

Decarbonizing the Energy Sector: Assessing Policy, Innovation, and Investment Pathways Under Paris Agreement Pledges

Link Foundation Energy Fellowship Final Report

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Project narrative

Investment in low-carbon energy must more than double by 2030 to achieve the Paris Agreement goal of limiting global warming to well below 2°C, or 1.5°C.¹ To help drive this transformation, the Agreement establishes a “pledge-and-review” system under which countries make commitments (“nationally determined contributions,” or NDCs), report on progress, and undergo international review.² Around 70% of NDCs contain economy-wide greenhouse gas (GHG) reduction targets, and many also contain energy-focused pledges.³ As such, the NDCs have been characterized as “clean energy investment plans” that will help drive energy decarbonization.⁴ Yet while the literature is rich with modeling studies showing how the energy sector would need to change to achieve the NDCs⁵, the role of the NDCs in *driving* that change - via domestic policy, innovation, and investment, for example - has not been empirically tested.

Countries approach their emissions-reduction targets differently.⁶ Some countries pledge in their NDCs to go beyond what their existing policies can achieve, whereas other countries make pledges that merely reflect business-as-usual. This in itself suggests greater scope for NDC influence in some countries than in others. Moreover, after making a pledge, some countries take additional policy action, whereas others make no progress or even backslide.⁷ Likewise, more than 100 countries have set targets to reach net-zero emissions, but these goals take a range of legal forms. These observations raise important questions regarding the role of the Paris commitments in transforming energy supply and utilization. The answers can help inform future rounds of commitments, which countries must bring forward every five years.

With support from the Link Foundation, I sought to investigate the relationship between countries’ Paris Agreement pledges and their domestic energy policy and investment decisions from three angles. First, I conceptualized and analyzed the climate policy “implementation gap” - that is, the gap between the pledges countries make under the Paris Agreement and the policies they adopt domestically.⁸ Second, I examined the implementation gap in the context of COVID-19 recovery spending in the energy sector, and the extent to which stronger Paris pledges correlated with “cleaner” recovery spending.⁹ Third, I explored the relationship between net-zero emissions pledges, law, and implementation policy (e.g., for energy decarbonization), and analyzed the implications of pledge credibility for global temperature.¹⁰ In ongoing work, I am now investigating “strategic pledging” as a potential driver of variation in the implementation gap, as well as the relationship between net-zero pledges and their technical feasibility

¹ IEA (2019)

² Falkner (2016)

³ Climate Watch (2018)

⁴ <https://energypost.eu/paris-means-energy-sector-start-new-clean-economy/>

⁵ e.g. IEA (2016), van Soest et al. (2017)

⁶ den Elzen et al. (2019)

⁷ Fransen and Levin (2017)

⁸ Fransen et al. (2023)

⁹ Egli et al. (2023)

¹⁰ Rogelj et al. (2023)

and cost, including in the energy sector. I also examine the extent to which Paris pledges influence legislative agendas and energy policy.

*Conceptualizing the implementation gap.*¹¹ The implementation gap has two parts: a policy adoption gap and a policy outcome gap (Figure 1). The policy adoption gap exists between emissions pledges and projected emissions under policies as adopted. The policy outcome gap exists between projected emissions under policies as adopted, assuming their implementation, and the emissions outcomes that adopted policies ultimately achieve. This component of the implementation gap can only be quantified post hoc and the international policy debate largely ignores it, assuming that adopted policies result directly in emissions reductions.

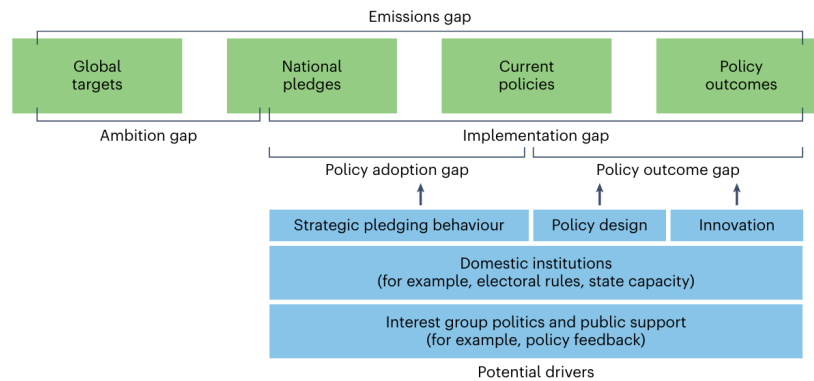


Figure 1. The implementation gap and its contributing factors (Fransen et al. 2023).

The policy adoption gap varies widely across countries (Figure 2). During the first round of nationally determined contributions (NDCs) — the emission reduction pledges that countries make under the Paris Agreement — the policy adoption gap ranged from –84% to 85% as a fraction of each country’s 2019 emissions. Countries with a positive gap have projected emissions higher than their targets, meaning they will need stronger domestic policy to achieve their targets, all else held equal. Meanwhile, countries with a negative gap are already on track to exceed their targets under current domestic policies.

¹¹ Fransen et al. (2023)

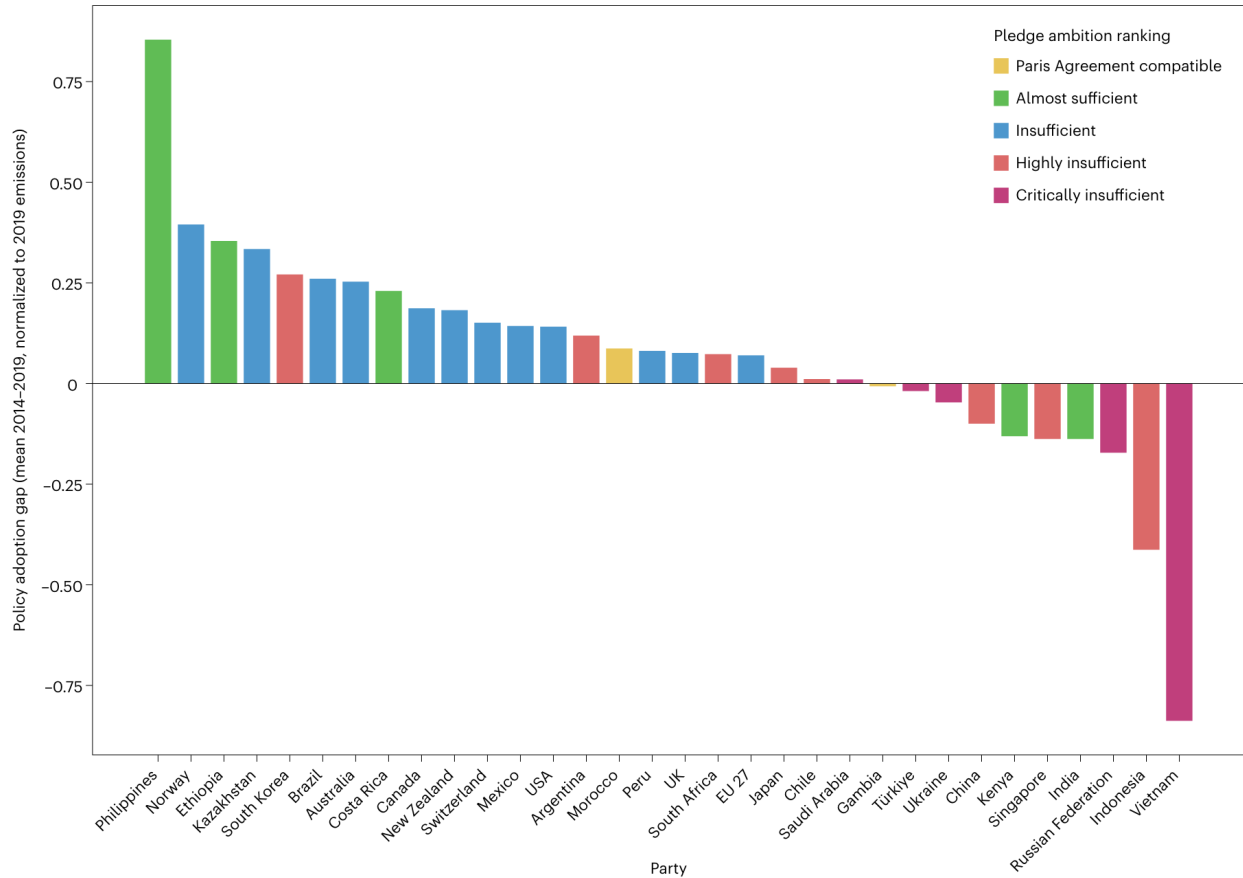


Figure 2. The policy adoption gap (2014–2019) and pledge ambition ranking for select parties to the Paris Agreement (Fransen et al. 2023).

In the absence of a direct measurement of the policy outcome gap, we mapped the relationship between the perceived strength of adopted national climate policy and lagged climate policy outcomes (Figure 3), measured by the Climate Change Performance Index. For countries falling along the diagonal line, the strength of adopted climate policy is positively correlated with climate policy outcomes. This is the relationship that many policy analysts assume. Yet a substantial number of countries do not exhibit this correlation. Falling to the lower right of the line would indicate strong policies but weak outcomes, suggesting the potential for a policy outcome gap. Likewise, falling to the upper left of the diagonal suggests the possibility for policies to over-deliver relative to projections — in other words, a negative policy outcome gap.

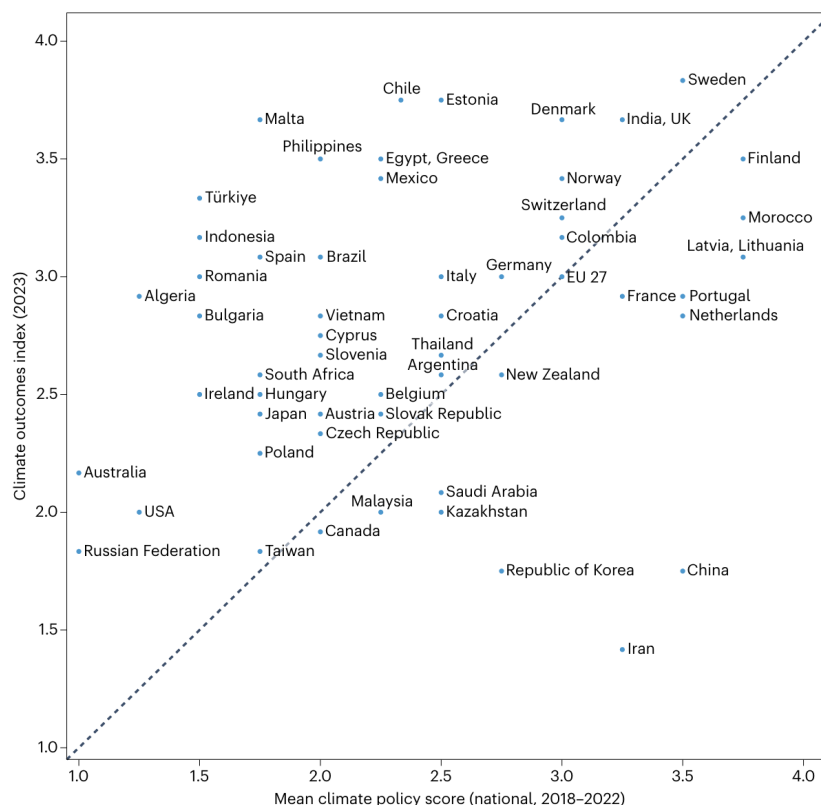


Figure 3. Strength of domestic climate policy (2018–2022) versus climate-related outcomes (2023) (Fransen et al. 2023).

Whether countries face a policy adoption or outcome gap does not fall along conventional fault lines, such as industrialized versus developing countries or climate leaders versus climate followers. This points to the need for better measurement of both components of the implementation gap, particularly when it comes to the policy outcome gap, and for analysis of the causes across countries. This will help to identify where in the policy process challenges lie for the different countries, when formulating or enforcing policy, and ultimately help to devise effective strategies to close the gap.

*The implementation gap in clean energy COVID-19 recovery spending.*¹² In order to advance understanding of the implementation gap, we also explored the relationship between Paris Agreement pledges and domestic policy in the context of post-COVID recovery spending on clean energy. We found that most countries missed the opportunity to respond to COVID-19 with massive green energy spending to accelerate the decarbonization of the economy. Overall, only 32% of recovery spending was green (Figure 4B). Even more concerning, assessment of the extent to which national climate policy ambition is translated into the economic policies of recovery spending showed limited evidence that high ambition is related to greener spending. For example, Peru’s national climate policy is relatively ambitious, but none of its quantified energy-related recovery spending was green. Japan’s very green recovery spending, on the other hand, stands out against its mediocre national climate policy ambition.

¹² Egli et al. (2023)

As a measure of how much governments prioritize climate action in the near term, recovery spending paints a different picture than national climate policy.

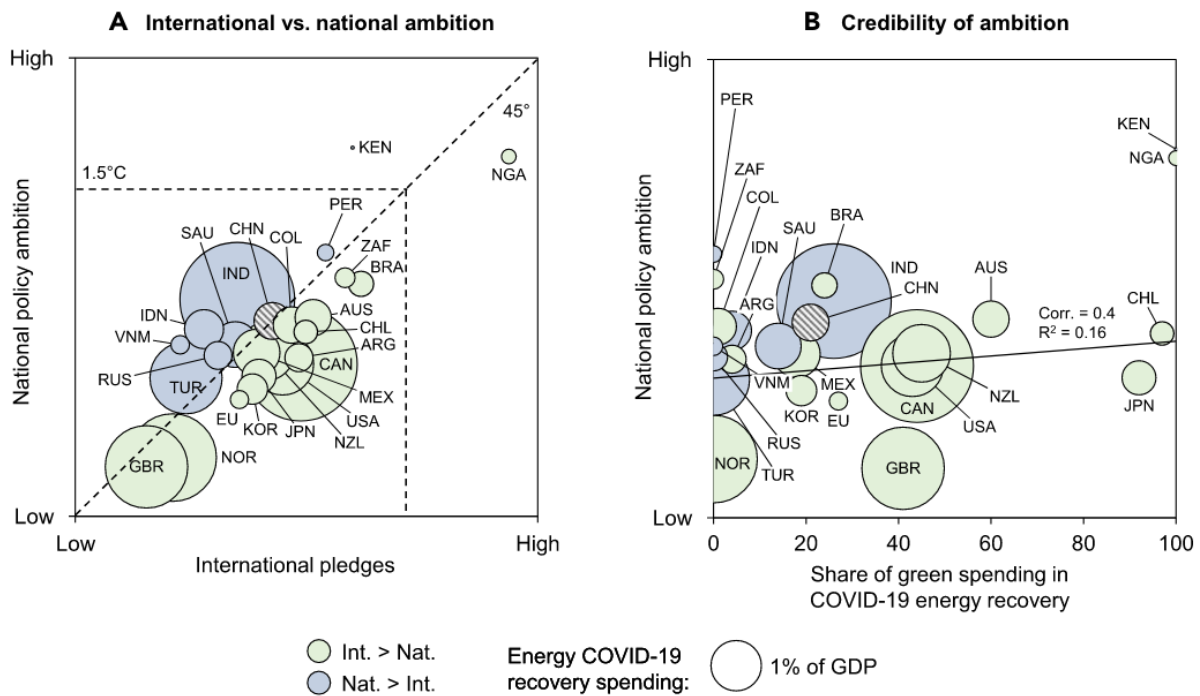


Figure 4. Climate policy ambition and recovery spending (Egli et al. 2023).

*Implications of the net-zero credibility gap.*¹³ Finally, we found that assumptions regarding the credibility of net-zero emissions pledges - and the extent to which they can be assumed to lead to decarbonization in the energy sector and across the economy - carry profound implications for global temperature outcomes. We rated net-zero pledge credibility based on whether the pledge is legally binding, whether it is backed by an implementation plan, and the pledging country's current emissions trajectory. Based on those ratings, we developed five pledge implementation scenarios, and estimated global temperature change in 2100 under each scenario. We found that when only high-credibility pledges are considered, temperature would warm by 2.4°C, in contrast to 1.7°C when less credible pledges were included (Figure 5).

¹³ Rogelj et al. (2023)

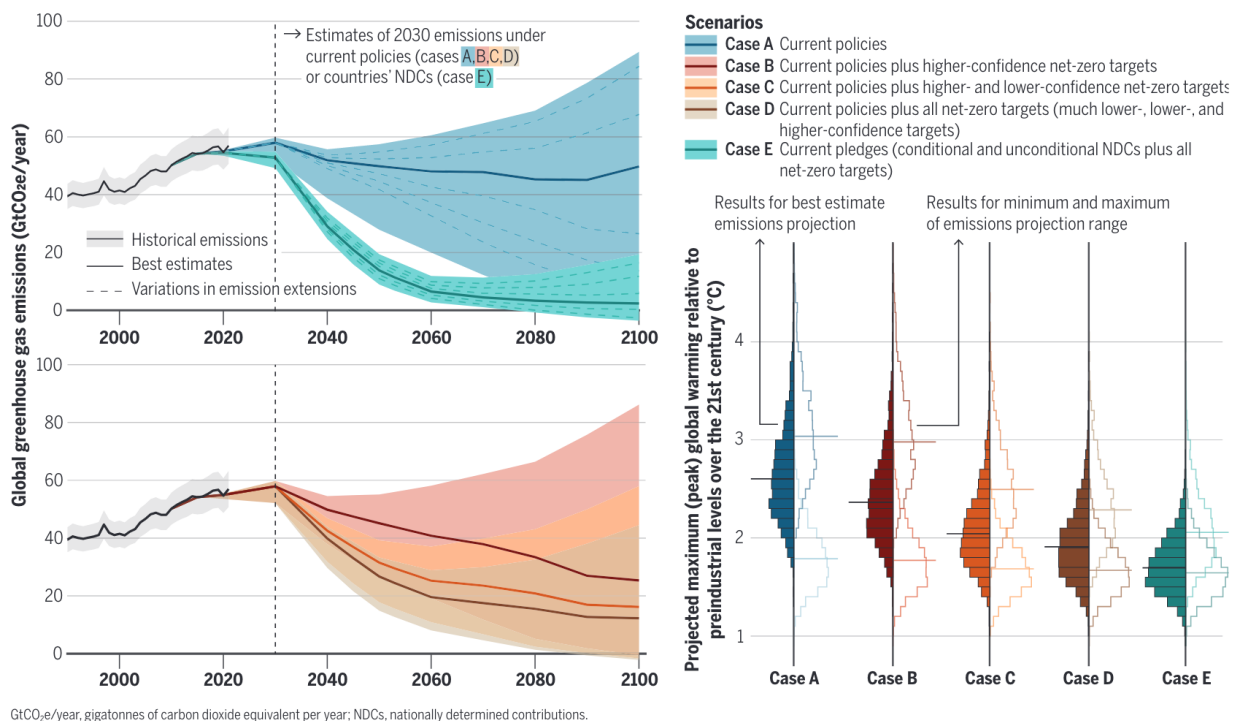


Figure 5. Emissions and peak temperature projections of five scenarios reflecting levels of target achievement (Rogelj et al. 2023).

Ongoing and future work. The research outlined above highlights the need to understand under what circumstances, and via what channels, Paris Agreement pledges can credibly be expected to influence domestic policy and investment decisions. In ongoing work, I am exploring this topic from three angles. First, I analyze the relationship between net-zero emissions pledges and the technical potential to reduce emissions and increase removals under different cost scenarios. Second, I investigate the factors countries consider in designing their pledges, with a focus on policy signaling. Finally, I examine the role of Paris Agreement pledges in setting legislative agendas - one possible channel by which international treaties are hypothesized to influence domestic policy.

Published and forthcoming journal articles acknowledging Link Foundation support

Egli, Florian, Nicolas Schmid, **Taryn Fransen**, Anna Stünzi, Abdurashed Isah, Adrianna Pineda, Christopher Beaton, and Tobias S. Schmidt. "Scrutinizing Countries' Climate Commitments: Insights from Recovery Spending." *One Earth* 6, no. 9 (September 15, 2023): 1082–84. <https://doi.org/10.1016/j.oneear.2023.08.022>.

Fransen, Taryn, Jonas Meckling, Anna Stünzi, Tobias S. Schmidt, Florian Egli, Nicolas Schmid, and Christopher Beaton. "Taking Stock of the Implementation Gap in Climate Policy." *Nature Climate Change*, July 27, 2023, 1–4. <https://doi.org/10.1038/s41558-023-01755-9>.

Rogelj, Joeri, **Taryn Fransen**, Michel G. J. den Elzen, Robin D. Lamboll, Clea Schumer, Takeshi Kuramochi, Frederic Hans, Silke Mooldijk, and Joana Portugal-Pereira. “Credibility Gap in Net-Zero Climate Targets Leaves World at High Risk.” *Science* 380, no. 6649 (June 9, 2023): 1014–16. <https://doi.org/10.1126/science.adg6428>.

Fransen, Taryn and Jonas Meckling. “Explaining Variation in Pledging Behavior under the Paris Agreement.” In preparation.

Fransen, Taryn, Sophie Boehm, Kemen Austin, Robert Beach, Alice Favero, Claire Fyson, Jonas Hörsch, Jeff Petrusa, and Stephanie Roe. “Technical potential and pledging behavior: A bottom-up assessment of net-zero targets.” In preparation.

How did the fellowship make a difference?

Simply put, the Link fellowship was the primary source of funding that supported my contributions to all of the work described herein. Without the generous support of the Link Foundation, a mere fraction of this research would have been possible.

References

Climate Watch NDC Content. 2018. Washington, DC: World Resources Institute. Available online at: <https://www.climatewatchdata.org>

den Elzen, Michel, Takeshi Kuramochi, Niklas Höhne, Jasmin Cantzler, Kendall Esmeijer, Hanna Fekete, Taryn Fransen, et al. “Are the G20 Economies Making Enough Progress to Meet Their NDC Targets?” *Energy Policy* 126 (March 2019): 238–50. <https://doi.org/10.1016/j.enpol.2018.11.027>.

Egli, Florian, Nicolas Schmid, Taryn Fransen, Anna Stünzi, Abdulrasheed Isah, Adrianna Pineda, Christopher Beaton, and Tobias S. Schmidt. “Scrutinizing Countries’ Climate Commitments: Insights from Recovery Spending.” *One Earth* 6, no. 9 (September 15, 2023): 1082–84. <https://doi.org/10.1016/j.oneear.2023.08.022>.

Falkner, Robert. “The Paris Agreement and the New Logic of International Climate Politics.” *International Affairs* 92, no. 5 (September 2016): 1107–25. <https://doi.org/10.1111/1468-2346.12708>.

Fransen, Taryn, and Kelly Levin. “The Climate Effect of the Trump Administration.” *World Resources Institute: INSIDER*, December 6, 2017. <https://www.wri.org/blog/2017/12/insider-climate-effect-trump-administration>.

Fransen, Taryn, Jonas Meckling, Anna Stünzi, Tobias S. Schmidt, Florian Egli, Nicolas Schmid, and Christopher Beaton. “Taking Stock of the Implementation Gap in Climate Policy.” *Nature Climate Change*, July 27, 2023, 1–4. <https://doi.org/10.1038/s41558-023-01755-9>.

IEA. “World Energy Outlook 2016.” Paris, 2016. <https://www.iea.org/reports/world-energy-outlook-2016>.

IEA. “World Energy Investment 2019.” Paris, 2019. <https://www.iea.org/reports/world-energy-investment-2019>.

Rogelj, Joeri, Taryn Fransen, Michel G. J. den Elzen, Robin D. Lamboll, Clea Schumer, Takeshi Kuramochi, Frederic Hans, Silke Mooldijk, and Joana Portugal-Pereira. "Credibility Gap in Net-Zero Climate Targets Leaves World at High Risk." *Science* 380, no. 6649 (June 9, 2023): 1014–16.

<https://doi.org/10.1126/science.adg6428>.

van Soest, Heleen L., Harmen Sytze de Boer, Mark Roelfsema, Michel G.J. den Elzen, Annemiek Admiraal, Detlef P. van Vuuren, Andries F. Hof, et al. "Early Action on Paris Agreement Allows for More Time to Change Energy Systems." *Climatic Change* 144, no. 2 (September 1, 2017): 165–79.

<https://doi.org/10.1007/s10584-017-2027-8>.