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Malaysia’s Renewable Energy Target Jungle: Are Unclear Definitions and Insufficient Monitoring Reducing Accountability?

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ABSTRACT

In 2019, the Director of Energy at the Ministry of Economic Affairs claimed that Renewable Energy (RE) capacity additions already exceeded the target for 2020 by three times. However, the quoted additions included large hydro, which was excluded in the initial target definition. In fact, by 2020, the RE capacity fell significantly short of the target. The example shows that there is little scrutiny over statements made by public officials, and that they can make inaccurate claims without being held publicly accountable. Over the last two decades, Malaysia has issued a large number of Renewable Energy (RE) targets, policies, action plans and roadmaps. Nevertheless, in 2020, less than 2% of electricity generation came from renewable sources other than large hydro. The purpose of this paper is to analyse the achievement of past RE targets and dissect how those achievements were monitored by policymakers, authorities and in the public discourse. The research finds that several obstacles prevent effective monitoring, like confusion created by unclear and changing definitions of RE, as well as the lack of access to sufficiently high-quality data. The difficulty of monitoring target achievement allows decision-makers to set targets without appropriate implementation measures, or to make inaccurate claims without risking public consequences.

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1. Introduction

Malaysia is an upper-middle-income country with reasonable RE resources, especially for solar power (IRENA, 2023). Nevertheless, in terms of RE development in the power sector, there has been relatively slow progress. In 2021, less than 2% of electricity generation came from RE other than large hydropower (which had an additional share of 16%). In comparison, Vietnam, which has a more constrained economic situation and energy consumption, but a comparable renewable energy resource endowment, managed to achieve 11% of its electricity generation from Solar PV alone and another 31% came from hydropower (IRENA, 2023).

The World Bank claims that a move away from incumbent structures of high-carbon energy supply can help to spur the change needed to successfully maneuver a country out of the “middle-income trap” (World Bank, 2024). As such, the low share of RE in the Malaysian power grid can become a significant liability for keeping high GDP growth rates. Furthermore, the failure to meet RE targets also threatens the credibility of the country in the eyes of foreign investors.

This raises questions about the reasons for the sluggish growth of RE in the Malaysian power grid. There are usually multiple, coinciding factors, but this analysis focuses on one of the potential contributors, namely RE targets and their monitoring. The logic is that inadequate monitoring of the achievement of RE goals can result in lacking accountability of the actors responsible for the achievement of the targets. For example, if the public cannot assess whether targets have been met, the responsible actors have fewer incentives to “walk the extra mile” to ensure goal achievement. This paper provides evidence that changing RE targets and a lack of transparent information have made it complicated for the public to effectively evaluate target achievement. Furthermore, in this context of ambiguity, some actors have made questionable claims of success in target achievement.

This paper includes an introduction, followed by the second section which describes the dynamic history and the overall functioning of the Malaysian power sector. The third section provides the theoretical foundation for the implementation of Energy Transition policies from a social science perspective. This is followed by the research question, methodology and data sources. The results section provides observations related to past RE targets since 2001 in chronological order. The sixth section contains a comprehensive summary of all the results. Since the findings only relate to RE targets as one reason for slow RE development, there is a final discussion section which proposes other potential culprits to be analysed in further research.

2. Historical context and functioning of the power sector in Malaysia

1945-1980: Initial dominance of fuel oil for power generation

The public electricity sector in Malaysia was initiated after World War 2, but gained relevant size only in the 1970s, with 5 TWh of electricity sold in the second half of the decade (Jalal & Bodger, 2009; Chong, Ni, Ma, Liu, & Li, 2015). In 1980, 87% of power was generated with fuel oil[1].

1981-2000: Rapid expansion of the power sector and switch to natural gas as the dominant fuel

Following the oil crisis, a Four-Fuel Diversification policy was introduced in 1981, aiming at diversifying the energy supply with natural gas, hydro energy and coal. This resulted in an increased exploitation of domestic natural gas resources. By 2000, fuel oil was almost phased out from power generation and substituted with natural gas, which accounted for 79% of a now much larger electricity generation of 69 TWh[1].

2001-2020: Further growth of the power sector with a focus on coal

The Four-Fuel policy was initially not successful in significantly increasing the role of coal. New initiatives in the 7th and 8th Malaysia plan periods to ensure generation capacity adequacy and to reduce dependence on natural gas, together with the effect of the New Mineral Policy in a more liberalized power sector resulted in the construction of a significant number of coal power stations only in the 2000s (Abdul-Manan, Baharuddin, & Chang, 2015; Jalal & Bodger, 2009). Coal overtook gas as the dominant power generation fuel in 2016[1] and corresponded to 53% of the total 167 TWh public power generation in 2020[1]. It is noteworthy that the 89 TWh coal power generation in 2020 was much higher than the total power generation in 2000 (69 TWh) and that the 2020 natural gas power generation in absolute terms is only slightly lower than in 2000, even though the share in the total generation decreased from 79% to 29%.

The role of large hydropower

Hydropower was one of the first power generation sources and was included in the 1981 Four-Fuel policy. Even though significant capacity was commissioned in the first half of the 1980s, the importance of this technology gradually declined. While hydropower contributed 12.5% to the total power generation in 1980 and increased its share to almost 25% in 1985[1], its contribution decreased to only 5% in 2010[1]. Significant increases were seen again only in the 2010s, mostly driven by the addition of the 2,400 MW Bakun dam and the 944 MW Murum dam in Sarawak. Those two dams alone represented more than 2/3 of all hydropower produced in Malaysia in 2020[1]. Amongst others, the main motivation for their construction was

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[1]Sources: (Economic Planning Unit Malaysia, 1986; Economic Planning Unit Malaysia, 2001; Energy Commission Malaysia, 2013; Energy Commission Malaysia, 2018; Energy Commission Malaysia, 2023). Percentage refers to the generation mix by public licensees, excluding off-grid generation.

to allocate energy-intensive industry to Sarawak and to spur regional development (accompanied by the Sarawak Corridor of Renewable Energy Master Plan). There were also plans to develop a power interconnector to Peninsular for export of hydropower (Sovacool & Bulan, 2012). Nevertheless, the power interconnection project was later discontinued.

Table 1: Historical Power Generation Mix in Malaysia

Generation mix[1]	**1980**	**2000**	**2020**
Oil	87.2%	5.3%	0.4%
Gas	0.3%	78.7%	28.8%
Coal	0%	7.9%	53.0%
Hydro	12.5%	8.0%	16.3%
Other (incl. RE)	0%	0.1%	1.6%
Total generation (TWh)	9	69	168

The role of other renewable energies

In 2001, Malaysia introduced RE as "fifth fuel" in its Eight Malaysia plan. The definition of RE included biogas, biomass, municipal waste, solar and mini-hydro (<30 MW)[2]. One of the motivations was to further diversify power generation in the context of potentially declining oil and gas resources (Khairudin, et al., 2020). Following the initial poor off-take of RE, a more substantial National Renewable Energy Policy and Action Plan (NREPAP) was proposed in 2008 and implemented in subsequent years. Nevertheless, as of 2020, grid-connected renewables (other than hydro with more than 30 MW) only contributed 5% to the total capacity and 2% to the total power generation.

Functioning of the power sector in Malaysia and responsible actors

Power sector planning in Malaysia involves various policy documents and roadmaps issued by ministries of the federal or state governments. Most notably, the Malaysia Plan is a federal development plan that is produced every five years by the Economic Planning Unit. This entity is located under the National Planning Council of the cabinet and collaborates with various economic-related ministries for the preparation of the plans, which are later approved by the cabinet and the parliament. There is usually a mid-term review during the execution period to evaluate the implementation (Lee & Chew-Ging, 2017). The Malaysia Plans cover the entire federal territory and targets should, ideally, be aligned with the plans of the individual states.

[2] It is noteworthy that hydropower in Malaysia is split into size categories (micro-, mini-, small- and large hydropower). For example, mini-hydro in the definition of the fifth-fuel policy refers to hydropower plants with less than 30 MW capacity. For the avoidance of doubt, in this paper, the category is always complemented by the defined size.

Sector-specific policies include the National Energy Policy 2022-2040 and the Generation Development Plan. Latter is applicable for Peninsular Malaysia only, and several agencies collaborate for its implementation. The planning is led by the JPPPET (Planning and Implementation Committee for Electricity and Supply Tariff of Malaysia), a committee comprising representatives from relevant ministries, agencies, and utilities. The required generation and transmission capacities are then tendered by the Energy Commission (EC).

Furthermore, federal and state-specific policies and master plans have been elaborated by different ministries specifically on topics related to RE, for example, the National Renewable Energy Policy and Action Plan (NREPAP, 2009), the Renewable Energy Act (2011), the Green Technology Master Plan (GTMP, 2017), the Malaysia Renewable Energy Roadmap (MyRER, 2021) or the National Energy Transition Roadmap (NETR, 2022).

For the execution of the Renewable Energy Act of 2011, the Sustainable Energy Development Agency (SEDA) was created. It was entrusted with tendering capacities for the Feed-in-Tariff in Peninsular and Sabah, covering RE installations of up to 30 MW (Ghazali, Abdul , & Karim, 2021). SEDA, on behalf of the ministry responsible for energy, also allocates quotas, e.g. for Net Energy Metering. Large-scale solar and hydro capacities in Peninsular are tendered by the Energy Commission (Kumar, Poudineh, & Shamsuddin, 2021). Some quotas for RE to participate in the market in Peninsular can also be allocated by the Single Buyer, notably under the Corporate Green Power Programme (CGPP).

3. Theoretical foundation for planning and implementation of Energy Transition policies

Energy Systems as reproducing socio-technical regimes

For an analytical purpose, it is valuable to consider the energy system as a socio-technical regime. Socio-technical regimes are relatively stable configurations of institutions, techniques and artifacts, as well as rules, practices and networks that determine the 'normal' development and use of technologies (Rip & Kemp, 1998). For example, we build power plants not only because we have the technical capability to do so, but because power plants can help satisfy social needs like the ability to work at night with the help of lighting.

Reproducing socio-technical regimes includes elements of path dependency. For example, in a system that uses gas turbines for power generation, with employees trained in how to operate and maintain the generation and transmission equipment, with regulation and grid codes being tailored for this production regime and with established relationships between gas providers and power plant owners, there is no reason to change this "well-lubricated machine", unless some pressures arise. Smith, Stirling, & Berkhout (2005) state reasons for such pressures in changing ideologies among political and economic elites, cultural entrenchments in consumerism and public attitudes towards consumption, or incumbent regimes facing tangible economic competitive pressures from other regimes. For example, the Four-Fuel-Diversification-Policy of 1981 can be seen as a response to the oil crisis, which created pressure due to changing ideologies (related to the dependence on oil) and due to economic competitiveness (related to the risk of price shocks for oil). The authors further claim that regimes tend to reproduce themselves and that they are more successful in doing so when they have high "adaptive flexibility". For example, the change from oil to gas as the predominant fuel in power generation in the 1980s and 1990s did not happen as a disruption of the complete system resulting in new actors, institutions and infrastructure that replaced incumbents. Rather, it was largely a result of the adaptation and growth of existing structures. For example, some existing oil power plants were able to be retrofitted to use natural gas.

Smith, Stirling, & Berkhout further argue that different actors in society can challenge the status quo of the regime. However, they need power and agency to articulate sufficient regime selection pressure (i.e. to request an alternative approach) and to mobilize resources needed to materialize adaptive capacity (i.e. to implement change). This is because strategy decisions and implementation are usually not done by individuals acting only on their own behalf but by agents performing the role of decision-makers representing or relying on the support of a larger group of people or an organization.

Agency, decision-makers and accountability

Agency theory can be used to better understand the articulation of preferences, the policy implementation process, as well as the relevance of monitoring and control. Shapiro (2005) explains that agency arises when one party acts on behalf of another. The vague outline of an agency relationship in political science is that "principals delegate to agents the authority to carry out their political preferences. However, the goals of principals and agents may conflict, and because of asymmetries of information, principals cannot be sure that agents are carrying out their will… So principals contrive incentives to align agents interests with their own and undertake monitoring of the agents behavior" (p. 271).

In electoral democracies, this promises to provide electoral agency, in which "voters can hold political officials accountable for their policy choices" (Gailmard, 2014, p. 6). The electorate (principal) votes for a party (agent) to implement their political preferences (Figure 1). One political preference could be, for example, reducing electricity costs. If the preference (electricity cost) can be objectively and holistically monitored by the principal, the agent can be held accountable, and consequences can be applied if the desired outcome is not achieved. The threat of punishment increases the incentives of the agent to act according to the preference of the electorate and not in self-interest. As such, it is paramount for the principal to have good quality information to effectively monitor the results of the actions of the agent. If the realization of political preference (low electricity cost in this example) could not be observed, if the definition of the preference allowed for several interpretations, or if data to measure the outcome was not available, the agent could have less fear of consequences and less incentives to perform actions that lead to an outcome aligned with the preference of the principal.

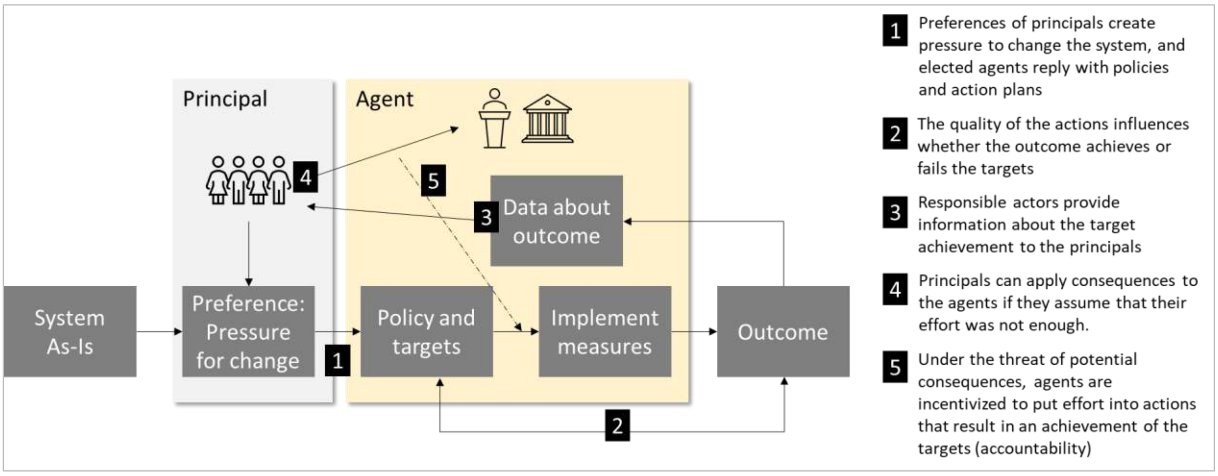

Figure 1: Schematic depiction of the principal-agent relationship in electoral democracies

It should be noted that accountability can be created independently from the type of political system and from the legal obligations of agents to achieve targets. For example, unlike in many other countries, roadmaps and action plans related to RE development are not legally binding in Malaysia. Nevertheless, both legally binding and non-binding documents or statements can contribute to the legitimization of political actors. For example, accountability can be created both if the responsible actor must fear getting sued in court for non-compliance, as well as if there is a threat of humiliation, loss of legitimacy, loss of trust, elections, position or rank. Therefore, this paper does not include an analysis of the legal implications of policies and action plans but assumes that all official documents and statements can have more or less relevant consequences on accountability.

Monitoring metrics to create accountability

The Principal-Agent relationship shows the importance of monitoring of information about policy outcomes to create accountability of actors that we entrust with decision-making and implementation. In many cases, information is made available in the form of metrics. Sareen (2020) claims that for a country, energy metrics “are both an outcome and a cause of how its energy system is configured” (p. 31) and that actors regularly use metrics to legitimize action or non-action related to changes in the energy system. The lack of effective metrics can lead to failure in achieving policy goals. For example, the Four-Fuel Policy of 1981 did not include targets for different technologies, nor sufficient monitoring of the progress towards four-fuel diversification. This resulted in a high concentration of gas as power source by the year 2000 and shows that policies without effective metrics might turn out to be not more than words on paper. In this paper, the metrics of concern are RE generation and capacity shares.

1. Research question, methodology and data sources

a. Research question

Building on the theory, if RE targets can be easily monitored, they can create accountability and incentivize agents to put in place measures to adapt the energy system accordingly. Weak monitoring practices, instead, can result in lacking accountability of actors who are responsible for the achievement of the targets.

The question addressed in this paper is: How has RE target achievement been monitored in Malaysia?

There is no comprehensive research about RE target achievement in Malaysia that can be relied upon. Therefore, the first task is to assess which targets have been achieved and which ones have not.[3] Once the achievement is known, the monitoring practice needs to be assessed, focussing on three elements:

- How are responsible actors communicating about targets and their achievement? Are their claims correct?
- How can principals verify target achievement and claims? Is it easy for the public to identify wrong claims and failed achievements?
- Do principals hold responsible actors accountable for failed targets or wrong claims?

Bovens et al. (2006) argue that ex-post "policy evaluation is an inherently normative act, a matter of political judgement", risking degrading into a "blame game" (p. 319f). It should be highlighted that the aim of this paper is not to show if targets have been met, but on a more methodological level to show how target achievements are communicated by responsible actors and how they are discussed in public discourse[4].

b. Methodology and data sources

Concrete RE policies and targets have been issued since the Five-Fuel-Diversification strategy of the Eight Malaysia Plan of 2001. This analysis covers subsequent RE targets and their monitoring practice. Since many RE targets relate to outcomes in 2025 and those

[3] It is worth noting that target achievement can be a result of deliberate actions of responsible actors (e.g. implementation of meaningful support systems), but also due to external factors (e.g. a price decline supporting solar PV growth or the Covid pandemic delaying construction).

[4] This further avoids the analysis of whether the culprit is the previous or current ruling political party. Whenever there is a monitoring activity (report, comment, interview) by a public authority, then the current representative is assuming the role of agent, making more or less accurate statements about the goal achievement. For example, if an incoming minister wrongly claims that a goal was achieved, even though the failure was caused by the previous government, it is the minister making the claim in this moment, and proofing that he/she made a wrong statement can lead to him/her being held accountable.

outcomes can be reasonably estimated[5], the discussion about those targets as well as their potential achievement is also included in the analysis.

The documents taken into consideration are:

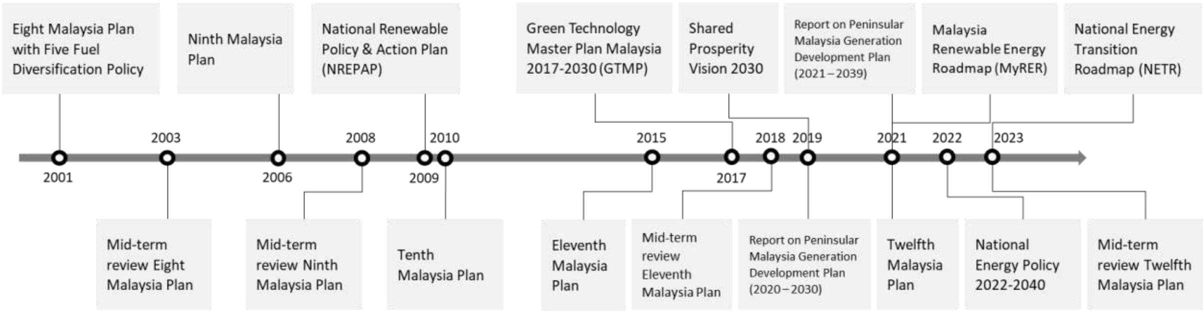

Figure 2: RE Policies and Roadmaps in Malaysia

Target achievement

For the assessment of the target achievement, RE targets of official publications since 2001 will be compared with the actual achieved outcome or with the estimated results for 2025. For the historical actual RE capacity and generation, different sources are used. First, the policy documents themselves sometimes provide data about the status quo of the power sector. Further, the National Energy Balances (NEB) are available online from 2009 onwards. For the estimate of the 2025 RE capacity, historical figures are reconciled with awarded projects under construction (see chapter 5.a.).

When targets are compared with actual outcomes, it is important to ensure that both deal with the same underlying definition. For example, when assessing the achievement of a target of "25% RE share in 2025", several points must be assured.

First, the definition of "RE" must be equal between the target and the actuals. Before 2016, the RE definition generally did not include large hydro. Therefore, actuals including large hydro cannot be compared with a target excluding large hydro. Further points of attention are whether off-grid installations are included in the definition and whether the definition covers the entire Malaysia or only parts of it (e.g. Peninsular). Overall, the focus of this paper lies in the discussion of federal RE targets.

Second, it must be clarified if it is a generation or capacity target. Measuring the share of RE in the total power system is not trivial. Different load factors of different technologies can result in a high RE share in the capacity mix, while the share in the generation mix remains low. For example, if RE capacity targets are filled with Solar PV, which generally has a lower load factor

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[5] Most RE technologies have a development, construction, and commissioning period of well over 2 years. Therefore, a reasonable estimate for 2025 can be done, including existing capacity and ongoing projects in advanced development that can be reasonably assumed to be commissioned by the end of 2025.

compared to other technologies, the country might achieve a high capacity mix of RE, while the actual generation from RE compared to the total generation remains low.

Monitoring practice

The monitoring practice for RE targets will be assessed qualitatively and cover the three elements raised in the research question:

Communication about targets and their achievement: This point analyses statements made (or not made) by responsible actors in interviews and by publications of public entities (e.g. the “Energy Malaysia” magazine). The analysis distinguishes “correct claims”, whereby goal achievement (positive and negative) was correctly communicated, “wrong claims”, whereby failed goal achievement was wrongly presented as success and “no claims”, whereby communication about failed goals was avoided.

Ease of verification of claims: This point analyses if the targets are clearly defined and articulated, and if high-quality data is timely available so that Principals (stakeholders and the public) can assess the goal achievement and whether claims are correct. Instances of unclear targets and data are provided as substantiation.

Public discourse about target achievement: To assess this point, news articles, reports and comments by media, the public, market participants, scientists and consulting firms have been collected in a non-systematic way and some outstanding observations have been added as supporting evidence.

2. Results

a. 2025 actual RE capacity forecast

For the projections of 2025 RE capacity and generation, we reconcile the latest as-is information (Energy Commission Malaysia, 2024) with information related to actual and planned additions under the Feed-in-tariff (FiT) and Net-energy-Metering (NEM) schemes (Sustainable Energy Development Authority, 2023), the Large-scale Solar (LSS) scheme (Energy Commission Malaysia, 2024) and the Corporate Green Power Program (CGPP) scheme (Single Buyer, 2024). The detailed assumptions are provided in Annex 1.

Given the long development and construction duration of power generation projects, we assume that no projects will be realized by 2025 other than the projects that are already operational or have been awarded under any of the above-mentioned schemes.

Table 2: Estimated RE capacity in 2025 in Malaysia

Resource	Grid connected capacity 2025 (MW)	Off-grid capacity 2025 (MW)	Total capacity 2025 (MW)	Share of total capacity (44 GW)
Large Hydro	5,692	-	5,692	12.9%
Small hydro	342	-	342	0.8%
Mini hydro	187	2	189	0.4%
Solar PV	5,098	12	5,110	11.6%
Biomass	163	300	463	1.1%
Biogas	198	5	203	0.5%
MSW	26	-	26	0.1%
Total	11,706	319	12,025	
% of total cap. (44 GW)	26.6%	0.7%	27.3%	

b. Eight Malaysia Plan with Five Fuel Diversification (8MP, 2001)

The Eight Malaysia Plan (Economic Planning Unit Malaysia, 2001) incorporated the Fifth-Fuel paradigm. In order of priority, biomass, biogas, municipal waste, solar and mini-hydro were targeted to diversify electricity and heat provision. The policy was accompanied by the Small Renewable Energy Power Programme (SREP), which provided a fixed tariff for the feed-in of power delivered to the grid. Some authors (Haw, Salleh, & Jones, 2006; Maulud & Saidi, 2012) suggest that the Fifth-Fuel Policy targeted 500 MW, or "5% of the total electricity demand" (Jalal & Bodger, 2009, p. 442) to be derived from those sources by 2005. Nevertheless, the

Eight Malaysia Plan does not specify a target for RE deployment. By 2005, only two projects with 12 MW combined capacity were realized under the SREP (Jalal & Bodger, 2009).

c. Ninth Malaysia Plan (9MP, 2006)

Target achievement

The Ninth Malaysia Plan (Economic Planning Unit Malaysia, 2006) uses the same definition of RE as the Eight Malaysia Plan and introduced a target of 300 MW grid-connected RE in Peninsular Malaysia and 50 MW grid-connected RE in Sabah by 2010. The Tenth Malaysia Plan (Economic Planning Unit Malaysia, 2010) reported that in 2009, 41.5 MW grid-connected RE was achieved, falling significantly short of the 350 MW target.

Monitoring, claims and public discourse

No claims: The Mid-Term Review of the Ninth Malaysia Plan (Economic Planning Unit Malaysia, 2008) did not mention that the RE deployment was not on track.

Correct claims: The Tenth Malaysia Plan in 2010 and the NREPAP (2009) were very open about targets not being achieved. The NREPAP is transparent about the failure and adds a long analysis of the root causes for RE implementation issues. This honest discourse about past challenges and the attempt to learn lessons for the future can be seen as a good practice.

Public discourse: Maulud and Saidi (2012) argue that the targets were “failed miserably”.

d. National Renewable Energy Policy and Action Plan (NREPAP, 2009)

The NREPAP (Ministry of Energy, Green Technology and Water Malaysia, 2009) was developed with a stakeholder consultation and the endorsement of the results by the JPPPET at the end of 2008. The policy became effective in 2009 and set targets for the development of RE other than hydro with a capacity of more than 30 MW.

The policy was followed by the introduction of a Feed-in-tariff (FiT), financed by a RE Fund that collected initially 1.0% and as of 2014, 1.6% of the electricity bill, except for domestic end-users with a monthly consumption of less than 300 kWh (Sustainable Energy Development Agency , 2014). However, the NREPAP calculated that a 2% RE Fund contribution would be required to achieve the targets (p. 50). The Sustainable Energy Development Agency (SEDA) was established as an agency for the administration of the FiT and the RE Funds.

The RE and connected carbon emission reduction targets of the NREPAP were taken into consideration at the COP15 summit in Copenhagen in 2009 when Malaysia pledged to reduce its carbon intensity by 40% in 2020 against 2005 (Ministry of Natural Resources and Environment Malaysia, 2010/11).

Target achievement

NREPAP contains a comprehensive set of targets. It covers the technologies Biomass, biogas, municipal solid waste (MSW), solar PV and mini-hydro (<30 MW). Only grid-connected installations are considered in the policy. Further, targets for both RE capacity and generation for 2050 are defined, with intermediary targets every 5 years. Target achievement for 2015, 2020 and 2025 for both capacity and generation is assessed below[6].

Table 3: Achievement of NREPAP targets

Technology	Year	Capacity Target (MW)	Capacity achieved (MW)	Deviation (%)	Generation Target (GWh)	Generation achieved (GWh)	Deviation (%)
Biomass	2015	330	84	-75%	2,024	98	-95%
	2020	800	100	-88%	4,906	201	-96%
	2025*	1,190	205	-83%	7,297	413	-94%
Biogas	2015	100	12	-88%	613	44	-93%
	2020	240	111	-54%	1,472	427	-71%
	2025*	350	263	-25%	2,146	1,014	-53%
Mini-Hydro	2015	290	71	-76%	1,450	182	-87%
	2020	490	123	-75%	2,450	483	-80%
	2025*	490	187	-62%	2,450	737	-70%
Solar PV	2015	55	161	193%	61	160	162%
	2020	175	1,338	665%	194	2,044	954%
	2025*	399	5,098	1,178%	456	7,592	1,565%
Solid waste1[7]	2015	200	10	-95%	1,223	61	-95%

[6] The actuals for 2015 and 2020 are derived from the tables on renewable capacity and generation from public licensees of the NEBs in 2015 and 2020. Nevertheless, for 2015, there are some discrepancies in the NEB (Energy Commission Malaysia, 2017). According to information from the SEDA Annual Report 2015, the installed capacity and generation might be slightly higher than shown in this table. For estimating the actual power generation from RE in 2025, it was assumed that the different technologies have the same load factor as in 2020 (45% for mini hydro, 44% for biogas, 23% for biomass and 17% for solar PV) and a generous 70% is assumed for MSW.

[7] Actuals for 2015 from Yong et al. (2019), who refer to 1MW incineration, 9.4MW landfill gas. For 2020, Tang et al. (2021) report 19.7MW landfill gas and 1MW incinerator. The Kajang RDF plant has been reported to be closed (GAIA, 2024). It is unclear if those installations are already be covered by biomass and biogas statistics in the NEB but due to the low volume, potential double-counting would not materially change the results.

	2020	360	21	-94%	2,208	129	-94%
	2025*	380	26	-93%	2,330	159	-93%
Total	2015	975	338	-65%	5,371	545	-90%
	2020	2,065	1,693	-18%	11,230	3,284	-71%
	2025*	2,809	5,779	106%	14,679	9,915	-32%

*2025 numbers are estimates based on the outlined assumptions

In 2015, all technologies except Solar PV fell significantly short of their targets, both in terms of capacity and generation. In 2020, a solar capacity of more than seven times the target caused that the overall capacity target was only slightly missed. Nevertheless, since Solar PV with a low capacity factor represented 80% of the total capacity of the four technologies, only around one-third of the generation target could be met.

In 2025, strong Solar PV more than overcompensates the capacity shortfalls of mini-hydro, biomass and biogas, resulting in an overall significantly exceeded capacity target for 2025. Nevertheless, due to the high participation of solar PV and the very low performance of biomass (achieving only around 6% of the target generation[8]), the overall generation target will not be met.

Monitoring, claims and public discourse

No claims:

NREPAP (2009) foresaw provisions for monitoring and review of so-called SMART targets. It states that the targets “need to be reviewed every 3 years” and that a “tolerance of 10% of the target is allowable” (p. 70). However, to the knowledge of the author, there has not been any systematic review as required by the policy.

The Tenth Malaysia Plan (2010) adopted, with minor changes, the NREPAP for its 2015 targets. As such, the most relevant review of the NREPAP targets for 2015 took place in the review section of the Eleventh Malaysia Plan (2015). The review is only positive, stating that the FiT, “has increased installed capacity between 2009 and 2014 fivefold to 243 MW” and “reduced GHGs emission by 432,000 tonnes of carbon dioxide equivalent (tCO2eq)” (p. 6-5). However, there is no acknowledgement of a shortfall of the capacity target by more than 50% and of the generation target by almost 90%, which significantly exceeds the 10% tolerance proposed by the NREPAP.

Wrong claims:

[8] Zamri et al. (2022) analyse the reasons for the low palm oil biomass utilization for power generation and state low efficiency of biomass power generation and the remoteness of the palm oil plantations causing high cost for grid connection or transport of the biomass amongst the culprits. Nevertheless, those factors were known in 2009 when the targets were made, calling into question whether enough diligence was put into assessing the feasibility of the targets.

The “Energy Malaysia” journal, Vol. 7 (Energy Commission Malaysia, 2016) claimed that “In 2014, total installed capacity for renewables reached 245MW. Although this was just short of the 250MW target, the progress made was still tremendous.” (p. 20). However, the target for 2015 was 975 MW and the progress compared to the target was underwhelming.

The Third National Communication and Second Biennial Update Report to the UNFCCC (Ministry of Energy, Science, Technology, Environment and Climate Change Malaysia, 2018) compares the RE installed capacity with NREPAP targets but adds off-grid installations to the actual capacity (p. 188), wrongly suggesting that the 2015 target has almost been met.

SEDA wrongly links the NREPAP with a 20% target. On their homepage, they claim that the policy vision is “achieving 20% Renewable Energy (RE) capacity mix by 2025” (Sustainable Energy Development Agency Malaysia, 2024).

Public discourse:

In “Energy Malaysia”, Vol. 14 (Energy Commission Malaysia, 2018), the director of the ASEAN Centre for Energy claimed that “The current RE installed capacity of 1.2 gigawatts (GW) as of 2015 even surpasses the national target of 985 megawatts (MW) which was set in 2010” (p. 9). Nevertheless, this contrasts with the achievement of only 338 MW as shown in this analysis.

Some news articles (The Star, 2023; Economic Times, 2023) not only wrongly connect NREPAP to a 20% target, but also compare it with the actual capacity mix of 25% in 2023, which mostly consists of large hydro, while the target excludes this technology.

e. Eleventh Malaysia Plan (11MP, 2015)

Target achievement

The Eleventh Malaysia Plan (Economic Planning Unit Malaysia, 2015) confirmed the NREPAP target for 2020, aiming for 2,080 MW installed RE capacity. In 2020, 1,693 MW have been achieved, failing the target by 19%[9]. Solar PV accounted for the main capacity share in 2020 (79% of the 1,693 MW). This contrasts with the intention in 2015 that Solar PV should merely represent 9% of the 2020 target capacity.

Monitoring, claims and public discourse

Wrong claims: In “Energy Malaysia”, Vol. 18 (Energy Commission Malaysia, 2019), the Director of Energy at the Ministry of Economic Affairs is quoted that “most impressively, there was an additional 7,260 MW of renewable power installed capacity added by 2017, which far exceeds the 2,080 MW target under the 11MP.” (p. 27). Nevertheless, the increase in capacity

[9] Interestingly, the target is stated in proportion of the total generation capacity of Peninsular and Sabah, without reference to Sarawak. Nevertheless, we assume that the definition follows the tradition of the NREPAP and the Tenth Malaysia Plan and continues to include Sarawak.

is due to the addition of around 5.5 GW of hydro (> 30MW) in the definition of RE. As such, the claim of exceeding targets is misleading.

f. Green Technology Master Plan (GTMP, 2017)

The GTMP (Ministry of Energy, Green Technology and Water Malaysia, 2017) aims to promote "green growth as one of six game changers altering the trajectory of the nation's growth" (p. 7). Furthermore, it was produced in the context of the Paris Agreements of COP 21, in which Malaysia pledged to reduce its carbon intensity (per GDP) in 2030 by 45% compared to 2005 (Ministry of Energy, Science, Technology, Environment and Climate Change Malaysia, 2018). Also, the targets reflect the ASEAN Plan of Action for Energy Cooperation (APAEC) 2016-2025 (ASEAN Centre for Energy, 2015). Under this agreement, ASEAN member states pledged to increase the share of renewable energy in the total primary energy supply[10] to 23% by 2025. It adopts the agreement by ASEAN Ministers of Energy to harmonize the definition of Renewable Energy. As such, the targets include large hydro as renewable energy and account for both on- and off-grid installations.

Target achievement

Table 4: Achievement of GTMP targets

	Capacity Target	Capacity achieved	Deviation (%)
2020	20% of installed capacity	23%	+15%
2025	23% of installed capacity	27%	+35%

The targets will be comfortably achieved. Nevertheless, it needs to be stressed that with the adjustment of the definition of RE (including large hydro and off-grid), the targets were not very ambitious. In fact, according to the NEB 2016, at the end of 2016, already 22% of installed capacity fell under this new definition of RE, largely due to major hydro, which accounted for more than 18% of the total installed capacity.

Monitoring, claims and public discourse

Wrong claims: Besides the statement that targets are "aspirational", there are several elements of the Master Plan that cause suspicion of being deceiving. For example, the RE capacity mix target of 30% in 2030 is compared with RE mix targets in other regions, suggesting that the Malaysian targets are very high (p. 29). However, the comparison is made with different metrics (total primary energy supply and electricity generation). This is a comparison of "apples and oranges" and creates the wrong image of aspirational targets in Malaysia.

[10] Covering the entire energy sector and not only electricity

Further, the report claims that a 13% annual growth rate for renewables from 2010 until 2016 was driven by strong efforts under the NREPAP and the FiT (p. 34). The growth of RE (in the GTMP definition incl. large hydro) from 2010-2016 was almost exclusively caused by large hydro additions (Ulu Jelai 372 MW, Hulu Terengganu 265 MW, Bakun 2400 MW and Murum 944 MW). However, those long-term developments were not significantly impacted by the NREPAP and technologies covered by NREPAP fell significantly behind the targets of the NREPAP.

g. Mid-term review of the Eleventh Malaysia Plan (MTR 11MP, 2018)

The mid-term review (Economic Planning Unit Malaysia, 2018) followed the 14th General Elections resulting in a new government led by Mahathir bin Mohamad.

Target achievement

The mid-term review includes an updated target for renewable energy capacity until 2020. The new target of 8,885 MW by 2020 considers the updated definition of RE, including large hydro and off-grid installations. The achieved capacity was 8,156 MW, which is 8% lower than the target.

Monitoring, claims and public discourse

Correct claims: The target achievement was appropriately evaluated in the Twelfth Malaysia Plan. The review pointed out challenges that led to low growth of RE and proposed measures that could alleviate issues.

h. Shared Prosperity Vision 2030 (2019)

Target achievement

The report (Ministry of Economic Affairs Malaysia, 2019) was prepared in the context of the ambitions of the incoming government to increase the share of RE (excluding large hydro) to 20% in 2025. While other documents already adopted the new definition agreed in ASEAN (including large hydro), this step back to a previous definition added some confusion. It is not sure whether the target includes off-grid installations. It is estimated that the RE capacity share (excl. large hydro) will be 14.4% in 2025, which is 30% below the target.

Monitoring, claims and public discourse

No claims: The target was also picked up in the Report on Peninsular Malaysia Generation Development Plan 2019 (2020-2030) (JPPPET, 2020). Nevertheless, further discussion returned to include large hydro in the targets as of 2021. As such, there is little reference to the failure of the 20% target.

i. Report on Peninsular Malaysia Generation Development Plan 2021-2039; Twelfth Malaysia Plan and MyRER (2021)

Within 2021, several documents were launched that all incorporate a 31% RE capacity target by 2025. All documents define RE including large hydro and off-grid installations, according to the ASEAN agreement. The update of the target came after the ASEAN ministers of energy meeting endorsed a new target for 35% RE power capacity mix in 2025 (ASEAN Centre for Energy, 2023). The 31% target was first mentioned in an official document in March 2021, in the Report on Peninsular Malaysia Generation Development Plan 2020 (2021-2039) (JPPPET, 2021). The Twelfth Malaysia Plan followed in July 2021 (Economic Planning Unit Malaysia, 2021). The MyRER (Sustainable Energy Development Agency Malaysia, 2021) was published in December 2021 and includes, besides the 31% target, a roadmap showing the required capacity per technology to reach the overall target.

Target achievement

Table 5: Achievement of GDP, 12MP and MyRER targets

2025 targets	Capacity Target	Estimated Capacity	Deviation (%)
Overall RE target (%)*	31%	27%	-12%
Solar PV	4,707	5,110	9%
Biomass[11]	862	463	-46%
Biogas	333	203	-39%
Small hydro**	1,153	531	-54%
Large hydro	5,862	5,692	-3%

*Including large hydro; **Hydro with less than 100 MW capacity

It is estimated that Solar PV can exceed the roadmap scenario, while biogas, biomass and hydro will fall short significantly. It is not clear why significant additions of hydro were foreseen in 2021. Hydro has a long development and construction time (>4 years even for small projects) and at the time of the writing of MyRER, only a fraction of the required additions was in the development pipeline with foreseeable COD in 2025.

MyRER also included a projection for the generation mix in 2025 under the new capacity target scenario of 14.7 TWh for renewable energy excluding large hydro. Applying the 2020 load factors on the estimated capacity, this target will also not be achieved with an expected 9.9 TWh.

[11] For Biomass, the shortfall could be partly due to definition, since MyRER assumes there were 594 MW installed in 2020, whereas the NEB 2020 only counts 413 MW. However, it is a shortcoming that it is not clear what the underlying definition of a technology is.

Monitoring, claims and public discourse

The progress towards 31% RE has been monitored in the mid-term review of the Twelfth Malaysia Plan (2023), showing that by 2022 24.3% have been achieved.

Wrong claims: There has been confusion caused by the changing RE definition. “Energy Malaysia”, Vol. 22 (Energy Commission Malaysia, 2022) claims that the target was raised, quoting the Minister of Energy and Natural Resources that “Malaysia is pushing for a higher target in RE” (p. 38). The SEDA Annual report also claimed that “enthusiastic participation from all stakeholders” (Sustainable Energy Development Agency Malaysia, 2021, p. 31) led to a higher RE target.

Public discourse:

Several reports also state that the new target represents an increase in ambitions from the previous 20% target (New Straits Times, 2023; Business Times, 2021). However, a blog from IHS Markit (S&P Global, 2021) shows that the target might seem to be higher, but that the actual capacity additions needed to fulfil the target are lower, due to the inclusion of large hydro, which represented over 16% of total capacity in 2020. In fact, the minister for energy, science, technology, environment and climate change already explained in 2019 that the inclusion of large hydro to the 20% target would result in an RE share of around 40% (CNBC, 2019).

Other consulting firms were confused by the new targets and made wrong assessments. Apricum (Apricum, 2022) assumed that 31% RE capacity can be achieved with 8.53 GW, while this figure refers to Peninsular only. This report was picked up by several news articles. For example, one article (The Sun, 2024) states within the same document that 31% RE in Malaysia in 2025 will be achieved with 8.53 GW and 13 GW. Furthermore, consulting firm GlobalData criticised the 31% target as unrealistic, comparing it with the actual RE capacity of 9.1% as of 2023 (GlobalData, 2023). Nevertheless, the actual capacity is exclusive of either large hydro or Sarawak, which are, instead, included in the 31% target. The study was quoted by other articles. Interestingly, two articles (Solarquarter, 2023; Green Review, 2023) made another mistake by claiming that the RE target relates to “31% of its total power generation” (instead of capacity) and wrongly claiming that this will be missed as “only 5.5%” will be generated by the respective sources.

j. National Energy Transition Roadmap (NETR, 2022)

Target achievement

The NETR was prepared by the Ministry of Economy. The 2050 Target is 70% RE capacity share. While there is no intermediary 2025 target, a projection for the power system installed capacity share of RE of 27% in 2025 was provided (p. 33). It is not sure if off-grid systems are included in this figure.

Table 6: Achievement of NETR projection

2025 Projection	Capacity projection	Estimated Capacity	Deviation (%)
Solar PV	12%	11%	-3%
Hydro	14%	14%	1%
Bioenergy	1%	2%	51%

Monitoring, claims and public discourse

MIDA wrongly linked the NETR to a 31% RE target for 2025 (Malaysian Investment Development Authority, n.d.). While the 31% target is still applicable today, the NETR projects only 27% achievement. However, policymakers and stakeholders in the energy industry still use the 31% target in their communication. For example, the minister of Natural Resources, Environment and Climate Change still claimed in 2023 that the country is on track for the 31% target (New Straits Times, 2023). As such, the latest projection from NETR does not seem to contribute to the clarification of RE targets.

3. Summary of the results

Target achievement

In sum, only the targets of the GTMP, which were not very ambitious, will be met. While the NREPAP capacity targets will be met in 2025, most of the capacity comes from Solar PV with a low load factor. Therefore, the generation volume target will not be met. Targets for a 2025 capacity mix of 20% without large hydro (2018/19) and 31% with large hydro (2021) will both be missed. The NETR (2022) provides a more realistic projection for 2025 RE capacity of 27%, which will possibly be met.

The increase in the RE capacity share is largely due to the deployment of Solar PV, which outperformed the expectations, and the inclusion of large hydro in the definition, which saw significant increases with the addition of the Bakun and Murum dams. However, the contribution of mini- and small hydro, as well as bioenergy is small and well below most of the targets.

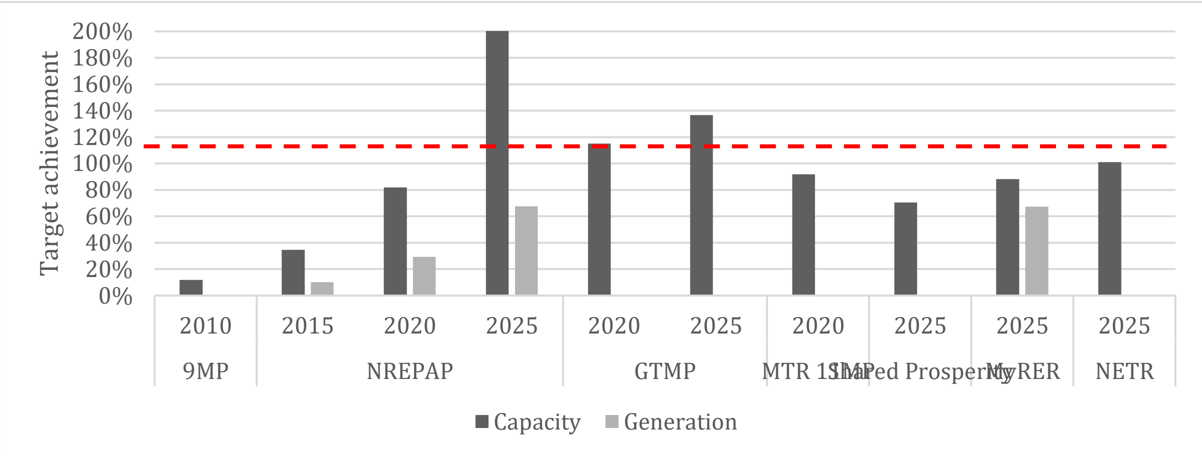

Figure 3: Percentage of achievement of capacity and generation targets / projections (100% is full achievement)

Monitoring and claims by official actors

Correct claims: In some instances, a critical assessment of past achievements was done and root causes for failure were discussed (e.g. in the NREPAP or the Mid-term review of the Eleventh Malaysia Plan).

No claims: In many instances, there was no monitoring of past RE targets. For example, even though systematic and periodic monitoring was required by the NREPAP, it has not been conducted.

Wrong claims: In many instances, there was a reference to goal achievement related to past RE targets, but the reference was incorrect. The main sources of errors were that the referred target is incorrect and that the definition of RE in the actual outcome is different from the definition of RE in the target to which it is compared. This is especially related to the inclusion of large hydropower in the actual capacity, for example in the claim of the Director of Energy at the Ministry of Economic Affairs in 2019 that the achieved 7.3 GW far exceed the 2.1 GW target under the Eleventh Malaysia Plan.

In many cases, monitoring by official parties suggested that the achievement of RE targets was better than it actually was. Also, the omission of monitoring was mostly done when the results were not favourable. Further, the deceiving framing of the revision of the 2025 target from 20% to 31% as an increase of ambition stands out since the revision comes with the inclusion of large hydro, which effectively results in a decrease of ambition.

Difficulty in assessing the actual outcome and verifying claims

This paper includes many examples of official documents, ministers or media making mistakes in assessing the achievement of targets. In fact, several factors contributed to the confusion and complicate the task of assessing whether targets were met.

Unclear target definition:

NREPAP was a good example of setting well defined targets. The policy applies the SMART methodology, meaning that the target was defined to be specific, measurable, achievable, realistic and time-specific. Nevertheless, not all targets are clearly defined. For example, in the JPPPET documents and the NETR, it is not fully clear whether off-grid installations are included in the definition of RE. Further, rapidly changing targets and definitions led to confusion of stakeholders who mixed up different targets and definitions. For example, the NREPAP was wrongly linked with a 20% target, and large hydro was included, excluded and later again included in the RE definition.

Table 7: Evolution of RE definition

	9MP, 2006	**NREPAP, 2009**	**11MP, 2015**	**GTMP, 2017**	**MTR 11MP, 2018**	**Shared Prosperity Vision, 2019**	**Peninsular Malaysia Generation Dev. Plan, 2021**	**MyRER, 2021**	**12MP, 2021**	**NETR, 2022**
Large Hydro included	X	X	X	✓	✓	X	✓	✓	✓	✓
Off-grid included	?	X	X	✓	✓	?	?	✓	?	?
All Malaysia	X	✓	?	✓	✓	✓	✓	✓	✓	✓
Capacity target	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Generation target	x	✓	x	x	x	x	x	✓	x	x

Quality of data of actual outcome:

Especially during the early years of the data provision by the Energy Commission, it is sometimes hard to assess what the actual capacity and generation of different technologies was. For example, the information on biomass-related installed capacity in the NEBs of 2010 and 2011 was not coherent and could not have been reconciled. This results in difficulty in providing a good proximate figure of the actual biomass capacity during those years.

Further, it was not always possible to reconcile data from different data sources, for example, the National Energy Balance, the Electricity Supply Industry Malaysia Performance and Statistical Information and other official documents. For example, the Supply Industry Statistical Information of 2015 (Energy Commission Malaysia, 2017) reported a total capacity of 32.6 GW and total electricity sales of 124.7 TWh (44% to domestic clients, 21% to industry), while the NEB reported 30.4 GW installed capacity and consumption of 132.2 TWh (46% industry, 21% residential).

Delay of data provision:

In August 2024, the latest reliable official data is from the NEB of 2020. Even though 2021 has finished more than 2 ½ years ago, no reliable official data is available yet. This makes it complicated to judge statements of achievements. For example, the minister said in 2023 that RE capacity is currently 25% of total capacity. Nevertheless, it might only be possible in 2025 to independently check whether this claim was accurate.

A 2023 report by the think tank EMBER and Subak (Ember, Subak, 2023) on data transparency for the power sector in Asia confirmed the issue related to data availability and ranked transparency in Malaysia as insufficient. In particular, poor performance was assessed for the criteria related to publishing lag, ease of access and temporal and geographical granularity.

Articulation of target failure

Some stakeholders raised issues related to targets and their achievement, e.g. Maulud & Saidi (2012) who claimed that the targets were “failed miserably” or IHS Markit, who explained that the shift from a 20% to a 31% target was actually a decrease in ambition. Further, mostly international media picked up negative reports about Malaysia’s performance in Energy Transitions, e.g. Solarquarter (2023) and Green Review (2023). Nevertheless, the domestic media articles that were screened mostly quoted the statements of the authorities and critical questioning of the claims was not observed.

4. Discussion and further research

The results show that the preconditions for accountability of responsible actors are not convincingly present. It has been shown that it is difficult for the public to exercise control over decision-makers since targets are confusing and appropriate information is not available. One key assumption in this paper is that the public as principal wants authorities as agents to move towards RE sources. Nevertheless, the question arises as to whether it is plausible that the Malaysian public is in fact the principal pushing for low-carbon Energy.

There seems to be limited interest by the public to hold decision-makers accountable. For example, when claiming that the target revision from 20% to 31% is an increase in ambition, there was no widespread investigation on this claim, e.g. by the media. Only IHS Markit created a report that falsified this claim.

Furthermore, there seems to be a limited willingness to pay for transition support. While NREPAP argued that 2% of the electricity bill would be necessary to achieve the targets, the initial contribution to the RE Fund was only set at 1% and later revised to 1.6%. This resulted in the cumulative collection of less than RM 7b until 2022, while fuel and Imbalance Cost Pass-Through (ICPT) subsidies accounted for RM 52b and RM 10b respectively in 2022 alone (Ministry of Finance Malaysia, 2024). As a further comparison, the equivalent contribution of German power consumers to RE development, the “EEG-Umlage”, collected EUR 212b (around RM 976b) over the same time horizon 2014-2022.

Victor et al. (2022) asked experts about the motivation for climate goals. Around 60% of respondents from OECD Europe countries list climate change mitigation and pressure from civil society amongst the most important motivations. For non-OECD rest of the world countries, those values are only around 45% and 25% respectively. More important motivations are economic growth opportunities, local environmental pollution, getting international concessions or increasing the international reputation. Based on those results, it cannot be taken for granted that there is a general “willingness” of society to push and pay for GHG emission reductions and it is possible that climate goals might be rather a response to external pressures. Further research could apply the methodology of Victor et al. for Malaysia to better understand the motivations for climate goals and the interest groups that advocate them.

Another potential reason for the lack of monitoring by the public which requires further research is the ability for the public to coordinate to hold responsible actors accountable. As mentioned in the first part of this paper, actors need power and agency to produce pressure. This pressure cannot be exerted by individuals, but it requires them to form interest groups to gain a critical mass to be heard. However, existing local environmental movements might not be able to scale to more complex topics on a national level like energy transitions.

Finally, institutions and incumbency could be potential reasons for slow RE development. From an institutional point of view, a common constraint for the application of agency theory in policy is the claim that policy-making is not merely the aggregation of preferences in society, but that decision-making in policy is embedded in a set of institutions, like “procedures used to make these choices” (Immergut, 2006, p. 575), that can have significant impact on the policy outcomes. Ferejohn (1986) and Gailmard (2014) claim that the level of accountability depends on the institutional arrangements. However, the power sector in Malaysia has seen a dynamic development and various regime changes in its recent history. Therefore, it is unlikely that long-lasting institutions have a significant impact on the choice of fuel, for example oil, gas or coal. Astoria (2017) argues that there are further cases of institutions that can slow down the transition to renewable energy. Notably, incumbency can manifest itself in a "paradigmatic instance of hydrocarbon infrastructure composed of technological devices, human capacities, and a supporting legal apparatus" (p. 325) that creates path dependency in a centralized system of power generation. For example, the capabilities, legal and market systems can be tailored around easily controllable centralized generation, which can be in stark contrast with, e.g. decentralized Solar PV generation by so-called prosumers.

Astoria further claims that incumbent economic actors can defend their institutions of incumbency in a "rent-seeking" strategy. Andrews-Speed (2016) argues that incumbent actors can show resistance to change due to their "investment not just in physical assets but also in political assets" (p. 222). An example of incumbency in Malaysia is the case of Solar PV. Solar PV is significantly cheaper than thermal power, but the development has been constrained by incumbent actors and decision makers. The awarded LSS contracts have been continuously under 25 sen/kWh since 2019. This compares with a generation tariff of 26.2 sen/kWh (2022-24) and an ICPT surcharge of 17-20 sen/kWh in 2023/24. The generation tariff additionally benefits from a price cap and discounts for domestic piped gas for power producers. In the meanwhile, Solar PV module prices fell to a historical low and the domestic PV ecosystem has gained maturity. Nevertheless, policymakers restricted its potential with caps on auction quotas, referring to the impact on system operation. Yet, learnings from other countries show that integration costs at this stage of low PV penetration are still moderate.

Therefore, further research should be conducted using institutional theory to see which role incumbent technologies, players and institutions played in blocking more ambitious Solar PV addition quotas. A dedicated analysis could focus on the economic interests of incumbents (in terms of profit evolution or stranded assets) or on their methodologies to adapt to changing paradigms. Large incumbent actors have significant exposure to renewable assets abroad, e.g. TNB, which has invested in RE assets in the UK since 2016 that now operate under the brand Vantage (The Malaysian Reserve, 2021). Nevertheless, the first LSS rounds allocated many solar projects to non-traditional and foreign actors. This might be a threat to the economic interests of incumbents and require them to react, either via restricting the development, getting their own stake in the development, or a combination of both. In 2022, Petronas reacted with the launch of "Gentari", an entity specialized in clean energy. However, the renewable assets of Gentari or TNB (excluding large hydro) are still heavily focussed abroad.

The impact of cultural differences on accountability as limitation of the analysis

In this paper, it is assumed that policies and statements made by decision-makers create accountability. However, this relationship highly depends on the predominant political culture and practice in a country. Andrews-Speed (2022) shows the relevance of culture in the design and implementation of energy policy. He uses the example of China, where political and legal culture traces back to Confucian traditions like hierarchy and harmony. In this context, a rather holistic approach to preserving legitimacy involves "accepting severe contradictions and ambiguities in the policy framework" (p. 262). This contrasts with paradigms in the West and has implications for the binding character of, e.g. emission reduction targets. While in Western countries climate targets are often enshrined in laws and actions to achieve targets can be enforced, e.g. by the public, countries with a more holistic and flexible culture might be able to accept non-achievement and re-interpretation of targets in response to following other goals. As such, the accountability created by monitoring the outcome of political decisions can differ according to the predominant culture. This has also implications for the credibility of policy and targets. For example, Victor et al. (2022) look at the credibility of climate commitments following the Paris Agreement. They find that the geopolitical background of the country and the quality of its institutions have a significant impact on the credibility of the climate pledges made by the country.

5. Conclusion

The Malaysian power generation regime faces pressure to decarbonize its system, for example through international expectations and increasing competition from the cheaper RE technology Solar PV.

In line with the presented theory, policymakers and public authorities reacted to the increasing pressure and presented pathways to transition the power generation regime towards renewable energies. This includes a myriad of policies, master plans and roadmaps that have been created in this context.

The analysis has shown that many of the RE targets have not been achieved or will not be achieved in 2025. Moreover, the communication and monitoring activities of RE target achievement are highly problematic in several ways. In many cases, negative performance is not evaluated, or inaccurate claims were made that suggested better progress, e.g. by using a different RE definition for the actual outcome compared to the target.

Metrics and performance measurement can help implement regime change by, amongst others, creating accountability. Therefore, this work suggests that inadequate accountability due to insufficient RE target monitoring can be one of the reasons for the non-achievement of the targets. Under the current monitoring practice, decision-makers could potentially set ambitious targets to improve their legitimacy, without putting in place adequate measures to achieve the targets. They could rely on several methods to inaccurately claim that their efforts resulted in success, like changing definitions or making misleading statements. Further, they could benefit from information asymmetry since insufficient data is available for the public to assess the progress of the RE roll-out. Due to the confusion created by the many RE target changes and limited data transparency, the public faces difficulties in evaluating statements about RE made by public officials. In the agency theory, those elements reduce the possibility of meaningful monitoring and control of the actions of decision-makers, reducing their accountability and incentives to implement more significant and effective measures.

While the consistency of official RE statistics improved over the last decade, the data is still not sufficiently timely available. Further, official documents continue to have vague definitions of RE, e.g. in the latest NETR. Steps should be taken to provide the public with transparent and timely information about RE progress and clearly defined RE targets so that they can effectively monitor the development and make their own judgement.

6. Bibliography

Abdul-Manan, A., Baharuddin, A., & Chang, L. (2015). Ex-post critical evaluations of energy policies in Malaysia from 1970 to 2010: A historical institutionalism perspective. *Energies, 8*(3), 1936-1957.

Andrews-Speed, P. (2016). Applying institutional theory to the low-carbon energy transition. *Energy Research & Social Science, 13*, 216-225.

Andrews-Speed, P. (2022). How may National culture shape public policy? The case of energy policy in China. *The Energy Journal, 43*(3), 257-273.

Apricum. (2022, 10 17). *Solar power in ASEAN: market regulatory and M&A updates and highlights*. Retrieved from https://apricum-group.com/solar-power-in-asean-market-regulatory-and-ma-updates-and-highlights/?cn-reloaded=1

ASEAN Centre for Energy. (2015). *ASEAN Plan Of Action For Energy Cooperation (APAEC) 2016-2025. Phase I: 2016-2020.*

ASEAN Centre for Energy. (2023). *ASEAN Plan Of Action For Energy Cooperation (APAEC) 2016-2025. Phase II: 2021-2020.*

Astoria, R. (2017). Incumbency and the legal configuration of hydrocarbon infrastructure. In *The political economy of clean energy transitions* (p. 313).

Bovens, M., t Hart, P., & Kuipers, S. (2006). The politics of policy evaluation. In *The Oxford Handbook of Public Policy* (pp. 319-335).

Business Times. (2017, 10 11). *Malaysia to issue more green sukuk for infra projects*. Retrieved from https://www.nst.com.my/business/2017/10/289898/malaysia-issue-more-green-sukuk-infra-projects

Business Times. (2021, 12 06). *Malaysia's 2025 renewable target to be backed by strong solar power growth: Fitch Solutions*. Retrieved from https://www.businesstimes.com.sg/international/asean/malaysias-2025-renewable-target-to-be-backed-by-strong-solar-power-growth-fitch-solutions

Chong, C., Ni, W., Ma, L., Liu, P., & Li, Z. (2015). The Use of Energy in Malaysia: Tracing Energy Flows from Primary Source to End Use. *Energies*, 2828-2866.

CNBC. (2019, 10 30). *Malaysia is targeting a higher level of renewables in its energy mix by 2025, says its environment minister*. Retrieved from https://www.cnbc.com/2019/10/30/malaysia-environment-minister-on-renewables-lynas-haze-husband.html

Ecomonic Planning Unit Malaysia. (2023). *Mid-term Review of the Twelfth Malaysia Plan 2021-2025.*

Economic Planning Unit Malaysia. (1986). Fifth Malaysia Plan, 1986-1990.

Economic Planning Unit Malaysia. (2001). Eight Malaysia Plan, 2001-2005.

Economic Planning Unit Malaysia. (2006). *Ninth Malaysia Plan 2006-2010.*

Economic Planning Unit Malaysia. (2008). *Mid-Term Review of the Ninth Malaysia Plan 2006-2010.*

Economic Planning Unit Malaysia. (2010). *Tenth Malaysia Plan 2011-2015.*

Economic Planning Unit Malaysia. (2015). *Eleventh Malaysia Plan 2016-2020.*

Economic Planning Unit Malaysia. (2018). *Mid-Term Review of the Eleventh Malaysia Plan 2016-2020.*

Economic Planning Unit Malaysia. (2021). *Twelfth Malaysia Plan 2021-2025.*

Economic Times. (2023, 10 30). *Solar powers Malaysia's renewable energy push*. Retrieved from https://energy.economictimes.indiatimes.com/news/renewable/solar-powers-malaysias-renewable-energy-push/104816255#:~:text=A%20total%20of%201492.12MW,is%20yet%20to%20be%20operational

Ember, Subak. (2023). *Asia Data Transparency Report 2023.*

Energy Commission Malaysia. (2013). *National Energy Balance 2010.*

Energy Commission Malaysia. (2016). Energy Malaysia. *Volume 7*.

Energy Commission Malaysia. (2017). *National Energy Balance 2015.*

Energy Commission Malaysia. (2017). *Performance and Statistical Information on Electricity Supply Industry in Malaysia 2015.*

Energy Commission Malaysia. (2018). Energy Malaysia. *Volume 14*.

Energy Commission Malaysia. (2018). National Energy Balance 2016.

Energy Commission Malaysia. (2019). Energy Malaysia. *Volume 18*.

Energy Commission Malaysia. (2022). Energy Malaysia. *Volume 22*.

Energy Commission Malaysia. (2023). National Energy Balance 2020.

Energy Commission Malaysia. (2024, 05 15). *Infographic - Total Operational Renewable Energy Capacity in Malaysia.* Retrieved from https://www.st.gov.my/en/contents/files/download/97/web%20-%20RE%20Capacity%20%28updated%2015%20May%202024%29.pdf

Energy Commission Malaysia. (2024). *LSS Progress By Region (Q1 2024).* Retrieved from https://www.st.gov.my/contents/2024/LSS%20Region/LSS%20Progress%20By%20Region%20(Q1%202024).pdf

Ferejohn, J. (1986). Incumbent performance and electoral control. *Public choice*, 5-25.

GAIA. (2024, 02 20). Retrieved from https://www.no-burn.org/batu-arang-incinerator-fight-a-beacon-as-communities-in-asia-pacific-challenges-waste-burning-industrys-fake-promises/

Gailmard, S. (2014). Accountability and principal-agent theory.

Ghazali, F., Abdul , H., & Karim, R. (2021). A comparative study on legal frameworks on renewable energy in Malaysia and India: towards the commitments under the Paris agreement. *UUM Journal of Legal Studies (UUMJLS), 12*(1), 93-118.

GlobalData. (2023, 01 23). *Malaysia renewables growth hindered by unrealistic targets and absence of robust policies, says GlobalData*. Retrieved from https://www.globaldata.com/media/power/malaysia-renewables-growth-hindered-unrealistic-targets-absence-robust-policies-says-globaldata/

Green Review. (2023, 01 24). *Malaysia renewables growth hindered by unrealistic targets and no robust policies: GlobalData*. Retrieved from https://greenreview.com.au/energy/malaysia-renewables-growth-hindered-by-unrealistic-targets-and-no-robust-policies-globaldata/

Haw, L., Salleh, E., & Jones, P. (2006). Renewable energy policy and initiatives in Malaysia. *Int J Sustain Trop Des Res Prac*, 32-39.

Immergut, E. (2006). Institutional constraints on policy. In *The Oxford Handbook of Public Policy* (pp. 557-571).

IRENA. (2023). Statistical Profiles. Retrieved from https://www.irena.org/Data/Energy-Profiles

Jalal, T., & Bodger, P. (2009). National energy policies and the electricity sector in Malaysia. *2009 3rd International Conference on Energy and Environment (ICEE)*, 385-392.

JPPPET. (2020). *Report on Peninsular Malaysia Generation Development Plan 2019 (2020-2030) .*

JPPPET. (2021). *Report on Peninsular Malaysia Generation Development Plan 2020 (2021-2039) .*

Khairudin, N., Bidin, R., Akhiar, A., Ideris, F., Abd Rahman, A., & et al. . (2020). Renewable energy development in Malaysia: Communication barriers towards achieving the national renewable energy target. In *IOP Conference Series: Earth and Environmental Science* (1 ed., Vol. 476, p. 012080).

Kumar, M., Poudineh, R., & Shamsuddin, A. (2021). *Electricity supply industry reform and design of competitive electricity market in Malaysa.* Oxford Institute of Energy Studies.

Lee, C., & Chew-Ging, L. (2017). The evolution of development planning in Malaysia. *Journal of Southeast Asian Economies*, 436-461.

Malaysian Investment Development Authority. (n.d.). *NATIONAL ENERGY TRANSITION ROADMAP (NETR): CHARTING A PATH TO A SUSTAINABLE ENERGY LANDSCAPE*. Retrieved from https://www.mida.gov.my/national-energy-transition-roadmap-netr-charting-a-path-to-a-sustainable-energy-landscape/#:~:text=The%20NETR%20sets%20ambitious%20targets,an%20impressive%2070%25%20by%202050.

Maulud, A., & Saidi, H. (2012). The Malaysian fifth fuel policy: Re-strategising the Malaysian renewable energy initiatives. *Energy policy, 48*, 88-92.

Ministry of Economic Affairs Malaysia. (2019). *Shared Prosperity Vision 2030.*

Ministry of Economy Malaysia. (2022). *National Energy Transition Roadmap.*

Ministry of Energy, Green Technology and Water Malaysia. (2009). *National Renewable Energy Policy and Action Plan.*

Ministry of Energy, Green Technology and Water Malaysia. (2017). *Green Technology Master Plan Malaysia 2017-2030.*

Ministry of Energy, Science, Technology, Environment and Climate Change Malaysia. (2018). *Third National Communication and Second Biennial Update Report to the UNFCCC.*

Ministry of Finance Malaysia. (2024). *Budget 2024 - Section 3: Federal Government Expenditure.* https://belanjawan.mof.gov.my/pdf/belanjawan2024/revenue/section3.pdf.

Ministry of Natural Resources and Environment Malaysia. (2010/11). *Second National Communication to the UNFCCC.*

New Straits Times. (2023, 03 20). *Malaysia's renewable energy supply now at 25pct, on right track to achieve 2025 target*. Retrieved from https://www.nst.com.my/news/nation/2023/03/890899/malaysias-renewable-energy-supply-now-25pct-right-track-achieve-2025

New Straits Times. (2023, 04 18). *Towards zero emission round the clock*. Retrieved from https://www.nst.com.my/opinion/columnists/2023/04/900988/towards-zero-emission-round-clock

Rip, A., & Kemp, R. (1998). Technological change. In *Human choice and climate change: Vol. II, Resources and Technology* (pp. 327-399).

S&P Global. (2021, 07 02). *Malaysia's new Energy Transition Plan: Lower renewable capacity addition and a phase out of coal leads to a sizeable increase in gas requirements and affordability concern*. Retrieved from https://www.spglobal.com/commodityinsights/en/ci/research-analysis/malaysias-new-energy-transition-plan-lower-renewable-capacity.html

Sareen, S. (2020). Metrics for an accountable energy transition? Legitimating the governance of solar uptake. *Geoforum, 114*, 30-39.

Shapiro, S. (2005). Agency Theory. *Annu. Rev. Sociol., 31*(1), 263-284.

Single Buyer. (2024, 07 16). Retrieved from https://www.singlebuyer.com.my/index.php

Smith, A., Stirling, A., & Berkhout, F. (2005). The governance of sustainable socio-technical transitions. *Research policy, 34*(10), 1491-1510.

Solarquarter. (2023, 01 25). *Malaysia Renewables Growth Hindered By Unrealistic Targets And Absence Of Robust Policies, Says Report*. Retrieved from https://solarquarter.com/2023/01/25/malaysia-renewables-growth-hindered-by-unrealistic-targets-and-absence-of-robust-policies-says-report/

Sovacool, B., & Bulan, L. (2012). Energy security and hydropower development in Malaysia: The drivers and challenges facing the Sarawak Corridor of Renewable Energy (SCORE). *Renewable Energy, 40*(1), 113-129.

Sustainable Energy Development Agency . (2014). *Annual Report 2013.*

Sustainable Energy Development Agency Malaysia. (2021). *Annual Report 2020.*

Sustainable Energy Development Agency Malaysia. (2021). *Malaysia Renewable Energy Roadmap.*

Sustainable Energy Development Agency Malaysia. (2024, 07 18). *National Renewable Energy Policy*. Retrieved from https://www.seda.gov.my/policies/national-renewable-energy-policy-and-action-plan-2009/

Sustainable Energy Development Authority. (2023). *Annual Report 2022.*

Tang, Y., Tang, K., Maharjan, A., Aziz, A., & Bunrith, S. (2021). Malaysia moving towards a sustainability municipal waste management. *Industrial and Domestic Waste Management*, 26-40.

The Edge Malaysia. (2023, 10 19). *Malaysia's RE capacity at 25%, but only generates 6% of electricity — Nik Nazmi*. Retrieved from https://theedgemalaysia.com/node/686828

The Malaysian Reserve. (2021, 07 05). *TNB launches Vantage RE to accelerate its ESG drive*. Retrieved from https://themalaysianreserve.com/2021/07/05/tnb-launches-vantage-re-to-accelerate-its-esg-drive/

The Star. (2023, 11 05). *Solar powers Malaysia's renewable energy push*. Retrieved from https://www.thestar.com.my/news/focus/2023/11/05/solar-powers-malaysias-renewable-energy-push

The Sun. (2024, 01 03). *Ecological advantages of utilising solar energy*. Retrieved from https://thesun.my/business-news/ecological-advantages-of-utilising-solar-energy-LK11934168

Victor, D., Lumkowsky, M., & Dannenberg, A. (2022). Determining the credibility of commitments in international climate policy. *Nature Climate Change, 12*(9), 793-800.

World Bank. (2024). *World Development Report 2024: The Middle-Income.* Washington DC.: Commons Attribution CC BY 3.0 IGO. doi:10.1596/978-1-4648-2078-6

Yong, Z., Bashir, M., Ng, C., Sethupathi, S., Lim, J., & Show, P. (2019). Sustainable waste-to-energy development in Malaysia: Appraisal of environmental, financial, and public issues related with energy recovery from municipal solid waste. *Processes, 7*(10), 676.

Zamri, M. F. (2022). An overview of palm oil biomass for power generation sector decarbonization in Malaysia: Progress, challenges, and prospects. *Wiley Interdisciplinary Reviews: Energy and Environment, 11*(4), e437.

10. Annex

Assumptions for the estimation of 2025 RE capacity

Large Hydro: The NEB 2020 states 5,692 MW of large hydropower plants (>100 MW) operational at the end of 2020. There are no large hydro projects in development with expected entry in operation until 2025.

Small Hydro (excl. mini): According to NEB 2020, 342 MW small hydropower plants (>30 MW, but <=100 MW) were operational in 2020. There is no knowledge about projects of this size currently under construction with COD before 2025.

Mini Hydro: According to ST, in 2024, 137MW of mini hydro were operational. In 2019 and 2020, 177 MW and 248 MW small hydro plants (<=30MW) were approved for FiT with COD by 2024 and 2025 respectively. From the 9 largest approved installations (248 MW), desk research (google, maps, interviews) showed that not even one is under construction or can be expected to become operational by 2025. Since smaller projects might also only have a low success rate, it is estimated that only additional 50MW of the 425MW awarded additional projects will be operational in 2025.

Solar PV: Given that solar has a short project development phase, it is assumed that the entire awarded capacity will be developed by 2025. This includes 323 MW from FiT, 500MW from NEM2.0, 1,000MW from NEM3.0, 2,445MW from LSS (ST) and 800MW from CGPP. Further, self-consumption of 12MW and 30MW PV outside specific programs (based on NEB 2020) are included.

Biomass: According to NEB 2020, 412.6 MW biomass power was operational, 299.6 MW of which was from self-generation and 70.7 MW from FiT. It is noteworthy that the installed capacity was significantly lower than in 2017, when it reached 748 MW. According to SEDA (2023), 104.5MW were still in progress, of which 62MW should have been commissioned by 2023. Nevertheless, ST shows that a total of only 79MW were operational in 2024, indicating project delays and cancellation. Therefore, it is assumed that only 50MW out of the 104.5MW can reach COD by 2025, resulting in 463MW total capacity.

Biogas: According to SEDA (2023), FiT capacity in 2022 was 138MW and 125MW awarded projects were still outstanding, 68MW of which should have been commissioned by 2023. Nevertheless, EC (2024) shows that only 155MW were operational in 2024, indicating project delays and cancellation. Therefore, it is assumed that only 60 MW of the 125MW will reach COD by 2025, resulting in total FiT capacity of 198MW.

MSW: It is assumed that all installed and planned plants in (Yong, et al., 2019) are realized. FiT plants are already covered by the allocated FiT quota for biomass and biogas.

Total generation capacity and renewable share: NETR (2022) assumes a total capacity in 2025 of 46 GW. MyRER (2021) assumes 42.3 GW in 2025, but it is not sure whether off-grid fossil installations have been considered in these figures. To calculate the share of RE, we assume 44 GW.