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Public Attitudes Towards Energy Policy and Sustainable Development Goals in ASEAN

Edited by

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Foreword

The global energy landscape has been changing drastically. We are in the midst of uncertainty. Last year we witnessed increased international momentum toward net zero 2050, and COP26 in Glasgow played a historic role in this regard, as many governments committed to carbon neutrality either by 2050 or 2060. At the same time, ironically, since the global economy has started to recover from the coronavirus disease 2019 (COVID-19) pandemic, the fossil fuel markets, particularly the natural gas market, have become very tight, making prices high. It was in this environment that Russia began invading Ukraine in February this year. The Russia–Ukraine war has had a huge impact on global energy demand and supply, especially in Europe, where dependency on Russian fossil fuels was and remains very significant. Although international determination to move toward net zero is firm, the possible paths to this goal should be carefully reviewed given this new energy environment.

The governments of the Association of Southeast Asian Nations (ASEAN) countries have taken on ambitious policy goals in relation to emissions; however, like many other countries, the ASEAN member countries have also been severely affected by COVID-19 and by the uncertainty and extremely high energy prices triggered by Russia's invasion of Ukraine. ASEAN is emerging in the global energy arena in terms of energy demand. Its commitment to net zero will have large implications for energy because ASEAN's reliance on fossil fuels, particularly on coal, means that major efforts will be required to improve its energy systems. A rapid rise of clean electricity will be one of the keys to this energy system improvement.

We have conducted research on willingness to pay (WTP) in Myanmar, Lao PDR, Malaysia, the Philippines, Thailand, Viet Nam, and Indonesia. This research started three years ago, when the global energy situation was completely different from now. During this period, the ASEAN countries have made steady progress towards meeting their commitments under the 2015 Paris Agreement and the Sustainable Development Goals (SDGs). As policies to achieve these goals remain in full swing, public perspectives need to be considered. This is exactly what this research aims to contribute, given that it tries to analyse public preferences for renewable energy and other climate change actions in ASEAN, particularly in urban areas.

Net zero 2050 is a goal widely shared at global level. In order to reach this goal, international cooperation is necessary. ASEAN member countries are exerting great efforts to achieve this goal. This WTP study was conducted in collaboration with university professors in the respective countries. The survey in these countries was also affected by the COVID-19 pandemic. Research based on surveys in the ASEAN countries is scant; thus, we believe this report will provide a solid first step to understand the reality of energy in ASEAN. In doing so, we believe this report will also contribute to energy policymaking in ASEAN countries and stimulate a wider discussion on WTP and energy and climate change policy in ASEAN.

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List of Abbreviations and Acronyms

ACE	ASEAN Centre for Energy
AEDP	Alternative Energy Development Plan
AGGPM	Asia Green Growth Partnership Ministerial Meeting
AMS	ASEAN Member States
APAEC	ASEAN Plan of Action for Energy Cooperation
APS	APAEC targets scenario
ASEAN	Association of Southeast Asian Nations
ATS	AMS targets scenario
BAU	business-as-usual
CD	carbon dioxide removal
CO_2	carbon dioxide
COP26	Conference of the Parties 26 (2021 United Nations Climate Change Conference)
CVM	contingent valuation method
DCE	discrete choice experiment
ERIA	East Asia and the Association of Southeast Asian Nations
ETM	Energy Transition Mechanism
EU	European Union
FIT	feed-in tariff
GHG	greenhouse gas
IEA	International Energy Agency
IPCC	Intergovernmental Panel on Climate Change
IRENA	International Renewable Energy Agency

LCOE	levelised cost of electricity
Lao PDR	Lao People’s Democratic Republic
MM	Metropolitan Manila
NDC	Nationally Determined Contributions
NREP	National Renewable Energy Program
PDP	Power Development Plan
PV	photovoltaic
RE	renewable energy
SDGs	Sustainable Development Goals
TFEC	total final energy consumption
TPES	total primary energy supply
UN	United Nations
UNESCAP	United Nations Economic and Social Commission for Asia and the Pacific
WTP	willingness to pay

Executive Summary

The issue of climate change continues to be on the global agenda, despite the rising concerns about energy security and hikes in energy prices. Governments are strengthening policies to achieve their goal of reducing greenhouse and CO_2 emissions to net zero, which will contain global warming below 1.5 or 2 degrees. Southeast Asia is not an exception and its action needs to accelerate. Policymakers must carefully craft various policy instruments to full the climate policy goal, considering which instrument to use in what order and when. Decarbonisation entails a significant change in all aspects of society and the economy, and policies need to consider the reactions of various stakeholders. It would be helpful to examine the public perceptions of various policies and technological options and their willingness-to-pay (WTP) for new policies. If the cost of decarbonisation exceeds that of the WTP, the public may start to oppose such policy measures.

This report presents the results of a survey study on public perceptions and WTP for renewables and other climate-related technologies in Southeast Asia. The paper first presents the findings of this year's surveys in Indonesia and Malaysia. It then combines it with the findings of our previous works and synthesizes the perceptions and WTP values in various countries in the Association of Southeast Asian Nations (ASEAN). In the following, we summarise the combined results from all the countries.

In all the surveys, the public is consistently concerned about climate change but not always thinking of climate change directly. For example, when asked about the most pressing environmental concerns, the respondents chose issues such as global warming, air pollution, flooding, etc. Flooding could be increasing because of climate change. In addition, air pollution is related to fossil fuel combustion.

Amongst the renewable options, our series of surveys demonstrated that solar PV is considered the most environmentally friendly, except in Indonesia, where hydropower is viewed very positively. The perceived environmental friendliness is associated with the knowledge of technologies in all countries, where solar PV is the most well-known except in Indonesia. More importantly, the perceived environmental friendliness of other technologies, and in particular, bioenergy, was not on par with that of solar. This year's survey experiment

with different information about renewables shows that tailoring information could help improve the perceptions of renewables, including that of bioenergy.

The WTP values for increasing the share of renewable energy to 40% were positive except for a few cases. Although it varies by technology and country, there is a general pattern in the WTP values: the WTP for solar is generally the highest, as is the perception of environmental friendliness. The WTP for solar ranged from a minimum of −0.4% (for Indonesia in 2022) to a maximum of 25.1% (for Lao PDR in 2020). As with the perception of environmental friendliness, WTP for biomass was generally low, with the lowest in all countries except Mandalay, the Philippines, and Indonesia. The WTP for biomass ranged from a minimum of −2.7% (for Indonesia in 2022) to a maximum of 14.2% (for Lao PDR in 2020). Wind and mini hydro (also called mini-hydropower or small-scale hydropower) took intermediate values in most countries. The WTP for wind ranged from a minimum of −3.5% (for Indonesia in 2022) to a maximum of 16.5% (for Lao PDR in 2020). The WTP for mini hydro ranged from a minimum of 2.7% (for Thailand in 2021) to a maximum of 23.3% (for Lao PDR in 2020). Note that the negative values are found for all RE in Indonesia and biomass in Malaysia. The reason for the negative WTP may include special factors, such as the fact that the coronavirus pandemic is now in its third year, and electricity and fuel prices are rising due to trends in the international market.

The respondents are unaware of carbon dioxide removal (CDR, or carbon removal), which ranges from tree-planting to chemical engineering absorption to enhanced weathering through spraying crushed rocks. The respondents agreed with the possible benefits and risks of CDR, including its ability to 'buy time' for more climate change mitigation and negative side effects on the environment. The degree of agreement varied from one country to another, and a more fine-grained study is warranted in light of the necessity of CDR worldwide to get to net- zero targets.

Given the differing WTP for different renewable types, the sequence of introduction of different types of renewables and the ASEAN-wide grid connection should be carefully considered. For instance, the public might better accept grid connection if it is explained to increase solar PV, at least in the short run. Also, abundant solar resources might allow for a focus on it and possibly even for exports if there's a surplus electricity generation.

Nonetheless, the respondents in all the surveyed countries suffered from income losses due to the coronavirus disease 2019 pandemic. This year especially saw a double effect of the Ukrainian crisis and inflation. In particular, households are increasingly worried about inflation. The respondents this year reported negative WTP values, indicating a preference for the current condition. That implies policymakers should be cautious about renewable measures in the short run.

Chapter 1

Introduction

The issue of climate change continues to be prominent on the global agenda, despite the rising concerns about energy security. Governments are strengthening their policies to achieve the goals of reducing greenhouse and CO_2 emissions to net zero, with the aim of containing global warming below 1.5 degrees or 2 degrees. Southeast Asia is no exception. Policymakers in Southeast Asia have to carefully craft various policy instruments to accelerate action, considering which instruments to apply in what order and when. Decarbonisation entails a significant change in all aspects of society and the economy, and policies need to take into account the reactions of various stakeholders. It will be helpful to examine public perceptions of various policies and technological options, including their willingness to pay (WTP) for new policies.

This report presents the results of a 3-year survey project on WTP for and perceptions of climate-related technologies across 9 cities in 7 ASEAN countries. The project began in 2019 and the survey period overlapped with the global coronavirus disease 2019 (COVID-19) pandemic. Despite this hardship, surveys were completed in all target countries. Nevertheless, the pandemic affected the respondents of the survey, as they suffered from fear of getting the virus compounded by the anxiety of financial difficulties. Thus, the WTP levels found in this report would be biased and probably conservative.

The background of this study was already presented in the previous report (Yoshikawa, 2021), but global energy and climate policy remains in flux. For instance, despite severe influence of COVID-19, RE achieved record growth globally (International Energy Agency (IEA), 2022a). The following is a brief update of energy and climate policy.

1. Recent Trends in Global Energy and Climate Policy

1.1. Strengthening global climate policy

Globally, climate policy continues to be strengthened. The United Nations (UN) brought nearly 200 countries together for the 2021 global climate summit, known as COP26, held in Glasgow, Scotland, with the UK presiding. A total of 197 countries signed the outcome document, called the Glasgow Climate Pact and (United Nations Framework Convention on Climate Change (UNFCCC), 2021) finalised the so-called Paris Rulebook, which describes the detailed operationalisation of the Paris Agreement. According to the UN News, initially 'the phase-out of unabated coal power and of inefficient subsidies for fossil fuels' was intended to be mentioned in the Glasgow Climate Pact, but in the end this was revised to merely 'phase down' (United Nations, 2021)' coal use. However, even this was a very big achievement, and COP26 was the first time in history that the UN parties agreed to a position on phasing down a particular type of fossil fuel. Viet Nam was amongst the signatories for coal phase-out (Dan, 2021; Henry, 2021) . The United States and China also issued the Joint Glasgow Declaration (Office of the Spokesperson, 2021) committing to cooperate on climate change issues in the 2020s.

1.2. Increasing concerns about climate

Nevertheless, concerns about climate change are becoming ever more serious. Reports by the IPCC Working Groups I and II established that human-induced climate change impact is unequivocal and widespread (Intergovernmental Panel on Climate Change (IPCC), 2021). and the Working Group III demonstrated that carbon dioxide emissions must reach net zero (Intergovernmental Panel on Climate Change (IPCC), 2022) in the 2050s in order to contain global warming below 1.5 degrees C. Major transitions in the energy sector are required to limit global warming, including a substantial reduction in fossil fuel use, promotion of electrification, improvement in energy efficiency and support for clean energy such as solar and wind power. Economically speaking, there is sufficient global capital and liquidity (Intergovernmental Panel on Climate Change (IPCC), 2022) to achieve a net zero goal when governments and public sectors are aligned. In Asia, the Asia Green Growth Partnership Ministerial Meeting (AGGPM) Public–Private Forum (Arifin et al., 2022) has been held for the last couple of years, to promote energy transitions; in addition, proactively engaged in renewable energy, the Asian Development Bank (ADB) started a feasibility study called

Energy Transition Mechanism (ETM) (Asian Development Bank (ADB), 2021), to find funds to purchase coal-fired power plants and retire them.

2. Global Trend in Renewable Energy and Costs

2.1. Shifting energy landscape: Renewables achieving record growth

Against this background of climate change concerns and the intention of the international community to take climate action, in 2021 renewables achieved a record growth, 3% higher (International Energy Agency (IEA), 2021c) than 2020, which was already exceptional. According to the IEA's report Renewables 2021, the forecasted renewable power capacity to be added in 2021 was almost 290 GW (International Energy Agency (IEA), 2021a). Solar PV led renewable power expansion in 2021, followed by wind and hydropower. Solar PV accounted for almost 60 % (International Energy Agency (IEA), 2021a) of the worldwide renewable capacity expansion. The growth of hydropower, bioenergy, geothermal, and concentrated solar power only achieved 11 % (International Energy Agency (IEA), 2021c) of the RE capacity expansion worldwide. Biofuels' growth slowed down as the price more than doubled by October 2021. China remains the leading country in renewable capacity expansion, achieving 43 % (International Energy Agency (IEA), 2021a) of the renewable capacity expansion worldwide. Four markets—China, Europe, the US, and India—are the global leaders (International Energy Agency (IEA), 2021a) in renewables, achieving 80% of renewable capacity expansion worldwide.

2.2. Technologies achieving advancement along with strengthened climate policy

Technology advancement contributes to renewable energy expansion globally, along with strengthened climate policy. The cost of renewables fell globally with the impact of the global COVID-19 pandemic and the resulting disruption, according to the International Renewable Energy Agency (IRENA) report (International Renewable Energy Agency (IRENA), 2021a) In particular, solar PV and wind power technologies have (International Energy Agency (IEA), 2022b) achieved remarkable cost reduction in the last decade. Both the global weighted-average levelised cost of electricity (LCOE) of utility-scale solar PV and that of residential PV systems fell significantly. Utility-scale solar PV dropped in cost by 85 %, (International Renewable Energy Agency (IRENA), 2021a) between 2010 and 2020. The operating costs for

solar PV and onshore wind are lower than those of coal-fired power plants. Renewables contribute to energy security, as an affordable source of energy.

3. Energy and Climate Policy in ASEAN

Renewable energy is achieving record growth globally (International Energy Agency (IEA), 2022b). In ASEAN, however, the RE growth is rather gradual, though nine of ten ASEAN Member States (AMSs), that is, Indonesia, Malaysia, Myanmar, Viet Nam, Thailand, Lao PDR, Brunei Darussalam, Cambodia, and Singapore (all except the Philippines) have made a commitment or pledge to reach net zero CO_2 emissions. In 2020, shares of installed power capacity are as follows (Muhammad Rizki Kresnawan and Beni Suryadi, 2022): Coal and gas are major sources of power supply in ASEAN, at 31.4% and 30.9% respectively. Oil contributed only 4.2%. RE share increased from 18.5% to 33.5% between 2006 and 2020. Of the RE categories, hydropower was the largest contributor, achieving almost 21% in the power capacity mix. The total of the RE remainder was as follows: solar PV, bioenergy, geothermal, wind, and other at 12.5%. Therefore, ASEAN countries need to significantly expand its renewable capacity to honour their pledge or commitment to net zero.

4. Changes in consumer mindset due to COVID-19

4.1. COVID-19 pandemic impacts on ASEAN countries

As COVID-19 spread in ASEAN countries, our survey took place in 7 countries, 5 of which were highly affected by the pandemic (ASEAN Biodiaspora Virtual Center (ABVC), 2022). The outbreak of COVID-19 had negative impacts on both consumer mindset and the economies of ASEAN countries. Policy interventions, such as lockdowns, travel restrictions, and so forth, in particular social distancing policy, made respondents in the surveys very alert towards survey staff members, and some refused to participate in the survey, concerned with COVID-19 exposure.

4.2. Financial difficulties hitting households in ASEAN countries

During the initial stages of the COVID-19 pandemic, ASEAN households suffered from financial difficulties, loss of employment, decrease in sales of family businesses, etc. In particular, more than 75% of households in Indonesia, the Philippines, and Thailand

experienced financial difficulties, according to ADBI's database (Peter J. Morgan and Long Q. Trinh, 2021). In fact, financial difficulties in these countries were significantly higher compared to the rest of ASEAN. The financial difficulties experienced by the respondents negatively should have affected their WTP, suggesting that the WTP would be higher under more normal circumstances.

5. Energy Security is Back: Ukraine Conflict and Implications for RE Transition

The Ukraine conflict is exacerbating energy security issues. Russia, one of the world's top oil and natural gas exporters (International Energy Agency (IEA), 2021b), started its 'special military operation' into Ukraine in February 2022 (Ministry of Foreign Affairs of Japan, 2022). Russia remains Europe's main supplier; however, the European Commission is determined to reduce the European Union's Russian gas dependence by two-thirds in 2022 (European Commission, 2022b). Europe has been facing increased energy prices for several months (European Commission, 2022a), and uncertainty on supply from Russia is worsening the problem, as Big Oil companies, like BP and Shell, have attempted self-sanctioning on their own (Robin, 2022). In order to stabilise energy prices, the European Commission allows Member States to set and regulate energy prices for vulnerable consumers, households, and micro-enterprises. There is the possibility that the Ukraine conflict might accelerate the European Commission's further investment in RE transition (European Commission, 2022b). In the meantime, the price of crude oil and natural gas has increased in Asia as well. The upward pressure on energy prices might reduce ASEAN's economic resilience after the COVID-19 pandemic (Dylan, 2022). The situation may be made even worse with the global shortage of grains.

6. Overview of this Study

6.1. Three-year consecutive survey on WTP across cities in 7 ASEAN countries

The report consists of the full 2022 survey as well as summary of the past 3 years of research (Table 1.1). This WTP study targets urban areas in 7 ASEAN countries: Thailand, Viet Nam, Lao PDR, Myanmar, the Philippines, Malaysia, and Indonesia. In 2022, the survey was conducted in both Malaysia and Indonesia. What was unique about the 2022 survey in Malaysia was the survey experiment, which randomly assigned different information

materials to survey respondents, investigating how the information presented may affect survey responses. A set of three different information materials on renewable energy was prepared for Malaysia. A survey experiment was also conducted on CDR. The 2022 survey in Indonesia was quite similar to the one conducted in 2021, and the sample size was the biggest amongstst the 7 surveyed ASEAN countries.

Table 1.1. Survey Outline

City	Country	Period	Sample Size
Bangkok	Thailand	1. June to August 2020 2. December 2020 to March 2021	1. DCE: 250 2. DCE: 250
Ho Chi Minh City	Viet Nam	May to July 2020	DCE: 319 CVM: 301
Vientiane	Lao PDR	July to August 2020	DCE: 400
Yangon	Myanmar	August 2020	DCE: 250
Mandalay	Myanmar	July to August 2020	DCE: 250
Manila	The Philippines	December 2020 to April 2021	DCE: 250 CVM: 250
Kuala Nerus **Kuala Terengganu**	Malaysia	1. February to March 2021 2. April to June 2022	1. DCE: 300 2. DCE: 1,050
Jakarta	Indonesia	March to May 2022	DCE: 1,000

Note: DCE stands for discrete choice experiment and CVM, contingent valuation method.

6.2. Methods

Discrete choice experiments (DCEs) and the contingent valuation method (CVM) were employed for the survey in 2020 and 2021. The survey experiment was newly employed in the 2022 survey conducted in Malaysia. Each survey was conducted by local researchers from the author team.

Unfortunately, like in 2020 and 2021, the pandemic impacted the survey this year. Some refused to take the survey for fear of infection, and WTP was undeniably affected by the short-term COVID-19 factor. Thus, the WTP amount revealed in this report would probably be an underestimate for future policy design implications regarding RE and electric mobility (e-motorcycle).

The report is structured as follows. Chapter 2 summarises the policy trends regarding RE. Chapter 3 presents the methodology and survey design. Chapter 4 summarises the sampling strategies adopted for each of the cities included in this research. Chapter 5 provides an overview of the descriptive statistics for the responses. Chapter 6 analyses the results of the survey on WTP for renewable energy in the five ASEAN cities. Chapter 7 provides an overview of the attitude survey on CDR in Malaysia. Chapter 8 provides an overview of the seven-country comparison. Chapter 9 provides policy implications and concludes this report.

Chapter 2

Review of Energy Policies in Surveyed Countries

This report presents the 2022 surveys conducted in Malaysia and Indonesia. This chapter gives background information about the two countries.

1. Malaysia

A previous report (Yoshikawa, 2021) gave an overview of Malaysia's energy and climate situations, but here, for the ease of readers, we present some background materials.

1.1. Energy sector overview

Malaysia is rich in oil, gas, and coal. In 2018, from export of crude oil, liquefied natural gas, and petroleum products, Malaysia earned RM 156,665 million, representing 15.6% of its export economy (Zulkifli, 2020). Malaysia has a significant energy reserve in gas, in terms of energy equivalency measured as four times its crude oil reserves (Zulkifli, 2021). Historically in Malaysia, power generation relied on fossil fuels, namely natural gas and coal.

However, Malaysia also promotes renewable energy, such as hydropower, biomass, and solar (International Renewable Energy Agency (IRENA), 2021b; Zulkifli, 2021), Currently, it is reducing its dependence on fossil fuels and increasing its renewable energy market and infrastructure.

In 2019, Malaysia's electricity generation mix was 42.8% for coal, 40.2% for natural gas, and 0.5% for oil (Suruhanjaya Tenaga (ST), 2020). Renewable energy is mainly hydropower at 14.8%. According to the Energy Commission of Malaysia, four tenders for large-scale solar (LSS) projects were held, in 2016, 2017, 2019, and 2020 (Malaysia Energy Commission, n.d.-a; Richard and Rachel, 2022). In March 202I, the 30 companies of the fourth bidding cycle for LSS were pre-selected. The shortlisted plant capacity was a total of 823.06 MW across two project categories (Malaysia Energy Commission, n.d.-b).

1.2. Government institutions

In 2021, the Ministry of Energy and Natural Resources of Malaysia (KeTSA) adopted the goal of reaching 31% of RE share in the national installed capacity mix by 2025 (Sustainable Energy Development Authority (SEDA) Malaysia, 2021). The Energy Commission and the Sustainable Energy Development Authority (SEDA) are responsible for regulating the implementation of Renewable (Sustainable Energy Development Authority (SEDA) Malaysia, n.d.). The Energy Commission was formed under the Energy Commission Act 2001 (Malaysia Energy Commission, n.d.-c). SEDA came under the Sustainable Energy Development Authority Act 2011 [Act 726](Sustainable Energy Development Authority (SEDA) Malaysia, 2011). Malaysia implemented the SEDA Feed-in Tariff (FiT), and the Energy Commission supports the Net Energy Metering (NEM) schemes, supporting solar photovoltaics as a long-term renewable energy source (Husain et al., 2021).

1.3. Energy sector strategy

As stated in the 12th Malaysia Plan (12MP) (2021–2025), 'The environmental sustainability dimension, amongst others include the blue economy, green technology, renewable energy as well as adaptation and mitigation of climate change'. (Malaysian Administrative Modernization and Management Planning Unit, n.d.) Malaysia aims to achieve 31% renewable energy capacity by 2025 and 40% by 2035 (Malaysian Investment Development Authority, 2021). This target brings Malaysia's global climate commitment to 45% of the 2005 level in 2030, outlining the economy-wide reduction of carbon intensity. This is expected to further drive down the carbon emission intensity in the power sector, to 60% in 2035 (Ministry of Energy and Natural Resources, 2021).

2. Indonesia

2.1. Energy sector overview

Indonesia's population is approximately 250 million people (Damuri, 2017), the fourth largest in the world (Asian Development Bank (ADB), 2020). Thus, Indonesia plays a significant role as a major consumer, as well as a producer, of energy internationally. Indonesia is also the largest economy in ASEAN (Damuri, 2017) and an active member and 2022 chair country of the G20. Indonesia is rich in natural resources. It produces coal, as the fourth-largest producer globally (International Energy Agency, n.d.-b). In Southeast Asia, Indonesia is the

largest gas provider and agriculturally the largest producer of biofuels worldwide (International Energy Agency, n.d.-b). Indonesia's electricity generation by source in 2020 varies by orders of magnitude, starting with coal at 180689.0 GWh, natural gas 50796.0 GWh, hydropower 19454.0 GWh, geothermal 15563.0 Gah, biofuels 13562.0 GWh, oil 7245.0 GWh, wind 473.0 GWh, and waste at 21.0 GWh (International Energy Agency, n.d.-a) (Figure). Indonesia's energy grid generation mix in 2020 (Figure) was 62.81% for coal, 17.64% for natural gas, and 2.52% for oil. Renewable energy amounted to 17.904%, with the breakdown being hydropower at 6.76%, geothermal at 5.40%, and biofuels at 4.71% (Figure). The remainder comprised wind and waste. The national utility, Perusahaan Listrik Negara (PLN), made it a priority to reach 100% electrification by 2024 (Perusahaan Listrik Negara (PLN), 2020). To establish universal access to electricity, Indonesia will extend the existing grid, off-grid, and mini-grid solutions, such as mini hydro and solar technologies, etc. (Asian Development Bank (ADB), 2016).

2.2. Government institutions

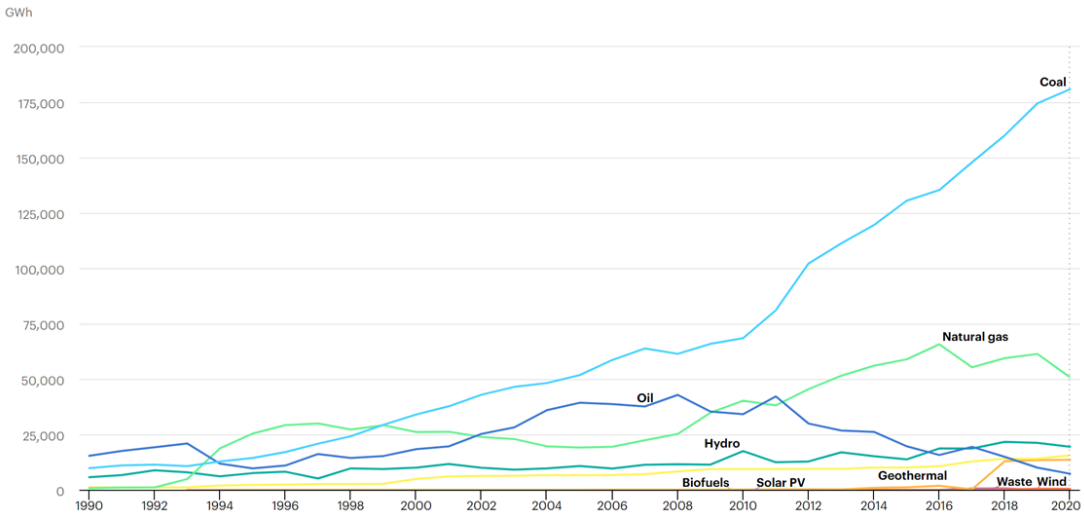
The National Energy Council produces the KEN bringing together seven ministries and energy sector stakeholders. The coordinating body for energy across ministries is the Coordinating Ministry for Maritime and Investment Affairs(Asian Development Bank (ADB), 2020). RPJMN is the guidance of budgetary and government programs in relation to Indonesia's energy policy (Asian Development Bank (ADB), 2020). It is prepared by the Ministry of National Development Planning (BAPPENAS/Badan Perencanaan Pembangunan Nasional).

2.3. Energy sector strategy

The National Energy Policy (KEN/Kebijakan Energi Nasional) (Asian Development Bank (ADB), 2020) 2014 targets a primary energy mix of 23% new and renewable energy by 2025 and 31% by 2050 (Table). The National Medium-Term Development Plan (2015–2019) (RPJMN/Nasional Rencana Pembangunan Jangka Menengah) (Asian Development Bank (ADB), 2020) launched a 35 GW expansion programme (Table), announced in 2015. RPJMN aimed the electrification rate at 81.5% for 2014 and revised it up to 96.6% for 2019 (Table). The Electricity Power Supply Business Plan (2017–2026) (RUPTL, Rencana Usaha Penyediaan Tenaga Listrik) (Asian Development Bank (ADB), 2016) launched by the Indonesian government in conjunction with the state-owned National Electricity Company, PLN, (Asian

Development Bank (ADB), 2020); Organization for Economic Co-operation and Development, 2021) set national targets for 2026, expecting oil to be 0.39%, coal at 50.44%, natural gas at 26.72% and renewable energy at 22.45% (Ministry of Energy and Mineral Resources, 2017) (Table 2.1)). RPJMN (2020–2024) also targets reducing GHG emissions by 27.3% and increasing renewable energy to 23% by 2024 (Table). RUPTL (2021–2030) set the goal for coal to 34%, natural gas to 14% and renewable energy to 51.6 % (Table). RUPTL (2020–2029) set an ambition to achieve a new and renewable energy share of 23% by 2025 and 31% by 2050 (Table 2.2).

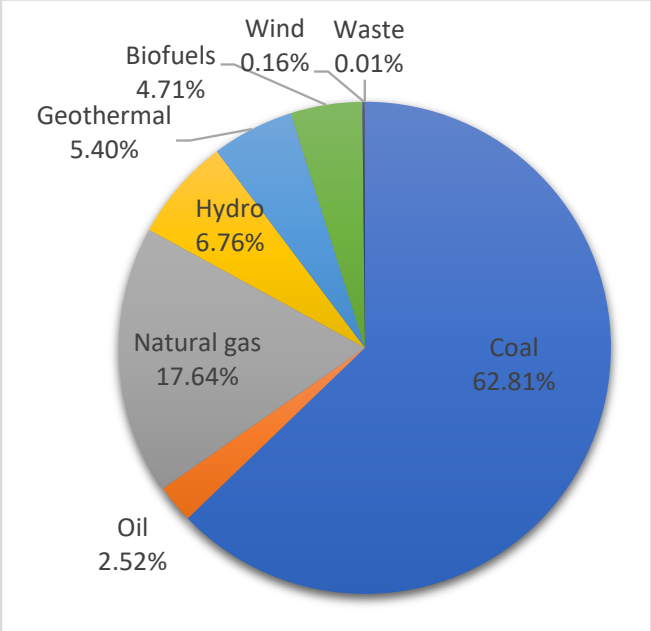
Figure 2.1. Electricity Generation by Source, Indonesia (1990–2020)



PV = photovoltaic.

Source: IEA electricity data browser: (International Energy Agency (IEA), n.d.) (accessed 8 March 2022).

Figure 2.2. Electricity Generation Mix in Indonesia (2020)



Source: charted by the authors based on data from the IEA electricity data browser: (International Energy Agency (IEA), n.d.) (accessed 8 March 2022).

Table 2.1. Renewable Energy Policy Deployment and Development in Indonesia

Plans	Policies, Measures, Targets
National Energy Policy (KEN, 2014)	• Increase share of primary energy from new and renewable sources to 23% by 2025 and 31% by 2050
National Medium-Term Development Plan (RPJMN, 2015–2019)	• Increase generation capacity by approximately 35 GW • Electrification rate from 81.5% (2014) to 96.6% (2019)
Electricity Power Supply Business Plan (RUPTL, 2017–2026)	• Jointly developed annually by Indonesia's central government and state-owned power company, PLN • To 0.39% oil, 50.44% coal, 26.72% natural gas, and 22.45% renewable energy in 2026
National Medium-Term Development Plan (RPJMN, 2020–2024)	• Reduce greenhouse gas emissions by 27.3% by 2024 • Increase share of new and renewable energy from 8.55% (2019) to 23% (2024)
Electricity Power Supply Business Plan (RUPTL, 2021–2030)	• Coal 34%, natural gas 14%, renewable energy 51.6% by 2030

Source: (KYUDENKO, 2019; Ozaki, 2021; PLN, 2021).

Table 2.2. Energy Policies in Indonesia (2019–2020)

Policy Area	Targets	References, Sources
Power	23% share of renewable energy in primary energy supply by 2025 and 31% by 2050 from forthcoming RUPTL 2020–2029.	(International Energy Agency (IEA), 2020)
	The Global Coal to Clean Power Transition Statement; partially excluded the third clause on ceasing issuance of permits and direct government support for, and construction of new unabated coal power plants.	(Kresnawan and Beni, 2022)
	Subsidise household rooftop solar installations as part of its COVID-19 recovery	(UNESCAP, 2021)
Transport	Introduction of the B30 programme to increase biodiesel blends to 30% in gasoil.	(International Energy Agency (IEA), 2020)
	Biofuel blending or incentives as part of its COVID-19 recovery	(International Energy Agency (IEA), 2020)
Nationally Determined Contribution (NDCS)	29% GHG emissions reduction relative to BAU by 2030	(Kresnawan and Beni, 2022)

Source: (International Energy Agency (IEA), 2020), (Kresnawan and Beni, 2022) and (UNESCAP, 2021) ; compiled and edited by the authors.

Chapter 3

Methodology: Survey Design

1. Survey Overview

Following last year's analysis, a series of household surveys were conducted in three cities in two countries to explore the willingness to pay (WTP) for renewables in the Association of Southeast Asian Nations (ASEAN) countries. A discrete choice experiment (DCE) was conducted in Jakarta (Indonesia) and Kuala Terengganu and Kuala Nerus (Malaysia).

Local researchers, in collaboration with the author, conducted each survey. Table 3.1 describes the survey period for each city. The survey instrument for Malaysia is presented in the Appendix as an illustration. The survey was influenced by the COVID-19 pandemic.

Table 3.1. Survey Period

City	Period
Jakarta	March to May 2022
Kuala Terengganu and Kuala Nerus	April to June 2022

Source: Authors.

Our basic approach is similar to that of the last report, except for the survey experiments that were conducted in Malaysia. To support our readers, however, the following gives a brief description of the method used.

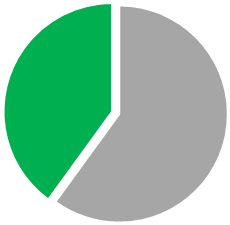
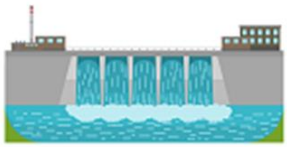
2. Discrete Choice Experiment

2.1. Theoretical background

DCE is a stated preference methodology to measure the WTP of respondents. The stated preference method is appropriate for a hypothetical choice scenario with a smaller number of samples. Please see more details of the theoretical background in the previous report (Yoshikawa, 2021).

The DCE asks respondents to choose from choice sets to elicit preferences. There are three alternatives (scenarios) in each choice set, and each set has a collection of attributes with defined levels (Table 3.2). Respondents are requested to select the most preferred alternatives amongstst the choice set.

Table 3.2. Sample Question from the DCE Survey

Choice Set 1	Alternative A	Alternative B	Alternative C (Status Quo)
Renewable Energy (%)	30 % Renewable Energy 	40 % Renewable Energy 	17 % Renewable Energy 
Main Type of Renewable Energy	 Biomass	 Solar	 Hydropower
% Increase in Monthly Electricity Bill	Your monthly electricity bill will **increase** by **25%**	Your monthly electricity bill will **increase** by **2%**	Unchanged

DCE = discrete choice experiment.

Source: Authors.

2.2. Attributes and levels

Two common characteristics regarding renewable energy (RE) policy were selected for the experiment: the RE share of future total generation capacity and the RE type with a higher share. For easier understanding of survey respondents, only one of these renewable sources will increase its own share, even if the current share is collective. These attributes were designed at three to four levels depending on the circumstances of each country.

The price attribute was defined as the percentage increase in residents' monthly electricity bills. The increase in the monthly electricity tariff levels was determined, in part based on the results from the last phase (Yoshikawa, 2021) and in consultation with local collaborators. Table 3.3 displays the three attributes along with their corresponding levels.

Table 3.3. Attributes and Their Levels by Country

	Future Share of RE*	Type of RE	Increase in Monthly Electricity Tariff	Status
Indonesia	15%/35%/45%/50% in 2030	Solar/wind/biomass/ geothermal	2%/10%/15%/25 %	11%** by large-scale hydropower
Malaysia	25%/30%/35%/40% in 2035	Solar/biomass/mini hydro	2%/5%/10%/15% /25%	current 17% by large-scale hydropower

RE = renewable energy.

* The target year of each country was set according to each government's plan, as explained below.

Source: Authors.

** The 2020 RE rate is 17% according to the IEA, but the previous survey used the RE share in primary energy of 11% in 2015.

Indonesia

Renewable share levels in Indonesia were set at 15%, 35%, 45%, and 50%, given that the share of RE in 2015 was calculated as 11% of the total of hydropower, geothermal, biofuels, solar, wind, and waste. Based on the Indonesia Electric Power Supply Business Plan 2021–2030 (RUPTL 2021–2030) (PLN, 2021), the target share of RE generation capacity in 2030 is projected as 51.6%. An RE share of 29.6% in 2028 was the goal of the 2019 plan. However, the target share of RE generation capacity was significantly increased to meet the goal of achieving net zero emissions (zero net greenhouse gas emissions) by 2060 in line with the Paris Agreement.

Malaysia

In 2020, the Ministry of Energy and Natural Resources of Malaysia (KeTSA) set a target to increase the share of RE in the national installed capacity mix to 31% in 2025 and 40% in 2035

(Sustainable Energy Development Authority (SEDA) Malaysia, 2021). Thus, we set the maximum level of share of RE in 2035 to 40%.

Blocks and Choice Sets

We produced the necessary combinations of choice sets using the numerical analysis software MATLAB. We set seven to eight choice sets per respondent, as response quality degrades when eight to 16 comparisons are made (Pearmain and Kroes, 1990). Choice sets assigned to each respondent comprise a block. A block is configured such that the number of occurrences of alternatives is equal. Table 3.4 shows the number of alternatives, choice sets, and blocks.

Table 3.4. Number of Choice Sets and Blocks for Each Country

	Blocks	Choice Sets
Indonesia	11	88
Malaysia	11	88

Source: Authors.

Sample size

A certain number of samples are needed to evaluate WTP in DCEs. (Kuriyama et al., 2013) reported that 200 samples are sufficient for statistical analysis in DCEs. We followed the formula (3–1) provided by (de Bekker-Grob et al., 2015).

$$\frac{nta}{c} > \mathbf{500}, \qquad (\mathbf{3}-\mathbf{1})$$

where *n* is the number of respondents, *t* is the number of tasks, *a* is the number of alternatives, and *c* is the largest number of attribute levels.

For our design, *c* = 5 (maximum), *t* = 8 (maximum), and *a* = 2 because the status quo alternative should not be counted. Therefore, we determined that the number of respondents should be *n* > 156, and we collected > 300 samples for each type of information material.

3. Survey Experiment

It is well established that public perceptions of unfamiliar technologies are shaped by the framing of the information given to the respondents. Our previous research (Yoshikawa, 2021) demonstrated that citizens do not possess sufficient understanding of renewable energy, and it is crucial to understand the impact of framing on impressions of renewable energy and on WTP. Moreover, this is crucial for CDR, which is new even to policymakers.

To understand possible framing impacts, a survey experiment was conducted in which participants were randomly divided into three informational groups, each receiving different info about RE (Table 3.5) and CDR (Table 3.6).

RE comes with a number of benefits such as improved energy security but also with additional costs including the costs to system integration to deal with intermittencies. We therefore created one type that emphasises the benefits of RE and another one that discusses the additional costs.

Table 3.5. Three Informational Descriptions about RE

Choice explanation 1. (neutral)	Choice explanation 2. (add positive)	Choice explanation 3. (add negative)
Though coal-, crude-oil-, and gas-fired thermal power plants contribute more than 80% of the gross electricity production in Malaysia, the electricity generation by these fossil fuels produces a large amount of greenhouse gases, which contribute considerably to the process of global warming. Switching fossil fuels to renewable energy sources (e.g., solar, wind, biomass, and small-scale or mini hydro) is considered to be an important measure of global warming mitigation, because greenhouse gases emission from the production of renewable energy is much lower than that from coal and gas thermal power.		
(blank)	In addition, they do not incur fuel costs (with the exception of biomass power generation) and are based in the domestic territory, leading to greater energy self-sufficiency and less energy imports from foreign countries. They are renewable by definition, and there is no need to worry about depletion.	However, because the energy source of renewable energy is of natural origin, it is subject to environmental factors such as weather and continuously fluctuates, and may require energy storage such as batteries for a back-up. Some energy sources, such as geothermal and wind, are concentrated in limited areas, and long-distance transmission may be required to send electricity to urban areas.
The installation of renewable energy sources might increase the cost of electricity production. As a result, the retail price of electricity may have to increase. We would like to know your WTP for the increased renewable energy production.		

For CDR, the previous research has shown the importance of 'naturalness' in affecting people's attitudes (Corner and Pidgeon, 2015). In particular, planting trees (afforestation/reforestation) is often favoured by the publics. To assess the difference in perception by technology or storage medium, we have prepared three types of information with three different storage locations: plants, rocks, and the ocean.

Table 3.6. Three Informational Materials about CDR

Choice explanation 1. (plant)	Choice explanation 2. (rock)	Choice explanation 3. (ocean)
Carbon dioxide removal or 'CDR' is a group of strategies that might be able to slow or reverse climate change. These strategies remove excess carbon dioxide (CO_2) from the atmosphere through various biological, chemical, or physical processes.		
The carbon dioxide would be stored in plant matter, such as in trees and soils, so that it cannot contribute to an increase in the Earth's temperature. This method has the potential to store CO_2 for around 20–100 years.	The carbon dioxide would be stored deep underground, for example in rock formations, so that it cannot contribute to an increase in the Earth's temperature. This method has the potential to store CO_2 for thousands of years.	The carbon dioxide would be stored in ocean waters or under the ocean floor, so that it cannot contribute to an increase in the Earth's temperature. This method has the potential to store CO_2 for hundreds or possibly thousands of years.

Chapter 4

Sampling Strategy

1. Introduction

This chapter summarises the sampling strategies adopted for the two urban areas investigated in this report: Terengannu-Kuala Nerus in Malaysia and Jakarta in Indonesia. These describe the systematic approach for identifying respondents, limiting sampling bias, which would compromise the validity of the generalisation of the WTP results to the entire population surveyed. The sampling strategy adopted depends on the available data to the researchers. Hence, differences do exist between cities. These were designed so all households would have the closest possible probability of identifying as respondents for the survey. In both cities, the sampling strategy adopted was a multi-stage stratified sampling with differences to adapt to the local contexts explained below.

2. Indonesia — Jakarta

This study covers the area of the Special Capital of Jakarta in Indonesia, the administrative and economic centre and largest city in the country (Figure 4.1). The initial sampling plan was a simple random sampling method using household lists provided by the local government's statistical agency. However, this approach was not possible due to a lack of consent from citizens to release such a list. An alternative approach was designed in consultation with an experienced surveying company to address the challenges due to local context, such as unstructured and mixed-used land parcels in a neighbourhood commonly found in Indonesia's cities.

Figure 4.1. Special Capital Region of Jakarta in Indonesia

Source: Authors. Created with mapchart.net

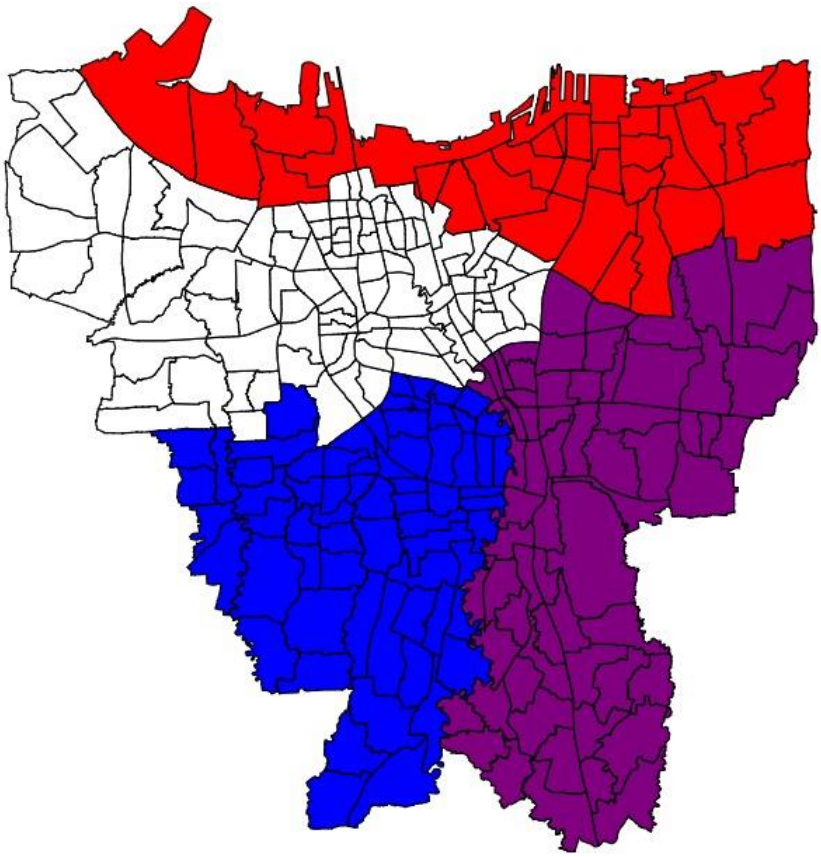
A stratified sampling method was adopted. The Special Capital Region of Jakarta consists of six cities: West, Central, South, East, North, and Thousand Islands (Table 4.1). The three cities were selected based on the diversity of economic situation. North Jakarta is predominantly lower income, South is wealthier, and East and West are relatively more balanced. Central Jakarta is concentrated with the governmental offices. Thousand Islands represents a majorly different context. Therefore, the surveyed areas included subdistricts in South, East, and North Jakarta (see Figure 4.2). The number of respondents was divided across these three areas proportionally to their population.

Table 4.1. Jakarta's Administrative Districts and Population in 2021

City	Number of Districts	Number of Sub-districts	Total Population
Central Jakarta	8 districts	44 sub-districts	1,066,460
North Jakarta	6 districts	31 sub-districts	1,834,501
West Jakarta	8 districts	56 sub-districts	2,569,462
South Jakarta	10 districts	65 sub-districts	2,373,219
East Jakarta	10 districts	65 sub-districts	3,234,003
Thousand Islands	2 districts	6 sub-districts	25,625

Source: Susenas dataset, accessed from https://www.bps.go.id/index.php/subjek/81

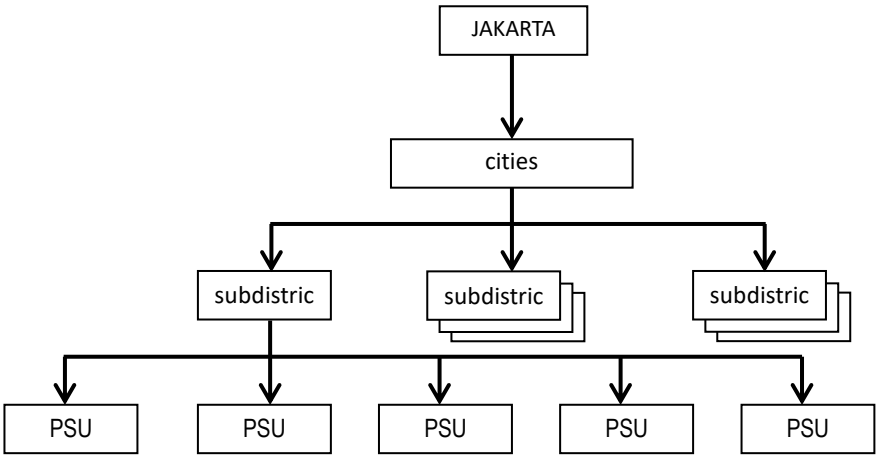
Figure 4.2. Surveyed Cities in Jakarta (East, North, South)



Source: Authors.

The respondents were divided into the following (see Figure 4.2): South Jakarta, 321 respondents; East Jakarta, 415 respondents; North Jakarta, 264 respondents. These three cities consist of 42 subdistricts (known as kelurahan), and from each subdistrict, three primary sampling units (PSUs) were randomly determined. The PSU was the smallest sampling unit at the smallest regional level (usually the Rukun Tetangga/RT). On average, 50 households live in a single PSU. A summary of the sampling method is presented Figure 4.2.

Figure 4.3. Administrative Levels in Jakarta and Sampling Method



Source: Authors.

PSU: primary sampling unit.

The detailed steps were as follows:

(1) Three cities were selected from six cities in the Jakarta Province. These cities were proportionally selected according to three socio-economic levels, high, medium, and low income cities. The Jakarta Province was represented by North, East, and South Jakarta. Moreover, the number of respondents were proportionally distributed according to the city's population density. The respondents were divided as the following: South Jakarta, 321 respondent; East Jakarta, 415 respondents, and North Jakarta, 264 respondents.

(2) 24 subdistricts (known as kelurahan) were randomly selected from these three cities. Then, from the each selected subdistrict, the primary sampling unit (PSU) was randomly determined. PSU was the smallest sampling unit at the smallest regional level (usually the Rukun Tetangga/RT). On average there are 50 households live in a single PSU.

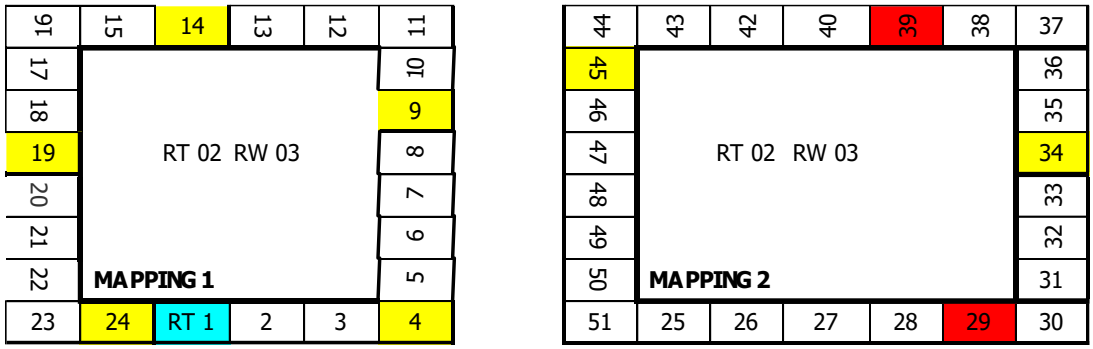
(3) In Indonesia, the use of land parcels is not uniform. There is a high possibility that public facilities such as schools, mosques, and informal shops are present amongst houses. Therefore, the common percentage for public facilities, including unoccupied houses and vacant parcels, was approximately assumed to be 40% while non-response rate caused by illiteracy or refusal to be interviewed was assumed to be 33.3%. Therefore the calculations were as follows (Formula (4-1) (4-2)):

$$Number\ of\ house\ to\ be\ contacted: 5 \times 1.4 \times 1.33 = 9.31 \qquad (\mathbf{4-1})$$

$$Interval\ between\ houses: \frac{50}{9.31} = 5.37\ \ rounded\ to\ 5 \qquad (\mathbf{4-2})$$

(4) Figure 4.4 describes an example of the process adopted for the respondents' identification within each land parcel. The first house belonged to the head of the RT who lives there or the one adjacent to it. Using results from the above calculation, the interviewers approached five households within one PSU; the houses were in land parcels 4, 9, 14, 19, etc.

Figure 4.4. Example of The Identification Process for Respondents in Land Parcels



RT = Rukun Tetangga

Legends:

- Blue Highlight : Start Respondent/Initial Respondent
- Yellow Highlight : Respondent that is successfully interviewed
- Red Highlight : Prospective Respondent who cannot be interviewed for various reasons

Source: Authors.

The number of successful respondents who can be interviewed in one sub-district is around 10–12.

Then the respondent's criteria are constructed based on the justification of the researchers, including the quota for these criteria. Most of the quota criteria used; refer to the proportion of data from BPS (Badan Pusat Statistik/Central Bureau of Statistics) Jakarta.

Several criteria for respondents in this study include:

- **Sex**
- **Marital Status**
- **Prepaid and Postpaid**
- **Installed Capacity**
- **SEC (Social Economic Classification)**

An exception is made for customers with an electricity capacity of 450 kVA; the recruitment for these customers utilised a method that used booster (finding respondents with certain criteria without following the randomisation rule with intervals). However, the number of successful respondents remains around 10–12 people per sub-district (kelurahan).

The Social Economic Classification (SEC) (Table 4.2) criteria utilised in this study refer to the latest classification used by Nielsen for the latest market research conducted in Indonesia.

Table 4.2. Social Economic Classification (SEC)

A +	More than Rp. 6,000,001
A	Rp. 4,000,001 – Rp. 6,000,000
B	Rp. 3,000,001 – Rp. 4,000,000
C1	Rp. 2,200,001 – Rp. 3,000,000
C2	Rp. 1,500,001 – Rp. 2,200,000
D	Rp. 1,200,001 – Rp. 1,500,000
E	Rp. 1,200,000 or less

Source: Nielsen, accessed from https://indonesiadata.id/produk/profil-ses-indonesia-2021/

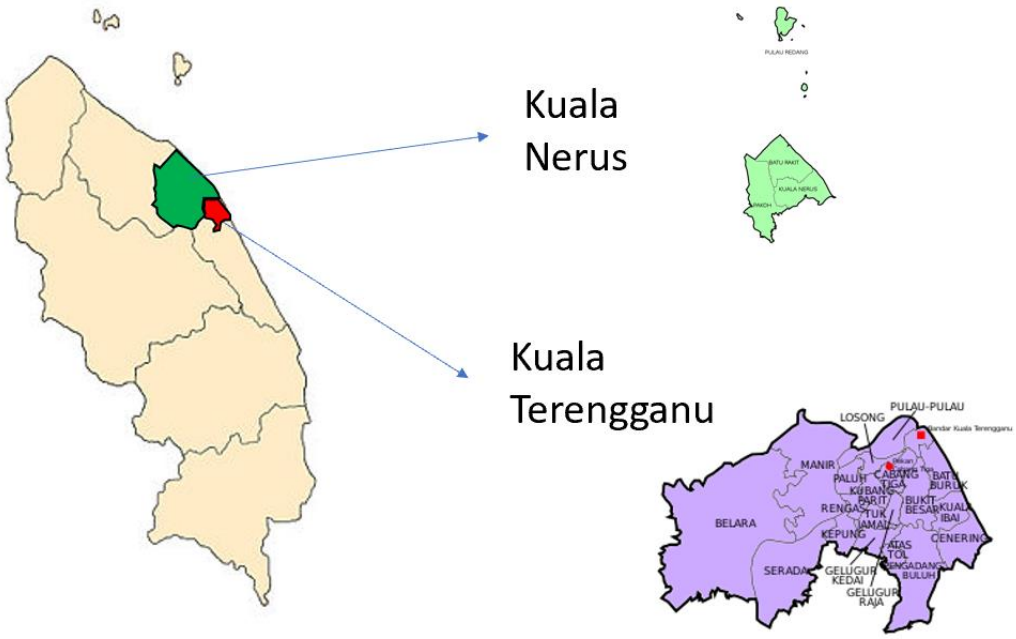
3. Malaysia – Kuala Nerus and Kuala Terengganu

This study surveyed two of the eight administrative districts (AD) in the State of Terengganu on the East coast of Peninsular Malaysia (see Figure 4.5 and Figure 4.6). Kuala Terengganu is the royal capital of the state and its administrative and economic centre. Despite its small size, the city area, including Kuala Nerus, is the largest in the state. Kuala Nerus is a recent creation after its separation from the Kuala Terengganu district in 2014. Nonetheless, it is still governed by the Kuala Terengganu City Council. In practice, the urban area sprawls over the two districts.

Figure 4.5. States in Malaysia (Terengganu highlighted)

Source: Authors. Created with mapchart.net

Figure 4.6. Administrative Districts Surveyed (Kuala Nerus and Kuala Terengganu)

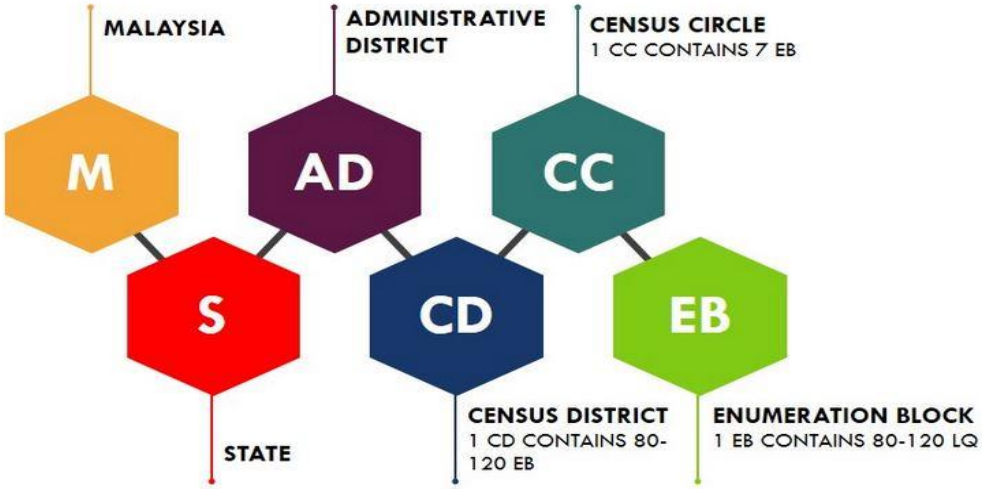


Source: Authors modified from (Fikku fiq, 2014; Zh9567, 2020).

The sampling strategy adopted was a multi-level stratified approach following the official division into enumeration blocks (EB) by the government of Malaysia census (see Figure .). The sampling framework used is a list of EBs updated with information on Living Quarters (LQ) from the 2020 Population and Housing Census. An EB is a land area artificially created

and consists of specific boundaries. On average, one EB contains about 80 to 120 LQ with approximately 500 to 600 persons. Sampling was developed by the Department of Statistics, Malaysia. Approximately 80 to 120 Ebs form a census district (CD). The survey covers only urban areas in both districts in Terengganu and therefore does not include the districts' rural areas. The following are the Ebs, EB's no, total LQs, and the number of samples in each EB of the two districts.

Figure 4.7. Administrative Districts Surveyed (Kuala Nerus and Kuala Terengganu)



Source: The official source (Department of Statistics Malaysia, 2020).

Following the official division provided by the national census, the number of samples was distributed proportionally between Kuala Terengganu and Kuala Nerus, considering their population. That is 51,778 and 30,397 people, respectively, resulting in 654 samples in Kuala Terengganu and 396 in Kuala Nerus (see Table 4.3). This required sample (KT=654, KN=396) was selected randomly by utilising Stata across the list of all LQs in the EB provided by the department of Official Statistics in Malaysia (DOSM). Table 4.4 summarises the resulting distribution of samples.

Table 4.3. Samples by District

District	Number of households (HHs)	Share of total	Number of samples
Kuala Terengganu	51,778	62	654
Kuala Nerus	30,397	38	396
	82,175	100	1,050

Source: Based on authors' calculations and the official source (Department of Statistics Malaysia, 2020).

Table 4.4. Enumeration Block (EB), EB's number, Living Quarter and Number of Samples of Kuala Terengganu and Kuala Nerus Districts

BLOCK	Enumeration Block (EB)	EB's number	Living Quarters	Number of Samples
KUALA TERENGGANU				
1	Tok Jamal	11024070C	74	42
2	Kuala Ibai 1	11008036B	83	40
	Kuala Ibai 2	11008130A	77	41
	Kuala Ibai 3	11005079	37	15
3	Cenering	11008058	135	49
4	Manir	11014017	92	52
5	Belara 1	11006064B	120	58
	Belara 2	11006079	137	42
6	Rengas	11024026B	80	32
7	Cabang Tiga	11024055A	125	44
8	Batu Buruk	11005089	111	32
9	Pengadang Buloh	11008097B	80	30
10	Kubang Parit	11024034C	127	31
11	Bandar 1	11005052	103	68
	Bandar 2	11005037	66	30
	Bandar 3	11005028	63	48
				654
KUALA NERUS				
1	Kuala Nerus 1	11006035	144	72
3	Kuala Nerus 2	11013102 B	105	62
5	Kuala Nerus 3	11006044B	120	71
7	Batu Rakit 1	11006018A	87	53
9	Batu Rakit 2	11013074	137	90
11	Batu Rakit 3	11013066B	92	48
				396

Source: The official source (Department of Statistics Malaysia, 2020).

Chapter 5

Descriptive Results

1. Overview

This chapter provides an overview of the descriptive statistics of the responses. The number of respondents in each country is as follows: Indonesia: n=1000, Malaysia: n=1050. Table 5.1 and Figure 5.1 show the employment status of all respondents in the two countries. Although survey experiments were conducted in Malaysia and not Indonesia, we first present the pooled results.

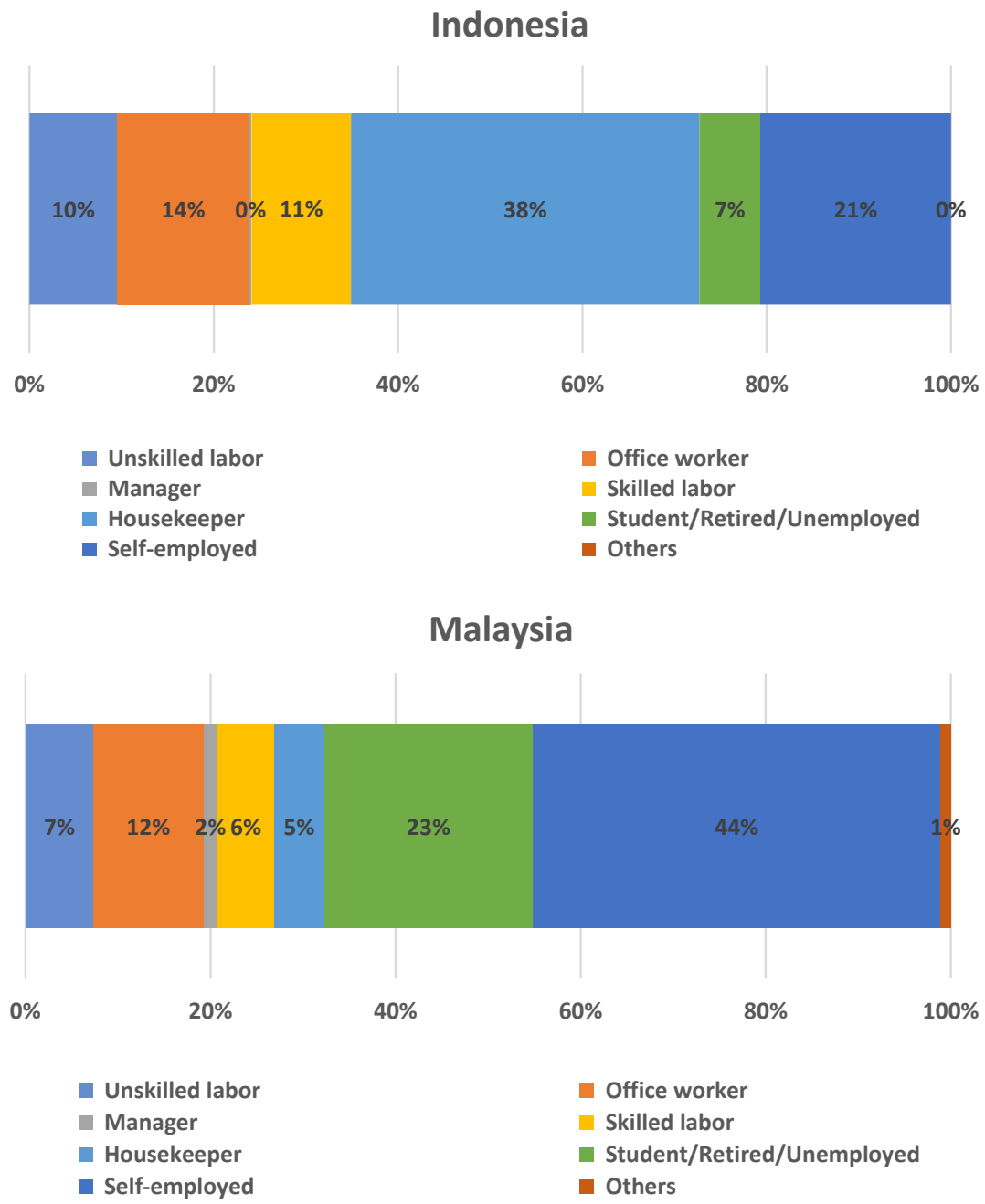
Most common occupations differ by country. The most common occupations are as follows: in Malaysia, self-employed (44%) followed by student/retired/unemployed (23%); in Indonesia, housekeeper (38%), followed by self-employed (21%). Note that most of the surveys were conducted during daytime, and the respondents thus tended to be those who remain at home during the daytime.

Table 5.1. Occupation of Respondents in All Regions

Country	**Indonesia** (n=1000)		**Malaysia** (n=1050)	
	Number of respondents	%	Number of respondents	%
1. Unskilled labour	95	10%	77	7%
2. Office worker	144	14%	125	12%
3. Manager	2	0%	16	2%
4. Skilled labour	108	11%	64	6%
5. Housekeeper	378	38%	57	5%
6. Student/Retired/ Unemployed	66	7%	237	23%
7. Self-employed	207	21%	462	44%
8. Others	0	0%	12	1%
Blank	0	0%	0	0.0%
SUM	1000	100%	601	100%

Source: Authors' calculation.

Figure 5.1. Respondent Occupation Percentages

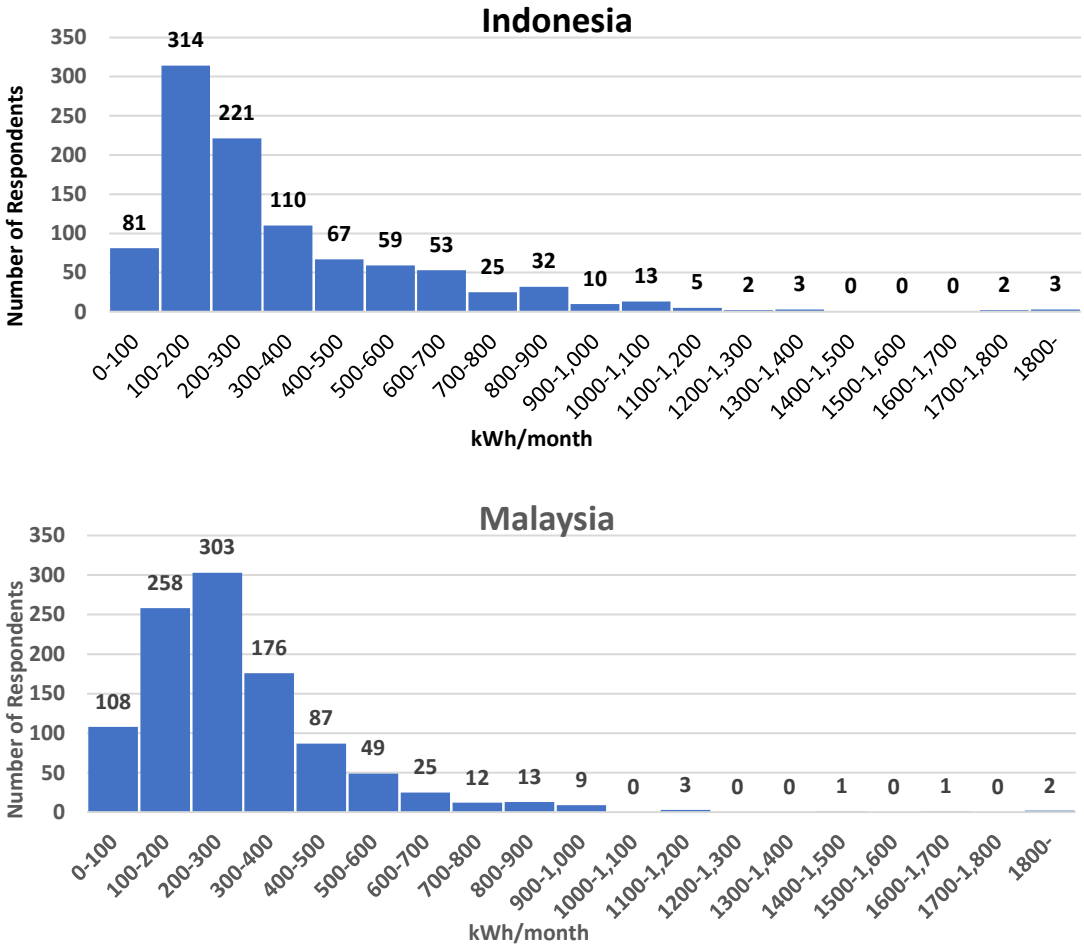


Source: Authors' calculation.

2. Monthly Electricity Consumption

Figure 5.2 shows the electricity consumption per month in each country. The most frequent level of monthly electricity consumption ranged from 100–200 kilowatt hours (kWh)/month in Indonesia and 200–300 kWh/month in Malaysia. Both distributions have a long tail.

Figure 5.2. Electricity Consumption



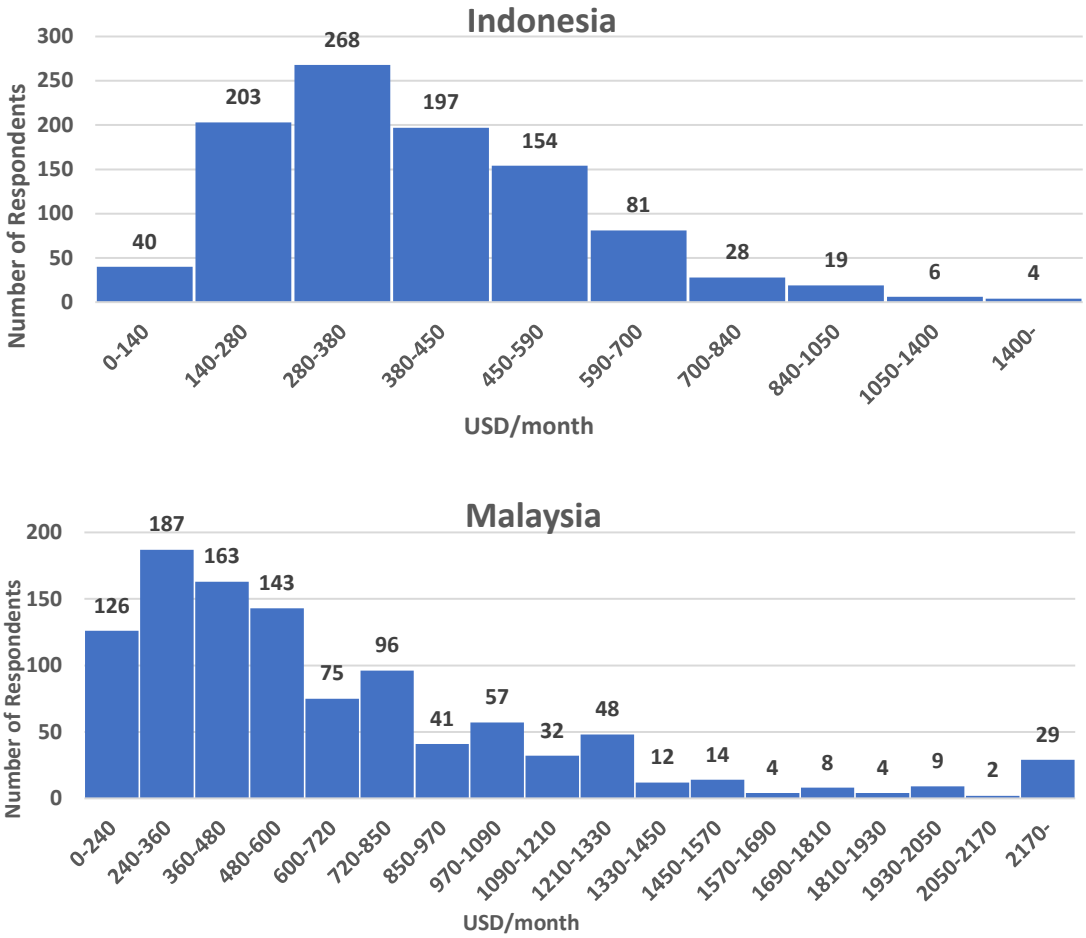
kWh = kilowatt hour.

Source: Authors' calculation.

3. Monthly income

Figure 5.3 shows the monthly income in the two countries. The most frequent levels of income were US$280–380/month in Indonesia and US$240–360/month in Malaysia. Both distributions have a long tail as with the electricity consumption. The distribution of monthly electricity consumption does not follow the same pattern as the monthly income distribution in the two examined regions.

Figure 5.3. Distribution of Monthly Income

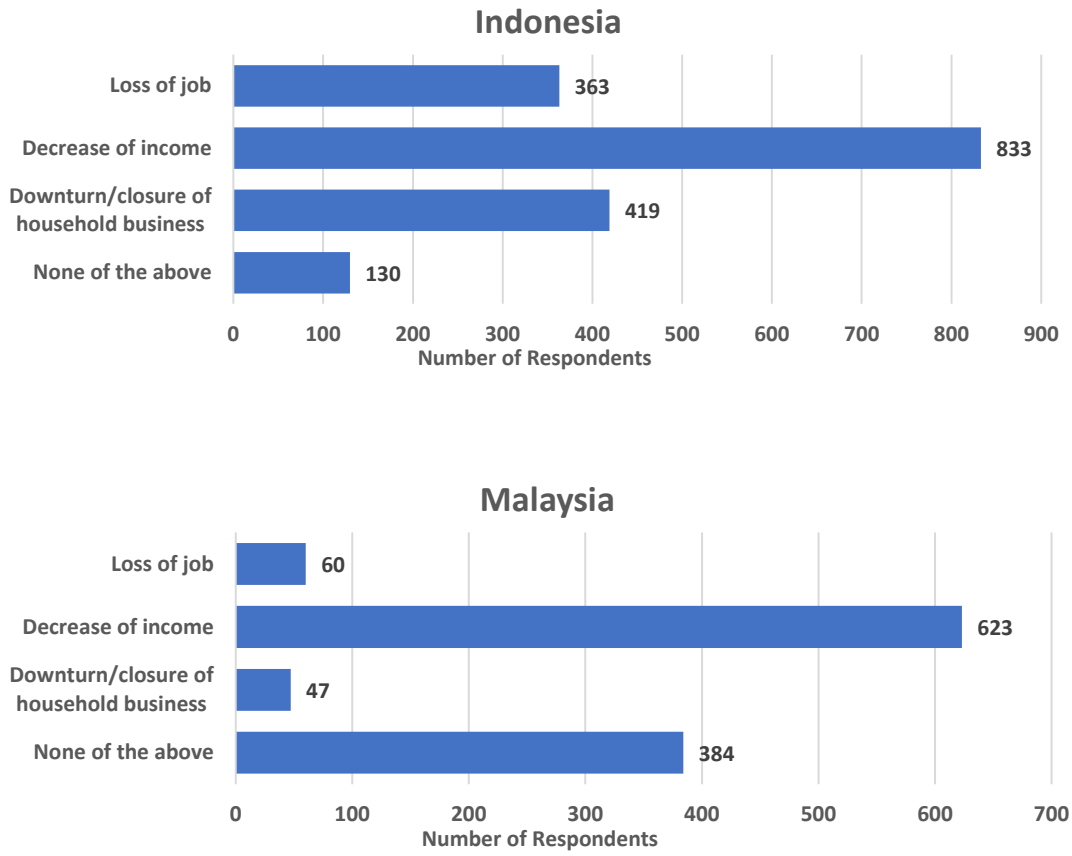


Source: Authors' calculation.

4. Effects of COVID-19

As noted, the survey was conducted during the COVID-19 pandemic, which affected the respondents deeply. Figure 5.4 shows the results for the effects of COVID-19 on the respondents. In both countries, more than 60% of respondents indicated 'Decrease of income'. However, in Malaysia, about one in three respondents chose none of 'Decrease of income' or 'Loss of job' or 'Downturn/closure of household business.

Figure 5.4. Effects of the COVID-19 Pandemic

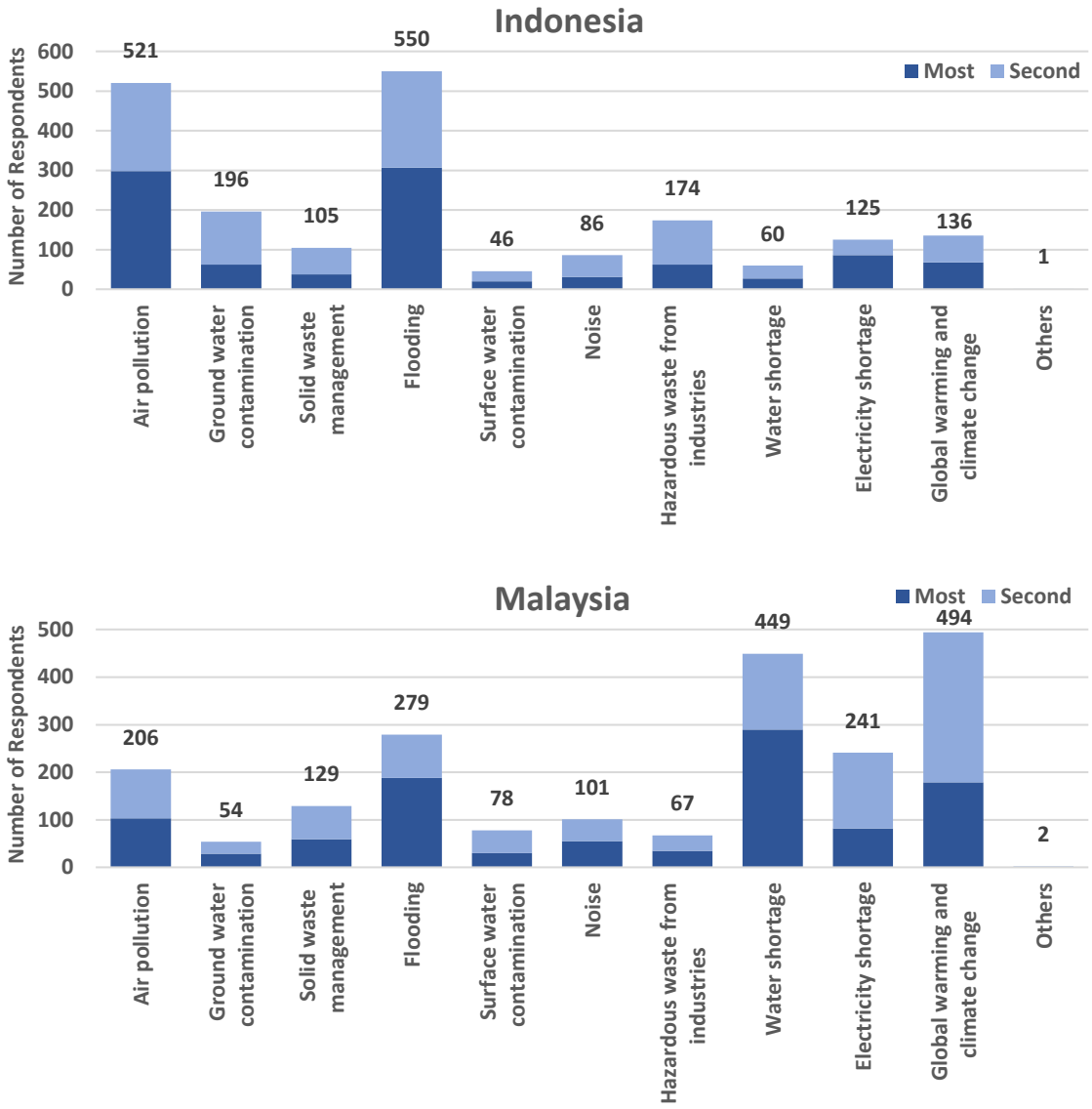


Source: Authors' calculation.

5. Attitudes Towards Environmental Issues

Figure 5.5 shows the environmental issues considered most and second-most important by respondents. In Indonesia, many respondents selected 'Flooding' and 'Air pollution'. In Malaysia, respondents selected 'Water shortage' as the most and 'Global warming and climate change' as the second-most important. The trend to pay attention to global warming and climate change was also seen in the 2021 results in Malaysia. Note that the respondents might also have chosen flooding or water shortage as impacts of anthropogenic climate change. Additionally, it is noteworthy that air pollution is related to fossil fuel combustion.

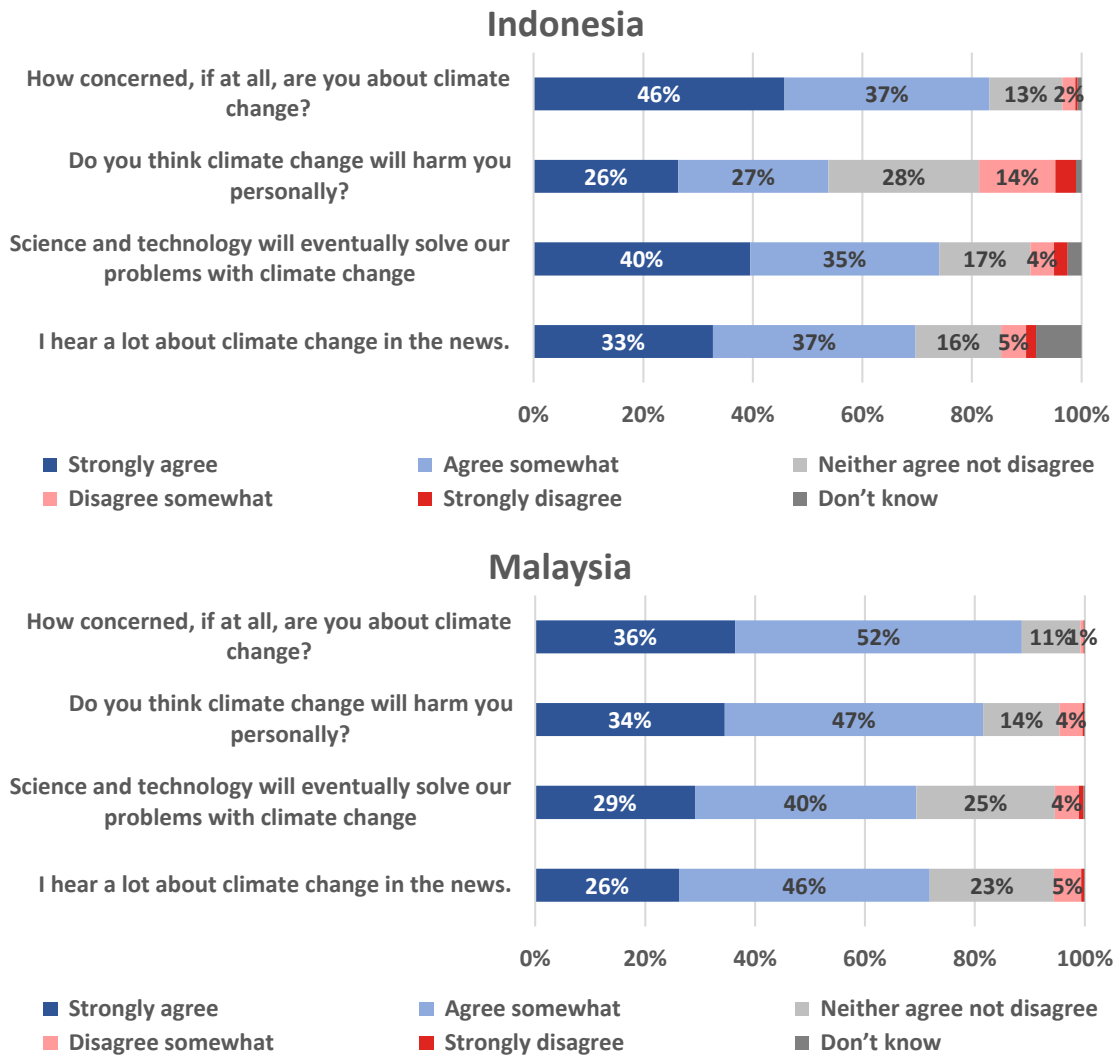
Figure 5.5. Perceived Importance of Environmental Issues



Source: Authors' calculation.

Figure 5.6 shows the attitudes towards climate change in both countries. Many respondents are concerned about climate change and have heard a lot about climate change in the news. In Malaysia, about 80% of the respondents either strongly agree or agree with the statement that climate change will harm them personally. The fraction is smaller in Indonesia, at about 53%.

Figure 5.6. Attitudes Towards Climate Change Issue

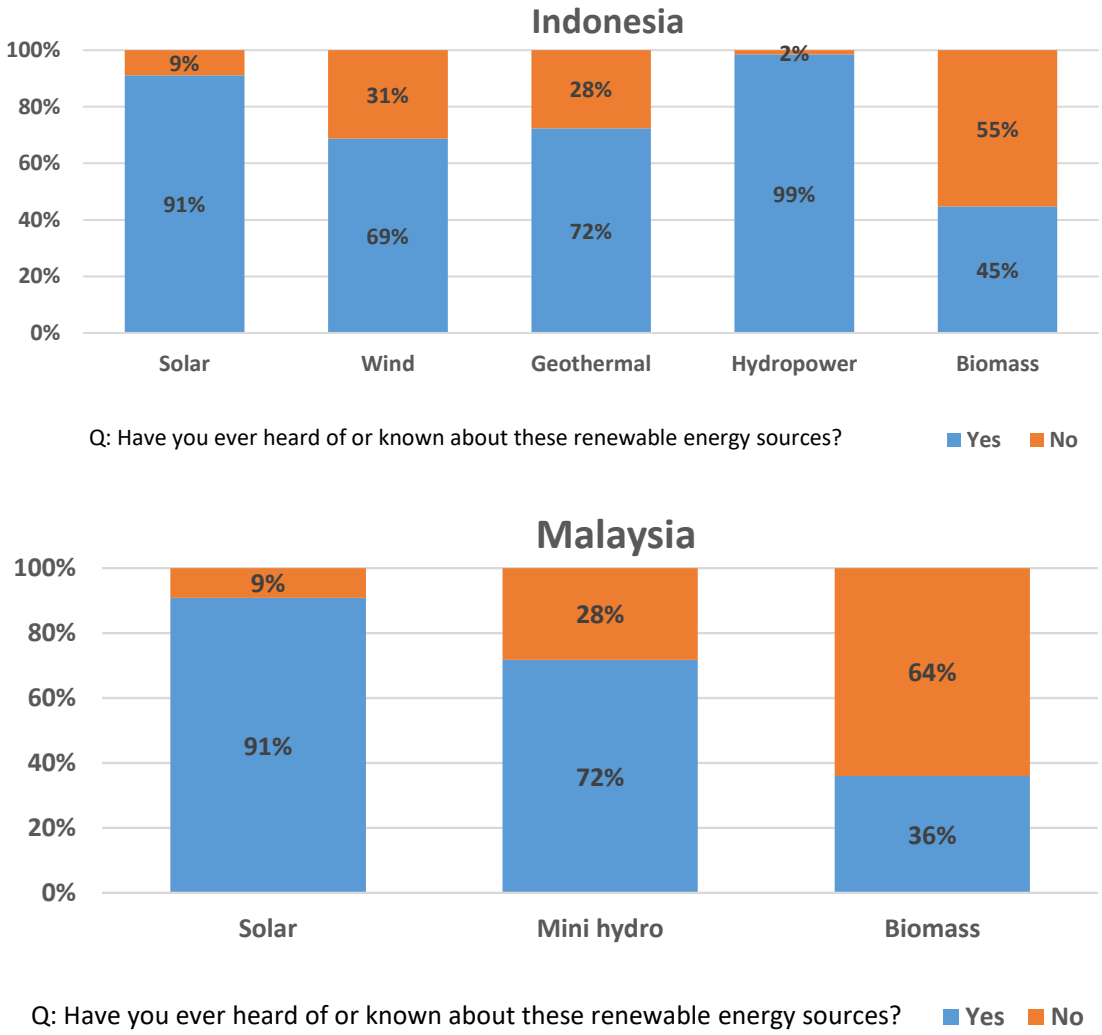


Source: Authors' calculation.

6. Attitudes Towards Types of Renewable Energy

Figure 5.7 shows people's knowledge about renewable energy sources. In Indonesia, hydropower was the most popular, with 99% answering 'Yes'. Solar was popular too, with about 90% answering 'Yes' in both countries. Biomass was least well known in both countries, especially in Malaysia, where only 36% of respondents answered 'Yes'.

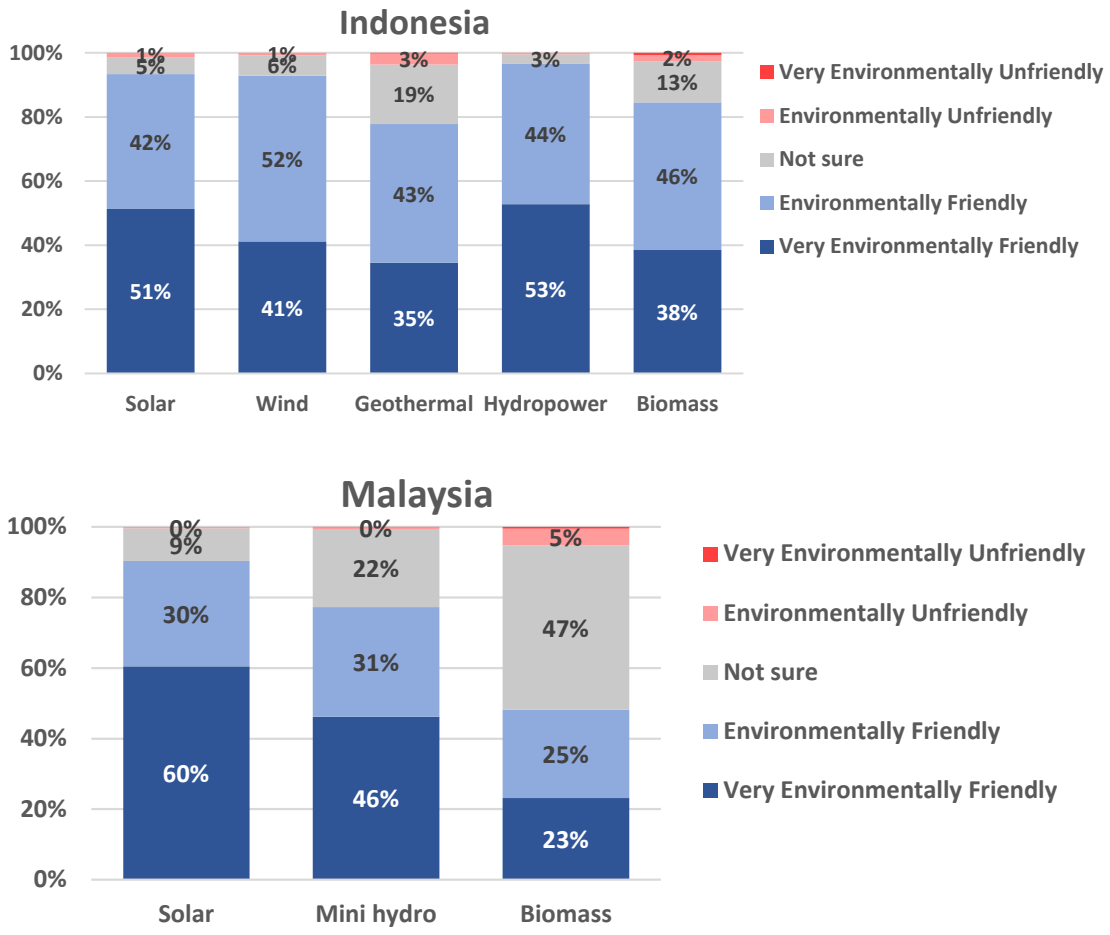
Figure 5.7. Knowledge About Renewable Energy Sources



Source: Authors' calculation.

Figure 5.8 shows the proportions of respondent evaluations regarding RE types. In Indonesia, hydropower was considered the most environmentally friendly. Solar energy was considered environmentally friendly in both Indonesia (51% responded 'very environmentally friendly') and Malaysia (60% responded 'very environmentally friendly'). Respondents expressed concerns regarding biomass in Indonesia (2% responded 'environmentally unfriendly'), Malaysia (5% responded 'environmentally unfriendly'). The same pattern was observed in the prior two years' surveys, where solar was considered more environmentally friendly and biomass less environmentally friendly in all surveyed countries.

Figure 5.8. Attitudes Towards Renewable Energy



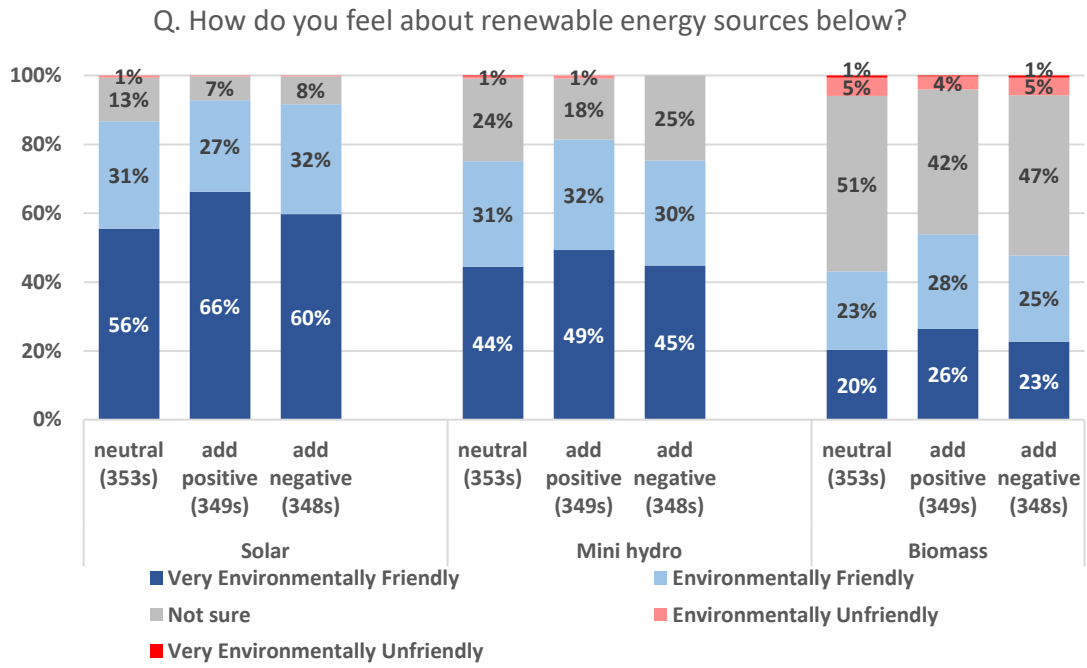
Source: Authors' calculation.

7. Survey Experiments on Renewable Energy in Malaysia

A survey experiment was conducted in which participants were randomly divided into groups each receiving one of three informational materials about renewable energy.

Figure 5.9 shows the proportions of respondent evaluations regarding RE types in Malaysia. More respondents in the 'add positive' group selected that solar and biomass are very environmentally friendly. A Kruskal-Wallis H test was conducted to determine if the response was different for three groups that either listened to: (a) neutral (n = 353); (b) add positive (n = 349); and (c) add negative (n = 348). A Kruskal-Wallis H test showed that there was a statistically significant difference in the response between the three groups, $\chi^2(2) = 10.209$, $p = 0.0061$ for solar and $\chi^2(2) = 8.286$, $p = 0.0159$ for biomass.

Figure 5.9. Attitudes Towards Renewable Energy

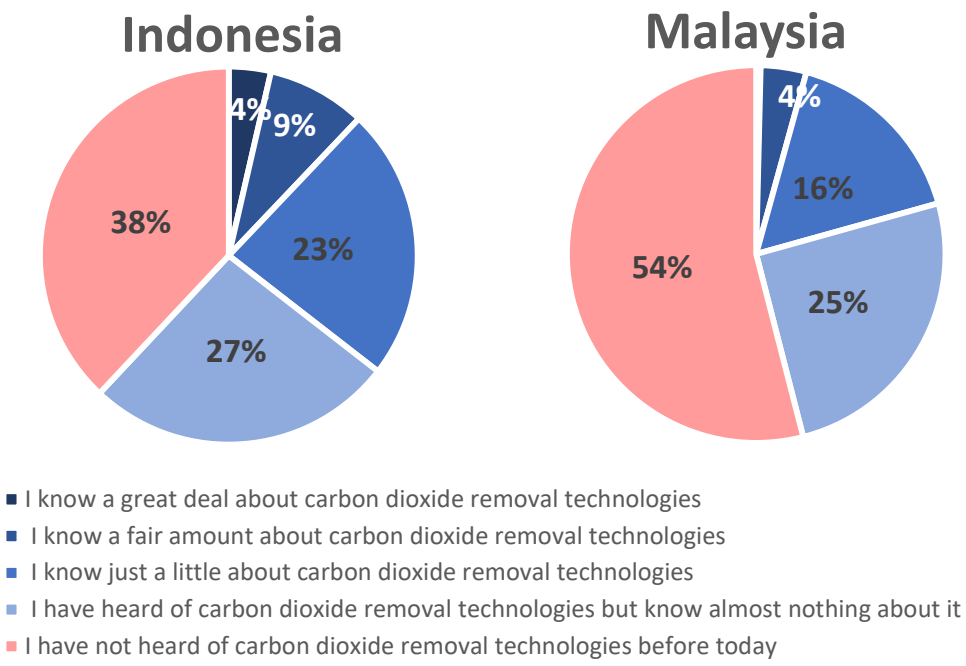


Source: Authors' calculation.

8. Attitudes Towards Carbon Dioxide Removal Technologies

Figure 5.10 shows people's knowledge about carbon dioxide removal (CDR) technologies. CDR was not familiar with the respondents. The largest number of Indonesian respondents (38%) and Malaysian respondents (54%) answered 'I have not heard of them'.

Figure 5.10. Knowledge of CDR Technology

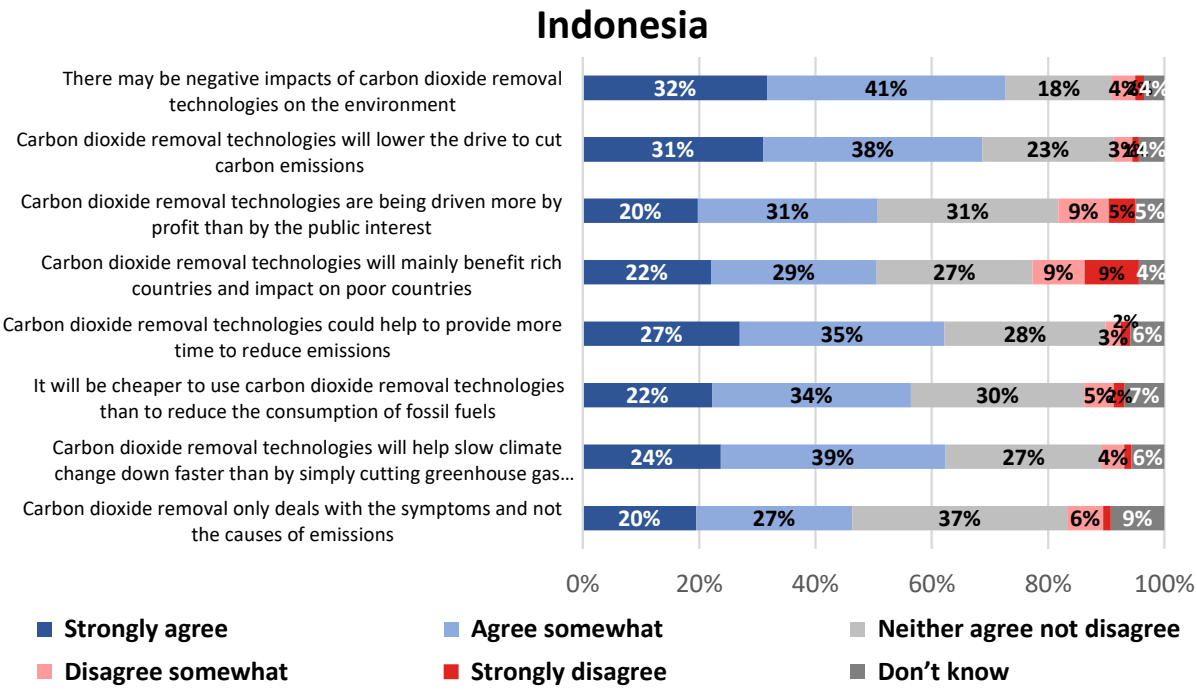


CDR = carbon dioxide removal.

Source: Authors' calculation.

Figure 5.11 shows the attitudes towards the risks and benefits of CDRs in Indonesia, where 73% of respondents answered either 'Strongly agree' or 'Agree somewhat' to the statement 'There may be negative impacts of [CDR] on the environment'. Similarly, 69% of respondents answered either 'Strongly disagree' or 'Disagree somewhat' to the statement '[CDR] will lower the drive to cut carbon emissions'. The results from Malaysia, where a survey experiment was conducted, will be described in Chapter 7.

Figure 5.11. Attitudes Towards CDR Technologies

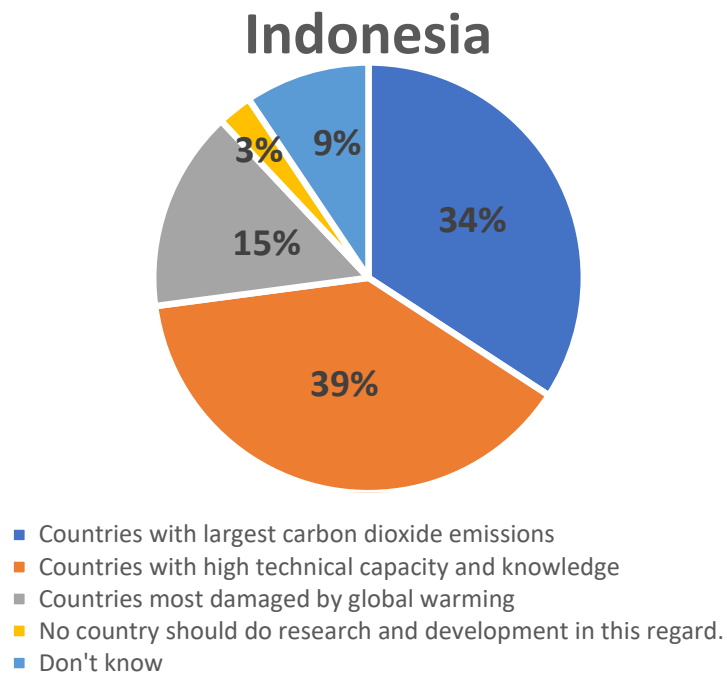


CDR = carbon dioxide removal.

Source: Authors' calculation.

Finally, Figure 5.12 shows the attitudes towards the future of CDR research and development in Indonesia. The highest share of respondents (39%) answered that the countries with high technical capacity and knowledge should be foremost in developing such technologies, followed by countries with the largest CO_2 emissions (34%).

Figure 5.12. Answer to 'In your Opinion, what Countries Should be at the Forefront in the Development of Carbon Removal Technology?'



Source: Authors' calculation.

Chapter 6

Analysis of Survey Results on the Willingness to Pay for Renewable Energy in Indonesia and Malaysia

This chapter analyses the results of the willingness to pay (WTP) survey for renewable energy (RE) in Malaysia and Indonesia, where this year's surveys were conducted.

1. Discrete Choice Model Results

2. Regression Analysis

As shown in the previous chapter, the sample covered 1000 households in Indonesia and 1050 in Malaysia. From this sample, households with outlier values for the monthly electricity bill were excluded from the following regression analysis.

We estimated household WTP using the conditional logit. The utility was assumed to be a linear function of attributes of RE share and price. RE types, including solar, biomass, wind, mini hydro, and geothermal, were represented by dummy variables. Hydropower (Indonesia and Malaysia) was considered the status quo type in the model. Mathematically, for respondent *i*, the utility of choosing an alternative *j* is a function of the characteristics of the alternative *j*, and the utility function (U_{ij}) contains two parts: a deterministic part V_{ij} for observed characteristics and a stochastic error part ε_{ij} for unobserved variables.

$$\boldsymbol{U_{ij} = V_{ij} + \varepsilon_{ij}} \qquad (\mathbf{6-1})$$

where the deterministic part V_{ij} represents the observable portion of the utility that can be measured and is related to both attributes of alternatives and characteristics of the respondent. It is expressed as a linear-in-parameter function:

$$\boldsymbol{V_{ij} = \sum_{k} X_{jk}\beta_k} \qquad (\mathbf{6-2})$$

where X_{jk} is the *k* attribute value of the alternative *j* , and β_k is the coefficient associated with the *k*th attribute.

Table 6.1 presents the results of our utility model. The pseudo R squared for Malaysia is not high.

Table 6.1. Utility Function Estimates

Variables	Countries	
	Indonesia	Malaysia
Price	−0.096***	−0.070***
(% of the monthly bill)	(0.003)	(.003)
RE share (%)	0.017***	0.006*
	(0.002)	(0.003)
Renewable energy types		
Base type	Hydropower	Hydropower
Solar	−0.548***	0.404***
	(0.063)	(0.065)
Wind	−0.839***	-
	(0.065)	
Geothermal	−1.280***	-
	(0.072)	
Mini Hydro	-	0.096
		(0.065)
Biomass	−0.762***	−0.253***
	(0.067)	(0.068)
Obs	24,000	24,096
Number of households	1,000	1,050
Log-likelihood	−6,219	-7,953
Pseudo R^2	0.292	0.099

RE = renewable energy.

Note: Robust standard errors are in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Source: Authors' calculation.

The results can be summarised as follows:

- Respondents prefer higher RE shares, and the RE share coefficients in all three cities were positive and significant.
- Increased price reduces the utility of households.
- Amongst all the renewable energy types, solar is the most preferred in terms of the effect of the dummy variable.

2.1. WTP Estimations

Estimates of WTP for different RE share levels and different RE types were calculated using the results of the conditional logit. We converted both significant and insignificant parameters into marginal WTP by dividing the marginal utility of attributes by the marginal utility of price. The utility function of the household can be expressed as follows:

$$\boldsymbol{V_j = \beta_1 share_j + \beta_2 Solar_j + \beta_3 Wind_j + \beta_4 Hyd_j + \beta_5 Geo_j + \beta_6 Bio_j + \beta_7 Price_j} \qquad \boldsymbol{(6-3)}$$

where V_j is the utility of choice set *j*; $share_j$ is the RE share amongst total electricity production of choice set *j*; $Solar_j$, $Wind_j$, Hyd_j, Geo_j, and Bio_j are dummy variables representing RE types of choice set *j*; and $Price_j$ represents the percentage of increasing monthly electricity tariffs.

To examine $Price_j$ at different $share$ levels, we specified $share_j$ and determined the changes in WTP_j using the following function:

$$\boldsymbol{WTP_j = \frac{\beta_1(share_j - share_{sq}) + \beta_2 Solar_j + \beta_3 Wind_j + \beta_4 Hyd_j + \beta_5 Geo_j + \beta_6 Bio_j}{-\beta_7}} \qquad \boldsymbol{(6-4)}$$

Table 6.2 shows the estimation of the mean WTP in the percentage of monthly electricity bills in United States dollars (US$) when increasing the RE share. It follows the same pattern as the results of last year.

Table 6.2. Willingness to Pay Estimates for Renewable Energy Types in % of Monthly Electricity Bill

	RE Share	Solar % of monthly electricity bill (US$)	Wind % of monthly electricity bill (US$)	Geothermal % of monthly electricity bill (US$)	Mini Hydro % of monthly electricity bill (US$)	Biomass % of monthly electricity bill (US$)
Indonesia (status quo = 11%)	20%	−4.08% (−1.27)	−7.12% (−2.22)	−11.72% (−3.66)	-	−6.31% (−1.97)
	30%	−2.25% (−0.70)	−5.29% (−1.65)	−9.89% (−3.09)	-	−4.48% (−1.40)
	40%	−0.43% (−0.13)	−3.47% (−1.08)	−8.07% (−2.52)	-	−2.65% (−0.83)
	50%	1.40% (0.44)	−1.64% (−0.51)	−6.24% (−1.95)	-	−0.83% (−0.26)
Malaysia (status quo = 17%)	30%	6.90% (1.60)	-	-	2.48% (0.58)	−2.52% (−0.58)
	40%	7.76% (1.80)	-	-	3.34% (0.77)	−1.67% (−0.39)
	50%	8.61% (2.00)	-	-	4.19% (0.97)	−0.81% (−0.19)

Note 1: The official exchange rate by the World Bank in 2019 was used for the conversions (US$1 = Rp14,147.67 = RM4.1) (World Bank, n.d.-b)

Note 2: The mean monthly electricity bills are as follows: Indonesia, US$31.2/month; Malaysia, US$23.2/month.

Note 3: The status quo of renewable share is different in cities (Indonesia, 11%; Malaysia, 17%).

Source: Authors' calculation.

Chapter 7

Attitude Survey on CDR in Malaysia

1. Introduction

As described in Chapter 1 of this report, the IPCC report indicated that global net prize carbon dioxide emissions must reach zero by 2050 in order to keep the temperature increase associated with global warming below 1.5 degrees Celsius. This 'net' is the key point: carbon dioxide removal (CDR) is needed to offset emissions from those parts of the planet where emissions are difficult to achieve.

CDR can be accomplished by a variety of methods, including afforestation, enhanced weathering, ocean fertilisation, and direct air capture. These methods vary widely in terms of carbon sequestration duration, cost, potential, side effects, co-benefits, and many other aspects. In Europe, the concept of responsible innovation has led to ongoing technological development while considering public dialogue and public recognition from the early stages.

The IPCC figures mentioned earlier refer to global emissions as a whole, and the same applies to emerging and developing countries that need to reduce their emissions. Therefore, it is necessary to discuss CDR in ASEAN as well, to understand the public's attitude towards this technology and to develop it in an appropriate direction.

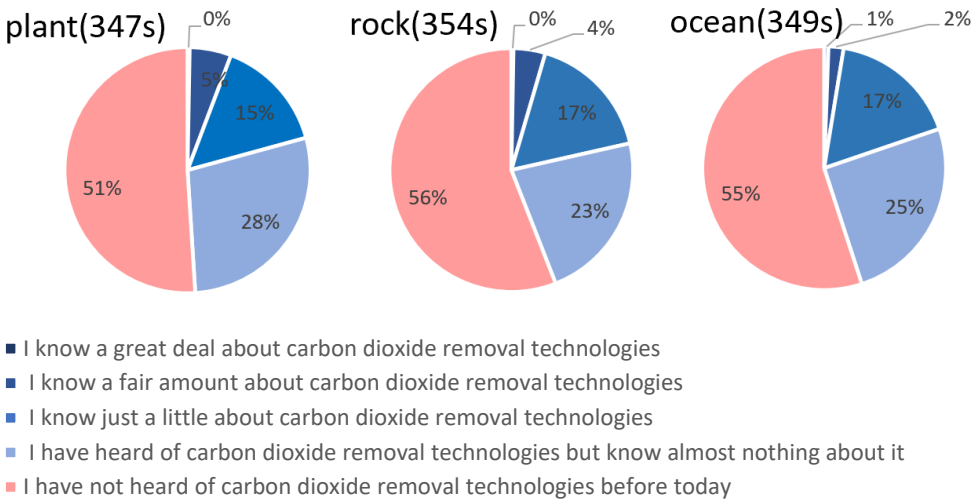
This chapter focuses on the CDR part of the questionnaire survey in Malaysia. The results of the questionnaire strongly depend on the way information is provided. A survey experiment was thus conducted in which three types of information were prepared and participants were randomly divided. The findings in this chapter are expected to serve as a basis for discussions on CDR, which are likely to take off in ASEAN countries in the future.

2. Results

2.1. Knowledge of CDR Technologies

Figure 7.1 shows people's knowledge about CDR technologies. Regardless of the type of technology, more than half the respondents did not know about CDR.

Figure 7.1. Knowledge of CDR Technologies



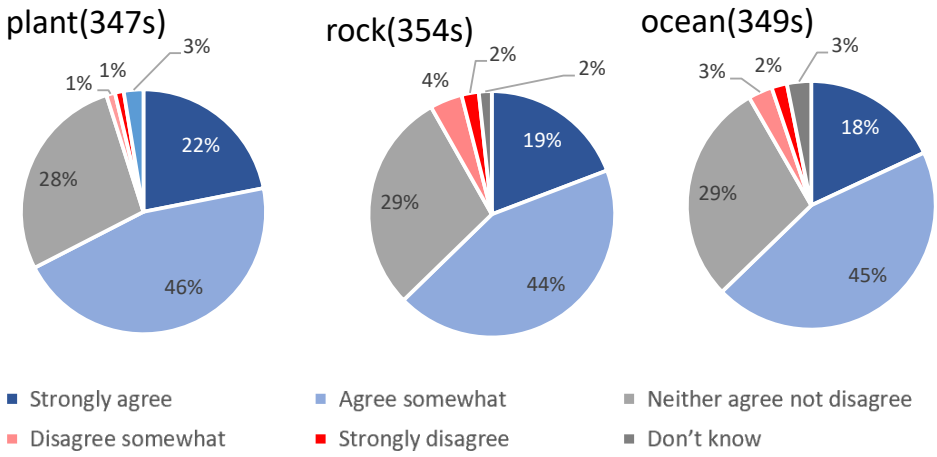
Source: Authors' calculation.

2.2. Attitudes Towards CDR Technologies

Figure 7.2 shows the proportions of respondent evaluations regarding the use of CDR as a way to combat climate change. About 70% of plant respondents selected 'strongly agree' or 'agree somewhat'.

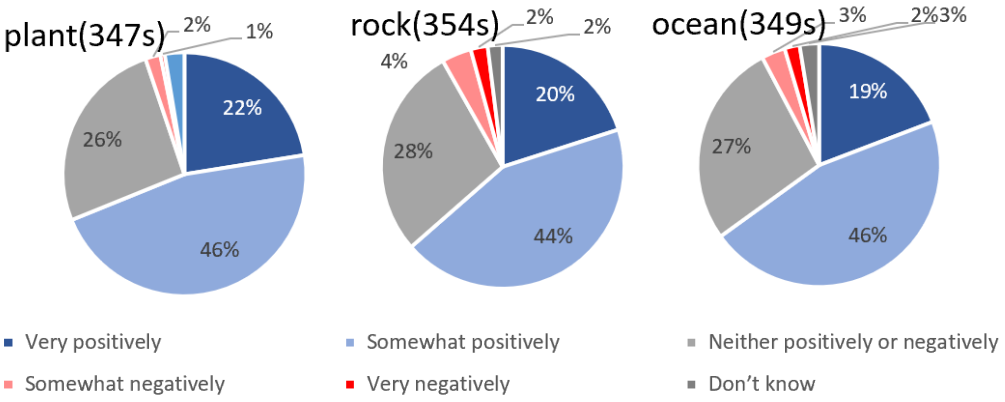
Figure 7.3 shows the proportions of respondent evaluations regarding feelings about CDR. As in the previous question, about 70% of plant respondents selected 'very positively' or 'somewhat positively'.

Figure 7.2. Would You Support or Oppose the Use of CDR as a Way to Tackle Climate Change?



Source: Authors' calculation.

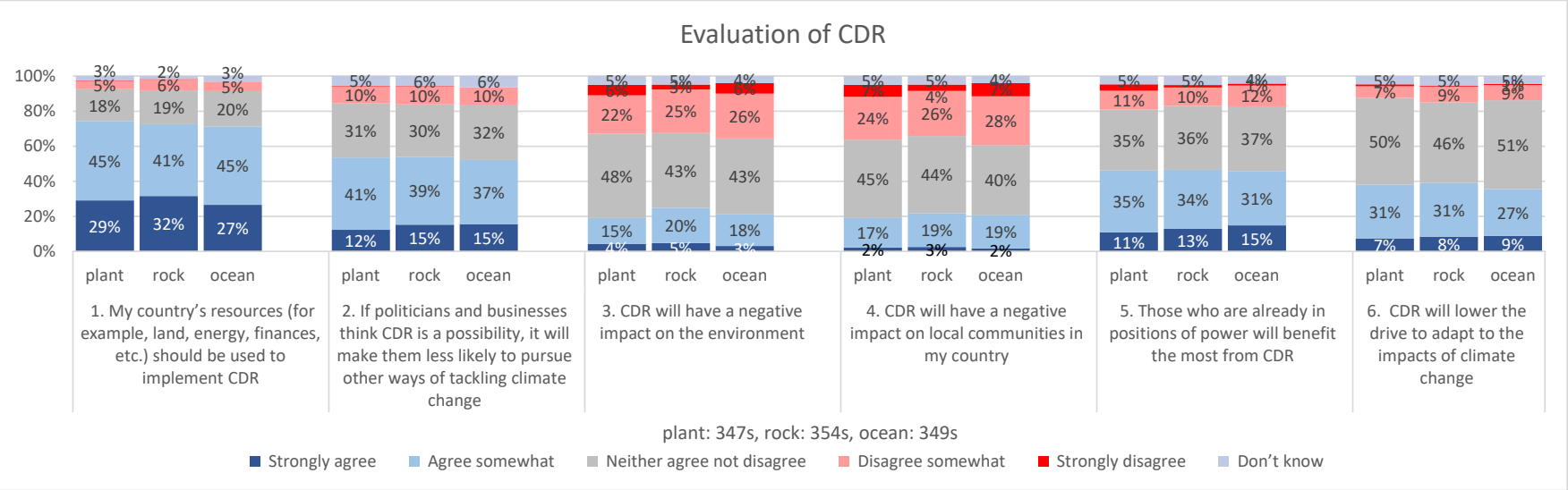
Figure 7.3. How Do You Feel about Carbon Dioxide Removal?



Source: Authors' calculation.

Figure 7.4 shows the attitudes towards the risks and benefits of CDR options. The groups did not differ so much in terms of the level of support.

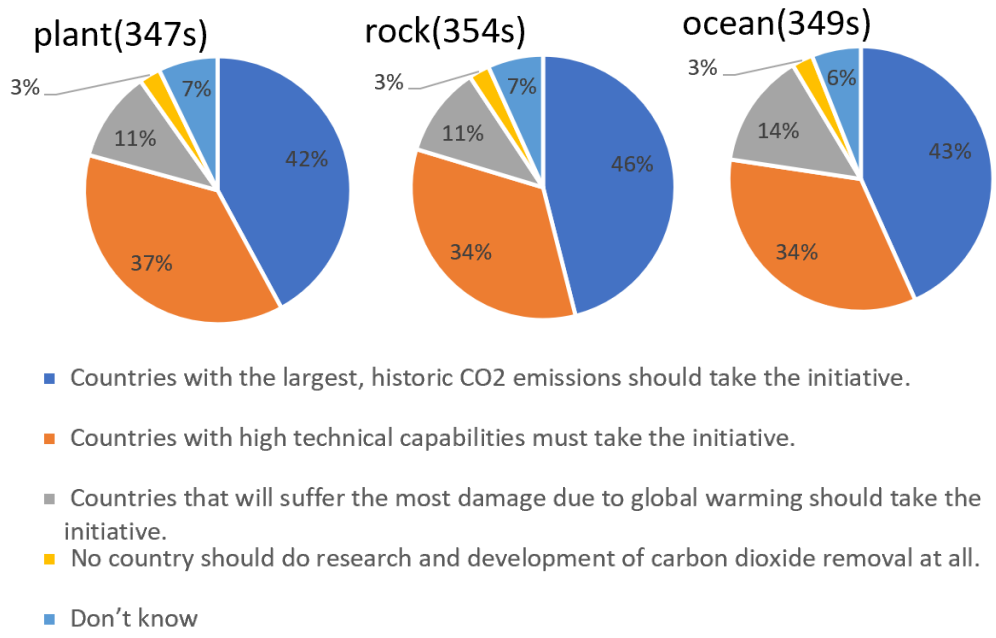
Figure 7.4. To What Extent Do You Agree or Disagree with the Following Statements?



Source: Authors' calculation.

Finally, Figure 7.5 shows attitudes towards the future of CDR research and development. More than 40% of the plant, ocean and rock respondents answered that countries with the largest historic CO_2 emissions should take the initiative. More than 30% of the plant, ocean and rock respondents answered that countries with high technical capabilities must take the initiative.

Figure 7.5. Who Do You Think Should Take the Lead Internationally on Research Into Carbon Dioxide Removal?



Source: Authors' calculation.

The survey experiment on CDR did not yield statistically significant results in a series of Kruskal-Wallis tests.

3. Conclusion

In our survey on CDR in Malaysia, we found that the respondents are largely unaware of CDR, which ranges from tree-planting to chemical engineering absorption to enhanced weathering through spraying crushed rocks. The respondents agreed with possible benefits and risks of CDR, including its ability to 'buy time' for more climate change mitigation and negative side effects on the environment.

Chapter 8

Seven-Country Comparison

1. Overview

This chapter provides an overview of the descriptive statistics of the responses. The number of respondents in each country is as follows: Myanmar, n=500; Lao PDR, n=400; the Philippines, n=500; Viet Nam, n= 587; Indonesia, n=1000; Thailand, n=each 250 in 2020 and 2021; Malaysia, n=300 in 2021 and n=1050 in 2022. Additional materials are included in the Appendix 2.

Table 8.1 describes the survey period for each city. Note that this chapter combines the results from Yangon and Mandalay for the survey in Myanmar in 2020, except for the WTP results.

Table 8.1. Respondents in All Regions

Country	City	Period	Respondents
Myanmar	Yangon and Mandalay	July to August 2020	500
Lao PDR	Vientiane	July to August 2020	400
Philippines	Manila	December 2020 to April 2021	500
Viet Nam	Ho Chi Minh (CVM and DCE)	May to July 2020	587
Indonesia	Jakarta	March to May 2022	1,000
Thailand	Bangkok	June to August 2020	250
		December 2020 to March 2021	250
Malaysia	Kuala Terengganu and Kuala Nerus	February to March 2021	300
		April to June 2022	1,050

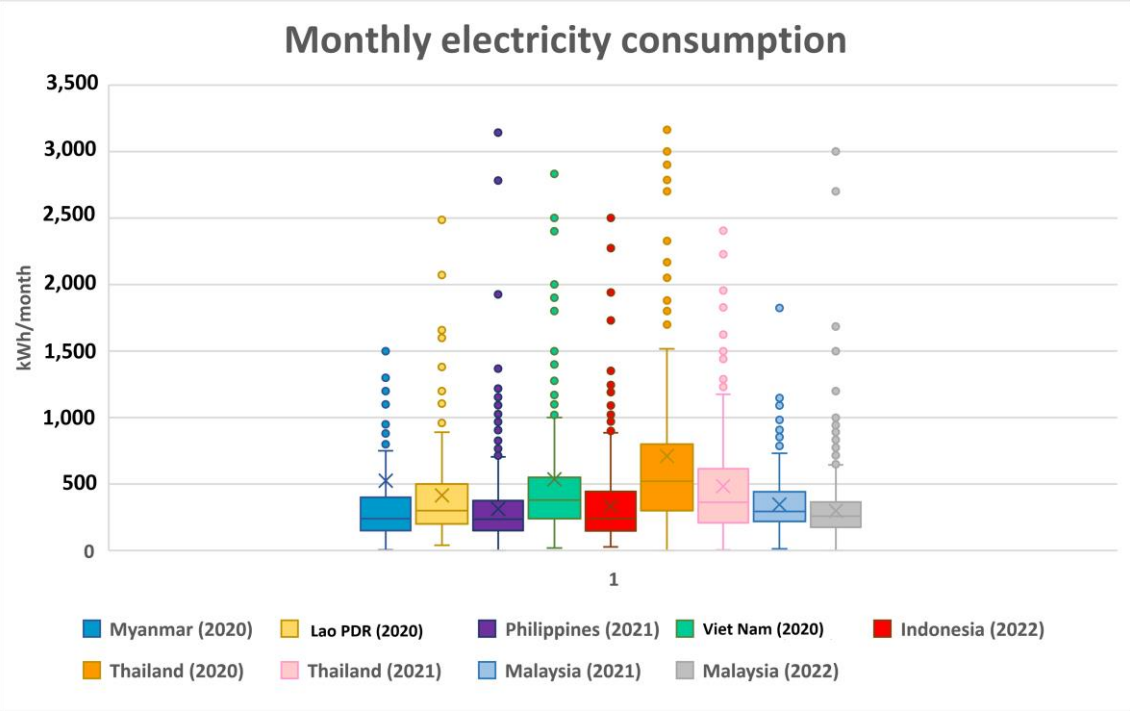
Note: Listed in ascending order of GDP per capita in 2020; (World Bank, n.d.-a).

Source: Authors' calculation.

2. Monthly Electricity Consumption

Figure 8.1 shows the electricity consumption per month in each country. The highest average was in Thailand (2020) and the lowest average was in Malaysia (2022).

Figure 8.1. Attitudes Towards Climate Change Issue



kWh = kilowatt hour.

Note: Outlier is 9 points.

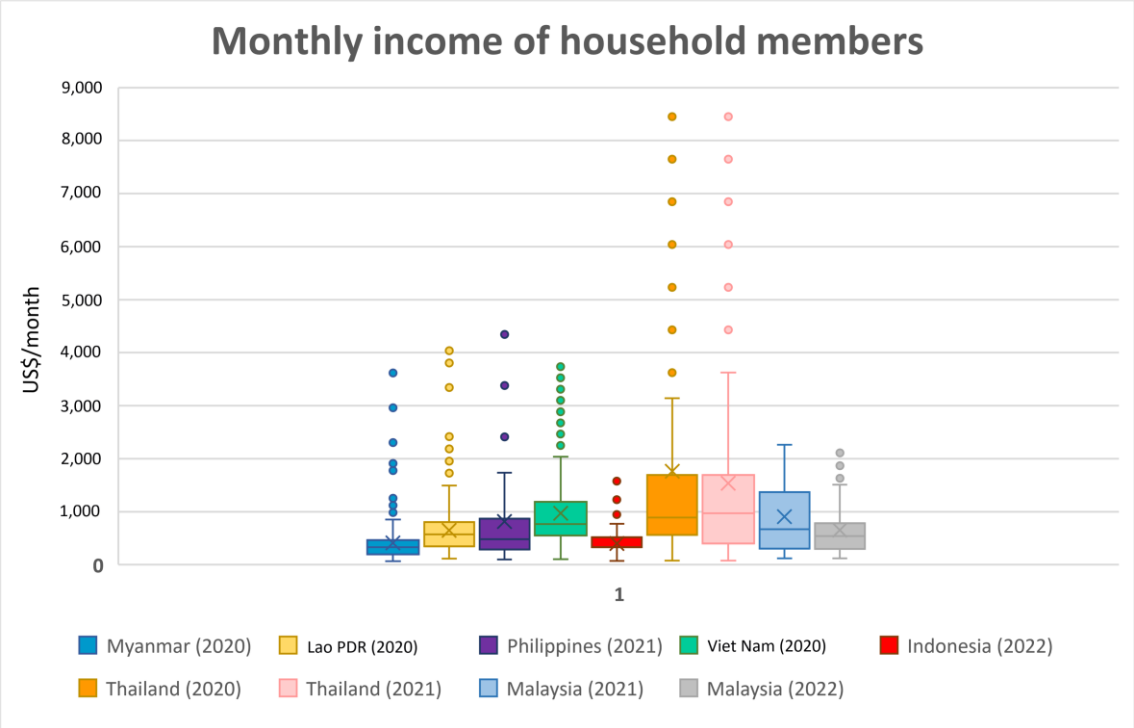
Source: Authors' calculation.

3. Monthly income

Figure 8.2 shows the monthly income in each country. The highest average was in Thailand (2020) and the lowest average was in Indonesia (2022). Countries are listed in ascending order of GDP per capita in 2020, although income is not proportional to GDP per capita.

The distribution of monthly electricity consumption does not follow a similar pattern as the monthly income distribution in the seven examined regions.

Figure 8.2. Distribution of Monthly Income

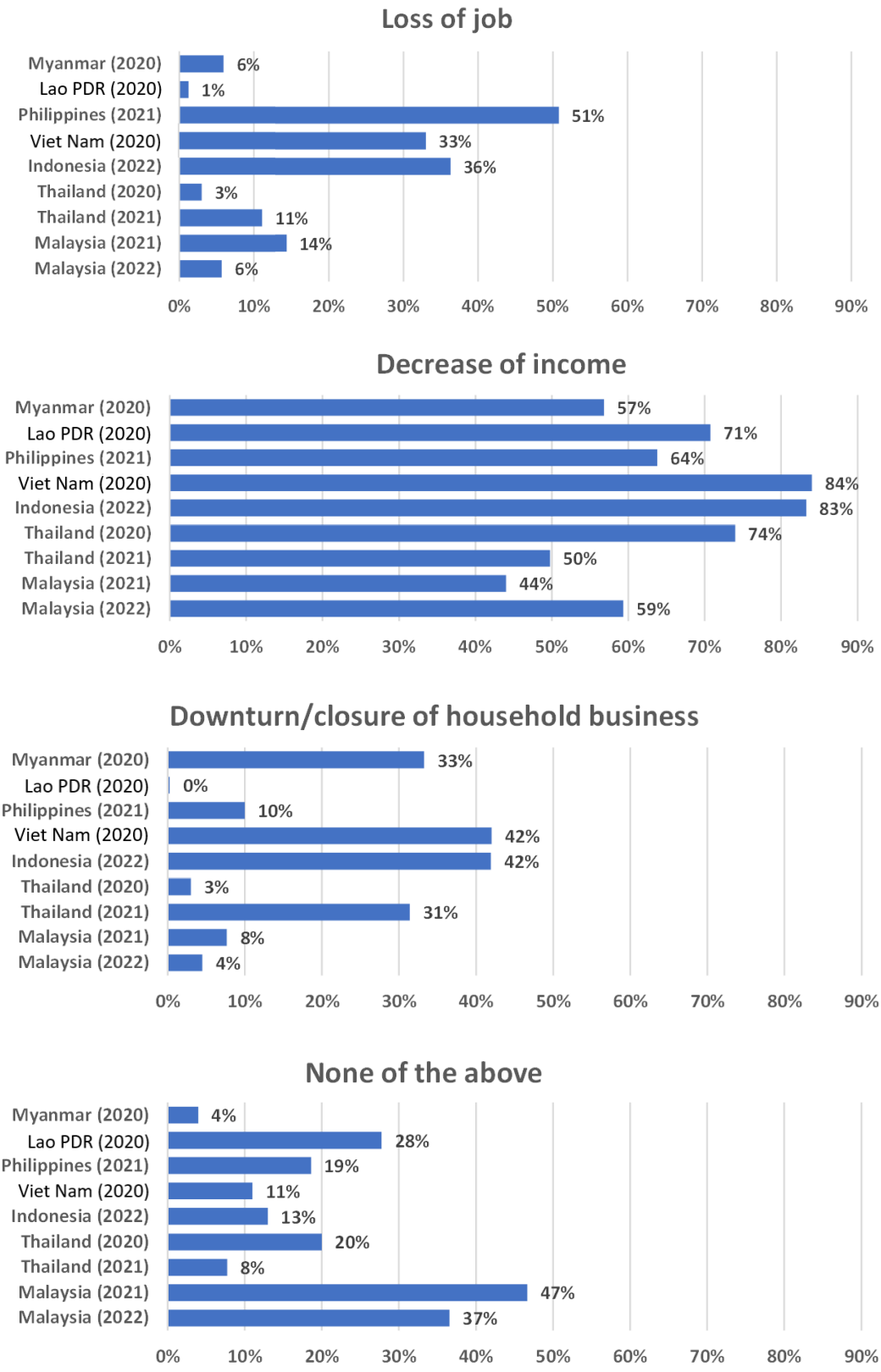


Source: Authors' calculation.

4. Effects of COVID-19

As noted, the survey was conducted during the COVID-19 pandemic. **Error! Reference source not found.** shows the results on the effects of COVID-19 on the respondents. In all countries, many respondents selected 'Decrease of income'. In the Philippines, about half of the respondents selected 'Loss of job'. In Viet Nam and Indonesia, the number of respondents who selected 'Downturn/closure of household business' was high. In Malaysia, more than 37% of respondents did not select none of 'Decrease of income' or 'Loss of job', or 'Downturn/closure of household business.

Figure 8.3. Effects of the COVID-19 Pandemic



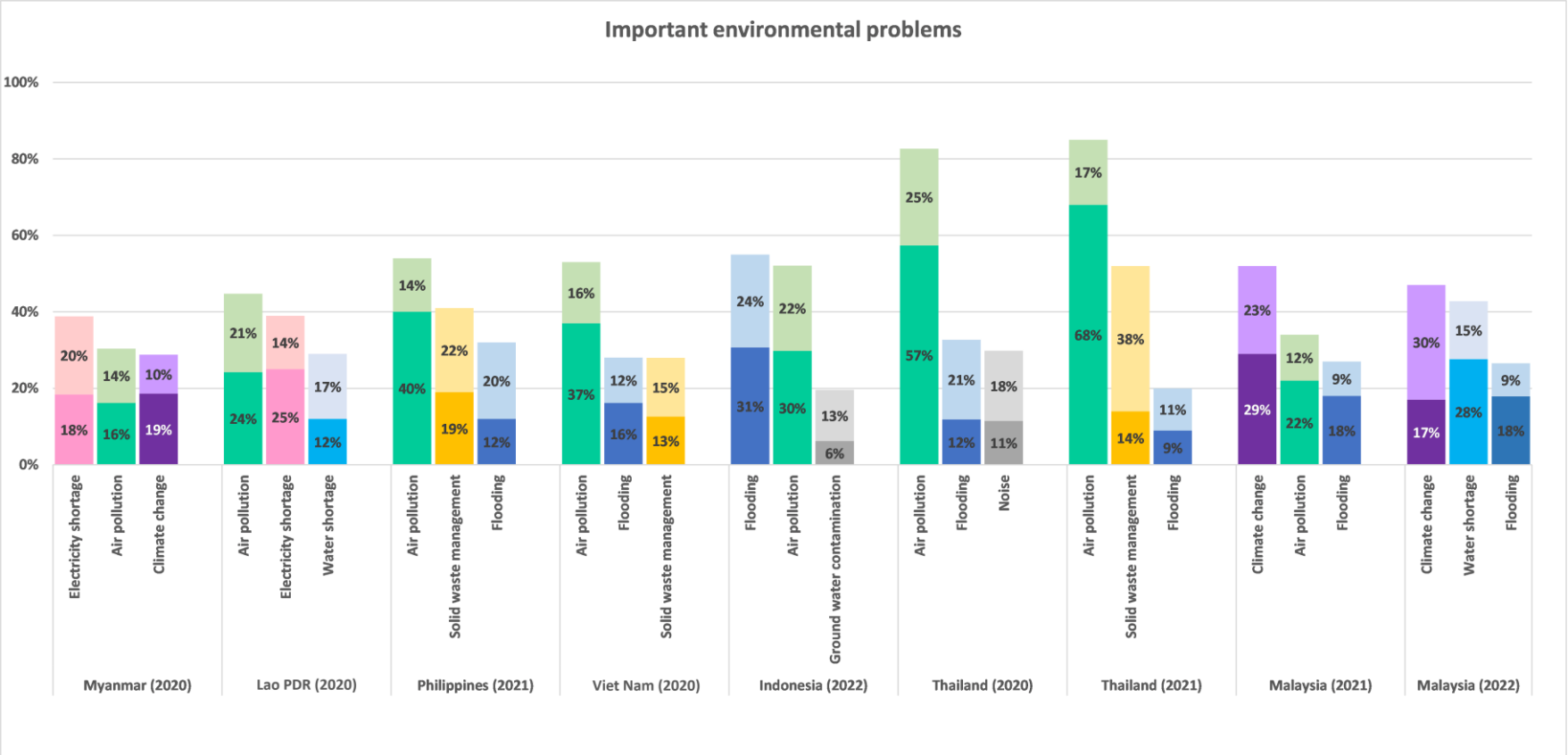
Note: Single answer for Myanmar, Lao PDR, and Thailand

Source: Authors' calculation.

5. Attitudes Towards Environmental Issues

Figure 8.4 shows the top three environmental issues in each country, based on the sum of the environmental issues that respondents consider the most and second most important. Air pollution and flooding are serious environmental problems and are amongst the top three in seven and five countries, respectively. In Myanmar and Malaysia (2021 and 2022), more than 30% of respondents selected 'Global warming and climate change' as the most and second-most important.

Figure 8.4. Perceived Importance of Environmental Issues



Note: The upper block in each bar is the second-biggest problem, and the lower block represents the biggest problem. 'Global warming and climate change' were not included in Thailand (2021)'s questionnaire.

Source: Authors' calculation.

Figure 8.5 shows the attitudes toward climate change in the four countries, with the question added from 2021. In the Philippines, respondents were more strongly concerned about the effects of climate change than in other countries. Respondents who answered 'Strongly agreed' to the first and second questions were 75% and 71%, respectively. For the third question, respondents in the four countries showed similar patterns. Over 70% of respondents in all four countries responded 'I hear a lot about climate change in the news'.

Figure 8.5. Attitudes Towards Climate Change Issue

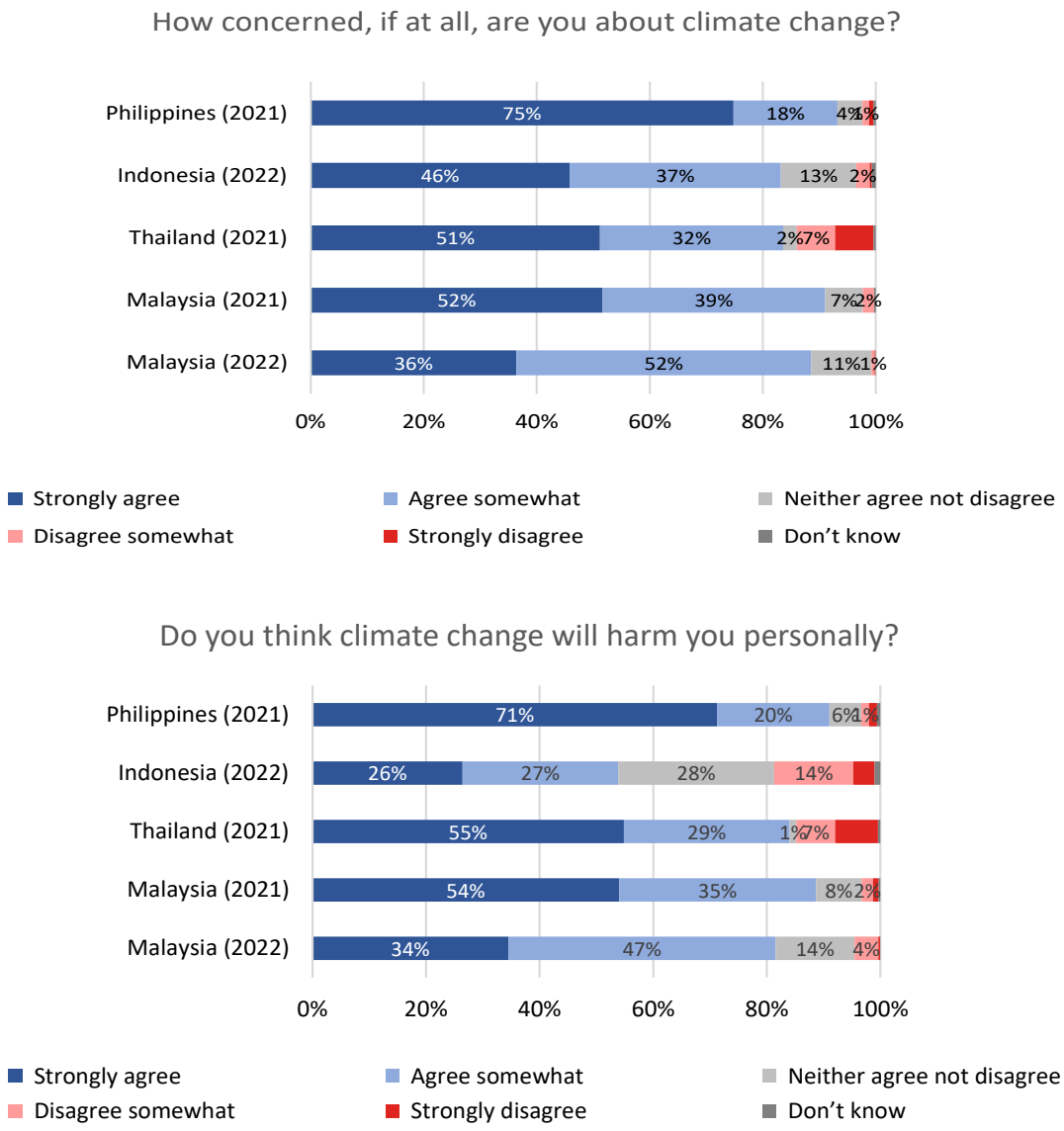
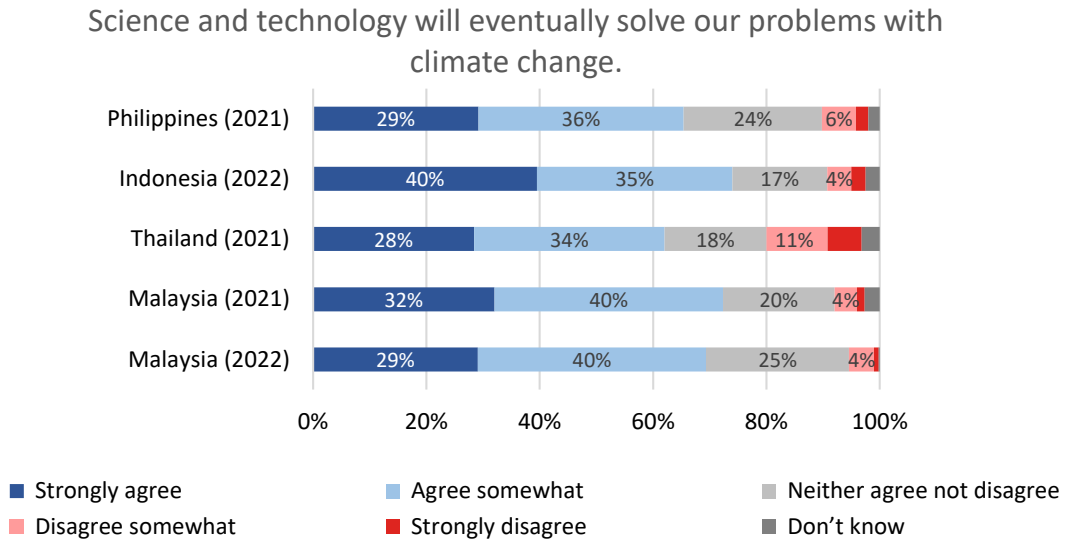
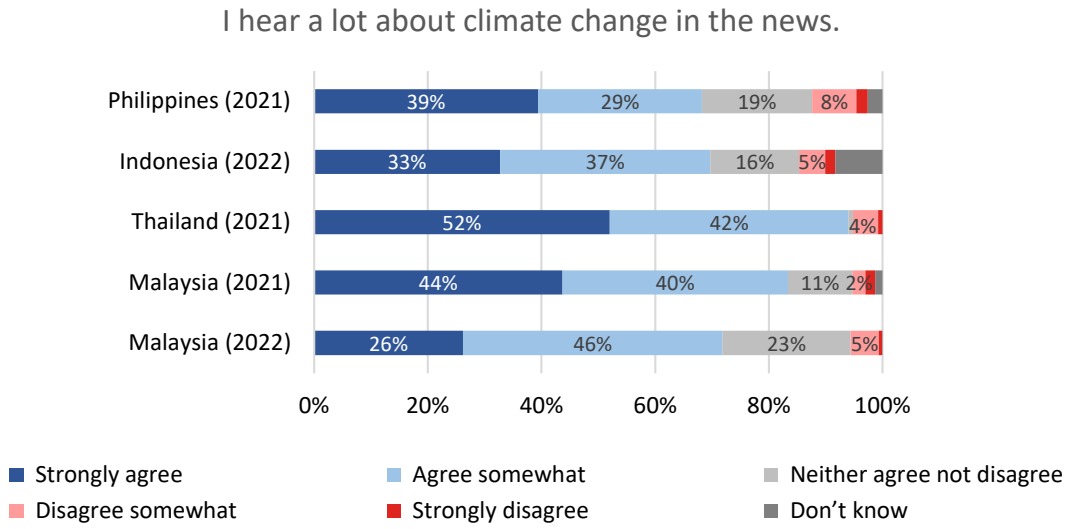


Figure 8.5. (continued)



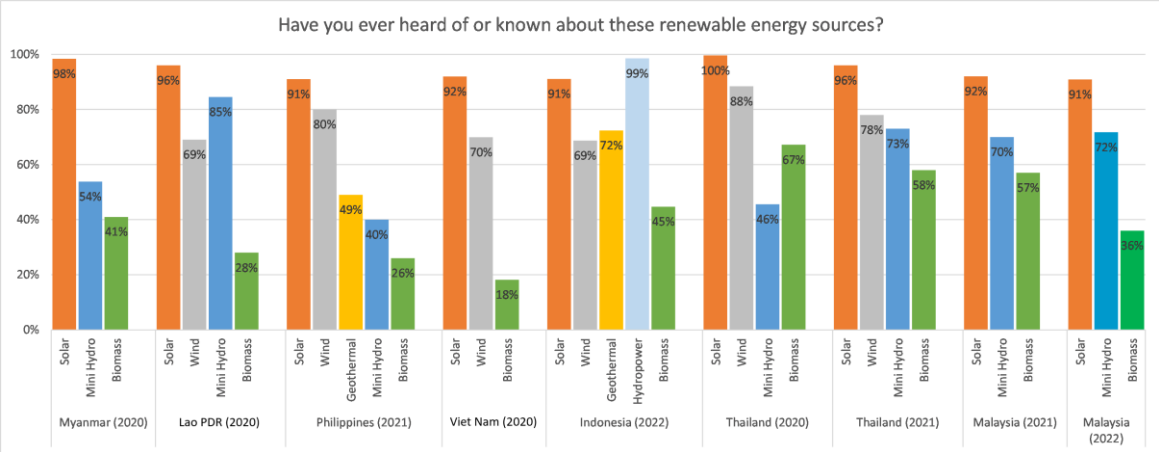


Source: Authors' calculation.

6. Attitudes Towards Types of Renewable Energy

Figure 8.6 shows people's knowledge about renewable energy sources. Solar was the most popular except in Indonesia, with over 90% answering 'Yes' in all countries. Biomass was least well known in all countries except Thailand in 2021, especially in Viet Nam, where only 18% of respondents answered 'Yes'.

Figure 8.6. Knowledge About Renewable Energy Sources

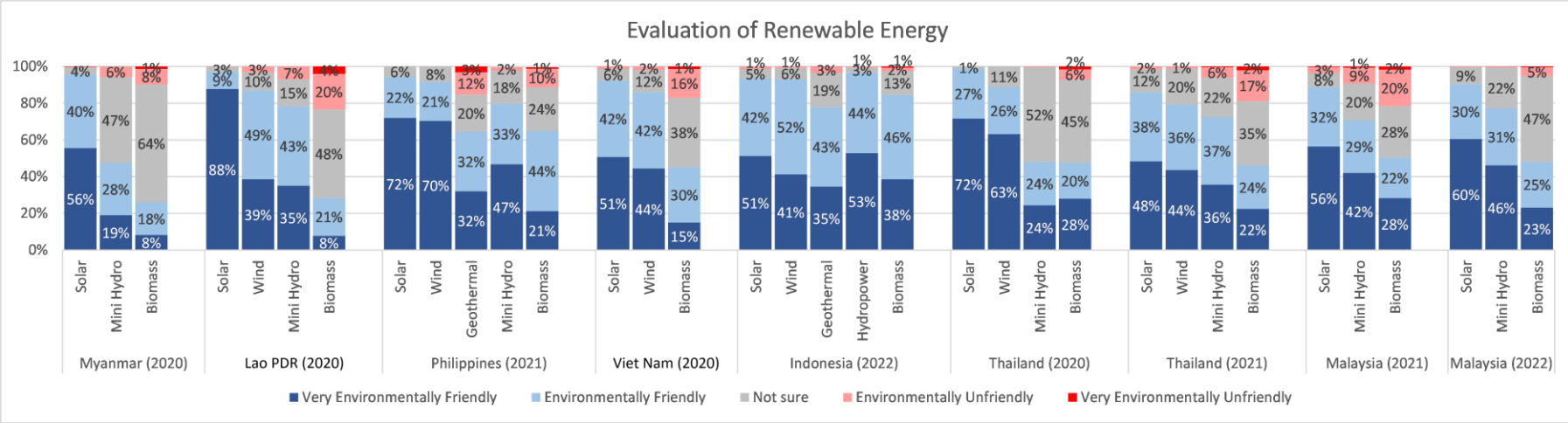


Note: Indonesia is a large-scale hydropower

Source: Authors' calculation.

Figure 8.7 shows the proportions of respondent evaluations regarding RE types. The high valuation of renewable energy is proportional to the level of recognition. In all regions except Indonesia, solar energy was considered most environmentally friendly. In Lao PDR, 88% responded 'very environmentally friendly'. Respondents expressed more concerns regarding biomass in Lao PDR and Malaysia in 2021 (more than 20% responded 'environmentally unfriendly' and 'Very Environmentally Unfriendly').

Figure 8.7. Attitudes Towards Renewable Energy



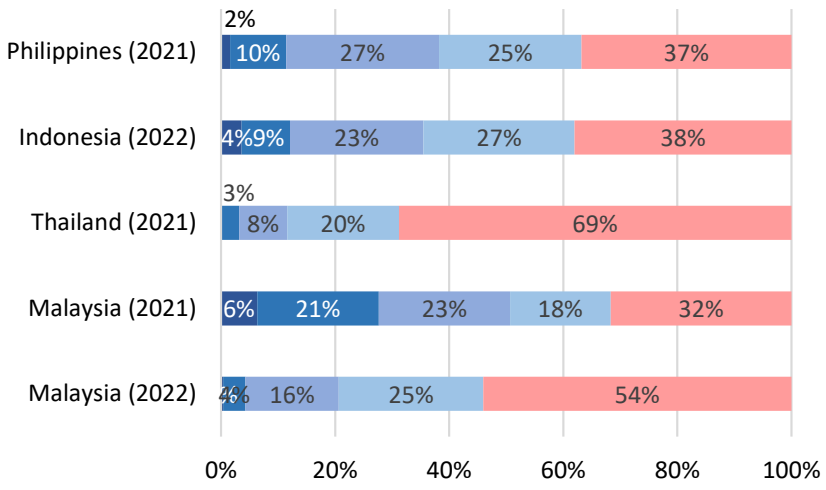
Source: Authors' calculation.

7. Attitudes Towards Carbon Dioxide Removal Technologies

- I know a great deal about carbon dioxide removal technologies
- I know a fair amount about carbon dioxide removal technologies
- I know just a little about carbon dioxide removal technologies
- I have heard of carbon dioxide removal technologies but know almost nothing about it
- I have not heard of carbon dioxide removal technologies before today

Figure 8.8 shows people's knowledge of carbon dioxide removal (CDR) technology. In the Philippines, Indonesia, and Malaysia in 2021, 27%, 23%, and 23% of respondents, respectively, answered 'I know just a little about (CDR)', with over 60% of respondents saying they have at least heard of it. However, in Thailand and Malaysia in 2022, more than half of the respondents had never heard of it.

Figure 8.8. Knowledge of CDR Technologies



- I know a great deal about carbon dioxide removal technologies
- I know a fair amount about carbon dioxide removal technologies
- I know just a little about carbon dioxide removal technologies
- I have heard of carbon dioxide removal technologies but know almost nothing about it
- I have not heard of carbon dioxide removal technologies before today

CDR = carbon dioxide removal

Source: Authors' calculation.

Figure 8.9 shows the attitudes towards the risks and benefits of CDR options in the four countries. The Philippines was more neutral than the other countries, with about 30% ‘undecided’ and more than 20% ‘don't know’ for all questions. The highest support came from Malaysia, where 71% of respondents answered either ‘Strongly agree’ or ‘Agree somewhat’ to the statement of ‘[CDR] technologies could help […] provide more time to reduce emissions’. The lowest support came from Indonesia, where 73% of respondents answered either ‘Strongly agree’ or ‘Agree somewhat’ to the statement ‘There may be negative impacts of [CDR] technologies on the environment’.

Figure 8.9. Attitudes Towards CDR Technologies

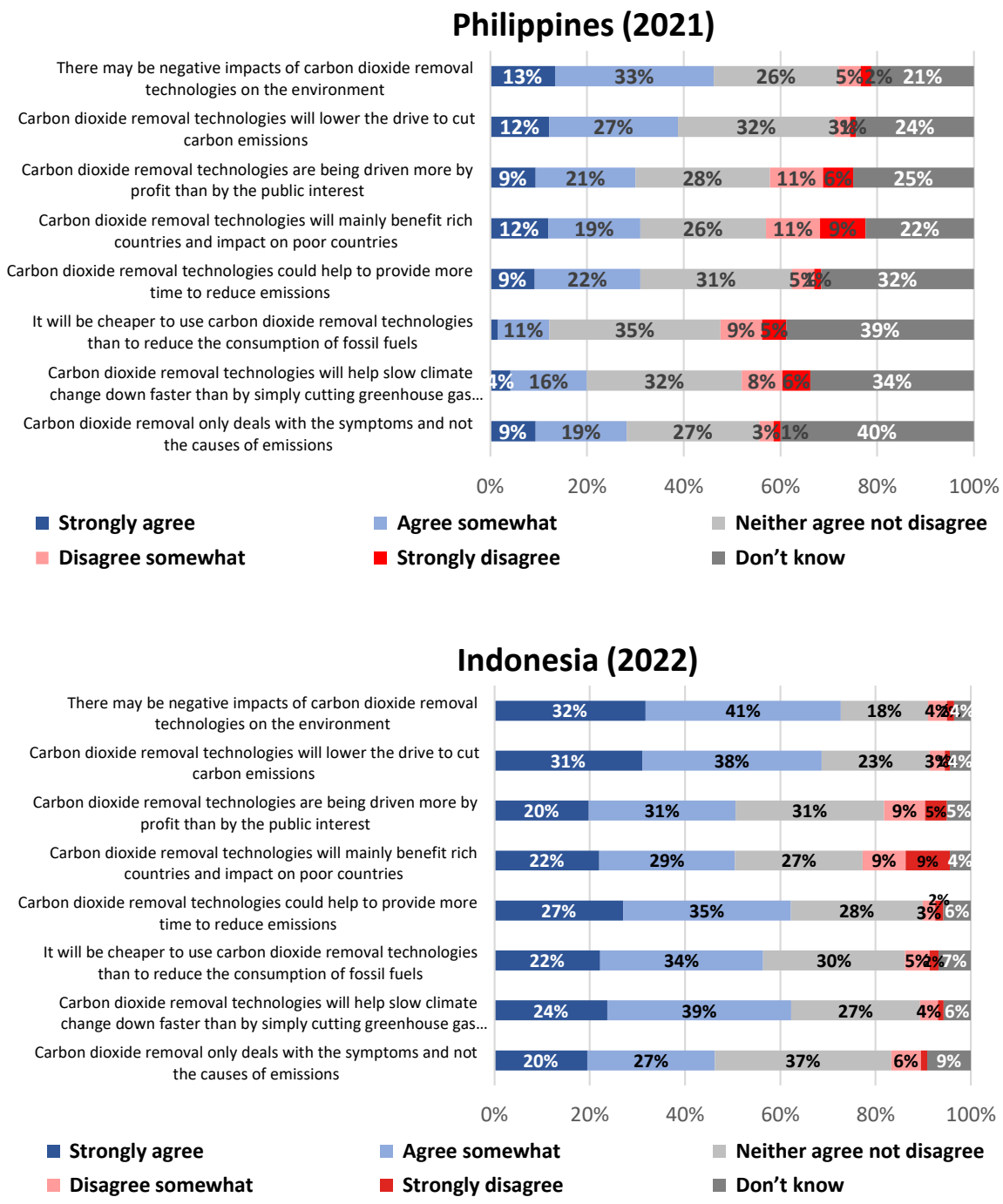
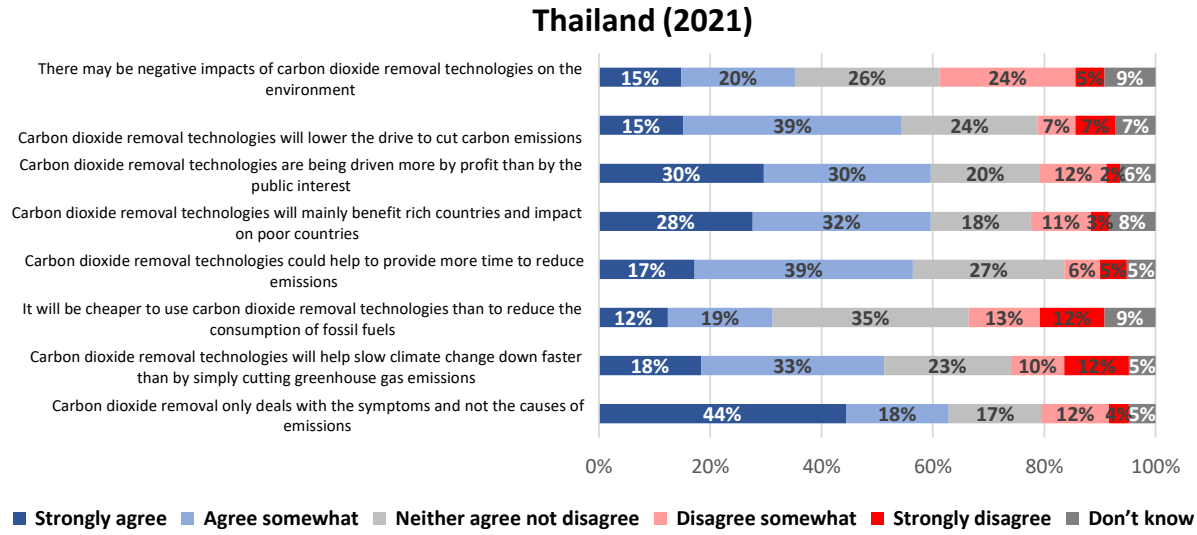
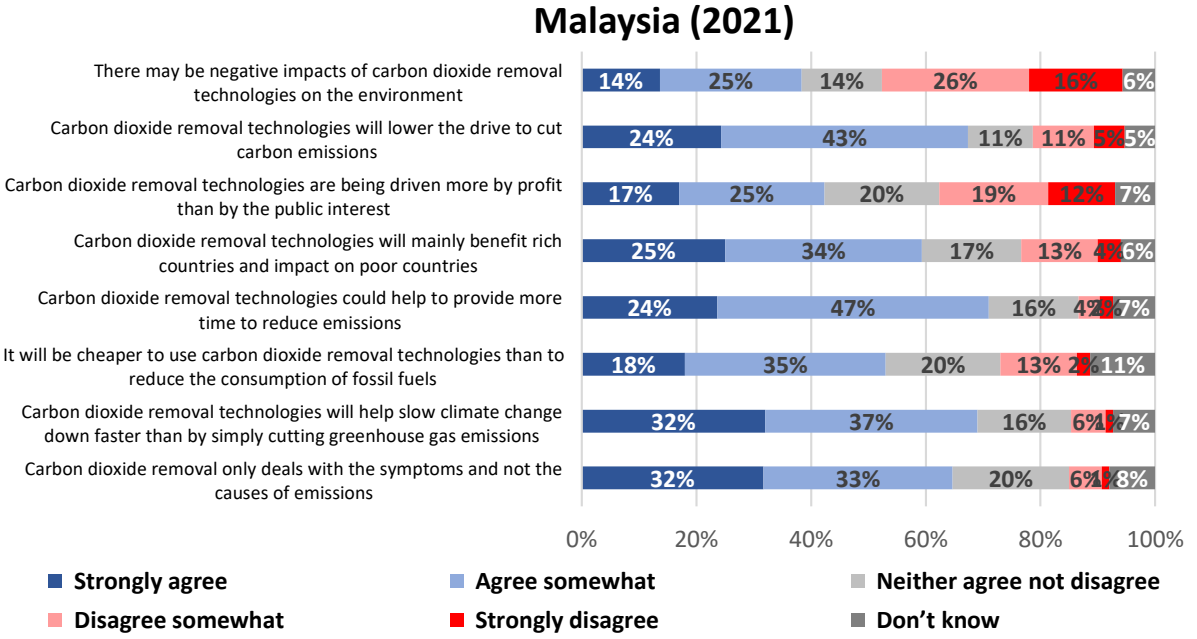


Figure 8.9. (continued)





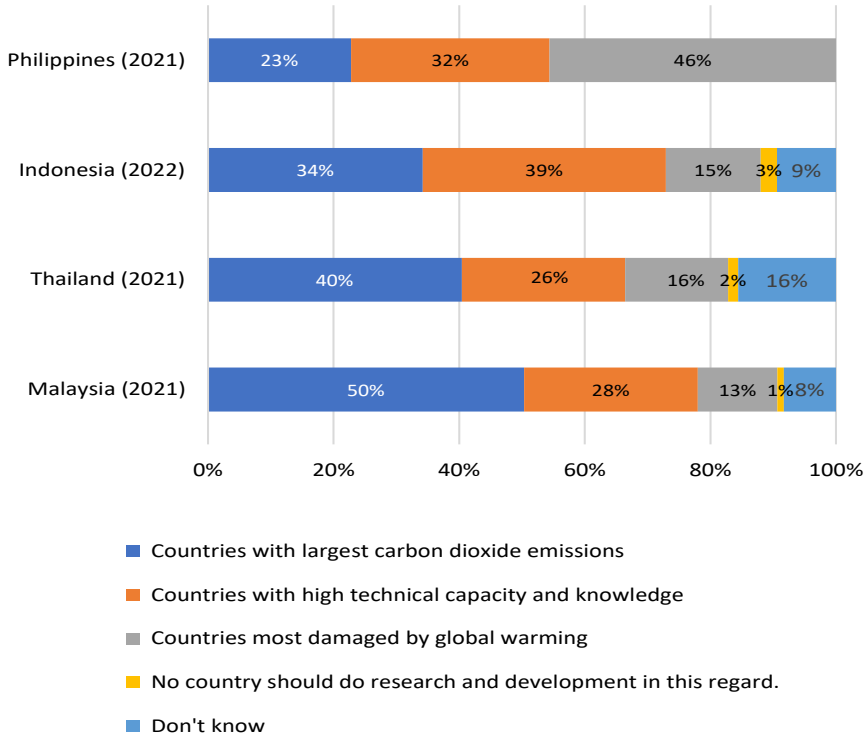
Note: Malaysia in 2022 is not listed because the question was reviewed.

Source: Authors' calculation.

Finally, Figure 8.10 shows the attitudes towards the future of CDR research and development in the four countries. In the Philippines, the highest share of respondents (46%) answered that the countries that would be most damaged by global warming should be foremost in developing such technologies. In Indonesia, the highest share of respondents (37%)

answered that the countries with the highest technical capacity and knowledge should be foremost in developing such technologies. In Thailand and Malaysia, the highest share of respondents answered that the countries with the largest carbon dioxide emissions should be foremost in developing carbon removal technologies, with 40% and 50% respectively.

Figure 8.10. Answer to 'In Your Opinion, What Countries Should be at the Forefront in the Development of Carbon Removal Technology?'



Note: 'No country should do research and development in this regard' and 'Don't know' were not included in the questionnaire for the Philippines.

Source: Authors' calculation.

8. WTP Estimations

- I know a great deal about carbon dioxide removal technologies
- I know a fair amount about carbon dioxide removal technologies
- I know just a little about carbon dioxide removal technologies
- I have heard of carbon dioxide removal technologies but know almost nothing about it
- I have not heard of carbon dioxide removal technologies before today

Table 8.2 shows the estimation of the mean WTP in the percentage of monthly electricity bills in United States dollars (US$) when increasing the RE share. The WTP values for increasing the share of renewable energy to 40% were positive except for a few cases. Although it varies by technology and country, there is a general pattern in the WTP values: the WTP for solar is generally the highest, as is the perception of environmental friendliness. The WTP for solar ranged from a minimum of −0.4% (for Indonesia in 2022) to a maximum of 25.1% (for Lao PDR in 2020). As with the perception of environmental friendliness, WTP for biomass was generally low, with the lowest in all countries except Mandalay, the Philippines, and Indonesia. The WTP for biomass ranged from a minimum of −2.7% (for Indonesia in 2022) to a maximum of 14.2% (for Lao PDR in 2020). Wind and mini hydro (also called mini-hydropower or small-scale hydropower) took intermediate values in most countries. The WTP for wind ranged from a minimum of −3.5% (for Indonesia in 2022) to a maximum of 16.5% (for Lao PDR in 2020). The WTP for mini hydro ranged from a minimum of 2.7% (for Thailand in 2021) to a maximum of 23.3% (for Lao PDR in 2020). Note that the negative values are found for all RE in Indonesia and biomass in Malaysia. The reason for the negative WTP may include special factors, such as the fact that the coronavirus pandemic is now in its third year, and electricity and fuel prices are rising due to trends in the international market.

Table 8.2. Willingness to Pay Estimates for Renewable Energy Types in 40% of Monthly Electricity Bill

	status quo	**Solar** % of monthly electricity bill (US$)	**Wind** % of monthly electricity bill (US$)	**Mini Hydro** % of monthly electricity bill (US$)	**Biomass** % of monthly electricity bill (US$)
Myanmar (2020) Yangon	0%	24.9% (5.3)	-	20.5% (4.3)	9.5% (2.0)
Myanmar (2020) Mandalay	0%	14.2% (9.6)	-	10.8% (7.3)	10.9% (7.3)
Lao PDR (2020)	0.025%	25.1% (9.4)	16.5% (6.2)	23.3% (8.7)	14.2% (5.3)

Philippines (2021)	30%	17.3% (8.7)	9.3% (4.7)	8.6% (4.4)	9.8% (5.0)
Viet Nam (2020)	7%	14.0% (7.3)	12.2% (6.4)	-	11.4% (5.9)
Indonesia (2022)	11%	−0.4% (−0.1)	−3.5% (−1.1)	-	−2.7% (−0.8)
Thailand (2021)	9%	5.5% (4.4)	3.2% (2.6)	2.7% (2.2)	2.5% (2.0)
Malaysia (2021)	6%	7.6% (2.1)	-	6.5% (1.8)	4.6% (1.3)
Malaysia (2022)	17%	7.8% (1.8)	-	3.3% (0.8)	−1.7% (−0.4)

Note 1: The official exchange rate by the World Bank in 2019 was used for conversions (US$1 = MK1,518 = KN8,679 = P51.8 = D23,050 = Rp14,147.67 = B31.1 = RM4.1). (World Bank, n.d.−b)

Note 2: The mean monthly electricity bills are as follows: Myanmar (Yangon, 21.2 US$/month; Mandalay, 67.4 US$/month); Lao PDR, 37.4 US$/month; Philippines, US$50.5/month; Viet Nam, 52.2 US$/month; Indonesia, US$31.2/month; Thailand, US$79.0/month; Malaysia (2021), US$27.1 /month; Malaysia (2022), US$23.2/month.

Note 3: The status quo of renewable share is different across the cities: Myanmar, 0%; Lao PDR, 0%; the Philippines, 30%; Viet Nam, 7%; Indonesia, 11%; Thailand, 9%; Malaysia (2021), 6%; Malaysia (2022), 17%.

Note 4: The WTP results for Thailand in 2020 are excluded due to statistical insignificance.

Source: Authors' calculation.

Chapter 9

Policy Implications and Conclusions

The issue of climate change continues to be on the global agenda, despite the rising concerns about energy security and hikes in energy prices. Before and after COP26 of the United Nations Framework Convention on Climate Change, governments have been strengthening their policies to achieve the goals of reducing greenhouse and CO_2 emissions to net zero, which will contain global warming below 1.5 or 2 degrees. Emerging countries, including Southeast Asia, are no exception. Many countries are exploring (but not necessarily committing to) net zero targets.

Climate policy is, in other words, shifting from pledges to implementation and actions. Policymakers, therefore, have to carefully craft various policy instruments to accelerate action, considering which instrument to use in what order and when. Decarbonisation entails a significant change in all aspects of society and the economy, and policies must consider the reactions of various stakeholders. It would be helpful to examine public perceptions of various policies and technological options and their WTP for new policies. On the one hand, if the cost of decarbonisation exceeds that of WTP, the public may start to oppose such policy measures. On the other hand, the public may get excited about an option they prefer.

This report presented the results of a household survey study on public perceptions and WTP for renewables and other climate-related technologies in Southeast Asia. The study first presented this year's survey findings in Indonesia and Malaysia. It then combined this with those from previous works and synthesised the perceptions and WTP values in various countries in the ASEAN. The targeted countries were chosen based on their large population sizes and diverse economic development situations.

The three-part survey was conducted from 2020 to 2022: In Myanmar, 500 samples from July to August 2020; in Lao PDR, 400 samples from July to August 2020; in Viet Nam, 620 samples from May to July 2020; in Thailand, 250 samples each, from June to August 2020 and December 2020 to March 2021, 500 samples from December 2020 to April 2021 in the

Philippines, 300 samples from February to March 2021 and 1050 samples from April to June 2022 in Malaysia. In Indonesia, 1,000 samples were collected from March to May 2022, for a total of 4,870 samples from seven countries.

DCE (discrete choice experiment) and CVM (contingent valuation method) were employed to the survey in 2020 and 2021. The survey experiment was newly employed in the 2022 survey conducted in Malaysia. Each survey was conducted by local academic collaborators. Given the heterogeneous city backgrounds, the sampling strategy was designed in consultation with local collaborators to suit the condition of each city. Our survey questions included sociodemographics, electricity consumption patterns, DCE or CVM questions on renewable WTP, and attitudes toward CDR.

A D-optimal matrix design was utilised for the DCE design. We focused on 'new' renewables, excluding large-scale hydropower: solar, wind, biomass, mini hydro, and geothermal. Each respondent was presented with a series of choice experiments, each of which presented three alternatives with different shares of renewables and types of renewables. The survey instrument was modified for each country to reflect the different energy situations, including the current renewable penetration level, the dominant type of renewables, and available renewable energy options.

In all the surveys, the public is consistently concerned about climate change, but they do not always directly think of climate change. When asked about the most pressing environmental concerns, the respondents chose issues such as global warming, air pollution, flooding, etc. Flooding could be increasing because of climate change. In addition, air pollution is related to fossil fuel combustion.

Amongst the renewable options, our series of surveys demonstrated that solar PV is considered the most environmentally friendly, except for Indonesia, where hydropower is viewed very positively. The perceived environmental friendliness is associated with the knowledge of technologies in all countries where solar PV is the most well-known. More importantly, the perceived environmental friendliness of other technologies, and in particular, bioenergy, was not on par with that of solar. This year's survey experiment with different information about renewables shows that tailoring information could help improve the perception of bioenergy.

The WTP values for increasing the share of renewable energy to 40% were positive except for a few exceptions. Although it varies by technology and country, there is a general pattern in the WTP values: the WTP for solar is generally the highest, as is the perception of environmental friendliness. The WTP for solar ranged from a minimum of −0.4% (for Indonesia in 2022) to a maximum of 25.1% (for Lao PDR in 2020). As with the perception of environmental friendliness, WTP for biomass was generally low, with the lowest in all countries except Mandalay, the Philippines, and Indonesia. The WTP for biomass ranged from a minimum of −2.7% (for Indonesia in 2022) to a maximum of 14.2% (for Lao PDR in 2020). Wind and mini hydro in most countries took intermediate values. 40%, WTP for wind ranged from a minimum of −3.5% (for Indonesia in 2022) to a maximum of 16.5% (for Lao PDR in 2020). 40%, WTP for mini hydro ranged from a minimum of 2.7% (for Thailand in 2021) to a maximum of 23.3% (for Lao PDR in 2020). Note that the negative values are for all RE in Indonesia and biomass in Malaysia. The reason for this may include special factors such as the fact that the coronavirus pandemic is now in its third year, and electricity and fuel prices are rising due to trends in the international market.

The respondents are unaware of carbon dioxide removal (CDR, or carbon removal), which ranges from tree-planting to chemical engineering absorption to enhanced weathering through spraying crushed rocks. The respondents agreed with the possible benefits and risks of CDR, including its ability to 'buy time' for more climate change mitigation and negative side effects on the environment. The degree of agreement varied from country to country, and a more fine-grained study is warranted in light of the necessity of CDR worldwide to get to net zero targets.

The respondents in all the surveyed countries suffered from income losses due to the COVID-19 pandemic. This year especially saw a double effect of the Ukrainian crisis and inflation. The respondents this year reported negative WTP values, an indication of the preference for the current condition.

The present findings may be biased because of this. The WTP could be higher, had the surveys been conducted at the time without the COVID-19 pandemic.

Our surveys elucidated how much consumers can afford to pay to switch to clean energy. Although they are willing to pay under normal circumstances, this year's survey, in particular, elucidated the difficulty of increasing costs in an unlikely event. On a more positive note, we

found that bioenergy, in particular, suffers from a poor performance image, which can be improved by better communication.

Given the differing WTP for different renewable types, the sequence of introduction of different types of renewables and the ASEAN-wide grid connection should be carefully considered. For instance, the public might better accept grid connection if it is explained to increase solar PV, at least in the short run. Also, abundant solar resources might allow for a focus on it and possibly even for exports if there's a surplus electricity generation.

Nevertheless, the current concern about inflation is a cause for concern. This year's WTP was particularly low and sometimes in the region of negative values. This has likely been influenced by global concerns about living costs, which have inevitably affected Indonesia and Malaysia. Countries are already taking policies to counteract the effect of the rising costs. All this also implies that policymakers should be very cautious about renewable measures in the short run.

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Appendices

Appendix 1. Questionnaire for the Malaysia

'PUBLIC ATTITUDES TOWARDS ENERGY POLICY AND SUSTAINABLE DEVELOPMENT IN ASEAN PHASE 3'

Dear Sir/Madam,

a) This survey is conducted by University Malaysia Terengganu in collaboration with the Institute for Future Initiatives (IFI), The University of Tokyo, Japan.

b) You are selected to participate in this survey at random to provide information and opinions related to renewable energy.

c) Your answers to this survey will be treated confidentially. Any personal information gathered in this survey will not be given to the third party. Only anonymized data will be shared with other researchers. This survey has been reviewed and approved by the University of Tokyo's Ethical Review Expert Committee.

d) Your cooperation in undertaking this study is very much appreciated.

Thank You

SURVEY ON ELECTRICITY CONSUMPTION

AND ATTITUDE TOWARDS CLEANER SOURCES OF ENERGY

INFORMATION SHEET

must be given to respondent

Dear Sir/Madam,

We would like to invite you to participate in our survey.

Purpose: The purpose of this research is to investigate household's electricity consumption and attitudes towards cleaner sources of energy as well as willingness to pay.

Methods: We will ask you questions about your opinions on several issues related to electricity consumption and housing, and collect geographic location and some demographic information of your family. The interview will take approximately 60 minutes.

Confidentiality: Your answers to this survey will be stored in a computer anonymously. Any personal identification information, including your name, will not be entered into the computer. Your name will only appear on the consent form and/or your payment receipt.

Benefits: You will be compensated RM30.00 if you decide to participate in our survey and complete the questionnaire.

Risks: There are no known risks.

Withdrawal from the survey: We would like to interview an adult member of your family who pays monthly electricity bills, or uses the most electricity. Your participation is completely voluntary. You are free to discontinue participation at any time during the interview. You are free to refuse answering any question during the interview.

Use of your information: Your information will be analysed using statistical techniques and will be used to write academic papers and reports. Only group information will be presented or published. If you withdraw during the interview, the questionnaire will be destroyed and the information you provided cannot be used in the analysis.

In the case you have any questions about the questionnaire, please contact the investigator:

CONSENT FORM

enumerator keep this

Do you understand that you have been asked to participate in a research survey?	□ Yes	□ No
Have you received and read a copy of the Information Sheet?	□ Yes	□ No
Do you understand the benefits and risks involved in participating in this survey?	□ Yes	□ No
Do you understand that you can quit taking part in this survey at any time?	□ Yes	□ No
Has confidentiality been explained to you?	□ Yes	□ No
Do you understand how your answers will be used?	□ Yes	□ No
Do you know what your answers will be used for?	□ Yes	□ No
Do you give us permission to use your data for the purposes specified?	□ Yes	□ No
Do you agree to participate in the survey?	□ Yes	□ No

[*Enumerators are not allowed to interview if there is any answer of 'No' in the above questions*]

I agree to participate in the survey.

_____ _____

Name and Signature Date

Phone:

ID: _____

Version: _____

SURVEY ON ELECTRICITY CONSUMPTION AND ATTITUDES TOWARDS CLEANER SOURCES OF ENERGY

Enumerator

_____

Date of interview

_____ _____ 2022

dd mm

Question 1. (p1q1) Does your household have **an electricity meter** installed directly from Tenaga Nasional Berhad (TNB)?

□ 1. Yes → **Go to Part 1**.

□ 2. No → **Enumerator stops the survey and reports to the supervisor**.

PART I: ELECTRICITY CONSUMPTION

*Enumerator **DO NOT** ask to see the electricity bills to fill in Question 2 and 3. Simply record the answers from respondents for these two questions.*

*These two questions ask the household's electricity consumption and bill, including domestic uses and household business (if more than one meter, then sum up the amounts from all the bills of meters for an average month). The electricity consumption asked in these two questions also include the quantity shared with other households, tenants, and business renters. However, **DO NOT** include the amount of electricity of tenants/renters who have registered for their own electricity meter with TNB.*

Question 2. (p1q2) In the past 12 months, on your best estimate what is your household's average monthly electricity consumption as in your electricity bills? _____ **kWh/month**.

Question 3. (p1q3) In the past 12 months, on your best estimate how much is your household's average monthly electricity bill? _____ **RM /month**.

Question 4. (p1q4) Does your household share electricity with neighbouring households, tenants or business renters?

□ 1. Yes → Go to **Question 5**. □ 2. No → Go to **Question 6**.

Question 5. (p1q5) Out of the monthly electricity consumption of [*copy the response from Question 2 here*]_____ kWh/month, how much electricity is consumed by these neighbouring households, tenants and business renters who share electricity with your households? _____ kWh/month.

Question 6. (p1q6) Your household has... [*Choose one only*]

□ 1. Residential electricity meter only.

□ 2. Business electricity meter only.

□ 3. Both residential and business electricity meters.

Enumerators ask *for permission to see the **residential** electricity bills for the last three months and fill in the following information in **Questions 7** to **13**. In case the household does not have a residential electricity meter, ask for electricity bills for manufacturing/commercial uses instead.*

Question 7. (p1q7) Electricity consumption and electricity bills

a. Month __ year 20___: _____ kWh, amount (tax and KWTTB included): _____RM.

b. Month __ year 20___: _____ kWh, amount (tax and KWTTB included): _____RM.

c. Month __ year 20___: _____ kWh, amount (tax and KWTTB included): _____RM.

Question 8. (p1q8) Customer name (as in electricity bill).

Question 9. (p1q9) Please check the applicable box.

□ 1. I am the customer on the electricity bill and normally pay for it

□ 2. I'm not the customer on the electricity bill but normally pay bills of the family

□ 3. None of the above

Question 10. (p1q10) Address where the electricity meter is installed: *house number and street name*: _____, *District*: _____, *State*: _____.

Question 11. (p1q11) Customer ID (as in monthly electricity bill): **No. Kontrak**_____.

Question 12. (p1q12) Tariff code (as in monthly electricity bill): _____. *Enumerator records this code in full, for example 'A: Kediaman'.*

Question 13. (p1q13) Voltage level (as in monthly electricity bill): _____.

Question 14. (p1q14) Number of households sharing the meter (as in electricity bill): _____ households.

Question 15. (p1q15) The reason why more than one household shares your electricity meter? *Enumerator ask this question if **the number of households is greater than 1**.*

□ 1. Tenants/Renters/Neighbours household registration books

□ 2. My family have more than one

Question 16. (p1q16) Enumerators ask for permission to take a photo of the recent bill amongst the electricity bills viewed.

*Enumerator asks **Question 17** to **Question 19** if the response to **Question 6** is '3' (Residential and business electricity meter), otherwise go to **Question 20**.*

Question 17. (p1q17) In the past 12 months, on your best estimate what is the average monthly electricity quantity measured by manufacturing/business electricity meter? _____ **kWh**.

Question 18. (p1q18) In the past 12 months, on your best estimate how much is the average monthly bill for this business electricity connection? _____ **RM/month**.

Question 19. (p1q19) Enumerators ask for permission to take a photo of the recent business electricity bill.

Question 20. (p1q20) Does your household run a small business (restaurant, coffee shop, inn...) at home?

Enumerators: *Only include business run by the surveyed household*. *Do not include businesses run by renters*. *Having housing units for long-term rent **IS NOT** considered a business*.

□ 1. Yes → *Go to **Question 22**.*

□ 2. No → Go to **Question 25**.

[*LOGICAL CHECK – IN THE SURVEY SOLUTION DESIGN, PUT THIS QUESTION AT THE END OF THE INTERVIEW*] *If the response to Question 7 is '2' or '3', and the answer to this question is 'No', then ask why having a business electricity meter while not running a business.*

Question 21. (p1q21) What is your household business activity? Note: not including housing units for long-term rent.

□ 1. Grocery	□ 8. Hotel/inn
□ 2. Specialty store	□ 9. Agriculture
□ 3. Restaurant	□ 10. Bike/car wash
□ 4. Coffee shop	□ 11. Bike/car repair shop
□ 5. Laundry services/ironing	□ 12. Household manufacturing plant
□ 6. Barber/Beauty shop	□ 13. Others, specify: _____
□ 7. Tailor shop	

Question 21. (p1q22) Does your household install a private electricity meter to count, or do you know, the volume of electricity used by this business?

□ 1. Yes → Go to **Question 23**. □ 2. No → Go to **Question 24**.

Question 22. (p1q23) What is the average monthly volume of electricity consumed by this business? _____ kWh. → Go to **Question 25**

Question 23. (p1q24) What is the proportion of the total monthly electricity volume used for this business per total volume?

□ a. A quarter	□ c. Three quarter
□ b. A half	□ d. Almost all

Question 24. (p2q25) In the past year, how many times has your household experienced a power outage? _____ times/year.

Question 25. (p2q26) What is the average length of the power outages your household has experienced over the past year? _____ hours/time.

PART 2: CHOICE EXPERIMENT

INTRODUCTION TO THE CHOICE QUESTIONS

CHOICE Explanation

Choice explanation 1: Though coal-, crude-oil- and gas-fired thermal power plants contribute more than 80% of the gross electricity production in Malaysia, the electricity generation by these fossil fuels produce a great amount of greenhouse gases, which considerably contribute to the process of global warming.

Switching fossil fuels to renewable energy sources (e.g., solar, wind, biomass and small-scale or mini hydropower) is considered to be an important measure of global warming mitigation because greenhouse gases emission from the production of renewable energy is much lower than coal and gas thermal power.

The installation of renewable energy sources might increase the cost of electricity production. As a result, the retail price of electricity may have to increase. We would like to know your WTP for the increased renewable energy production.

Choice explanation 2: Though coal-, crude-oil- and gas-fired thermal power plants contribute more than 80% of the gross electricity production in Malaysia, the electricity generation by these fossil fuels produce a great amount of greenhouse gases, which considerably contribute to the process of global warming.

Switching fossil fuels to renewable energy sources (e.g. solar, wind, biomass and small-scale or mini hydropower) is considered to be an important measure of global warming mitigation because greenhouse gases emission from the production of renewable energy is much lower than coal and gas thermal power. In addition, they do not incur fuel costs (with the exception of biomass power generation) and are based in the domestic territory, leading to greater energy self-sufficiency and less energy imports from foreign countries. They are renewable by definition, and there is no need to worry about depletion.

The installation of renewable energy sources might increase the cost of electricity production. As a result, the retail price of electricity may have to increase. We would like to know your WTP for the increased renewable energy production.

Choice explanation 3: Though coal-, crude-oil- and gas-fired thermal power plants contribute more than 80% of the gross electricity production in Malaysia, the electricity generation by these fossil fuels produce a great amount of greenhouse gases, which considerably contribute to the process of global warming.

Switching fossil fuels to renewable energy sources (e.g., solar, wind, biomass and small-scale or mini hydropower) is considered to be an important measure of global warming mitigation because greenhouse gases emission from the production of renewable energy is much lower than coal and gas thermal power.

However, since the energy source of renewable energy is of natural origin, it is subject to environmental factors such as weather and continuously fluctuates, and may require energy storage such as batteries for a back-up. Some energy sources, such as geothermal and wind, are concentrated in limited areas, and long-distance transmission may be required to send electricity to urban areas. The installation of renewable energy sources might increase the cost of electricity production. As a result, the retail price of electricity may have to increase. We would like to know your WTP for the increased renewable energy production.

You will now be asked to answer seven to eight questions, each requesting you to make a choice between three alternatives of energy services. Each alternative is characterized by three attributes:

- **the share of renewable energy in total capacity**: the current level is 17% and this figure is far from sufficient level. In the following questions, we assume that it increases to 25%/30%/35%/40% in 2035, in order to understand your preferences on renewable energy.
- **type of renewable energy**: Besides solar energy which is the most popular renewable energy, mini hydro energy (up to 30 MW) and biomass energy are also considerable in Malaysia. Please consider the increase of renewable energy will be powered by only one of these sources though the current share of 17% is combined of those renewable power sources.
- **increase in monthly electricity bill**: as producing renewable energy is likely more costly at this moment, the monthly electricity bill of your households as well as all other households in Malaysia may also increase when the share of renewable energy increases. Please note that the increase in monthly bill is in percentage, so households with higher monthly electricity bills would have to pay larger additional amounts. The bill includes service tax (6%) and renewable energy fund (KWTBB) (1.6%).

Please assume that your monthly bill won't increase until the share of renewable energy indicated in each choice question is achieved. Please also assume that any attributes other than the three attributes presented in the alternatives remained identical. We would like to know which alternative you most prefer.

CHOICE TASKS

Choice task 1: Enumerator give the **Card 1** of **Block #**. Record the CSID on the choice card here _____. Then ask the respondent to make the choice.

□ 1. Alternative A □ 2. Alternative B □ 3. Alternative C

Choice task 2: Enumerator give the **Card 2** of **Block #**. Record the CSID on the choice card here _____. Then ask the respondent to make the choice.

□ 1. Alternative A □ 2. Alternative B □ 3. Alternative C

Choice task 3: Enumerator give the **Card 3** of **Block #**. Record the CSID on the choice card here _____. Then ask the respondent to make the choice.

□ 1. Alternative A □ 2. Alternative B □ 3. Alternative C

Choice task 4: Enumerator give the **Card 4** of **Block #**. Record the CSID on the choice card here _____. Then ask the respondent to make the choice.

□ 1. Alternative A □ 2. Alternative B □ 3. Alternative C

Choice task 5: Enumerator give the **Card 5** of **Block #**. Record the CSID on the choice card here _____. Then ask the respondent to make the choice.

□ 1. Alternative A □ 2. Alternative B □ 3. Alternative C

Choice task 6: Enumerator give the **Card 6** of **Block #**. Record the CSID on the choice card here _____. Then ask the respondent to make the choice.

□ 1. Alternative A □ 2. Alternative B □ 3. Alternative C

Choice task 7: Enumerator give the **Card 7** of **Block #**. Record the CSID on the choice card here _____. Then ask the respondent to make the choice.

□ 1. Alternative A □ 2. Alternative B □ 3. Alternative C

Choice task 8: Enumerator give the **Card 8** of **Block #**. Record the CSID on the choice card here _____. Then ask the respondent to make the choice.

□ 1. Alternative A □ 2. Alternative B □ 3. Alternative C

FOLLOW-UP QUESTIONS

FU-Q 1. (p2q1) How certain are you of the choices you made?

□ 1. Very certain □ 2. Certain □ 3. Not sure □ 4. Uncertain □ 5. Very uncertain

FU-Q 2: (p2q2) Have you ever heard of or known about renewable energy sources below?

Solar power	□ 1. Yes	□ 2. No
Biomass/waste power	□ 1. Yes	□ 2. No
Mini hydropower	□ 1. Yes	□ 2. No

FU-Q 3: (p2q3) How do you feel about renewable energy sources below?

	1. Very Environmentally Friendly	2. Environmentally Friendly	3. Not sure	4. Environmentally Unfriendly	5. Very Environmentally Unfriendly
Solar power	□	□	□	□	□
Biomass/ waste power	□	□	□	□	□
Mini hydropower	□	□	□	□	□

FU-Q 4. (p2q4) Are the types of renewable energy, i.e. solar energy and mini hydro energy, important to you when making your choice?

□ 1. Yes □ 2. No

FU-Q 5. (p2q5) Do you consider the proportion of renewable energy, i.e. solar energy and mini hydro energy, when making your choices?

□ 1. Yes □ 2. No

FU-Q 6. (p2q6) When making your choices between alternatives, do you think that the shares of renewable energy presented in the alternatives are feasible to implement?

□ 1. Yes □ 2. No

FU-Q 7. (p2q7) Do you think that your household's monthly electricity bill would increase if the share of renewable energy increases?

□ 1. Yes □ 2. No

FU-Q 8. (p2q8) Have you ever known about the difference between large-scale hydropower and small-scale (mini) hydropower?

□ 1. Yes □ 2. No

FU-Q 9. (p2q9) Do you have any knowledge about the renewable energy fund (TKWBB) which is charged to your monthly electricity bill?

□ 1. Yes □ 2. No

FU-Q 10. (p2q10) Do you have any knowledge on how the renewable energy fund (TKWBB) is used to encourage consumption of renewable energy at premises (house, building, office, factory) respectively?

□ 1. Yes □ 2. No

PART 3: ATTITUDES TOWARDS ENVIRONMENTAL ISSUES

Question 26. (p3q27) Please consider the following energy and environmental problems

1. Air pollution	6. Noise
2. Groundwater contamination	7. Hazardous waste from industries
3. Solid waste management	8. Water shortage
4. Flooding	9. Electricity shortage
5. Surface water contamination	10. Global warming and climate change
	11. Others, specify: _____

Which one of these environmental problems is the most important one that the government should solve in this city in the next 10 years?

a. Most important: _____

b. Second important: _____

Question 27. (p3q28) Do you agree or disagree with the following statements?

	Strongly agree (1)	Agree somewhat (2)	Neither agree not disagree (3)	Disagree somewhat (4)	Strongly disagree (5)	Don't know (0)
1. The government should subsidize electricity for poor households.	□	□	□	□	□	□
2. I don't care about the source of electricity. I prefer the cheapest electricity source.	□	□	□	□	□	□
3. I am willing to pay more for electricity if there are less blackouts.	□	□	□	□	□	□
4. The government should provide electricity at a higher price to encourage electricity saving practices	□	□	□	□	□	□

Question 28. (p3q29) Do you agree or disagree with the following statements?

	Strongly agree (1)	Agree somewhat (2)	Neither agree not disagree (3)	Disagree somewhat (4)	Strongly disagree (5)	Don't know (0)
1. How concerned, if at all, are you about climate change?	□	□	□	□	□	□
2. Do you think climate change will harm you personally?	□	□	□	□	□	□
3. Science and technology will eventually solve our problems with climate change	□	□	□	□	□	□
4. Renewable energy is good for the environment.	□	□	□	□	□	□
5. I hear a lot about renewable energy in the news.	□	□	□	□	□	□
6. I hear a lot about climate change in the news.	□	□	□	□	□	□

Please read the following information carefully:

Carbon dioxide removal or 'CDR' is a group of strategies that might be able to slow or reverse climate change. These strategies remove excess carbon dioxide (CO_2) from the atmosphere through various biological, chemical or physical processes.

CHOICE Explanation

Choice explanation 1: The carbon dioxide would be stored in plant matter, such as in trees and soils, so that it cannot contribute to an increase in the Earth's temperature. This method has the potential to store CO_2 for around 20-100 years.

Choice explanation 2: The carbon dioxide would be stored deep underground, for example in rock formations, so that it cannot contribute to an increase in the Earth's temperature. This method has the potential to store CO_2 for thousands of years.

Choice explanation 3: The carbon dioxide would be stored in ocean waters or under the ocean floor, so that it cannot contribute to an increase in the Earth's temperature. This method has the potential to store CO_2 for hundreds or possibly thousands of years.

Question 29. (p3q30) Before today, how much, if anything, would you say that you know about carbon dioxide removal technologies? (***Please choose only one***)

1. I know a great deal about carbon dioxide removal technologies
2. I know a fair amount about carbon dioxide removal technologies
3. I know just a little about carbon dioxide removal technologies
4. I have heard of carbon dioxide removal technologies but know almost nothing about it
5. I have not heard of carbon dioxide removal technologies before today

Question 30. (p3q31) Would you support or oppose the use of CDR as a way to tackle climate change?

□ 1. strongly support	□ 2. support somewhat	□ 3. neither support nor oppose	□ 4. oppose somewhat	□ 5. strongly oppose	□ 5. don't know

Question 31. (p3q32) How do you feel about carbon dioxide removal?

□ 1. very positively	□ 2. somewhat positively	□ 3. neither positively or negatively	□ 4. somewhat negatively	□ 5. very negatively	□ 5. don't know

Question 32. (p3q33) Some people believe that carbon dioxide removal technologies may have associated risks and benefits. To what extent do you agree or disagree with the following statements?

	Strongly agree (1)	Agree somewhat (2)	Neither agree not disagree (3)	Disagree somewhat (4)	Strong-ly disagree (5)	Don't know (0)
1. My country's resources (for example, land, energy, finances, etc.) should be used to implement CDR	□	□	□	□	□	□
2. If politicians and businesses think CDR is a possibility, it will make them less likely to pursue other ways of tackling climate change	□	□	□	□	□	□
3. CDR will have a negative impact on the environment	□	□	□	□	□	□
4. CDR will have a negative impact on local communities in my country	□	□	□	□	□	□
5. Those who are already in positions of power will benefit the most from CDR	□	□	□	□	□	□
6. CDR will lower the drive to adapt to the impacts of climate change	□	□	□	□	□	□

Question 33. (p3q34) Who do you think should take the lead internationally on research into carbon dioxide removal? (Please select only one)

□ 1. Countries with the largest, historic CO_2 emissions should take the initiative.

□ 2. Countries with high technical capabilities must take the initiative.

□ 3. Countries that will suffer the most damage due to global warming should take the initiative.

□ 4. No country should do research and development of carbon dioxide removal at all.

□ 5. Don't know.

PART 4: HOUSEHOLD INFORMATION

Question 34. (p4q35) How you and your family been affected by the epidemic of COVID-19 in any of the following ways? *Check all that apply.*

□ 1. Loss of job

□ 2. Decrease of income

□ 3. Downturn/closure of household business

□ 4. None of the above

Question 35. (p4q36) How many members are there in your household? Enumerator: Include members who have lived at home for at least 6 months in the last 12 months.

	Number of members
a. Household members (total)	
b. Number of family members regularly staying home during daytime	
c. Number of children aged under 6	
d. Number of members aged above 60	

Question 36. (p4q37) What is the total monthly income of household members?

□ 1. < RM1000	□ 7. RM3501−4000	□ 13. RM6501−7000
□ 2. RM1001−1500	□ 8. RM4001−4500	□ 14. RM7001−7500
□ 3. RM1501−2000	□ 9. RM4501−5000	□ 15. RM7501−8000
□ 4. RM2001−2500	□ 10. RM5001−5500	□ 16. RM8001−8500
□ 5. RM2501−3000	□ 11. RM5501−6000	□ 17. RM8501−9000
□ 6. RM3001−3500	□ 12. RM6001−6500	□ 18. > RM9001

Enumerator: (p4q37a) Please also ask the respondent what is **the total gross monthly income** (including allowances and other benefits): RM_____/month

Question 37. ((p4q38) What is your gender?

□ 1. Male □ 2. Female

Question 38. (p4q39) How old are you? _____ years old.

Question 39. (p4q40) Are you currently smoking?

□ 1. YES. (p4q40a) How many sticks per day?: _____

□ 2. NO.

Question 40. (p4q41) What is your occupation?

□ 1. Unskilled labour	□ 5. Housekeeper
□ 2. Office worker	□ 6. Student/Retired/Unemployed
□ 3. Manager	□ 7. Self-employed
□ 4. Skilled labor	□ 8. Others, specify: _____(p4q41a)

Question 41. (p4q42) What is your highest level of education?

□ 1. Under primary school	□ 5. College
□ 2. Primary school	□ 6. University
□ 3. Secondary school	□ 7. Master degree or higher
□ 4. High school	

Question 42. (p4q43) What is your ethnic group?

□ 1. Malay □ 2. Chinese □ 3. Indian □ 4. Bumiputera Sabah/Sarawak

□ 5. Others (_____)

Question 43. (p4Q44) What is your marital status?

□ 1. Single □ 2. Married □ 3. Widow/Widower

Question 44. (p4q45) Please indicate how happy and content you are with your current living conditions. Please use a scale of 0−10, where 0 is very unhappy/discontented and 10 is perfectly happy/contented: _____

Question 45. (p4q46) Just before the COVID 19 pandemic, how happy and content were you with your life? Please use a scale of 0−10, where 0 is totally unhappy and 10 is very happy:_____

THANK YOU FOR YOUR TIME!

PART 5: QUALITY MANAGEMENT

The following questions are for enumerators.

Question 46. (p5q47) How would you judge the overall quality of this interview?

- ☐ 1. Excellent
- ☐ 2. Good
- ☐ 3. Fair
- ☐ 4. Poor
- ☐ 5. Unsure; difficult to say

Question 47. (p5q48) Do you think the respondent thought carefully about the valuation questions and made an effort to give truthful answers?

- ☐ 1. Definitely yes
- ☐ 2. Probably yes
- ☐ 3. Not sure/Difficult to say
- ☐ 4. Probably not
- ☐ 5. Definitely not

Question 48. (p5q49) How many people were listening to the interview, other than the respondent?

a. Number of other household members ____

b. Number of non-household members ____

c. Total number of people listening ____

Question 49. (p5q50) Do you have any other comments to add about what happened during the interview that was noteworthy or interesting?

_____

_____

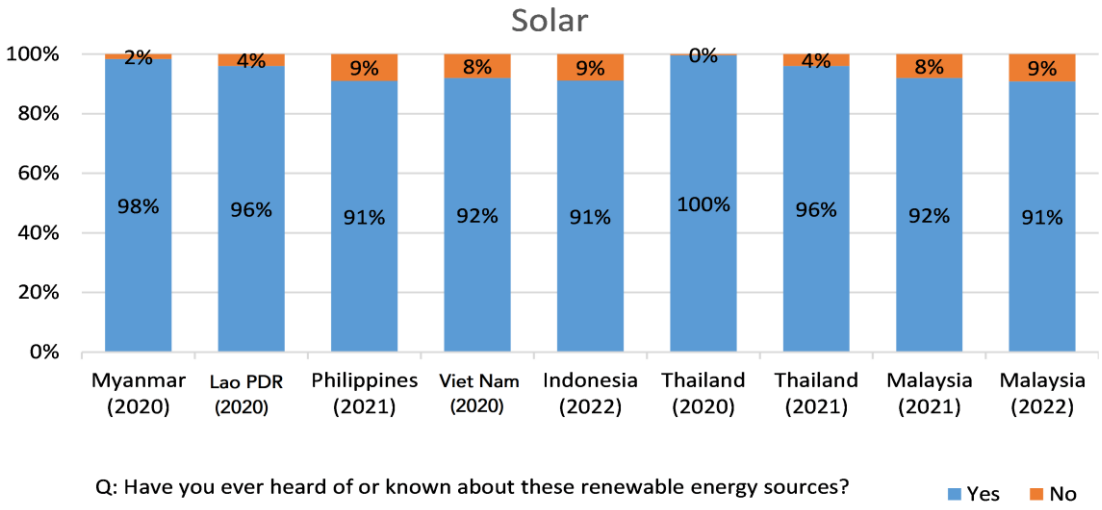
Question 50. (p5q51) Enumerator stands in the house and collect the GPS location using smart phone/tablet:

Question 51. (p5q52) Picture 1 − Enumerator takes a photo of the front of the house and records distinguishing features.

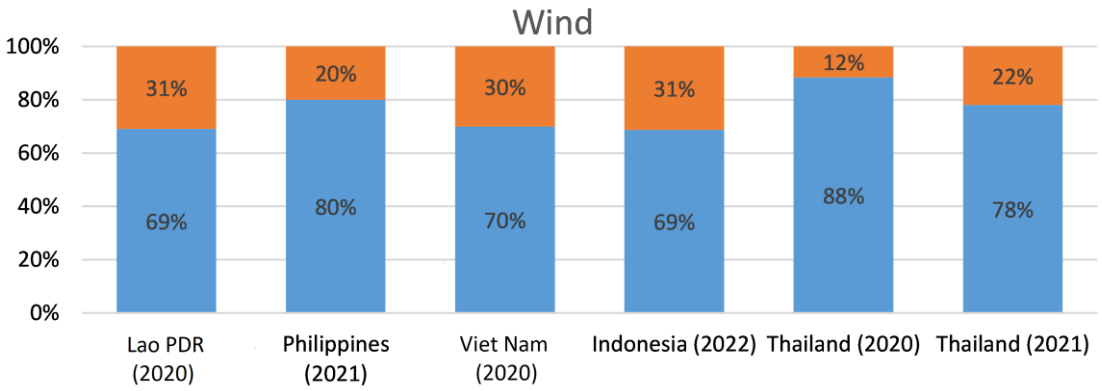
Question 52. (p5q53) Picture 2 − Enumerator takes a photo of the front of the house and records distinguishing features.

Appendix 2. Attitudes Towards Types of Renewable Energy

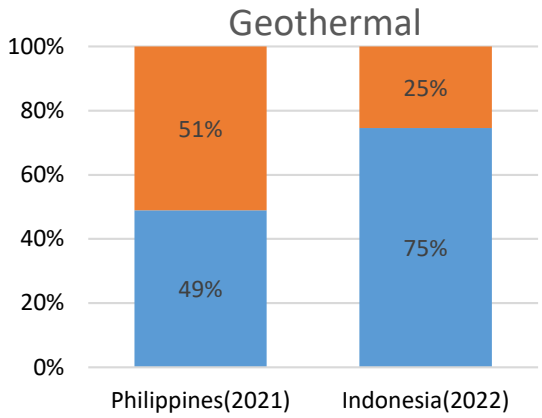
Figure A-1. Knowledge About Renewable Energy Sources



Q: Have you ever heard of or known about these renewable energy sources? ■ Yes ■ No

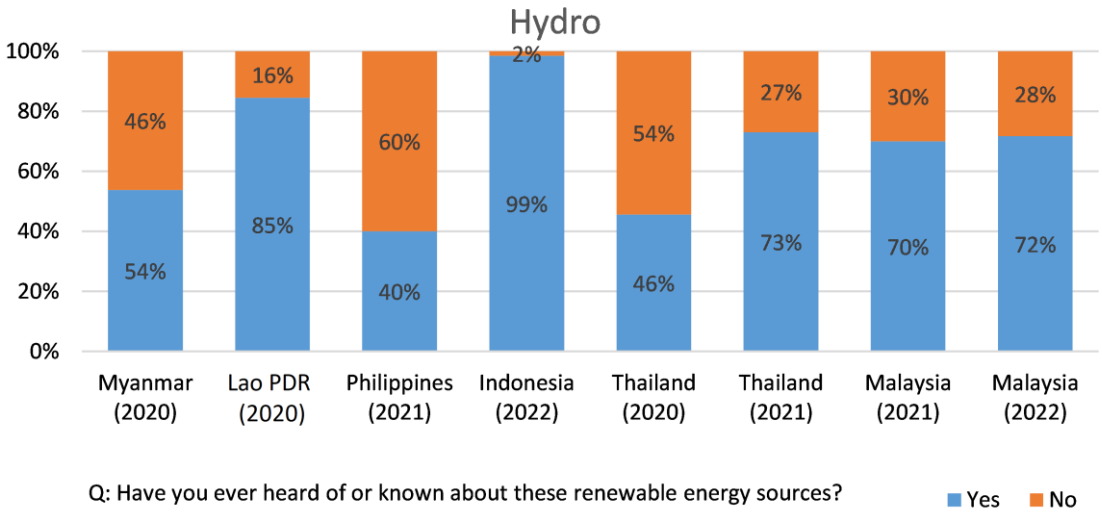


Q: Have you ever heard of or known about these renewable energy sources? ■ Yes ■ No

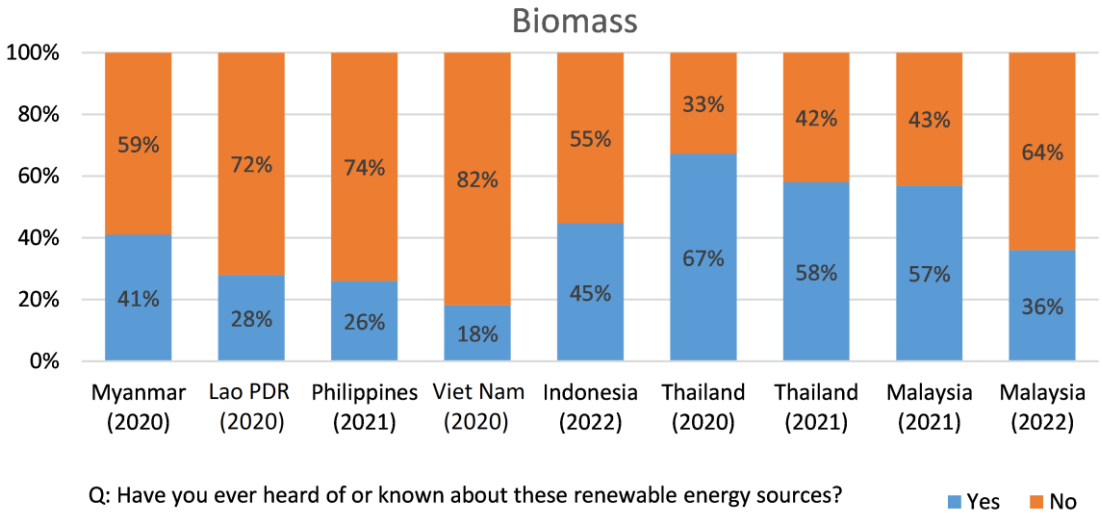


Q: Have you ever heard of or known about these renewable energy sources? ■ Yes ■ No

Figure A-1. (continued)



Note: Indonesia is large-scale hydropower, others are mini hydro.



Source: Study Team.

Figure A-2. Attitudes Towards Renewable Energy

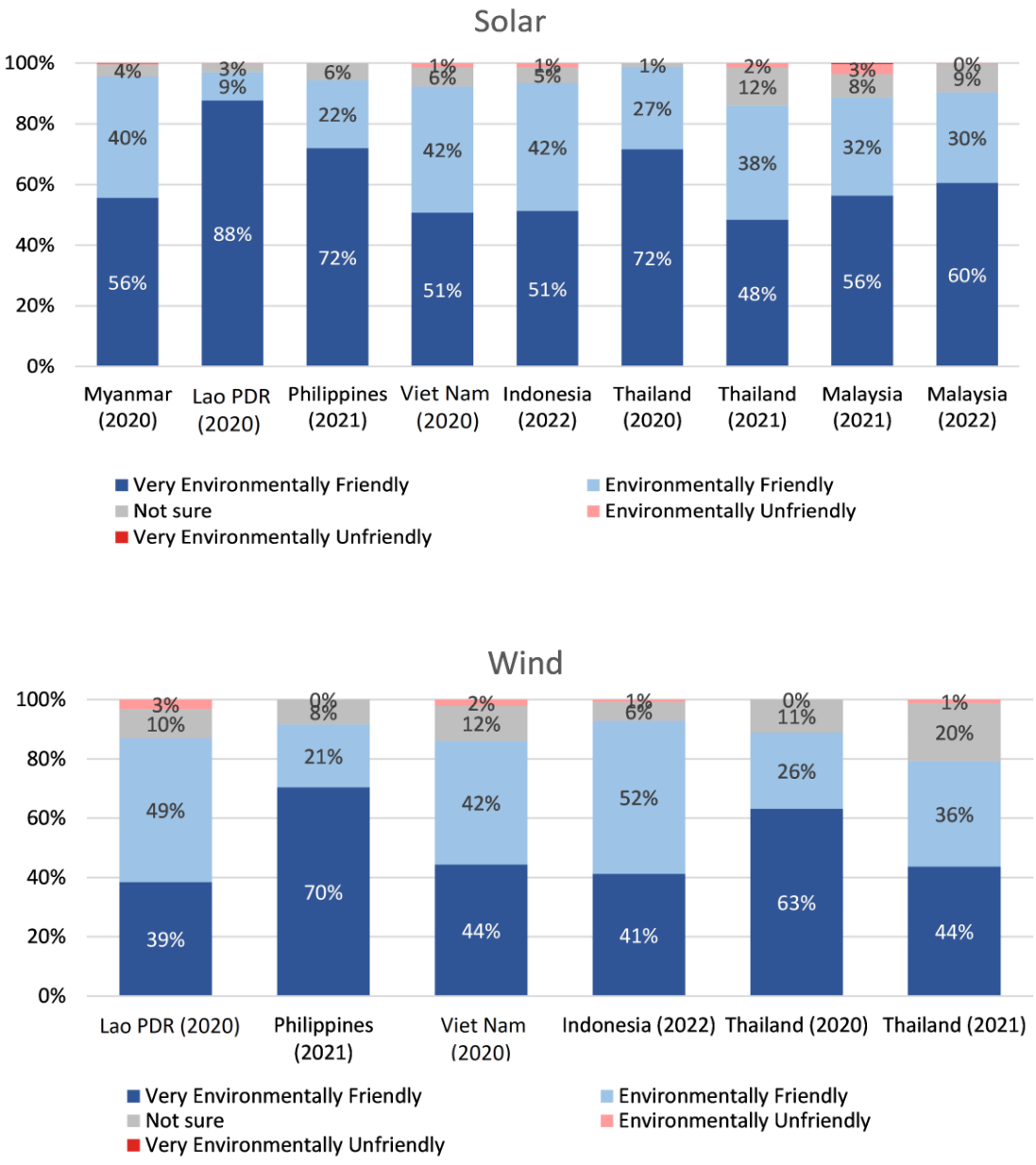
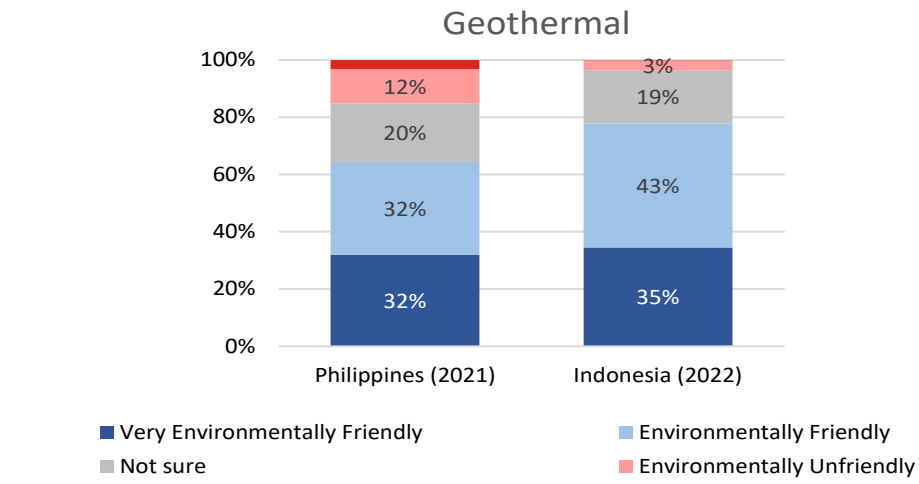
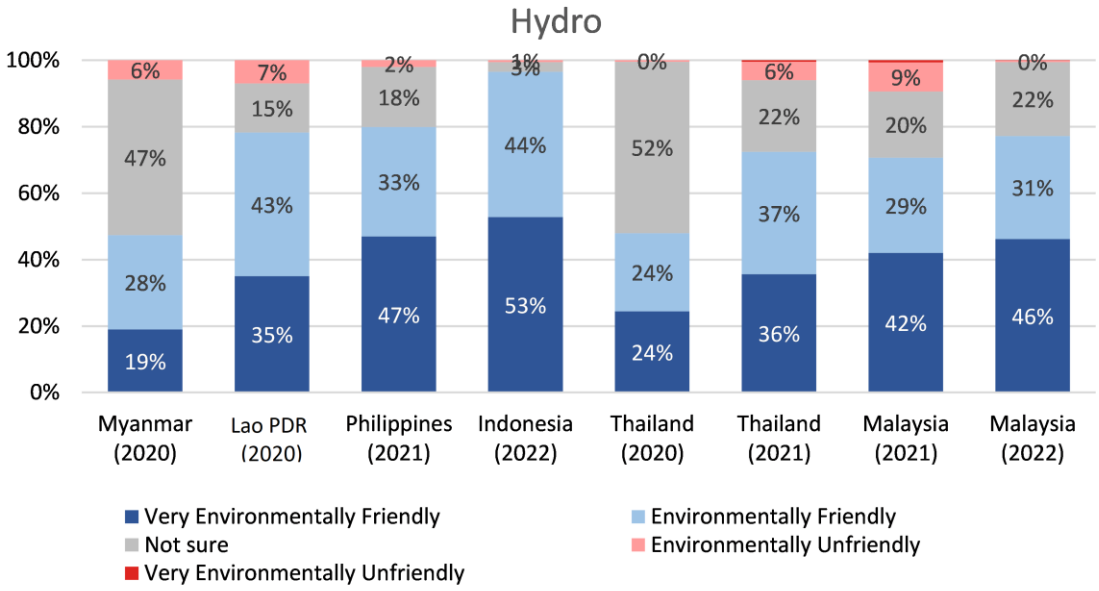


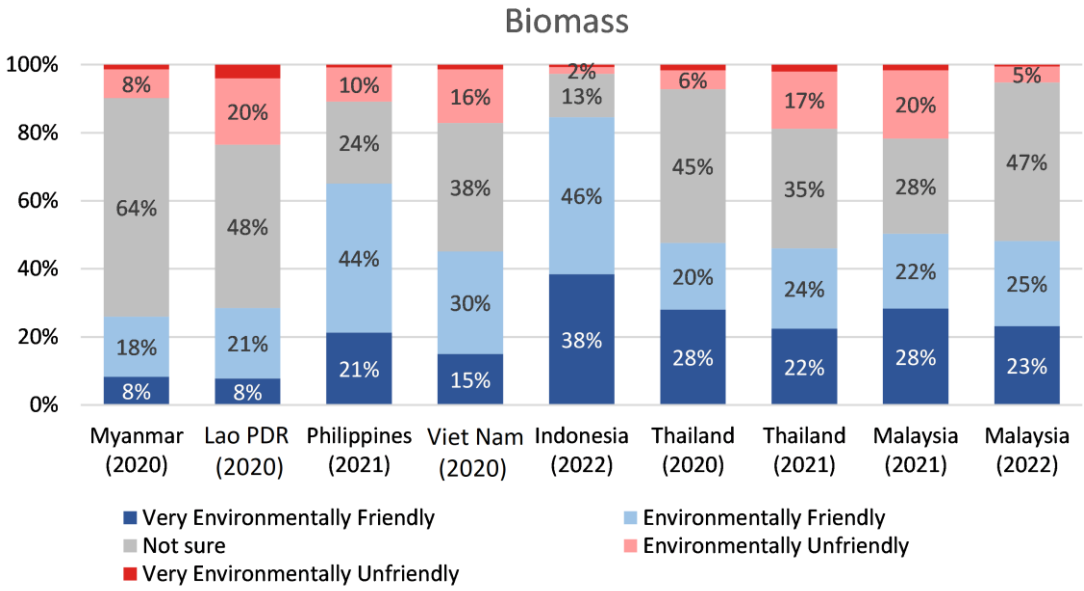
Figure A-2. (continued)





Note: Indonesia is large-scale hydropower, others are mini hydro.

Figure A-2. (continued)



Source: Study Team.