition discourse. These are listed in more details below:

- Local regions with income-dependency on fossil fuels

The energy transition may negatively impact on gross regional domestic product (GRDP) in coal-producing areas, deficit in the trade balance, and increased unemployment – further widening inequality. Simamora and Gabriella [36] identify at least five regions in Indonesia with significant GRDP reliance on mining and quarrying activities. While the regional government may realise this, they have minimum authority as most controls are pulled towards the central government and there is a lack of communication between both the

national and subnational levels and within each government institution.

• Informal sector

The informal sector dominates employment in Indonesia with 70 million people, compared to the 56 million in the formal sector [75]. Mining activities often foster the growth of the informal sector in the surrounding environment – causing potential important, unobserved impact to informal workers. The trade union publicly highlights the missing coordination between MoEF and the Ministry of Manpower. Workers in the informal sector are often self-employed and possess neither work rights nor social protection [76] – making them even more vulnerable to changes. Unemployment rates tend not to be calculated and externalised by markets [63].

• The foremost, remote, and underdeveloped regions (*Terdepan, Tertinggal, Tertinggal* or 3T)

Indonesia classifies its remote areas as the 3T regions – most are underdeveloped, and some have not been electrified. While Indonesia has shown progress in achieving universal energy access, this ratio does not consider the quality and reliability of access [25]. There are known challenges in advancing these regions with the lack of infrastructure, education, and capabilities, high level of social sensitivity, and proneness to cultural conflict. This is increasingly important to address not only to reduce inequality but also to avoiding the risk of unacceptability and greater resistance from energy poor households. Chapman and Okushima [77] find that energy-poor households tend to have a negative attitude towards transition, causing a significant barrier to an inclusive transition.

• The indigenous and local communities

The legal protection of the Indigenous rights in land regulations in Indonesia is stated in the Constitution and in the Basic Agrarian Law (Law No. 5 1960). However, the implementation of these rights is lacking [78]. With renewables projects expected to increase, land acquisition problems have been foreseen [79]. This puts local communities at risk as they face challenging requirements in securing customary land rights while lacking legal certainty [78,80]. Yenneti, Day and Golubchikov [81] highlight a gap between the official rhetoric of an inclusive renewable energy development project and its implementation. Large scale renewable projects may come with the risk of livelihoods loss due to land acquisitions. Land related issues can make indigenous communities, who are dependent on local resources and already marginalised in the current structure, even more vulnerable [63]. In 2019 alone, there were recorded cases of environmental-related violence against 48 indigenous communities in Indonesia [20]. Moreover, a growing reliance on biodiesel in the transition plan raises concerns on human rights and deforestation problems associated with palm oil. There was an international case of the denial of indigenous peoples' rights in Indonesia related to the expansion of oil palm plantations on indigenous territories [82,83].

• Children and youth

With the accumulating and long-term risks of climate change, children and youth will most likely be the most impacted. However, their representation is among the most limited in the discussion. This is not unique to Indonesia as the current global political, legal, and social institutions are often not equipped to consider future and long-term interests into present decisions [84,85]. There is also a huge inequity dimension with children facing 'extremely high-risk', not only from environmental hazards but also from development deprivations, in countries who emit the least [86]. Debates on how best to represent future generations are also very scarce and mostly limited to academics.

The new Energy Transition Roadmap show some progress by dedicating a specific section on Just Transition Policies but lacks an acknowledgement to the vulnerable communities listed above. It captured the risks within formal employment only, from which it shows that while net gains in employment due to the transition are expected,

these new jobs will likely be in different locations and dispersed, unlike the spatially concentrated nature of coal mining.

3.3. Barriers in implementation

A pattern of similar “barriers” has surfaced from the literature analysis and interviews. Stakeholders from the policymaking, private, and civil society sectors notably evoked the main barriers as related to regulatory difficulties and conflicting stakeholders, which is confirmed by Sunitiyoso et al. [33] and Widya Yudha et al. [87]. The other top barrier is the perceived high cost, which is feared as an additional burden by the power utilities, government, and the public. Table 4 summarises the main identified barriers by stakeholder's groups:

It clearly emerged from the interviews that while all stakeholders groups agree that energy transition will occur, their views on the process by which it should be done varied differently. Debates involve the types of energies, who needs to be involved, and when the net-zero target should be reached. Significant challenges arise from the country's heavy dependence on fossil fuels, subsidies for coal-fired power [47,88] and industries opposing the transition [89]. For instance, most NGOs interviewed expressed their concerns in how the association of the coal industry still strongly advocates for keeping coal in the future energy mix. The monopolistic structure in Indonesia's electricity landscape remains a challenge, with actors reporting the lack of transparency and policy coordination and little recognition of the private sector's role [27]. Meanwhile, interviews with the business sector confirm that domestic policies which continue to embrace coal-fired power maintains the demand for Chinese-backed coal plants in Indonesia. The lack of carbon tax and heavily subsidised fossil fuels sustain the situation [90] and create an unlevel playing field for renewables. Continuing this path may further trigger overconfidence in coal's competitiveness, creating risks of uncalculated emission cost and stranded assets. Prolonging the current policy may result in a higher CO₂ abatement cost in 2050 [91], causing economic disadvantages in the long run. This validates Sunitiyoso et al. [33] and Widya Yudha et al. [87] findings of diverging vision and goals between the main stakeholders; such as MEMR's lack of control over PLN; and lack of coordination between ministries. Relva et al. [92] also consider that this political destabilisation hampers the creation of coherent long-term energy planning. The inaccessible energy dialogue that excludes vulnerable groups also risk growing resistance towards transition from energy poor households.

3.4. Intentions vs reality in low-carbon transitions and inclusivity

All the non-governmental actors interviewed considered that inclusivity is not yet materialised as a priority in low-carbon transitions policies. However, an opposite view emerged from interviews with governments actors, who saw it as already embedded in the current national efforts. Public hearings and consultations are indeed held in the policymaking process, but actors from NGOs revealed that they often consider not being included enough and experiencing certain power imbalances, especially against the incumbent groups. Some argue that it

Table 4
Key stakeholder groups and their main barriers.

Stakeholder groups	Main barriers according to each group
Government	- High cost of renewables - Conflicting stakeholders
Coal industry players	- High cost of renewables - Inadequate regulation support, realised as complex and non-transparent procurement process and volatile, mixed signals from the government
NGO/CSOs	- Conflicting stakeholders - Lack of political willingness from the government
Academics/research group	- High cost of renewables - Conflicting stakeholders

is not feasible for the central government to involve all parties – putting pressure on the regional governments to be more inclusive instead.

The updated NDC document LTS-LCCR 2050 explicitly acknowledges just transition, gender equality, intergenerational equity, and indigenous and local communities as strategic supporting issues. However, implementation remains a bottleneck challenge, and policies and programmes continue favouring large scale and on-grid fossil fuels [25]. Government officials admit that a just and inclusive transition is still in the early stages and related organisations are still in discussion. While all actors agree on the importance of an inclusive transition, a majority of interviewees believe the topic cannot be a priority as long as the country struggles to move away from fossil fuels. Most non-governmental actors also tend to see the concept as a western-driven issue, as those advocating for it are mainly foreign donors who incorporate it into aid indicators.

This is not to say that the efforts in remedying inequality in the local communities through low-carbon developments in Indonesia have been scarce. This study also gathered perspectives from NGOs that conduct programmes to improve the community socioeconomic wellbeing while increasing the renewable energy mix through off-grid renewables. Most of these programmes are led by foreign actors and the central government. However, the results of this have often been unsustainable. For example, the market-based solar home system programme from the World Bank was a big success in Sri Lanka, but only reached less than 5 % of the original sales target in Indonesia. Critical differences found include the lack of community participation and ownership [62]. A similar failure was found from a government-initiated microgrid programme. The one-sided policy incentivised short-term outputs and failed to distribute responsibilities to government levels and local communities [93]. The complexity in implementing these local programmes often occupies actors on technical and economic aspects – undermining the focus on inclusivity. Overall, inclusivity faces two current barriers in energy transition: disparity between laws and realities and unsuccessful or unsustainable local-based renewable development programmes.

4. Analysis and discussion

4.1. Cause-and-effect relationships between barriers

The barriers identified in the previous section are dynamically interconnected and exceptionally interdependent. For example, high costs can be traced to a lack of project investments, due to the limited confidence of private organisation in the renewables (RE) market, which comes from inadequate regulations support, complex and non-transparent procurement processes, and volatile, mixed signals in the transition itself. From the interviews and the literature, we elicited three reinforcing loops which impede on the acceleration of inclusive energy transitions in Indonesia: mixed political signals, stagnating investments, and lack of implementation capacity at the local level. To illustrate this, a causal-loop diagram in Fig. 2 aims to draw out feedback connections between barriers and their root causes, which are further described below.

A CLD must be read as follows: a (+) sign between variables indicates a mutually positive or “reinforcing” relationship, in other words if variable A increases, then variable B increases as well; by opposition a (-) sign indicates a negative or “balancing” relationship, where if variable A increases, then variable B decreases.

Loop 1: Conflicting agencies and fragmented power can lead to more contradictory regulations, less confidence in the renewable market, and less investments in RE projects which then loop back to increased conflicting agencies and fragmented power. This represents how continued mixed political signals reinforce themselves by breeding uncertainty in the RE market. An addition to this loop is an inequality of the level playing field, where a lack of investments in RE projects increases the cost of renewables, which fuels continued support for coal and fragmented power initiatives. The price of renewables is still a major socio-political and technical blockage to transitions in Indonesia.

Loop 2: Contradictory regulations lead to complex permitting and procurement processes, which dampen confidence in the RE market. In turn, investments in RE projects are stalled, which increases conflicts in regulatory decision-making agents, reinforcing the creation of overlapping or contradictory regulations. This loop

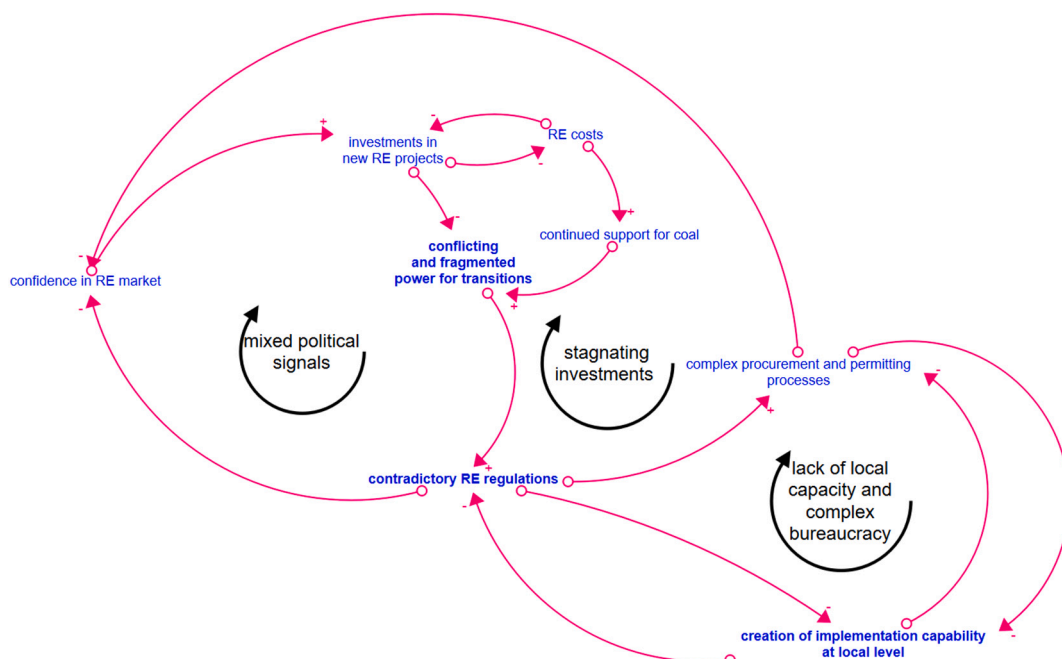


Fig. 2. Causal loop diagram showcasing socio-political components in Indonesia's energy transition.

illustrates how complex processes led by conflicting regulations hamper investments which rapidly stagnate over time.

Loop 3: This loop illustrates the lack of capability creation at the implementation level. As in loop 2, contradictory regulations lead to complex permitting processes, which here influence negatively the creation of implementation capability, which reinforces the creation of inconsistent and contradictory regulations, as they cannot be informed by knowledgeable local actors. There is also a reinforcing top-down and bottom-up double causality between complex processes and capacity at the local level, each reinforcing the other over time via a lack of experiences and a lack of transmission of local knowledge.

These loops are interwoven around the three major root causes and barriers to transitions elicited in this study: conflicting and fragmented agencies, contradictory and inconsistent regulations, and the lack of capacity at the implementation level (represented in bold in the diagram).

- The conflicting agencies in policymaking

While it is encouraging to see increasing exchanges and debates, the challenge of coordination between different organisations is a persisting barrier. This becomes apparent from the various announcements from different ministries on Indonesia's climate policy, carrying different net-zero targets ranging between 2045 and 2070 [55,58,94]— before now it is unified to '2060 or sooner'. Organisations are also often faced with re-structurisation which undermines the stability required in any long-term planning, making it difficult to complete programmes and focus efforts at the implementation level. Historically, there was a president's special office for climate change, but this was dissolved during the new president's cabinet. This contrasts to the views of many of the actors that consider top-down political leadership necessary, which echoes Setyowati's [25] findings.

Neglect of renewable energy relates to a variety of political and economic factors, including lobbying and the use of coal to satisfy increased energy demand [95]. Coal consumption has recently surged, supported by public subsidies and, predictably within a political economy approach, backed by powerful industries [95] including offices of overseas export credit agencies from China, Japan, and South Korea [96].

- Overlapping and inconsistent existing regulations

While Rogge, Kern and Howlett [97] highlight the need for multiple instrument mixes to overcome barriers in energy transitions, Rahman, Dargusch and Wadley [47] note the challenge of potential contradictory policies governing renewable energy. The fragmented power across jurisdictional levels prevents change within the electricity system and constraints support for renewable energy [12]. The national and regional plans as well as the long-term and mid-term plans are often disconnected with differences in the stipulated targets in the different documents. The national plan is therefore considered insufficiently foresightful and should be modified to enable reforms [47]. An effort to synchronise these different regulations have been made by Bappenas [98], who identified issues including the organisational aspect, lack of linkages, and missing clear guidelines for the document preparation. Meanwhile, there is a missing overarching national law as a legal umbrella for renewable energy. This is the space where the NRE bill from the DPR is expected to fill. The missing legal precondition tacitly indicates a fragile political state of Indonesia's renewable energy development. This absence further gives worrying signs to investors of an unstable political regime [5].

- Lack of capacity at the implementation level

The low awareness and capabilities at the regional level often hinder the implementation of renewable energy. Many regional officials lack the incentive to learn about renewable energy, which

causes the lack of experts in drafting RUED and the Regional Regulation [67,99]. This triggers poor capital allocation and ineffective procurement [12]. This has not gone unnoticed by the central government as Bappenas [98] asserts this lack of regional capacity as an issue in delivering RUED. Different stakeholders variedly perceive the role, responsibilities, and interests of the regional government. Some argue that the regional government's involvement complicates the process, and the Job Creation Law could solve the problem. Other actors stand for local development's closer reach and a supposedly better understanding of the region's potential. Pulling permitting and licensing processes to the central government may undermine these perspectives.

4.2. Systems archetypes

To provide a higher-level perspective and understanding on this complex societal system, it is helpful to relate identified patterns of behaviours and root causes to well-known systems "archetypes" as defined by Wright and Meadows [39]. Also called "systems traps", these archetypes are systems structures which produce common patterns of problematic behaviours [39]. Their identification can help reveal common systems structures and behaviours over time and elicit appropriate levers of change to bring the system back to a more desirable state.

The analysis conducted so far, and the root causes and feedback loops highlighted in the previous section and in Fig. 2, help highlight four patterns of behaviours that are likely to drive the system towards unintended consequences and can dampen efforts towards transitions. The illustrative CLD do not feature arrows with polarities, as they may vary between generic archetypes and specific case-study variables. Crossing marks represent noticeable time delays.

- Policy resistance

This pattern happens when interventions on a system fail to achieve the desired outcome – caused by fragmented efforts from various actors who resist change and pull towards their own goals. Actors with conflicting interests, leading to overlapping regulations, are likely to reflect this archetype. This pattern calls for pinning down the driving causes, bringing all actors together, and shifting their efforts towards a bigger common goal. By understanding economic value and social justice as the main drivers, interventions should drive investment and industry growth (Fig. 3).

- Success to the successful

The current system generates a reinforcing influence of incumbents who have more power and are systematically rewarded in a reinforcing "winning" cycle. As different actors compete for the energy market, fossil fuel incumbents with stronger lobbying power could influence the decision-making process more, further sustaining

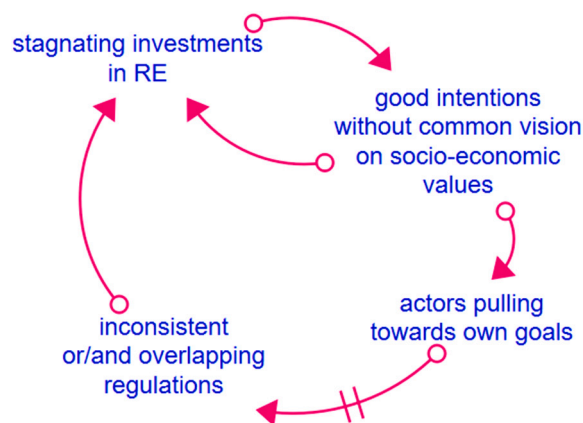


Fig. 3. Creation of policy resistance.

the gap (Fig. 4). The monopolistic structure also provides significant barriers to entry. To break this trap, diversification, consistent regulations, and levelling the playing field between fossil fuels and renewable energy are necessary.

• Growth and underinvestment

This trap can also be called “drift to low performance”. By allowing performance standards to be influenced by unsatisfactory past performances, the system tends to be dragged towards a reinforcing cycle of low performance. In our study, this is reflected by the continued perception of ‘high-cost, unreliable renewables’ that sustains the stagnant renewable market and investments. The lack of capacity and incentives to learn about renewable energies in the government also further creates under-performing programmes, which in turn reinforces the low capacity available at the implementation level. This pattern, illustrated in Fig. 5, is closely related to the loop of lack of capability at the implementation level shown in Fig. 2, which becomes eventually a pattern of underinvestment in human skills and creation of capacity. This belief remains a systemic legacy that influences current decisions. Increasing access to information, reinforcing development standards, setting objectives based on the best past performance rather than the worst, and strengthening paradigm change among actors could provide a way out from the pattern.

• Seeking the wrong goal

Finally, and closely related to the creation of policy resistance in this context (Fig. 3), when the indicators of success are incompletely defined or only signify short-term interests, the system tends to produce more unintended results. While efforts in addressing vulnerable groups through local renewable energy development and stating inclusivity in the constitution are well-intentioned, failure in clarifying a clear objective and means to achieve it cause a lack of tangible results. The system then is producing “efforts” rather than “results” [39].

4.3. Policy recommendations: making the dynamics work

Following the analysis of root causes, systems archetypes, and possible corrective high-level interventions, the following recommendations are suggested:

• Levelling the economic playing field

As economic affordability remains a significant driver in the decision-making process, clear market instruments and signals are crucial. Pressuring the financial sector to scale up climate investment in renewables is necessary, including disbursing financial support from development banks and foreign actors. Involving investors further in energy transition discussions can put a spotlight on market support for renewables. Investors should also ensure their sustainability strategies integrate social justice elements. Indonesia could champion opportunities to foster local industries in the renewable

energy supply and market. Strengthening local leverage in terms of the competitiveness of goods and trade would push towards domestic production [87]. The announcement of net-zero goals from PLN and Pertamina is an important step forward and need to be appraised and supported.

Additionally, proactive measures like removing subsidies of fossil fuels and carbon pricing mechanisms are crucial [52,100]. Rules should be clear to embed incentives in pursuing energy transition. The proper carbon tax scheme will allow emissions reduction, incentivise renewables growth, and boost revenue to support economic recovery. The narrative of cheap fossil fuels should no longer be relevant and internalising the climate risks should be done.

• Developing an independent agency with a clear goal for the energy transition

The inexistence of an organisation with a coordinating mandate across different actors leaves many barriers unsolved. Solid political courage from the government is therefore needed to drive the fossil fuel industry and state-owned companies and enable the market for renewable energy [101]. Establishing an independent body with a clear mandate and authority to manage energy transitions would allow a new dynamic in the system and steer more clarity in the process. In practice, this institution should work with Bappenas, MEMR, and Investment Coordinating Agency (BKPM) to name a few, to clarify, streamline, and publicise guidance and regulations. They should also foster and coordinate partnerships and direct actors towards a clear common goal. The economic viability should be treated as one indicator, alongside policy formation, financing, institutional capacity, and social justice needs [102]. The NRE law can legalise this body and regulate its source of funds. This body could also develop a long-term roadmap – unifying different ministries – while synchronising policies for each energy subsector and non-energy sector, increasing national-regional coordination, and reviewing incentive and disincentive mechanisms. In the context of decentralisation, the institution should also work and empower the regional participation, as detailed below. This type of independent agency with special mandate is not unprecedented in Indonesia. *Komisi Pemberantas Korupsi* (KPK), a specific anticorruption agency is one highly regarded example. Its success can be attributed to its robust institutional design that allows institutional independence and fiscal autonomy. KPK has also become an example on how an organisation can advance its agenda independently and strategically [103].

• Explicitly addressing inclusion and the risk to impacted groups to reduce inequalities

The renewable energy transition has the potential to defuse existing and future inequalities by generating green jobs and eradicating corruption in the previous energy system. This needs conscious planning and multi-stakeholder engagement, including considering potential inequality impacts in all stages of policy-making [104,105]. The government should explicitly elaborate on how inclusivity and socio-justice concepts are planned to be

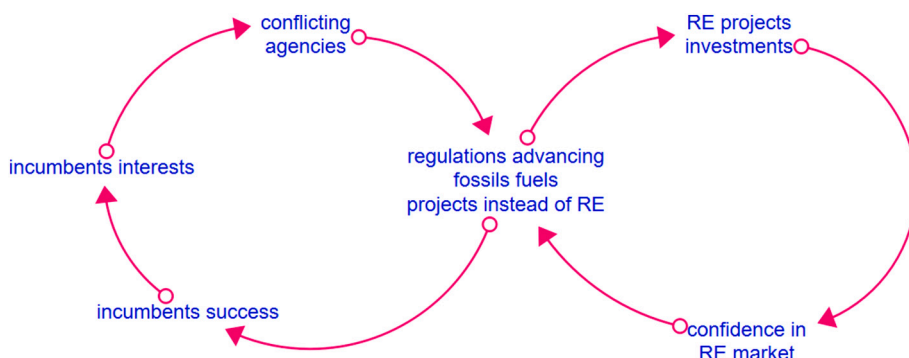


Fig. 4. Success to the incumbents.

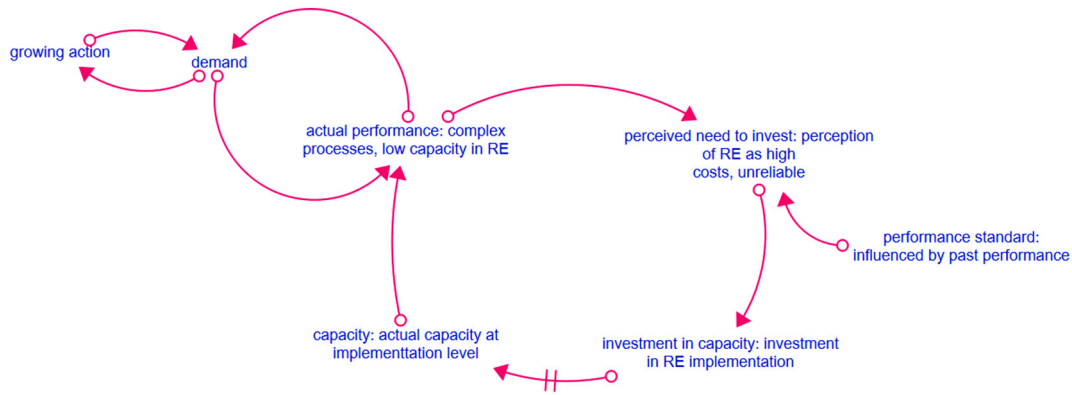


Fig. 5. Growth and underinvestment in local capability.

implemented in the coming regulations and potentially link actions under the United Nations' Sustainable Development Goals (UNSDGs). Conducting an impact assessment that aims to formalise work, improve social conditions, and ensure support to the affected workers is necessary for both the formal and informal workforce [63,76]. Embedding inclusivity would also need a tailored approach, considering Indonesia's rich social and cultural norms. It is not enough to invite affected groups to participate in meetings. Conscious efforts to increase people's awareness, knowledge and capacity are also needed. Further engaging labour unions can create synergy for social change and address structural disadvantages that generate social and economic insecurity [106]. All of this should also avoid disruption and social friction between social groups.

In the 3T regions, linking electricity access to agriculture and productive usage can increase local wellbeing through village-based renewable energy development programmes. This needs to be held in an adequate duration to also incorporate skill-building and ensure

sustainable changes. The intermediary organisation can be further supported to build communities' ownership, enhance capacities, transfer knowledge and technology, establish innovative financing models, and shape policy [107].

Non-state actors have key roles in increasing public awareness and involvement. Independent media, NGOs, and academics can map out problems in current energy policies, educate Indonesian society on the issues, educate civil society, and bring pressure on programme-implementing parties [93,108]. An inclusive energy transition should include plans and programmes to increase public engagement. This would be an essential component in generating a paradigm shift in the system.

- Empowering regional participation through data, monitoring, evaluation

While simplifying permitting processes through the Job Creation Law may need time to be evaluated, regional involvement should still be empowered. The region's potential for inclusive local

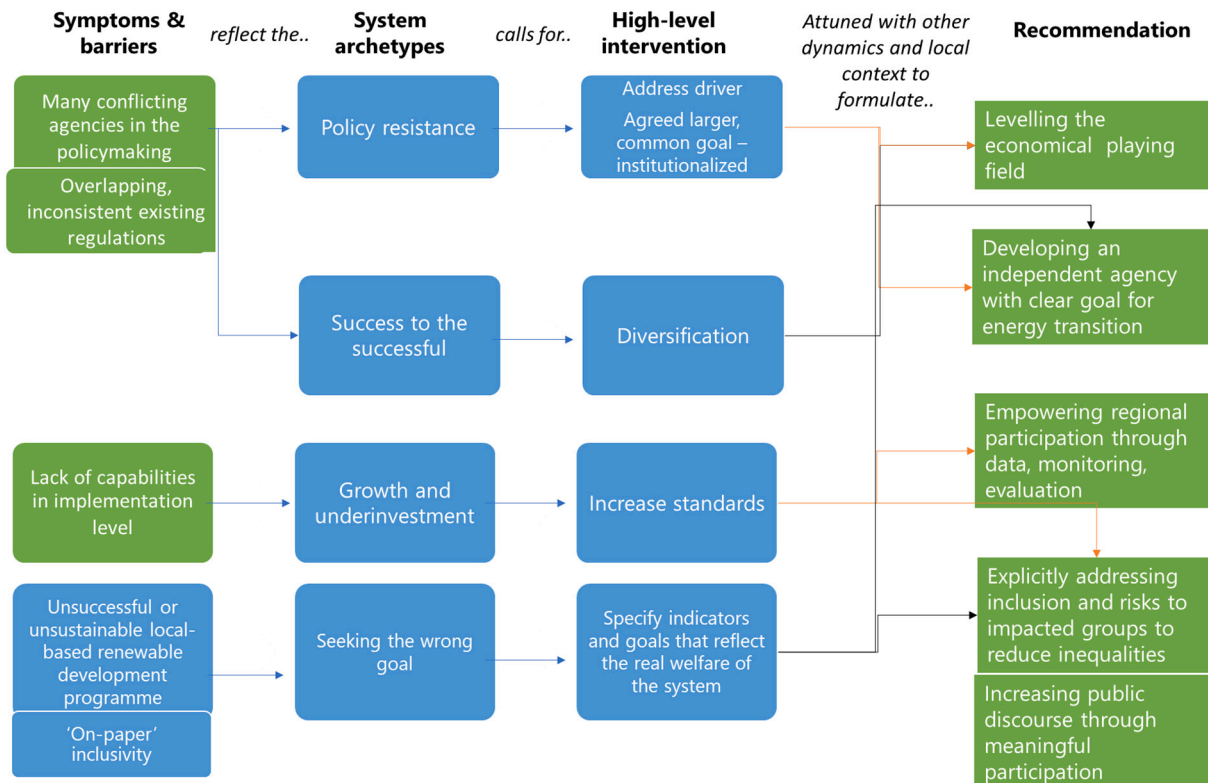


Fig. 6. Summary of analysis conveying identified barriers and root causes, the reflected systems archetypes, required high-level interventions, and recommendations.

development should be formalised and leveraged. The newly formed Association of Oil and Gas and Renewable Energy Producing Regions (*Asosiasi Daerah Penghasil Migas dan Energi Terbarukan* or ADPMET) can seize this opportunity by championing an inclusive transition and driving more regional cooperation. The association could intensify efforts to map renewable potentials, vulnerabilities towards transition, form planning partnerships, and establish energy forums at the regional level. This can address a more balanced, inclusive, equal, and accelerated energy transition at the local and trans-local scales [109]. The current implementation of the Low Carbon Development project at the province-level, which Bappenas led, could be expanded to include vulnerable regions.

The summary of the analysis, including the reflected systems archetypes and high-level intervention based on Wright and Meadows [39], as well as the formulated recommendations, is shown in Fig. 6.

5. Conclusion

By looking in depths into Indonesia's energy transitions as a case study, this research highlights some of the most important socio-political dynamics affecting the inclusive transitions in developing countries. A mixed-method approach of literature reviews and interviews help represent a rich picture of decision-making actors and vulnerable groups that can be disproportionately impacted and identify barriers and gaps in making inclusive transitions a reality. Results are organised into a system thinking framework and a causal loop diagram which allow to highlight negative systems patterns and provide timely and meaningful policy recommendations.

This research argues that inclusive transitions can be an answer to enable sustained and efficient energy transitions, especially in developing and fossil fuel producing and dependant countries, to ensure concrete emission reductions by improving policy certainty and mitigating resistance risks from different actors. This can be done by recognising the more vulnerable stakeholders, such as local regions with income-dependency on fossil fuels, the informal sector, the indigenous and local community, as well as children and youth, and turning the potential of economic growth and employment into reality. To achieve this, socio-political dynamics need to be addressed explicitly.

The study shows the main barriers to sustainable transitions include actors with conflicting interests, inconsistent regulations, strong opposing incumbency, and low capability at the implementing level. Further research could give more attention to the produced causal loop diagram and continue the system dynamics model which are appropriate to create quantified complex socio-technical systems. Future research should also aim to involve directly several representatives of vulnerable groups with comprehensive and appropriate ethical considerations, as the stakeholders interviewed in the present study were mostly selected for their policy knowledge of the national context. We hope to encourage more exploration and academic contributions on the specific dynamics of developing countries, to help policymakers and relevant actors in their consideration of oncoming energy regulations to shape inclusive energy transitions.

Declaration of competing interest

Annisa Sekarintias, Brunilde Verrier and Jennifer Cronin have no affiliations or interests to be declared related to this project.

Data availability

The data that has been used is confidential.

Acknowledgements

We would like to give our warmest thanks to the interview participants who provided important insights and helped refine findings from

the literature, as well as to the anonymous reviewers of this manuscript for their insightful comments and suggestions of improvements.

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