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Just Transitions to
Decarbonisation in the
Asia-Pacific

Just Transitions in Japan

June 2022

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About Just Transitions to Decarbonisation in the Asia-Pacific

Working in partnership with teams from the UK Science & Innovation Network, the programme examines how just transitions whilst tackling climate change and biodiversity is key to supporting inclusive economies and societies in the future. Through the programme, the Academy awarded funding to seven research projects exploring the actions required in the Asia-Pacific to tackle climate change and biodiversity loss, to identify opportunities for decarbonising economies and societies, and to recommend options and pathways for communities, workers, businesses, policymakers and the wider public. The programme was funded by the UK's Department for Business, Energy and Industrial Strategy.

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Executive summary

This report outlines key issues for a just transition in Japan. Despite its status as a high-emitting nation and international criticism for reliance on fossil fuel power generation, Japan has only explicitly engaged with just transitions thinking to a limited extent. Nevertheless, the impacts of the Fukushima nuclear disaster on adjacent host communities, plus recent experience of difficulties faced by former coal-mining municipalities, show awareness within Japan of how energy and sustainability transitions may disproportionately affect less empowered people or places. Given Japan's location in the Asia-Pacific region and the resource constraints it faces, understandings of how just transition thinking can develop in Japan may be of significant value to other industrialising (or decarbonising) nations.

The report first reviews existing understandings and interpretations of a just transition in Japan. Japan's core climate change plan makes reference to the need for a just transition in the context of protecting jobs and regional economies during the net-zero transition. There is a groundswell of engagement by local governments on decarbonisation, with the aim of attaining net-zero carbon dioxide emissions by 2050. NGOs emphasise the importance of fossil fuel and nuclear power sector workers' jobs, and support for municipalities who rely heavily on revenue from thermal power stations.

The second part of the report reviews regional challenges and opportunities, as they relate to the vision for decarbonisation laid out by Japan's national government. Available regional data indicates that more rural regions such as Hokuriku and Tohoku may have a higher proportion of the labour force involved in activities such as thermal power generation, steel manufacturing and petrochemicals refining, and that the largest workforce in carbon-intensive sectors in absolute terms may be located close to major urban centres of Kanto and Kansai. Conversely, regions such as Hokuriku, Tohoku and Kyushu may be best placed to benefit from net-zero jobs in renewable energy infrastructure, with opportunity to retrain or re-deploy existing workers and infrastructure. Further fine-scale data and better understanding of skills is needed to understand opportunities and challenges with certainty.

The third part of the report evaluates a case study of just transitions at a local level: Yubari City in Hokkaido, where a rapid phase-out of coal mining in the 1970s and 80s resulted in a loss of income in municipal bankruptcy. Yubari's efforts at sustainable urban planning and the work of third sector organisations since offers an illustration of how the lived environment can be transitioned to a more sustainable form.

The fourth section looks at jobs and skills required for climate adaptation and resilience. Jobs related to resilience, e.g. infrastructure upgrades, new-build or retrofit of climate-resilient housing, public health, may provide another pathway to a just transition for regions that may have less opportunity for net-zero jobs. Potential environmental and biodiversity concerns associated with wind energy, carbon capture and storage, port expansion and decommissioning of thermal power infrastructure are also reviewed.

The report finishes with recommendations across sectors. National and local governments are recommended to foster opportunities for exchange and mutual learning between localities facing similar challenges; and to ensure that municipalities in areas with heavy reliance on carbon-intensive activities are given the skills and resourcing to be able to respond early and comprehensively. Industry and labour unions are recommended to develop finer-scale audits on the skills and characteristics of workforces for sectors such as thermal power workers; and to explore potential for skills passports and certification in new industries such as wind turbine maintenance. Non-governmental and third sector organisations are recommended to engage pro-actively with new renewables developments, especially offshore wind, to ensure strong local content in terms of jobs and economic uplift; and also to collaborate with locally-based NGOs, who may be better placed to initiate difficult conversations on just transitions in localities where carbon-intensive activities may be an important component of local identity. The report also identifies further research needs around finer-scale assessment of jobs and economic impacts and opportunities associated with decarbonisation in Japan (i.e. at prefectural or municipal level); and for ethnographic and in-depth research into how communities respond to the phase-out of thermal power infrastructure, by focusing on areas currently or soon to face the closure of thermal power plants.

1.0 Background and context

Rationale

This report provides an initial assessment of the contours of a just transition in Japan. Globally, there is notable interest in a just transition as an organising concept for ensuring that the transition to a net-zero and sustainable society does not disproportionately affect the least well-off or empowered places, and does not leave behind the places and people whose livelihoods are reliant on carbon-intensive activities. Yet despite Japan's status as a high-emitting nation and ongoing international criticism for a continued reliance on fossil fuel power generation, political actors in the country are only beginning to explicitly engage with what a just transition means for Japan. Nevertheless, the impacts of the Fukushima nuclear disaster on adjacent host communities, plus recent experience of financial difficulties faced by former coal-mining municipalities, indicate that there is awareness within Japan of the potential for energy and sustainability transitions to disproportionately affect less empowered people or places. This is reflected by a growing interest among Japan's environmental non-governmental organisations and researchers in understanding what a just transition means in a Japanese context, and in pushing the Japanese Government and high-emitting industries in the country to support a just transition. Given Japan's location in the Asia-Pacific region and the resource constraints it faces, understandings of how just transition thinking can develop in Japan may hence be of significant value to other industrialising (or decarbonising) nations in the Asia-Pacific and beyond.

2.0 What does a just transition mean in the Japanese context?

Key Insights

- Understandings of a just transition are still emerging in Japan, with NGOs, as well as some researchers, media and political actors, beginning to use just transitions language and consider the just transition implications for Japan specifically;
- Key drivers of a just transition in Japan at present are environmental NGOs and civil society organisations, as well as some communities themselves;
- Emergent issues for a just transition in Japan include considerations for workers in thermal, nuclear, steel and automotive sectors; understanding of implications for municipalities who are heavily reliant on carbon-intensive infrastructure for tax revenues; and building capacity at local government level to manage just transitions;
- Whilst explicit consideration of just transitions in Japan is still emerging, there is a much longer history of successful – and unsuccessful – attempts by local governments, labour unions and industries to transition localities away from fossil fuel economies in Japan in response to energy or economic circumstances. These historical examples of coal and industrial transitions can give insights into ‘what works’, and what does not, when it comes to local-level transitions with an explicit climate change component.

2.1 Definitions and understandings of just transition from key actors in Japan

To date, the concept of a ‘just transition’ (translated directly as 公正な移行) has received only limited attention within Japan. Japan’s overarching climate change plan makes brief reference to the inclusion of just transitions in the Paris Agreement, and to the importance of avoiding job losses and considering regional economies and businesses during the net-zero transition (Ministry of Environment, 2021b). Nevertheless, Japanese environmental NGO Kiko Network, a group with a strong focus on expediting the phase-out of Japanese coal-power domestically and overseas, in autumn 2021 published a report on what a just transition may mean for Japan (Kiko Network, 2021). Kiko Network estimates that 151,000 workers are employed in fossil fuel and energy-intensive industrial sectors in Japan, contributing 4,510 Billion Yen (approximately £35 billion) to the national economy. The Kiko Network report suggests that the closures of coal-fired power stations, steelworks and car manufacturing plants show the need for policy measures to support a just transition in Japan; and that Japan’s experience with the closure of coal mines offers insights

for what a just transition requires in a Japanese context. Kiko Network point out that early planning, collaboration between national and local governments and industry and trade unions, and follow-up consultations with workers all contributed to a successful transition for at least some parts of Japan's coal industry.

Interviews with key stakeholders conducted for this project similarly indicated that just transition thinking is at a very early stage for Japan as a whole, and indeed that the term 'just transition' does not have a long history of explicit use in documents or statements within Japan. A core component of emerging NGO activity on just transitions in Japan is focused very much on transitioning the national energy system away from coal-fired power, and in understanding what this may mean for communities and regions that currently rely on coal power stations for employment. Compared to European or North American contexts, labour unions arguably have a much less prominent role in Japan in driving forwards just transitions. Key drivers of a just transition in Japan at present are environmental NGOs and civil society organisations, as well as some communities themselves. Moreover, respondents also noted that discussions of 'justice' are less explicit in a Japanese context, and tend to be considered in terms of their legal implications rather than in terms of fairness to workers or communities and regions whose livelihoods may be negatively affected by a rapid and unmanaged transition away from carbon-intensive activity.

2.2 Just transition in government plans and policies in Japan

National government plans, policies and statements

Japan's Sixth Strategic Energy Plan was released in October 2021. The plan has the goal of reaching carbon neutrality by 2050, noting that energy accounts for approximately 80% of Japan's greenhouse gas emissions. The plan aims to reduce emissions by 46% (aiming towards 50%) by 2030 (from a 2013 baseline) (METI, 2021). According to the plan, by 2030 renewable sources are expected to account for 36-38% of electricity generated (solar 15%, wind 6%, geothermal 1%, bioenergy 5%, hydro power 10%). By 2030, nuclear is planned to make up 20% of Japan's electricity mix; gas 20%, coal 19% and oil and other sources 2%. The plan states that the longer-term goals of carbon neutrality by 2050 will be achieved by putting top priority on *renewable energy sources* – namely, solar photovoltaic, onshore wind, and offshore wind; with the creation of renewable energy promotion areas on-land and the identification of priority areas for offshore wind development. The plan, however, also includes new innovations in *thermal power* as a 'stable' baseload for Japan's energy system, with the aim of lowering the use of thermal power in the energy mix as far as possible and utilising co-firing with hydrogen and ammonia plus use of carbon capture and storage (CCS) technologies to further lower emissions. *Nuclear power* is also included within the plan, however its role is less clear and safety and public trust-building are noted as critical factors prior to restarts.

In the core text of the Sixth Strategic Energy Plan, direct reference to fairness is made only in the context of fairness within markets and business environments – i.e. fairness for operators and developers, rather than consumers and workers in carbon-intensive industries. Similarly, engagement and cooperation with host communities and local governments for large-scale energy infrastructure to enable a fair energy transition focuses largely (albeit not exclusively) on issues relating to nuclear power; or for understanding regional capacity to implement renewable energy infrastructure.

Underpinning the Sixth Basic Energy Plan is Japan’s Plan for Global Warming Countermeasures (Ministry of Environment, 2021). This sets the target of a carbon-neutral society by 2050, and a 46% (aiming for 50%) reduction in carbon dioxide emissions by 2030. Japan’s climate change plan makes explicit mention of the need for a just transition in the context of providing support to prevent unemployment during aggressive decarbonisation, and also notes the need to consider regional characteristics plus the transition of local businesses and local economies as well as the labour force.

Japan’s government has also produced a ‘Roadmap to Beyond-Zero Carbon’, and in late 2020 laid out fourteen priority areas of green growth. These are potentially important for a just transition for carbon-intensive workers and regions, as they indicate areas in which there is likely to be growth and investment – and hence where jobs and economic opportunities associated with a net-zero society may lie. The priority sectors are split across energy (offshore wind; fuel ammonia; hydrogen; nuclear power); transport and manufacturing (mobility and battery; semiconductor and ICT; maritime; logistics, people flow and infrastructure; foods, agriculture, forestry and fisheries; aviation; carbon recycling); and home/office (housing and building, next generation photovoltaic; resource circulation; and lifestyle related industry) (METI, 2020).

Figure 1. Technical approaches to energy and climate mitigation within Japan Pavilion at COP26, November 2021

From top left: hydrogen society; offshore wind; carbon capture and storage; regional renewables



In public-facing rhetoric around COP26 and climate change actions more widely, the Japanese Government has frequently placed heavy emphasis on technological approaches to reducing emissions from energy sources, especially hydrogen technologies, carbon dioxide capture and storage, and large-scale wind installations (see Figure 1). These may have implications in terms of (a) the regions and localities that are expected to host storage and production facilities, versus where energy is required; and (b) the cost and availability of energy, especially given the current high price of hydrogen to consumers and lack of transportation infrastructure. Climate think-tank TransitionZero, in a report launched in early 2022, argued that the advanced coal technologies to which the Japanese Government referred at COP26 - ammonia co-firing, coal gasification (IGCC) and CCS - would be both costly and incompatible with net-zero targets (TransitionZero, 2022). TransitionZero instead called for a greater emphasis on renewables, especially offshore wind, and only for very limited and targeted use, if at all, of ammonia and CCS.

Offshore wind is hence gaining traction as a critical decarbonisation strategy for Japan, with the Ministry of Economy, Trade and Industry in autumn 2021 identifying 22 locations off the Japanese coast for upcoming and future licensing rounds, following the 2018 Offshore Renewable Energy Act. From a just transition perspective, however, there remains a need to ensure strong local content - as seen with the Goto Project in Nagasaki Prefecture (Japan's Floating Offshore Wind Group, 2021) - and to allay fishers' concerns about the effects of offshore wind on livelihoods.

At the time of finalising this report, Russian President Vladimir Putin launched a violent and aggressive invasion of Ukraine, supported by Belarussian President Alexander Lukashenko. Japan joined a breadth of 'Western' nations, including the UK, USA and the European Union, in imposing severe sanctions on Russia in response. Although it is not possible at present to predict with certainty what the impact of these sanctions will be on Japan's energy mix, let alone how this might affect the economic and employment prospects of Japan's carbon-intensive industries domestically, it is notable that major Japanese energy developers such as Mitsubishi, Mitsui & Co, Marubeni and Itochu own stakes in Russian LNG developments with Gazprom and Rosneft (S&P Global, 2022). With other operators such as Shell and BP withdrawing from projects in Russia and offloading their shares in Russian operators, it is likely that Japanese energy majors will come under increasing pressure, both domestically and internationally, to withdraw from projects in Russia. The Japanese Government and energy industries are also likely to face similar pressure to reduce - or eliminate completely - imports of fossil fuel energy from Russia. Prior to the invasion, Japan was already diverting LNG towards Europe and the USA to support energy security as the Ukraine crisis escalated (Reuters, 2022). From a just transition perspective within Japan, an important issue to follow will be to what extent - and with what - energy previously sourced from Russia is replaced; and whether Japan turns to alternative energy sources (e.g. nuclear power, prolonging life of existing coal plants) to free up LNG for the USA and European countries with greater need in the absence of Russian gas.

Just transitions in Japan at local and regional government levels

Local governments across Japan are also beginning to take the initiative and come to prominence as enablers of just transitions in their own locality. In summer 2021, Kyoto City Government became the first Japanese member of the Powering Past Coal Alliance, with a view to removing coal power from its local energy mix and encouraging the national government to expedite a phase-out of coal power. Fukushima Prefecture has also set the target of producing 100% of its energy from renewable sources by 2040 (Fukushima Prefecture, 2018). Japan's national ministry of environment keeps an inventory of local governments who committed to take actions towards net-zero carbon dioxide emissions by 2050, and by late 2021 had recorded 479 local governments (or 87.9% of all local governments in Japan) with policies related to net-zero (Ministry of Environment, 2021a). Within the Ministry of Environment inventory, however, there is no explicit mention of just transitions (although this is not to say that the term may be mentioned within local governments' own policies), and only one municipality – Hirono Township in Fukushima Prefecture – which makes explicit reference to transitioning a thermal power station workforce towards renewables.

Nonetheless, whilst some local governments are taking a leading role in initiating just transitions in Japan, there is difference in capacity and capability to engage with just transitions thinking – both domestically and internationally – between localities and regions. A particular concern is that local governments in some of the places that may need to engage most deeply with a just transition may lack the staffing or resourcing to engage. These concerns relate to skills and resourcing – with some local governments struggling for resourcing against a backdrop of declining populations and tax returns – and to the knowledge of energy and climate issues (as well as English language) in some local governments. In other words, there is a need to ensure there is good capacity to understand and engage with just transitions in all local governments, and not only in 'pioneer' or flagship cases.

3.0 Understanding the geography of a just transition in Japan

Key Insights

- Particularly in more rural regions of Japan, carbon-intensive activities such as employment in thermal power stations is a relatively large proportion of the total workforce;
- Regions with the highest opportunities for development of net-zero infrastructure do not necessarily match up to the regions where carbon-intensive activities make up a larger proportion of the workforce;
- For rural areas with high renewables potential such as Tohoku, Hokuriku and Kyushu, consideration of how to link energy, manufacturing and construction jobs will be crucial to bring local benefit from renewable energy deployment.

3.1 Regional challenges under Japan's net zero transformation

Jobs associated with the most carbon-intensive industries can be estimated to understand which regions may rely most heavily on particular activities for employment and economic benefit (see Table 1 and Figure 2). As well as absolute numbers, it is important is to look at the relative proportions of the workforce between regions, and use this as a starting point to consider which regions may face the biggest impacts and require the greatest support in helping Japan to meet its climate obligations.

Table 1. Estimation of carbon-intensive jobs in major emitting sectors by region

Region	Fossil fuel power	Steel	Petro-chemical	Nuclear*	Vehicle**	Paper**
Hokkaido	456	1041	815	598	2689	16160
Tohoku	1613	1760	788	2375	10757	18469
Minami-Kanto	3216	1760	6597	N/A	18824	N/A
Kita Kanto-Koshin	928	1760	1070	318	32270	20778
Hokuriku	935	1760	N/A	6187	2689	13852
Tokai	2339	3246	2722	1046	86054	46173
Kinki	1695	7374	2595	N/A	16135	27704
Chugoku	1084	530	3044	370	10757	16160
Shikoku	552	530	750	585	N/A	16160
Kyushu	1279	5666	739	1521	18824	11543
Okinawa	110	N/A	N/A	N/A	N/A	N/A

* whilst not 'carbon intensive' per se, nuclear is included for context as nuclear power workers are frequently considered in Japan within the context of a just transition. Note also that the Fukushima Dai'ichi plant is excluded from this estimate, as jobs there concern engineering and environmental management rather than power generation.

** figures for vehicle manufacturing and paper and pulp are estimates based on industry association figures.

Figure 2. Regions of Japan set out in Japan Labour Force Survey



The figures estimated in Table 1 give a sense in absolute terms of where the workforce in carbon-intensive sectors – and hence where people who may be likely to be affected by Japan’s transition to a net-zero society – may be located. What is immediately noticeable is that the region with the greatest number of fossil fuel power sector workers and also petrochemicals workers, is Minami-Kanto – in other words, the Tokyo metropolitan area. This is perhaps not surprising given the number of thermal power stations and oil refineries that are located around Tokyo Bay, and the associated demand generated by the significant population concentration in the area. The Kinki Region – in particular Osaka and the industrialised coast of Hyogo Prefecture – hosts the largest share of steel jobs; followed by Kyushu, again unsurprising given the long history of steelmaking in the Kitakyushu area. Similarly, the large number of vehicle manufacturing jobs in the Tokai region intuitively makes sense if one considers that Toyota is headquartered in Nagoya. Two points that are notable, however, are (a) the large petrochemical refining capacity and associated jobs in the Chugoku area to the south-west of Japan; and (b) the very high number of nuclear power sector workers in the largely rural Hokuriku region.

More useful in terms of understanding which regions may face the most pressure and require the most support for a just transition is, however, the *relative* sizes of the workforce in each region as a proportion of the overall regional labour force. Figure 3 shows the number of workers in each region in the most carbon-intensive activities outlined in Japan’s submission to the Paris Agreement (as above) as a proportion of the total labour force in each region listed in the 2020 Japan Labour Force Survey.

Figure 3. Workers in carbon-intensive activities as a proportion of the total regional labour force in Japan

Region	Fossil fuel	Steel	Petro-chemical	Nuclear*	Vehicle**	Paper**
Hokkaido	<	>	>	<	<	>
Tohoku	^	>	<	>	<	>
Minami-Kanto	<	<	>		<	
Kita Kanto-Koshin	<	<	<	<	>	>
Hokuriku	^	^		^	<	>
Tokai	>	>	>	<	^	>
Kinki	<	^	<		<	<
Chugoku	>	>	^	>	>	>
Shikoku	>	<	>	<		^
Kyushu	<	^	<	<	>	<
Okinawa	<					

- ▲ Comparatively very high proportion of workforce (>1 SD above average)
- > Above-average proportion of workforce (0-1SD above average)
- < Below-average proportion of workforce
- Not applicable/no major infrastructure in region

* whilst not ‘carbon intensive’ per se, nuclear is included for context as nuclear power workers are frequently considered in Japan within the context of a just transition. Note also that the Fukushima Dai’ichi plant is excluded from this estimate, as jobs there concern engineering and environmental management rather than power generation.

** figures for vehicle manufacturing and paper and pulp are estimates based on industry association figures.

In Figure 3, it is notable that there is a very high proportion of fossil fuel power workers in Hokuriku and Tohoku regions, and an above average proportion of workers in the Tokai, Chugoku and Shikoku regions. This may prove especially challenging for Hokuriku and Tohoku Prefectures, and also Shikoku, given that they are largely rural regions with fewer immediate opportunities for changing employment than, say, the industrial coastal centres of Tokai or to a lesser extent Chugoku. From an environmental justice perspective, it is also worth pointing out that Tohoku and to a lesser extent Hokuriku are host to several thermal power stations which provide power for major urban centres (especially Tokyo) rather than the people living in the immediate vicinity.

3.2 Regional opportunities under Japan's net zero transformation

Japan's Roadmap to Beyond Zero Carbon (METI, 2020) identifies 14 priority green growth sectors. These can be condensed into five broad categories of industries and jobs may offer region-specific opportunities for fair and decent net-zero jobs, and which may be able to draw on the skills and infrastructure of carbon-intensive regions in Japan and their workforces (see Table 2).

Table 2: growth sectors within Japan's Roadmap to Beyond Zero Carbon which may have potential to support a regional just transition (adapted from METI, 2020)

Sector	Types of job
Wind power	Manufacturing of wind turbines Installation of wind turbines Operation and maintenance of wind turbines
Hydrogen, CCS and fuel ammonia	Construction of combustion burners Production of fuel ammonia Production of turbines for power generation Installation and maintenance of hydrogen heating and fuelling infrastructure Operation of ports for import of hydrogen from overseas Operation of carbon dioxide storage sites Construction of carrier ships for hydrogen and CO ₂ Operation of carrier ships for hydrogen and CO ₂
Mobility and battery	Manufacturing of electric vehicles and fuel cell vehicles
Housing and building	Retrofit and new-build of e.g. solar cells, heat pumps.
Nature-based	Nature-based solutions-related: - climate-smart agriculture; - forestry for carbon sequestration; - 'blue carbon' marine carbon sequestration.

It is more challenging to estimate the size of the regional jobs opportunity associated with current or emergent net-zero initiatives, given that the industries in cases do not yet exist. It is possible, however, to get a sense of the relative sizes of the current labour forces in each region and to understand how these may match up to future jobs and skills requirements at a regional level. Figure 3 shows key sectors and job families from the Japan Labour Force Survey that match up to the net-zero action requirements laid out in Table 2 above, and indicates whether the labour force in each region is above, at, or below the average across Japan's regions. This can give a sense of how well each region may be currently placed to take advantage of net-zero job opportunities, and also to understand where there may be labour or skills shortages that could be filled by retraining workers currently employed in carbon-intensive industries.

Electricity, gas, heat and water supply jobs may be relevant to the deployment of wind power; the operation of hydrogen, CCS and fuel ammonia infrastructure; and the installation/retrofit and maintenance of energy-efficient apparatus in residential and commercial settings. *Manufacturing* jobs may be relevant to the manufacturing of wind turbines; the building of new ships to carry carbon dioxide and hydrogen (given Japan's preference for ship-based as opposed to pipeline-based transport); and the manufacture of EV and FCV vehicles. *Construction* jobs may be relevant to the installation of on- and offshore wind turbines; and to the construction of new energy-efficient buildings and retrofit of old housing stock. *Agriculture and forestry* and *fisheries* workers may have the skills to realise nature-based approaches to climate mitigation, especially sequestration in forests or in kelp and seagrass beds.

Figure 4: comparative workforce sizes for sectors relevant to net-zero jobs within Japan (source: Japan Labour Force Survey)

Region	Electricity, gas, heat, water		Manufacturing		Construction		Nature-based		
	Opp	Labour	Opp	Labour	Opp	Labour	Opp	Labour	
								Agric/Forest	Fish
Hokkaido	^	-	-	<	-	-	^	-	-
Tohoku	^	-	-	-	^	^	<	^	-
Minami-Kanto	-	-	-	-	-	<	<	<	<
Kita Kanto-Koshin	<	^	-	^	-	-	-	-	<
Hokuriku	^	^	-	-	-	-	^	-	<
Tokai	-	-	^	^	-	<	-	-	-
Kinki	-	-	-	-	<	<	<	<	-
Chugoku	-	-	-	-	^	-	<	-	^
Shikoku	-	-	-	-	^	-	^	^	^
Kyushu	^	-	^	-	^	-	^	^	-
Okinawa	<	<	<	<	-	^	-	-	<

- ▲ Comparatively very high proportion of workforce (>1 SD above average)
- Average proportion of workforce (0-1SD above average)
- < Comparatively very low proportion of workforce (<1 SD below average)

Worth noting from Figure 4 is that in the Hokkaido, Tohoku and Kyushu regions, the size of the electricity, gas, heat and water workforce may be slightly smaller in comparison to the size of the opportunity that may arise from wind energy potential. In the case of Tohoku though, Figure 3 previously showed that Tohoku has a disproportionately large fossil fuel power workforce. It may thus be the case that jobs in renewable energy offer a pathway to a just transition for Tohoku's fossil fuel power workers in particular. The large electricity, gas, heat and water workforce in Hokuriku appears to match well with the wind energy potential and carbon capture and storage potential in the region, and also the large proportion of fossil fuel and nuclear power workers in the region. In the Kita Kanto-Koshin region north of Tokyo, by contrast, the relatively large electricity, gas, heat and water workforce is perhaps not matched by the potential for jobs in renewables and net-zero infrastructure.

In terms of manufacturing, again in Kyushu and Hokkaido the size of the workforce may be relatively small in comparison to the opportunity for renewables. In Kyushu and to a lesser extent Hokkaido, the large proportion of steel workers may mean there is an opportunity to draw on existing skills and infrastructure in steelmaking, and to expand the manufacturing sector, to produce offshore wind turbine components locally. Indeed, the Goto Offshore Wind Demonstrator in Kyushu and the Muroran Offshore Wind Promotion Association in Hokkaido are both placing significant emphasis on potential for local content in the offshore wind supply chain (Japan's Floating Offshore Wind Group, 2021; Muroran Offshore Wind Industry Promotion Association, n.d.). The large manufacturing workforce in Tokai can be explained by the high number of vehicle plants in the region, especially those belonging to Toyota, where transitioning these plants to EV and FCV production may offer a pathway to a just transition.

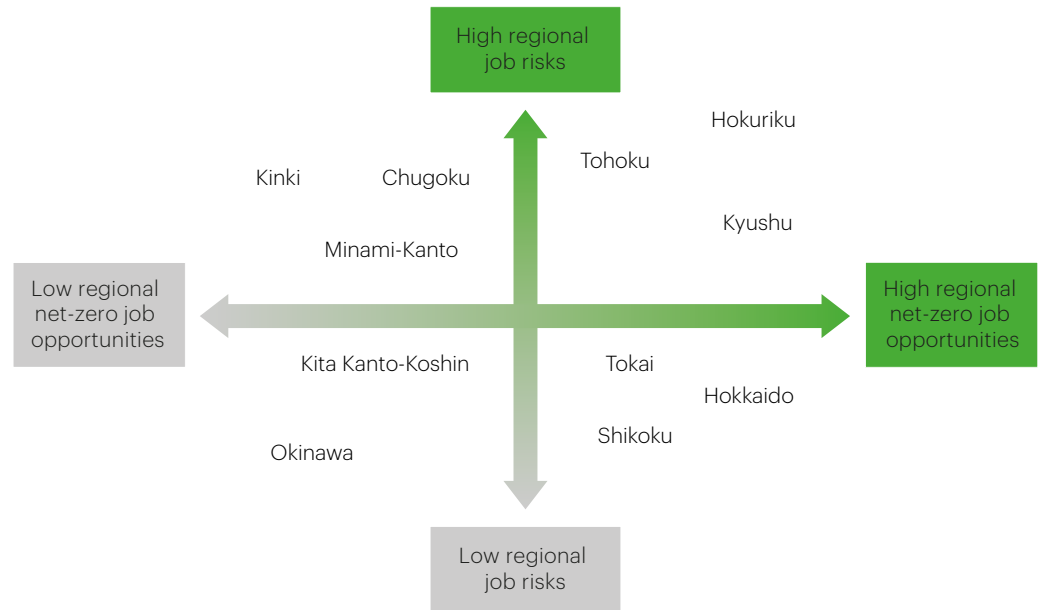
In the construction sector, in the southern regions of Chugoku, Shikoku and Kyushu, the combination of high residential solar potential plus ageing housing stock means there is high opportunity for jobs in retrofit and new-build of energy-efficient buildings (and also, in Kyushu, installation of wind turbines). This may offer a retraining just transition opportunity for Chugoku in particular, which has a high proportion of workers across carbon-intensive sectors.

Although the size of the nature-based jobs sector for mitigation may be small, it is nonetheless noteworthy that Shikoku has a large farming, forestry and fisheries workforce concomitant with its land- and sea-based carbon sequestration potential. In Hokkaido and to a lesser extent Kyushu, there is a notable nature-based jobs potential in relation to the workforce proportion. Climate adaptation and resilience jobs are discussed later on in this report, and findings suggest that stewardship of land- and sea-based carbon sequestration (e.g. climate-positive agriculture, forestry, blue carbon) may offer opportunities for land-based workers in the event of changes in productivity or consumption patterns.

3.3 Regional just transition opportunity summary

Figure 5 summarises the previous sections by dividing the regions of Japan into four groups.

Figure 5: Regions of Japan according to climate job risk versus climate job opportunity



The *high-risk high-opportunity* regions of Hokuriku, Kyushu and Tohoku are regions where workers in carbon-intensive sectors make up a comparatively large proportion of the workforce, but also where there are significant opportunities in terms of on- and offshore wind (all 3 regions); shipbuilding to support a hydrogen and ammonia economy (Kyushu); and carbon capture and storage (Hokuriku and Tohoku). In these regions, strong local content policies and support to ensure workers' skills, acquired during carbon-intensive activities, remain relevant will be necessary to ensure local workforces and communities can take advantage of opportunities and ensure a just transition.

The *low-risk high-opportunity* regions of Hokkaido, Tokai and Shikoku are regions where the risks to the labour force are comparatively lower (although there are still notable sites of carbon-intensive infrastructure in each region), but where there is significant opportunity for fair and decent work in support of a net zero Japan. In Hokkaido, these opportunities come in the form of on- and offshore renewables and carbon capture and storage. In Tokai, the main opportunity is related to production of EVs and FCVs to support a transition from current petrol-powered vehicle production. In Shikoku, opportunities come from retrofit or new-build housing, in response to ageing housing stock and high solar PV potential, and also shipbuilding to meet hydrogen and carbon dioxide transport needs. In these regions (especially the more rural regions of Hokkaido and Shikoku), it may be necessary to take measures to ensure the workforce and new infrastructure are in place to enable the regions to take advantage of opportunities that arise.

The *high-risk low-opportunity* regions of Chugoku, Kinki and Minami-Kanto are regions where there is a relatively high carbon-intensive workforce, and fewer immediate opportunities to offset these risks with net-zero jobs. In Chugoku, there is a comparatively large petrochemicals workforce, with limited potential for wind energy (albeit significant potential for jobs in energy efficiency via retrofit and new-build residential housing, and opportunities for shipbuilding). In both Minami-Kanto and Kinki regions, the sheer numbers of people employed in fossil fuel power generation, petrochemicals and steel (especially Kinki) represents a challenge for a just transition, even if the workforces are not necessarily large in proportion to the overall regional workforce. In these regions, on- and offshore renewable energy and carbon dioxide storage potential is limited. For regions in this group, it may be important for governments and industry to consider how regional carbon-intensive industries may be reappropriated to provide benefits to Japan as a whole through regional cooperation. For instance, steel making and shipbuilding in Kinki and Chugoku may support offshore wind and hydrogen economies elsewhere in Japan; whereas petrochemicals and LNG imports in Chugoku and Minami-Kanto may (if handled sensitively) support imports of hydrogen from overseas and/or domestic low-carbon production of hydrogen and fuel ammonia.

Finally, the *low-risk low-opportunity* regions of Kita Kanto-Koshin and Okinawa are regions where there is not a specific risk to the workforce, but also few identified opportunities for growth via net-zero jobs. Kita Kanto-Koshin does however have carbon-intensive infrastructure in the form of thermal power and vehicle manufacturing. It is worth noting in the case of Okinawa, however, that the relatively small labour force size and the distinctive regional characteristics (i.e. population distributed across islands, each of which requires energy infrastructure and distribution) may make comparison with other regions challenging. In these regions, whilst there may not be a single stand-out issue that is faced, it is nonetheless important to develop a fuller understanding of just transition challenges that may be faced at the local level (and which may not readily be apparent from high-level workforce data alone) and to ensure that the regional workforce and infrastructure on the whole is well-suited to respond to locally-specific challenges.

4.0 Place-based approach to just transitions: the case of Yubari

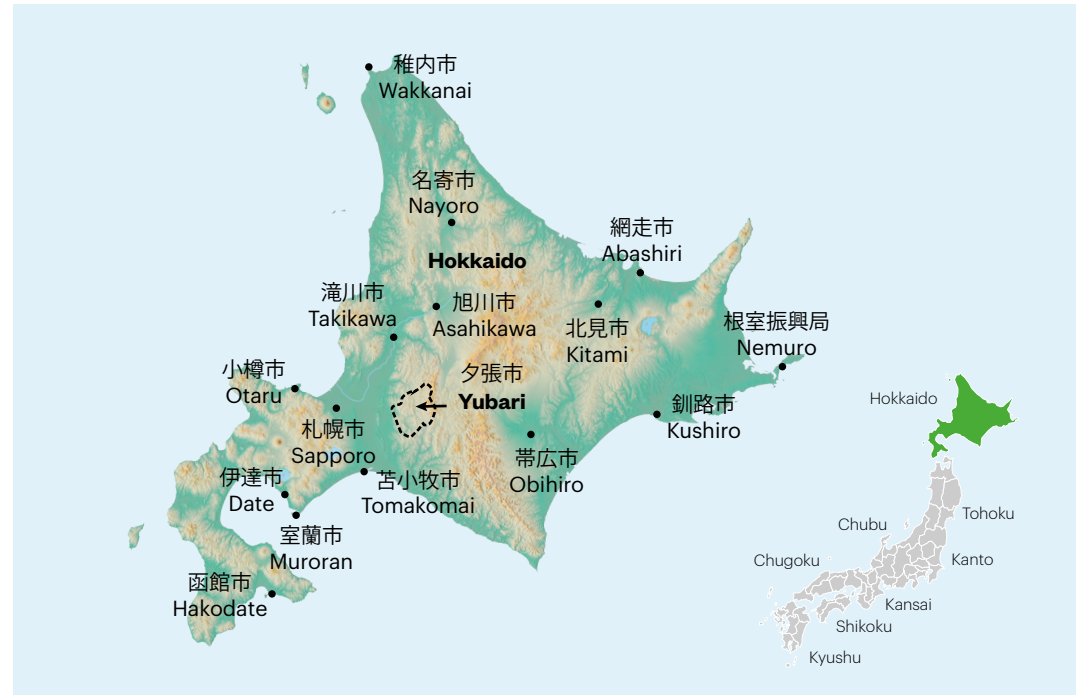
Labour force statistics and regional infrastructural inventories can give a sense of where current carbon-intensive infrastructure and labour forces may be located in relation to where opportunities may arise. However, what regional statistics cannot illustrate are the place-based aspects of just transitions. It is broadly acknowledged in the social sciences that as well as affecting labour forces and local economies, transitions away from carbon-intensive activity can have profound implications on the lived environment, and on people's sense of place and identity. To illustrate what all of this might mean in the Japanese context, this section presents the case study of Yubari in Hokkaido. Yubari offers an example of a rapid but un-managed transition away from fossil fuel activity, specifically coal mining, that had significant negative consequences for the local economy and workforce. At the same time, more recent government and civil society activity in Yubari also offers insights into how a carbon-intensive locality can transition into a more sustainable and equitable form through reorganisation of the lived environment.

Key Insights

- Yubari is often considered a 'classic' case of why a place-based transition matters in Japan within scholarly literature and international media reporting on energy matters within Japan;
- Urban planning responses to the legacy of carbon-intensive activity on the built and lived environment are an important enabler for a just transition;
- Civil society organisations have an important role in sustaining community resilience and enabling community learning in the post-fossil fuel transition.

Geography and environmental characteristics

Figure 6: location of Yubari within Hokkaido



Yubari is located in Sorachi Subprefecture in central Hokkaido, Japan's northernmost island (see Figure 6). The city developed along the Yubari River and its tributaries, and is located on the Ishikari coalfield. Yubari is bounded by mountain ranges to the west and east. To the east, there is also Lake Shuparo – created artificially by the construction of the Shuparo Dam – and Mt. Yubari. In common with much of Hokkaido, Yubari experiences significant snowfall in winter, although levels of snowfall have been markedly lower in recent years as a result of climate change. The area in which Yubari is located is also seeing changes in ecology and biodiversity which are linked to climate change (as well as a longer-term decline in predators), such as expansion of bamboo grasses and deer populations.

Industrial history and current status

Through the earlier part of the 20th Century, Yubari was one of Japan’s major coal-mining regions, the population of the city reaching approximately 120,000 people by the 1960s. However, broader shifts in Japan’s energy mix away from coal and towards oil, gas and nuclear power (with coal for thermal power increasingly being imported from overseas) led to the gradual closure of the city’s mines. The last mine closed in the early 1990s. Many mine workers had come from elsewhere in Japan to work in the coal industry, and hence moved elsewhere to seek other opportunities once the mines closed rather than remaining in Yubari. Subsequent attempts to replace the major employment provided by coal mining with large-scale tourism-related economic activities largely failed. Coupled with an already ageing and declining population in line with broader trends in rural Japan, the loss of employment and tax revenue led to Yubari City effectively declaring bankruptcy in 2007. Yubari’s population has continued to decline, and of 2022 is just over 7,000 people.

What is significant about Yubari is the physical legacy left by coal mining on the built and lived-in environment, and the challenges this raises for transitioning to a just and sustainable society (see Figure 7). A significant contribution to the city bankruptcy was the legacy of large-scale physical infrastructure – schools, hospitals, housing – built to support the coal industry, for which the city had to assume liability after the end of mining. Moreover, the urban development pattern of Yubari, with different districts built up alongside coal deposits and mine entrances, led to a small population scattered over a large area after the end of mining activities. It has also been reported anecdotally that the different corporate and organisational structures of the two main mining companies – Hokkaido Coal to the west and Mitsubishi Coal to the east – were reflected in different community and household cultures between the various districts of Yubari.

Figure 7. Former coal workers’ housing in Shimizusawa, Yubari



Coal mining left a legacy of pollution (albeit minor) as well as infrastructure in Yubari, which the city government and third-sector organisations have had to deal with. Interviewed residents reported how in the past, the rivers of Yubari would run black due to discharges from coal-washing processes, to the extent that children would colour rivers in black when they drew landscapes in school. Slag heaps/spoil tips left by the coal industry, whilst not necessarily containing any materials that are immediately dangerous to the surrounding environment, nonetheless contain wires, rails and other artificial materials. Whilst not posing any immediate danger, these slag heaps also require monitoring and management to ensure they do not collapse, especially after seismic activity such as the 2018 Eastern Iwate Earthquake.

What can Yubari teach us about just transitions in Japan and beyond?

Yubari is perhaps the best-known example internationally of the regional challenges associated with fossil fuel transitions in Japan. Yubari's bankruptcy, population shrinkage and vacant buildings have received coverage in diverse media outlets (Daily Mail, 2016; Hendy, 2014; NHK World Japan, 2018). Such coverage tends to focus on empty and decaying buildings and on the decline of Yubari, often employing imagery of vacant and derelict land to portray a cautionary tale of what may lie ahead for other carbon-intensive areas of Japan and beyond under concomitant pressures of energy transitions and ageing and declining populations. What has received less attention, however, are the more recent efforts that are happening at the municipal and community level to create a resilient and sustainable society within Yubari. In this sense, Yubari is working towards a post-hoc just transition, in that efforts to redress inequalities and mitigate the impacts of post-fossil fuel transitions come after the city has already experienced negative economic and social effects from a transition away from coal.

Yubari City Government has initiated a long-term urban planning strategy to move residents towards a core area in the centre of the city area, with a view towards reducing the need to provide services and utilities to peripheral areas. This is supported by the construction of a new community hub, and housing to both support an ageing population and attract younger residences. These measures are bolstered by a social welfare programme to reduce childcare and schooling costs. In other words, physical relocation and re-shaping of the post-coal environment is underpinned by a broader suite of social welfare and social policy measures (Mabon & Shih, 2018).

Figure 8. Walking tour of former Shimizusawa Station hosted by Shimizusawa Project NGO



The *Shimizusawa Project* NGO (<https://www.shimizusawa.com/>) for instance coordinates a breadth of activities across Yubari aimed at enabling learning from Yubari's coal-mining history whilst supporting community resilience and well-being (see Figure 8). Shimizusawa Project has its offices in former company housing for coal miners, which it uses as a community space as well as flexible working space and accommodation for visiting artists and researchers during residencies. Shimizusawa Project uses the 'ecomuseum' concept to promote small-scale and informed learning about Yubari's industrial heritage among visitors from elsewhere in Japan and overseas, by enabling access to legacy mining infrastructure such as the now-closed Shimizusawa Thermal Power Station, old miners' housing, and the slag heaps left behind by coal mining. The NGO also supports a breadth of activities within Yubari to support societal wellbeing and resilience in the face of the challenges they city faces, including *kodomo shokudo* (a children's cafeteria where children can eat meals for free or at very low cost), a regular town walk to encourage residents and visitors to support local businesses, and environmental education activities to support recreation and interaction among the biodiversity that has emerged on the former slag heaps left by the mining industries.

Similarly, the *Yuparikozakura no Kai* NGO – a group established to protect the rich biodiversity of Yubari's mountains, and especially the *Yupari kozakura* flower – has a strong focus on environmental education, in particular encouraging the city's residents to build awareness of the rich nature in their surroundings. The group – along with others – works to ensure environmental protection on Mt. Yubari through surveying and monitoring plants, providing advice and guidance to walkers, and conducting regular patrols to guard against theft of rare plants. Re-establishing connections with nature, and promoting outdoor recreation, is considered an important strategy for maintaining connectivity and supporting wellbeing during the transformation of Yubari into a post-coal city.

Nonetheless, a key emerging concern of civil society actors within Yubari is around stigmatisation through association with (a) the financial difficulties faced by the city following its bankruptcy in the late 2000s; and (b) potential negative associations with coal and the coal industry as broader awareness of the environmentally harmful impacts of coal spread across Japan post-COP26. There is particular concern that young people who live in and grow up in Yubari may face stigmatisation through association with the coal industry.

To learn more about the past and present of Yubari, explore the ‘virtual field trip’ created as a project output: <https://energyvalues.wordpress.com/2022/03/02/yubari-virtual-field-trip/>

5.0 Just transitions, climate change adaptation and biodiversity

Key Insights

- Despite its long history of experience with hazards and disasters, Japan is still at significant risk from climate change impacts and requires major additional adaptation and resilience actions;
- Adaptation and resilience jobs may provide additional and underexplored opportunities to support a just transition for carbon-intensive workforces, especially in more urbanised regions such as Kanto and Kansai;
- Continued consideration of any impacts or trade-offs between biodiversity and net-zero infrastructure will be necessary, although there are significant improvements in publicly-available environmental data for on- and nearshore wind.

Japan's long experience with natural hazards means the country is relatively well-equipped in terms of policy to be able to adapt to climate change (Hijioka et al., 2016). However, as indicated in the country's National Adaptation Plan, what is required is a step-change in the scale and extent of resilience-related infrastructure in order to be able to cope with climate extremes. Landslides in Atami, Shizuoka Prefecture in early 2021 and flooding in Kurume, Fukuoka Prefecture in summer 2021 illustrate the extent to which climate-related weather extremes may overwhelm existing infrastructure in Japan, and hence the need for investment in adaptation actions.

Figure 9 shows how the projected climate impacts and associated adaptation and resilience requirements by region match up to local labour forces. This is done by cross-referencing regional adaptation impacts identified in Japan's National Adaptation Plan (and relevant scholarly literature) with data from the Japan Labour Force Survey.

Just Transitions in Japan

Figure 9. Relation between regional climate impacts/adaptation requirements and regional labour forces for associated job families

Region	Adaptation area	Agriculture/forestry/fisheries		Water and resources	Disasters	Human health	Eco-systems	Cross-cutting		
		Agriculture, forestry	Fishery	Electricity, gas, heat, water	Construction	Medical care and welfare	Research/technical	Research/technical	ICT	Public affairs
Hokkaido	Risk	^	^	>	>	^	>			
	Jobs	-	-	-	-	-	-	-	-	>
Tohoku	Risk	>	>	>	>	^	-			
	Jobs	>	-	-	>	-	-	-	-	-
Minami-Kanto	Risk	^	^	-	-	^	>			
	Jobs	<	<	-	<	<	<	>	>	-
Kita Kanto-Koshin	Risk	>	>	-	^	^	-			
	Jobs	-	<	-	-	-	-	-	-	-
Hokuriku	Risk	^	^	^	^	-	-			
	Jobs	-	<	>	-	-	-	-	-	-
Tokai	Risk	>	>	-	^	-	>			
	Jobs	-	-	-	<	<	<	-	-	<
Kinki	Risk	-	-	>	^	-	>			
	Jobs	<	-	-	<	-	-	-	-	<
Chugoku	Risk	-	-	>	^	-	-			
	Jobs	<	>	-	-	-	-	-	-	-
Shikoku	Risk	^	^	-	^	>	-			
	Jobs	>	>	-	-	>	>	-	-	-
Kyushu	Risk	^	^	^	^	>	>			
	Jobs	>	-	-	-	>	>	-	-	-
Okinawa	Risk	-	-	-	-	^	^			
	Jobs	-	<	<	>	>	>	-	-	>

- Risk**
- ▲ Significantly higher impacts than Japan overall
 - > Higher impacts than Japan overall
 - Impacts at same level as Japan overall
 - No data/no significant impacts compared to Japan overall

- Jobs**
- > Large labour force (>1SD above Japan average)
 - Average labour force (within 1SD of Japan average)
 - < Small labour force (>1SD below Japan average)
 - No data/no significant impacts compared to Japan overall

What is worth noting from the matrix are points where the projected regional climate risk is high, and where the labour force is either significantly below average (pointing to a possible shortfall in workers and/or an opportunity for workers from carbon-intensive sectors to retrain and reskill) or significantly above average (meaning, especially for agriculture, forestry and fisheries, that jobs may be at risk – or at least workers may need to retrain in order to be able to adapt to changes – due to regional climate change impacts).

Among major urban centres, Tokyo and its surroundings (Minami-Kanto) are projected to suffer high health impacts, but currently have a shortage of medical workers to be able to respond. Osaka-Kyoto-Kobe and surroundings (Kinki) and also Tokai (Nagoya, Hamamatsu and others) are projected to have high risk from climate-related disasters, but may struggle to find construction workers able to enhance the resilience of the built environment. It is thus possible that retraining and recruitment in health and welfare (Kanto) and construction (Kansai, Tokai) may offer retraining or reskilling opportunities for carbon-intensive workers in order to support resilience challenges.

In more rural regions, Shikoku and Kyushu in particular have a large workforce in agriculture, forestry and fisheries, and are also projected to suffer significant climate impacts in these sectors. There may hence be a need to provide alternative jobs for workers in these sectors if climate change makes their activities non-profitable – or at least retraining and upskilling in new approaches and techniques in order to make these nature-based jobs resilient. At the same time, however, workers undertaking nature-based jobs in forestry and to a lesser extent agriculture may also have important skills which can help to realise Eco-Disaster Risk Reduction and nature-based approaches to climate adaptation and mitigation. Tapping into the skills of forestry and agricultural workers in Shikoku and Kyushu may thus be an important part of ensuring a just transition and reducing harm, given both regions face significant disaster risk.

For cross-cutting challenges, Hokkaido and Okinawa are well-resourced with public officials to support adaptation and resilience planning; whereas Kinki and Tokai may struggle with staff at present able to implement adaptation planning.

6.0 Conclusions and recommendations

Based on the findings and materials in the previous sections, as well as the content of the full report, the following areas of action are proposed to support a just transition in Japan.

Governmental actors within Japan

- At a national government level in Japan, it is clear that whilst there is an emerging understanding of the need for a just transition – as evidenced in the inclusion of the term in Japan’s core climate change policy – there is less clarity on what a just transition means in a specifically Japanese context, and on the steps that may need to be taken to facilitate a just transition for Japan. Along similar lines to the Scottish Government’s Just Transition Commission, there may hence be value in initiating and coordinating a national just transition in Japan by identifying and working with at-risk sectors and regions;
- At a local government level, levels of resourcing to allow local governments to coordinate and respond to just transition imperatives may vary significantly across regions and municipalities. Local governments can have a key role in coordinating interaction between sectors, in order to take advantage of opportunities that may arise in the net-zero transition and return benefit to local communities and workforces. However, particularly in rural areas and regions away from Japan’s largest cities, just transition challenges can come against a backdrop of ageing and declining populations and associated declines in revenue. It is hence vital that local governments in regions that are at high risk under the net-zero transition are well supported with resourcing and skills from a national level;
- Related to the above, local governments may benefit from opportunities for peer-to-peer learning on managing just transitions in their localities. The mapping of the comparative risks and opportunities faced by different regions within Japan shows, for example, that municipalities in regions such as Tohoku, Hokuriku and Kyushu may face *similar* kinds of challenges under a just transition. Examples such as the Hokkaido city of Muroran’s collaboration with Aberdeen in the UK also illustrates how opportunities for mutual learning from places with similar characteristics may extend internationally.

Industry and trade unions

- A critical challenge faced globally – not only in Japan – is to understand how well the skills of an existing carbon intensive workforce, and also the infrastructure of carbon-intensive regions, matches up to what is required for net-zero technologies. It is vital not to make assumptions about how easily workers in one sector or job type will be able to transition to other job types, even if the job profiles appear similar. However, it is at present hard to find data within Japan on characteristics of the labour force in carbon-intensive industries that allows this richer understanding of labour force characteristics to emerge. This is especially so for fossil fuel and nuclear power workers who (whilst representing upwards of 50,000 jobs in absolute terms) make up a relatively small proportion of the overall labour force in Japan, which can make it hard to identify trends and characteristics in government data. There is hence a real need for industry associations and/or trade unions to develop in-depth and publicly-available data on the characteristics of the workforce in carbon-intensive industries, which will enable governments, researchers and NGOs to make more precise policy recommendations;
- Related to the above is the value of training and certification for workers aiming to transition to net-zero jobs. The vision of Iwaki City to develop a certification scheme for wind power maintenance and operations workers stands as a good example of how the skills requirements for a just transition in Japan can be more formally recognised. Identifying the kinds of net-zero jobs that are likely to emerge in a locality, and initiating retraining and reskilling programmes early on for workers in sectors that are scheduled for closure, will be especially important in more rural regions (e.g. Tohoku, Hokuriku, Shikoku) where there are fewer opportunities for diversification;
- The significance of jobs relating to climate change adaptation and resilience should also not be overlooked. The effects of extreme weather events across Japan in recent years serve as a stark reminder of the impacts that climate change will have on the country, and on the need for upgrades to infrastructure as well as replacement or retrofit of older housing stock. Sectors like construction and utility may therefore be able to support a just transition by linking mitigation- and adaptation-related jobs, and considering these together.

Non-governmental organisations and third sector organisations

- NGOs can have an important role in coordinating dialogue between sectors, and in helping to identify potential opportunities and synergies. To date, much of the NGO activity on just transitions in Japan has focused on site-specific opposition to new-build thermal power stations. This activity is an important part of enabling a just and net-zero transition. In addition, however, environmental NGOs may be well placed to facilitate mutual learning and dialogues between municipalities and regions facing *similar* issues across Japan (and, indeed, with regions internationally who are facing similar challenges). More detailed analysis of prefectural or municipal characteristics to build on the regional analysis presented in this report may help to pinpoint potential participant localities;

- Given the strong rhetoric of the Japanese Government on the role of hydrogen in a net zero society and in hydrogen and ammonia co-firing plus carbon capture and storage in the thermal power sector, it is understandable and important that NGOs continue to strongly oppose coal and gas power within Japan. At the same time, however, the Japanese Government's announcement of offshore wind promotion areas, as well as identification of potential for onshore solar and wind, presents a chance for positive messaging on how net zero energy technologies can represent a bright future for carbon-intensive regions and workforces. This can also involve engaging pro-actively with new renewables developments, especially offshore wind, to ensure strong local content in terms of jobs and economic uplift;
- It is also important to note the heterogeneity of NGOs that exist within Japan. Community-level NGOs, such as the Shimizusawa Project in the former coal city of Yubari, show the important role that third sector organisations working locally can have in initiating potentially sensitive or difficult conversations about just transitions for localities where carbon-intensive industry is not only a major employer, but also a core component of local identity. Collaboration with locally-based NGOs, who may not have an explicit environmental focus, may thus be a valuable pathway in Japan to stimulating thinking on what a just transition might mean at a local level.

Academics and researchers

- Further research could build on extant work into the geographical impact of energy transitions for Japan, by aggregating prefectural or municipal-level data to assess where job impacts (and conversely) opportunities may be found at a finer scale. This may aid in identifying localities that are facing similar challenges, and could hence help to support mutual learning between local governments and civil society actors from across Japan;
- Similarly, subsequent work could go further in quantifying the jobs opportunity associated with Japan's on- and offshore wind potential, as well as with potential in other areas such as solar PV manufacture and installation. Whilst quantifying jobs associated with renewable energy is widely acknowledged, quantitative estimations of how many jobs may be created – and where – under different deployment pathways may give a fuller picture of the size of the net-zero jobs opportunity in Japan;
- In terms of place-based just transitions, in-depth and ethnographic research tracking community dynamics during the process of the phase-out of thermal power stations scheduled for decommissioning may give valuable and rich insights into some of the issues faced at a local level as Japan moves towards phase-down of fossil fuel power.

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