



The imperative for integrative low emissions development: evaluating integrative fit of low emissions development strategies across eight countries

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Abstract

The Paris Agreement encourages nations to develop long term low emissions strategies to articulate their pathways to achieve net zero by 2050. While mitigating global temperature increase and shifting to low emissions development are integrated challenges (defined by complex relationships between dynamic factors that need to be considered together to understand the whole), integrative approaches are not consistently used and not well understood in the governance of social-ecological systems. This study presents a Framework for Integrative Strategy that highlights key dimensions required for national strategies to have integrative fit with shifting nations to low emissions development. When applied to the national strategies of eight high greenhouse gas emitting countries, only Germany, Japan and South Africa scored a 'fit' score well above their 'gap'. Collectively, there are significant gaps in six out of seven dimensions, where four have gaps greater than fit. This significant integrative gap suggests low likelihood of achieving a sustainable low emissions future.

Keywords:

Long-term low emissions strategies, integrative policy, UNFCCC, decarbonization, socio-ecological system transformation,

JEL Classification:

Q01, Q54, Q56, Q58

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1. Introduction

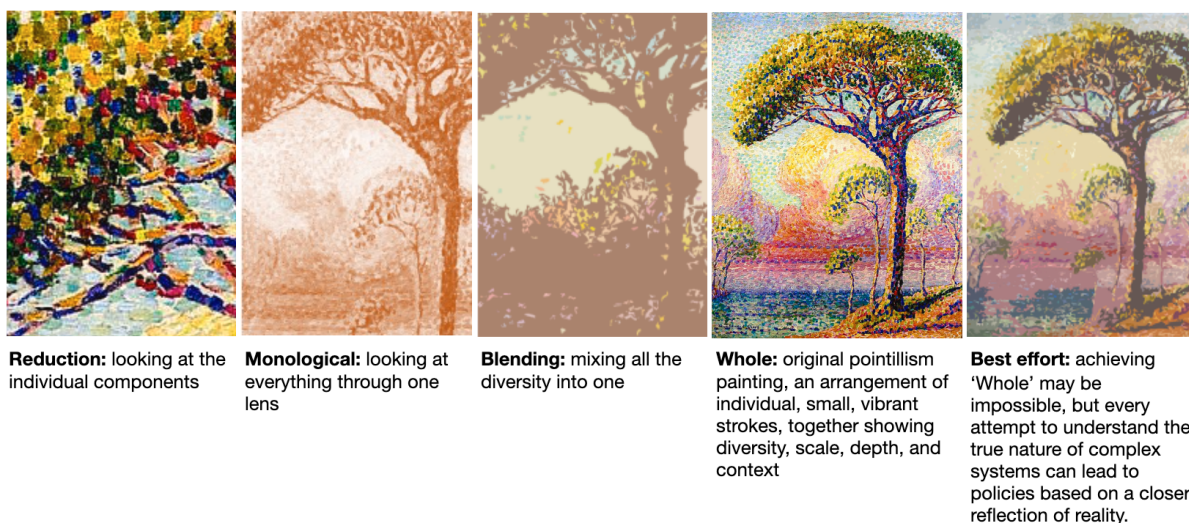
Climate change has emerged as the most significant crisis of our era. According to the Intergovernmental Panel on Climate Change (IPCC), climate change is posing concurrent risks that are increasingly severe, interconnected, and in many cases, irreversible (IPCC 2022). The Anthropocene era means humans are now the dominant force impacting the dynamics of the planet. This could pose a bleak future, yet it also suggests that with a concerted global effort, it is possible for humans to shape a sustainable future. The Paris Agreement, established in 2015 and signed on by more than 190 nations, urged countries to craft Long-Term Low Emissions Development Strategies (national strategies) that would realise their Nationally Determined Contributions (NDCs) and targets. Developing a national strategy helps to ensure that countries are taking tangible actions towards emissions reduction and low carbon development rather than merely expressing commitments without meaningful action. National strategies must offer a comprehensive and integrated vision to steer countries toward sustainable pathways and away from unsustainable development (Rocha & Falduto 2019; Sartor et al. 2017). Such a shift requires profound societal, economic, and systemic transformations across all sectors and regions (Jotzo et al. 2021).

National strategies are addressing an integrated challenge. What makes a challenge ‘integrated’ is the complex interconnected nature of multiple factors that need to be considered holistically to be able to understand and address it (Holling 2001; Fried et al. 2022). There is significant risk and uncertainty surrounding the future social, economic, technological, and political landscapes impacting low emissions development (Foxon et al. 2009; Elliott et al. 2019). Concurrent global crises compound the complexity – challenges such as terrorism, food insecurity, intensifying weather hazards, mass migration, livelihood insecurity, land degradation, biodiversity loss and pollution just to name a few (IPCC 2022; Banerjee 2021). Meanwhile, the imperative to act quickly is high as climate hazards intensify worldwide, delaying action will only increase costs and difficulties (IPCC 2022; Jotzo et al. 2021). Hence, shifting towards low emissions development is a complex task demanding integrative approaches that ‘fit’ its integrated nature.

Approaches have ‘integrative fit’ if they provide structures that reflect the integrative nature of the socio-ecological systems they seek to manage, and ‘integrative gaps’ for when they do not (Folke et al., 2007; Epstein et al., 2015; Bodin, 2017; Fried et al. 2022; Guerrero et al. 2015). Despite the

urgent need, integrative approaches are not well understood and not consistently used when addressing social-ecological system challenges (Weitz et al. 2017; Albrecht et al, 2018). For this study ‘integrative’ refers to the characteristic of the need to jointly consider interconnecting factors to form a holistic understanding. To be clear, integration in this case is not ‘blending’ considerations into a single concern (see Figure 1). Instead, it seeks to understand something through synthesizing a holistic view of individual parts, recognizing diversity and the role each factor plays in the complex system (Figure 1 fourth variation – ‘Whole’).

Figure 1 Variations of ‘A Pine Tree’, 1905 by Henri Edmond Cross, illustrating ways of thinking



This study identifies key dimensions of integration for shifting towards low emissions development that national strategies should account for, which led to the development of the *Framework for Integrative Strategy*. Eight national strategies were evaluated against the framework to glean insights into their integrative fit to achieving Paris Agreement's goals. The framework can help improve the quality of low emissions national strategies and be used to guide and strengthen policy and strategy development across a range of complex socio-economic and environmental issues. This study also provides a unifying framework for defining disparate dimensions and lenses of integration to analyse strategies and policies addressing complex integrative challenges. Applying the framework on national strategies demonstrates the value of evaluating integration as a framework to improve strategy and policy development.

2. Methodology

The study involved three overarching stages: 1) developing a framework for assessing integrative fit, 2) applying the framework to gather indications of integrative fit, and 3) analysing and drawing insights from the gathered data. A literature review was carried out across scholarly papers and expert advisory papers for national strategies to develop an initial framework. Adjustments and refinements to the framework were made iteratively over several in-depth scans and analysis of eight selected national strategies. The degree of integration against the framework was evaluated through qualitative interpretation and analysis.

2.1. Literature

2.1.1. Observing integrative failures

Rittel and Webber (1980s), and then later Levin (early 2000s) described ‘wicked’ and ‘super wicked’ challenges as those characterized by high degrees of uncertainty and dynamic interaction patterns that cut across domains, scale, and jurisdictional boundaries, compounded by acute urgency, insidiousness, and a lack of reliable institutions to address them (Candel & Biesbroek 2016; Foxon et al. 2009). Simplistic approaches to managing natural resources have had the insidious effect of exacerbating the problems those approaches were meant to solve (Forrester 1998; Meadows 2008) – what Westley et al. (2011) call ‘the paradox of innovation’. For example, bigger fishing fleets set to increase yield led to decreasing fish stocks and less yield over the long term (Folke et al. 2007). Many fields exhibit similar failures (Baird & Barney 2017; HLPE 2017; Huitric 2005) Gross Domestic Product (GDP) has been known to drive to unsustainable economic practices, yet it still dominates public policy (Costanza et al. 2014). These literatures call for a transformation in policy mindset needed for addressing climate.

2.1.2. Integrative fit

While centuries of positivist traditions and innovations have made addressing integrated challenges elusive (Scrase & Sheate 2002), integrative approaches are increasingly in focus. Since Young and Underdal first described integrative fit in the 1980’s, other scholars have furthered the concept (Folke et al 2007; Guerrero et al. 2015; Epstein et al., 2015; Bodin, 2017; Bergsten et al., 2019; Fried et al. 2022). Guerrero et al. (2015) emphasized formal collaborative processes for environmental governance. Bodin (2017) discussed horizontal integration – joint consideration of

factors crossing relevant domains (e.g. environmental, social, economic, political, industry sectors etc.), and vertical integration – joint consideration of factors spanning across scales of governance (local, national, regional, international). Fried et al. (2022) emphasised awareness and understanding of complex interconnections that actors should have when they manage environmental issues. The lack of institutional capacity to take integrative approaches has attracted scholarly attention (Folk et al. 2007), prompting further exploration into its nuanced dimensions.

2.1.3 Challenges of integration

Using integrative approaches requires overcoming several challenges. Integration between stakeholders is often subject to barriers such as time and effort, and differences in process, language and mental models (Bell et al. 2014; Varis, Enckell & Keskinen 2014). Power structures among system actors can upset processes, leading to mistrust of the resulting strategy and stymie implementation efforts (Adelle & Russel 2013; Bergsten et al. 2019). Integration cannot account for a lack of will and determination to aim for ambitious climate mitigation targets (Candel & Biesbroek 2016). Hence, other mechanisms are also necessary to remind and push leaders to taking ambitious actions towards low emissions development.

2.1.4. Best practice on developing national strategies

Recognizing the immense complexity involved in developing national strategies, experts and scholars have produced literature to guide country leaders on good practices (Rocha & Falduto 2019, Sartor et al. 2017; Jotzo et al. 2021; Hans et al. 2020; WRI & UNDP 2018; Sato & Altamirano 2019; Aguilar Jaber et al. 2020; Elliott et al. 2019). A breakdown of relevant dimensions from these studies follows below.

1) Integration of perspectives: Engaging a wide range of stakeholders (including NGOs, civil society, academia, industry, policymakers across agencies and jurisdictions, communities, and others) to understand their perspectives can lead to improved strategy quality and better outcomes for affected communities (Sartor et al. 2017; Ostrom 2010; IPCC 2022; Waisman et al. 2019; Rocha & Falduto 2019). However, policymakers need to be careful to balance voices such that stakeholders with varying degrees of power get represented fairly, particularly to achieve a fair and just transition (Sartor et al. 2017). Hence, stakeholder engagement needs to be synthesized to

reflect a good understanding of stakeholder perspectives before arriving at solutions (Elliott et al. 2019; Rocha & Falduto 2019).

2) Integrative goal setting: Experts encouraged clarifying the multiple objectives that will be prioritized to guide alignment (Grafakos et al. 2019; Candel & Biesbroek 2016). National strategies require integrating goals for sustainability, climate adaptation and mitigation, socio-economic development, the Sustainable Development Goals (SDGs) along with decarbonization (Rocha & Falduto 2019; Fried et al. 2022; Banerjee 2021). Integration of goals allows for identifying synergies and areas of conflict that require reconciliation (Sartor et al. 2017; Jotzo et al. 2021; United Nations 2015b).

3) Framing integrative transformation: Transformative changes in social and economic structures are needed to achieve large reductions in GHG emissions and sustain a low emissions pathway (Jotzo et al. 2021; Foxon et al. 2009; Westley et al. 2011; IPCC 2022). Dominant pre-existing structures and belief systems create path dependency and can resist change (Candel & Biesbroek 2016; Banerjee 2021). Many existing paradigms have been shaped by technological advancements (Westley et al. 2011), yet capacity to shape social institution systems have been underdeveloped in comparison (even though they are more complex and require greater innovation) (Forrester 1998).

4) Integration of systemic causal factors: Complex systems are comprised of interconnected social-ecological causal factors that create feedback dynamics (Bergsten et al. 2019; Kurtz and Snowden 2003; Folke et al. 2007; Fried et al. 2022; Banerjee 2021). The interconnections of related issues need to be considered to understand the whole – such as emissions trends, transboundary supply-chains, market fluctuations, natural resource flows, development needs, economic patterns, technological developments, sectoral contexts (Holling 2001; Jotzo et al. 2021; Sartor et al. 2017; Foxon et al. 2009; Ostrom 2010; IPCC 2022; Guerrero et al. 2015). The task of synthesizing the multitude of considerations requires deep reflection and synthesis (Folke et al. 2007).

5) Integration of temporal factors: National strategies should serve as a long-term vision to guide short term decision making (Jotzo et al. 2021). Strategies need to consider the timing of actions and the timescale by which different interventions can take effect (Rocha & Falduto 2019; Sartor et al. 2017), and account for different socio-ecological processes (Guerrero et al. 2015).

Without considering temporal factors, strategies will not achieve their goals in time and risk locking into unsustainable pathways that reduce opportunities for prosperity in the future (Elliott et al. 2019; Grafakos et al. 2019). Delaying action will likely incur greater costs and confront greater difficulties in the context of increased hazards and compounding risks (Bell et al. 2014; IPCC 2022; Jotzo et al. 2021).

6) Integrative implementation principles: Implementation of strategy interventions need to ensure mutually reinforcing, synergistic effects to optimize the use of limited resources and reduce potential conflicts and trade-offs while maximizing outcomes (Grafakos et al. 2019; IPCC 2022; Bell et al. 2014; Fried et al. 2022; Candel & Biesbroek 2016). Interventions should be selected and designed with a theory of leverage so that a ‘small change can lead to a large shift’ (Rocha & Falduto 2019; Banerjee 2021). Integration is not the norm and synergy and coordination will not emerge automatically. Hence, principles of integration require constant reinforcement, advocacy, and design, (Varis, Enckell & Keskinen 2014).

7) Integrative decision making and implementation through stakeholder involvement: Managing complex social-environmental issues relies on the actions, coordination, and decision-making responsibilities of many system actors (Ostrom 2010; Folke et al. 2007; Guerrero et al. 2015; Jotzo et al. 2021; Elliott et al. 2019). Experts recommend involving stakeholders and representatives in decision making and institutionalising their ongoing participation in implementation processes (Rocha & Falduto 2019; Waisman et al. 2019). Strategies lacking plans for meaningful stakeholder involvement risk losing trust and buy-in from key actors (Elliott et al. 2019; Ostrom 2010).

2.2. Selection of National Strategies

Eight national strategies were selected to be evaluated. A set of characteristics were considered to avoid biasing the selection and provide a broad perspective. The strategies were from within the top 20 highest emitting countries, based on Climate Watch (Friedlingstein et al. 2022). The countries also needed to have submitted an English language national strategy to the UNFCCC portal by January 2023. Four other characteristics were considered as summarised in Table 1.

Table 1 Selection of national strategy countries – by emissions ranking.

	Emissions ranking	Development status ^a	Net exporter or importer of fossil fuels ^b	Collectivism or individualism ^c	Governance regime ^d
China	1	Developing	Net importer	20 (Collectivist)	Closed autocracy
United States	2	Developed	Net exporter	91 (Individualistic)	Liberal democracy
India	3	Developing	Net exporter	48 (Mid leaning collectivist)	Electoral autocracy
Indonesia	4	Developing	Net exporter	14 (Collectivist)	Electoral democracy
Japan	7	Developed	Net importer	46 (Mid leaning collectivist)	Liberal democracy
Germany	11	Developed	Net importer	67 (Leaning individualistic)	Liberal democracy
Australia	15	Developed	Net exporter	90 (Individualistic)	Liberal democracy
South Africa	16	Developing	Net exporter	65 (Leaning individualistic)	Electoral democracy

^a **Development status** based on the UN classification (United Nations 2014).

^b **Net importer or exporter of fossil fuels** based on 2020 data from Our World in Data (Our World in Data 2022)

^c **Cultural tendency for Individualism vs Collectivism** based on the Hofstede Model (Hofstede 2011)

^d **Governance regime** based on Our World in Data's high-level characterization of governance regimes (Herre 2021)

The author recognizes that each characteristic described here is a simplification of highly complex patterns of political, cultural, and economic dynamics, but these are being used as a heuristic for the purposes of this study.

3. The Framework for Integrative Strategy

The *Framework for Integrative Strategy* was developed as a rubric and tool to evaluate the degree to which national strategies have integrative fit to address the nature of shifting to low emissions development. While nothing can guarantee or predict success, greater integrative fit of national strategies will increase the chances of achieving their purported goals and contributions to the Paris Agreement. The framework comprises seven distinct yet interrelated integration dimensions (Table 2 provides a summary of all the dimensions)

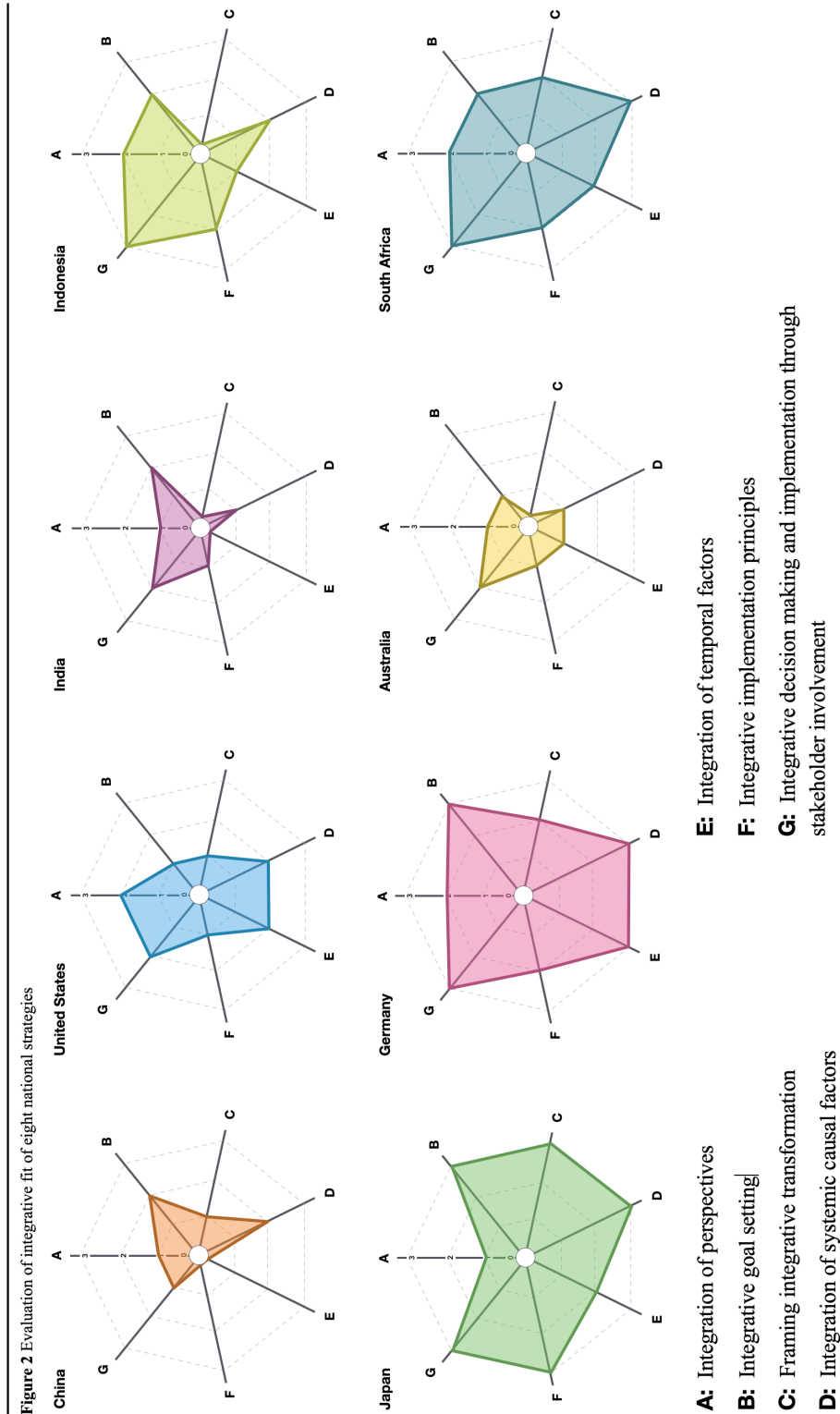
Table 2 Framework for Integrative Strategy

Integration dimension	Explanation	Scoring			
		0	1	2	3
Integration of perspectives	The degree of engagement and substantive understating of the needs of relevant stakeholders who may affect or be affected by the strategy. Relevant stakeholders should be engaged in strategy development, and their diverse needs and motivations be synthesized into a holistic understanding of how the system operates.	No indication of any engagement with relevant stakeholders.	Minimal engagement or recognition of the need to engage with stakeholders. Engagement with a limited set of stakeholders.	Some engagement with relevant stakeholders or shows recognition of the need to engage with stakeholders to include their perspectives in the strategy.	Extensive engagement with relevant stakeholders and demonstrates an integrative understanding of stakeholder perspectives through the strategy.
Integrative goal setting	The degree to which outcomes of the strategy are framed holistically to include multiple interdependent objectives that are relevant to achieving a sustainable low emissions development regime. Strategies should aim to achieve outcomes in addition to decarbonization ^a	No indication of considering objectives beyond decarbonization.	Singular or narrow objectives framing with minimal consideration of other objectives beyond those suggested by the Paris Agreement.	Some consideration of a set of objectives that need to be addressed, but not explicitly framing them as integrated or holistic.	Holistic framing of objectives and a vision for a low emissions regime and addresses a range of objectives, emphasizing the need to synergistically achieve them together.
Framing integrative transformation	The degree to which the strategy anticipates transforming economic, political, and social structures to achieve a low emissions regime. A transformation approach seeks to question, reimagine, and redesign dominant, fundamental structures that govern how the system and its actors behave.	No indication of considering transformation.	Some recognition of the need for changes yet with no or limited mentions of more fundamental or structural change.	Some mentions of transformative change being needed, but with little substantiation in the strategy.	Extensive discussion of transformations needed to shift towards low emissions development with analysis and vision setting consistent with a transformative outlook.
Integration of systemic causal factors	The degree to which the strategy synthesizes interconnecting factors and dynamics driving or inhibiting progress towards strategy goals. Strategies should demonstrate a holistic understanding of how system drivers and phenomena perpetuate system outcomes such as high GHG emissions.	No indication of considering systemic causal factors.	Limited discussion of factors or interconnections between different areas of concern (beyond those mandated by the Paris Agreement).	Some discussion of interconnections within and across sectors and geographic scales.	Extensive discussion of multiple domains of concern and drawing non-obvious relationships between causal factors across sectors and geographic scales.
Integration of temporal factors	The degree to which the strategy synthesises short-term considerations with long term impacts. Strategies should consider how current trends and patterns may evolve at multiple timescales and drive effects in the future ^c .	No indication of considering temporal factors.	Minimal mentions of short-term and long-term considerations.	Some consideration of short-term factors that impact the long-term, yet they are disconnected and incoherent.	Extensive discussions of short-term and long-term considerations are coherent and recognize the time constant of change.
Framing integrative implementation principles	The degree of explicit emphasis on requiring measures to be coherent, synergistic, holistically designed and carried out. Strategies should explicitly identify synergies and create virtuous feedback loops in their proposed measures ^d .	No indication of integrative principles.	Minimal mentions of interconnections between interventions.	Some discussion for the need to coordinate or synergize intervention efforts.	Strong emphasis on need to amplify or accelerate impact through leverage and alignment reinforced by discussion of synergistic effects in proposed interventions.
Integrative stakeholder involvement of decision making & implementation	The degree to which the strategy expects to involve relevant stakeholders in decision making and strategy implementation. Strategies should articulate implementation plans to activate stakeholders with the agency and imperative to collaborate ^e , while enabling and supporting stakeholders in less privileged positions to engage in strategy development and implementation ^f .	No indication of involving stakeholders for implementation.	Implied strategy development and implementation will be limited to one group or organization with limited collaboration with other stakeholders.	Some discussion of collaboration and coordination between a limited group of stakeholders with limited involvement of others.	Extensive discussion of involving and activating an extended group of diverse stakeholders to take ownership of the strategy including development and implementation. Discussion of growing involvement over time.

- ^a Such as striving for gender and socioeconomic equity, health and nutrition, environmental resilience, and etc..
- ^b Such as feedback loops between social, economic, political, and environmental forces, drivers of demand as well as drivers of supply, dynamics arising from the interaction of different scale governance and geographic contexts, and etc..
- ^c Such as recognition of the time required for system level change, lag time between interventions and their results, life cycles of investment decisions, and etc..|
- ^d Strategies would also stress the value of coordinating measures from different sectors (e.g., government policies, industry driven initiatives, community movements, etc.) and anticipate their interacting causal effects.
- ^e Such as international governments, policymakers, large companies, industry alliances, NGOs, and etc..
- ^f Such as low socio-economic communities, vulnerable groups like women and children, and etc..

4. Findings

The *Framework for Integrative Strategy* was used to evaluate the integrative fit of the eight selected national strategies. Evaluation scores for each dimension of each national strategy was visualized in a multi-factor ‘spider-chart’ to compare across them (Figure 2).



4.1. Indications of integration of perspectives

Most of the studied strategies incorporated some discussion of either having engaged with stakeholders to develop their strategy, or the intention to engage with stakeholders eventually. Comparatively high scoring strategies expressed intent to form their strategies based on wide engagement with stakeholders (Germany, South Africa, US, Indonesia). Some strategies discussed engagement more as consultations, which suggests a lower level of involvement compared to engaging stakeholders to inform strategy design (Japan). Others described engaging with a small group of experts, with limited intention to engage more broadly (Australia, India). Some mentioned consultations were carried out to develop their strategy but were vague about who (India and China). There seems to be a general understanding that gaining stakeholder perspectives is needed, though no country explicitly discussed a synthesized understanding of their stakeholder engagements in their strategies.

4.2. Indications of integrative goal setting

Mentions of economic, technological and equity outcomes were expected and were seen across all evaluated strategies. Some countries were more exclusively focused on technological and economic goals (Australia and US). In contrast, others discussed and reinforced the need to achieve disparate goals together and referenced the SDGs (which emphasize the simultaneous achievement of 17 goals) (Japan and Germany). China's strategy declared a multi-objective vision for the transition towards a green future. Strategies by developing countries had a greater emphasis on social and equity outcomes, and issues that may be more acute in developing contexts, such as electricity access and livelihood precarity (India, Indonesia, South Africa). In most cases, strategies identified co-benefits of achieving low emissions development with future prosperity. The goals of each strategy permeated throughout the documents, reflecting the lens through which concerns were analysed and prioritised.

4.3. Indications of framing integrative transformation

With a few exceptions, most strategies scored low on framing integrative transformation. Strategies from Japan, Germany and South Africa noted that current structures may be unsuited for a new low emissions regime, explaining that fundamental restructuring of economic, industrial and social structures may be required. Japan's strategy framed future societies as paradigmatically

different and ventured to imagine new paradigms based on current trends. South Africa's strategy claimed they were not being transformative enough in their current measures and will need to explore more transformative ideas. Other strategies made claims about the future looking different but offered few details to elaborate. Some strategies suggested incorporating climate concerns to existing structures and metrics (China, US). Some strategies had no indication of taking a transformative view or considering alternative development metrics other than existing models (Australia, India). In these strategies, the concept of 'transformation' tended to refer to technological advancement.

4.4. Indications of integration of systemic causal factors

Most strategies provided some analysis of causal factors in key sectors noted by the Paris Agreement – i.e. energy, transportation, infrastructure, industry and agriculture (2015, p. 2). Many strategies discussed the negative impact of climate on their development (India, US, South Africa). Some strategies were narrow in their analysis and only discussed direct economic and technological factors, rather than exploring indirect relationships and taking a more systemic view (Australia, India). Many strategies explored drivers of stakeholder behaviour and alignment to the transitions (US, South Africa, Indonesia, Japan). Some strategies mentioned other factors such as legal systems and social norms (China, Germany, Indonesia, Japan). Some strategies explored demand-side considerations as well as supply (Germany, South Africa). Most strategies analysed integrative factors within sectors and supply chains, such as barriers and inhibitors of technological development and uptake, or product design innovation (Germany, US, Japan, Indonesia). Few strategies were explicit in the need to consider interconnecting factors across sectors (Germany, US, Japan). From a scale perspective, some countries identified international demand and supply leakage (Australia, Indonesia, Japan, Germany), while some emphasised the need to accommodate different local conditions (India, South Africa).

4.5. Indications of integration of temporal factors

Temporal factors were not emphasized by most strategies. Strategies that mentioned temporal factors had a common concern that investments in projects today could become 'stranded' because of lack of demand in the future (Indonesia, Japan, Germany, South Africa). Some strategies also discussed factors such as time lag between implementation and results of interventions and the

necessity of establishing enabling mechanisms to facilitate intermediate transitions (US, Germany, South Africa). Fossil fuel export dependent countries were concerned about the volatility in demand for their product, which featured throughout their strategies as concerns about livelihoods and social equity (South Africa, Australia, Indonesia, India). In addition to the aforementioned factors, Germany's strategy also discussed the importance of acting early to avoid more difficult and costly abatement required in the future.

4.6. Indications of integrative implementation principles

The emphasis on integrative implementation principles was generally low. India's strategy urged integrating modes of transport. Indonesia and China's strategies discussed integrative land use planning, and the need to integrate mitigation and adaptation considerations. All strategies discussed decarbonization technologies as important mitigation measures, yet the US and Australia's strategies overemphasized technologies with few mentions of other kinds of measures. In contrast, some strategies discussed packages of mixed measures to work together across different sectors (Germany, Japan, South Africa). Japan and South Africa's strategies both emphasized the role of non-technical measures. The South Africa strategy emphasized the importance of implementation synergies to avoid creating conflict or policy incoherence and undermining efforts.

4.7. Indications of integrative stakeholder involvement of decision making and implementation

Most strategies studied discussed coordination and collaboration efforts between relevant government agencies, industry sectors, experts and local communities, yet the nature of such collaborations can be varied. Some strategies emphasized the need to identify challenges and explore solutions with diverse stakeholders, which suggests giving some degree of power to non-government sectors (Germany, Japan, US). Some strategies were more focused on collaborations with experts and industry rather than citizens and communities (Australia, India). The Indonesia and South Africa strategies pointed out the need to enhance institutional capabilities to enable low emissions development as it requires dealing with timescales and coordination of higher complexity than what they are used to.

5. Implications

Aggregating the findings in Table 3 revealed four collective integrative gaps and six systemic patterns that demonstrate the merits of integrative approaches. These are discussed below.

Table 3 Summation of integrative fit – in order of emissions ranking

Integration dimension	National Strategies										Collective	
	China	United States	India	Indonesia	Japan	Germany	Australia	South Africa	Fit (sum)	Gap		
Integration of perspectives	1	2	1	2	1	2	1	2	12	12		
Integrative goal setting	2	1	2	2	3	3	1	2	16	8		
Framing integrative transformation	1	1	0	0	3	2	0	2	9	15		
Integration of systemic causal factors	2	2	1	2	3	3	1	3	17	7		
Integration of temporal factors	0	2	0	1	2	3	1	2	11	13		
Framing integrative implementation principles	0	1	1	2	3	2	1	2	12	12		
Integrative stakeholder involvement of decision making & implementation	1	2	2	3	3	3	2	3	19	5		
Fit (sum)	7	11	7	12	18	18	7	16				
Gap	14	10	14	9	3	3	14	5				

A collective fit was derived from adding the scores together and the gap was the difference between a perfect score and the fit. The highlighted collective gaps are where the gap is equal or larger than the fit.

5.1. Four collective integrative gaps

5.1.1. Gap 1: Synthesis of stakeholder perspectives

While every studied national strategy mentioned consultations or engagement with stakeholders, no strategy included a synthesis or reflection of the diverse perspectives of these stakeholders within the strategy. Without reflecting a balanced and integrated account of their different perspectives, motivations and goals in the strategy, there is little assurance that stakeholder perspectives have been fairly and adequately incorporated. It also allows strategy authors to make claims about the needs of stakeholders without demonstrating a true understanding of those needs and how they may align or conflict with each other.

5.1.2. Gap 2: Framing integrative transformation

Most studied strategies demonstrated a lack of awareness that current prevalent economic and social systems may be driving high emissions development outcomes. The Japan and Germany strategies were distinct in that they both questioned the strong link between consumption and prosperity, which they argued need to be broken to enable economic success in a low emissions regime. In contrast, Australia, India, the US and Indonesia had more traditional economic framing in their strategies, which are likely to entrench paradigms that perpetuate extractive economies and climate instability. The collective gap is a lack of reflection on paradigmatic structures necessary to facilitate a transition towards a low emissions trajectory.

5.1.3. Gap 3: Integration of temporal factors

Shifting towards a low emissions regime is a long-range plan, as it takes time to affect the necessary change. South Africa's was the only strategy that emphasized back-casting to ensure interventions are designed to achieve the necessary impact by the required timeframes, rather than only what is possible in the moment. Meanwhile Germany's strategy was the only one that emphasised the efficacy and cost savings from early mitigation and abatement. Unfortunately, the collective gap in integrating temporal factors indicates a patchy awareness to time considerations across countries, which is a major risk for achieving net zero emissions in time for 2050.

5.1.4. Gap 4: Emphasizing integrative and synergistic principles

Among the strategies studied, there was a limited emphasis on integrative principles or requirement for interventions to be synergistic. Since institutions do not typically operate in integrative ways, integrative principles need to be explicitly declared and reinforced, especially when listing seemingly independent interventions. Desired causal effects and positive synergies need to be articulated so that actors can track the anticipated effects of interventions and adjust them if required. Without emphasizing integrative principles, interventions are likely to be carried out in silos, resulting in conflicts or missed opportunities to leverage coordinated feedback effects.

5.2. Six systemic patterns

5.2.1. Transformation framing begets holism

Strategies that had a transformation-based vision of low emissions development for their country had a more holistic and integrative discussion around causal factors, temporal considerations and synergistic interventions (e.g., Japan, Germany, South Africa), compared to those that had a narrower frame of the future (e.g., US, Australia, India). For example, Japan's strategy claimed, 'the world has entered the era of great competition in decarbonization' (p. 3) and so it will need to service households 'generating electricity' rather than 'purchasing electricity' and turning 'consumers' into 'prosumers' (p. 49). Meanwhile, Germany's strategy envisioned future success in a competitive decarbonized landscape (p. 7). Transformative framing also led strategies to question existing paradigms. Germany's strategy suggested developing metrics other than GDP to measure progress towards low emissions development, otherwise sustainability will always create trade-offs and demerits against economic success (p. 74). This transformative outlook suggests authors adopted a holistic mindset, enabling them to expand their analyses beyond sectoral and institutional boundaries, which also manifested in more integrative views of other dimensions.

5.2.2. Technology bias and economic lens limits opportunities

Strategies that emphasized a technological or economic centric view tended to focus on a narrower range of opportunities for innovation. Australia's strategy highlighted a 'technology not taxes' mantra, which reflected its emphasis on investing in reducing the cost of renewable technologies and proposing little to no interventions in other domains (such as behaviour and lifestyle innovations, business model innovations, civil design innovations, etc.). Viewing the shift to low emissions development as a technological challenge, may lead to a disproportionate focus on

financing technologies and new infrastructure (Miller 1985). This perspective raises the argument that the availability of funds becomes a bottleneck for commitment and progress (India, p. 20). Strategies with a technology and economic bias tended to focus more on ‘supply-side’ concerns (i.e., trying to meet the increasing demand for energy and production) and less on ‘demand-side’ drivers (i.e., reducing the need in the first place). Strategies relying on market forces to drive these changes assume that lower prices alone will result in behavioural shifts. This techno-centric approach, combined with a reliance on capitalist forces, can limit the potential for innovation opportunities that could otherwise arise from an integrated perspective.

5.2.3. The integration lens as a detector of ‘greenwashing’

The evaluation of national strategies across multiple dimensions of integration revealed a distinction between genuine sustainability efforts and potential instances of ‘greenwashing’. The Circular Economy (Ellen MacArthur Foundation 2015) and the SDGs (United Nations 2015b) are two examples of such concepts mentioned by many studied strategies (China, Germany, India, Indonesia, Japan, South Africa). These concepts are inherently integrative (i.e. achieving circularity at the societal level involves integrating consideration of multiple materials, how they are used and reused, as well as navigating their movement across international borders, different industry sectors and user consumption habits). Therefore, a strategy that has genuine intent to drive circularity would naturally score high on at least four dimensions of integration: transformation framing, causal factors, implementation principles, stakeholder involvement. Strategies that mentioned circularity without any discussion of its implications in detail could indicate ‘greenwashing’.

5.2.4. High integration relates to perseverance and tolerance to complexity

High-scoring strategies demonstrated perseverance to navigate conflicts and anticipated that doing so would uncover non-obvious connections and opportunities for innovative interventions. Germany, Japan, and South Africa’s strategies recognized that change could create conflict and complexity, yet showed a willingness to tackle conflicting priorities to avoid imbalances that may compromise the necessary change for achieving strategy goals. Rather than viewing conflicts as barriers, these strategies embraced the benefits of diverse perspectives and sought to leverage opposing views to uncover new possibilities and non-obvious innovation opportunities. By

acknowledging and insisting on persevering through conflict, these strategies exhibited greater confidence in their ability to transform their economies and succeed in the future.

5.2.5. Low integration relates to conservatism and reductionism

Conversely, strategies that scored low against the framework exhibited more conservativeness, relying on conventional paradigms and reductionist mindsets that accepted trade-offs without seeking alternative options. There is a distinction between balancing conflicts to seek a solution that achieves multiple outcomes and choosing one option over another assuming that achieving both is impossible. Low scoring strategies leaned towards the latter. For instance, India's strategy emphasized that capital investment for low emissions development conflicted with more urgent development and social equity priorities (p. 20). Some strategies relied on conventional paradigms such as price incentives and GDP for determining decarbonisation pathways. Indonesia's strategy used GDP projections modelling that limited showing benefits of more ambitious low emissions scenarios (p. 89). Paradoxically, fossil fuel export dependant countries may lack the confidence to reinvent their economies, yet these are the economies in the greatest need for innovation and transformation to advance in a low emissions regime.

5.2.6. Silence on politics and power structures

A notable observation across all strategies was the absence of discussion surrounding political power and its causal factors. While assumptions about industry motivations and citizens' lifestyles were more prevalent, political dynamics received less attention. For instance, the administration in power of the US between 2016-2020 exited from the Paris Agreement. This was tangentially mentioned in the US strategy (p. 1), yet how their political process may hinder future progress towards low emissions development was never addressed. Similar questions could be posed to India and Australia, where sentiments towards climate change are politically polarizing. Political governance structures deeply impact the shift towards low emissions development and incorporating a critique of them into national strategies is both possible¹ and necessary.

¹ Elliott et al. (2019) described a participatory process in Djibouti where the final strategy included critical points about the government's past progress.

5.3. Limitations

This study may have been limited by interpretation of language. The language used in the national strategies could have led to false positives or negatives regarding signs of integration.

Additionally, the way language was used by different cultures and how they chose to portray their strategy could vary greatly. It was unclear at times whether to interpret the strategy as a genuine reflection of the country's perspective or only represented the viewpoints of the author. Such factors could alter interpretation, which would then affect evaluations.

6. Conclusion

Reaching and sustaining a state of low emissions development is a complex, integrative challenge. As such, it requires approaches that has integrative fit with the nature of the challenge. Evaluating the long term national strategies of eight high emitting countries against the *Framework for Integrative Strategies*, we should be concerned that collectively: 1) country leaders have low capacity to synthesise and reconcile complex stakeholder perspectives; 2) there is a lack of awareness and questioning of systemic structures causing current high emissions outcomes; 3) there is a lack of emphasis on the timing of action to achieve net zero by 2050; and 4) there is a lack of emphasis on breaking silos and achieving synergistic effects in the implementation of interventions. The national strategies of Germany and Japan demonstrate relatively higher capacity for integrative strategy development, while the strategies of countries such as Australia, China and India demonstrate a dire lack of integrative consideration. This study finds that most studied countries lack the capacity to confront the complexities and the transformation required of shifting to a low emissions regime, an assumption that can be fairly extrapolated to the broader global community.

Using the *Framework for Integrative Strategies* as a guide for developing strategies and policies to address integrative socio-ecological challenges will be beneficial for leaders and policy makers to earnestly grapple with complex and systemic issues across silos. Similarly, there is a need to develop capacity for integrative mindsets to synthesize diverse information, and build structures that promote integrative thinking (e.g. new paradigms and metrics for progress and success, or models for distributing resources equitably while rewarding innovation towards low emissions development). Future research may explore ways to demystify integrative strategy and policy development processes for national strategies and close integrative gaps. Additionally, studies may be needed to identify mechanisms to enable integrative approaches. This study underscores the urgent need for integrative national strategies to achieve the Paris Agreement. Country leaders must confront the immensity and complexity of the net zero emissions challenge – only then will it be possible to achieve sustainable future.

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Appendices

Appendix 1: Reference quotes from national strategies for integration of perspectives

Country	Reference examples
Germany	<ul style="list-style-type: none">- The Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety set up a dialogue process to give representatives of the Länder (federal states) and local authorities, business and industry and civil society associations, and the general public the opportunity to actively contribute to developing the strategy (p.15)
South Africa	<ul style="list-style-type: none">- The strategy incorporated a policy document that was a culmination iterative participatory policy development process involving a wide range of stakeholders including national departments, provincial and local governments, parastatals, academia, research institutions, business, civil society and labour.” (p.17)
United States	<ul style="list-style-type: none">- The strategy incorporated previous strategies that engaged stakeholders from work unions, advocates, fence line communities, youth, scientists, governmental workers, indigenous leaders, businesses, schools and higher education institutions, among others. (p.11)
Indonesia	<ul style="list-style-type: none">- The strategy reaffirmed its NDC’s commitment for a participatory process with party and non-party stakeholders including private sector, civil societies, vulnerable groups, women, Masyarakat Hukum Adat communities and local communities, for both planning and implementation. (p.117). It also discussed balancing social and economy interests through participatory implementation of subsector measures. (p.47)
Japan	<ul style="list-style-type: none">- Provide enabling structures for stakeholders to develop and sustain their communities to align them towards the goals of the strategy (p.48).
Australia	<ul style="list-style-type: none">- The strategy relied heavily on the analysis and modelling by the Department of Industry, Science, Energy and Resources and consulting firm McKinsey (p.15).
India	<ul style="list-style-type: none">- The strategy was developed through an Inter-Departmental Steering Committee, which had representation from government agencies, and a Technical Advisory Committee of Experts, which had representation from academia and research organizations (p.25). Others involved in the strategy’s

development were inter-ministerial and stakeholder task groups (p.16) – yet it is unclear who was involved in the stakeholder task groups.

China

- The strategy was based on ‘national conditions and future development strategy with in-depth research and demonstration and extensive solicitation of opinions from all parties’ (p.3) – with no indication of who the parties were.
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Appendix 2: Reference quotes from national strategies for integration of goal setting

Country	Reference examples
Australia	<ul style="list-style-type: none">- Achieving the Technology Investment Roadmap coupled with global trends like electrifying transport would enable net zero emissions by 2050, while supporting existing industries, creating new jobs and export opportunities from low emissions technologies, and ensuring the ongoing prosperity rural regions (p.11)- With our natural endowments, experienced regional industries and skilled workforce, Australia is uniquely placed to benefit as this global shift unfolds. We can prosper in a world in transition and capitalise on the global shift to a new energy economy” (p.81)
United States	<ul style="list-style-type: none">- Action towards net-zero would help the US avoid climate change and boost the U.S. economy and the health and well-being of all Americans – improving air quality, expand new industries to create high-quality jobs, maintain economic competitiveness, and enable sustainable, broad-based economic growth (p.50)
Germany	<ul style="list-style-type: none">- Focusing on climate targets clearly helps to identify scope for action and proposals for action, which should be realised in conjunction with the global SDGs and other goals – such as those set out in the National Policy Strategy on Bioeconomy – in order to fully harness any synergy effects. (p.14)- Climate action that is successful over the long term must go hand in hand with sustainable use and conservation of resources and must not threaten the preservation of biodiversity (p.29)
Japan	<ul style="list-style-type: none">- The Government aims at creating the “Circular and Ecological Economy,” where each regional community utilizes regional resources in a sustainable manner and formulates a self-reliant and decentralized society while building

broader networks, in order to advance local decarbonization, and achieve the SDGs with integrated improvements on the environment, economy and society, thereby achieving a net-zero, resilient and comfortable community and living by 2050 (p.48)

- Japan aims to maximize the co-benefits with all other SDGs than SDG13 on Climate Action in its transition to a decarbonized society (p.10)

India

- India's mitigation efforts are driven not just by climate-specific policies, but also by broader development choices. India seeks to identify and explore opportunities to shift to low-carbon development pathways, while ensuring adequate access to household energy, energy security, and energy for the development of all sectors of the economy. (p.2)
- Adaptation measures and building resilience to potential climate impacts are necessary to maintain India's development gains and human development outcomes and sustain its growth and development. (p.3)

China

- China will make good efforts to accelerate the construction of a green and low-carbon circular economic system and a clean, low-carbon, safe and efficient energy system, and vigorously promote low-carbon technological innovation and the development of low-carbon industries, comprehensively form green modes of production and living, significantly improve the quality and stability of the ecosystem, build a comprehensive and effective climate governance system. (p.8)

Indonesia

- The strategy is designed by considering the need to balance between emission reduction and economic development, and putting emission reduction, economic growth, justice or fairness and climate resilient development as an integral part of the strategy's goal. (p.2)

South Africa

- All policy measures targeting the low carbon transition should be aligned with the fulfilment of the country's developmental objectives, which include alleviating poverty and reducing inequality, creating sustainable jobs and increasing the provision of basic services to all South Africans. (p.57)
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Appendix 3: Reference quotes from national strategies for integration of framing integrative transformation

Country	Reference examples
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Japan

- Japan will strongly promote the “re-design” of its economy and society to make it sustainable and resilient, through accelerating green growth by innovation and “three types of transitions,” namely towards “a decarbonized society,” “a circular economy” and “a decentralized society,” ... (p.2)
- Society 5.0, a society that solves social issues and creates value through the digital revolution and the integration of imagination and creativity of various people, is expected to contribute, by digitalization, to climate change measures with cross-cutting interactions beyond areas such as energy and mobility. (p.10)

Germany

- The strategy introduces a paradigm shift. In future, renewable energies and energy efficiency will be the standard for investments. In this way, the strategy creates the necessary conditions to keep Germany's economy competitive in a decarbonising world. (p.7)
- This means that models other than gross domestic product (GDP) must be considered. The German government will examine whether and to what extent it is possible to add different benchmarks for prosperity. (p.74)

South Africa

- To achieve such a trajectory, transformational rather than incremental change is needed... ..the transformation described in the IPCC Special Report on 1.5 degrees will require planning over a 30-year timeframe to ensure broad-based change across all sectors in a coordinated manner. (p.4)
- The desired end-state should be linked to the present, but by ‘backcasting’ rather than forecasting. This means that requirements for intermediate step between today and the long-term goal are deduced not on the basis of how compatible they may be with the current context, but rather in terms of what is required for the end-state to be achieved... (p.59)
- Many of the measures address only the short term, and are not considered transformational. (p.x)

United States

- deployment of clean technologies in all sectors, policies to enhance and support our natural and working lands, partnerships to catalyze market transformation, improved integration of climate into financial markets including enhanced climate risk disclosure, and the promulgation and enforcement of new and existing regulations rooted in law. (p.6)

China

- ...implement the new development concept, build a new development pattern, promote high-quality development; adhere to the system concept,
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and handle the relationship between development and emission reduction, overall and part, short-term and medium-to-long-term, incorporate peaking carbon dioxide emission and carbon neutrality into the overall layout of economic and social development and ecological civilization construction, take the lead in green transformation in all areas of economic and social development, focus on the Green and low-carbon energy development, accelerate the formation of resource-saving and environment friendly industrial structures, modes of production, lifestyles and spatial patterns, unswervingly pursue ecological priority, green and low-carbon high quality development roads to ensure that peaking carbon dioxide emission and carbon neutrality are achieved on schedule. (p.7)

Australia

- Shifting demands by our customers are likely to result in material declines in some of our major export commodities... ..We will support and partner with communities and businesses to capture new markets and help manage the transition. (p.26)

Indonesia

- Increasing agricultural productivity and cropping intensity are key factors in meeting food demand in line with population and GDP growth, at the same time maintaining emission by reducing deforestation. This can be achieved by using high quality seeds, fertilizing, and adoption of agricultural technology. To achieve food security, efforts must be made to increase the productivity of staple foods such as rice, corn and others. (p.46)

India

- A shift away from fossil fuels in this sector could have a negative impact on India's sustained growth and rise in GDP and a negative impact on employment due to contraction in sectors such as mining, petroleum refining, and manufacturing. (p.42)
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Appendix 4: Reference quotes from national strategies for integration of systemic causal factors

Country	Reference examples
India	<ul style="list-style-type: none"> - Lower industrial reliance on fossil fuels could reduce the costs of purchasing coal and gas in spot markets. (p.45) - These technologies need to be locally adapted and scaled up to ensure climate resilience according to the country's ecosystems and local population needs... (p.62)

United States

- Climate change is a national security threat because it is globally destabilizingThis means that mitigating the risk of climate change not only delivers ecological, public health, and economic benefits, but also enhances national and global security. (p.53)
- However, developments in these sectors over time are interdependent. For example, widespread adoption in leading energy efficiency practices in buildings could significantly impact overall electricity demand, reducing the amount of new clean energy installations. (p.18)

South Africa

- ... taking into account the impact of both population growth and economic development, and the role that energy-efficiency and demand-side interventions can play. (p.23)
- ... a cross-cutting analysis of such pathways will help identify common needs. An aggregate understanding of the evolution over time of such critical factors such as levels of capital investment, consumer prices of different energy options, and requirements for skilled workers in various industries (increasing and decreasing), will set out the parameters for the cross-cutting approaches ... (p.59)

Australia

- Reducing technology costs means the world can reduce emissions rapidly, with smaller impacts on economic growth and without the need for sustained costly policies. (p.29)
- We will continue to export our traditional energy exports for as long as our customers demand them. If we were to withdraw supply and reduce our exports, other countries would fill the gap in supply. Australia's coal and gas export industries will continue through to 2050 and beyond, supporting jobs and regional communities. (p.19)

Indonesia

- Integrating mitigation and adaptation measures can also increase local people's acceptance and interest in mainstreaming climate change actions. Adaptation emphasizes the urgent needs of local communities, while mitigation has more long-term global benefits. (p.25)
 - Some fraction of the workforces are working from home (teleworking) by opening businesses at their homes such as small shops, maintenance and repair services and restaurants. (p.60)
 - On the other hand, the transformation will also exhibit major international spillovers. Indonesia may take large-scale afforestation/reforestation and
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forest conservation to meet its climate goals but its dependence on food import may increase. This will have major implications in other countries to increase the commodity exports to Indonesia and these may also cause an increase in emission of the exporting countries. (p.30)

Japan

- ... lifecycle of infrastructures, the use of materials that contribute to limiting carbon dioxide (CO₂) emissions and the R&D pertaining to reduced environmental impacts, at each phase of planning and designing, construction, replacement as well as demolition, while making efforts in monitoring the CO₂ emissions. (p.7)
- ... shift in consumption pattern from price-focused to quality-focused, the development of digital technologies, the transition to a circular economy and a decentralized society, and the change in workstyles, will all contribute to the realization of carbon neutrality. (p.6)
- ...since it is possible to trade steel with foreign countries in terms of imports and exports, even if Japan reduced its manufacturing and the accompanying GHG emissions, it could merely increase overseas production and corresponding GHG emissions therein, effectively transferring them to another country. (p.27)

China

- China will take the cultivation of the green and low-carbon lifestyle as an important indicator for improving the living environment and raising the level of social civilization. Efforts will be made to extensively advocate and publicize the ways of simple and moderate, green, low-carbon, civilized and healthy life, and also to establish and further improve the policies and management systems that promote green life and green consumption. (p.25)

Germany

- Electricity will continue to be a “precious resource” because the increased use of renewable energy necessitates land and public support and is to some extent at odds with nature and landscape conservation concerns. (p.37)
 - It is becoming increasingly essential to think about different sectors and the interaction between them in an integrated way... (p.14)
 - ...because land is needed to produce food, the significance of the contribution to mitigating climate change made by bioenergy from cultivated biomass will be limited. (p.35)
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- We will reduce carbon leakage, such as the displacement of greenhouse gas emissions from Germany to other countries that have a less stringent climate policy. (p.19)
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Appendix 5: Reference quotes from national strategies for integration of temporal factors

Country	Reference examples
Indonesia	<ul style="list-style-type: none"> - Consideration of locked-in phenomenon of fossil fuel-based power plant such as coal power plant will be essential in the planning of power plant for the period of 2020 to 2050. (p.68) - Substitution of fossil energy by renewable energy will cause fossil energy resources are left unexploited and remain left underground and become stranded assets with some economic implications to the country. (p.66)
Japan	<ul style="list-style-type: none"> - ...since the lifetime of equipment is generally 30-40 years, it is necessary to consider the timing of replacement of equipment with a view to realizing net-zero by 2050. (p.30)
Germany	<ul style="list-style-type: none"> - Investments in fossil structures with a service life beyond 2050 are at risk of becoming stranded assets for the companies concerned, with the associated risk of job losses for their employees. (p.17) - Moreover, decisions and investments being made in many areas of the economic infrastructure today will pave the way for development up to 2030, 2050 or even beyond. (p.27) - The earlier this transformation is tackled and the more cost-effective it is, the lower the social burden and economic risks will be. (p.14) A strategy of this kind is wiser than responding to the need for climate action later with expensive repair work and the associated destruction of capital – which would have high added economic and social costs. ... Time is of the essence. (p.26)
South Africa	<ul style="list-style-type: none"> - The timing dimension is crucial. While 2050 may seem a long way off for citizens going about their daily life, or indeed in terms of changing government administrations, the speed of technological change is determined by the lifetime of assets and their rate of replacement. (p.4)

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- The incentives provided will have to be coherent with the long-term development pathway in order to ensure short-term mitigation actions do not lead to emissions lock-in, nor a boost for assets which may become stranded later. (p.46)
 - ... aim of the Strategy is to address poverty and unemployment, although the role in climate change mitigation in the liquid fuels sector is recognized. (p.26)

United States

- Many buildings built today will still be in active use by 2050, which means that even immediate actions to improve new buildings take years before making a significant impact in the overall building stock. (p. 32)
- Making progress this decade requires investing in domestic manufacturing and reliable supply chains for clean fuels, batteries, and vehicles. (p.15)

Australia

- We will continue to supply energy exports in the form our customers want it. Without affordable low emissions technologies, global demand for our existing energy exports will continue, and other countries will fill the gap if Australia is forced out of global markets early. (p.27)
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Appendix 6: Reference quotes from national strategies for framing integrative implementation principles

Country	Reference examples
India	<ul style="list-style-type: none"> - Studies have shown that a focus of the development of the Indian transport sector through fuel efficient modes of transport and a focus on expanding public transport can have the maximum impact on avoiding CO2 emissions in the sector. Understanding the composition of different modes is essential in crafting appropriate policies to induce a modal shift. (p.36)
Indonesia	<ul style="list-style-type: none"> - The regulation provides a strong legal basis for integrated, comprehensive, spatially explicit land use planning at the national and sub-national level, by adopting landscape-based approach for food, water, and energy securities based on sound ecosystem management environmentally, socially and economically. (p.110) - Through this synergic implementation, Indonesia will increase climate resilience, reduce vulnerability and exposure, and adapt to climate change, as well as deliver emission reduction. (p.22)

China	<ul style="list-style-type: none"> - Coordinate efforts to promote afforestation, ecological restoration and systemic governance, and promote and improve the service functions of ecosystem. Reduce the social costs of climate change mitigation and improve the resilience of territorial space by protecting, restoring and improving natural resource management. (p.22)
Australia	<ul style="list-style-type: none"> - Achieving the global Paris goals requires transformative technologies to be deployed across the economy. There are no silver bullets – a portfolio of technologies will be needed across and within sectors. (p.27)
United States	<ul style="list-style-type: none"> - These challenges are substantial but can be addressed through an integrated strategy of investment, innovation, and new technology deployment. (p.27)
Germany	<ul style="list-style-type: none"> - ... the commission is to develop a mix of instruments targeting economic development, structural change, social compatibility and climate action. (p.8) - That will make it increasingly necessary to take an integrated view which goes beyond individual buildings and takes into account interactions with the energy and transport sectors. (p.45) - ... intelligently structure the enabling environment, for example by ensuring that legislation takes the investment cycles of businesses and the economy into account, internalising external costs, creating appropriate economic incentive structures, establishing the necessary legal basis and offering opportunities for dialogue and participation. (p.28)
South Africa	<ul style="list-style-type: none"> - It is helpful to present policies not as stand-alone actions but rather as parts of policy packages, combinations of measures which may include planning, regulatory, financial, and other instruments to collectively drive towards the desired outcome, providing capabilities and overcoming barriers to change. (p.xviii) - ...the Pathways study to explore the impact of alternative economic growth trajectories on the country's emissions trajectory, looking at the implementation of structural changes rather than the implementation of purely technical interventions. (p.59) - ...for mitigation in the agricultural sector it is proposed that a strategic and integrated approach is taken that addresses sustainable agriculture more broadly and to build synergies and avoid conflicts between climate change

mitigation and other policy objectives, and to avoid offsetting mitigation efforts through intensification of production or land use change. (p.36)

Japan

- In order to realize a decarbonized society, it is important to overcome the simplistic view of “innovation is technological,” and to promote “innovation for the practical application and wide use” for the technology to be adopted in the society. (p.72)
 - Thus, it is imperative to create a virtuous cycle of the economy and the environment by changing the people’s conventional mindset and proactively working towards carbon neutrality, which would transform the industrial structure, drive the socio-economic reform, and lead to the next strong growth. (p.16)
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Appendix 7: Reference quotes from national strategies for integrative stakeholder involvement

Country	Reference examples
India	<ul style="list-style-type: none">- Studies have shown that a focus of the development of the Indian transport sector through fuel efficient modes of transport and a focus on expanding public transport can have the maximum impact on avoiding CO2 emissions in the sector. Understanding the composition of different modes is essential in crafting appropriate policies to induce a modal shift. (p.36)
Indonesia	<ul style="list-style-type: none">- The regulation provides a strong legal basis for integrated, comprehensive, spatially explicit land use planning at the national and sub-national level, by adopting landscape-based approach for food, water, and energy securities based on sound ecosystem management environmentally, socially and economically. (p.110)- Through this synergic implementation, Indonesia will increase climate resilience, reduce vulnerability and exposure, and adapt to climate change, as well as deliver emission reduction. (p.22)
China	<ul style="list-style-type: none">- Coordinate efforts to promote afforestation, ecological restoration and systemic governance, and promote and improve the service functions of ecosystem. Reduce the social costs of climate change mitigation and improve the resilience of territorial space by protecting, restoring and improving natural resource management. (p.22)

Australia	<ul style="list-style-type: none"> - Achieving the global Paris goals requires transformative technologies to be deployed across the economy. There are no silver bullets – a portfolio of technologies will be needed across and within sectors. (p.27)
United States	<ul style="list-style-type: none"> - These challenges are substantial but can be addressed through an integrated strategy of investment, innovation, and new technology deployment. (p.27)
Germany	<ul style="list-style-type: none"> - ... the commission is to develop a mix of instruments targeting economic development, structural change, social compatibility and climate action. (p.8) - That will make it increasingly necessary to take an integrated view which goes beyond individual buildings and takes into account interactions with the energy and transport sectors. (p.45) - ... intelligently structure the enabling environment, for example by ensuring that legislation takes the investment cycles of businesses and the economy into account, internalising external costs, creating appropriate economic incentive structures, establishing the necessary legal basis and offering opportunities for dialogue and participation. (p.28)
South Africa	<ul style="list-style-type: none"> - It is helpful to present policies not as stand-alone actions but rather as parts of policy packages, combinations of measures which may include planning, regulatory, financial, and other instruments to collectively drive towards the desired outcome, providing capabilities and overcoming barriers to change. (p.xviii) - ...the Pathways study to explore the impact of alternative economic growth trajectories on the country's emissions trajectory, looking at the implementation of structural changes rather than the implementation of purely technical interventions. (p.59) - ...for mitigation in the agricultural sector it is proposed that a strategic and integrated approach is taken that addresses sustainable agriculture more broadly and to build synergies and avoid conflicts between climate change mitigation and other policy objectives, and to avoid offsetting mitigation efforts through intensification of production or land use change. (p.36)
Japan	<ul style="list-style-type: none"> - In order to realize a decarbonized society, it is important to overcome the simplistic view of "innovation is technological," and to promote "innovation for the practical application and wide use" for the technology to be adopted in the society. (p.72)

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- Thus, it is imperative to create a virtuous cycle of the economy and the environment by changing the people's conventional mindset and proactively working towards carbon neutrality, which would transform the industrial structure, drive the socio-economic reform, and lead to the next strong growth. (p.16)
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