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Lithuania's, Latvia's and Japan's Climate Policies. Are we Far from the Ideals of the Paris Agreement?

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Abstract **– The study compares the most recent developments in energy policies in Japan, Lithuania, and Latvia to mitigate climate change, indicating the most problematic parts and highlighting the areas where all three could collaborate. The ambition of each country is estimated by the submitted Intended Nationally Determined Contributions (INDCs), the legal framework for addressing climate change, the trends in energy intensity, and the penetration of the non-fossil fuel sector, comparing them with a common goal to become carbon neutral by 2050 and whether they abide by the recommendations by IPCC. The methodology is based on a literature review and data analysis of the three countries. In addition to the political will, the study also considers external factors such as the impact of the COVID-19 pandemic and the Russian invasion of Ukraine on climate change mitigation policies. Therefore, this study offers a comprehensive outlook of the things to be achieved so that all three countries would become role models to follow in climate policy. It fosters a viewpoint that each country needs to develop and constantly improve its climate change policies. The national targets must be continuously reviewed and updated to close the ambition and implementation gaps. The study also attempts to discuss Japan's differing approaches regarding the role of modern technologies and a green economy compared to Latvia and Lithuania. In addition, increasingly demanding ambitions will be needed as decarbonisation remains too slow in the three countries and globally.**

Keywords **– Ambition gap; climate change; COVID-19 pandemic; decarbonisation; INDC; policy evaluation; Russian invasion of Ukraine.**

1. INTRODUCTION

There is unequivocal evidence that the climate has been warming at unprecedented levels and that anthropogenic greenhouse gas (GHG) emissions play a significant role [1]. As the record yearly temperatures sweep the world and the extreme events become more prevalent, tackling climate change becomes a pressing challenge for each country. Despite differences in energy infrastructure and consumption trends among countries, as well as the extent to which they contribute to cumulative GHG emissions, the vast majority of countries have finally agreed to lower their impact on climate change. Since the ratification of the Paris Agreement, there have been attempts by the global community to create a carbon-neutral economy by the middle of the 21st century, thus likely limiting the warming to 1.5 °C above pre-industrial levels, an agreed "safe" warming threshold, as suggested by the IPCC AR6 [1]. To achieve this, the world needs to act in unison in addressing this global issue. This is reflected by the fact that 197 states (including the EU) signed the Paris Agreement, among

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which 194 ratified the Agreement [2]. Furthermore, 122 states and the EU have pledged to reach carbon neutrality by 2050 or earlier [2].

Even though climate change is a global phenomenon, case studies of specific regions or countries are necessary to understand how policies differ and indicate how far we are from the net zero goal. The reason for comparing Japan, Lithuania, and Latvia, despite significant differences in size, is due to some similarities that these countries face in the path of decarbonisation. As developed OECD member countries, they also share similar demographic challenges. This study does not include Estonia, as it is the only one among the four to secure all its energy needs with a positive balance. In addition, comparing four countries would require a lengthier study, but comparing three countries helps us understand the possible areas for collaboration. Alternatively, comparing Japan with the European Union would add more complexity due to heterogeneous energy policies among the EU member states. All three countries are a part of the United Nations Framework Convention on Climate Change (UNFCCC) adopted in 1992, which built the ground for national commitments and mechanisms to reduce GHG emissions. In addition, they are all signatories of the Kyoto Protocol, even though Japan had withdrawn from the second commitment period (2013-2020). All three countries signed and ratified the Paris Agreement with a commitment period of 2021–2030 and the United Nations' 2030 Agenda for Sustainable Development. In addition, Latvia and Lithuania, as EU members, participate in the EU Green Deal initiatives and the EU Strategy on Adaptation to Climate Change.

Meanwhile, the evaluation of goals and the assessment of implementation are crucial to making more demanding policies in the future. Furthermore, understanding the development of the energy policies and support mechanism of the energy sector enables us to assess the progress (or backslide) as time lapses [3].

Even though up-to-date studies about Japan's climate policies exist [4], [5], new studies about the energy policy in the Baltic States remain scarce or unavailable, particularly the comparative ones [6]. Notable exceptions for the Latvian case are studies by Aboltins *et al.*, Kalna *et al.*, and Aboltins and Jaunzems [7]–[9]. However, they tend to focus on a single policy document and are not comparative. Another exception is a study by Tikova and Dvorak on Lithuanian and Bulgarian climate change policy trends and a green recovery after the COVID-19 pandemic [10]. In addition, several outdated studies on climate change mitigation policies exist for the three countries.

Latvia, Lithuania, and Japan have the same target for the year 2050 (net zero emissions) and face significant challenges, albeit on different scales, namely the dependence on energy imports, which include fossil fuels (FF). In addition, all three of them aim to minimise this dependence sharply. Lithuania and Latvia even strive to become clean energy exporters by focusing entirely on renewables. Japan also intends to expand its renewable energy sector (RES) and minimise dependence [11]. Latvia is the least dependent on energy imports. Japan and Lithuania had nuclear power plants and, thus, a notable share of nuclear power in the past. This changed significantly after Lithuania decommissioned its nuclear power plant and Japan reconsidered its atomic power policy after the 2011 Tohoku earthquake and tsunami. The share of FF in total energy consumption increased from 81.3 % in 2010 to 93.5 % in Japan and even more drastically in Lithuania – from 64.9 % in 2009 to 95.3 % in 2010 [12]. All three countries are currently boosting renewable energy and expecting a significant increase in energy consumption in the future due to the surge of electric vehicles and other modern technologies, such as hydrogen production plants.

This study addresses the following questions: What are the main similarities and differences between climate change policies in Japan, Latvia, and Lithuania? Are the 2025–2050 policies sufficient to reach the Paris Agreement goals, and do policy documents properly reflect the challenges? How wide are implementation and ambition gaps? Has the COVID-19 pandemic, with a lockdown and a full-scale Russian invasion of Ukraine, impacted greenhouse gas emissions and climate policies in the three countries? This study analyses the most recent climate policy developments in three countries, evaluating the readiness of each country to reach the carbon neutrality target. It is known that the COVID-19 pandemic and its lockdown positively affected greenhouse gas emissions worldwide; the Russian invasion sharply cut the amounts of FF purchased from Russia, increased demand for liquefied natural gas, and encouraged a quicker shift to renewable energy in many European countries [13]. However, little analysis was done on countries like Latvia and Lithuania [10].

2. Assessment Methodology

2.1. General Methodology

Different methodologies may be applied to assess a country's climate policies. A 2009 study attempted a quantitative method to rate the Latvian climate policy based on policies' relevance, efficiency, efficacy, and impact [6]. This study evaluates the policies by reviewing the newest documents that form the central national policy and collects data on indicators reflecting the decarbonisation efforts, such as historical, estimated, and pledged greenhouse gas emission levels. For simplicity reasons, land use, land-use change, and forestry (LULUCF) are excluded from most of the GHG emissions figures in the analysis. The efficacy is understood as a compatibility with the Paris Agreement goals. The research estimates whether the goals in policy documents not to emit more GHG than is allowed to keep the warming limit below +1.5 °C (ambition gap) are sufficient, also taking into consideration the possible implementation gap in fulfilling such goal. First, to estimate the ambition gap, it is evaluated whether the nationally determined contributions (NDC) and National climate strategies correspond and whether the ultimate goals could be deemed ambitious enough to reach the Paris Agreement targets. In addition, the implementation gap is considered in case there are known hurdles in legislation, considering whether proposed and historical emission cuts in contributing sectors are adequate. In the case of the sector analysis, GHG reductions in energy, transport, industry, agriculture, waste, and LULUCF are considered (Fig. 1).

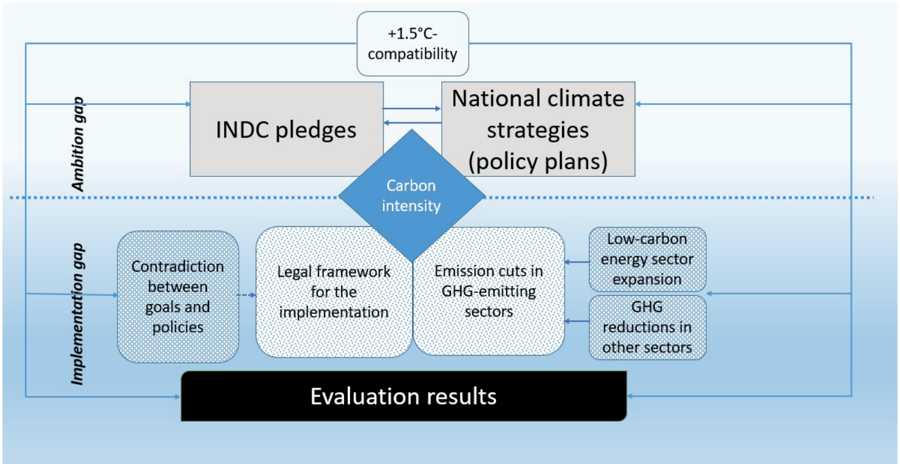


Fig. 1. The graph explaining the evaluation method.

Depending on the available evidence, whether the legal framework facilitates the implementation of the policies or if they widen an implementation gap is also considered. The ambition gap focuses on the projected greenhouse gas emissions for 2030 and is based on the recommendations of the IPCC 6th Assessment Report, OECD, and the methodology of Climate Action Trackers [1], [14], [15].

Unforeseen changes in geopolitical or epidemic situations may significantly affect the policies. As this study was written in 2024, it concludes with a short analysis of the impact of the COVID-19 pandemic and the Russian invasion of Ukraine on climate policy implementation in the form of incentives for economic recovery and the FF divestment.

2.2. Evaluation of Policies

This study evaluates the current strategies, including the legal framework of climate change policies in all three countries. The evaluation compares the situation and the climate aims, including NDC pledges and major policy documents [16], [17].

The primary policy documents analysed in this study are as follows:

- Japan: the GX Basic Policy (2023) [18] and The Basic Energy Plan (updated in 2021, scheduled to be updated in 2024 or 2025) [11];
- Latvia: Plan for the adaptation to climate change for the period until 2030 (2019), Strategy for reaching climate neutrality until 2050 (2019), and National Energy and Climate Plan 2021–2030 for Latvia (2024) [19], [20];
- Lithuania: Climate Change Programme (2019), National Energy and Climate Plan 2021–2030 (2024), and National Climate Change Management Agenda (2021) [21], [22].

Multiple methods exist to estimate the ambition gap, including future GHG projection models [15]. This study presents a rough estimate based on the projected GHG emissions (CO_2e) per capita (or carbon intensity) change [23]. The projected carbon intensity is calculated based on the pledged emission cuts by 2030, adjusted by the projected population:

$$CI(2030) = \frac{CI(2005)\cdot r}{Pop(2030)}, \tag{1}$$

where *CI*(2030) is carbon intensity (GHG emissions) per capita in 2030, and *CI*(2005) is carbon intensity as of 2005, r is a GHG reduction pledge (in percentage), *Pop*(2030) is a population size by 2030, based on the most recent World Bank estimates [24].

The safe carbon intensity threshold by 2030 is taken from the IPCC 6th AR, which recommended a decrease in 57 % of GHG emissions between 2019 and 2030, requiring carbon intensity to drop to 3.58 t of CO_2e per capita.

The ambition gap Δr is calculated as a difference between the exemplary Paris Agreement-compatible GHG reduction by 2030, as recommended by the IPCC 6th AR r(ideal), and a projected GHG emission cut by 2030 (based on NDC), r.

$$\Delta r = r - r(\text{ideal}), \tag{2}$$

$$r(\text{ideal}) = \frac{Pop(2030)\cdot 3.58}{E(\text{hist})}, \tag{3}$$

where E(hist) is GHG emissions in 2005 for Latvia and Lithuania and 2013 for Japan.

3. RESULTS

3.1. Similarities and Differences

Lithuania, Latvia, and Japan have been significantly expanding their renewable energy capacity, as the national plans highly favour the development of the RES, particularly in Latvia and Lithuania. As of 2022, three-quarters of all domestically generated electricity came from low-carbon sources (Table 1). Lithuania was also estimated to have the second-highest wind power share in its electricity mix among EU countries (46 %) [25]. However, unlike Latvia, Lithuania remains highly dependent on energy imports (Table 1). Latvia also saw significant growth in its wind power sector over the past five years [25]. In Japan, the share of low-carbon sources in total electricity generation has reached 27.0 % in 2022, its best result since 2011, even though the FF share remains higher than in any year between 1985 and 2010 [35] (Table 1). In addition, Japan still burns coal and relies on energy imports, see Table 1. A feed-in tariff scheme introduced in 2012 is expected to further boost renewable energy expansion, while a moderate expansion of nuclear power will decrease the FF share.

Each of the three countries has strategies and policy documents to reach carbon neutrality by 2050. All three countries signed the Paris Agreement adopted at COP21 on April 22, 2016, through which it pledged to achieve the principal Paris Agreement goal, to hold the increase in global temperatures below 2.0 °C above pre-industrial levels, preferably limiting the increase to 1.5 °C, by minimising their carbon footprint. The Diet of Japan ratified the Paris Agreement on November 8, 2016, followed by Lithuanian Seimas on February 2, 2017, and Latvian Saeima on March 16, 2017. All three countries drafted their NDCs in 2015 (Lithuania and Latvia did so on behalf of the European Union). Japan updated it more frequently, as the current version is the fourth one (most recent update in 2021), while Lithuania and Latvia use the third but more recently updated version [1], [26].

Per capita GHG emissions in Japan (9.1 t) are higher than in Lithuania and Latvia (6.7 t and 5.4 t) and, in the case of Japan, above the world average (6.7 t) as of 2022. All three countries diminished carbon intensity per capita compared to 1990 (Lithuania by –48.6 %, Latvia by –4.9 %, and Japan by –12.2 %), excluding LULUCF. However, while carbon intensity per capita (excluding LULUCF) has decreased in Japan since 2005 (–16.1 %), this value has remained the same in Lithuania and increased by +0.1 % in Latvia [14], [2]–[4].

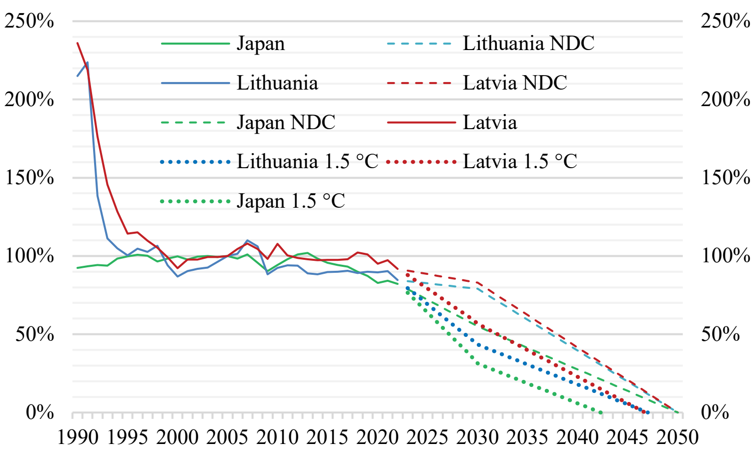
Japan reached its peak emissions in 2013 and has had an annual downward trend ever since, with a minor exception in 2021. Meanwhile, peaks in Latvia and Lithuania were reached between 1990 and 1991, followed by a fluctuating decrease trend in overall emissions. The share of global emissions has dropped in all three countries. It is estimated that Lithuania, with 18.9 $MtCO_2e$, was responsible for 0.2 %, and Latvia, with 10.1 $MtCO_2e$, for a bit over 0.1 % of the global emissions at their peaks (Table 1, Fig. 2(a)). As of 2022, the contribution dropped far below 0.1 % [27]. Meanwhile, Japan contributed 5.4 % in 1974, during the oil crisis, and its contribution has shrunk to 2.8 % (1.1 $GtCO_2e$, Table 1) [23]. Meanwhile, LULUCF serves as a carbon sink in Japan and particularly in Lithuania, while in Latvia, it is responsible for additional net emissions (Table 1).

The energy sector in Lithuania and Latvia has a similar share in the total GHG emission contributions of 62.3–63.7 %, and agriculture accounts for over one-fifth of the total emissions. More than half of the emissions are attributable to transport in Lithuania [5]. Meanwhile, Japan's share of energy-related GHG emissions is even higher and stands at 87.5 % (Fig. 2(b)). The industry share of the three countries is relatively similar, but the emissions from agriculture in Japan cover only 3 %. The share of emissions from the waste sector in Japan is also lower compared to Lithuania and Latvia. (Fig. 1).

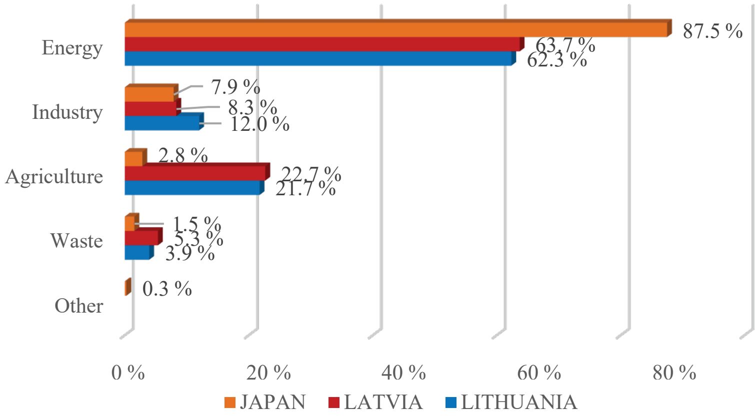
TABLE 1. CLIMATE CHANGE-RELATED STRATEGIES, CURRENT AND ESTIMATED DATA*

	Japan	Latvia	Lithuania
Ratification of the Paris Agreement	November 8, 2016	March 16, 2017	February 2, 2017
Current NDC	The fourth revision (2021)	The third revision (2023)*	The third revision (2023)*
2030 Goal (NDC)	46 % GHG emission cut by 2030 compared to 2013	17 % GHG emission cut by 2030 compared to 2005	21 % GHG emission cut by 2030 compared to 2005
Self-sufficiency ratio (2022)	12.6 % [28]	61.3 % [29]	27.6 % [29]
Coal in the electricity mix?	Yes, 27.8 % [30]	No	No
Share of low-carbon sources in generated electricity (2022)	27.0 % [35]	75.8 % [35]	75.2 % [35]
GHG (2022, excl. LULUCF)	1135.0 $MtCO_2e$ [2]	10.1 $MtCO_2e$ [3]	18.9 $MtCO_2e$ [4]
GHG (2022, incl. LULUCF)	1084.8 $MtCO_2e$ [2]	15.1 $MtCO_2e$ [3]	12.5 $MtCO_2e$ [4]

Another notable similarity between Japan and Lithuania is the diminished role of nuclear power. Lithuania originally envisaged a dominant role for nuclear power in energy generation, and it used to produce over 70 % of the electricity demand in 2008 [6]. Some energy generated in a Lithuanian nuclear power plant was supplied to Latvia. Meanwhile, Japan also aspired to generate 41 % of its electricity from nuclear power [7], an increase from the 2010 levels (30 %) [6], [7]. However, Lithuania had to close both reactors of its only Ignalina Nuclear Power Plant in 2004 and 2009, respectively, as a part of the accession to the European Union. Later, it abandoned its original plans to build a new nuclear power plant, initially set by the Atomic Power Plant Law passed in 2007. Japan was forced to temporarily shut down all its reactors and reconsider its nuclear policy after the 2011 Sendai earthquake and tsunami, which triggered a nuclear accident. Even though nuclear power remains a dividing issue in Japanese politics, Prime Minister Kishida has talked numerous times about the need to expand the nuclear power sector and expects to increase the share of nuclear power from 6 % in 2022 to 20–22 % by 2030. Meanwhile, in Lithuania, the most recent National Energy Independence Strategy reintroduces nuclear power through small modular reactors (SMRs) with a capacity of 1 GW using the Gen IV technology to be built in the future [8].



(a)



(b)

Fig. 2. (a) The dynamics of historical GHG emissions in Lithuania, Latvia, and Japan between 1990 and 2022 (100 %=2005 baseline), including the emissions for 2030 and 2050 according to NDCs (dotted line); (b) GHG emissions by sector as of 2022 (emissions from energy and transport are under the same category) [27].

3.2. NDC Pledges

Regarding the NDC pledges of Lithuania and Latvia, both countries submitted their goals as a single pledge by the EU. Lithuania and Latvia pledged to reduce GHG emissions by 21 % and 17 % by 2030 compared to 2005, respectively, lower than the average EU target of 40 % [1]. On the other hand, this means a reduction of approximately 58 % and 55.5 % GHG compared to 1990, exceeding the common goal set in the “Fit for 55” legislative framework of the European Commission (55 % reduction compared to the GHG levels in 1990). Such a reduction would require cuts of 639 ktCO_2e for Latvia and 661 ktCO_2e of net GHG for Lithuania from 2026 to 2029, respectively. However, even though such reductions may be sufficient to cut GHG emissions by 40 % in 2030, the policies between 2030 and 2050 remain less evident in the EU and, thus, in Latvia and Lithuania. No previous studies indicated ambition gaps for Lithuania and Latvia, but the EU has been evaluated as having an ambition gap of 10–12 % [9]. However, the gap is evident when considering carbon intensity in those countries. If Latvia and Lithuania fulfil their INDC pledges, their GHG emissions per capita will drop to 5.2 tCO_2e and 6.5 tCO_2e, respectively, exceeding the recommended 3.58 tCO_2e threshold [10]. This study estimates an ambition gap of 35.6 % for Lithuania and 26.2 % for Latvia, excluding the LULUCF.

In its NDC, Japan has pledged to cut its emissions by 46 % by 2030, compared to 2013 [16]. According to the calculations by CAT, Japan risks failing to fulfil this goal under the current policies [15]. Furthermore, the Climate Analytics estimates the ambition gap of Japan to be 24–26 % wide [9]. If Japan fulfils its 2030 pledge, its GHG per capita will drop to 6.4 MtCO_2e, above the recommended threshold of 3.58 MtCO_2e [10]. This study estimates a similar ambition gap of the Japanese pledge for 2030 – 23.7 %.

The future carbon intensity per capita drops for Lithuania and Japan but increases for Latvia if the LULUCF sector is considered (4.8 tCO_2e, 6.0 tCO_2e, and 5.8 tCO_2e, respectively). As a result, the gap becomes significantly lower for Lithuania (14.9 %) but higher for Latvia (35.7 %). The gap in Japan drops more moderately to 20.4 %.

All three countries have included their net zero pledges in climate strategies but not legislation. In addition to NDC and climate strategies, Japan has one of the highest numbers of climate change laws. According to the estimation by Mateo-Márquez *et al*., the number of such laws is 14, more than in most developed countries [11].

3.3. National Climate Strategies

Lithuania expects a significant increase in solar capacity (+5.1 GW, according to the most recently updated NECP) and a 100 % renewable energy share in generated electricity by 2030 [25]. Lithuania held its first auction on the offshore wind park, and Latvia announced a potential increase in its first offshore wind farm capacity, ELWIND [25]. However, despite a significant breakthrough in renewables, particularly in PV development in Lithuania, the Lithuanian government enacted The Law for the Promotion of Renewable Energy, which set a gap of 2 GW in the PV-produced electricity for commercial solar park developers, curtailing its almost exponential growth [12].

Lithuania and Latvia confirmed their NDC-compatible updated version of the National Energy and Climate Plan (NECP) in July and October 2024, respectively. The national climate strategies of each country are analysed further in this sub-paragraph.

3.3.1. Japan

GHG has been diminishing in all sectors in Japan (Table 2, [13]).

The GX Basic Policy introduced many positive developments, including carbon pricing through the emissions trading scheme planned for 2026, albeit with voluntary participation. It also envisions the carbon levy in 2028 but with a low price – around JPY 1500/tCO_2. However, the Policy is also apologetic about the use of coal in co-firing with ammonia. Finances for hydrogen technologies are allocated, including co-firing in the power sector, hydrogen in steel production, and hydrogen EVs. The anticipated emission reduction for 2030 is shown in Table 2 (the LULUCF is not included). In addition to the applications of coal co-firing domestically, Japan plans to promote it overseas, possibly hindering decarbonisation efforts for the ASEAN countries [14].

Japan’s sixth Strategic Energy Plan presents CCS as one of the primary solutions to achieve the carbon neutrality target by 2050 [15]. However, as CCS is arguably efficient and not a commercialised technology, Japan risks failing to meet its goals. As of September 2023, the carbon capture efficacy still needs to catch up to 80 %, far from the goal of 95 % [16]. In addition, according to the latest IPCC report, the CCS has a GHG mitigation potential of only 3.2 % by 2030, far below renewables, energy efficiency, electrification, and methane leak reduction [10]. Furthermore, CCS technologies would require significantly more financing [45].

TABLE 2. PLANNED GHG REDUCTIONS BY 2030 AND ACTUAL CHANGES COMPARED TO 2005*

Sector	**Energy**	**Transport**	**Industry**	**Agriculture**	**Waste**	**LULUCF**
2030	*n/a*	–43 %	–37 %	*n/a*	*n/a*	+23.4 %
2020	–8 %	–29 %	–20 %	–12 %	–37 %	+23 %

*only CO_2 is accounted for in future emission cuts

The policy documents are not comprehensive about the proposed GHG cuts in the agriculture and waste sectors, while the energy sector is not singled out. They favour low-emission renewables and nuclear power, but unabated natural gas and coal persist. Japan aims to sink 47.7 Mt of CO_2

by LULUCF, an increase compared to 2005 but below its best-achieved record in 2014, 57.5 Mt. Neither of the two policy documents mentions the behavioural change dimension.

3.3.2. Latvia

Even though GHG emission cuts in each sector are discussed, precise estimates are only given to the transport and LULUCF sectors (Table 3, [20]).

Latvia has reduced GHG emissions in the energy and waste sectors (Table 3) [3]. Even though LULUCF is known to have served as a carbon sink in Latvia, it is estimated that it will continue its recent trend as a GHG emitter (Table 3, [19]). Meanwhile, LULUCF may play a significant role in helping Latvia reach carbon neutrality, as mentioned in the country's climate policy documents [19].

TABLE 3. PLANNED GHG REDUCTIONS BY 2030 AND ACTUAL CHANGES COMPARED TO 2005

Sector	Energy	Transport	Industry	Agriculture	Waste	LULUCF
2030	–35 %	–21 %	+46 %	+22 %	–40 %	net emissions
2022	–35 %	+1 %	+134 %	+26 %	–14 %	net emissions

The Strategy of Latvia for the Achievement of Climate Neutrality by 2050 includes comprehensive plans for the year 2040. This cross-sectional strategy also mentions the necessity of a behaviour change as one of the basic approaches to reach carbon neutrality in addition to technological solutions. However, only a tiny portion of the text is allocated to discuss lifestyle changes, and no information is given on their goals and implementation [19].

Policy documents favour renewables, but unabated natural gas is also included. The study by Aboltins and Jaunzems used a scheme proposed by Kettner and Kletzan to assess the interaction of Climate policy implementation with other policies. It found out that while NECP2030 secured synergetic interaction between different laws towards climate goals for most of the enlisted fourteen horizontal policy areas, three of them (related to biogas, energy supply systems, and particularly the social conditions aspect) contained clauses that do not contribute to reaching climate goals because of conflicting interests between policies [17]. Meanwhile, the recently updated NECP sets higher GHG emission cuts until 2030 than previously (17 %, or the NDC-enshrined target, instead of 6 % GHG emission reduction) and commits to GHG reductions in energy, transport and waste sectors. However, it also allows emission growth in the industry and agriculture sectors compared to 2005 and anticipates additional emissions rather than absorptions in LULUCF [20], [26].

3.3.3. Lithuania

On June 30, 2021, the Lithuanian Parliament approved the National Climate Change Management Agenda, which set the 2050 climate neutrality target, replacing the previous National Strategy for Climate Change Management Policy from 2012. The agenda sets the climate change management policy targets before 2030, before 2040, and before 2050. Ensuring energy security, mainly based on expanding the RES, is considered a part of national security [22]. Primary policy documents favour renewables, but unabated natural gas, mostly liquefied natural gas (LNG), remains not phased out until 2040.

The recently updated National Energy and Climate sets higher GHG emission cuts until 2030 than previously (21 %, or the NDC-enshrined target, instead of 9 % GHG emission reduction) [21]. Table 4 presents goals based on the above-mentioned national strategies, including the status quo as of 2022. It is worth noting that the LULUCF emissions remain negative in Lithuania, and the reductions are higher than in 2015. However, despite the negative value, GHG removals from LULUCF have decreased since 2012 [14], [21]. In addition, even though the net zero goal means a 100 % reduction in all sectors and may be compatible with the Paris Agreement, the earlier (2030 and 2040) goals lack ambition [21].

Some sectors are either stagnant or saw increased emissions. While a significant cut is being made in the energy and waste sector, the emissions from industrial processes and product use have been growing since 1995, while the emissions from agriculture remain stagnant, with a minor increase between 2005 and 2019, primarily due to the rise of synthetic fertilisers [14]. Among those, the transportation sub-sector remains the most problematic – it is the only area where emissions have grown since 1990 [14], [21]. The strategies estimate the decrease of GHG in all major contributing sectors. However, some ambitions are minimal, particularly for the industrial sector (Table 4).

The strategy does not seriously tackle the issue of emissions from transport. Lithuania has no carbon tax and a meagre fuel tax [14]. Lithuania focuses on an emission trading system (ETS), which encompasses 30 % of total GHG emissions [5]. Another place for improvement is energy efficiency, as only 4200 apartment buildings out of 18 000 are new or renovated, below the original pledge of 70 % by 2020 [49]. Lithuanian policy documents mention the importance of behavioural change in food waste and energy consumption via education [21]. However, this information occupies a relatively small share of the text in the document.

TABLE 4. PLANNED GHG REDUCTIONS BY TARGET YEARS COMPARED TO 2005

Target year	Energy	Transport	Industry	Agriculture	Waste	LULUCF
2030	n/a	–14 %	–19 %	–11 %	–65 %	+11.6 %
2022	–51 %	+43 %	–30 %	0 %	–48.1 %	+52 %

3.4. Developments Due to Forces Majeures

Some recent developments in the implementation of climate change policy were highly influenced by external factors or *forces majeures*. The last chapter of this analysis estimates the impact of the COVID-19 pandemic and a full-scale Russian invasion of Ukraine on green policies and FF use. These estimates take into consideration the existing data on green investment and the dynamics of the FF share in total energy consumption.

The COVID-19 lockdown positively impacted GHG emission cuts in all three countries. In Japan, energy and industry-related CO_2 emissions were estimated to have dropped by 7.5 % in the first six months of 2020. Furthermore, the annual GHG emissions fell by 5.3 % in Japan, 0.5 % in Lithuania, and 5.8 % in Latvia, Fig. 2(a). However, the lockdown also harmed the economies. All three countries experienced a recession in 2020: according to the IMF, GDP shrank by 4.5 % in Japan, 2.3 % in Latvia, and 0.1 % in Lithuania [46]. In addition, the pandemic claimed the lives of >74 000 people in Japan, >9800 in Lithuania and >7470 in Latvia as of 2024 [47].

Meanwhile, post-COVID-19 economic measures positively impacted the environment in Japan, Latvia, and Lithuania, based on the OECD data on the investments for boosting the post-COVID-19 pandemic recovery [49]. Japan invested the highest amount (46.34 billion USD), followed by Lithuania (2.13 billion USD) and Latvia (1.26 billion USD). Most spending in all three countries fell under the miscellaneous category. However, per capita investment was significantly higher in Lithuania (758 USD) and Latvia (668 USD) than in Japan (371 USD). In the case of Japan, investments included adaptation measures such as 46 million USD for the installation of self-consumption, on-site solar power generation facilities through power purchase agreements, over 18 billion USD in grants or loans for innovative technology developments contributing to achieving carbon neutrality target, over 19 million

USD for disaster prevention, mitigation, and national land resilience, 2 billion USD miscellaneous spending for the green recovery by Ministry of Economy, Trade and Industry (METI) for 2021FY, 495 million USD of Ministry of the Environment (MOE) miscellaneous spending for the green recovery for 2021FY, and 616 million USD spent by METI and MOE on digitalisation and green society for FY2020 [49]. On the other hand, the tendencies were much better compared to the global economic measures. Out of 1.55 trillion USD as of 2022 (195 USD per capita), 18.6 % of the spending had a negative impact on the environment, and 11.4 % had a mixed impact [49].

TABLE 5. INVESTMENTS IN MILLIONS OF USD IN GRANTS/LOANS, TAX REDUCTIONS, AND R&D SUBSIDIES [49]

	Japan	**Latvia**	**Lithuania**
Building sector	27	154	278
Energy sector	46	334	287
Surface transport	0	359	407
Multiple purposes	46 271	410	1156

In addition to the investments, a positive regulation change regarding wind power development was introduced in Latvia. While most investments were estimated to positively impact the GHG reduction, 328 million USD out of 410 million USD spent on multiple purposes in Latvia had a mixed effect, a notable example being the railway project *RailBaltica* [49].

The COVID-19 lockdown served as a catalyser for decarbonisation in all three countries where the RES expanded, and the FF consumption dropped amidst the decrease in total energy consumption. The positive developments were the most significant in Latvia (–14.8 % decrease for FF vs. 13.8 % increase for RES) and Japan (–8.0 % for FF vs. +8.4 % for RES), followed by Lithuania (–1.5 % for FF and +8.0 % for RES) as depicted in Fig. 3.

Another external force that impacted the development of the energy policies in Latvia and Lithuania but not so much in Japan was the Russian invasion of Ukraine on February 24, 2022. By triggering a global energy crisis and a surge of coal and natural gas prices, especially in Europe, it increased incentives for many countries to decarbonise themselves. On the other hand, the prices for the raw materials grew as well [50]. Japan was affected significantly less by the Russian invasion of Ukraine than Latvia and Lithuania, which were initially highly dependent on FF from Russia, particularly natural gas. Most natural gas and oil came predominantly from Russia until 2020 and beyond [13]. On the other hand, all three countries imposed economic sanctions on Russia, which had some financial repercussions. Latvia and Lithuania cut most energy imports from Russia as early as the first half of 2022, while Japan joined in December 2022 by imposing a ban on the import of most crude oil.

In April 2022, Lithuania adopted the renewable energy "Breakthrough Package" to accelerate solar and wind energy projects, setting plans to build offshore wind farms. However, the war had a positive impact not only on renewable energy. A natural gas pipeline connection with Poland was established in 2022, even though the project started in 2020. The impact is more visible in the Baltic States, as most of the natural gas used to be of Russian origin but not in Japan. Few studies exist regarding the impact on energy policy, particularly in Japan [5].

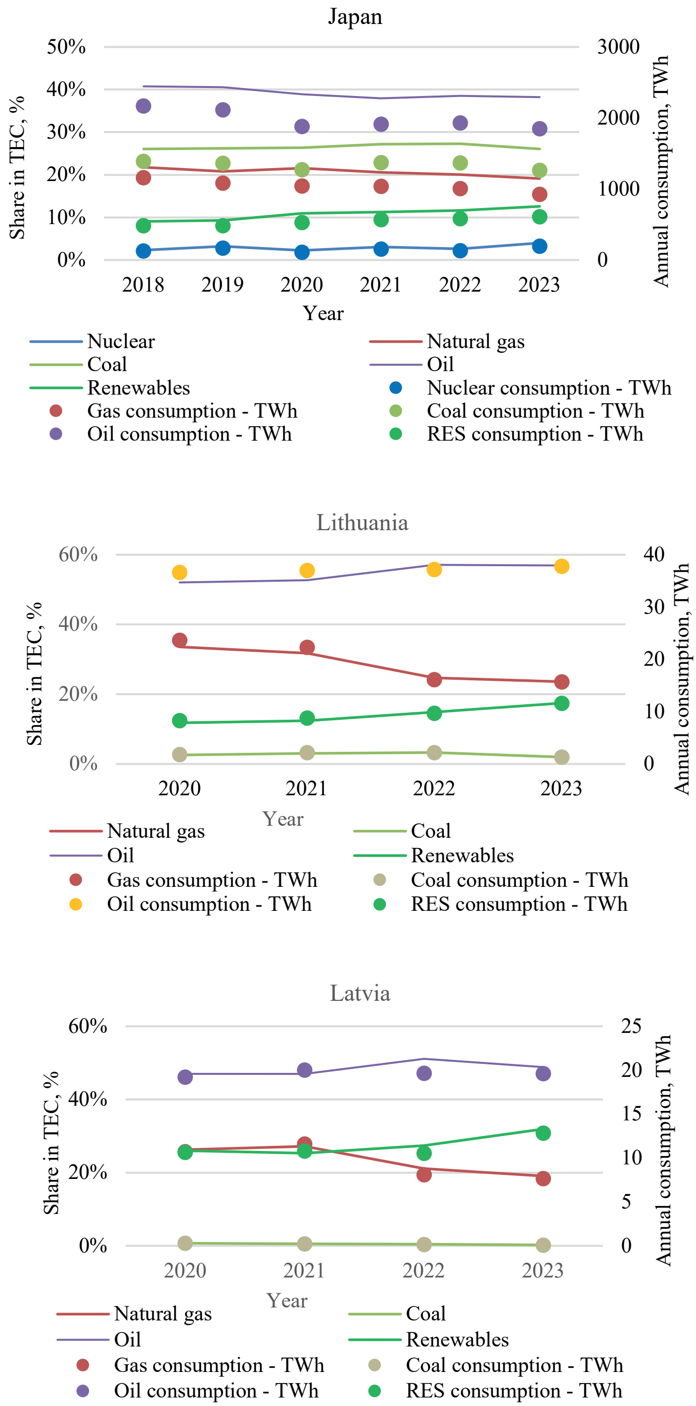


Fig. 3. Primary energy consumption by sector and the changes between 2018 and 2023 for Japan, Lithuania and Latvia. Left: (line = share in percentage, dots = annual consumption growth/decline, in TWh) [12].

As of 2021, Russia accounted for 3.6 % of crude oil imports, 8.8 % of LNG imports, and 11 % of coal imports for Japan) [18]. In addition, 9 % of nickel used in the positive electrode of nickel-hydrogen batteries and lithium-ion batteries and 4 % of cobalt used in the lithium-ion batteries originated from Russia. For countries like Latvia and Lithuania, this was an excellent opportunity to boost the natural gas divestment. This opportunity was seized to decrease the reliance on natural gas, even though it significantly increased demand for LNG in Latvia and Lithuania. Lithuania built a new LNG infrastructure to diversify its energy import sources. However, both Latvia and Lithuania saw a drop in natural gas consumption by 30.1 % and 27.9 %, respectively; the oil consumption in Lithuania increased by 0.5 % and continues to grow, a negative development, even though the increase for the RES in 2022 was 7.2 %, despite the total decrease in consumption, and the oil consumption also increased in Japan by 0.8 % in 2022, see Fig. 3. Despite the decrease of gas in the energy mix, Japan was the world's largest LNG importer in 2022, second only to China. While it is evident that the divestment in Russian oil and gas contributed to the quicker shift to the RES in Latvia and Lithuania, it is not clear to what extent the war affected the RES pace in the two countries.

4. DISCUSSION AND CONCLUSIONS

All three countries struggle with the dependence on energy imports, primarily FF. However, Latvia stands out as the least dependent country, while energy dependence in Japan remains high, with a relatively small increase to 17 % by 2024 estimated [28]. However, all three countries pledged to become carbon neutral by 2050 and have included this pledge in their national mitigation strategies.

Japan has a more ambitious emission cut goal than Lithuania and Latvia. Its pledge to cut 46 % of the emissions below the 2013 levels means a 45–46 % decrease from 2005. However, that would still keep Japan's GHG emissions per capita higher than Latvia's. Therefore, based on this value, Lithuania and Japan have the highest ambition gap. Nevertheless, all three countries will exceed the recommended threshold of 3.58 tCO_2e per capita, with Latvia expected to exceed the least. The ambition gap dynamics are different if LULUCF is considered. All three countries, especially Latvia, can potentially use LULUCF as a carbon sink. On the other hand, negative emissions from LULUCF have been recorded in Lithuania and Japan but no longer in Latvia. Latvia and Lithuania cut their emissions by more than 50 % compared to 1990, and all three countries decreased their emissions compared to 2014. However, the current GHG emission levels in Latvia and Lithuania are higher than in 2014 if LULUCF is included. Swift decarbonisation trends in the two countries are hindered by the continuous increase of GHG emissions in the transport sector for Lithuania and by industry, LULUCF, agriculture, and transport sectors for Latvia. The ambition gap for all three countries would look direr if considered a fair share target. The implementation gap remains wide for 2024–2030 despite the positive developments.

When comparing the climate mitigation goals set by Lithuania and Latvia to those of other EU countries, the reduction goals look among the lowest, particularly for Latvia (fourth lowest for Latvia and eighth lowest for Lithuania). Five countries (Denmark, Finland, Germany, Luxembourg, and Sweden) pledged to cut their GHG emissions in half by 2030, compared to 2005, and another six declared they would lower the emissions by more than 40 %, i.e., the reduction target of the entire EU [1]. Furthermore, Sweden, the EU country with one of the lowest carbon intensity in the bloc, expects to reach carbon neutrality by 2045. Other EU countries that set earlier carbon neutrality goals include Finland (2035), Austria (2040), and Germany (2045) [26]. Unless the LULUCF is considered, Lithuania's carbon intensity may be similar to the EU-27 average by 2030. Under this calculation, Latvia would fare better but lose the title of one of the least carbon-intense EU countries [23]. As of 2024, the US, the world's biggest economy, notable for its carbon intensity, has pledged to cut emissions by 52 % by 2030, compared to 2005. Such a goal has an ambition gap of 8–9 % and, if implemented, is better than the one of the EU and Japan [9]. Other developed countries with assessed ambition gaps for 2030 include Germany (9–12 %), France (22–27 %), Spain (25–31 %), Czechia (29–34 %), Poland (32–38 %), Italy (40–48 %). In comparison, the UK has one of the most Paris Agreement-compliant goals among the developed countries – according to some calculations, its 2030 pledge to reduce emissions by 68 % compared to 1990 has a gap of only 1 % for 2030 and 3–5 % for 2035 goal [9]. However, policies, finance and action are still considered "insufficient" [15]. As one may see, even though Japan's NDC is considered less ambitious than the overall goal of the EU and countries like the UK and the US, only some individual EU states have a lower ambition gap. Meanwhile, Japan's NDC is more ambitious than the one of South Korea (29–32 %) and China (52–79 %), not to mention countries with conditional targets [9]. It is also worth noting that the gap values may have varied had the methodology used in this study been applied to each country.

Latvian and Lithuanian policy documents mention behavioural change and the role of education as necessary to reach climate goals. Latvia also mentions that LULUCF will play a significant role in carbon neutrality. Meanwhile, Japanese policy documents focus on innovations, such as CCS, and do not explicitly mention lifestyle change. In addition, behaviour change focuses more on efficient energy use and consumption, including in the transport sector, but does not include the role of food.

Despite some differences in energy strategies, the three countries could collaborate on solar power, off-shore wind power, and hydrogen technologies. There have already been joint projects between Japan and the EU on advanced biofuels and the new generation of concentrator photovoltaics. Much of the technological collaboration has been going through the EU-Japan ties. However, there may also be opportunities for the private sector to engage. Significant differences between Japan and the two Baltic states include the role of ammonia and CCS.

Future studies may benefit from the overview of the impact of civil society, academics, and green-oriented businesses. Some municipalities, NGOs, academia, and businesses in all three countries have taken action to become role models in decarbonisation. In addition, a more thorough analysis of implementation gaps remains outside this study's scope. The analysis concludes that despite constant improvements in climate policies in all three countries, the pace and scale still need to be improved, with a considerable ambition gap for 2030 projections in all three countries.

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