All-of-Society Climate Pathway:

KEY POLICY LEVERS FOR 1.5°C-ALIGNED ACTION

SCHOOL OF PUBLIC POLICY
CENTER FOR GLOBAL SUSTAINABILITY

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EXECUTIVE SUMMARY

An "all-of-society" climate strategy that fuses national with subnational and all-of-society action can keep global climate goals—including 1.5°C—within reach.

Achieving our climate goals is still possible. Across the world, we are experiencing, today, how clean transitions in support of a better climate provide new jobs, better health, and vibrant economies equipped for the future. Across the world, the technologies we need for this transition exist today at low cost and with better performance. Across the world, we have new and valuable experience in policy implementation in different national circumstances to help us understand what works to support the transitions, ensure that benefits are widely shared, and protect our most vulnerable people. And the political basis of support continues to evolve rapidly. At this time of urgent need, countries around the world—joined by cities, states, provinces, businesses, investors, communities, and non-governmental actors of all kinds—have stepped up with commitments and concrete actions to realize immediate and accelerating action.

And this partnership across all of society is what the world needs to succeed. Experience of recent years, across all types of countries, demonstrates that actions rooted across all of society, support faster action, higher ambition, and more effective implementation. National governments, of course, are a central pillar of providing investment, regulatory direction, and funding for transition policies—and they also provide the critical political process through which subnational actions can be structured and supported. Yet beyond national governments, experience has shown that subnational governments, such as states, provinces, regions, counties, cities, and indigenous governments, can play a critical role in innovating, embracing change, setting bold goals, and identifying new areas of action and opportunity. Similarly, critical actors outside governments such as communities, businesses, universities, cultural institutions, and sectoral coalitions have demonstrated their own approaches to innovation and leadership to support climate action. This "all-of-society" strategy can accelerate change across an economy, and provide a basis for expanded and broader support for implementation. In short, when national governments partner with leaders in subnational governments, communities, business, and civil society, countries can go further, faster, more equitably, and more durably in achieving their climate goals.

Yet we know we are at a critical moment for action—and the next two years will be our test. This year—the year of the global stocktake under the Paris Agreement—the global community has undertaken a thorough assessment of the science and the progress thus far on reaching climate goals. While the stocktake highlighted some areas of real and accelerating progress over recent years, it also sounds a clear alarm about the need for urgent acceleration of that action toward both higher ambition and better implementation. Under the Paris Agreement, countries around the world now have two years to assess their opportunities for action and offer new targets for 2035. It is time to take the learning

from recent years and apply it to support every country, and particularly the world's major economies, to embrace the new opportunities that a rapidly evolving world provides.

This analysis shows how, by accelerating partnerships and all-of-society action, the world can still keep our global goal of 1.5°C within reach. The key question for the world is now not whether we need to act—but rather, how to organize our actions rapidly enough to achieve success. The rapid economic transformation required for this success will require an expanding and durable political basis of support, with clear strategies and feasible technological pathways that accelerate in the 2020s and continue over the ensuing two decades. Building on the knowledge of how all-of-society action can accelerate change, the analysis identifies eleven policy levers that can work better when undertaken in partnership. It lays out how keeping 1.5°C within reach will require engagement by key countries, working on all greenhouse gases and sectors, and integrating across all levels.

To highlight the underappreciated contribution from immediate and targeted emissions reductions of the short-lived climate pollutants, such as methane (CH_4), within this decade to limit temperature overshoot, the resulting All-of-Society 1.5°C pathway developed in this analysis is presented using the 20 year global warming potential (GWP20) metric in addition to the typical 100 year global warming potential (GWP100). It shows an immediate peak of global greenhouse gas emissions and a 32% emissions reduction between 2022 and 2030, followed by reductions reaching net-zero CO_2 by 2050, with 41% of total emissions reductions by 2030 from energy system CO_2, 6% from land use change CO_2, and 53% from non-CO_2 gases (see table ES1 for numbers using GWP100), illustrating the critical role of methane.

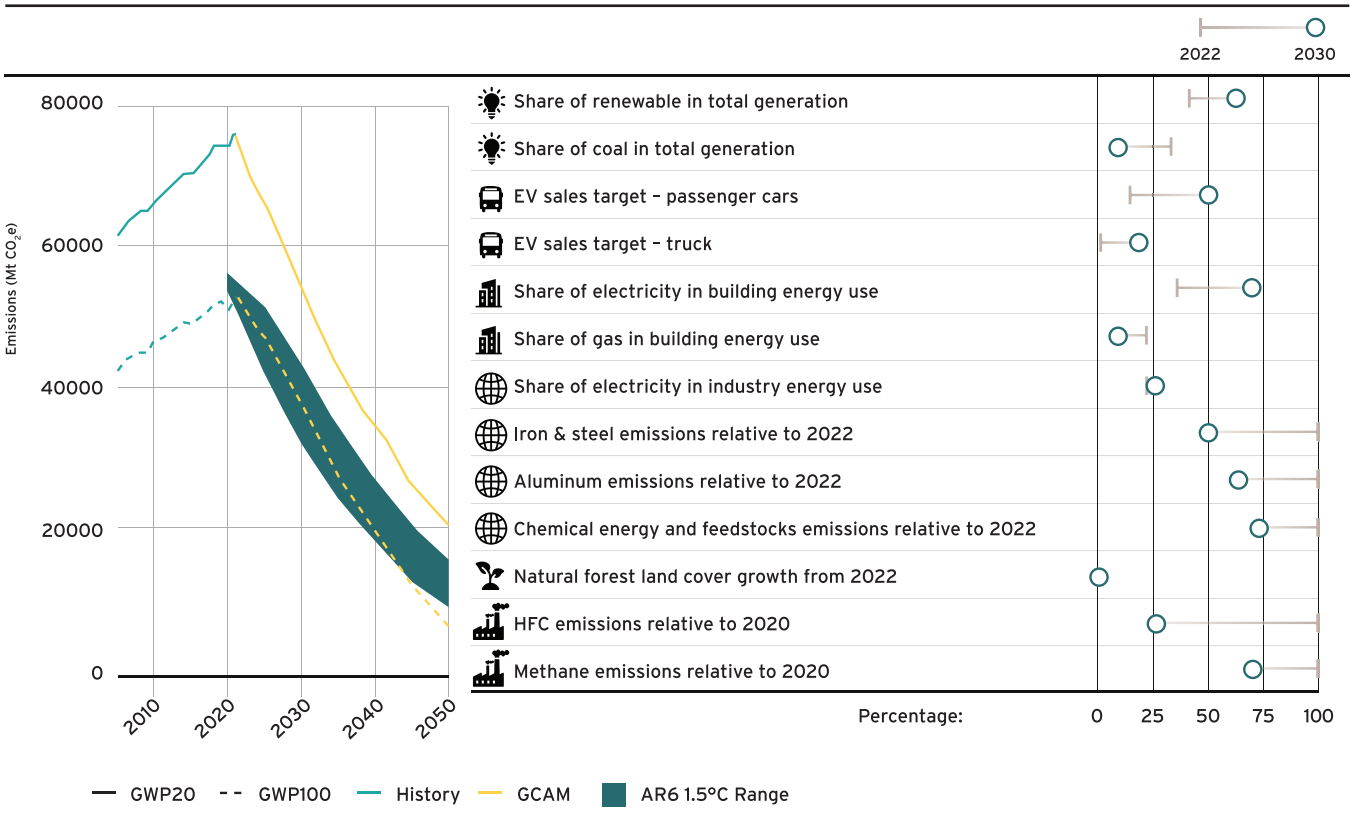
Table ES1. Percentage of Greenhouse Gas Emissions Reduction by 2030 and Contribution across Gases and in Different GWPs.

	GWP20	GWP100
Greenhouse gas emissions reduction between 2022 to 2030	32%	30%
Contribution from CO_2	47%	71%
Contribution from non-CO_2 gases	53%	29%

Significant progress can be made along key policy levers by 2030 globally, including:

- A threefold increase in total solar and wind installed capacity;
- A nearly 60% reduction in unabated coal power generation;
- 51% of new passenger car sales and 16% of new truck sales from electric vehicles;
- Phasing out solid fuels and phasing down gas consumption to 12% in buildings;
- 26% of industry energy use from electricity;
- Maintaining natural forest land area; and
- A 30% reduction in global methane emissions, including more than 75% reduction of energy-related methane, and a 73% reduction in hydrofluorocarbon (HFC) emissions from 2020.

Figure ES1. Global and Country Groups Greenhouse Gas Emissions Pathways under the *All-of-Society 1.5°C Pathway* and Global Key Policy Metrics Status in 2020 and 2030.



Historical and future emissions pathways are presented in both the 20 year global warming potential (GWP20) metric (in solid line) and the 100 year global warming potential (GWP100) metric (in dashed line). The AR6 1.5°C Range[1] includes scenarios that are in the category 1 (C1) – defined as limiting warming to 1.5°C (>50%) with no or limited overshoot – and category 2 (C2) – defined as returning warming to 1.5°C (>50%) after a high overshoot, narrowed within the 25-75% quartile range. Linear interpolation was used to estimate emissions in years with missing data. Historical data is from the Emissions Database for Global Atmospheric Research (EDGAR) dataset for fossil and industrial processes CO_2, N_2O and fluorinated gases (F-gas) emissions[2] with CH_4 from the Community Emissions Data System (CEDS),[3] adjusted with International Energy Agency (IEA) estimates for oil and gas CH_4 emissions,[4] and Climate Watch for LULUCF CO_2 estimates.[5]

The analysis shows how both national and subnational actors can support the All-of-Society 1.5°C pathway to be achieved through an all-of-society approach. Substantial opportunities for subnational actors to contribute across all sectors include advancing innovative policies, centering community and sustainable development in policy actions and helping to close the gap between national ambition and implementation. Particularly, large opportunities exist for subnational governments in the power and transportation sectors, and for business actors in the industry sector. National governments play a key role in setting policy priorities, establishing market trends and investing in new and emerging technologies to support action across all levels of governance. National policies and leadership are critical in hard-to-decarbonize sectors, including nonCO_2s, and parts of industry and transportation that will require significant research and development and investment to reduce costs. Increasing land sinks will also depend on the larger capacities and policy authorities of national governments.

ACHIEVING OUR GLOBAL CLIMATE GOALS THROUGH AN ALL-OF-SOCIETY APPROACH

Achieving our climate goals is still possible. Across the world, we are experiencing, today, how clean transitions in support of a better climate provide new jobs, better health, and vibrant economies equipped for the future. Across the world, the technologies we need for this transition exist today at low cost and with better performance. Across the world, we have new and valuable experience in policy implementation in different national circumstances to help us understand what works to support the transitions, ensure that benefits are widely shared, and protect our most vulnerable people. And the political basis of support continues to evolve rapidly. At this time of urgent need, countries around the world—joined by cities, states, provinces, businesses, investors, communities, and non-governmental actors of all kinds—have stepped up with commitments and concrete actions to realize immediate and accelerating action.

And this partnership across all of society is what the world needs to succeed. Experience of recent years, across all types of countries, demonstrates that actions rooted across all of society, support faster action, higher ambition, and more effective implementation. National governments, of course, are a central pillar of providing investment, regulatory direction, and funding for transition policies—and they also provide the critical political process through which subnational actions can be structured and supported. Yet beyond national governments, experience has shown that subnational governments, such as states, provinces, regions, counties, cities, and indigenous governments, can play a critical role in innovating, embracing change, setting bold goals, and identifying new areas of action and opportunity. Similarly, critical actors outside governments such as communities, businesses, universities, cultural institutions, and even sectoral coalitions have demonstrated their own approaches to innovation and leadership to support climate action. This "all-of-society" strategy can accelerate change across an economy, and provide a basis for expanded and broader support for implementation. In short, when national governments partner with leaders in subnational governments, communities, business, and civil society, countries can go further, faster, more equitably, and more durably in achieving their climate goals.

Yet we know we are at a critical moment for action—and the next two years will be our test. This year—the year of the so-called "Global Stocktake" under the Paris Agreement—the global community has undertaken a thorough assessment of the science and the progress thus far on reaching climate goals. While the Stocktake highlighted some areas of real and accelerating progress over recent years,[6,7] it also sounds a clear alarm about the need for urgent acceleration of that action toward both higher ambition and better implementation.[8–12] Under the Paris Agreement, countries around the world now have two years to assess their opportunities for action and offer new targets for 2035. It is time to take the learning from recent years and apply it to support every country, and particularly the world's major economies, to embrace the new opportunities that a rapidly evolving world provides.

This analysis shows how, by accelerating partnerships and all-of-society action, the world can still keep our global goal of 1.5°C within reach. The key question for the world is now not whether we need to act—but rather, how to organize our actions rapidly enough to achieve success. The rapid economic transformation required for this success will require an expanding and durable political basis of support, with clear strategies and feasible technological pathways that accelerate in the 2020s and continue over the ensuing two decades. Building on the knowledge of how all-of-society action can accelerate change, the analysis identifies eleven policy levers that can work better when undertaken in partnership. It lays out how keeping 1.5°C within reach will require engagement by key countries, working on all greenhouse gases and sectors, and integrating across all levels:

- ***Keeping 1.5°C within reach requires embarking on opportunities in all key emitting countries.*** The global top 20 emitters account for approximately 71% of global gross domestic product,[13] 65% of global population,[14] and 77% of global greenhouse gas emissions.[5] While these countries are at different stages in terms of development, energy transition, new technology deployment, and more the need for keeping 1.5°C is urgent and the challenges are substantial, it requires grasping all possible opportunities as much as we can and as quickly as we can, while taking into account individual country contexts.

- ***Keeping 1.5°C within reach requires taking targeted actions in all economic sectors and on all greenhouse gases.*** Emissions reductions can be achieved in different parts of the economy through key strategies like decarbonizing electricity generation, electrifying or switching to other low-carbon fuels in end-use consumption, managing sustainable demand growth, targeting short-lived climate pollutants beyond carbon, and offsetting hard-to-abate residual emissions through nature- or technology-based carbon dioxide removals.

- ***Keeping 1.5°C within reach requires integrating actions at all levels.*** It provides opportunities to ratchet ambition in key countries and globally and enables a more robust implementation strategy to deliver emissions reductions.[15] All-of-society actions support enhanced national ambition by raising awareness of opportunities and improving the understanding of benefits. Similarly, all-of-society actions can close the implementation gap by building broader political support and engaging governmental mechanisms. Identifying the gap that can be filled by subnational action, key opportunities for subnational actors, and areas for national support on a global level is critical for activating action across all actors and governance levels.

The report consists of two parts. The first part conducts detailed modeling of individual policy levers and quantifies the global emissions outcomes of accelerated actions based on current trends and policy targets in key emitting countries. The second part identifies the complementary roles of different actors, showcases successful subnational contributions in each of the key policy areas, and elaborates how an all-of-society strategy can help achieve the accelerated actions needed.

ASSESSING THE IMPACT OF A GLOBAL ALL-OF-SOCIETY STRATEGY

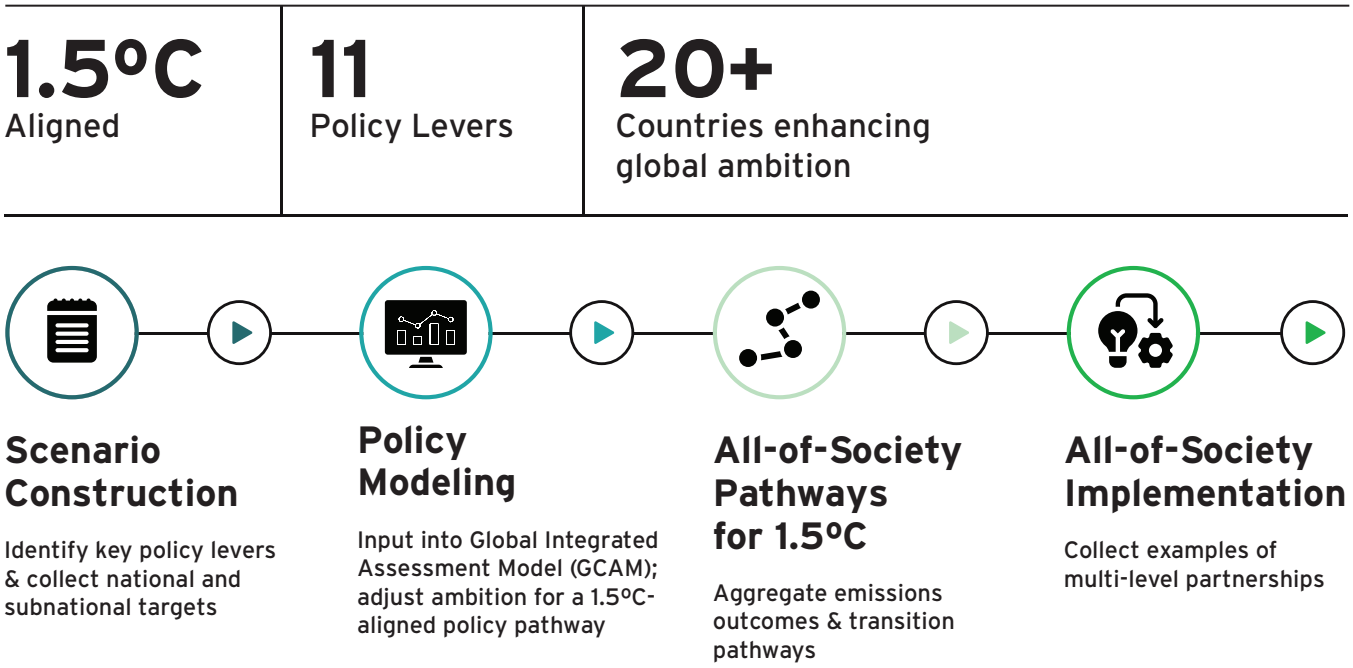
This analysis develops plausible pathways for countries to mobilize around these 11 key policy levers, across sectors and gases, through an all-of-society strategy that leverages multi-level partnerships and enables a pathway toward 1.5°C. Unlike previous top-down modeling approaches,[8,16] it is rooted in a detailed review and modeling of individual policy levers that reflect opportunities for integrated action across multiple governance levels. Eleven such policy levers are identified across energy sectors, land, and non-CO_2 gases to quickly drive down emissions through 2030 (Table 1). The research and modeling approach is based on assessments developed and published for the United States and several other countries.[17,18]

Table 1. Key policy levers identified to reduce emissions through 2030 and beyond

Sector	Key Policy Lever through 2030
Power	Increasing renewable energy deployment
	Phasing down coal
Transportation	Increasing electric vehicle deployment
	Shifting travel mode to various low-carbon options
Buildings	Increasing electrification and heat pump deployment
	Phasing down gas and solid fuels
Industry	Increasing electrification and fuel switching
	Setting peaking and net-zero targets for key industrial sectors
Land Use	Halting deforestation
Non-CO_2	Targeted methane emissions reduction
	Targeted HFC emissions reduction

The policy ambition for key emitting countries is determined based on national and subnational targets collected, current trends, and near-term potential to enhance ambition. By implementing and adjusting each policy lever according to individual country contexts, we aim to represent what is possible with best practice efforts across society. A global integrated assessment model, the Global Change Analysis Model (GCAM 6.0, jgcri.github.io/gcam-doc/) is used to quantify the aggregate emissions and temperature outcomes at the global level, with an iteration of ambition adjustments of the key levers to develop the plausible 1.5°C-aligned pathways through 2030 and beyond (Figure 1). Additional information is available in our technical appendix.

Figure 1. Research Design: Scenario Construction, Modeling Approach, and All-of-Society Implementation.



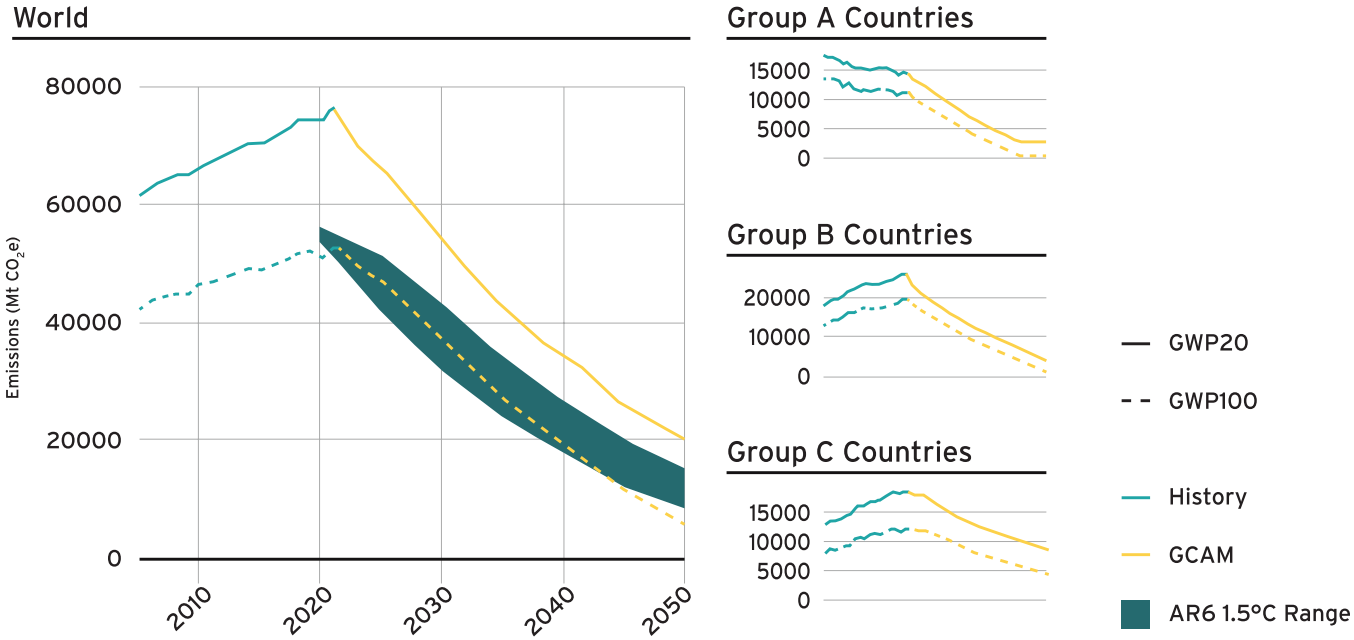
GLOBAL PATHWAY WITH KEY POLICY ACTIONS

To highlight the underappreciated contribution from immediate and targeted emissions reductions of the short-lived climate pollutants, such as methane (CH_4), within this decade to limit temperature overshoot, the resulting All-of-Society 1.5°C pathway developed in this analysis is presented using the 20 year global warming potential (GWP20) metric in addition to the typical 100 year global warming potential (GWP100). Under the All-of-Society 1.5°C pathway, global greenhouse gas emissions peak immediately and achieve a 32% reduction in 2030 from 2022 (30% measured in GWP100), followed by continued emissions reduction reaching net-zero CO_2 by 2050. The modeled emissions pathway is aligned with the 1.5°C scenarios in the IPCC AR6 database (Figure 2). It shows that even with immediate emissions peak and rapid reductions through 2030, it is unlikely to avoid 1.5°C overshoot. To keep the overshoot moderate, the Global All-of-Society pathway

requires substantial progress made along **all 11 key policy levers** (see next section) in **all key emitting countries** over the next few years. Moreover, in addition to targeting methane and other short-lived climate pollutants within this decade to limit the peak temperature, minimizing residual emissions and ramping up carbon dioxide removal options toward 2050 is key to enable the return to 1.5°C after the overshoot.

Key emitting countries are put into three groups with faster (Group A), medium (Group B), or slower (Group C) pace of transition based on their historical and current circumstances, including emissions trends and transition stages. Under the All-of-Society 1.5°C pathway, all three country groups make substantial progress in enhancing ambition from the current trends. Emissions pathways show different peaking and net-zero years, where Group A countries continue the declining trend in historical years and reach net-zero CO_2 by 2045, Group B countries peak immediately and reach net-zero CO_2 by 2050, and Group C countries decline significantly after 2025 and reach net-zero post-2050 (Figure 2). By 2030, the three country groups will achieve 35%, 39%, and 23% emissions reductions from 2022, respectively (and 39%, 35%, and 18% measured in GWP100).

Figure 2. Global and Country Groups Greenhouse Gas Emissions Pathways under the *All-of-Society 1.5°C Pathway*.



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Enhanced actions along the 11 key policy levers cover emissions from all sectors, including energy and land, and both CO_2 and non-CO_2 gases. Under the All-of-Society 1.5°C pathway, overall greenhouse gas emissions decline by 24.8 $GtCO_2e$ from 2022 to 2030 (16.2 $GtCO_2e$ measured in GWP100). When measured in GWP20, 41% of the emissions reduction is driven by decarbonization in the energy system, with the electricity sector contributing to 23% of the total reduction, and industry, transport, and buildings accounting for 18% of the total reduction from 2022 (Figure 3).

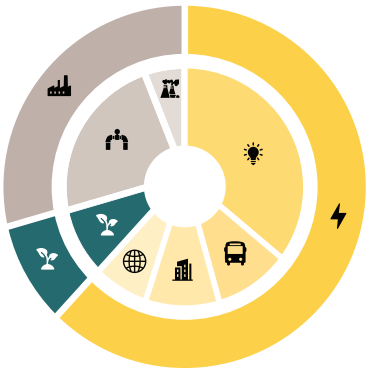
There are large opportunities and temperature impacts of targeted mitigation of non-CO_2 gases in the near term. Under the All-of-Society 1.5°C pathway, 53% of the 2030 emissions reduction comes from increased methane abatement in energy and waste sectors and targeted HFCs abatement under the Kigali Amendment to the Montreal Protocol, using GWP20. The methane-focused mitigation efforts, in particular, can lower peaking temperature by 0.06°C in 2035, compared to a CO_2-focused strategy.[19]

Critical emissions from land use occur from deforestation across regions where, in particular, the land sector can deliver important carbon sequestration where the land absorbs carbon. Carbon sequestration will be necessary for many countries with rich biodiversity to offset hard-to-abate emission residuals. Under the All-of-Society 1.5°C pathway, reductions in land use change emissions contribute to 6% of the total reductions by 2030, using GWP20.

Figure 3. Sectoral Contribution to Global Emissions Reduction between 2022 and 2030, Measured in Both GWP20 (top) and GWP100 (bottom).

GWP20

Energy	Non-CO_2s	Land Use
23% Electricity	**45%** CH_4	**6%** Lands
7% Transportation	**8%** F-Gases	
6% Buildings		
5% Industry		



GWP100

Energy	Non-CO_2s	Land Use
35% Electricity	**23%** CH_4	**9%** Lands
10% Transportation	**5%** F-Gases	
10% Buildings		
7% Industry		

More specifically, the emissions reductions are achieved through a set of concrete actions and targets around the 11 key policy levers. It is critical to note that all actions need to be taken and all targets need to be met in order to achieve the emissions reductions needed under the All-of-Society pathway to keep 1.5°C possible with moderate overshoot.

POWER

In the electricity sector, key policy levers include (1) accelerating renewable deployment and (2) phasing down coal. Globally, total installed solar and wind capacity increases by 3 times from 2022 to 2030 (Table 2), accounting for 88% of the total capacity added during the period. Together, with other renewable sources of energy, they contribute to over 62% of global total electricity generation in 2030, critical for both meeting increasing electricity demand and replacing phased-out fossil generation.

Globally, unabated coal power generation declines by nearly 60% and accounts for only 12% of total generation in 2030, compared to 36% in 2022 (Table 2). This can be achieved through a combination of canceling new builds, closing dated plants, and lowering the utilization of remaining coal fleets through feed-in priority for low-carbon generation, depending on specific country circumstances. Priorities on energy security and economic recovery have slowed down global progress in coal phaseout, and innovative policy and financing mechanisms are needed to break through the near-term challenges at the early-to-mid stage of the energy transition while balancing multiple development needs.[20]

Table 2. Electricity Key Targets in 2030 under the *All-of-Society 1.5°C Pathway* Compared to Today.

	2022	2030
Total installed solar and wind capacity	**2,162 GW[21]**	**8,900 GW**
Share of renewable in total generation	**40%[22]**	**62%**
Share of coal in total generation	**36%[22]**	**12%**

TRANSPORTATION

In the transport sector, key policy levers include (1) increasing electric vehicle (EV) deployment and (2) shifting travel mode to various low-carbon options. For passenger cars, electric vehicles accounted for 14% of global new sales in 2022, increasing rapidly to 51% by 2030 under the All-of-Society 1.5°C pathway (Table 3). Together with accelerated retirement of the inefficient internal combustion engine (ICE) stock, the share of EV in total stock increases from approximately 2% today to 39% in 2030. For trucks, electrification rate of new sales is only about 1% globally in 2022, and it increases to 16% by 2030 under the All-of-Society 1.5°C pathway, reaching 15% of the total stock.

As transport service demand continues to grow, particularly in developing countries with rapid population and income growth and urbanization, it is critical to meet the demand with increasing use of alternative low-carbon modes of transportation, such as walking and cycling, and public transit. Under the All-of-Society 1.5°C pathway, service provided by buses and trains (high speed rail and passenger rail) increases by 16% and 8% respectively in 2030 globally. Strategies to shift travel mode to low-carbon options vary across countries, which may require investments in public transportation infrastructure, more efficient city planning, and policies to encourage behavioral change based on culture acceptance and societal norms.

Table 3. Transportation Key Targets in 2030 under the *All-of-Society 1.5°C Pathway* Compared to Today.

	2022[23]	2030
EV sales target – passenger cars	14%	51%
Increase in bus and rail service	n.a.	16%, 8%
EV sales target – truck	1.0%	16%

BUILDINGS

In the buildings sector, key policy levers include (1) increasing electrification and heat pump deployment and (2) phasing down gas and solid fossil fuels. By 2030, electrification rate can reach over 71% in buildings globally, with on average 83% in commercial buildings and 63% in residential buildings (Table 4). At the same time, traditional fuels are replaced in different countries. Gas consumption is phased down to 12% globally in 2030, particularly driven by reductions in Group A countries from 29% to 16%; Coal consumption is phased out in Group B countries from 14% to nearly 0%, and traditional biomass consumption is phased out in Group C countries from 19% to less than 1%, driven by improved access to cleaner cooking options. Fuel switching needs to occur amid increasing energy use, as service demand increases by 12% in 2030 globally, largely driven by increasing consumption in Group C (22%) and other countries in the rest of the world.

Table 4. Buildings Key Targets in 2030 under the *All-of-Society 1.5°C Pathway* Compared to Today.

	2022[24]	2030
Share of electricity in building energy use	35%	71%
Share of gas in building energy use	23%	12%
Share of solid fuels in building energy use	24%	5%

INDUSTRY

In the industry sector, key policy levers include (1) increasing electrification and fuel switching and (2) setting peaking and net-zero targets for key sub-sectors. The industry sector includes diverse subsectors with heterogeneous characteristics and technology options to decarbonize. Increasing electrification is an important strategy for low- and medium-temperature sectors, and switching to low-carbon fuels (including hydrogen and biomass) are critical approaches for high-heat sectors, such as iron and steel, chemicals, and non-metallic minerals. Near-term fuel switching is challenging, especially amid near-term demand growth, but under the All-of-Society 1.5°C pathway, 26% of industry energy demand is met by electricity in 2030, up from 23% in 2022 (Table 5).

Switching to alternative fuel sources enables the phase down of coal in Group B countries (mainly in the iron and steel and cement subsectors), and gas in Group A countries. Setting emissions peaking and net-zero targets for individual industrial sectors or main companies has been adopted by governments and businesses, especially where few multinational corporations contribute to a large share of sectoral emissions (refer to narrative section). Voluntary corporate emissions reduction targets and accountability mechanisms can decarbonize production methods and set the ground for stronger regulations. These targets can help facilitate energy savings through more efficient production, accelerate deployment of low-carbon technologies, and promote technological advancements and applications to achieve long-term mitigation of the hard-to-abate emissions.

Table 5. Industry Key Targets in 2030 under the *All-of-Society 1.5°C Pathway* Compared to Today.

	2022	2030
Share of electricity in industry energy use	**23%**[24]	**26%**
Iron & steel emissions reduction from 2022*	**n.a.**	**50%**
Aluminum emissions reduction from 2022*	**n.a.**	**36%**
Chemical energy and feedstocks emissions reduction from 2022*	**n.a.**	**28%**

***Note: 2022 data is from GCAM**

LAND USE

In the land use sector, the key policy lever for 2030 is the global commitment to halt deforestation. Under the All-of-Society 1.5°C pathway, total natural forest land remains almost constant, with a small net growth between 2022 and 2030 (Table 6). Agriculture activities have been one of the main drivers of global deforestation.[25] While mitigating climate change and ensuring resilient ecosystems are essential, land management must also sustain food and fiber production, biodiversity, recreation, and cultural values in a growing global population. Achieving this balance hinges on locally informed policies that address the diverse needs of communities, the economy, and the environment.[26] Key strategies include supplemental policies supporting ongoing and equitable food production wherever afforestation and reforestation occur adjacent to agricultural lands and adopting measures to support the livelihoods of these landowners. In regions more prone to wildfire, wildfire mitigation and prevention policies could protect not only forests from degradation but vulnerable ecosystems relied on for tourism, food production, material goods, and of cultural significance.[27]

Table 6. Land Use Key Target in 2030 under the *All-of-Society 1.5°C Pathway* Compared to Today.

	2022*	2030
Natural forest land cover	**21.6 million km²**	**21.7 million km²**

***Note: 2022 data is from GCAM**

NON-CO_2S

On non-CO_2 gases, key policy levers include (1) targeted methane emissions reduction in energy and waste sectors and (2) targeted HFC gases mitigation under the Kigali Amendment. Reducing emissions of the short-lived climate forcer methane in the next few years is critical for reducing the short-term rate of warming. A reduction of global methane emissions by 30% in 2030 from 2020 levels (Table 7), or over 120 $MtCH_4$, (as pledged in the Global Methane Pledge) can lower the temperature increase in the next 12 years by 0.06°C (implying a rise of 0.28 instead of 0.34 with flat methane emissions).[19] The majority of reductions can come from the energy sector, which can achieve a 75% reduction (through larger reductions in oil and gas and around 50% reduction in coal methane). Emission from waste can be reduced by about a quarter by 2030. These reductions together allow for achieving the 30% target, but this requires that agricultural emissions do not increase further. F-Gas emissions are reduced as well, especially HFCs as outlined in the Kigali amendment, with emissions reduction reaching 73% in 2030 from 2020 levels (65% in GWP100). While group A countries start an early transition from HFCs, other regions gradually join and match the reduction rates based on regional contexts and development stages.

Table 7. Non-CO_2 Gases Key Targets in 2030 under the *All-of-Society 1.5°C* Pathway

	2030
Methane emissions reduction from 2020	**30%**
HFC emissions reduction from 2020	**73%**

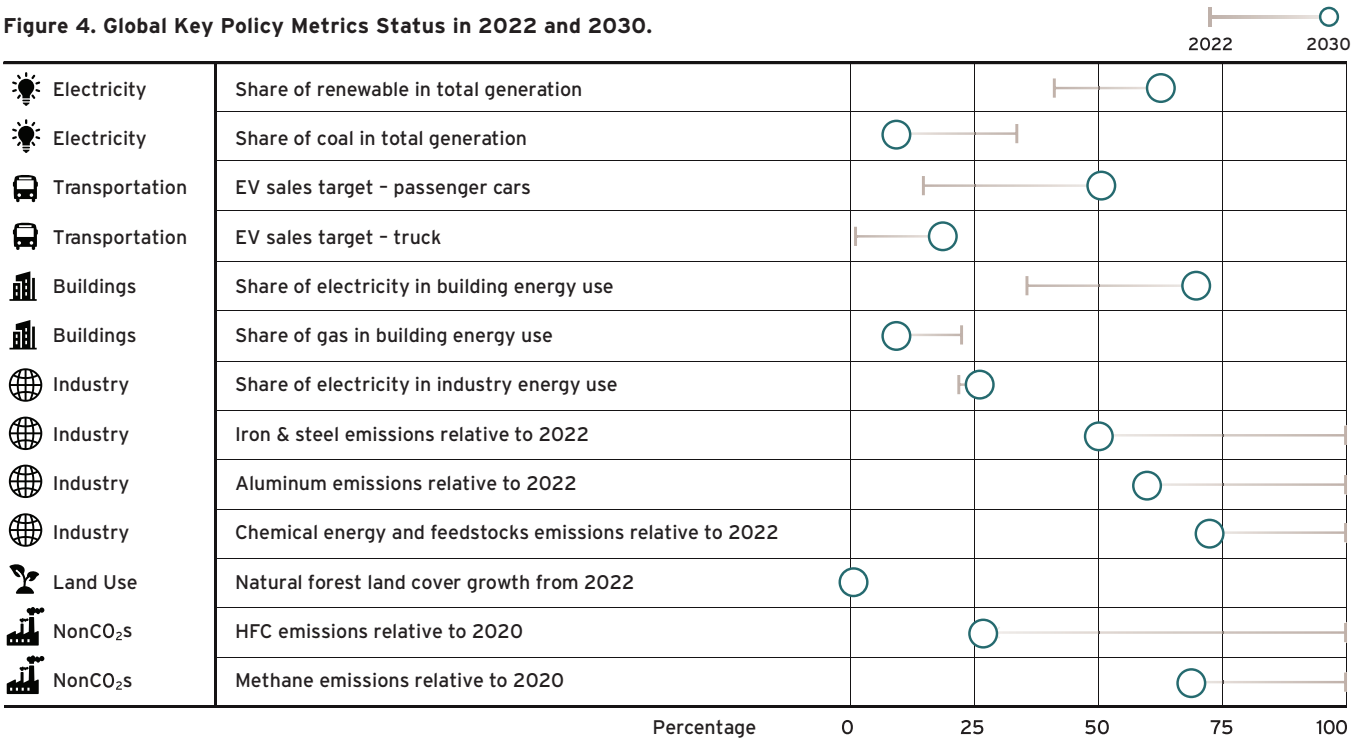
SUMMARY OF KEY METRICS UNDER THE GLOBAL PATHWAY

In summary, between today and 2030, significant progress needs to be made in terms of increasing share of renewables in electricity generation, increasing electrification across all end use sectors, increasing natural forest land area, and decreasing methane emissions (Figure 4). Under the All-of-Society 1.5°C pathway key policy targets achieved globally by 2030 include:

- 62% of electricity generation is met by renewable energy;
- 51% of new passenger car sales and 16% of new truck sales from electric vehicles;
- Phasing out solid fuels and phasing down gas consumption to 12% in buildings;
- 26% of industry energy use from electricity;
- Maintaining natural forest land area; and
- A 30% reduction in methane emissions and a 73% reduction in HFCs emissions.

Looking to 2050, ambition across all of these actions must be ratcheted for net-zero emissions, as fossil fuels are phased out from electricity and end-use sectors, and new technologies are made commercially available for use of alternative fuels in hard-to-abate sectors. Achieving these ambitious targets will require significant and immediate action, as well as long term planning and development, in all key emitting countries. Implementing the policies to enable globally achieving these outcomes will require an all-of-society approach.

Figure 4. Global Key Policy Metrics Status in 2022 and 2030.



HOW AN ALL-IN-SOCIETY APPROACH CAN ENHANCE AMBITION AND IMPLEMENTATION

Achieving the policy outcomes outlined in this analysis will be challenging, and will require enhanced ambition from all of society's actors to limit warming and avoid the worst impacts from climate change. Understanding the relative strengths and opportunities for action across policy actors is needed for successful implementation of policies across multiple levers of governance. Previous analysis has demonstrated how an all-of-society approach can deliver further and faster emissions reductions rooted in the foundation of innovation, ambition, and implementation from subnational actors.[28] At the sectoral level, an all-of-society strategy can achieve even more from hard to abate sectors. For example, in the United States, analysis finds subnational action alone from states and regions, cities and urban areas, indigenous groups, businesses, universities, non-profits, faith groups, and more can slash methane emissions by 16% from 2020 levels by 2030 (110 $MtCO_2e$). Combined with national ambition, the United States can extend these reductions to 30% by 2030 (227 $MtCO_2e$).[29]

Subnational actors play a significant role in enhancing national ambition and contributing toward global climate goals (Table 8). They are enforcers and monitors of policies, giving them a key role in the implementation of national commitments. Subnational actors can fill national governance gaps with innovative policies and commitments.[30] They also are more directly connected to constituents and communities, and thus are more effective at responding to regional conditions and are often more motivated to act on public health and environmental justice issues. Subnational policies can better reflect the geography, urban density and demographics of a region than national initiatives. They can also serve as an example of successful practices and/or testing ground for innovative policy ideas that can be used by other subnational actors or even scaled up to the national level. Smaller areas of impact and focus can mean less administrative or bureaucratic obstacles for policy implementation.[31]

To achieve global climate goals, national action is needed. National action is particularly important for enabling finance mechanisms at other levels of governance (Table 8). Additionally, the incentive to demonstrate international leadership is a significant opportunity to leverage action. By providing broad policy objectives, investing in new and emerging technologies and allocating funding for subnational policy actions, national governments can work closely with subnational governments on achieving shared policy outcomes.

Table 8. Strengths and Opportunities across National and Subnational Actors.

Subnational actor refers to all non-state actors, including states/provinces, cities, counties, private businesses and tribal nations. Political structures vary significantly across countries, so these observations may not be reflective of individual country conditions. They are meant to be illustrative of some of the different roles actors can play globally.

	National	Subnational
Strength	Holds significant legislative and regulatory power	Often implements, enforces and monitors policies[32]
	Sets broad policy objectives	Connects with community and constituents
	Establishes laws, standards that affect all subnationals	Often has more flexibility in policy implementation
Opportunity	Incentive to demonstrate international leadership	Drive enhanced ambition from national government
	Establish market trends	Innovate and demonstrate effectiveness of new policies
	Support subnational actors	Act quickly and early to drive emissions reduction
		Optimize national goals to the local level
		Supplement and execute on stated national ambition[30]
		Identify links between climate mitigation and sustainable development
		Request support from national government

Both national and subnational actors will need to play complementary but different roles in ensuring all policy levers are implemented and acted upon by 2030. Actions that could be taken by different policy actors to achieve the 11 key policy levers are outlined below.

POWER

Phasing out coal and expanding wind and solar deployment will require action across all levels of governance, and subnational actors can play a significant role in achieving key policy actions. To increase wind and solar deployment, driving down costs, setting high-ambition targets and investing in energy grid updates are critical. Setting renewable energy targets or clean energy portfolio standards is a mechanism for enhancing ambition.[17] Subsidies and tariffs can reduce costs of renewable deployment and incentivize domestic production of wind and solar. Subnational regional targets can encourage increased national ambition, as current provincial commitments in China for 2025 wind and solar capacity exceed national targets for 2030 by over 125 GW (Table 9). To meet policy targets, subnational governments can partner with private utilities to develop power purchase agreements to achieve renewable energy targets or goals.[33,34] National governments can invest in new and emerging technologies to help drive down costs and increase availability of renewables, such as the REnewEU policy and Green Deal Industrial Plan (Table 9). In addition to setting regional targets, subnational actors play an important role in updating regulatory policies, including on zoning and siting,[17] to limit fossil fuel development and increase renewable energy expansion.

Phasing-down coal will require actions across levels of governance to retire inefficient plans, develop just transition plans and increase grid planning. Actors can set retirement targets/benchmarks for plants within their jurisdictions, as well as set efficiency and environmental performance standards.[31] Developing local just transition plans, especially in areas that have a large amount of fossil fuel extraction, can be a key role for subnational governments in the energy transition, as shown by the just transition plan in Western Australia for state-owned coal power plants (Table 9). National plans for coal transition are needed as well, to help fund training programs, as in the EU (Table 9), and to ensure equitable distribution of clean energy and co-benefits of mitigation, such as air quality, health and employment opportunities across regions. In addition to reducing costs of technologies and developing plans for socioeconomic impacts from the transition, ensuring energy security and grid reliability will be important. The national government will need to play a key role in improving grid infrastructure and interconnectivity between areas with high demand and high renewable energy potential, especially since those may cross subnational borders.[35] Regional energy security plans and developments to reduce energy demand during peak times will also be needed as electrification increases.

Table 9. Example All-of-Society Actions for the Power Sector.

Policy Area	Actor/Policy	Implementation Strategy
Wind and solar deployment	**China:** commitments set by provinces for renewable energy deployment by 2025 exceed 2030 national targets by over 125 GW.[36]	Provinces can invest in science and technology innovation and industrial chain development, building supporting grid facilities, and implementing incentive policies for renewable energy projects.[37,38]
	The European Union REPowerEU plan and the EU Green Deal Industrial Plan: invests in new and emerging technologies.[39,40]	Both policies invest to transition from fossil fuels through renewables, hydrogen and infrastructure updates,[39] and update existing policies to streamline permitting processes, increase access to funding and reduce costs for manufacturing of clean energy technologies domestically. It will also develop training programs for green jobs.[40]
Coal Phaseout	**Western Australia:** state-owned power stations are set to retire by 2030.[41]	To enable a just transition, the state has a plan that focuses on providing jobs, through the development of new industrial projects and skills and training opportunities for workers in the coal mining region.[41]

TRANSPORTATION

The transportation sector is a key sector for all-of-society action, given that significant decarbonization actions are already being taken at the state and local level. Both subnational and national actors can expand incentives and regulations to encourage increased EV market share, accelerated retirement of combustion engine vehicles and increased use of public transportation. To increase EV deployment, they can create priority lanes and subsidized parking to incentivize the purchase of EVs.[42] Creating taxes, or disincentives for combustion engine vehicles, such as setting vehicle emissions and fuel economy and quality standards and congestion charges, vehicle registration fees, and road tolls,[31] waiving them for EVs or designating low or emission-free zones in large cities, like Amsterdam (Table 10), can help to accelerate retirement of non-EVs. Charging stations are a key component of any transportation transition plan - ensuring that consumers have access to electricity for their vehicles is needed to develop support and expand market share of this new transportation technology. Also, they can invest in technology innovation and help bring down the costs and implement measures to reduce costs of domestic battery manufacturing, as in India. National support can help to ensure EV deployment occurs somewhat consistently across regions. Subnational actors can help drive down costs by setting targets for actor-owned vehicle fleets and implementing policies focused on increasing innovation in electric vehicle technology. Ensuring that charging stations are accessible and distributed equitably is critical to expand EV deployment, and subnational actors can play a key role in assessing distribution and needs for EV charging infrastructure in their region, and create policies to ensure access, like in Zhejiang, China (Table 10).

To increase use of public transit, federal funding and subnational implementation efforts are needed. Subnational actors are often the lead policy actors in urban areas, and can also work to update urban infrastructure, including investing in public transit, increasing walkability of urban areas and increasing bike lanes, as well as set targets for public transportation use, as Buenos Aires has done.

Table 10. Example All-of-Society Actions for the Transportation Sector.

Policy Area	Actor/Policy	Implementation Strategy
Increasing electric vehicle deployment	**Action Plan Aimed at Accelerating the Development of New Energy Automobile Industry of Zhejiang Province:** plans to produce over 1.2 million EVs by 2025, over 60% of total automobile production in the province and 10% of national new energy automobile production.[43] **Action Plan for Improving High-Quality Charging Infrastructure Network System to Promote New Energy Vehicles in the Countryside of Zhejiang Province (2023-2025):** is focused on distribution of EVs across the province, with plans to have over 2.3 million charging stations by 2025, with over 900,000 installed in rural areas of the province.[44]	Both policies involve increasing investment and promoting consumption. The energy automobile industry policy plans to invest more than 100 million yuan in scientific and technological innovation in the field of new energy vehicles, and to broaden the financing channels for new energy vehicles, as well as to introduce incentives to expand the consumption of new energy vehicles.[43] The policy focused on charging infrastructure increases investment in the power grid to accommodate the construction of charging infrastructure, while setting up promotional bonuses to support the construction and operation of public charging infrastructure.[44]
	Faster Adoption and Manufacturing of Hybrid and Electric Vehicles: sets targets for electrification of vehicles and public transit in India.[45]	The policy includes cost-reduction measures to increase domestic battery manufacturing, exemption of battery-operated vehicles from permitting processes and waiving road tax on all EVs to help reduce costs.[45]
	Jakarta, Indonesia: committed to a 100% electrification of the Transjakarta bus fleet, accounting for over 10,000 buses, by 2030.[46,47]	Jakarta can implement several policy tools to help realize this goal, such as setting targets to phase out the sales of ICE buses, monetary incentives, regulations for fuel consumption and emissions, infrastructure planning, industrial policies, fleet purchase requirements, and preferential treatment for the electrified fleet.[48]
	Clean Air Action Plan: targets that all transportation in the Amsterdam will be zero-emissions by 2030.[49]	The city has designated zero-emission zones, certain areas as only for electric or low-emission vehicles in the city, to improve air quality and meet climate goals.[49]
Mode-shifting and increasing use of public transportation	**Buenos Aires:** is prioritizing efficient public transit and walkable infrastructure, including a goal for 75% of passengers to use public transit rather than individual vehicles by 2030.[50]	Streets originally designed for passenger vehicles are being retrofitted to cater to walkable infrastructure, with one street in each of the 48 neighborhoods being transformed into a space for shopping, recreation, and green spaces.[50]

BUILDINGS

Given the diversity of actors in the buildings sector, and factors influencing individual & community consumption patterns, housing policies and workplace organization and interactions, a combination of policies across actors can raise ambition. Increasing electrification in the buildings sector by reducing costs and offering incentives is important for enabling the switch away from other fuels. Subnational and national actors can play an important role by being early adopters of new technologies, setting targets for municipal buildings, conducting energy audits and advice programs, establishing building and equipment codes and standards,[31] and setting efficiency standards and ratings for new buildings. Providing subsidies for new technologies, as Norway has done for heat-pumps (Table 11), can help to drive down costs and expand new technology commercial availability. Such measures should also be linked to equity considerations that recognize historical inequities and energy burdens. National and subnational governments can play a key role in reducing costs by providing subsidies for efficient buildings, retrofits and installations, as well as certifications for energy efficiency improvements.[31] Additionally, utilities can support adoption of more efficient appliances and responsible consumption patterns through subsidies for efficiency and/or demand response programs.

Phasing out gas in buildings is a critical decarbonization measure for many countries, particular in group A. The phaseout of solid fuels, coal & traditional biomass-based fuels, by 2030 in countries in group B, C and the rest of the world can not only contribute substantially to mitigation but also to closing the energy access gap, and contribute towards advancing other health goals, including air quality. To phase down gas and solid fuels, actors can set targets for no-new fossil fuel builds, as Victoria, Australia has implemented (Table 11), as well as gradually phase out the subsidies for fossil fuels in buildings, while ensuring targeted and transitional options for the energy poor globally. National governments, development agencies, and subnational actors must enable scaling up and financing of new technologies, so they become affordable, increase consumer choice, and stimulate additional private investment (including through incentives or risk mitigation mechanisms). Countries with dedicated policy initiatives, such as India (Table 11), are increasing access to clean cooking fuels, and such policies and learnings can be integrated into building fuel-switching interventions in other parts of the world.

Table 11. Example All-of-Society Actions for the Buildings Sector.

Policy Area	Actor/Policy	Implementation Strategy
Increasing electrification and heat-pump deployment	**U.S. Climate Alliance:** pledges to install 20 million heat pumps by 2030.[51]	Heat pump installations will be subsidized through the Inflation Reduction Act through which families can claim up to $2000, the Infrastructure Jobs and Investment Act, and individual state policy efforts.[52]
	Net-Zero Carbon Buildings Commitment: requires signatories, including both national and subnational actors, to reduce energy consumption in existing structures and commit to building efficient structures powered by renewable energy by 2030. Stages of the commitment include disclosure of operational and embodied carbon, acting to achieve maximum emissions reductions, verifying progress, and advocating for further action within key supply chains. All levels of government can join the commitment, with signatories including cities like Cape Town, Johannesburg and Tokyo and private businesses, involved in construction and property management.[53]	All new structures must take into account alternative strategies to avoid embodied carbon, reduce energy consumption, and eliminate emissions from fossil fuel use. This may include actions such as the renovation of existing buildings rather than new development, retrofitting buildings with heat pumps, and ensuring new developments are powered by renewables.[53]
	Norway: covers approximately 25% of the investment costs of heat pumps and aid in the removal of gas-based sources of heating via subsidies.[54]	Since the implementation of these subsidies in 2008 (assumption need to check cite), heat pumps have risen to comprise 60% of Norway's market, with annual installations surpassing 120,000.[55,56]
Mode-shifting and increasing use of public transportation	**Victoria, Australia:** prohibits construction of gas connections in new homes and residential subdivisions after 2024.[57]	To implement this, Incentives include discounts for energy-efficient products and rebates for hot water, solar PV, and batteries. Regulatory measures include removing gas connection requirements for new developments and updates to the 2022 plumbing code to align with changes.[57]
	Pradhan Mantri Ujjwala Yojana: initiative in India is increasing LPG access particularly among rural women in poverty.[58]	Providing LPG connections to rural homes living below the poverty line.[58]

INDUSTRY

The industry sector is comprised of diverse subsectors, each with varying decarbonization pathways (Table 12). Electrification is a key strategy for low and medium temperature sectors, while high-heat industries may require alternative sources of fuel, and more research and development. Investing in research and development of new technologies and in pilot or demonstration projects like HYBRIT (Table 12), national and subnational actors can help to drive down costs and help to increase the number of technologies that are commercially available. National and subnational governments can also provide incentives for efficiency and electrification and can set efficiency and environmental performance standards.[31] Not only will subsidies be required to encourage fuel switching, but also incentives and regulations for early retirement of industry infrastructure are needed. Additionally, it will be necessary to update regulations to help industries make replacements to existing infrastructure.[35] For example, in the steel sector, policies that incentivize retrofitting with carbon capture, utilization and storage (CCUS) to minimize stranded assets and phase out blast furnaces without CCUS will be needed.[59]

Setting peaking and net-zero targets as a roadmap for decarbonization in specific subsectors will be critical for deploying specific and effective decarbonization approaches in industry. Private businesses and companies can use high energy prices as an opportunity for investment in efficiency, set energy management systems,[31] and publish investment and environmental performance roadmaps with quantified and tangible targets. In addition to making net-zero commitments, like the Global Cement & Concrete Association has (Table 12), manufacturing companies can join multilateral initiatives to drive innovation in the sector, advance decarbonization efforts and share best practices across actors and the international community, like the Science Based Targets Initiative to develop industry-wide standards and practices (Table 12). Developing certification standards and green public procurement programs can help increase demand for low-carbon products.[35] Enabling market mechanisms, potentially through procurement targets, such as outlined in the Green Public Procurement Pledge (Table 12), can help to develop a market for new, low-carbon products. Connecting industry to power sector policies is also important, as changes in electricity pricing and tariffs for industry can help incentivize electrification across industries.[35] Major manufacturing regions will need to coordinate on research, development, certification to ensure equitable access and progress in this sector, as well as develop just transition plans for decarbonization.[59]

Table 12. Example All-of-Society Actions for the Industry Sector.

Policy Area	Actor/Policy	Impact
Setting peaking and net-zero targets for key industrial sectors	**SteelZero:** Supported by The Climate Group and ResponsibleSteel, SteelZero is a global initiative supporting the transition to a net-zero steel industry.[60]	Over 400 companies have made a public commitment to buy and use 50% low emission steel by 2030 and procure, specify or stock 100% net-zero steel by 2050. Members report annually on progress to SteelZero leadership.[60]
	Green Public Procurement (GPP) Pledge: Led by Industrial Deep Decarbonization Initiative (IDDI), the pledge commits governments at all levels to using low-carbon steel, cement and concrete in public construction projects.[61]	The GPP Pledge has four levels of commitment through 2030, requiring countries to set reporting and emissions standards in industry. Governments aim to make official commitments at COP28 in Dubai.[61]
	The Science Based Targets Initiative (SBTi): developed emissions targets and reporting information clearly for the steel sector, to help private actors develop standards and comply with them.[62,63]	In 2023, SBTi released the Steel Science-Based Target-Setting Guidance and subsequent step-by-step tool showing companies how much and how quickly emissions need to be reduced to stay 1.5°C-aligned.[62,63]
	Global Cement & Concrete Association (GCCA): aims to achieve more sustainably made concrete.[64]	GCCA's net-zero 2050 roadmap highlights a number of key actions needed in the next decade, including increasing efficiency in concrete production and design and construction of products to reach net-zero emissions in 2050.[64]
Increasing electrification and fuel-switching	**HYBRIT:** is a demonstration project developed in partnership with across industries and power providers, with national and EU funding.[65]	This project will replace coal-blast furnace technology with direct reduction based on fossil-free hydrogen.[65]

LAND USE

This report highlights halting deforestation as one of the key policy levers to keep 1.5°C within reach. Yet, nature-based land use and biodiversity is inherently complex and depends largely on regional, financial, and physical circumstances. Natural disturbances such as wildfire, drought, pests, and more add additional complications. However, natural lands offer substantial opportunities for carbon sequestration and can help countries deliver on their climate goals.

In 2021 at COP26, 145 countries endorsed the Glasgow Leaders' Declaration on Forests and Land Use, agreeing to halt and reverse forest loss and land degradation by 2030.[66] This pledge highlights the critical role national governments, in the international space can play in enacting broad policy goals and commitments. National governments can set nationally-scaled benchmark targets and timelines, subsidies for sustainable forestry, certification schemes and can update and enforce forest law.[31] A number of national governments have specific land sink or forest stock targets as part of their NDC, including China, India and Indonesia.

Halting deforestation requires addressing multiple economic, social, and regional circumstances (Table 13). For example, timber production is a major source of income for many communities and especially in developing countries. To ensure an equitable transition away from deforestation, a framework that directly involves subnational actors and promotes the climate-smart economic stimulation of land management is necessary. The European Union was one of the first to prioritize subnational climate action in the forestry and agriculture sectors through direct pay to farmers and landowners to adopt climate-friendly land management practices (Table 13). The 2017 program, Common Agriculture Policy (CAP), has its criticisms,[67] but offers a framework for how to engage local and regional actors to disseminate funding based on their individual circumstances.[68] For example, a recent analysis finds that adopting a targeted regional strategy can allow CAP funding to support resilience against increased wildfires through targeted policies that improve conservation efforts and aligns climate-smart forest management with new value chains.[69] Partnerships across regions, as demonstrated by the Lingkar Temu Kabupaten Lestari (LTKL) in Indonesia and the Municipal Plans for the Conservation and Recovery of the Atlantic Forest in Brazil (Table 13), can help expand subnational actors' access to financing and technical capacity.

In addition to funding mechanisms to support regional practices, subnational actors can help disseminate information to small-scale farmers about sustainable practices and can subsidize small-scale farmers, and can update zoning for land use planning and enforcement as well as set increased ambition for regional reforestation targets.

Table 13: Example All-of-Society Actions for the Land Use Sector.

Policy Area	Actor/Policy	Impact
Halt Deforestation	**Declaration of the Sustainable District Vision 2030:** Lingkar Temu Kabupaten Lestari, Indonesia aims to protect at least 50% of the total forest area, peatlands, and other important ecosystems across 9 member districts in 6 provinces by 2030.[70]	LTKL has a multiphase implementation plan including, connecting member districts to financing options, developing consistent indicators for success, and hosting collaborative meetings to create action plans and strategies.[70]
	Municipal Plans for the Conservation and Recovery of the Atlantic Forest: Brazilian program to preserve the Atlantic Forest and its biodiversity across 17 states through local and civil society engagement.[71]	Working with municipalities, urban areas, and civil society, the plan encourages direct participation in protecting the Atlantic Forest. The municipal protected areas must be closely involved in the planning and implementation of forest protection policies. For example, the City of Curitiba, Brazil has fifteen Private Natural Heritage Reserves (RPPN)—voluntarily protected areas by local landowners who receive a tax credit for their environmental service.[71,72]
	AFR100 Initiative: The African Forest Landscape Restoration Initiative works to restore degraded and deforested land in Africa.[73]	AFR100 has a network of restoration champions and technical and financial partners, and works to develop pilot projects and share best practices across projects to best inform development.[73]
	European Union's Common Agriculture Policy Pillar II: Specific funding to distribute regionally in support of climate-smart land management policies such as wildfire prevention, organic farming, and afforestation efforts.	Austria, a largely rural country, has taken a producer-driven approach by engaging stakeholders directly to inform their CAP implementation plan. Austria spent 60% of its local development budget to support farmers in adopting climate-smart practices beyond those legally required, such as increasing carbon sequestration through new and efficient vegetation on multi-use lands.[74]

NON-CO_2S

Mitigating non-CO_2 emissions, especially methane (CH_4) in the next decade is critical for reducing warming. The reduced use of coal, oil and natural gas can contribute significantly to emission reductions, but much deeper cuts through reduced leakage rates are required to achieve 30% reduction of emissions from 2020.[19] These can be achieved through better maintenance of equipment, increased monitoring and measurements, and shutting down of the most polluting sites. Regulating fossil extraction is necessary, such as through the US Inflation Reduction Act methane fee or British Columbia, Canada's fugitive emissions guidelines (Table 14), to implement improved monitoring, repair and maintenance to reduce emissions, and shut down highly polluting low-production or super-emitting sites. Improved data availability for existing methane emissions is needed, along with comprehensive greenhouse gas reporting mechanisms and MRV systems which will require national initiative and collaboration with subnational governments and individual facilities to take meaningful action, more on reporting schemes.[75] Additionally, market mechanisms can be used to incentivize methane gas capture and utilization, along with other incentives such as market-based offset credits, emissions trading schemes, and carbon taxes.[75] Subnational actors can start or expand composting programs as planned in Buenos Aires,[50] and increase data analysis of facilities, emissions and activity data to improve methane estimates. Setting near-term emissions reduction goals, as done by the Subnational Methane Initiative (Table 14), can help to encourage enhanced action beyond the global methane pledge target of 30% by 2030. For additional analysis on methane emissions reduction, please see methane report.

Table 14. Example All-of-Society Actions for the Non-CO_2 Sector.

Policy Area	Actor/Policy	Impact
Targeted methane emissions reduction	**The United State's Inflation Reduction Act (IRA):** sets a methane fee of $1,500/tCH4 in the oil and gas sector.[29]	Implementing a methane fee would incentivize adoption of mitigation and emissions monitoring practices.
	Subnational Methane Initiative: Commits to reducing methane emissions, across multiple cities and states (California, Gauteng, Queretaro, Espirito Santo, Cross River State, Yucatan, Delhi).[76]	By joining this initiative, jurisdictions are committing to setting a methane emissions reduction goal and creating a methane action plan, as well as meeting with other participating jurisdictions to share best practices and exchange data.[77]
	Fugitive Emissions Management Guideline: British Columbia issued guidelines on fugitive methane emissions management plan components, leak detection survey info, data collection and management requirements.[78]	Develops standards, guidelines and transparency to increase data availability and consistency across facilities.[78]
Targeted HFCs emissions reduction	**Increased and Improved Waste Separation at Source:** Buenos Aires has a target of having 80% of waste composted by 2030 in their Climate Action Plan 2050.[50]	To increase compositing the City will launch both communication campaigns to inform consumers both about how to separate waste at the source and the importance of reusing and composting.[50]
	EU's F-gas Regulation of 2014: Sets emissions reduction target, reducing emissions leaks and limiting HFC sales on the EU market.[79]	This regulation limits the amount of HFCs that can be sold in the EU, requires checks and servicing of equipment and bans use of F-gases in new types of equipment.[79]

SUPPORTING MULTI-LEVEL PARTNERSHIPS

The role of partnerships and new forms of governance across all levels of society in addressing climate change has grown in prominence since the turn of the century.[80] Such multi-level partnerships will be key for a successful all-of-society 1.5°C pathway. For the purposes of this report and to examine how the pathways outlined will be realized, multi-level partnerships are defined as top-down by national governments or bottom-up activities driven by a foundation of ambition from subnational actors.[81] In addition, these partnerships can also occur laterally horizontally, helping bridge divides between sectors, geographies, cultures, and other societal factors.[82]

A number of critical mechanisms are needed to scale up action and enable near-term, significant actions. Highlighting areas where national leadership and/or support is needed for subnational action/enhanced country ambition is key.[83] Vertical integration of policies, to ensure that national policies encourage subnational governments to prepare action plans, policies and for local action can support effective action.[74] Networks and partnerships within and across actor types are a key mechanism for mobilizing and empowering action. Networks across subnational actors can provide the opportunity to access financing and disseminate and receive research, knowledge and best practices.[32] Additionally, more inter-network connections, across existing networks, can help to spur collective action.[32] Transnational cooperation and networks can increase local government capacity[84] and help improve their access to finances and disseminate research, knowledge, and best practices. Summits across subnational actors can create a space for ambitious climate dialogue and the involvement of underrepresented groups, paving the way for more inclusive and innovative policies.[32] Finally, identifying areas where different actors can collaborate and enhance others actions is needed to maximize the impact of any one actor.

Future research should evaluate country specific pathways and sectoral strategies in detail, to better identify the key actors and levers for rapid decarbonization. Additional research should evaluate national decarbonization pathways across key emitting countries, such as members of G20, to better inform mitigation approaches and understand how multi-level partnership at a country-level can help realize existing goals and feed into enhanced ambition. Focusing on additional key levers and decarbonization approaches, such as alternative modes of transportation and on efficiency/low-demand is needed to better inform pathways.

CONCLUSION

The next decade will be critical for making progress toward the international commitment of mitigating warming to below 1.5°C. While there are certainly challenges, our global goal can be achieved through-all-of-society action and partnership. This analysis shows how it can be possible, through enhanced action across key policy levers. Identifying areas for collaboration and enhanced action across multiple levels of governance will be key for ensuring effective and immediate action.

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