The Clean Economy Bridge Research Program

Innovative Policy & Market Mechanisms

Beyond Reskilling: Just Transition Strategies for Fossil Fuel-Dependent Economies in Germany, Canada, and the US.

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TABLE OF CONTENTS

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Abstract

Fossil fuel exploration and extraction has shaped local economies, public finances, political attitudes, and regional identities for decades. As climate change broadens energy security decisions beyond economic factors, sustainable economic growth and healthy economies means embedding social, health, cultural, environmental, and equity considerations into energy-related policy and market mechanisms. Climate policies have become more stringent and markets begin to shift, regions that rely on coal, oil, and gas are confronting not only the challenge of decarbonising but the question of what comes after. Governments and communities are experimenting with what is now widely called a just transition: a set of policies and practices meant to protect workers, stabilise communities, and support new forms of economic activity as high-carbon sectors decline or transform. This paper examines how that idea has been taken up in three different contexts: coal in Germany's North Rhine-Westphalia (NRW) region, and oil and gas in Alberta, Canada and Alaska, the United States. Using the Coal Commission's work to drive the coal phaseout in NRW, the paper hypothesises what successful analogous policies would look like in Alberta and Alaska.

This study employs a mixed-method, comparative case design, combining qualitative policy analysis, semi-structured stakeholder interviews, and quantitative economic assessment. The qualitative analysis moves beyond conventional labor-centric metrics to convey four fundamental policy deficits: social equity and inclusion, technological unemployment forecasting, place-based implementation, and community co-design. Comparative evidence suggests that existing strategies, even those with substantial financial commitments (e.g., Germany's Coal Commission), are insufficient because they fail to address the core sociological, geographical, and technological realities driving resistance inhibiting equity. The comparative results of the economic indicators for NRW, Alaska, and Alberta from 2015-2024 highlight substantial regional differences in gross domestic product (GDP) trends, sectoral employment structures, fossil fuel dependence, and public and private renewable investments.

The findings suggest the need for a sophisticated multi-level governance framework that marries two critical components: the high-level, long-term capital commitment and institutional stability seen in NRW's process, with decentralized implementation autonomy for co-design, capacity building, and localized decision-making power. The comparative analysis demonstrates that the current toolkit for just transition, largely focused on individual worker mitigation (retraining and severance), is structurally insufficient to address the deep economic, social, and political friction generated by energy shifts. The underlying problem is

that current policies treat the transition as a linear economic problem rather than a complex sociopolitical transformation that threatens identity and community structure.

This paper makes significant contributions to the economics of climate change by providing an in-depth analysis of how structural changes driven by climate adaptation and mitigation efforts impact labor markets, regional inequality and political feasibility across advanced economies.

Methodology

This study employs a mixed-method, comparative case design, combining qualitative policy analysis, semi-structured stakeholder interviews, and quantitative economic assessment. First, a structured literature and policy review examines just transition approaches in North Rhine-Westphalia (Germany), Alberta (Canada), and Alaska (United States), identifying recurring themes across governance structures, labour protections, community diversification, and federal-regional policy alignment, with EU and OECD frameworks providing additional reference context.

Second, qualitative insights were gathered through four semi-structured interviews with regional experts, including policy advisors, think-tank project leads, academic researchers (two in NRW, one in Alberta, and one in Alaska), using an interview guide informed by documented transition mechanisms, context-specific socioeconomic challenges, and each participant's expertise. Interviews were thematically analyzed to capture practitioner perspectives on policy effectiveness, barriers, local reception, and transferability of just transition frameworks across the transatlantic setting.

Third, the quantitative analysis evaluates transition outcomes by compiling a harmonized dataset for 2015-2024 covering sectoral employment trends, regional GDP dependence on fossil fuels, clean-energy investment flows, and the structural characteristics of each region's energy system, enabling assessment of how institutional frameworks and resource profiles shape the pace and composition of clean-energy transitions. By using a mixed-method, the analysis identified which German policies appear to drive equitable and durable economic restructuring and evaluates the feasibility of adapting these mechanisms to North American oil and gas dependent regions, directly addressing the documented literature gap on policy transferability.

Literature Review

Across the three regions, this literature review focuses on the kinds of public support that have been put in place for just transitions, how decisions are made, and whose interests are centred or sidelined in the process. Rather than treating just transition as a narrow question of retraining and compensation, the review pays particular attention to issues of identity, regional development, and long-term structural change. Together, these strands of work provide the basis for analysing whether public capital and transition policies are leading to genuine diversification, and what lessons might travel between regions facing different political, economic, and social conditions.

North Rhine-Westphalia

Coal and other fossil fuels have shaped entire regions for decades. As countries push to reduce emissions, the pressure to phase out coal and lignite is growing. For coal-dependent regions like North Rhine Westphalia (NRW) in Germany, this shift creates real economic and social risks. In response, governments often promote a just transition to protect workers and communities while shifting toward cleaner energy. Germany is widely seen as a leader in this area, especially because of its Coal Commission and large public support packages. These include retraining programs, early retirement benefits, income guarantees, and investments to support structural change.

Just Transition Policies and the Coal Commission

In 2018, Germany's Coal Commission, formally known as the Commission on Growth, Structural Change and Employment, developed a national plan to phase out coal-fired power by 2038, with the option to accelerate this to 2035. NRW, home to most of Germany's lignite operations, plays a major role in putting these plans into action. The Commission proposed a five-part strategy that includes phasing out coal mining and power plants step by step, supporting regions with around €40 billion for infrastructure and retraining, modernising the power system, protecting workers and local villages, and reviewing progress at regular intervals. The Coal Commission's recommendations can be disaggregated into six areas of a just transition: general assumptions for a just transition, structural policy, employment protection, environmental remediation, climate protection, energy markets, and reliability (Furnaro et al. 2021). Some of these recommendations include:

- Supporting workers through a variety of social and labor measures, including training and internal recruitment, as well as early retirement for employees aged 58 and older.
- Involvement of unions, businesses and the government to reach socially acceptable collective agreements ("Sozialverträglichkeit").
- Compensation mechanisms to hold down electricity prices to ensure that the cost of phasing out coal-powered electricity generation is not passed on to consumers.
- A dialogue between state governments and residents in mining regions to adjust open-cast mining plans.
- Compensation payments to power plant operators for decommissioning power plants.

"This coal commission was the instrument to get public acceptance for this transition and to get everyone on board"

— Industry Professional

Alongside federal plans, NRW has developed its own Energy and Climate Strategy, with goals to triple solar power capacity and double wind power by 2030 (Agora Energiewinde 2018). The state also plans to modernise its grid and promote clean industries such as hydrogen. These steps are meant to align local efforts with national climate goals while keeping NRW competitive and creating new jobs in the process.

Success of Coal Commission's Just Transition Policies

Although the Coal Commission's policies are still active and their full effects are yet to be felt, the Coal Commission has many unique qualities that make it an effective tool to initiate a just transition.

The Coal Commission was set up as a stakeholder commission. Stakeholder commissions offer the possibility of breaking stalemates and triggering a ratcheting-up of climate policies down the road. In Germany, the next government (from 2021 onwards) started discussions and planning for advancing the coal phase-out from 2038 to 2030. Hauenstein et al. (2023) suggest that the Coal Commission created and fostered a collaborative environment, enabling the cooperative work on finding joint solutions. It provided a space for individuals representing the various interest groups to get to know each other on a personal level and engage in a direct exchange. This contributed to increase the level of mutual understanding and trust, and the willingness to find an agreement. This can be considered a major achievement of the Commission compared to the status quo, in which pro- and contra-coal

interest groups formed “enemy camps”. Despite some drawbacks such as limited opportunities for informal exchange among participants and insufficient confidentiality of Commission meetings, the Commission’s members developed a shared commitment to engage intensively to achieve the Commission’s objectives–a precondition for successful collaborative policy formulation processes.

However, the willingness of the different interest groups to participate and engage in such a collaborative approach and working on compromise-based policy recommendations stemmed from the inability to enforce a unilateral policy decision. The context of the German Coal Commission was characterized by the highly contested and uncertain future of coal, the lack of sufficient power for one interest group or coalition to enforce their interests, and political parties with more to lose than to gain from taking the responsibility for a decision. In this situation, leaving the decision to a stakeholder commission offered policymakers the possibility to dilute responsibility and gain legitimacy for a derived policy, and interest groups the possibility to actively shape a possible policy formulation. On the other hand, the participants knew that it would be very difficult to enforce their interests outside of the Commission, and leaving the Commission would bear the risk of forgoing a say in the final decision. In other words, the governance structure of a stakeholder commission leads to a more collaborative approach as policymakers do not bear all the responsibility for the commission’s decisions, incentivising them to make it a more inclusive environment for interest groups. In the same vein, the stakeholder commission provides interest groups a singular, definite pathway for participation, thereby encouraging them to come to the table and engage with policymakers.

Some scholars suggest that the German Coal Commission derived its legitimacy in part from its bottom-up rhetoric of including regional stakeholders’ interests, even though the ultimate recommendations ended up being top-down policies. One reason for the limited bottom-up character of the recommendations might have been difficulties faced by regional stakeholders in participating effectively due to limited negotiation experience and other resources at their disposal. In a similar vein, younger generations also felt excluded from the conversation.

Public Reception of Coal Commission’s Just Transition Policies

Despite these strong policies and financial support, many workers still feel unsure about the future. Research shows that transitions are not only about money or training. People also worry about losing their identity and community. Kleinheisterkamp-González (2025) finds that in some parts of NRW, coal workers remain sceptical, even when their income is secure.

They associate coal with a way of life and fear that the transition will leave their regions behind.

This concern also appears in studies on reskilling. Chun (2024) argues that even when workers complete training programs, they still face unemployment if local industries are not growing. Training needs to be linked to real jobs, or it risks becoming a short-term solution. Wong et al. (2022) make a similar point. They argue that reskilling works best when it is combined with investment in infrastructure, innovation hubs, and long-term economic planning. Otherwise, workers end up with new skills but no place to use them.

Other researchers focus on how transition policies are organised. Kolde and Wagner (2022) find that transition planning often includes unions and large companies, but leaves out subcontracted workers and small businesses. These groups can be more vulnerable during transition, but have less influence over decisions. Heilmann and Popp (2020) also point out that although Germany has made long-term commitments, political delays and vague timelines slow down progress. They note that clear, inclusive, and transparent decision-making is needed to support real change.

A key question in the research is whether just transition policies are leading to genuine economic diversification. Oei et al. (2020) argue that Germany spent decades subsidising coal but did not do enough to build new industries. They say long-term change requires early investment in research, business development, and new infrastructure. Some regions in NRW have opened research centres or supported startup companies, but overall progress has been uneven. This shows that financial support alone does not guarantee new economic growth unless it is targeted and sustained.

Comparative studies show that Germany's structure and institutions make some aspects of its transition more effective. Barnes (2022) compares Germany to places like Appalachia in the United States and finds that the lack of national leadership and stable funding in the US leads to uneven results. Wong et al. (2022) add that Germany benefits from stronger social systems and public trust, which make it easier to implement long-term plans. These studies warn that while Germany offers useful insights, it is not a one-size-fits-all model. Policies must be adapted to the political and economic context of each region.

This study builds on these insights by asking whether public capital in NRW, especially in areas beyond worker support, has led to real economic change. It also looks at whether similar tools could help regions like Alberta or Alaska. The goal is to identify what types of

policies support long-term economic diversification and how these lessons might apply in different settings as the shift away from fossil fuels accelerates.

Alberta

Regional Introduction

The Canadian province of Alberta serves as a critical comparative case study, presenting a just transition challenge defined less by a regulated sector exit and more by high-stakes regional identity, severe political friction, and a strategy centered on sectoral transformation rather than phase-out (Gordan, 2025). The province's economy and social identity are dominated by the oil and gas sector, particularly the massive oil sands reserves, which contribute significantly to the national energy output and generate substantial public revenue. Accordingly, Alberta's oil and gas sector's value was $88 billion in 2024, accounting for a quarter of the province's total GDP and over 3% of the entire country's GDP (CAPP, 2025). The sector also encompassed over 200,000 direct jobs, comprising 8% of Alberta's total direct jobs (CAPP, 2025). This dependence has centered Alberta in Canada's decarbonization debate, marked by profound tension between federal mandates for emissions reductions, and the provincial government, which has expressed opposition to federal climate strategies (Kruger, 2023).

The Provincial Socioeconomic Identity and Transition-Related Stigma

To successfully execute any just transition mechanisms or policies, Alberta needs to address deeply-rooted socio-psychological barriers first. High wages, specialized skills, and a "boomtown" work ethic have cemented a powerful industrial identity, creating political resistance to transition policies. A cultural identity stemming from the oil and gas industry, characterized by "hardworking provider" and "blue-collar labourer" employment narratives, has made the penetration of alternative careers like those in social services or healthcare difficult. Coupled with the view that their work provides essential energy to Canadians and other communities around the world, many workers in the province would rather decarbonize the existing industry rather than abandoning it.

Additionally, there is stigma associated with workers seeking to transition, perpetuated by external employers. These employers frequently anticipate that former oil and gas workers, accustomed to inflated wages, will return to the hydrocarbon sector when commodity prices inevitably rebound. One worker anecdotally shared that some companies explicitly "don't

hire oil and gas people," highlighting the insufficiency of reskilling programs alone for a just transition.

Survey data further reveals the complexity of public attitudes. Below are a few key figures illustrating Alberta's social identity, beliefs, and public attitudes:

- When asked their opinion on whether global demand for oil and gas will decline in the next 15 years, Albertans surveyed were evenly split 48% to 48% (Pembina Institute, 2023).
- 82% support the active role of the government in planning for future opportunities for all workers (Pembina Institute, 2023).
- 59% support the provincial government's stance to resist the federal net-zero targets (Korzinski, 2023).
- Only 50% of Albertans believe that renewable power is reliable, and only 30% believe the economy would thrive without oil and gas (Korzinski, 2023).

Simultaneously:

- 70% of Albertans surveyed believe the provincial economy is too dependent on oil and gas (Pembina Institute, 2023).
- 65% of Albertans are supportive of the federal net-zero carbon emissions by 2050 goal; however, 81% believe that technology is the solution to reaching this goal, and contrastingly (Legault, 2024).
- On Alberta's seven-month moratorium on renewable energy development projects, 50% thought the provincial government was hurting jobs and the economy (Korzinski, 2023).
- 67% of Albertans believe climate change poses a severe threat to the planet (Pollara, 2024).

Overall, although many Albertans support climate action generally, there is a common assumption that their neighbours and communities oppose it. Additionally, what is defined as sufficient climate action also varies, with many not seeing a need to transition away from the oil and gas sector, but rather, pushing to decarbonize the sector through solutions like carbon capture, utilization, and storage (CCUS).

Alberta's Policy Baseline and Coal Transition Insights

Alberta's recently-completed coal phase-out provides many comparable lessons and insights, by setting the most relevant policy baseline for just transition strategies. Ahead of the initial

2030 goal, Alberta has already phased out coal-fired power generation as of June 2024 (Bailie, 2025). The coal transition primarily focused on individual mitigation mechanisms, in multiple ways contrasting Germany's structured social provisions.

On worker mitigation, the Coal Workforce Transition Program offered financial assistance up to 75% of previous weekly earnings with Employment Insurance benefits for up to 72 weeks, or until the worker re-secured full-time employment. This program also encompassed a one-time sum of $5,000 as a relocation fee for workers who moved at least 40km for a new role (Government of Alberta, 2022). In addition, the Coal and Electricity Transition Tuition (CETT) Voucher provided up to $12,000 for affected coal workers to pursue post-sendonary education that could catalyse careers in alternative fields. This program was available to the recently laid-off, as well as employees of more than 1 year at sites slated for closure within the next 5 years.

On community support, the Coal Community Transition Fund (CCTF) was a $5 million distribution to 17 affected municipalities and First Nations in March 2018, with funds being used for initiatives like public infrastructure projects with the potential to attract private sector investment; for example, road construction in Parkland County (World Resources Institute, 2021). However, this was criticized as a "one-off payout", and embodies insufficient community-level intervention. The lack of sustained capital led to implementation being underfunded compared to feasibility studies, and fell short of diversifying local economies to a high quality extent. Delayed stakeholder engagement was also cited, with unease and dissatisfaction arising from a prolonged gap between the coal phase-out announcement and the start of the consultative process (Vriens, 2018).

> *"Largely, I think the response they got from workers about the efficacy of that approach was that it was just not enough. Good ideas, good concepts. But in order for people to really avoid any kind of friction, it needed to be a lot more generous."*
>
> — Megan Gordon, Manager, Equitable Transition Program at the Pembina Institute

On industrial shift, Alberta's Off-Coal Agreement was established between the province and major coal companies (Vriens, 2018). Adhering to the goal of phasing out coal-fired power by 2030, companies would receive a portion of a total pool of $1.1 billion in payouts. For example, TransAlta was set to receive 14 years of transition payments to compensate for the reduced value of their facilities. Ultimately, although major coal companies were compensated to convert coal-fired power plants and an earlier sector exit was achieved, the

transition to natural gas risked investing in infrastructure that bolstered other carbon-intensive industries simultaneously.

Overall, the province has received over $5.6 million in federal funding through the Canada Coal Transition Initiative (CCTI) and Canada Coal Transition Initiative-Infrastructure Fund (CCTI-IF) (Government of Canada, 2022). Simultaneously, billions of dollars were pledged to be invested in economic diversification through provincial programs like the Alberta Petrochemicals Incentive Program (APIP), into other branches of energy like hydrogen and alternative petrochemicals (Government of Alberta, 2020). Even so, programs for individual worker mitigation were still deemed lacking by some workers, while one-time grants like the CCTF failed to materialize the structural investment and regional development needed for resilient community outcomes. This offers many learning outcomes and insights to take into account when considering a just O&G transition for the province.

Alberta's Climate Action: Production Decarbonization

Alberta's strategy for the oil and gas sector essentially rejects a mandated phase-out in favor of climate action through production decarbonization. This strategy optimizes existing technology and infrastructure to lead in "clean" hydrocarbon derivatives, primarily through significant investments in the following two mechanisms:

1. Carbon Capture, Utilization, and Storage (CCUS): To enable continued and cleaner O&G production, and the growth of the blue hydrogen economy (Government of Alberta, 2022).
2. Hydrogen and petrochemicals: The Alberta Hydrogen Roadmap outlines ambitions to produce clean hydrogen by upgrading natural gas, and storing carbon by-products underground, or repurposing them (Government of Alberta, 2021). Accordingly, the Alberta Petrochemicals Incentive Program (APIP) aims to position the province as a global top-ten petrochemical producer.

Workforce and Community Vulnerabilities in the O&G Transition Context

In late September of 2025, Imperial Oil announced a 20% cut to their workforce (equating 900 jobs) by the end of 2027, with most losses felt in Calgary (CBC/Radio Canada, 2025). Additionally, between 2014 and 2022, structural changes and automation led to the elimination of 35,160 oil and gas jobs; this means that reskilling or transition programs need to address the high-skilled, specialized demographic of O&G professionals. Current oil and gas-specific worker programs focus on technology transfer:

- EDGE UP (Energy to Digital Growth Education and Upskilling Project): A six-month transition program into digital technology roles (e.g. software development) for unemployed professionals in Calgary (Future Skills Centre, 2025).
- Green Economy Training (GET): A transition program into clean energy and technology employment, for foreign-trained STEM professionals currently working in the energy sector (CCIS, 2023).
- Iron & Earth: A nonprofit organization started in 2015 by oilsands workers to support the retraining of former tar sands workers and integrate more renewable energy into Alberta to diversify the province's economy (Williams, 2020).
- LIUNA Local 92: A labour organization representing over 7,000 members that actively works to make sure their skilled labour force maintains relevance through participation in the construction, maintenance, and growth of the renewable energy sector (LIUNA Local 92, n.d.).

Although Solas Energy Consulting and the Delphi Group forecast that approximately 20,000 new jobs could be created in Alberta's renewable energy sector by 2030, 153,000 people have been employed in the O&G sector as of 2018 (Gallagher et al, 2018). Furthermore, beyond individual worker challenges, a just transition must also consider risks to communities that have been built because of O&G exploration projects, and whose economies are fossil fuel-dependent (Gordan & McKenzie, 2025).

Primarily, the loss of a dominant industry risks propelling communities into "ghost towns," which the province has seen in previous historical coal and gas-producing towns like Nordegg, Alderson, and Cadomin. However, with regions like Fort McKay built almost entirely around a single fossil fuel industry, the presiding cash economy and disproportionate environmental damages prevent First Nations communities from sustaining traditional ways of life (Yu, 2024). Thus, a transition is undoubtedly necessary, but with proper safeguards in place.

Additionally, the O&G sector is also a fundamental public revenue driver for Alberta's provincial government, second-highest to taxes (Bloomberg, 2025). Historically, Alberta has fallen into deficits when resource revenue declines due to insufficient mitigation of the boom-and-bust cycle (Hill, 2024). Providing essential dollars for social security and public services, massive risks are posed with the loss of this revenue stream. However, the province's resource revenue has been described as a roller coaster, reaching as high as $25.2 billion in the 2023-2024 fiscal year and hitting a net debt position of $59.8 billion in 2020-2021 (Hill, 2024). With much volatility, if resource revenue declined to its average over the past two-decade period, Alberta would immediately be in deficit. Thus, again, this does not call for

a bolstering of the heavily fluctuating O&G sector, but rather, a transition that accounts for the sector's undisputed contributions to the province's funding, and factors that into provincial long-term planning.

> *"The way I look at oil and gas wages, because that's the really difficult thing… Government should not be subsidizing oil workers' wages so that they feel better with moving to another industry. But if we start sort of contextualizing it as you're getting this inflated wage because it's danger pay. You're getting more money because of the sacrifices you're making and the risk... because there's so much volatility."*
>
> — Industry Professional

Acknowledging Federal-Provincial Friction, Foundational Consensus, and Contested Narratives

Alberta is at the heart of Canada's just transition debate, and existing literature reaches a clear foundational consensus on the necessity of economic diversification in Alberta. This need is not purely climate-driven, but rather, rises from inherent structural job precarity tied to unstable market price fluctuations and accelerating workforce automation. Diversification is the necessary long-term strategy enabling the mitigation of inevitable industry contraction.

However, significant variance is seen between the provincial government and established or proposed federal climate policies, like the carbon tax and emissions caps. In fact, the Albertan government has been characterized as a prominent opponent of federal climate action, previously conveying that they would not recognize federally-imposed emissions reduction targets for their energy sector (Williams, 2023). Overpowering political and corporate interests necessitates transition strategies that prioritize equity and positive socioeconomic outlooks for communities. Thus, effective policy must also acknowledge that resistance is often rooted in non-economic, existential threats to identity.

> *"They are convinced… oil and gas is to stay… it's a big collective exercise in illusion."*
>
> — Industry Professional

Alaska

Regional Introduction

Alaska serves as an integral comparative case study, posing the challenges of a state whose economy lacks diversification and is heavily dependent on oil and gas revenue despite declining extraction, has limited oil and gas-specific transition programs, faces acute workforce development barriers, and also faces additional constraints due to its geographic remoteness.

Despite producing only 4% of the country's oil and gas, 85% of the state's revenue is dependent on the industry and nearly 25% of the state's workforce is employed in some part of the oil and gas value chain (Alaska Department of Revenue 2025). Yet, production has been in a steady decline since it boomed in the 1980s, going from nearly 2 million barrels a day to less than 470,000 barrels a day in 2025 (International Arctic Research Center 2023). The economic implications of a long-term decline in global oil demand are especially dire for Alaska. If production declines below a threshold of approximately 350,000 barrels per day, the Trans-Alaska Pipeline, responsible for transporting the crude to market, will have to shut down for operational and safety reasons (Sieminski et al. 2017).

While oil dwarfs other industries in economic impact, employment levels are also more volatile because oil exploration and production respond sensitively to oil market prices. Oil prices are set on the global market and drive levels of production more than other factors, including taxes. Downturns in oil prices generally align with periods of job loss and weaker economy. Developments in efficiency, like automation, have also led to fewer jobs returning after slumps in oil prices.

The lack of revenue diversity in the state ties its citizens and businesses to the boom and bust cycle of the global hydrocarbon economy, which Alaska cannot control or direct. This creates uncertainty in the state's economy that can disincentivize business investment and cause instability for individual households, particularly outside of the Railbelt. Diversification of the state's economy can buffer private and public sector jobs, investment and government budgets and can provide opportunities for innovative economic and technological advances to foster job growth for residents. Alaska does not have to choose between renewables or oil–the state's recently diversifying energy portfolio shows that Alaska can be a leader in deliberate energy transition if it chooses to be.

Analysis of Relevant Policies & Programs

Since Homer completed Alaska's first Climate Action Plan (CAP) in 2007, five other Alaska communities have worked to produce CAPs and their associated emissions inventories (United State Environmental Protection Agency 2024). As a planning document, a local CAP must be developed by the local or tribal government, reviewed by the public in a stakeholder engagement process, and finally adopted by the entity's governing body (United State Environmental Protection Agency 2024). Only three Alaska communities have completed this process, with three others in progress (United State Environmental Protection Agency 2024). Most communities who engaged in a CAP process produced some version of an emissions inventory (United State Environmental Protection Agency 2024). Additional inventories have been challenging given their labour-intensive nature. Juneau, which has inventories for 2007, 2010, and 2021, is the only community with more than two years of inventories on record (United State Environmental Protection Agency 2024).

Beyond the plans discussed above, relevant planning efforts in Alaska have largely focused on either:

1. Affordable, sustainable solutions for rural microgrids
2. Adaptation efforts to respond to the impacts of greenhouse gases.

All Alaska municipalities with planning commissions are required to submit comprehensive plans under Alaska statute as a "compilation of policy statements, goals, standards, and maps for guiding the physical, social, and economic development, both private and public, of a community… [including] statements of policies, goals, and standards; a land use plan; a community facilities plan; a transportation plan; and recommendations for implementation of the comprehensive plan." As the primary document guiding the actions of municipal officials, comprehensive plans have many implications for emissions reduction efforts (United State Environmental Protection Agency 2024).

<u>The Provincial Socioeconomic Identity and Transition-Related Stigma</u>

Since discovery in 1964, only 10 years after achieving statehood, oil and gas have been central to Alaska's state identity. In 1976, the state set up the Alaska Permanent Fund, a sovereign wealth fund to protect the state's oil revenues for its future generations (International Arctic Research Center 2023). Despite oil and gas extraction playing such a big role in the state's economic and cultural history, there is a seemingly surprising support for energy transition schemes. Here is a summary from a recent poll conducted by Dittman Research (New Energy Alaska 2023):

- Nearly four-out-of-five (78%) respondents believe that spending state tax dollars on renewable forms of energy is the right direction for the state – over half (55%) say it is "strongly" the right direction.
- Significant majorities of those surveyed believe using more renewable energy sources will create new jobs (86%), diversify our economy (74%), help us achieve energy independence (68%), and reduce pollution and improve public health (62%).
- Overall, 59% of Alaskans think it is realistic that Alaska could primarily use renewable sources of energy. Among those who think it is realistic, the top reason given for why Alaska is not currently using more renewables is "political".
- While there is support for a natural gas pipeline, fewer than a tenth of Alaskans (8%) think it is "very likely" that a gas line will be built within the next 5 to 8 years, the current estimate on when Cook Inlet gas supplies will be insufficient.

There is more support for renewable energy investment than opposition among all age groups, across all parts of the state, and among all political affiliations (Republican, Democrat, other). With such a convincing social licence to operate, it is important to investigate existing oil and gas-specific workforce transition policies in Alaska.

Workforce Challenges

Attracting, training, and placing hundreds of new workers in trade jobs in every region of the state has many challenges. Other industries will be competing for the limited supply of new workers. Another challenge is having enough qualified instructors to train the new workforce. Alaska has a shortage of trade instructors given the far more lucrative salaries offered in industry (United State Environmental Protection Agency 2024). An even larger obstacle is providing training and employment for persons living in rural Alaska, where occupational training opportunities are limited and compounded by transportation, climate, and technology barriers (United State Environmental Protection Agency 2024). Alaska's workforce training landscape is shaped by a combination of strengths and challenges rooted in its unique geography, economy, and culture. The presence of Alaska Native corporations plays a significant role in supporting workforce development, particularly in sectors such as construction, transportation, and tourism (United State Environmental Protection Agency 2024). Alaska also boasts a network of vocational and technical education institutions, including the University of Alaska system that also serves a community college mission,

regional training centers, and trade schools, which provide tailored training programs aligned with the state's workforce needs (United State Environmental Protection Agency 2024). Additionally, Alaska receives federal funding for workforce development, further bolstering training initiatives and skill-building opportunities (United State Environmental Protection Agency 2024, Alaska Energy Authority, n.d.).

Government Initiatives

Alaska Energy Transition Framework

Alaska's Energy Pathway and Strategic Energy Plan envision a transition built on resource diversification and community resilience. The state aims to balance fossil resource wealth with independence from external fuels through renewable integration and energy efficiency. Key themes include localized energy solutions, indigenous cooperation, and infrastructure modernization (United State Environmental Protection Agency 2024).

While Alaska's approach remains incremental, it emphasizes technological development (geothermal, hydro, wind, and microgrids) to support remote communities and reduce diesel reliance. Both the Renewable Energy Fund and Emerging Energy Technology Fund aimed to build capacity in rural Alaska (International Arctic Research Center 2023, United State Environmental Protection Agency 2024). They help communities maintain and expand existing renewable energy systems. They can also ensure that communities are able to share their knowledge and experience with others in Alaska and across the Arctic.

The Regional Clean Hydrogen Hubs program is an opportunity to ensure the benefits of energy investments are felt locally (United State Environmental Protection Agency 2024). Funded through the Bipartisan Infrastructure Law, the program established six to 10 regional hubs across the country focused on accelerating the production and use of hydrogen (United State Environmental Protection Agency 2024). Due to its natural gas resources and proximity to the West Coast and Asian markets, Alaska is a strong contender to be selected for one of the hubs . This would create further opportunities for communities in the state, such as through workforce development.

Alaska Regional Collaboration for Innovation and Commercialization Program's Energy Innovation Network supports community engagement and just transition. The network helps Alaska communities reach self-determined energy and economic goals. With a local to global

focus, it builds capacity for new homegrown energy industries designed and deployed in the state.

The Alaska Workforce Investment Board (AWIB) is the Governor of Alaska's appointed, lead planning and coordinating entity for Alaska's public workforce and development system. The Board provides policy oversight of state and federally funded job training and vocational education programs. Board members, who represent a variety of sectors in Alaska including business, industry, education, organized labor, and state government, examine employment trends and emerging occupations to ensure training efforts are aligned and that Alaskans are trained and ready for the jobs that pay well and are in demand (United State Environmental Protection Agency 2024).

Just Transition Programs

Although just transition schemes of any kind are facing headwinds in the US right now, the initiatives below serve as important reminders for the programmatic levers that have been exercised in the past to further the goals of a just transition.

TREC – Home Energy Efficiency Training

Alaska's Training for Residential Energy Contractors (TREC) program, funded by the Department of Energy, envisions a residential home energy efficiency training program that is focused on certifying an incumbent and new workforce, utilizing intermediary training providers like AWP, ABC Alaska pre-apprenticeship programs, and apprenticeships facilitated by the AFL-CIO, AVTEC, and UA to deliver medium and high wage occupation opportunities to disadvantaged communities (United State Environmental Protection Agency 2024).

Solar for All

In partnership with the Alaska Vocational and Technical school (AVTEC), Alaska Energy Authority (AEA n.d.) offers the Power Plant Operator training program that includes engine maintenance, troubleshooting and theory, electrical systems and generators, introduction to electrical distribution systems, diesel electric set operation, control panels, paralleling generator sets, load management, fuel management, waste heat recovery, plant

management, and power plant safety. As part of this program, AEA regularly updates course curriculum to be responsive to new and innovative solar system designs, and works with partners for program delivery (United State Environmental Protection Agency 2024).

In 2024, AEA was successful in securing a grant award of $62.5 million under the EPA's competitive Solar for All program. Under the State of Alaska's Solar for All grant, AEA partnered with the Alaska Housing Finance Corporation (AHFC) to expand access to solar energy across the state. Leveraging the agencies' expertise and efficiencies, AEA was tasked with developing community-scale solar photovoltaic projects in remote areas, while AHFC planned to deliver residential solar installations to underserved households.

However, under the current administration, The Alaska Energy Authority received formal notice from the U.S. Environmental Protection Agency stating that the Solar for All program has been terminated nationwide (Alaska Energy Authority 2025). Importantly, the grant did not require a state match, which is why no state funds were committed to the initiative at the onset. Although it is unclear as to what the state's plan is in the absence of this crucial government funding, it will certainly not be able to execute its planned programming in its original intended form.

Nonetheless, it is important to understand the various schemes introduced by the AEA to advance the energy transition in the state:

Rural Energy Training and Utility Assistance

AEA provides training opportunities to rural operators and managers for their energy infrastructure. The intent of this training is to ensure that the local operators and managers have the knowledge and skills to operate, maintain and sustain their energy infrastructure. AEA offers energy infrastructure training opportunities and support to rural operators and managers, including their:

- Circuit Rider Program: provides eligible utilities with technical assistance to improve the efficiency, safety, and reliability of their energy infrastructure and helps reduce the risk and severity of emergency conditions.
- Bulk Fuel Itinerant program
    - AEA's Bulk Fuel Operator training course at AVTEC provides students with the knowledge and skills necessary to safely operate and maintain a bulk fuel storage facility while complying with state and federal laws.
- Electric Itinerant Utility Training program

- With funds from the Denali Commission, AEA is developing an On-Site Utility Training program to instruct utility staff from rural communities that have received USDA Rural Utility Service funds in the past for power plant infrastructure.

Power Cost Equalization (PCE) program

The PCE program provides economic assistance to communities and residents of rural electric utilities where the cost of electricity can be three to five times higher than for customers in more urban areas of the state. AEA, along with the Regulatory Commission of Alaska (RCA), administers the program that serves 82,000 Alaskans in 193 communities that are largely reliant on diesel fuel for power generation.
The PCE program benefits rural communities by lowering the electricity costs paid by customers, which in turn helps to ensure the sustainability of remote economies dependent on available, reliable, centralized power.

Civil Society Organisations

Civil society organisations like the Renewable Energy Alaska Project (REAP n.d.) play an indispensable role in catalysing uptake for a just transition by mobilizing the community at a grassroots level. Founded in 2004 by Chris Rose, REAP is a non-profit organization dedicated to increasing the development of renewable energy and energy efficiency in Alaska through collaboration, education, training, and advocacy. REAP utilizes its collective expertise to educate Alaskans, collaborate with a wide group of stakeholders, and advocate for a clean energy future. REAP includes over 60 organizational members representing a diverse coalition of small and large Alaska electric utilities, conservation and consumer groups, businesses and developers, Alaska Native organizations, and municipal and educational institutions. Their objectives include:

- Educating K-12 students in science, technology, engineering, and math through the lens of clean energy.
- Promoting energy efficiency.
- Developing and implementing policies to increase the production of renewable energy in Alaska.
- Building a market in Alaska for renewable energy.
- Fostering and demonstrating stakeholder unity in support of renewable energy and energy efficiency in Alaska.

Qualitative Findings and Comparative Analysis of Policy Deficits

The qualitative analysis moves beyond conventional labor-centric metrics to convey four fundamental policy deficits: social equity and inclusion, technological unemployment forecasting, place-based implementation, and community co-design. Comparative evidence suggests that existing strategies, even those with substantial financial commitments (e.g., Germany's Coal Commission), are insufficient because they fail to address the core sociological, geographical, and technological realities driving resistance inhibiting equity.

Sectoral Intersectionality and Sociological Foundations

A critical finding across all three comparative regions is that worker and community resistance to decarbonizing carbon-intensive sectors like coal or oil and gas is not exclusively (or sometimes even primarily) economic. Just transition strategies focused on financial compensation and retraining workers often do not succeed because they ignore profound threats to ontological security: workers are not just worried about income, they are also concerned about losing their sense of self, community, and purpose.

Non-Economic Reasons for Resisting Energy Transitions: Ontological Security

In industrialized regions, fossil fuel work is typically connected to narratives of regional pride and contributions to society's essential energy, which must be taken into consideration when planning energy transitions (Scheer et al., 2022). High wages, specialized technical skills, and a "boomtown" work ethic have cemented a potent industrial identity, particularly in Alberta and Alaska, characterized by the image of the "hardworking provider". This employment is also often multi-generational, reinforcing a collective cultural heritage (Scheer et al., 2022).

> *"Somehow it's connected to their identity, big pickup trucks, and heavy engines, and oil and gas…If you land in Edmonton, in the airport, it says 'this is oil country'"*
>
> — Industry Professional

Even in NRW, where the German government provided generous mitigation policies including retraining, early retirement benefits, and income guarantees, many coal workers remained apprehensive. Income security alone cannot mitigate the profound worry about losing community and an associated way of life. This is because abrupt and severe disruptions to social roles arise from the loss of a job, causing psychosocial impacts. Displaced workers

report increased levels of depression and anxiety, as well as declines in self-confidence, self-esteem, and sense of purpose, and deteriorating social support systems (Carrington, 2021). Thus, treating the complex psychological and social risks of energy transitions as a mere economic calculation leads to ineffective policies and lack of community or worker buy-in.

Systemic Inequalities

Current transition policies suffer from a substantial "knowledge deficit regarding equity and justice for minority groups," resulting in a policy framework implicitly biased toward the traditionally dominant workforce (typically unionized, white, male, and high-income individuals). This policy blindness risks exacerbating existing systemic inequalities by overlooking groups who are simultaneously most vulnerable to displacement, and least capable of accessing transition support.

> *"[The] feelings of justice, energy justice, environmental justice and equity are really key in shaping people's support."*
>
> — Chad Walker, Assistant Professor at University of Dalhousie

Indigenous Energy Sovereignty and Recognition Justice

Indigenous communities face unique justice challenges rooted in historical disenfranchisement, including disproportionate exposure to environmental damages (e.g., pollution from the Alberta Oil Sands impacting traditional ways of life). The transition must recognize Indigenous communities not as passive policy recipients or even advisors, but as decision-makers and rights-holders, ensuring their rights to self-determination are upheld in all processes (UN Human Rights Council, 2025).

In Alberta, Indigenous-owned renewable energy projects exist and are viewed as a crucial step in economic reconciliation and correcting unjust legacies (Miller & Parkins, 2023). However, there is a distinct risk of 'pilot project syndrome,' where small, visible initiatives lack the necessary scale and political power to effect genuine systemic economic transformation (Miller & Parkins, 2023). Furthermore, the pursuit of "recognition justice" requires critical scrutiny, as some frameworks may only acknowledge Indigenous rights as long as they do not fundamentally challenge existing settler-colonial power structures and resource ownership (Whyte, 2024). This extends to many other regions across North America.

True equity necessitates moving beyond simply promoting Indigenous ownership of projects toward mandating Indigenous leadership and co-design over energy systems, realizing genuine energy sovereignty (Nogueira et al., 2023). This demands a restructuring of procedural justice, granting real decision-making authority over utility operations, infrastructure, and land use planning.

The Marginalization of Migrant and Female Workforces

Neglecting subcontracted, temporary, migrant, and non-traditional workers from the negotiation table highlights how policy outcomes are skewed toward the traditionally dominant workforce and other established power dynamics, such as large companies and major unions. For example, NRW's transition plans emphasized formal mitigation mechanisms like early retirement for long-term employees (Galgóczi, n.d.), but frequently failed to account and advocate for the highly vulnerable sub-contracted labor and migrant workers.

Moreover, the low female participation rate in the direct fossil fuel sector concentrates transition planning on male displacement (Scheer et al., 2022). Even outside of the fossil fuel industry, women and gender-marginalized people are disproportionately impacted by the secondary or subsequent effects of transition, as they often largely comprise essential sectors like healthcare, retail, social services that disintegrate when resource economies decline (Environmental Defense Fund, n.d.), and they also usually bear the load of increasing household costs.

This intersectional vulnerability is profound for migrant women who experience compounding risks related to low educational attainment, precarious migratory status, and unprotected informal jobs, which severely limits their access to essential services and increases health risks (Ceballos-Vásquez & Rengifo, 2024).

> *"If you don't find a replacement industry, and communities rely on…one big dominant industry, it has massive ripple effects when there's a downturn and it just impacts housing prices. So…you know, the industry collapses, people start leaving town. There's this massive influx of people trying to sell their home. Housing values drop. That's a massive financial loss for many people. If one worker leaves town and their spouse works at the library or the school or the hospital, you're losing essential workers to keep*

the community social fabric alive."

— Megan Gordon, Manager, Equitable Transition Program at the Pembina Institute

Centering transition planning around the dominant demographic in fossil fuel industries creates blind spots. Achieving equity-centered design means going beyond ensuring that the unique challenges faced by Indigenous peoples, migrant workers, and female workers are centred to prevent inadvertently reproducing existing systemic inequalities. The scope of analysis should also expand beyond the displaced individual worker to include the vulnerable household or community unit.

Automation-Induced Unemployment and Flawed Forecasting

Just transition policies also need to decouple climate policy (regulatory phase-out) from trending technological changes (automation and AI), neglecting technology as an independent, immediate, and accelerating driver of job displacement. This deficiency leads to workforce development strategies based on misaligned assumptions about future labor needs.

Technology-Driven Decarbonization

In Alberta and Alaska, the preferred climate strategy favours technology-driven production decarbonization like blue hydrogen production and CCUS over a mandated phase-out, and the transition also implicitly accelerates the adoption of efficiency measures. These efficiencies are predominantly achieved through massive automation and AI integration (Ernst & Young, 2019; Oilfield Witness, 2024).

Structural changes, automation, and corporate interests have already manifested notable job cuts independent of climate policy; for example, between 2014 and 2022, 35,160 oil and gas jobs were eliminated in Alberta alone. Corporate interests in leaner workforces means that despite high production levels, employment in the sector is lower now than it was a decade ago (Oilfield Witness, 2024). Independent of energy transitions or climate action, oil and gas companies are leveraging technological advancements to increase optimization and reduce production costs (Ernst & Young, 2019). Across multiple sectors, automation is driving job loss or altering role demands. Better forecasting of job displacement by specific job type and sub-sector, accounting for projected rates of automation adoption, can ensure public retraining investments target roles that will actually exist.

Precision in Workforce Planning and Quantifying Displacement

Effective just transitions require granular, occupation-specific forecasting to ensure limited public retraining funds are allocated efficiently. Without explicitly forecasting job displacement by specific occupation and sub-sector, policymakers risk wasting resources on misaligned workforce development efforts.

The risk of automation is highest for specialized blue-collar and mechanical occupations. Estimates suggest the probability of automation is as high as 80% to 95% for roles like (heavy) machinery operators, welders, and process technicians, in the petroleum industry, primarily due to increasing uptake of AI optimization, robotic systems, and remote control systems (Stanford, 2021). Similarly, autonomous trucks and loading equipment in mining operations are estimated to reduce labor demand by 30% (Stanford, 2021).

Furthermore, technological advances like remote monitoring and information technology analytics enable the centralization of remaining high-skilled technical and engineering jobs in urban control centers, relocating these roles away from the resource-dependent communities that require economic stabilization (Stanford, 2021). Thus, Active Labour Market Policies (ALMPs) must move beyond general forecasts (Galgóczi, n.d.) to focus on horizontal skills transfer (e.g., from process control to digital monitoring or renewable energy maintenance). This acknowledges that vertical movement within a fossil fuel sector prioritizing automation is not a feasible long-term solution.

Place-Based Implementation

To be geographically agnostic means failing to account for the vast differences in labor market functionality, infrastructure, and socioeconomic structure between large urban centers and remote resource communities (Canada Urban Institute, 2024). Transition strategies need to be adapted to local contexts rather than applying one-size-fits-all approaches. Urban hubs like Calgary or Anchorage face different challenges than remote resource communities like Fort McMurray or rural Alaska villages. Policy must respond to these differences.

"...That's where just transition comes. It's from the bottom up…these top down approaches to just transition research…start in a terrible place and don't center energy justice in the way that it should be. It's [about] localizing benefit as well. They're chopping trees down in their backyard, and those jobs are extremely local, right from from chopping down to processing, to

feeding, feeding the stoves, all of that [is] very localized. Whereas oil comes..regionally, maybe in the state, maybe around the world. I think people at the community level are able to get behind that if they are a community that's benefiting from these things. But obviously state level or wider communities might not all have these opportunities."

— Chad Walker, Assistant Professor at University of Dalhousie

The Urban-Rural Divide and Policy Misalignment

Urban hubs' challenges are drastically different from challenges faced by rural and remote regions. Urban centers like Calgary have seen transitioning high-skilled, white-collar professionals displaced by automation and industry consolidation, as was the case when Imperial Oil cut 900 jobs, primarily affecting Calgary staff. Thus, solutions must leverage non-fossil fuel industries for digital upskilling.

On the other hand, the threats remote resource communities (e.g., Fort McMurray in Alberta and rural Alaska) face are more existential in nature. Communities losing their most significant economic stake drives the risk of collapsing public services and infrastructure deficits. In Alaska, amplified geographic isolation compounds these risks, and further includes risks like shortages in educators or instructors, limited occupational training opportunities, and transportation or climate barriers that restrict rural resident access to other economies (i.e. poor connectivity). Policy intervention must look past commonly-hypothesized failures of skills mismatch to prioritize supply-side structural investments, such as building housing for skilled workers, funding vocational centers, and ensuring energy independence through local microgrids, to ensure that individual worker retraining can yield sustainable outcomes.

"I'm a geographer by training, so we love to talk about space and borders and boundaries where conflicts happen, even in renewable sectors. [Some] local communities hate wind farms, but the state or the province loves it…[and] support [these] kinds of things, largely through urban populations that voted for politicians, but then local communities have to deal with it. So, there's spatial dynamics at play. And oftentimes, these local communities, their voice, the seats, and the number of citizens they have are much smaller."

— Chad Walker, Assistant Professor at University of Dalhousie

The Untethered, Mobile Fly-in/Fly-out (FIFO) Workforce

The Fly-in/Fly-out (FIFO) workforce model, prevalent in Northern Alberta and Alaska, brings to light a unique failure of place-based policy. Despite being civically and perhaps socially detached from their regions of employment, FIFO workers contribute economically to remote project sites. Crucially, when displacement occurs, the economic shock is felt not in the actual place of work, but rather in the worker's distant (and often urban) home municipality. Traditional community funding mechanisms, such as Alberta's Coal Community Transition Fund (CCTF) (a criticized "one-off payout") are therefore irrelevant to these mobile workers.

The FIFO model allows industry to externalize the social costs of its workforce (housing, social services) onto distant municipalities. To ensure that the costs of kickstarting and completing transition pathways are internalized by sectors that benefit from the mobile labour structure, transition policies should mandate the creation of portable benefits and training endowments, funded by the resource industry through mechanisms like decommissioning fees or dedicated levies.

Community Co-Design, and Stakeholders as Policy Architects

Effective just transitions must move from passive post-ideation consultation to genuine community co-design, where affected populations wield real decision-making power over their economic and social future. Interviewees noted that, in several international contexts, rather than in Germany, community participation is often treated as a procedural step rather than a meaningful contribution to policy outcomes.

"Sometimes [community members] get invited, but in the end the decision-making is not really that they were considered; it's just like for the record."

— Nga Ngo Thuy, Project Manager at Agora Energiewende

Representation versus Autonomy

While Germany's Coal Commission was successful in fostering mutual understanding and collaboration between pro- and anti-coal interest groups, its structure ultimately resulted in top-down policies despite being heavily branded as bottom-up. This procedural deficiency occurred because regional stakeholders often lacked the necessary negotiation experience and technical resources to effectively participate against better-resourced government and large corporate interests.

In Alberta, a prolonged gap between the coal phase-out announcement and the start of the consultative process also led to widespread unease and dissatisfaction. Relying on short-term or one-time solutions (like the insufficient CCTF payout) reinforces distrust of the government and nearsightedness-induced anxiety, which greatly hinders future participatory processes (Płaza & Rzeńca, 2023).

The Co-Design Imperative: Empowering Local Decision-Making

Transformative change requires building local capacity for collaborative governance. Simply inviting stakeholders to consult is insufficient; policy must also mandate and fund the institutional capacity of local, non-governmental, and civil society groups (e.g. Alaska's Renewable Energy Alaska Project, REAP, which mobilizes diverse groups) (Runhaar et al., 2024). This capacity funding transforms stakeholders from passive policy recipients into empowered policy architects.

Genuine and effective co-design means involving stakeholders in social learning processes, which should be supported by transparent and accessible models (Kok et al., 2019). Successful localized initiatives are made possible through committed local leadership and centralized authorities or overarching governance that avoids micromanagement (Runhaar et al., 2024). This takes the concept of a just transition out of the abstract, making climate action an immediate social benefit rather than a perceived distant economic threat (Abram et al., 2022).

"Community capacity [plays] a large role as well, right? And I think it's important…to think of community capacity as not being this static thing, where some communities have it and some communities don't. Obviously, in the short term, that's very much the case. If you put out a proposal for clean energy projects that's due in a couple months, those with high capacity and resources are going to be the ones bidding and winning. But sometimes before that, there's a lot of programs–and they have been in the federal government in recent years–that are providing funding and providing resources to build up capacity and community. [These programs are] recognizing that not everyone's starting at the same starting line, in particular indigenous and equity seeking communities. I think policies and programs [are meant to] to provide resources [and] to provide capacity."

— Chad Walker, Assistant Professor at University of Dalhousie

Qualitative Conclusions

The ultimate need is for a sophisticated multi-level governance framework that marries two critical components: the high-level, long-term capital commitment and institutional stability seen in NRW's process, with radically decentralized implementation autonomy for co-design, capacity building, and localized decision-making power.

Table 1: Comparative Just Transition Policy Deficits: NRW, Alberta, and Alaska

Gap Category	**North Rhine-Westphalia (Germany) - Coal**	**Alberta (Canada) - O&G**	**Alaska (USA) - O&G**
Sectoral Intersectionality	Policies focused on unionized workers, risking exclusion of migrant and subcontracted workers (Galgóczi, n.d.). Gender policy lacked coherence, contributing to energy poverty (von Lüpke, 2023).	Acute research and policy deficit regarding Indigenous, migrant, and female workers. Key issues include historical disenfranchisement and lack of energy sovereignty (UN Human Rights Council, 2025; Miller & Parkins, 2023).	Workforce barriers compounded by geographic isolation and climate constraints. Notable dependence on public and tribal utilities.
Technological Unemployment	Alignment between retraining and emerging sector labor demand is necessary, although structural funds support diversification.	High automation risk (80-95%) for key blue-collar roles (Stanford, 2021); lack of precise, technology-informed forecasting for targeted resource allocation.	Declining production is exacerbated by efficiency and automation, undermining the stability needed for long-term workforce planning.
Place-Based Implementation	Benefits from national infrastructure and strong social protection. The challenge lies in large-scale structural	Centralized planning fails to differentiate between urban hubs and remote or rural resource-dependent communities. FIFO	Extreme challenges due to isolation, infrastructure, and lack of instructors. ALMPs must prioritize foundational structural

	transformation for dense industrial regions.	workforce policies are inadequate.	investments.
Community Co-Design	Policy outcomes were largely top-down; regional stakeholders lacked capacity and experience to participate effectively.	Delayed engagement and reliance on criticized, insufficient, one-off community payouts (CCTF). Policy framed workers as recipients rather than architects or co-designers (Płaza, & Rzeńca, 2023).	Policy constrained by local municipal or tribal scope; lack of consistent state or federal framework to mandate transformative co-design processes.

The comparative analysis demonstrates that the current toolkit for just transition, largely focused on individual worker mitigation (retraining and severance), is structurally insufficient to address the deep economic, social, and political friction generated by energy shifts. The underlying problem is that current policies treat the transition as a linear economic problem rather than a complex sociopolitical transformation that threatens identity and community structure.

Quantitative Analysis

Overview of Findings

This section presents the comparative results of the economic indicators for North Rhine–Westphalia (NRW), Alaska, and Alberta from 2015-2024. The findings highlight substantial regional differences in gross domestic product (GDP) trends, sectoral employment structures, fossil fuel dependence, and public and private renewable investments. Results are presented in two parts:

1) Baseline regional economic trajectories
2) Cross-regional analysis of renewable and fossil investment modeling, incorporating structural drivers of public-private investment behavior

Data Harmonization and Analytical Steps

To ensure proper merging of datasets, region labels were standardized. To normalize investment data, a purchasing power parity (PPP) conversion was uniformly applied across all capital expenditure (CAPEX) measures. All PPP adjustments follow Organisation for Economic Co-operation and Development (OECD) methodology for cross-regional comparability. Furthermore, columns were created to calculate new USD investments in the Renewable and O&G CAPEX sheets. Lastly, investment classifications emphasize transparency in definitions of "public" vs "private."

Visualization

The data was visualized in the following ways:

- Sectoral employment trends
- GDP per capita (PPP-adjusted) comparisons
- Linear-scale investment trends by region
- Public vs private renewable investment charts
- Cumulative CAPEX comparisons

Core Indicators

Economic Indicators

Annual GDP per capita and population data for each region were compiled using regional statistical offices, OECD measures, and harmonized purchasing power parity (PPP) conversion factors. GDP per capita is presented in 2021 international dollars (PPP-adjusted) to allow comparability across regions.

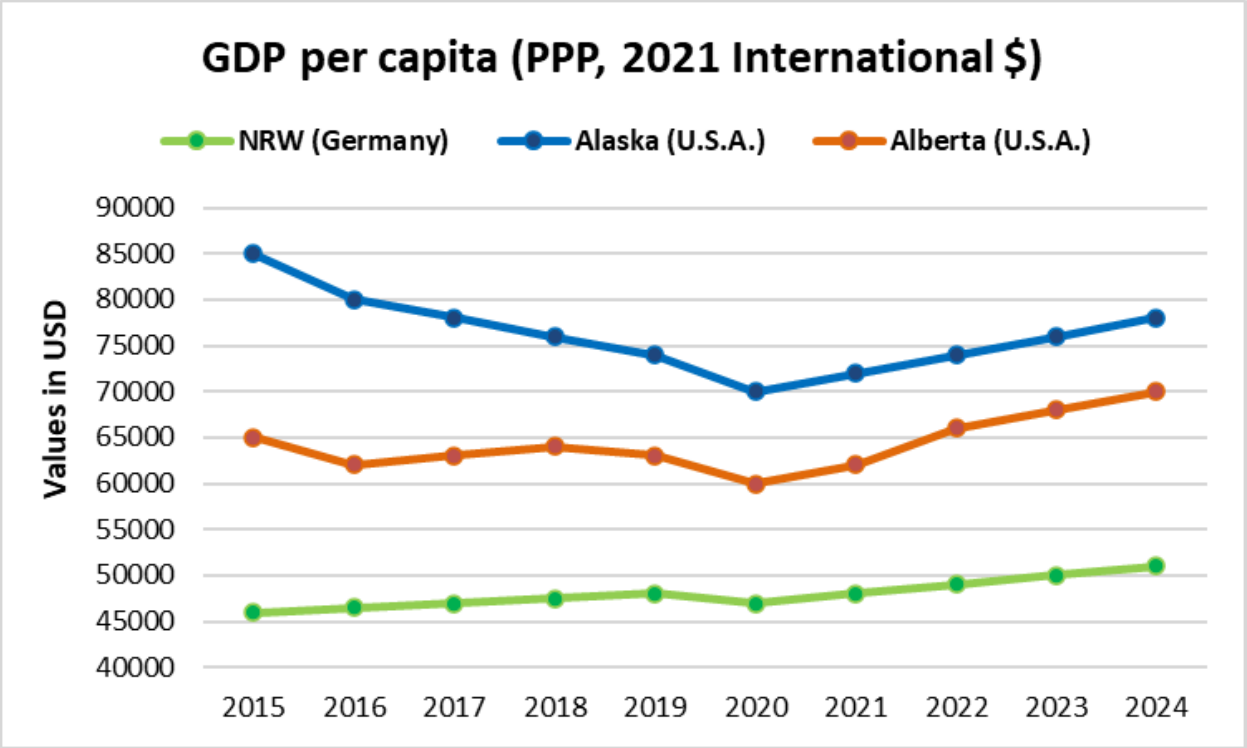

Figure 1: GDP per capita (PPP, 2021 International $)

Although NRW is the foundational and primary case study, it is important to note that its GDP per capita is the lowest of the three regions compared. This does not reflect economic weakness, but rather the distorting effect of oil and gas on regional economies. Oil and gas extraction tends to dramatically spike GDP per capita in producing regions like Alberta and Alaska, making these regions appear more prosperous on paper. However, this prosperity is volatile and tied to global commodity prices that these regions cannot control. NRW shows consistently lower GDP per capita compared to Alaska and Alberta, largely due to population size differences and the absence of resource-based value inflation. Alaska and Alberta are both resource-intensive economies and show higher GDP per capita output driven by their capital-intensive oil and gas sectors, despite smaller populations.

What this research focuses on is whether NRW's diversification strategy is creating more stable, sustainable economic growth over time, even if the absolute GDP per capita numbers are lower.
The sectoral employment data tells a compelling story about how transitions are actually unfolding in practice.

The above figure paints a picture about the respective economic landscape in the selected regions. NRW experienced a consistent increase in GDP per capita across the entire time period from $45,000 to a little over $50,000, increasing by more than 11% over the span of 10 years. However, the same does not hold true for Alberta and Alaska. While Alberta does see a net increase in GDP per capita from $65,000 to $70,000, is it a slightly smaller increase of ~8%. This can be owed to the increasing production in Alberta over the last decade. Alaska, on the other hand, as a result of the declining production, has also seen a steady decline in its GDP per capita, reducing from $85,000 to less than $78,000, an ~8% over the span of a decade.

Perhaps what is even more interesting than nominal changes in GDP per capita is its year-on-year volatility. Examining two specific periods, 2015-2016 and 2019-2020–both rife with political uncertainty from Brexit and monumental US elections, as well as economic shocks like the US increasing shale oil production and the COVID-19 pandemic, which led to oil price crashes–brings to light certain patterns. Alberta particularly displays a lot of short-term fluctuations, as high as ~5% year-on-year. This tendency is also displayed by Alaska, where year-on-year fluctuations can be as high as ~7%. NRW, on the other hand, seems much more insulated to these political and economic shocks. In 2015-2016, GDP per capita ended up increasing by ~2% and in 2019-2020, despite the pandemic, GDP per capita only decreased by ~2%, which is less than 50% of the effects these shocks had on the Albertan and Alaskan economy.

These patterns evidently point to the vulnerability faced by fossil-fuel dependent communities due to a lack of diversification in the economy. Reliance on oil and gas not only ties the economic prosperity of Alberta and Alaska directly to oil and gas production, but also results in their economies being more exposed to larger geopolitical and macroeconomic shocks. Contrastingly, the Coal Commission’s efforts seem to have put NRW’s economy on a more consistent path to economic prosperity and made it more resilient to these same shocks.

Labor Market Indicators

The next group of long-term indicators focuses on the labor market: total employment, employment by fossil fuel (coal in NRW; oil and gas in Alaska and Alberta) and renewable industry, as well as unemployment rates. These indicators help capture an economy's structural dependence on fossil industries as well as potential labor vulnerabilities during transitions.

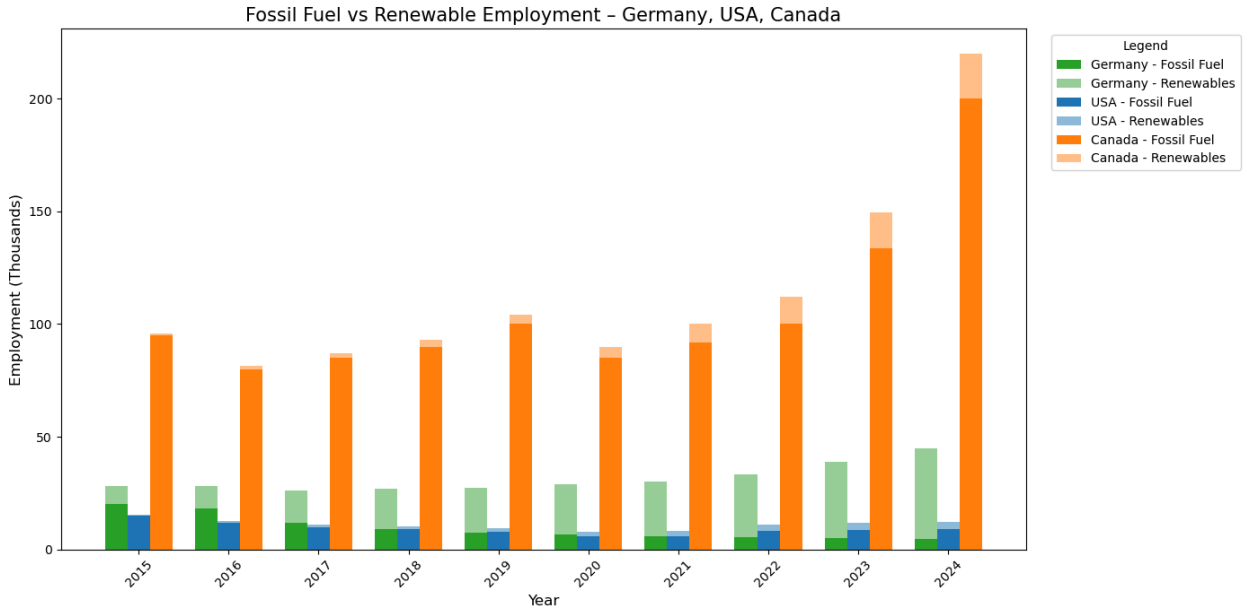

Figure 2: Fossil Fuel v.s. Renewable Employment - Germany, the US, and Canada

These indicators capture structural dependence on fossil industries and potential labor vulnerability during transitions. As observed in this graph above, all three regions were heavily dependent on the fossil fuel industry for employment at the start of our observation period. Alberta and Alaska depend almost entirely on oil and gas for employment, while NRW, although less dependent, still saw ~80% of their population dependent on coal. However, the Coal Commission's intentional efforts over the last decade have helped rebalance the split between employment in the fossil fuel and renewables industry in NRW. NRW exhibits a steady decline in coal employment offset by rising renewable jobs, reflecting a deliberate transition policy, leading to only ~10% of the workforce relying on coal for employment. A clear increase in renewable energy jobs over time, and critically, renewable employment overtakes coal employment between 2017 and 2018—right when the Coal Commission begins implementation work. This suggests that the comprehensive policy package, not just training programs, but also the investment in infrastructure and innovation hubs, is successfully creating alternative employment opportunities at scale.

On the other hand, in the absence of a similar concerted, intentional push, Alaska and Alberta are both still heavily reliant on the fossil fuel industry for employment. Alaska maintains stable fossil employment with minimal renewable labor growth, which is consistent with limited private renewable energy activity. Alaska shows a slower increase in renewable jobs compared to much faster growth in oil and gas employment. This reflects the booming nature of the industry during certain periods and the fact that renewable energy deployment remains heavily dependent on public grants rather than market-driven private investment.

Alberta demonstrates the slowest increase in renewable energy jobs compared to the oil and gas sector– reasonable given that Alberta is one of the biggest producers of oil and gas in North America. Alberta shows a slow increase in the renewable employment post-2015 with rising renewable labor associated with private-sector wind and solar development. The province's deregulated power market has attracted some renewable investment, particularly in wind and solar, but this hasn't yet translated into employment levels that rival the established hydrocarbon sector. The seven-month renewable energy moratorium further constrained job growth in clean energy. All these factors render only ~10% of the workforce in Alaska and Alberta in the renewables industry.

The labour market's dependency on an industry that is built on the premise of extracting a resource that is subject to market demand and, in the case of Alaska, declining production is a cause for concern. Not only is the economy heavily dependent on oil and gas as a source of revenue, but so are people's livelihoods. This dependence further accentuates the persistent economic distress and existential anxiety that these regions experience.

Investments

The next long-term indicator of focus is the evolution of investments in fossil fuel and renewable energy industries. The graph below displays this trend across all three regions. The graph further disaggregates the renewable energy investments to indicate whether they originated from the public or private sector.

Fossil Fuel Energy Investment Data (Coal, Oil and Gas)

Fossil capital expenditure (CAPEX) includes capital expenditures for exploration, production, processing, and related infrastructure. In the case of Alaska & Alberta, oil and gas CAPEX is dominated by private-sector investments, sourced from EIA, CAPP, AER, and producer-level reporting. Due to the structure of North American fossil markets, public CAPEX is minimal,

with government support typically flowing through tax incentives, subsidies, and infrastructure programs, rather than direct capital investment.

Renewable Energy Investments Data

Renewable energy investment data include public, private, and total annual investments in wind, solar, hydrogen, and grid modernization projects supporting renewables financed through public budgets.

- **Public investments include:** Direct government funding, Grants, Community/cooperative energy, and Public utilities or energy authorities (strong in Alaska)
- **Private investments include:** Independent Power Producers (IPPs), Corporate Power Purchase Agreements (PPAs), and Developer-led wind and solar portfolios (especially in Alberta).

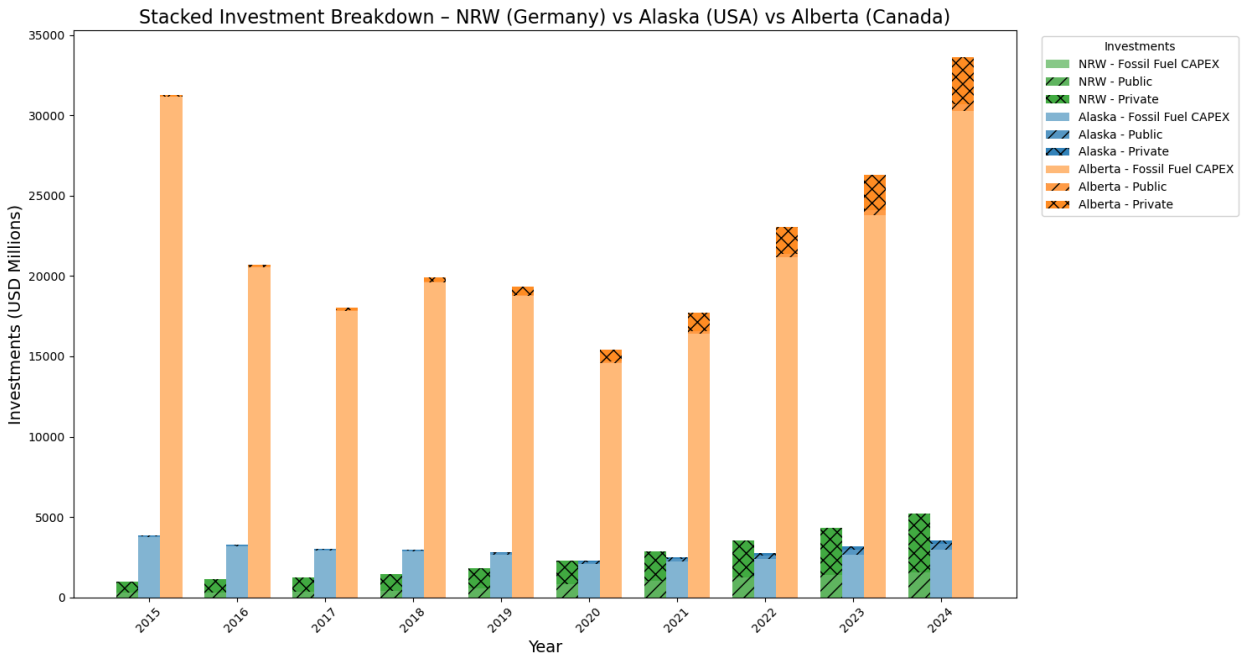

Figure 3: Fossil Fuel v.s. Renewable Investment (Private vs. Public) - Germany, the US, and Canada

Trends

There are multiple similarities seen between GDP-per-capita, employment, as well as investments. In the case of Alberta, oil and gas CAPEX is roughly the same at the start and end of the period under review. However, the year-on-year movement in oil and gas CAPEX fluctuates quite widely, sometimes showing as drastic as a ~33% increase between 2015 and 2016 and a ~36% increase between 2023 and 2024. This drastic volatility in domestic investment is not only guided by the international landscape of the oil and gas industry, but also indicative of the resulting unpredictability in employment as well as GDP. On the other hand, Alberta has the highest private renewable energy investments, with a 2,881% increase due to its deregulated electric market, corporate PPA activity, and strong wind/solar resource endowment. This rapidly increasing investment is proof of the notion that conducive policies and market mechanisms such as the corporate PPA ecosystem, can be strong catalysts for renewables investments from domestic as well as global investors, even in the face of very strong investments from the fossil fuel industry. Although public investment has increased in Alberta, it has primarily focused on grid innovation rather than direct renewable CAPEX.

Alaska faces a similar volatility in oil and gas investments, albeit not as drastic, while witnessing a steady decline in fossil fuel investments. However, unlike Alberta, private renewables investment in Alaska remains low due to structural constraints such as geographic isolation, harsh climate, limited grid integration, small market size, and lack of competitive energy markets. Investments in the renewable energy industry in Alaska are fueled by federal public grants received by public and tribal utilities, seeing a consistent 679% increase from 2015 to 2024, rather than market mechanisms. The recent termination of the Solar for All program, which would have provided $62.5 million in federal funding, exemplifies Alaska's vulnerability to policy shifts.

The story of NRW is very different from that of its North American counterparts. With the coal phaseout mandating divestment from the fossil fuel industry, NRW sees a consistent increase in public and private investments in renewables. Between 2015 and 2024, public investment in renewables has increased by 500%. More so, private investment has increased by 900%, which is driven by a highly industrialized economy with large firms pursuing industrial decarbonization strategies which is incentivized through long-term climate policy certainty. The strong public policy environment,be it the Energiewende (Germany’s long-term energy and climate strategy to transition from an energy system dominated by fossil and nuclear sources to one dominated by renewable energy sources), feed-in tariffs, or the coal phase-out–helps “crowd in” private capital. Therefore, renewables investments in NRW materialize through mixed ownership models among community-led cooperatives, municipal utilities, and industrial consortia.

The connection between the investment patterns and employment trends is clear: where there is more investment, whether private or public, in a particular sector, we see an increase in jobs. In Germany, it is the renewable sector. In Alaska and Alberta, oil and gas investment still dominates, and employment follows accordingly.

Evaluating the Current State of Research and Highlighting Blindspots

The existing body of research provides significant theoretical depth, especially in works that apply complex sociological concepts like ontological security and discursive analysis. This notably contributes to articulating and explaining non-economic forms of resistance to decarbonization. Many existing quantitative studies, such as those analyzing sectoral employment precarity, also take into consideration the risks faced by indirect and induced sectors, which lays the groundwork for broadening the scope of just transitions beyond traditional measures, and outside of targeted sectors alone.

However, the literature suffers from notable empirical and methodological deficiencies. The overarching critique remains the "lack of empirical studies on the opinions of Canadian oil and gas workers" (Bell, 2024). A reliance on secondary or theoretical models, rather than direct, consistent engagement with workers, limits the practical applicability of findings (Bell, 2024). Furthermore, much of the qualitative research depends on a non-random, targeted sample, reflecting a demographic bias towards the traditionally dominant workforce (which is predominantly white, male, conservative, high-income individuals) (Bell, 2024). This selection process risks overlooking the experience of the more marginalized groups who also face displacement.

Additionally, there are some limitations with regards to data availability that hinder research, especially when investigating investments. Although it is evident that coal CAPEX is dwindling to an eventual halt in Germany, due to the phaseout, it is hard to obtain actual data as the government has stopped reporting it. Furthermore, public investment is defined differently across regions due to unique governance structures. In both Alaska and Alberta (i.e. North American regions), there is potential for underestimating private deployment of renewables. Alaska's microgrid and tribal utility data may underrepresent small-scale private deployments. In the case of Alberta, although merchant market renewables are well-documented, private developer reporting varies by project. This underlines the need for consistent reporting guidelines and disclosure requirements to aid transparency.

Recommendations

Effective just transition policy requires interconnected design imperatives that explicitly address the identified gaps:

1. **Equity-Centered Design**: Policy, programs, and investments must centre intersectionality, rather than designing for the dominating demographic. This also includes expanding the breadth of scope from the individual job to the household and community unit, which necessitates dedicated and mandated funding to build the political capacity of historically marginalized or underserved groups to equally participate in policy creation. Programs and investments should be designed with the intention to increase community ownership of projects, driving community uptake alongside ensuring that the benefits of these policies are reaped by the local communities themselves. Policymakers and any stakeholder with decision-making authority must recognize that intersectional approaches are not supplementary to just transition frameworks but foundational to their legitimacy and effectiveness, so as to avoid unintentionally manifesting historical systemic inequalities in new systems.
    - In Alberta, ensure that funding mechanisms include induced sectors as well. A fund for community stability (i.e. not just directly-impacted industry workers) addresses groups traditionally neglected and disproportionately impacted–accordingly, service, hospitality, and care economy workers who often suffer the most during economic contractions yet rarely qualify for industrial transition aid.
    - In Alaska, structure funding programs to ensure greater community ownership of energy transition projects, which shall help pour the financial benefits of these projects to all members of the community directly into these communities. This shall help ease the burden of transition on all community members and equitably distribute the proceeds of these transition projects.
2. **Technology-Informed Workforce Planning**: To prevent inefficiently allocating limited public capital on retraining programs for technological "ghost jobs" or downwards trending roles, future transition strategies should mandate granular, occupation-specific job forecasting that takes into account projected automation or displacement rates. This maximizes resilient skills transferability into emerging, long-term industries, and considers job risks independent of those from climate policy.
    - In Alberta, commission occupation-specific audits to identify which O&G roles are at high risk of automation (e.g., haul truck drivers, process technicians) over the next decade and adjust current reskilling and upskilling programs as

needed for future-proofing. Additionally, prioritize horizontal over vertical reskilling to create favourable conditions for cross-sectoral transfers.

- In Alaska, expand and inventory technical assistance, training and workforce development to identify gaps, increase capability & capacity building activities for Training a Rural Energy Workforce. i.e. apprenticeship programs for energy production. Additionally, conduct an audit of O&G roles to identify jobs that are most easily transferable and most likely to be lost to automation to help design effective reskilling and upskilling programs.

3. **Localized Implementation:** Prioritizing supply-side infrastructural investments in remote and rural communities, and legally mandating co-design mechanisms contribute to transforming stakeholders into policy architects. Governance frameworks must be established that marry implementation power decentralization with the stability and long-term capital commitment of a centralized model (e.g. Germany's structural funds).
    - In Alberta, formally bifurcate the provincial transition strategy between rural and urban communities, with separate budgets. Fiscally acknowledging that building resilience and diversifying economic pillars looks different between rural and urban regions of the province is the first step to avoiding generalized mechanisms that serve certain demographics more than others. For example, a priority for Calgary or Edmonton may be helping workers diversify into the existing technology and finance sectors, while a priority for non-major cities may be infrastructure solvency.
    - In Alaska, given the vastly different socioeconomic and geographical landscapes, develop distinct transition strategies for rural and urban communities by conducting community-specific Integrated Resource Plans (IRPs) to forecast energy demand and generation for community and regional future energy needs. These hyper-local plans shall acknowledge this regional disparity and help tailor strategies that are most helpful to the needs of the communities in question. For example, while coastal Alaska might benefit from a greater emphasis on building up hydropower production, the priority in rural Alaska would be upskilling the workforce on technologies like microgrids and Small Modular Nuclear Reactors (SMRs).
4. **Policy Certainty & Consistent Public Infrastructure Investments:** Policy certainty is integral to sustain the momentum for a just energy transition as it acts as a strong signal for private investment, enables community action, and delivers dividends on long-term economic indicators such as income and employment. In NRW, the private sector seems committed to wide-scale industrial decarbonization strategies due to firm energy

transition policies and consistent investments from the government. On the other hand, policy inconsistencies have been a big impediment to gaining and sustaining momentum for the energy transition in Alberta and Alaska.

- In Alberta, technical grid-connection bottlenecks can be removed if public infrastructure funding goes towards modernizing the Alberta Interconnected Electric System (AIES) to enable handling higher loads of variable renewable energy. Ideally, a renewable investment guarantee pact would enact certain safeguards for renewable energy permitting and investor assurance; however, recognizing the historical political trends and grounding recommended action items in realistic contexts is of paramount importance.
- In Alaska, strategizing and prioritizing State of Alaska funding to match federal funding and federal financing to build and expand sustainable transmission and distribution lines in Alaska. Not only would this bring Alaska on par with the US transmission systems, it would also provide a much-needed buffer for any federal policy uncertainty, which shall eventually aid Alaskan energy security and lower energy costs.

Conclusion

This paper sought to answer how insights from North Rhine-Westphalia's coal transition can inform the design of equitable and durable just transition strategies in fossil-fuel-dependent regions such as Alberta and Alaska. Using a mixed-method approach, the analysis demonstrates that despite differing regional contexts, existing policies remain constrained by similar structural gaps including insufficient attention to sociological foundations, inadequate forecasting of automation-driven displacement, weak place-based implementation, and limited community co-design.

Qualitatively, findings show that transitions falter when treated primarily as economic problems of retraining and compensation. Worker and community identities, systemic inequities, and the absence of meaningful local authority shape acceptance far more than financial measures alone. Quantitatively, comparative indicators reveal NRW's relatively stable economic trajectory and demonstrable shift from coal to renewable employment, outcomes tied to sustained public investment and long-term institutional planning. In contrast, Alberta and Alaska continue to experience volatility, high dependence on oil and gas employment, and slower renewable sector growth, reflecting the absence of coordinated diversification strategies.

Together, these findings underscore that effective just transitions require multi-level governance, combining stable long-term capital commitments with decentralized, community-led decision-making power. They also necessitate policies that anticipate technological disruption, prioritize equity, and invest in the structural conditions needed for new industries to emerge. The recommendations that follow draw directly from these qualitative and quantitative findings and outline concrete steps for achieving transitions that are low-carbon, socially equitable, and economically resilient.

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