



Net Zero Readiness Index 2021

KPMG IMPACT

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The Net Zero Readiness Index (NZRI) is a tool that compares the progress of 32 countries in reducing the greenhouse gas emissions that cause climate change, and assesses their preparedness and ability to achieve Net Zero emissions of these gases by 2050.

KPMG has selected the 32 countries to capture insights from across developed and emerging economies and current energy exporters. They include members of the G20 intergovernmental forum, as well as G20 invitees, which are emerging or large economies; members of the Organization of the Petroleum Exporting Countries; and countries that had a Net Zero target in place at the time of framing the methodology.

The date 2050 was proposed by a 2018 report of the United Nation's (UN) Intergovernmental Panel on Climate Change, which said that cutting net emissions by about 45 percent from 2010 to 2030, then 100 percent by 2050 would limit temperature rises to 1.5 degrees Celsius. The panel said that doing this would lessen the still-substantial damage that global warming will cause over the coming decades.¹

In August 2021, a report by the panel approved by 195 governments said that humanity has already warmed the planet by approximately 1.1 degrees Celsius, that 1.5 degrees is likely to be reached or exceeded in the next 2 decades and that without immediate, rapid and large-scale reductions in emissions, limiting warming to 1.5 or even 2 degrees will be beyond reach.²



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The NZRI uses the World Resources Institute definition of Net Zero. Primarily, this involves reducing greenhouse gas emissions caused by humans as close as possible to zero. Remaining emissions are balanced by an equivalent amount of carbon removal from the atmosphere, effectively neutralizing humanity’s future impact on the world’s climate.³

The main greenhouse gas is carbon dioxide, and work towards Net Zero is often called ‘decarbonization’ to reflect the focus on this gas, which is released when fossil fuels are burnt. However, emissions of methane and nitrous oxide also make significant contributions to climate change and are included in this Index.

How the NZRI works

For each of the 32 countries, the NZRI considers 103 indicators that KPMG considers as key drivers to achieving Net Zero. The indicators have been split between national preparedness and sector readiness. National preparedness considers a country’s national commitment to decarbonize, its past decarbonization performance and the national enabling environment for decarbonization.

Sector readiness covers the five highest emitting sectors: electricity and heat; transport; buildings; industry; and agriculture, land use, land use change and forestry (in the report referred to as agriculture, land use and forestry).

The Index looks at the indicators for sector readiness through three lenses: decarbonization status, government action and delivery capability. The indicators are aligned to the fifth assessment report of the UN’s Intergovernmental Panel on Climate Change published in 2014⁴ and insights from KPMG professionals. For each of the 32 countries, our local experts provide a qualitative overlay sharing local context and their views on challenges, successes and imminent initiatives.

Through this analysis, KPMG has identified key observations and insights that we see as critical to understanding and overcoming the challenges of the transition to Net Zero at a global level. The 32 participating countries have been grouped into two categories: our view of the top-performing 25 countries in the race to Net Zero based on progress to-date and established initiatives; and seven countries to watch where KPMG is seeing significant opportunities to advance their decarbonization efforts through large-scale projects and emerging escalation initiatives.

As countries around the world race to implement policies to reduce carbon emissions, it is likely there will be movement, perhaps significant, in the rankings. KPMG intends to update the NZRI regularly and share insights on an ongoing basis.

More information on the results, methodology and sources used can be found in the Appendix.

The following abbreviations are used in the text: CO₂ (carbon dioxide); ESG (environmental, social and governance); GDP (gross domestic product); GW (gigawatt); MtCO₂e (megatonnes of CO₂ equivalent, used to measure greenhouse gas emissions). US dollar equivalents for local currencies are correct as of August 2021.

The intended audience for the NZRI is governments and the public sector, multilateral organizations, investors and financial institutions, the private sector, and the general public. It is likely to be of particular interest to any entity, department, business or person with an interest or responsibility in advancing the Net Zero agenda.



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Climate change is *the* existential challenge facing humanity. It is now, at last, well accepted that if we do not urgently limit the rate of global warming, the future for our children and grandchildren is very bleak, indeed.

Since the Industrial Revolution, concentrations of greenhouse gases in the atmosphere have surged to now their highest levels in 3 million years. The UN says this has driven a global temperature increase of 0.85 degrees Celsius between 1880 to 2012, and a rise in average sea levels of 19cm.⁵ NASA has seen the minimum average area covered by Arctic sea ice each year almost halve since 1979.⁶ Most of the results of climate change will continue for centuries, even if we stopped emissions tomorrow. Resulting stresses on natural resources will have consequences far beyond the environment, likely giving rise to broader social instability and conflict concerns.

Over the last year more and more governments have committed to 'Net Zero' — which means stopping most greenhouse gas emissions completely, with mitigation measures to cancel the effects of those remaining. It is the world's greatest common challenge, requiring an unprecedented alignment of human effort from individuals, businesses and governments.

Agreements to cut emissions and reach Net Zero are made at a national level and all countries have a role to play. This is recognized by the 2015 Paris Agreement, ratified by 186 countries and territories, which aims to keep global temperature rises this century well below 2 degrees Celsius and try to limit them to 1.5 degrees.

KPMG has produced this first Net Zero Readiness Index in order to assess 32 countries' progress towards reaching Net Zero. While we cannot underplay the phenomenal effort that lies before us, there are grounds for optimism, with nine of these countries having set a Net Zero target in

law and 10 more having stated a target. The majority of the countries in this research have reduced emissions between 2005 and 2018, many by significant amounts.

Unfortunately, notwithstanding this progress, the world as a whole has not only failed in the last 5 years to reduce emissions, they have actually increased. The scale of the challenge can therefore seem daunting, but as Christiana Figueres, former Executive Secretary of the UN Framework Convention on Climate Change, argues, we have a collective responsibility to focus optimistically on how society will solve this problem rather than be overwhelmed by it.⁷

KPMG has ranked countries on their preparedness and ability to reach Net Zero by 2050, and provided insights into the strategies being adopted that are working well. The hope from this is that other countries can learn, copy and adapt their own roadmaps to Net Zero.

Progress is rapid, with new technology solutions, market and policy mechanisms and consumer behaviors emerging every day. KPMG expects many new commitments and initiatives in advance of COP26, in Glasgow in November. The faster this report is out of date, the happier we will be.

Ultimately, the climate challenge can only be met if society as a whole changes behaviors. Although not all countries are equally responsible for the problem, and consequences will vary, as with COVID-19, no one and no country is safe until the world is safe. It is vital that every country does everything it can to contribute. It demands that individuals, organizations and countries collaborate to an unprecedented degree, and act transparently and honestly.

KPMG hopes that the NZRI can help provide some of the transparency and honesty needed, and spur the collaboration required to take the world all the way to Net Zero.



Richard Threlfall

Partner,
Global Head of KPMG IMPACT
and Global Head of Infrastructure,
KPMG International



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Source: KPMG International (2021)

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India

Heavily investing in renewables with 100 gigawatts (GW) installed to date, and strong government action in industry, and agriculture and forestry.

Indonesia

Strong potential for renewable energy, particularly in geothermal generation.

Nigeria

Investing efforts to tie emission reduction initiatives into economic recovery plans.

Russia

Large areas of forest cover provide significant opportunity to create natural carbon sinks.

Saudi Arabia

Leveraging economic opportunity to drive energy transition through mega projects.

South Africa

Electricity sector has started its decarbonization journey with other sectors expected to follow suit.

Thailand

Started sector level intervention, including green industry standards, public transport and electric vehicle (EV) manufacturing capacity.



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Top six countries

Six European countries are the clear leaders in the first NZRI. Each of these countries has already significantly cut emissions and each has announced a Net Zero target date. They are exploring innovative ways to meet their goals, but all have significant challenges to solve.

1st Norway

Net Zero target date: 2030 (carbon neutrality)

Rankings

- 3rd for national preparedness
 - 1st for policies and enabling environment
- 1st for overall sector score
 - 1st for transport sector
 - 2nd for industry

Strengths

- A major renewable generator that exports electricity to neighboring countries.
- A world leader in adopting electric vehicles as a result of tax incentives and ban on sale of combustion engines.
- Highest number of clean technology companies in the industry sector, and highest investment and planned capacity of carbon capture and storage.

Challenges

- Geographic dispersion and broader environmental concerns may limit growth in renewables capacity.
- Historical economic reliance on oil exports.

2nd United Kingdom

Net Zero target date: 2050

Rankings

- 1st for national preparedness
 - 2nd for policies and enabling environment
- 2nd for overall sector score
 - 2nd for electricity and heat sector
 - 3rd for industry sector

Strengths

- Political consensus and clear policy framework, including an independent Committee on Climate Change.
- Power sector largely decarbonized with coal generation planned to end in 2024.
- Mandatory building energy certification and large retrofit market size.

Challenges

- Millions of homes will need replacements for gas-fired boilers and better insulation, with no firm plan for this.
- Politicians have not yet engaged with citizens about lifestyle changes that Net Zero is likely to require.

3rd Sweden

Net Zero target date: 2045

Rankings

- 2nd for national preparedness
 - 1st for performance on emissions intensity of GDP
- 6th for overall sector score
 - 1st for buildings sector
 - 2nd for transport sector

Strengths

- In 2017, Sweden became the first country to set a legally binding Net Zero target, with government, industry and many people committed.
- All electricity already comes from low-carbon sources, and the country aims to make its transport sector free of fossil fuels by 2030.
- New construction increasingly uses wood and there is a focus on energy efficiency in buildings.

Challenges

- Despite some world-leading companies, other private sector organizations are moving more slowly.
- Previous experience suggests incentives and price signals may be needed to change individual behavior.



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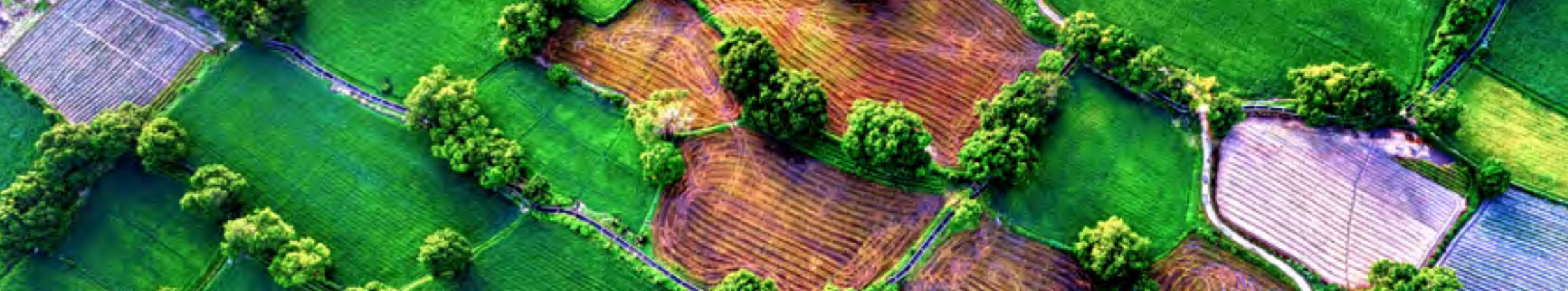
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4th Denmark

Net Zero target date: 2050

Rankings

- 4th for national preparedness
 - 2nd for performance on emissions intensity of GDP
- 5th for overall sector score
 - 1st for electricity and heat sector
 - 5th for industry sector

Strengths

- Denmark has an annual parliamentary vote on climate strategy, introduced following a national petition.
- Most electricity is already produced from renewable sources and has the highest number of clean energy companies per capita.
- It is planning an artificial 'energy island' in the North Sea to generate offshore wind with private sector expertise.

Challenges

- Large pork and dairy sectors contribute to agriculture, land use and forestry generating almost a quarter of the country's greenhouse gases.
- Imported emissions from goods produced overseas, including agricultural produce and items that may support deforestation.

5th Germany

Net Zero target date: 2045

Rankings

- 7th for national preparedness
- 3rd for overall sector score
 - 3rd for transport sector
 - 4th for industry sector

Strengths

- Popularity of the country's Green Party has contributed to most parties adopting strong environmental positions.
- Industrial companies are researching ways to decarbonize, such as using green hydrogen to make steel.
- Government support for electric vehicle ownership and charging legislation.

Challenges

- Decision to phase out nuclear power means electricity production from coal will have to continue for longer to plug a resulting energy gap.
- Wind generation off northern coasts will require strengthened electricity grid to middle and south of country.

6th France

Net Zero target date: 2050

Rankings

- 5th for national preparedness
 - 3rd for policies and enabling environment
- 8th for overall sector score
 - 5th for electricity and heat sector

Strengths

- Government has tried new ways to collaborate on policy development, including a citizens' convention of 150 randomly chosen people.
- Nuclear energy and renewables, including offshore wind mean 91 percent of electricity is low carbon.
- One of the first European countries to develop a national clean hydrogen strategy.

Challenges

- Strong opposition to increased vehicle fuel taxes from suburban and rural 'gilets jaunes' protest movement.
- Needs to further develop carbon offset market through work with the private sector and potentially the EU.



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NZRI key observations

1. Countries are lagging in adopting Net Zero targets and signing them into law.

The 32 countries in the NZRI are responsible for around three-quarters of global emissions. Only nine of them have so far made binding Net Zero commitments under their national laws that place legal obligations on their governments to deliver. These nine countries — Canada, Denmark, France, Germany, Hungary, Japan, New Zealand, Sweden and the UK — together account for only around 8 percent of global emissions.

Another 10 countries in the Index, accounting for 43 percent of global emissions, have set Net Zero targets in policy documents or political pledges, but have not implemented any legal mechanisms that require their governments to achieve them. Such targets are therefore better considered as intentions rather than commitments.

The remaining 13 countries in the Index, accounting for 24 percent of global emissions, have not yet adopted any form of national Net Zero target.



Given the urgency and scale of the Net Zero challenge, the slow pace of countries adopting legally binding targets is deeply concerning.

Richard Threlfall

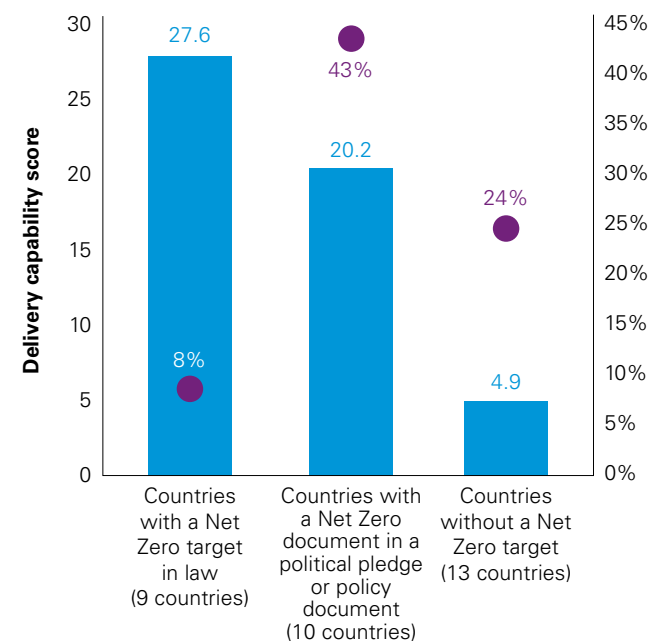
Global Head of KPMG IMPACT and Global Head of Infrastructure, KPMG International

“The private and financial sectors are the engine of low-carbon growth and they are crying out for clarity and certainty in government Net Zero policies. Adopting legally binding Net Zero targets is the best way for governments to send a clear policy signal and kick start the cleaner, greener economies the world so urgently needs.”

2. A lack of delivery capability is the weak point in global Net Zero ambitions.

Delivery capability is one of the key measures in the Index and reflects low-carbon market activity across the five sectors, such as green technology patents, clean technology companies and innovation rates (see Figure 1). KPMG’s analysis reveals that Net Zero delivery capability is largely lacking in many countries, including some high-income countries. However, it is worth noting that countries with a Net Zero target, legally binding or in policy, demonstrate stronger delivery capability across the sectors.

Figure 1: Average delivery capability by Net Zero commitment status



■ Average delivery capability

● Share of global emissions (secondary axis)

Source: KPMG International (2021)



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More than half of the countries in the Index have near zero scores for patents and clean technology companies. Additionally, a majority of countries are struggling to develop sizeable sector-specific clean technology markets.

The ratio of renewable energy development to fossil fuels remains low in many countries while in transport, many countries are lagging on investment in public transport and electric vehicle charging infrastructure. Markets for energy efficient building retrofitting remain small across much of the Index.

In industry, only a few countries have developed plans for low-carbon industrial clusters that bring together complementary technologies such as combining biogas or hydrogen production with carbon capture infrastructure. However, technologies such as wind energy, solar energy, electric vehicles and battery storage have achieved commercial maturity in some countries, demonstrating that support mechanisms that stimulate demand can result in self-sustaining markets. Such mechanisms include infrastructure discounted loans, risk mitigation mechanisms and direct grants. As projects from these plans come to market, there will be a need for increased investment from the financial sector and enhanced risk mitigation by energy system stakeholders.

Norway, Denmark and the UK lead the field for Net Zero delivery capability when averaged out across the five sectors:

- Norway’s strong performance in Net Zero delivery capability is a result of its leadership in investment into public transport, the size of its electric vehicle charging market and its well-developed plans for low-carbon industrial clusters. It is also one of the global leaders in clean technology companies in the electricity and heat, industry, agriculture, land use and forestry, and transport sectors.

- Denmark has the highest number of clean energy companies relative to its population, the second highest number of clean transport companies and the fourth highest number of clean technology companies in agriculture, land use and forestry. Denmark also ranks second in the Index for its per capita infrastructure investment, indicating a strong momentum on investment in public transport.
- The UK has the highest score in the Index for the ratio of clean energy projects to fossil fuel projects. It is also a strong performer on investing in public transport, energy efficient retrofitting of buildings and low-carbon industrial clusters.

Other countries that score well for delivery capability are Japan, the global leader in clean transport and industrial decarbonization patents per capita, and South Korea, which leads in patents related to clean electricity and heat, and building energy efficiency.

“The current lack of delivery capability in 80 percent of the countries analyzed in our Index could be an Achilles’ heel for the global transition to Net Zero,” says Threlfall. “Whatever ambitions governments might have and whatever commitments they might make, they simply cannot achieve Net Zero if the delivery capability is not there.”

“That’s why it’s critical for governments to focus on supporting the clean tech businesses required

to deliver emissions reduction. This means spurring investment in research and development, providing support mechanisms for early stage innovation by small and medium-sized enterprises and creating markets for low-carbon products and services among other initiatives.”

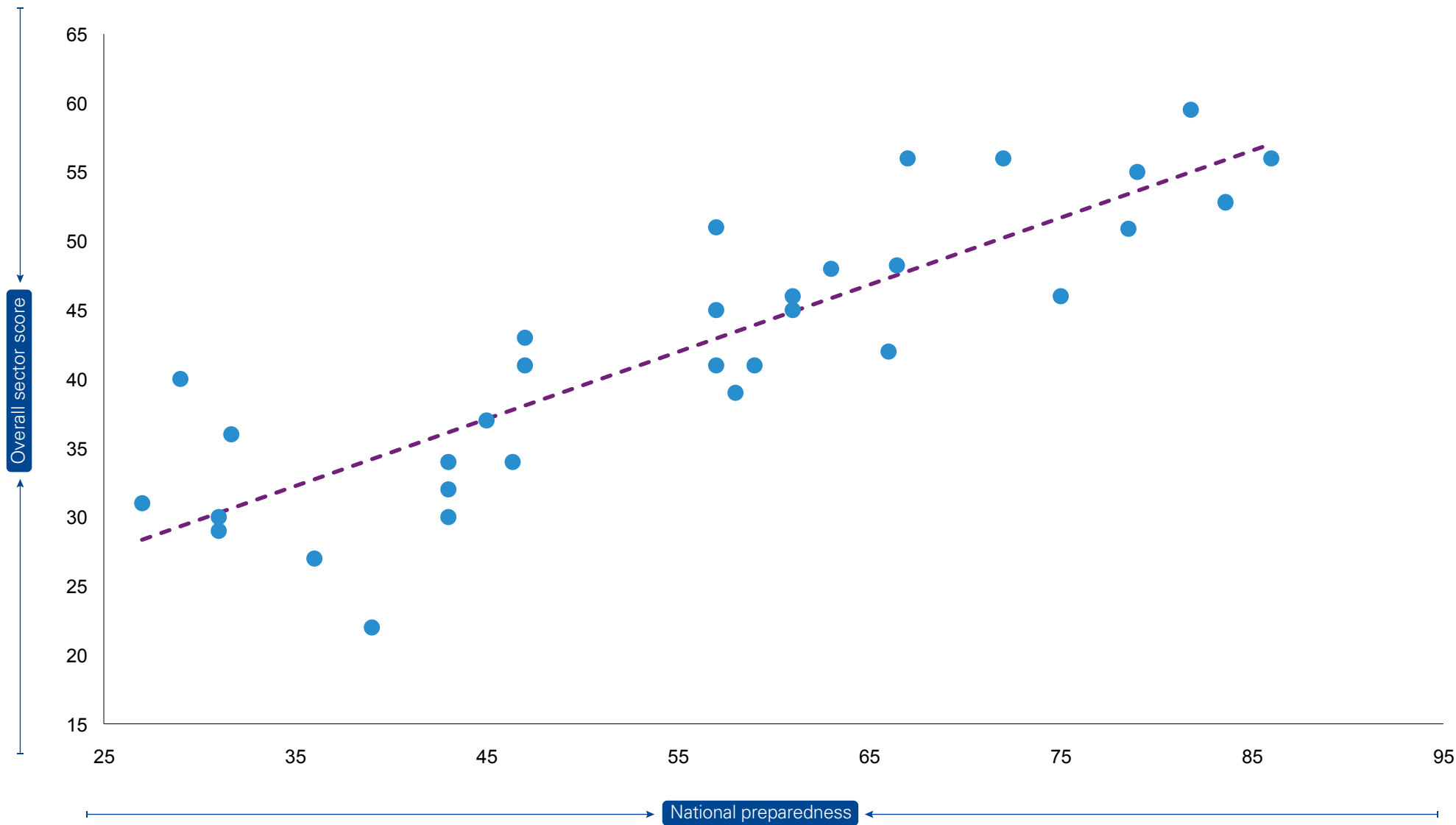
3. National preparedness is largely mirrored in sector readiness.

The Index gives countries a national preparedness score based on its national commitments to decarbonize, its past decarbonization performance, and the national enabling environment for decarbonization.

It shows that, in most countries, the level of Net Zero preparedness on the national level is mirrored by the level of readiness in the five key sectors of electricity and heat, industry, transport, buildings, and agriculture, land use and forestry (see Figure 2 on page 13). Countries that score well on a national level also score well on a sectoral level, while countries that score less well for national preparedness also score less well for sector readiness. This relationship makes intuitive sense given that what happens, or does not happen, at a national level can be expected to have a strong influence on progress, or lack of progress, at a sectoral level.



Figure 2: Overall sector score versus national preparedness



Source: KPMG International (2021)

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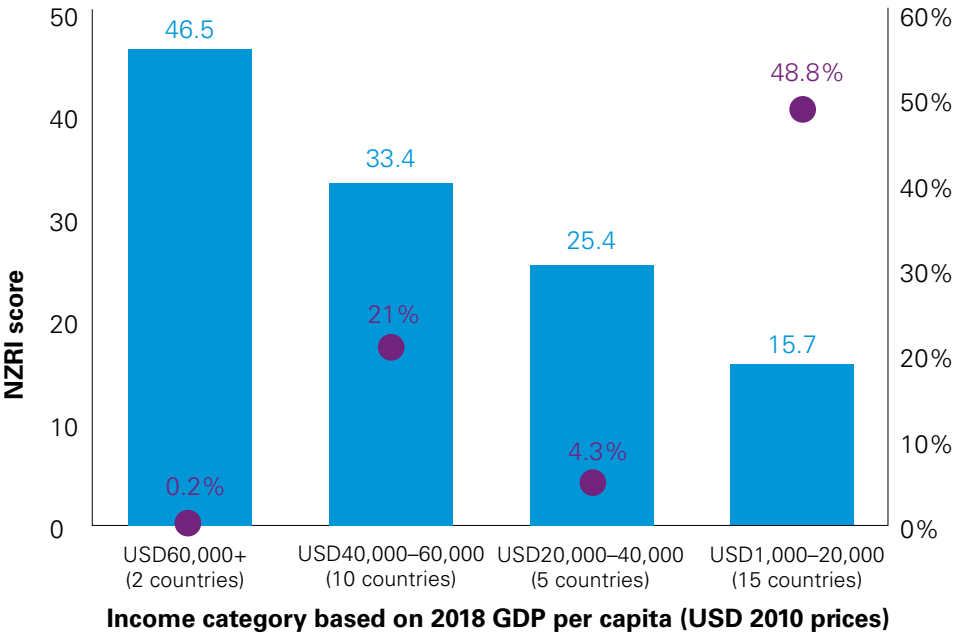
4. Readiness to achieve Net Zero is linked to prosperity.

The Index shows a clear correlation between national preparedness to achieve Net Zero and economic prosperity (see Figure 3 below). Countries with high GDP per capita score higher on the Index, while the countries at the lower end have lower GDP per capita.

There are 15 countries whose GDP per capita falls between USD1,000–20,000 who account for almost half of global emissions. It is therefore critical that higher income countries that have made progress on decarbonization support these 15 countries in improving their Net Zero readiness.

Our analysis also showed four high GDP countries who achieve relatively low scores on the Index. This suggests that while some countries may have the economic muscle in place to improve their Net Zero readiness, they have yet to fully flex these muscles.

Figure 3: Average Net Zero Readiness Index by income group



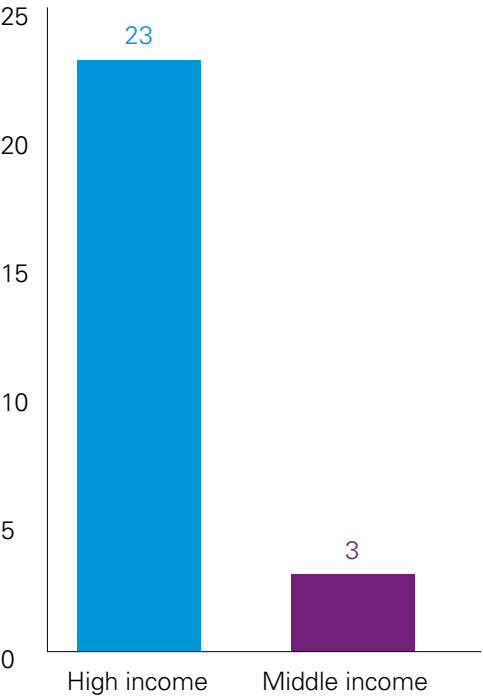
Sources: KPMG International (2021); World Bank (2021)



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Unsurprisingly, the Index also shows that a country's Net Zero delivery capability is directly correlated to its economic prosperity. As Figure 4 below shows, the average Index score for delivery capability among high income countries is some seven times higher than among middle-income countries.⁸ This highlights an acute global challenge in terms of how to improve Net Zero delivery capability beyond the richest countries in the world, especially given that the middle-income countries in the Index account for 48 percent of global emissions.

Figure 4: Average delivery capability score by income group



Sources: KPMG International (2021); World Bank (2021)

Increased mobilization of climate finance will continue to help middle-income countries to drive decarbonization. Mikaela McQuade, Director, Energy, Climate and Resources, Eurasia Group, says that capital can be unleashed by using Article 6 of the Paris Agreement, through which parties can cooperate on achieving their respective nationally determined contributions by developing and trading internationally transferred mitigation outcomes. “The investments and flows of knowledge, information and technologies from advanced economies to the middle-income countries, many of which have burgeoning climate policy frameworks, can drive cost-effective emissions mitigation globally,” she says.

Private commitments have also spurred a frenzy of offset projects and market speculation, development and investment. As more corporate entities and investors commit to achieving Net Zero emissions by 2050, the demand for carbon offsets is rapidly

escalating. As Mark Carney, UN Special Envoy on Climate Action and Finance and Head of the Taskforce on Scaling Voluntary Carbon Markets, said in November 2020, “the most cost-effective of these, with the biggest emission reduction potential, are in developing and emerging economies.”⁹

McQuade warns that a narrow focus on climate by investors could exacerbate the development and Net Zero readiness gaps between advanced and emerging economies. A bias has developed in the assessment of countries’ ESG scores, with about 90 percent of these determined by its level of development. Between this assessment and an increasing integration of climate change resilience and readiness — both of which are lower in the developing world — into sovereign creditworthiness, there is a high and growing risk of capital being diverted to wealthy nations from those lower- and middle-income countries that need it most.



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Ultimately, the key to achieving Net Zero lies in collaboration between the public, private and financial sectors, supported by public opinion and behavior change. Compiling the KPMG Net Zero Readiness Index has involved speaking to a wide range of KPMG specialists working at an international level as well as in each of the 32 countries covered by the Index. The following insights on global Net Zero transition are based on their observations.

1 Setting a Net Zero target is only the first step.

It is also critical for governments to clearly set out strategies and actions through which they intend to deliver their Net Zero ambitions, including milestones and interim reduction targets, as well as economy-wide mechanisms such as carbon taxes and emissions trading. Businesses require clear plans, policies and support mechanisms from government in order to stimulate delivery capability at sector level.

Some countries already have detailed plans to reach Net Zero and look likely to meet their targets. The unprecedentedly fast development of COVID-19 vaccines shows what scientifically based research and development can achieve when the urgency of a global crisis is understood and acted upon.

2 Governments need to harness the power of the financial markets to deliver Net Zero.

Investors and banks are increasingly factoring climate risk and Net Zero transition into their investment and lending decisions, and there is escalating growth in climate-related financial products such as green and climate funds, bonds and blended instruments that are moving capital into clean energy, mobility and industry.

Governments can enhance access to such financing by creating enabling environments such as sustainable

finance strategies, policies and regulatory frameworks. Carbon pricing and support systems for clean investments tell the financial sector that a country is committed to global climate efforts, while a robust national project pipeline that considers climate risks and opportunities will further attract investor interest.

3 Introducing mandatory reporting for businesses will help to accelerate Net Zero transition.

Corporate transparency on emissions, climate-related financial risk and readiness for Net Zero transition is essential to spur private sector innovation and harness the power of the financial sector. Making such disclosures mandatory, as the UK and New Zealand have done with the Taskforce on Climate-related Financial Disclosures (TCFD) recommendations, accelerates the availability of the data investors and lenders rely on to make greener investment and lending decisions.

4 Political alignment and collaboration at all levels is powerful.

EU policies have shown how supra-national alignment can advance decarbonization across jurisdictions, driving up collective readiness for Net Zero. Although other trading blocs require less integration than the EU, their co-operative structures may offer opportunities



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to deepen Net Zero collaboration between multiple member states with for example the Association of Southeast Asian Nations working with the UK government in this area.¹⁰

Many countries are missing the opportunity to align Net Zero action at national and sub-national levels. States and cities are often more agile than national governments and can foster innovation and skills that can then support national decarbonization strategies. Research for the NZRI identified a number of examples of progressive state- or city-level decarbonization projects and initiatives that could act as incubators for national efforts. While there may be geographical or political hurdles to be overcome in converting sub-national projects into national ones, the potential is there.

5 Building public support for climate action should be a key focus for governments.

As public concern mounts over the effects of climate change, support for climate action is increasing around the world, building pressure on the public, private and financial sectors. However, opposition remains. For example, objections to renewable energy projects based on visual and local environmental impacts or lack of trust have delayed and, in some cases, undermined political will. Net Zero measures, therefore, should clearly communicate benefits to the public, such as highlighting the lower pollution levels of electric vehicles and the health benefits of eating less meat.

Some Net Zero efforts require a particularly strong push to change consumer behavior. Agriculture, for example, remains a politically sensitive sector with some governments holding back on targeted policies such as the reduction of methane emissions from livestock. While some jurisdictions have introduced health-related taxes on products, including cigarettes and sugar, governments have yet to apply such disincentives to high-emission food products like meat and dairy. Policymakers can

apply lessons from energy sector decarbonization efforts to start nudging the agriculture sector and consumers toward lower carbon dietary choices.












At the same time, policymakers must ensure that emissions-based disincentives do not unfairly disadvantage low- and middle-income consumers. Pairing disincentives with incentives can be effective, such as combining a ban on petrol and diesel vehicles with subsidies that make electric alternatives cheaper. Governments must also tackle employment uncertainty for workers in high-carbon sectors, such as fossil fuels and conventional vehicles, through initiatives that protect jobs and create green employment opportunities.

6 Ongoing geopolitical tensions have the potential to turn Net Zero into an arena of climate competition, rather than cooperation.

Some of the world’s largest economies are scrambling to become the most consequential actors in the next generation of global supply chains as the new world of energy takes shape. Coordination around global climate ambition is certainly necessary, and COP26 is positioned to become the focal point for these overtures. However, the global reaction to the EU’s proposed carbon border adjustment mechanism may not be the only clash over protectionism between campaigners looking to meet ambitions in what they see as an equitable way, and those looking to protect their carbon intensive assets and related jobs from international pressure and competition.

With sweeping regulation, investment and incentives, heightened state interest is likely to drive welcome developments in Net Zero industries. But if climate becomes the next technology race, along the lines of previous space and arms races, progress will likely be unequal. This may generate risks and costs for companies and investors trying to navigate an unclear, inconsistent and protectionist policy landscape.



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While several countries have made progress in decarbonizing electricity and heat, there is a high degree of variability compared with other sectors in the NZRI. Improvements in access to electricity, a key sustainable development indicator and enabler of energy systems decarbonization, is evident across the NZRI countries with most already at 100 percent, and 90 percent of the world’s population having access to electricity in 2019.¹¹ This means fewer countries are held back by concerns about basic energy security, which enables more investment into renewable energy, energy networks and resilience. While intermittency of renewables could be challenging in some countries, the last decade has seen technological development and commercialization of various energy storage technologies that can improve resilience. Investors are keen to support clean energy projects, but governments need to continue providing support mechanisms and expanding project pipelines.

The UN International Panel on Climate Change assessment report, published in 2014, recommended the use of natural gas as a transition fuel to assist in shifting away from coal and oil. This transitional role of natural gas in power generation, as well as other sectors is projected to continue until at least 2025.

Delivery capability

The top five countries in the Index for electricity and heat have all invested strongly in delivery capability. Examples include significant planned grid investment in Chile, a robust set of clean energy infrastructure projects in the UK and active clean technology markets in Denmark.

The world has made substantial progress on decarbonizing electricity generation over recent years, but there is still much more that needs to be done. Mike Hayes, KPMG IMPACT Global Climate Change and Decarbonization Lead, KPMG in Ireland, says that European countries will need to quadruple renewable generation over the next 10–15 years.



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This will be needed to replace remaining power generation that generates greenhouse gases, but also to serve rising new demand for green electricity from sectors including transport and industry and to help catalyze the emerging green hydrogen industry. “There is no point having electric cars driven with electricity sourced from fossil fuels,” says Hayes.

This expansion is expected across all forms of renewable generation. For offshore wind, as well as adding to the fleet of turbines fixed to the seabed, operators will introduce floating units that can work in deep water, allowing new areas of ocean to be used for power generation. Hayes also expects expanded use of solar power and renewed interest in wave and tidal power over the next decade. The UK, ranked second for electricity and heat, is considered a world leader in the tidal power market, an area with exciting potential.

The NZRI highlights a lack of planned investment in grid infrastructure. This will have to change says Hayes, as connecting new power sources to consumers and coping with greatly increased capacity will require substantial investment.

Government action

The countries ranking highest in electricity and heat also score well on government action. Many are implementing mechanisms including mid-term renewable energy targets, renewable obligations for utilities, tradeable renewables certificates, net metering that allows consumers to sell power back to the grid, low-carbon hydrogen strategies and support mechanisms. Government intervention will be required in some countries to make it easier for companies to buy power specifically from renewable sources to support them in moving to Net Zero, by making regulatory and legal changes. Hayes says the regulatory environment is increasingly supportive, with July 2021’s European Green Deal raising the EU’s 2030 target for renewable electricity from 32 percent of all generation to 40 percent, compared with around 20 percent now.

Heating is less decarbonized than electricity and will need focused attention over the coming decade, Hayes says. Unlike electricity, much heat generation currently takes place in people’s homes through burning fossil fuels. Alternatives including electrically

operated heat pumps are expensive to install and green hydrogen is currently uncompetitive on price.

The NZRI shows that incentivization and support mechanisms are currently under-used by countries, but Hayes believes governments will have to intervene: “Government intervention has helped to foster renewable energy through support and tariffs. More will have to be done to foster the decarbonization of heat.”

The Index results show a clear interdependence between delivery capability and supporting policy mechanisms to escalate the rollout of renewable energy. On both electricity and heat decarbonization, governments should look at lowering barriers for project developers, such as making it easier and quicker to obtain planning permissions and connect to power grids. There is an abundance of capital to fund such work. Hayes adds: “If you free up the regulatory barriers, investors will flow in. Shortage of projects is the issue.”

“Denmark’s score reflects a combination of high long-term ambitions and focused short-term actions. This has given Denmark a high penetration of renewable energy in electricity and heat production, and stimulated industrial leadership in green technology.”

Mads Fink-Jensen
Partner, ESG Lead
KPMG in Denmark

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Sector league table — Electricity and heat

Country	Share in national emissions	Sector readiness	Decarbonization status	Government action	Delivery capability
Denmark	25%				
UK	25%				
Chile	33%				
Sweden	19%				
France	15%				
New Zealand	8%				
Norway	32%				
Canada	28%				
Germany	39%				
South Korea	53%				
US	36%				
Spain	29%				
Italy	30%				
Japan	48%				
Singapore	41%				
Australia	36%				
Hungary	23%				
Brazil	7%				
Poland	41%				
Mexico	30%				
Argentina	17%				
China	43%				
Malaysia	34%				
Turkey	33%				
UAE	30%				



Source: KPMG International (2021)

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While there are some front runners in the race to decarbonize transportation, the NZRI shows that the majority of governments have not yet set clear dates to ban the sale of vehicles with internal combustion engines, or are struggling with the political and economic implications of such actions. The research also finds a low share of domestic travel taking place by rail and insufficient adoption of electric vehicles, the latter resulting from a lack of government incentives and poor availability of electric charging infrastructure.

Norway is leading the charge on decarbonizing transport. The country, which has set a date to ban the sale of combustion engines, is also prioritizing incentives for adopting electric vehicles while making significant investments in public transport. But although it has a good-sized charging infrastructure market, it is struggling to meet the demand for charging stations, highlighting the importance of the availability of supporting infrastructure in decarbonization efforts.

Public transport and trip-sharing

China, which ranks fourth in the transport sector, is the only country where rail makes up the clear majority of domestic travel measured by distance, suggesting a need for many countries to invest more heavily in public transport. In addition to developing its availability, governments will need to take further steps to subsidize public transport fares to encourage use. The connectivity of rural areas plays another important role in this aspect, being the major area still reliant on individual mobility rather than public transport.

Steffen Wagner, Global Head of Transport & Logistics, KPMG in Germany, says a decisive change would be to persuade car users to share trips and vehicles. “The public sector needs to provide the platform, as no one else is likely to do this, as well as incentives,” he says.

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Top five countries in transport decarbonization readiness



China, which scores the highest for shared vehicle use in the Index, implemented incentive mechanisms for car sharing back in 2017, and has developed large-scale domestic ride sharing companies. More recently, the German cities of Hanover and Hamburg have worked to set up such services, including a program with MOIA, a subsidiary of Volkswagen Group, which uses electric vehicles and targets a specific niche in public transport between shared taxi and bus rides.¹²

Electric vehicles

Countries will need to stop, or at least limit, the use of internal combustion engines in cars, but 18 of the 32 countries in the Index have not yet set dates to end sales of such vehicles. Wagner says there are also challenges involved in scaling up and standardizing the charging infrastructure needed for electric vehicles.

Except in Norway, national adoption rates for electric vehicles are very low, although China has the largest electric vehicle fleet by size and is investing heavily in both vehicle and battery production. Globally, slow adoption can in part be put down to a lack of sufficient charging infrastructure and too few incentive mechanisms. There are lessons to be learned from Norway which has used tax, parking and toll fee exemptions to encourage adoption, as well being early to fund municipal electric vehicle charging

infrastructure. Other road vehicles, trains and ferries also need to be decarbonized, with some requiring alternative technologies to electrical batteries such as green hydrogen.

As well as decarbonizing vehicles, freight providers need to adopt greater transparency. At present, a consignment may be handled by a number of different operators, making it difficult to assess total emissions. Some companies are pioneering decarbonized deliveries, including Deutsche Post DHL's development of its own electric StreetScooter vehicles¹³ and Holland Shipyards Group retrofitting hydrogen fuel cells in a vessel used to transport containers between Rotterdam and Antwerp.¹⁴ Governments have a role to play, too and in June 2021, Switzerland's Council of States approved the development of Cargo sous terrain, a new national delivery system for smaller items that will use tunnels and electric vehicles to connect distribution centers to cities.¹⁵

Active mobility

Governments also need to encourage people to walk and cycle more, particularly in compact and well-planned towns and cities. Wagner says that urban planning is a key tool in achieving this, pointing to the Danish capital Copenhagen's comprehensive network of cycle paths that are physically separated from roads

and have redesigned intersections to make these safer for cycling. As a result of these and other measures, in 2018, 28 percent of all journeys in the city were made by bicycle, rising to 49 percent of commuter trips for work or study.¹⁶ This development is not only limited to end-consumer traffic. It also holds considerable potential for urban last mile freight services using electrically assisted cargo bikes and makes use of a more localized micro-hub infrastructure for their distribution networks.

But many cities face challenges in this area, including long journey distances resulting from low density development, lack of existing sidewalks for pedestrians and residents who are used to driving rather than using public transport. Local opposition to reallocating road space from cars to bicycles can also make it hard to build such infrastructure, meaning governments will need to work to convince people of the potential benefits. The intelligent use of road space as a public space will play a crucial role in combined traffic of the future, with the goal to reduce carbon emissions. This goal can only be attained, if an integrated approach is chosen and if governments take deliberate action to turn visions into reality.

“The success of introducing electric vehicles into the Norwegian market and their popularity is in many ways driven by using carrots rather than sticks, by making electric vehicles more attractive through lower taxes and fees. In upcoming years, the change from fossil fuels to electricity in the transport sector will require large investments in energy infrastructure throughout the country.”

Johanne Solum Ness
Senior Associate
KPMG in Norway

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Sector league table — Transport

Country	Share in national emissions	Sector readiness	Decarbonization status	Government action	Delivery capability
Norway	27%	<div><div></div></div>	<div><div></div></div>	<div><div></div></div>	<div><div></div></div>
Sweden	36%	<div><div></div></div>	<div><div></div></div>	<div><div></div></div>	<div><div></div></div>
Germany	20%	<div><div></div></div>	<div><div></div></div>	<div><div></div></div>	<div><div></div></div>
China	8%	<div><div></div></div>	<div><div></div></div>	<div><div></div></div>	<div><div></div></div>
South Korea	14%	<div><div></div></div>	<div><div></div></div>	<div><div></div></div>	<div><div></div></div>
Denmark	28%	<div><div></div></div>	<div><div></div></div>	<div><div></div></div>	<div><div></div></div>
France	31%	<div><div></div></div>	<div><div></div></div>	<div><div></div></div>	<div><div></div></div>
Singapore	11%	<div><div></div></div>	<div><div></div></div>	<div><div></div></div>	<div><div></div></div>
UK	28%	<div><div></div></div>	<div><div></div></div>	<div><div></div></div>	<div><div></div></div>
Japan	17%	<div><div></div></div>	<div><div></div></div>	<div><div></div></div>	<div><div></div></div>
Spain	29%	<div><div></div></div>	<div><div></div></div>	<div><div></div></div>	<div><div></div></div>
Brazil	14%	<div><div></div></div>	<div><div></div></div>	<div><div></div></div>	<div><div></div></div>
US	30%	<div><div></div></div>	<div><div></div></div>	<div><div></div></div>	<div><div></div></div>
Poland	17%	<div><div></div></div>	<div><div></div></div>	<div><div></div></div>	<div><div></div></div>
Italy	26%	<div><div></div></div>	<div><div></div></div>	<div><div></div></div>	<div><div></div></div>
Canada	26%	<div><div></div></div>	<div><div></div></div>	<div><div></div></div>	<div><div></div></div>
Argentina	13%	<div><div></div></div>	<div><div></div></div>	<div><div></div></div>	<div><div></div></div>
Hungary	23%	<div><div></div></div>	<div><div></div></div>	<div><div></div></div>	<div><div></div></div>
Malaysia	17%	<div><div></div></div>	<div><div></div></div>	<div><div></div></div>	<div><div></div></div>
Australia	16%	<div><div></div></div>	<div><div></div></div>	<div><div></div></div>	<div><div></div></div>
UAE	16%	<div><div></div></div>	<div><div></div></div>	<div><div></div></div>	<div><div></div></div>
Mexico	24%	<div><div></div></div>	<div><div></div></div>	<div><div></div></div>	<div><div></div></div>
New Zealand	21%	<div><div></div></div>	<div><div></div></div>	<div><div></div></div>	<div><div></div></div>
Turkey	17%	<div><div></div></div>	<div><div></div></div>	<div><div></div></div>	<div><div></div></div>
Chile	27%	<div><div></div></div>	<div><div></div></div>	<div><div></div></div>	<div><div></div></div>

Source: KPMG International (2021)



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The buildings sector sees relatively low levels of variability in decarbonization readiness between countries. This is due to consistent policy responses to building energy efficiency and continuing efforts to encourage the spread of green buildings. On average, the countries in the NZRI perform better on policies for low energy new buildings than on retrofitting existing buildings.

Overall, efforts to decarbonize buildings look inadequate as extreme weather events are increasing demand for electricity and driving growth in the sector's energy consumption. Emissions from buildings plateaued between 2013 and 2016, but both direct and indirect emissions from buildings have since increased. This is due to increased demand for both heating and cooling which has occurred despite a reduction in emissions intensity measured by energy use per square meter of floor space. Extreme heat in 2019, which was the second hottest year on record, was partially responsible for higher electricity requirements that year.

As climate scientists expect extreme weather events to become more frequent in future, the energy efficiency of buildings will need to improve faster. Further, buildings need to be climate risk resilient as assets for both households and businesses. The climate risk resilience of the buildings sector is also closely tied to the resilience of the energy system, particularly for electricity and commercial heating.

Retrofitting challenges

The majority of countries in the NZRI support policies for retrofitting existing buildings, but for many this remains a huge challenge to their decarbonization efforts. The Index highlights the strong need for investment in delivery with all countries except the UK having underdeveloped retrofit markets. Inertia, capital cost and lack of awareness of benefits are among the factors that slow the decarbonization of



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Top five countries in buildings decarbonization readiness



existing buildings, even though improving energy efficiency usually saves money as well as emissions. Anvesha Thakker, Global Co-Head of Climate Change and Decarbonization, KPMG in India says: “Other than energy efficiency measures, solutions to decarbonize such as on-site solar or solar with battery solutions need to be explored. If space is a constraint, subject to regulations, off-site renewable energy procurement solutions are also often available and can be explored.”

Mike Hayes says that organizations often fail to consider the option of improving existing buildings. He adds that such work can be beset by arguments between landlords and tenants and that accounting rules can lead to energy efficiency projects ending up on organizations’ balance sheets unintentionally.

Government action

New construction needs to be regulated so it is built smart, green and efficient. The International Energy Agency calculates that new high performance construction will need to increase from around 275 million square meters to cover almost 5 billion square meters to support the organization’s 2030 Sustainable Development Scenario.¹⁷ The higher costs involved make it unlikely that market forces alone will deliver these.

The NZRI shows governments in 23 of the 32 countries prioritizing energy efficiency by implementing mandatory building energy certification. However, only Canada and Japan have substantial coverage of building sector emissions included in their UN climate change nationally determined contributions, a mechanism that the Global Alliance for Building and Construction sees as crucial to encourage faster and more ambitious large-scale action along with long-term strategies and regulatory measures.¹⁸

Delivery capability

The green buildings market across the countries in the Index is in its infancy. But Japan and South Korea, which are placed second and third overall in the buildings sector, are both actively developing building energy efficiency and carbon management solutions.

Hayes says that projects will increasingly need to be built to high environmental standards to attract high-quality corporate tenants, by providing access to green power including integrated solar or hydrogen fuel cells. Companies planning foreign direct investment, particularly those with heavy power needs such as data centers, are likely to increasingly insist upon such access: “It is critical for any country adopting a meaningful direct investment program that they can guarantee renewable energy for those companies,” he says.



“We have for a long time seen a high interest in sustainability issues within real estate in Sweden, and have had success, particularly with new buildings prioritizing energy efficiency and the increasing use of wood rather than concrete. Refurbishing existing buildings is more difficult in the face of increasing extreme weather conditions.”

Torbjörn Westman
Partner, KPMG in Sweden

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Sector league table — Buildings

Country	Share in national emissions	Sector readiness	Decarbonization status	Government action	Delivery capability
Sweden	3%				
Japan	9%				
South Korea	7%				
UK	20%				
Germany	15%				
Denmark	6%				
France	16%				
Norway	3%				
Italy	17%				
Hungary	17%				
Poland	11%				
Spain	8%				
Turkey	10%				
UAE	0%				
Canada	10%				
US	9%				
China	4%				
Singapore	1%				
New Zealand	2%				
Mexico	3%				
Brazil	2%				
Chile	6%				
Argentina	8%				
Australia	2%				
Malaysia	1%				



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Industry is the sector on which the NZRI's 32 countries have the highest degree of variability, across decarbonization progress, government action and delivery capability. Direct industrial emissions have plateaued since 2021, with a modest reduction among non-energy intensive industries. The International Energy Agency says that energy efficiency, uptake of clean energy and fuels, low-carbon process routes including carbon capture and storage (CCS), and ambitious work on material efficiency are critical to industrial decarbonization.¹⁹

Government action

Wafa Jafri, Director, Energy Lead Advisory, KPMG in the UK, says that some countries could improve their performance by removing regulatory barriers that stop less energy-intensive industrial users buying their own renewable energy. “The decarbonization market is evolving and a lot of energy companies want to be part of that solution, but the mechanisms need to be right to drive that forward,” she says.

On CCS, the NZRI flags low implementation of policy and even lower planned capacity to date outside of Norway which is the clear leader, followed by the UK and the US. Jafri says that energy-intensive industries need more involvement from governments, including financial support to help them decarbonize their processes and set up CCS projects, as well as the imposition of steep carbon taxes. “Without proper investment in low-carbon technology we cannot close the gap to achieving Net Zero,” she says. “The impact of higher carbon taxes and similar measures such as the carbon border adjustment mechanism should be considered as part of any investment decision,” adds Mike Hayes.

Circularity and efficiency

One area of improvement is productivity relative to industrial energy consumption. An increased uptake of industrial energy efficiency policies can drive progress in productivity of energy consumption. Another area is productivity relative to material input, with 29 of the



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Top five countries in industrial decarbonization readiness



32 countries having adopted a circular economy or resource recovery policy in the form of a law, strategy or action plan.

Supply chains

Jafri adds that reported industrial emissions are only now including greenhouse gas emissions associated with the activities of a business, but not directly

generated by that business or the energy it uses, known as scope 3 emissions. In the case of equipment such as jet engines, operational emissions far outweigh those required to build them, meaning industry has an even greater impact than its numbers suggest. There is an urgent need to address scope 3 emissions, although an increasing number of companies are taking accountability for them in emissions reduction targets, in response to customer and investor pressure.

Financing innovation

The Index flags there is still low delivery capability in the sector with underdeveloped clean tech markets, low numbers of industrial decarbonization technology patents and only nine countries with low-carbon industrial clusters in development.

Jafri says that lots of people are motivated to develop cleaner industrial technologies but there is a shortage of early-stage funding for such research as it does not fit conventional venture capital models: “People don’t know how to fund it. All you have are government grants.” One answer could be for investment firms to set up specific innovation funds for green industrial technologies.

Thakker says this would be especially critical if investment is needed in technologies such as green hydrogen, CCS and carbon usage which are critical for bridging gaps in decarbonization, especially in the so-called ‘harder to abate’ sectors such as metals, chemicals and cement. “While these industries are actively exploring their strategies and launching pilots, full-scale commercialization of such technologies may be some way off and would require more investment in innovation,” she adds.



The difficulty that companies face is in measuring actual industrial emissions throughout their supply chains. Significant investment and cost increases are required to actualize Net Zero, but companies cannot make critical investment decisions without a correct understanding of their business environments. Such an understanding of actual industrial emissions will be a key driver in facilitating investment in green technology and Net Zero energy solutions. ”

Narimichi Ukai

Strategy Partner for Energy and Infrastructure
KPMG in Japan



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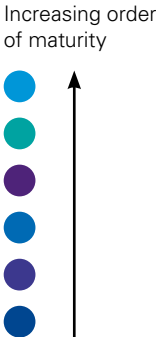
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Country	Share in national emissions	Sector readiness	Decarbonization status	Government action	Delivery capability
Japan	24%				
Norway	26%				
UK	16%				
Germany	19%				
Denmark	17%				
Italy	19%				
Sweden	25%				
France	20%				
US	18%				
Spain	21%				
Canada	23%				
Australia	18%				
Hungary	21%				
Poland	22%				
New Zealand	15%				
Mexico	25%				
South Korea	24%				
China	40%				
Singapore	47%				
Chile	23%				
Malaysia	22%				
Argentina	20%				
Brazil	12%				
Turkey	30%				
UAE	53%				



Source: KPMG International (2021)

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Agriculture, land use and forestry

The majority of countries in the Index have strong policy responses to food loss, but the data shows there is still high levels of end-user waste at retail and consumer levels. No governments in the Index have implemented taxes on carbon intensive food products, despite it being likely that encouraging more climate conscious diets will require government intervention.

Efficiency of land use in agriculture is very low, reflecting underinvestment in research and

development, and underdeveloped clean technology markets. Innovation in this area will be critical to sustainably increasing productivity and efficiency.

Similarly, more work needs to be done to protect the world's forests. The proportion of forest area under long-term management or located in protected areas is still relatively low, with forest certification an underused measure in enhancing sustainable management.

Feeding the world sustainably

According to the World Health Organization, in 2016 around 2 billion people in the world were overweight or obese²⁰ while a 2019 report by the UN Food and Agriculture Organization (FAO) estimated that a similar number of people, mostly in low- and middle-income countries, do not have regular access to safe, nutritious and sufficient food.²¹ In addition to food security, economist Nicoletta Batini in her book *The Economics of Sustainable Food* wrote: "Science shows that the practices currently used in conventional agriculture and fishing are harming the planet beyond repair... fears are rising that industrial agriculture and fishing may not be able to feed a growing world."²²

Agriculture needs to produce greater amounts of food while enhancing nutritional qualities, as well as using less natural capital and supporting the development of ecosystems on behalf of society, says Ian Proudfoot, Global Head of Agribusiness, KPMG in New Zealand. "The need for the system to deliver on all of these objectives simultaneously means that transitioning toward zero emissions is only one variable in a highly complex equation that has to be balanced," he adds.

Technology

While most countries in the Index are investing in research and development for sustainable agricultural practices, this is not yet sufficiently improving delivery capabilities. China, which has the world's largest agriculture sector, reports by far the highest number of emissions reduction patents in agriculture, land use and forestry followed by Denmark, South Korea and the US. But apart from these countries, this is an area of significant underinvestment.

New Zealand, which tops the sector overall, has a high number of agriculture clean technology companies, followed by Singapore, Norway and Denmark. There are several technology areas which promise progress over the next decade. Gene editing could allow significant



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Top five countries in agriculture, land use and forestry decarbonization readiness



progress, but many governments are opposed, with Proudfoot saying their views are often based on older and less sophisticated genetic modification technologies. Agriculture and food production are attracting high levels of research investment in areas including data and artificial intelligence, new growing systems, more extensive use of waste biomass and alternatives to animal products such as lab-grown meat.

There are also ways to reduce emissions from livestock and reduce the land needed to grow animal feed, including seaweed supplements to cut methane from digestion and using insects as a protein source. Modern versions of regenerative farming that support the interdependence of organisms could increase production while also providing decarbonization services such as locking carbon in soil.

Forests and oceans

Many countries in the Index are investing in reforestation initiatives but face challenges. China’s billion tree project was launched in 1978 and has helped increase forest cover from 12 percent to nearly 22 percent despite some issues on planning.²³ Turkey was recognized by the UN Food and Agriculture Organization as the country in the EU with the highest net gain in forest area between 2010 and 2020 but suffered setbacks in 2020 due to wildfires.²⁴ In addition

to reforestation, more needs to be done to protect existing forests. Canada scored highest for forest certification in the NZRI as the country having the largest area of third-party certified forests.²⁵

Proudfoot says that thought also needs to go into carbon offsetting, as many current schemes involve planting trees without consideration of whether the land involved is being removed from food production. Some existing offsetting operations are exposed to climate change related risks as shown by summer forest fires in North America, meaning that climate risk considerations should become an integral part of offsetting and afforestation operations.²⁶

He adds that oceans play a major role in both food production and in lessening the impact of climate change, with around 70 percent of carbon dioxide generated by humanity absorbed by seas.²⁷ “The practicalities of sequestering carbon in ocean plants needs to be a top research priority,” he says.

Food loss

The NZRI shows many governments have established policies on food loss, but that waste at the end-user level is still too high in higher income countries. The US has the highest proportion of food waste for end-users followed by Canada, Australia and New Zealand, showing more work needs to be done to incentivize

consumers and retail sectors to minimize waste. As part of its Towards Net Zero Waste Initiative, Singapore has implemented a food waste reduction publicity and outreach program to raise awareness and guide consumer choices as well as developing a food waste minimization guidebook to help minimize waste across retail supply chains.²⁸

Dietary change

There is no getting away from the fact that people in many developed countries should be encouraged to eat less, particularly animal products, with COVID-19 highlighting health risks that can result from obesity, diabetes and other conditions linked to overconsumption as well as the impacts on climate change of these high emissions products.

The US is the clear outlier among the NZRI countries with the highest dependence on meat and dairy and the highest calorie supply in excess of per-person FAO recommendations. Dietary change will require a massive public health effort, “but is likely the most significant step the food system can take towards reducing its impact on the climate,” Proudfoot says.

“The government and our food and natural fiber product sectors in New Zealand have entered into a climate action partnership, He Waka Eke Noa (we are all in this together), focused on reducing emissions in a sustainable way. The partnership has created the opportunity for the industry to be integrally involved in designing a pathway to achieving the desired zero carbon outcome rather than the traditional approach of government taking regulatory actions in response to current performance.”

Ian Proudfoot
Global Head of Agribusiness
KPMG in New Zealand

* While Singapore scores well in decarbonization of agriculture, land use and forestry, this sector’s share in national emissions is negligible since Singapore is dependent on imports for agricultural produce.


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Sector league table — Agriculture, land use and forestry


Country	Share in national emissions	Sector readiness	Decarbonization status	Government action	Delivery capability
New Zealand	55%	<div></div>	<div></div>	<div></div>	<div></div>
China	6%	<div></div>	<div></div>	<div></div>	<div></div>
US	7%	<div></div>	<div></div>	<div></div>	<div></div>
Sweden	16%	<div></div>	<div></div>	<div></div>	<div></div>
Singapore	0%	<div></div>	<div></div>	<div></div>	<div></div>
Denmark	24%	<div></div>	<div></div>	<div></div>	<div></div>
Norway	11%	<div></div>	<div></div>	<div></div>	<div></div>
Canada	13%	<div></div>	<div></div>	<div></div>	<div></div>
France	18%	<div></div>	<div></div>	<div></div>	<div></div>
Japan	2%	<div></div>	<div></div>	<div></div>	<div></div>
UK	12%	<div></div>	<div></div>	<div></div>	<div></div>
South Korea	2%	<div></div>	<div></div>	<div></div>	<div></div>
Germany	7%	<div></div>	<div></div>	<div></div>	<div></div>
Malaysia	26%	<div></div>	<div></div>	<div></div>	<div></div>
Italy	8%	<div></div>	<div></div>	<div></div>	<div></div>
Hungary	16%	<div></div>	<div></div>	<div></div>	<div></div>
Brazil	65%	<div></div>	<div></div>	<div></div>	<div></div>
Chile	10%	<div></div>	<div></div>	<div></div>	<div></div>
Poland	8%	<div></div>	<div></div>	<div></div>	<div></div>
Spain	13%	<div></div>	<div></div>	<div></div>	<div></div>
Australia	27%	<div></div>	<div></div>	<div></div>	<div></div>
Argentina	43%	<div></div>	<div></div>	<div></div>	<div></div>
Mexico	17%	<div></div>	<div></div>	<div></div>	<div></div>
Turkey	10%	<div></div>	<div></div>	<div></div>	<div></div>
UAE	1%	<div></div>	<div></div>	<div></div>	<div></div>




Source: KPMG International (2021)




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Country	Net Zero Readiness Index	National preparedness	Sector readiness
Norway	49.2	82.1	60.0
United Kingdom	48.4	86.3	56.1
Sweden	44.7	83.8	53.4
Denmark	43.8	79.3	55.2
Germany	40.4	72.1	56.0
France	39.8	78.9	50.5
Japan	37.6	67.1	56.0
Canada	34.2	74.9	45.7
New Zealand	32.1	66.5	48.3
Italy	29.9	62.5	47.8
South Korea	29.1	57.3	50.7
Spain	28.0	61.2	45.8
Hungary	28.0	66.3	42.3
United States	27.9	61.5	45.3
Singapore	25.6	57.2	44.7
Chile	24.2	58.5	41.4
Australia	23.5	57.1	41.1
Brazil	22.5	58.2	38.8
Poland	20.0	46.5	43.1
China	19.4	46.7	41.5
Malaysia	16.5	45.1	36.5
Argentina	15.7	46.1	34.2
Mexico	14.6	42.9	34.1
Turkey	13.5	42.6	31.7
United Arab Emirates	12.8	43.1	29.7



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Norway



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readiness



National
preparedness

One of the world's largest oil and gas exporters is the most ready to transition to Net Zero due to private and public investment into renewable energy and electrifying transport — but will economic considerations slow the speed of change?

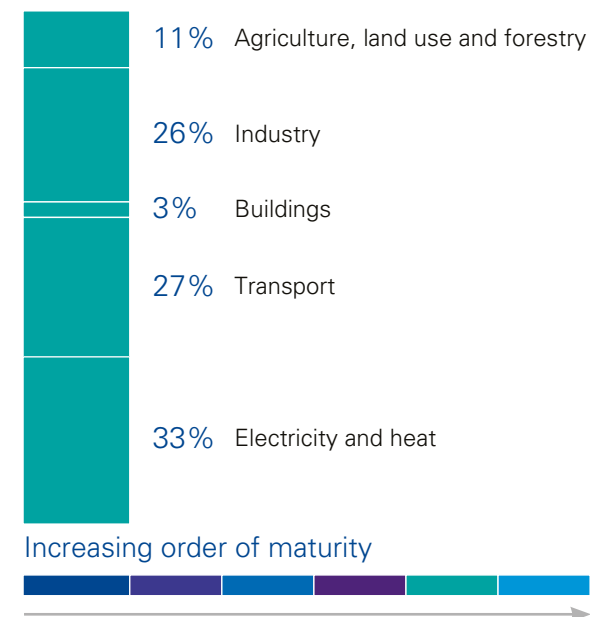
Private and public momentum

In June 2016, the Norwegian parliament moved its target date for carbon neutrality forward from 2050 to 2030, two decades earlier than the commonly-used UN target.²⁹ Although Norway leads the inaugural NZRI and is placed third on national preparedness, it faces significant decisions over how it continues to tackle climate change.

Geographic and economic considerations may constrain the pace of 'green' government ambitions. For example, carbon-intensive aviation rather than rail is used to link many towns and cities due to the country's mountainous geography. Much of Norway is covered by forest, but only 5 percent out of a 10 percent target set by the Norwegian parliament is formally protected. Reaching this target will largely depend on voluntary protection of forests on privately-owned land and limiting the impact on commercial forestry interests.

Most critically, the future of the country's energy production will be an issue for the country's general election in September 2021. It is a leader in renewable electricity generation, but relies economically on exports of oil and gas and is in seventh position in the electricity and heat sector. Should it power fossil fuel extraction using renewables,

Sector emissions shares and performance



Source: KPMG International (2021)



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decarbonizing the process if not the fuel itself, or look to end extraction completely, considering potential economic impacts in the short term, or climate risks in the future? Norway is certainly not alone in this challenge but is one of the most well-equipped oil producers to lead the way.

Energy transition

A full transition to renewables may be hampered by rising electricity demand driven by decarbonization work. For example, Norway ranks first for the transport sector in the NZRI; electricity is increasingly needed for transport where Norway leads the world in adopting electric vehicles as a result of generous registration tax incentives and VAT exemptions, as well as an upcoming ban on the sale of combustion engines. Buildings are also mostly heated with electricity, district heating, geothermal or heat from waste rather than fossil fuels, although significant reductions in energy consumption could still be achieved by introducing energy efficiency measures for older buildings.

But the biggest issue remains the gap between the domestic and regional demand for renewable power and what Norway can generate. Building more capacity is increasingly difficult, with some communities opposing new wind turbines because of their visual impact and disruption of wildlife and reindeer husbandry. Their construction also affects local environments, in some cases with implications for biodiversity and climate change if marshlands and wetlands are disturbed, causing release of methane. Similarly, hydroelectric power often requires dams and reservoirs. “We have a challenge balancing those kinds of needs,” says Johanne Solum Ness, Senior Associate at KPMG in Norway.

There are lower-impact ways to increase renewable generation, such as improving efficiency of existing hydropower locations. Norway is well-placed to use its expertise in marine fossil fuel extraction to build offshore

windfarms, with partly state-owned oil producer Equinor planning rapid expansion off Norway — including to power oil and gas platforms — as well in other countries including Poland, the UK and the US.³⁰ In addition, Freyr, based in northern Norway, is aiming to develop environmentally-friendly battery technologies which can help balance supply and demand.³¹

Norway is also likely to have an outsized influence on the broader region’s readiness to achieve Net Zero. The country currently exports renewable electricity to neighboring countries and is about to connect to the UK through the world’s longest undersea electricity cable, completed in June 2021 and due to go live in October.³² In addition, Norway’s sovereign wealth fund — founded on oil and gas revenues and the world’s largest at USD1.3 trillion — has a mandate to invest up to 2 percent of the fund’s assets in renewable energy assets and projects, primarily across the US and Europe.

Green technologies

Norway boasts the highest number of industrial clean technology companies relative to population, with a strong focus on circular economy practices of regenerating, reusing and repairing goods.

With the expertise and wealth it has from oil and gas production, Norway can also play a leading role in developing several of the technologies that could help solve the problem their use has caused. “Norway is in a special position to do that,” says Ness.

Norway topped the carbon capture and storage policy and planned storage capacity indicators in the NZRI, and receives the highest ratings from the Global CCS Institute on both policy and planned storage capacity. Its use could allow Norway and other countries to reach Net Zero without scrapping all fossil fuel use, although this looks likely to be expensive for decades to come.

Norway is also likely to have an outsized influence on the broader region’s readiness to achieve Net Zero. The country currently exports renewable electricity to neighboring countries and is about to connect to the UK through the world’s longest undersea electricity cable, completed in June 2021 and due to go live in October.

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United Kingdom



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readiness



National
preparedness

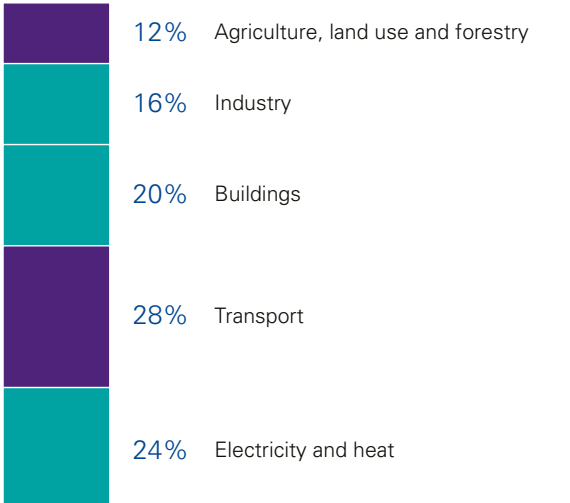
Cross-party political support and clear legally-backed targets have enabled the comparatively swift decarbonization of the power sector in the UK — but many challenges lie ahead, particularly on heat and buildings as the UK moves towards Net Zero.

Institutional framework

Along with being second overall, the UK gained the highest national preparedness score of the NZRI where it provides a model for other countries — while showing how much more remains to be done. The 2008 Climate Change Act required the government to reduce national emissions of six greenhouse gases by at least 80 percent between 1990 and 2050. It also set up mechanisms to support this, including a carbon budget framework and an independent Committee on Climate Change. The act, introduced under a Labour government, had cross-party support and has been developed by subsequent Conservative-led administrations, with the reductions target recently increased to 68 percent by 2030 on the way to Net Zero by 2050.³³

“This institutional set-up and framework is a real strength of the UK,” says Simon Virley, Vice Chair and UK Head of Energy and Natural Resources, “reinforced by high levels of public support.” It has produced strong results, with the second greatest reduction in greenhouse gas emissions of the 32 countries in the NZRI, falling by 34 percent between 2005 and 2018.

Sector emissions shares and performance



Increasing order of maturity



Source: KPMG International (2021)



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“That climate change and the UK’s pathway to Net Zero has remained such a high priority, in principle and practice, through the disruption of Brexit speaks volumes about the level of entrenched commitment — a positive sign for Net Zero-oriented policy longevity,” says Mikaela McQuade, Director, Energy, Climate and Resources, Eurasia Group. “As Prime Minister Boris Johnson readies to host COP26 in Glasgow, he will be looking to bolster the UK’s policy offering and will be motivated to use all tools available to him to get others to do the same. Even if domestic policy enthusiasm wavers over the medium- to long-term, the economic integration of the UK with the EU will embed a baseline level of expected policy ambition — especially when considering the EU’s push for carbon border adjustments.”

Energy transition

One of the biggest achievements so far has been the rapid progress made in the decarbonization of the power sector, with the UK ranking second on the electricity and heat sector in the NZRI behind Denmark, with comparatively more aggressive government action for clean energy. The last coal-fired power station is due to close by 2024 and the proportion of renewable energy used in electricity production rose from 7 percent in 2008 to above 40 percent in 2020.³⁴

Progress is also being made on converting industrial processes to using hydrogen and carbon capture, with the UK ranking third on the industry sector in the NZRI. On transport, overall adoption may be low at present, but electric cars and small vans are increasing in popularity; their lifetime costs may now be comparatively lower than fossil fuel alternatives, which the government has banned the sale of after 2030, with new heavy goods vehicles banned from 2040 at

the latest.³⁵ But Virley says that more clear political signals are needed, including more detailed sector-specific plans. “We don’t need any more targets,” he says. “Now, the devil is in the policy detail.”

Public engagement

Most of the work which will directly affect citizens is also yet to come, Virley says. Despite mandatory building energy certification and high levels of household energy security which contribute to the country’s fourth-placed rating in the buildings sector, many Britons live in poorly-insulated houses which were built many decades ago, and around 9 in 10 houses are heated by natural gas. The government says that 600,000 homes a year will need to install a heat pump by 2028, while its Climate Change Committee puts the figure at 1 million annually by 2030. However, last year only around 30,000 heat pumps, which usually require the retrofitting of better insulation to be effective, were installed.

There have been a number of false starts and failed policies under successive governments when it comes to green home improvements, including the recently-scraped Green Homes Grant.³⁶ “A weakness in all of these is not thinking sufficiently about the consumer,” Virley says. “We have to design policies that work for people, not in theory.” Some local leaders, including the mayors of London and Greater Manchester are working on local area energy planning, in order to find the lowest cost way to transition to Net Zero in that area. But national politicians have had limited engagement with citizens about changing their home heating, or on other changes such as moving to electric vehicles, flying less and eating less meat. “This needs to change if we are to move forward in the UK,” says Virley.

One of the biggest achievements so far has been the rapid progress made in the decarbonization of the power sector, with the UK ranking second on the electricity and heat sector in the NZRI behind Denmark, with comparatively more aggressive government action for clean energy. The last coal-fired power station is due to close by 2024 and the proportion of renewable energy used in electricity production rose from 7 percent in 2008 to above 40 percent in 2020.

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Sweden



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Sector
readiness



National
preparedness

Sweden enjoys a first mover advantage in green policy and technology and is a leader on efficient new buildings, but risks slipping in the NZRI if cutting-edge work by a few organizations is not widely adopted.

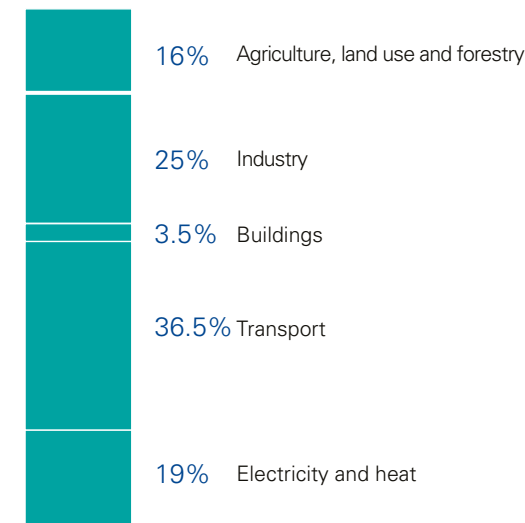
A comparatively low-carbon economy

Third-placed Sweden is ranked second on national preparedness and leads on performance in reducing emissions intensity of GDP. In 2017, it became the first country to set a legally-binding Net Zero target date of 2045, 5 years before the UN target.³⁷

It is used to being an environmental pioneer, as the first country to pass an environmental protection act in 1967 and having led on issues including recycling and reducing acid rain.³⁸ “The government is committed, and has been for a long time. Industry is also committed and the majority of people are starting to commit to this as well,” says Torbjörn Westman, Partner, KPMG in Sweden.

Sweden, which ranks fourth on electricity and heat, already generates all of its electricity from low-carbon sources, but will need to expand capacity and maturity of the grid to move to Net Zero, as much generation takes place in the north of the country while most people live in the south. “I’m pretty sure this will be solved, but it will be a huge investment to fix the infrastructure,” says Westman.

Sector emissions shares and performance



Increasing order of maturity



Source: KPMG International (2021)



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The country is placed second on transport owing to government action on electric vehicle charging legislation and low-carbon fuel mandates. The country aims to make its transport sector free of fossil fuels by 2030, ahead of its overall Net Zero target of 2045. Vehicle-makers Volvo and Scania are both involved in developing technologies, with Scania having launched its first fully electric truck in 2020.³⁹

Innovative technologies

Sweden leads the NZRI's buildings sector, with new construction increasingly using wood rather than concrete and focusing on energy efficiency, through the use of ecolabels. Westman says that it will be more difficult to refurbish existing buildings, including allowing them to be cooled, as well as heated, as outside temperatures rise.

The country is also pioneering the decarbonization of industry through the Hybrit research project which aims to make steel without using fossil fuels, a process currently responsible for 10 percent of national emissions. A pilot plant inaugurated by SSAB, LKAB and Vattenfall in 2020 will produce sponge iron (which is used to make steel) with larger facilities planned.⁴⁰

However, Westman says that while Sweden has companies that are best in their class, others are moving more slowly: "It's important to get the whole pack together, moving forward."

Financial incentives

The increasing importance of green financing, where investment is dependent on projects and companies meeting environmental standards, should help achieve this. Again, Sweden has early experience with Vasakronan, a commercial property company owned by pension funds, having issued the world's first green corporate bond in 2013.⁴¹

Private and public sector support for green technologies may also be needed to incentivize individual behavior, alongside education for both people and organizations. For example, previous attempts to shift drivers to using biofuel only succeeded when the option became cheaper than alternatives. "One thing we can't forget is change management," Westman says. "The country is getting there, but needs to continue that movement."

Sweden leads the NZRI's buildings sector, with new construction increasingly using wood rather than concrete and a focus on their energy efficiency, including through the use of ecolabels. Westman says that it will be more difficult to refurbish existing buildings, including allowing them to be cooled, as well as heated, as outside temperatures rise.

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Denmark



**Net Zero
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Sector
readiness



National
preparedness

Highly ambitious, an international advocate for climate policy and a leader in green energy and technology, Denmark's next step on the path to Net Zero is to reduce its continued reliance on emission-intensive agricultural exports and imports.

Climate diplomacy

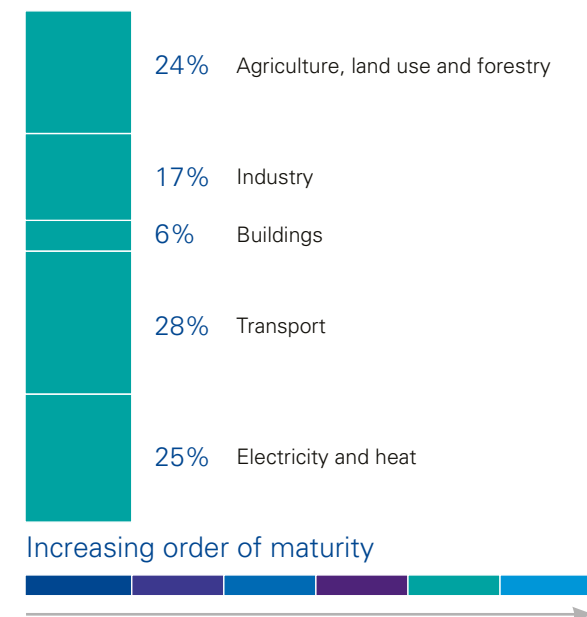
In June 2020, fourth-placed Denmark's parliament approved legally binding CO₂ emission reduction targets, including Net Zero by 2050 and a 70 percent reduction by 2030 compared with 1990s emissions, giving it the lowest emissions for 2030 based on declared national determined contributions. The legislation behind this, which requires the parliament to assess each year whether the government complies with the Climate Act or should be required to act further, was adopted following a widely signed national petition.⁴²

Since hosting the Copenhagen climate change summit in 2009 the country has carried out 'climate diplomacy', including support for poorer countries to decarbonize. "Denmark is consistently known to punch well above its weight on climate action," says Mads Fink-Jensen, Partner, ESG Lead, KPMG in Denmark.

Market infrastructure

Denmark leads the electricity and heat sector in the NZRI, due to tradable renewable energy certificates, net metering, policy on adopting hydrogen and low use of coal.

Sector emissions shares and performance



Source: KPMG International (2021)



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Most electricity is already produced from renewable sources and the government has set 2050 as a deadline for the country to end oil and gas extraction.

The country also benefits from exports linked to renewables, both wind power equipment and energy itself, with plans to generate more of the latter through offshore wind ‘energy islands’. As well as using existing islands, this includes plans for an artificial energy island 80 kilometers from the Danish coast in the North Sea, majority-owned by government but with significant use of private sector technology and expertise.⁴³

More generally, the private sector is closely involved with Danish decarbonization work through climate partnerships covering 13 industries, which include the heads of some of the country’s largest companies. Financial services are increasingly focused on the issue, with a September 2019 pledge by the pension industry to invest 350 billion Danish krone (DKK) (USD55 billion) in green assets.⁴⁴

Harder-to-decarbonize sectors

Denmark’s powerful shipping industry is also working to reduce its emissions. In August 2021, Maersk announced that Hyundai Heavy Industries will


construct eight ocean-going container vessels that can run on carbon-neutral methanol, which will enter service from 2024 and allow it to offer carbon neutral transportation on the high seas.⁴⁵ The company has also led a group establishing a non-profit research center for zero carbon shipping which has opened in Copenhagen.⁴⁶


The country is a major exporter of pork and dairy products, and agriculture, land use and forestry is responsible for 23 percent of the country’s emissions, higher than any other European country in the NZRI. However, the government has unveiled plans to cut emissions from the sector. In April 2021, it announced spending on research into technologies that could reduce emissions from agriculture, including solutions such as biogas fuels, as well as plans for a partial ban on farming with peat soil.⁴⁷

Fink-Jensen says that Denmark is increasingly considering the impact of emissions from imports, which she sees as the country’s next frontier in reducing and eliminating emissions. This includes agricultural produce and materials linked to deforestation such as soya, palm oil, coffee and cocoa, with the agriculture ministry considering the topic.


Most electricity is already produced from renewable sources and the government has set 2050 as a deadline for the country to end oil and gas extraction. The country also benefits from exports linked to renewables, both wind power equipment and energy itself, with plans to generate more of the latter through offshore wind ‘energy islands’.

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Germany

5th

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3rd

Sector
readiness

7th

National
preparedness

Germany's position in the top five comes down to cross-party ambition and well-established policies on climate change. Its plans to extend use of offshore wind, but exit from nuclear power, requires the country to only gradually phase out coal until 2038.

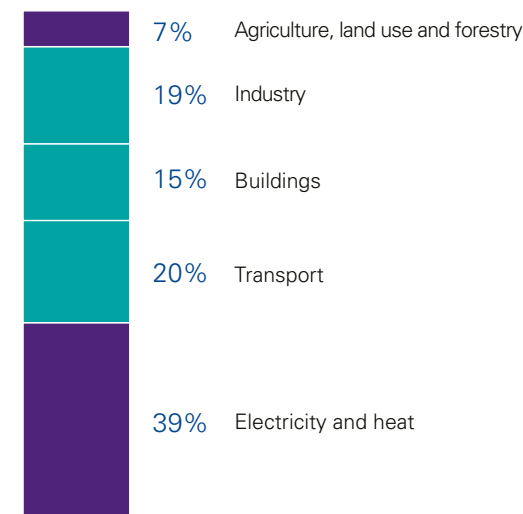
Political ambition

Germany's fifth place overall is down to the progress it has already made on decarbonization, contributing to a low emissions intensity compared with GDP, and its ambitious targets for the next few years. In May 2021, the government tightened its legal targets to emissions cuts of 65 percent by 2030 compared with 1990 levels, then 88 percent by 2040 and Net Zero by 2045, after a constitutional court ruling.⁴⁸

The speed of change could increase in light of September's national elections after the Green Party won a significant share of the vote and will likely enter a coalition government. Goran Mazar, Head of ESG, KPMG in Germany, says that as environmentalism is accepted by most parties, this would be likely to accelerate existing processes such as by further tightening national emission reduction targets.

"A key political shift in the EU over the past 2 decades has been that climate action, including a green transition, has moved from a mostly left-wing fringe into the political mainstream," says Henning Gloystein, Director, Energy, Climate and Resources, Eurasia Group. "This is perhaps best seen in Germany, where any of the likely government

Sector emissions shares and performance



Increasing order of maturity



Source: KPMG International (2021)



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coalitions following September’s elections will likely mean more climate policy action. With the exception of a few details, all parties that will form the next government believe a green transition will in the longer-term benefit Germany’s industry.”

Renewables mix

Just over half of the country’s electricity comes from low-carbon sources, a quarter of which is made up of wind power. Also, the country’s Energiewende (energy transition) policy is well-established.

However, this transition has been complicated by the country’s 2011 decision to phase out nuclear power by the end of 2022 following the Fukushima disaster in Japan.⁴⁹ Mazar says that this has led the country to prioritize development of renewable energy, but adds: “It’s difficult to terminate coal and nuclear at the same time.” Germany does not plan to fully phase out coal electricity production until 2038 — a gradual approach but slower exodus when compared to the UK — but market forces such as escalating carbon permit prices in the EU will be likely to bring production to an end much sooner.

There are ambitious plans to develop green hydrogen as part of reducing CO₂ emissions, particularly from industry, but Walter Bürger-Kley, Advisory Partner at KPMG in Germany, says that barriers around cost and distribution of infrastructure remain. Similarly, wind generation off the northern coasts will require improved transmission networks to reach the middle and south of the country.

Industrial structure

Germany is ranked fourth on the industry sector. Industry’s strong rating is based partly on government support for circularity, the replacement of fluorinated greenhouse gases and plans for industrial clusters

focused on low-carbon industries. Regarding energy-intensive industries, multinational steel maker ArcelorMittal plans to pioneer work on hydrogen-powered blast furnaces at its sites in Germany.⁵⁰ Mazar says hydrogen is likely to be required to make steel and cement, although it will be hard to make cement, in particular, completely carbon-neutral. This may require greater consideration of ‘embedded carbon’ — that is required for construction rather than operation — in the building sector and the support of renovation over demolition.

The country’s third place in the NZRI for transport is based partly on government support for electric vehicle purchase and ownership incentives, low-carbon fuel mandates, and charging infrastructure. Mazar says that the country’s major vehicle makers including BMW, Daimler and VW started development of electric vehicles later than some others, but are now making progress.

On public transport, the Green Party has proposed policies to make flying and driving less attractive — although the disclosure of these policies has contributed to the party slipping in the polls. These include tax changes that would make both modes more expensive and speed limits of 130 kilometers an hour across the autobahn road network, some of which has no speed limit.⁵¹

As part of a Buildings Energy Act which came into force in November 2020, Germany is working to decarbonize domestic heating.⁵² From 2026, the country plans to limit the installation of oil heating systems and fossil fuel heating boilers, a significant step given that buildings contribute 15 percent of emissions.


Germany does not plan to fully phase out coal electricity production until 2038 — a gradual approach but slower exodus when compared to the UK — but market forces such as escalating carbon permit prices in the EU will be likely to bring production to an end much sooner.


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France



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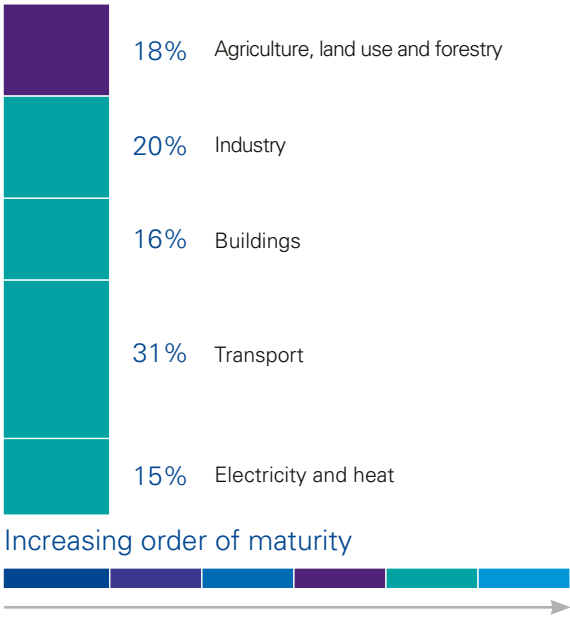
Faced with risk of political and policy momentum being derailed by social opposition to costs of climate change mitigation, France’s government tries new ways to engage citizens in decision-making.

Policy framework

Coming in at sixth overall, France punches above its ranking in a number of categories in the NZRI. The country is ranked third for policies and enabling environment, contributing to it being placed fifth on national preparedness overall. In working toward meeting its legally binding 2050 Net Zero target, it partly benefits from implementing EU environmental policies, as well as domestic regulations including climate-related disclosures for financial institutions.

France was one of the first European countries to develop a national clean hydrogen strategy in 2018. In 2019, it established an expert independent body, Haut Conseil pour le Climat (high council on climate), to assess governmental policy and its impacts⁵³ and in September 2020, it allocated 30 billion euros (EUR) (USD35 billion) of its EUR100 billion post-COVID-19 recovery plan to green energy work, including hydrogen fuel development.⁵⁴ It already generates 91 percent of electricity from low-carbon sources, mainly nuclear but increasingly from renewable sources including offshore wind.

Sector emissions shares and performance



Source: KPMG International (2021)



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Social cost

But while there is general public and corporate support for reducing emissions, policies including increased vehicle fuel taxes have been strongly resisted by the ‘gilets jaunes’ (yellow vests) protest movement.⁵⁵ Many living in suburban and rural France rely on cars for transport and employment, and protestors saw their targeting as an attack by urban elites. “If you want another carbon tax, it will need a lot of scrutiny to make sure it does not repeat the errors of the past and addresses everyone,” says Clément le Gouvello, Senior Manager, Climate Team, KPMG in France.

To that end, President Emmanuel Macron set up the Convention Citoyenne pour le Climat (citizens’ convention on climate), a group of 150 randomly chosen adults with expert support, who met between October 2019 and June 2020 to draw up plans to cut greenhouse gas emissions by at least 40 percent by 2030.⁵⁶ However, while Macron originally said he would pass their proposals unfiltered to parliament, only around 40 percent of these were included in a climate bill.⁵⁷ Legislators made further changes as it went through parliament, which passed in July 2021 and includes a ban on most domestic flights for which a rail alternative of less than 2.5 hours is available.⁵⁸

Land use

France has one of the largest areas of agricultural land among European countries and controls the second-largest area of ocean worldwide due to its overseas territories in the Atlantic, Indian and Pacific oceans. As such, it has a huge responsibility in protecting its carbon sinks and supporting efforts to move to less emissive agricultural methods, such as through regenerative agriculture and agroecology, to meet its Paris Agreement objectives. At the One Planet Summit in January 2021, the government introduced a plan to protect 30 percent of both its maritime and land territories by 2030.⁵⁹

The government is also incentivizing the private sector to part-finance projects in the national voluntary carbon offset program, Label bas carbone (low-carbon label). Although still in progress, this market could gain momentum and encourage more forestry, agriculture, peatland and other low-carbon projects to be partly sponsored by the private sector.

Le Gouvello says that since few countries in Europe have created markets for carbon offsets, the EU could consider taking a larger role in scaling up and coordinating the existing national voluntary carbon markets, through defining a common set of rules to issue carbon credits, or establishing a controlling body for example, he adds.

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Japan



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A leader in technological developments including hydrogen supply chains and green building measures, but faces challenges including reliance on fossil fuel finance, limited current potential to develop renewables and unpopularity of nuclear power.

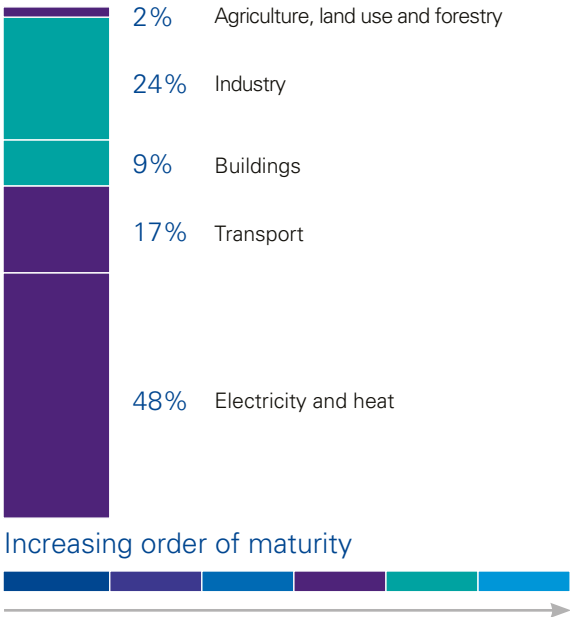
Political will

Japan, which ranks seventh overall, has strong financial resources to help it move away from its current reliance on imported fossil fuels, which attract some subsidies, and meet a 2050 Net Zero target announced by Prime Minister Yoshihide Suga in October 2020.⁶⁰ In April 2021, Suga increased its interim 2030 target for emissions reductions from 26 percent on 2013 levels to 46 percent.⁶¹ However, to support its credibility in this area the government will need to decrease its exposure to fossil fuel financing and tackle Japan's continued financing of coal internationally.

Adoption of clean energy

The country also faces a number of constraints in adopting cleaner power. It has limited land available for onshore renewable generation and lacks the shallow seas that other countries are using to develop offshore wind. Narimichi Ukai, Strategy Partner for Energy and Infrastructure, KPMG in Japan, says that the country aims to introduce floating offshore wind power technologies to implement significant deep-sea wind projects in the 2040s. In the meantime, the country is regulating land use to make it easier to set up onshore solar and wind projects and investigating the introduction of a carbon tax.

Sector emissions shares and performance



Source: KPMG International (2021)

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In 2011, Japan generated around 30 percent of its electricity from nuclear power stations and planned to expand that to at least 40 percent.⁶² However, in March that year, an earthquake-triggered tsunami caused a meltdown at the Fukushima Daiichi plant, contaminating a wide area of land, turning the public against nuclear power and leading to all stations being closed. Two restarted in 2015 with eight following since and more seeking approval to do so. Ukai says nuclear power remains unpopular but adds: “Without nuclear, Japan has no way to meet the requirements for CO₂ reduction.”

Sectoral readiness

Japan’s position in the NZRI is boosted by its strong sectoral performance, including first place on industry and second place on buildings. On the latter, energy certification is mandatory, heat pump technology is widely used, and some projects use integrated solar generation and building management technology.

On industry, the country scores highly on areas including efficient use of materials, low emissions from waste and strong policies on circularity and the replacement of fluorinated greenhouse gases. However, Ukai says there are problems ahead given power generation issues. Companies setting their own Net Zero targets want their factories to use carbon neutral power to meet the requirements of

their customers and investors, and the cost of doing so in Japan is still far higher than in Europe where green electricity is highly competitive, meaning manufacturing could be shifted overseas.

Japan aims to be a world leader in developing liquefied hydrogen (LH₂) supply chains. In March 2021, Kawasaki Heavy Industries delivered the world’s first purpose-built LH₂ carrier, Suiso Frontier,⁶³ and the company has also become the first to complete a LH₂ regasification terminal at Kobe.⁶⁴ It is also planning to build the world’s first LH₂ liquefaction facility in Queensland, Australia and is working with the Port of Rotterdam in the Netherlands to build LH₂ facilities.

Japan was also an early adopter of hybrid electric vehicles but has been slower in the mass development of battery-only vehicles. Manufacturers including Honda, Nissan and Toyota are supporting the development and introduction of electric vehicles in Japan and elsewhere, and the government offers subsidies for their adoption. As part of a zero emissions strategy for the COVID-19 delayed Olympic and Paralympic Games in July and August 2021, the Tokyo Metropolitan Government strategically adopted hydrogen-fueled buses for use during the events as part of promoting the fuel’s use for transport and other applications.⁶⁵

On industry, the country scores highly on areas including efficient use of materials, low emissions from waste and strong policies on circularity and the replacement of fluorinated greenhouse gases. However, Ukai says there are problems ahead given power generation issues.

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Canada



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Canada's heavy reliance on fossil fuel and fossil fuel exports, extreme climate and cultural challenges make decarbonization challenging, but political will is increasing with legislation for targets and mechanisms to support markets.

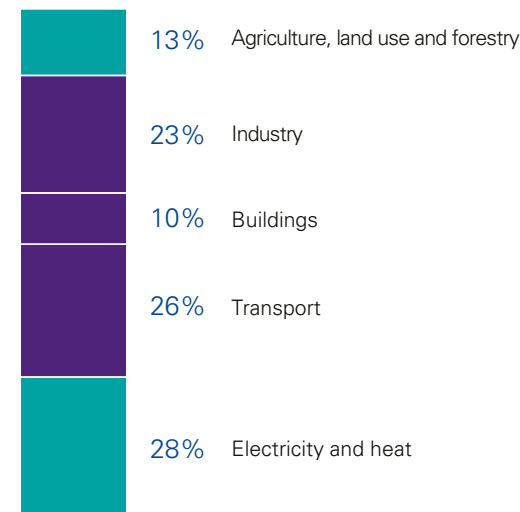
Political will

Canada, which is ranked eighth overall and sixth on national preparedness, faces challenges to its decarbonization credibility as a major exporter of oil that is also developing a liquid natural gas export facility. But there is political will to change, with the federal government introducing a Net Zero Emissions Accountability act, which came into law in June 2021 and set legally-binding 5 yearly emissions targets from 2030.

Jonathan Erling, Executive Director at KPMG in Canada, notes the federal government introduced a carbon price of 170 Canadian dollars per tonne (CAD) (USD136) by 2030,⁶⁶ with the income recycled to citizens through income tax credits. It has also spent on projects designed to reduce emissions, such as upgrading power grids and subsidizing home energy efficiency upgrades. "While some view this as movement in the right direction, others say government project support is not necessarily directed to the most cost-effective places," he adds.

"A March 2021 finding by the Supreme Court of Canada states the federal carbon price is constitutional had important practical effects and effectively nullified the

Sector emissions shares and performance



Increasing order of maturity



Source: KPMG International (2021)



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debate as to whether a carbon tax can be implemented to a conversation about stringency that treats carbon pricing as certain,” adds Mikaela McQuade, Director, Energy, Climate and Resources, Eurasia Group. “For the business and investment environment, a consistent and predetermined price signal will allow long-term planning for economic decarbonization projects.”

Challenges to scaling renewable electricity

Canada produces around 67 percent of its electricity from renewable resources with Ontario, Canada’s most populous province, generating about 95 percent of its electricity from zero emissions sources including nuclear. There is huge potential to further develop such sources including wind, hydroelectric and, in Alberta, geothermal.

But Erling says that there are still major challenges in moving to a Net Zero future. For example, Ontario relies extensively on natural gas to heat buildings and the province experiences severe winters where temperatures can dip to minus 20 degrees Celsius or below. On such days, Ontario’s gas network delivers three or four times the energy of its electricity grid, so heating buildings with electricity would require adding massive additional capacity to the power grid, where such capacity would only be used for a few months each year. Some Canadian cities experience temperatures of minus 40 degrees Celsius or colder, beyond the capacity of air-source heat pump technology, which is one option that might facilitate the use of electricity for heating. “Canada hasn’t really figured out how to replace natural gas,” says Erling.

In 2016, Ontario’s government considered banning the use of natural gas for heating in new homes by 2030, but then backed away from this.⁶⁷ “I don’t think there is recognition, even among politicians, about how difficult the Net Zero target is,” says Erling. There are also tensions among Canadian provinces, with Alberta’s expanding production of natural gas and heavy crude from oil sands having led to corresponding increases in greenhouse gas emissions. Developing technologies for carbon capture and storage, making use of depleted oil wells, could provide a more environmentally friendly approach for continued fossil fuel production; however, this will take political will and active policy support.


Changing behavior


As a country with abundant sources of power, both fossil fuel and renewable, Erling says: “Canada has become accustomed to cheap energy and has built cities and lifestyles accordingly.” Urban areas are not as dense as elsewhere in the world, homes are larger and there is relatively little use of public transport. While the fuel efficiency of any given size of vehicle has increased over time, Canadians have increasingly adopted light trucks and sports utility vehicles rather than cars over recent years and the country has high transport emissions per person and a relatively low adoption of electric vehicles. Given Canada’s close economic ties with the United States, it also can be hard to diverge from American practices, both in terms of carbon pricing and in terms of technology standards.

Canada produces around 67 percent of its electricity from renewable resources with Ontario, Canada’s most populous province, generating about 95 percent of its electricity from zero emissions sources including nuclear. There is huge potential to further develop such sources including wind, hydroelectric and, in Alberta, geothermal.


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New Zealand



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Advantages include strong political will, an abundance of natural resources for renewable energy and heavy investments in green public transport, but the country will have to deal with agricultural methane emissions to reach Net Zero.

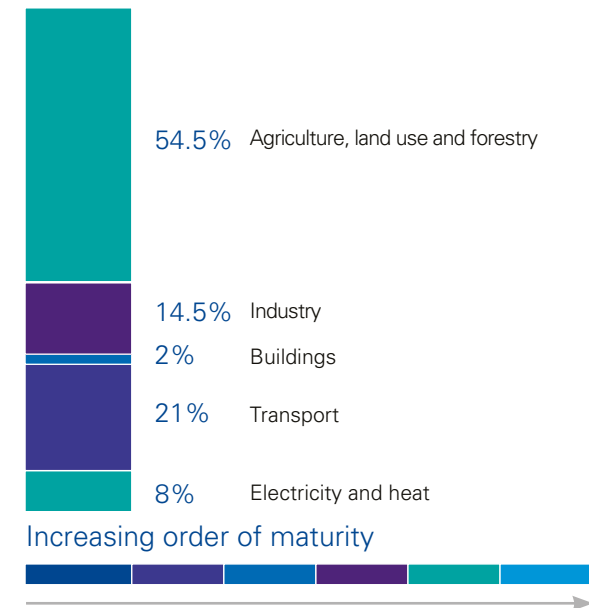
Political will

New Zealand ranks ninth on both the overall Index and on national preparedness, with a strong performance on policies and enabling environment. In 2019, the government amended the country's Climate Change Response Act with new measures drawing on the UK model, including an independent climate change commission, the adoption of emissions budgets and a commitment to reach Net Zero by 2050 in all greenhouse gases, with the exception of methane from livestock and landfill.⁶⁸ It is now working to complete these budgets for the next 10–15 years by the end of 2021.

New Zealand became the first country to legislate the use of Taskforce on Climate-related Financial Disclosures (TCFD) recommendations for certain companies and financial services organizations and in December 2020, it announced its Carbon Neutral Government Programme to make a number of the country's public sector organizations carbon neutral as early as 2025.⁶⁹

"There is a very strong political focus that has increased over the last couple of years," says Ronja Lidenhammar, Manager, Sustainable Value, KPMG in New Zealand.

Sector emissions shares and performance



Source: KPMG International (2021)



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Both public and private sector organizations are increasingly engaged in tackling climate change, and she sees co-operation as key: “There are some very big challenges ahead and it will take government and the private sector to work together.”

However, she adds that the country faces unusual challenges in moving towards Net Zero. Much electricity is already generated from renewable sources including hydroelectric and geothermal, but for other energy, the country relies heavily on oil and gas imports. There is relatively low potential to use solar power and nuclear energy has been politically unacceptable since the 1980s. As electricity demand increases, the development of large-scale pumped hydro storage facilities is challenging due to local concerns about negative ecological impacts. As a result, energy sources such as geothermal and wind, currently abundant but under-used resources, have the potential to be significantly increased. The energy authority is also working to reduce consumption in buildings and industry by encouraging improved efficiency.

Investing in transport

The government is working to improve public transport and has just launched its first Rail Investment Programme intended to improve rail services across the country, although from a very low base following a period of under-investment and, for much of the freight network, a state of managed decline.⁷⁰ There are also ambitions to encourage more walking and cycling. In February 2021, it announced funding for 22 low-emission transport projects to tackle the low adoption of electric vehicles and lack of availability of charging stations⁷¹ and in June said it will start subsidizing electric and plug-in hybrids to the value of 8,625 New Zealand dollars (NZD) (about USD6,000) for new vehicles and NZD3,450 for used ones and fund more charging facilities.⁷² However, these discounts will be funded by fees on higher emitting vehicles, leading to concerns from freight companies about the impact on the cost of trucks and complaints from farmers who

argue that current electric vehicles are unsuitable for agricultural use.⁷³ More broadly, New Zealand has yet to set a date to ban the sale of internal combustion engines.

Addressing agricultural emissions

New Zealand gets the highest score in the agricultural sector of the 32 countries in the Index, including for high levels of forest biomass, low levels of food loss resulting from strong government action and a comparatively high number of agricultural clean tech companies. However, there is significant work to be done across all countries in this sector. Lidenhammar says that the government has said little about how agriculture will need to change to support climate change goals compared with energy and transport: “It’s a very precious sector for New Zealand, a politically sensitive area.”

Given agriculture makes up a large share of the economy and that New Zealand is the world’s biggest dairy exporter, the omission of methane emissions from livestock and landfill will become a significant barrier to the country hitting a true Net Zero target unless it is addressed. There are plans to reduce methane through already-available low-emission feeds and in future breeding programs, methane vaccines that could utilize animal immune systems and the addition of seaweed to animal food.⁷⁴

“New Zealand’s government is generally very supportive of taking global action against climate change,” says Henning Gloystein, Director, Energy, Climate and Resources, Eurasia Group. “The country’s economic structure, however, poses some challenges. Arguably the biggest one will be to reduce methane emissions from its huge cattle livestock and dairy industry. New Zealand has faced similar policy pressure to reduce the impact of its timber industry by enacting ambitious reforestation policies. Solutions are likely a combination of improving technology, credible carbon offsetting measures, and allowing some cattle land to be re-forested.”

As electricity demand increases, the development of large-scale pumped hydro storage facilities is challenging due to local concerns about negative ecological impacts. As a result, energy sources such as geothermal and wind, currently abundant but under-used resources, have the potential to be significantly increased.

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Italy



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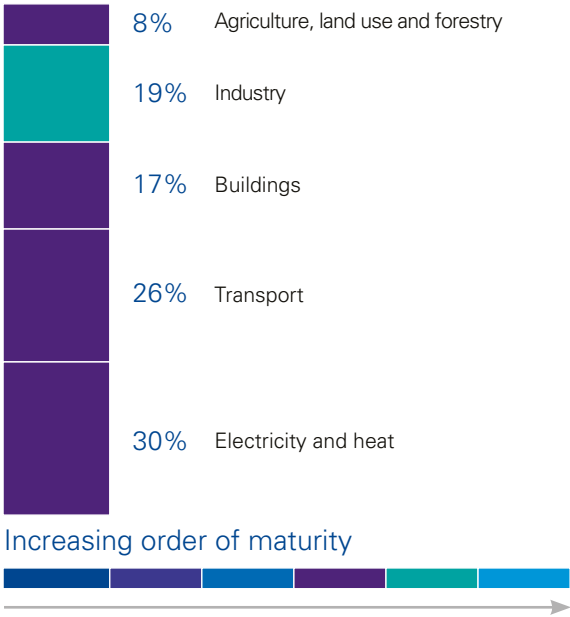
Italy faces high exposure to physical risks of climate change and faces significant effort on transport and buildings, but is set to benefit from adoption of strong EU policies and potential for offshore wind and solar.

Political will

Italy is ranked 10th overall and 11th for national preparedness, with key contributors including market-based emissions trading mechanisms and strong public support for climate action.

Italy's National Recovery and Resilience Plan published in May 2021 includes ecological transition as one of its six main areas, with EUR59 billion (USD69 billion) allocated to improved building efficiency, energy transition and sustainable mobility.⁷⁵ PierMario Barzaghi, Head of Sustainability and Climate Change Services, KPMG in Italy, says this includes encouraging industrial users to make direct use of renewable sources and alternatives including hydrogen, as well as carbon capture and storage technologies, and greater use of circularity. In addition to circular incentives, options for corporate sourcing of renewable energy and industrial decarbonization legislation contribute to the country's sixth-placed ranking on the industry sector, which also benefits from strong EU policies in this area.

Sector emissions shares and performance



Source: KPMG International (2021)



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A nationally specific transition

Barzaghi says that Italy’s main focus will be on energy transformation, ending the use of coal and plans to increase the use of renewables so they provide 70 percent use of electricity by 2030. However, this will require more agility from government: “In order to help ensure the ecological transition, it is necessary to support a bureaucratic transition, in order to reduce the lengthy procedures authorized, for example, for the installation of plants for renewables,” he says.

Italy is more exposed than some other European countries to the risks of climate change, due partly to its long coastline. But it also has more to gain from a transition to renewable power, with strong potential from offshore wind and solar, taking advantage of high irradiation levels in the south, as this can replace the use of oil and gas where the country has scarce domestic resources. “The energy transition represents an opportunity for Italy, and the path to be taken must be specific to the country,” he says.

Sectoral challenges

On transport, the country will need to shift away from its currently high use of cars and trucks to rail, which is low in usage by European standards. Road vehicles,












which are older and more polluting than the average for the continent, will need to be replaced with electric vehicles, which are currently little used. Unlike some countries, Italy had not announced a ban on the sale of vehicles using combustion engines but in July 2021, the EU announced an effective ban on the sale of new petrol and diesel cars as part of its 2035 emissions target.

Although new buildings are covered by a rigorous regulatory framework that includes high levels of efficiency, nearly two-thirds of Italy’s residential buildings were constructed before the country’s first law on energy saving was passed in 1976. Barzaghi says progress in this area will depend on deep renovation of existing buildings, adding “the effort required in this regard is decidedly challenging.” Around 70 percent of homes could use electric heat pumps for heating, with the remainder using green alternatives including solar thermal, district heating and hydrogen.

Italy’s performance on agriculture could be improved by technical changes such as changing cows’ diets to reduce methane emissions and adopting precision agriculture techniques that use fertilizers and protection products more efficiently. The country also has a high consumption of meat and dairy products, and there is room for improvement on food waste per person.

Italy is ranked 10th overall and 11th for national preparedness, with key contributors including low emissions intensity of imports compared to GDP, market-based emissions trading mechanisms and strong public support for climate action.

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South Korea



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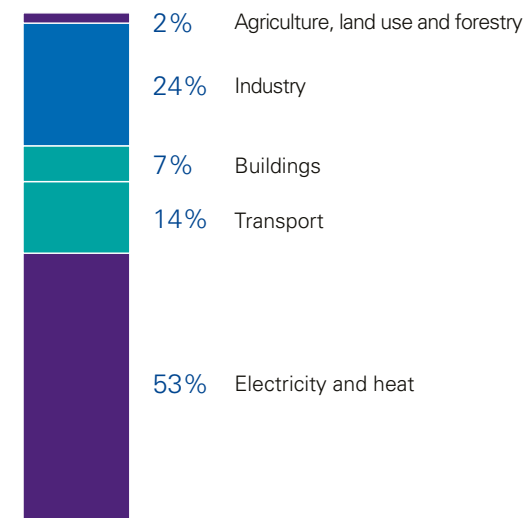
South Korea shows strong political determination with a 2050 Net Zero target, substantial Green Deal plans and the development of green transport and hydrogen technology, but challenges include economic reliance on petrochemicals and use of coal for electricity.

Public and private sector momentum

South Korea faces a significant challenge in decarbonization due to the role petrochemicals play in its economy. However, the government has committed to a transition with a target of reaching Net Zero by 2050 announced in October 2020. President Moon Jae-in's plans, made as part of a budget address to the national assembly, include spending 8 trillion South Korean won (KRW) (USD7 billion) on a Green New Deal, including KRW4.3 trillion on infrastructure for electric and hydrogen-powered vehicles and KRW2.4 trillion on upgrading buildings and urban spaces. He also said that the country would replace coal-fired power stations with renewable generation.⁷⁶

"It gives a strong signal to Korean companies that they need to figure out how to mitigate greenhouse emissions or remove carbon from their portfolios by 2050," says Ah-Ryung Lee, Manager, KPMG in Korea. But she adds that specific action plans or guidelines for corporates have not been prepared yet, making it difficult for companies to decide how to achieve this. The main mechanism at present is the emissions trading scheme set up in 2015, with changes planned under which credits will be charged for rather than freely available as at present, as well as more sectors being covered.

Sector emissions shares and performance



Increasing order of maturity



Source: KPMG International (2021)



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Reflective of this, Lee says that there is a strong trend for Korean companies to announce Net Zero target dates, but as with the government, details may be lacking. Some large companies have pledged to move to using renewable energy, with six members of the SK Group joining RE100, a global initiative through which companies commit to using only renewable power, in December 2020.⁷⁷ A national equivalent, K-RE100, was set up as a pilot by the government in March 2021, with 60 agencies and businesses participating.⁷⁸

Electricity and heat

South Korea is ranked 10th on electricity and heat, with demand- and supply-side market mechanisms for the adoption of clean energy contributing to this. While coal remains the largest source of power, the government has said it intends that 20 percent of power will come from renewables by 2030,⁷⁹ and Korean companies now have solid ways to purchase electricity generated solely from renewable sources through power purchase agreements after the official launch of K-RE100 this year. Some energy-intensive manufacturers have announced their own plans to decarbonize with Posco, the country’s largest steel maker, having said it will move to carbon neutrality by 2050 through the use of hydrogen and carbon capture, utilization and storage technologies.⁸⁰

Transport and buildings

Although power generation and industry are the most significant sectors in moving South Korea to Net Zero, the government has also published specific plans for adopting electric vehicles. Its voluntary K-EV100 project offers financial support for companies that pledge to power their fleets entirely with electricity by 2030, as well as spending announced by the president for charging infrastructure.

Existing widespread availability contributes to South Korea ranking fifth on transport along with a significant number of patents in clean transport. Some local governments are working to adopt electric-powered buses, although there is no national target for this. South Korea is also a leading developer of clean hydrogen technologies for use in cars and shipping.

South Korea ranks third on the buildings sector, a rating supported by the use of efficient heat pumps, mandatory building energy certification and innovation in building energy efficiency and carbon management.

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The government has set strong decarbonization ambitions through green transition work in its COVID-19 recovery plans and intends to move almost entirely to renewable energy by 2050.

Political will

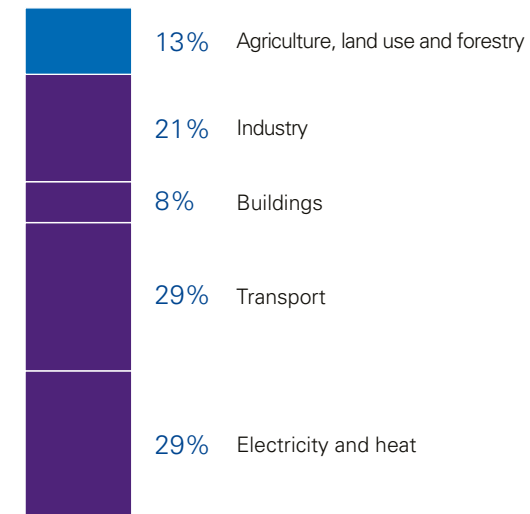
In October 2020, the Spanish government published a national COVID-19 recovery and resilience plan, España Puede (Spain can). Three of its 10 policy levers are partly or fully environmentally focused and 40 percent of its EUR140 billion (USD165 billion) planned public investment, some from EU funding, will be focused on green transition work.⁸¹

Ramon Pueyo Viñuales, Partner, Head of Sustainability and Corporate Governance, KPMG in Spain, says the plan's strong environmental coverage reflects recent political determination to tackle climate change. However, he adds that this has been the subject of polarized opinions in the past and that many initiatives have to be coordinated between the national government and Spain's powerful regions. Work may be needed to maintain public support, such as through the 'just transition strategy' that the country is using to support areas where coal mines have closed.⁸²

Energy transition

Spain plans to use renewables for 97 percent of its energy requirements by 2050, requiring a massive transition away

Sector emissions shares and performance



Increasing order of maturity



Source: KPMG International (2021)



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from current heavy use of fossil fuels in favor of solar, wind and energy efficiency. It aims to become a world leader in generating green hydrogen and is working closely with other countries in developing this sector.⁸³ In a recent review, the International Energy Agency said the country has made progress on electricity generation with renewables already providing a large minority of the supply.⁸⁴ “The energy sector is going in the right direction and there is strong political will, architecture and laws,” says Pueyo.

Green transformation

Spain ranks 12th on the buildings sector, with reasons including use of heat pumps, mandatory building energy certification for new construction and incentives for retrofitting and low-carbon buildings. The country experienced a construction boom in the 2000s and almost two-thirds of the population live

in apartments, one of the highest proportions in the EU.⁸⁵ But while newer and smaller homes have the potential to use less energy, the sector still faces considerable challenges. Pueyo says that many will need renovation to achieve high levels of efficiency. Housing rehabilitation is included in España Puede as a component of its urban and rural policy area, with plans to upgrade more than 1 million homes.⁸⁶

Agriculture and fishing are also covered by the national recovery plan as an area for green and digital transformation and Pueyo says there is significant potential for this. On transport, the priority is electrification, demonstrated by Spain’s plans in legislation to increase electric vehicle numbers to 250,000 with 100,000 charging points, although this is an area where most powers are devolved to regional governments. Industry similarly faces a transition to cleaner energy sources.

Spain plans to use renewables for 97 percent of its energy requirements by 2050, requiring a massive transition away from current heavy use of fossil fuels in favor of solar, wind and energy efficiency. It aims to become a world leader in generating green hydrogen and is working closely with other countries in developing this sector.

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Hungary has a Net Zero target in place and its financial sector is working to stimulate the flow of capital to decarbonization efforts. Much of its electricity is generated by nuclear power and it is developing solar capacity, energy efficiency and use of electric vehicles.



Sector
readiness



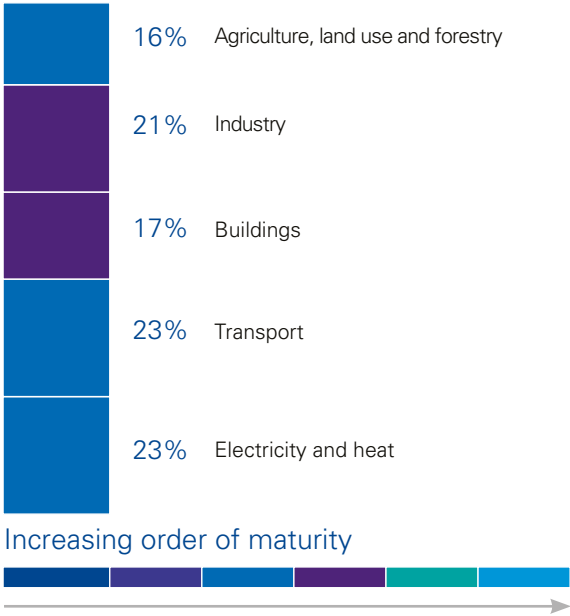
National
preparedness

Political will

Hungary’s government has accelerated work on carbon reduction over the last 2 years, according to István Szabó, Senior Manager, KPMG in Hungary. It is one of five countries that receives the highest score on contribution to global Net Zero, partly as a result of its June 2020 climate protection law that includes a 2050 Net Zero target.⁸⁷

For example, the government is trying to decarbonize transport through tax benefits and cash support for electric vehicles, and encouraging intermodal freight junctions for cities, so containers can be transported mostly by rail with road used for the last few kilometers. Regarding industry, a number of multinational manufacturers have large Hungarian factories which are run to high environmental standards, and the country’s EU membership means all have to meet its standards. Domestically focused companies can potentially benefit from available EU funds and green lending products to make a smooth transition in the following years, says Szabó.

Sector emissions shares and performance



Source: KPMG International (2021)



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Financial sector support

Having started a green program in 2019, in March 2021, the country’s central bank, Magyar Nemzeti Bank (MNB), published its first green report in which it said that the financial sector should do more to integrate environmental and sustainability considerations with regulation now allowing use of the EU’s green taxonomy.⁸⁸ It has also issued green guidelines for banks, among the first regulators in the EU to do so. These include rules that require banks to nominate responsible persons for managing sustainability risks or embedding ESG factors at the credit approval process. It followed this in July with measures to promote green mortgage lending.⁸⁹ MNB plans to introduce a discounted interest rate program for buying or building energy efficient residential properties. Szabó says the central bank’s stance is likely to encourage progress, adding: “If the financial sector is supporting the green transition, the real economy will move in that direction.”

Real economy

However, there are challenges to tackle in the real economy. Around 40 percent of Hungary’s electricity is generated by the Paks nuclear power plant, whose

first unit started generation in 1982, with four now in operation.⁹⁰ A 2014 intergovernmental agreement with Russia agreed construction of two new units which would start generation in the early 2030s, which if it goes ahead, would support Hungary in moving towards Net Zero.

Gas is currently the main alternative source for electricity production, although solar power generation capacity is increasing. Given the dominance of nuclear, which typically generates steady levels of power, and daily fluctuations from solar, grid management organization Mavir has seen issues in balancing supply and demand. As part of a new energy efficiency obligation scheme launched in 2021 targeting electricity, natural gas and transport fuel, the energy regulator has introduced penalties for electricity, gas and fuel providers who are not able to generate sufficient energy efficiency investments.

On buildings, Hungary is ranked 10th due to factors including the use of heat pumps, mandatory building energy certification and incentives to retrofit, some of which are EU measures. Szabó says that new developments tend to be built to high levels of energy efficiency but retrofitting existing ones can be a significant challenge.


On buildings, Hungary is ranked 10th due to factors including the use of heat pumps, mandatory building energy certification and incentives to retrofit, some of which are EU measures.


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United States of America



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As the US re-enters the UN Paris Agreement, a challenge will be to collate the view at the federal and state government level around Net Zero, but it also has high levels of private sector finance and an incredibly active clean tech market.

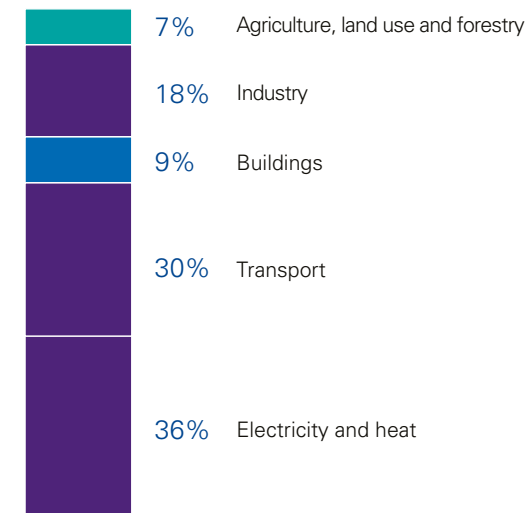
Political will and public opinion

The US is the world's second-largest producer of greenhouse gases. Following the election of President Joe Biden, on 19 February 2021, the country formally rejoined the UN Paris Agreement on climate change. In April 2021, Biden announced the US will aim to reduce emissions by at least 50 percent by 2030 compared with 2005 levels, on the way to reaching Net Zero by 2050.⁹¹

However, at the federal level, progress will likely be slower in terms of regulatory mandates around Net Zero and aligning the full federal government, combined with widely varying attitudes from cities and states. "You have an important political dynamic developing in the US that will be imperative to the country's ability to make progress towards Net Zero," says Mikaela McQuade, Director, Energy, Climate and Resources, Eurasia Group. "Many cities and states are pushing forward with decarbonization plans in spite of federal policy uncertainty."

While many individuals support green infrastructure in principle, these same individuals may oppose nearby projects that they believe would adversely impact their quality of life. However, it is a foregone conclusion that

Sector emissions shares and performance



Increasing order of maturity



Source: KPMG International (2021)



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trends around electrification and renewables will continue in the US. Furthermore, many American businesses and consumers increasingly want to buy from suppliers that share their environmental values, contributing to the private sector becoming active on decarbonization. Adding to that impetus, the investor action on decarbonization and climate change has made further progress in the US. This can be seen through the scope and scale of companies setting Net Zero targets, as well as the high numbers of clean tech companies operating across all sectors of the US economy.

Regulation and private sector finance

Among US strengths are investors who are already putting large volumes of capital into projects that support decarbonization, green bonds, and loans linked to sustainability. To meet shareholders' expectations, companies are finding they are now expected to provide tangible evidence that they understand their emissions and are making progress toward cutting them.

"Due to the flows into ESG capital, increasing investor focus on ESG, and the emerging realization that climate risk directly represents financial risk in many sectors, the Securities and Exchange Commission will likely require greater disclosure of climate risk for public companies, and those requirements will take shape in the near term," says Katherine Blue, IMPACT Advisory Leader, KPMG in the US. "Furthermore, the federal government in the Biden administration is expected to apply a philosophy of using the whole government to drive low-carbon technologies and green infrastructure, which will provide multiple levers through which Net Zero and decarbonization will be pursued. Lastly, the administration has a strong emphasis on climate justice as well, so ensuring that the energy transition does not disproportionately affect minority and under-represented communities in need."

"Additional progress by state and local governments may continue to accelerate through other tax policies, renewable energy targets, and other state requirements and incentives," she adds. "Even without policy and regulatory drivers, the investor interest in ESG, and in particular climate risk and the importance of Net Zero will continue to be a long-term trend and something to which all sectors will need to evaluate and contribute solutions."

Electricity and heat

The country is ranked 11th in the Index on the electricity and heat sector, which is responsible for more than a third of US emissions. In 2019, low-carbon generation including nuclear produced 38 percent of electricity, and the rapidly dropping cost of wind and especially solar energy production are pushing this percentage upwards. Batteries also have a growing role as they become larger, more energy-dense and significantly cheaper, allowing already-produced renewable electricity to be used when it is needed rather than solely when it is generated. Development of tax incentives and policies that accelerate investment in carbon capture, utilization technologies, and direct air capture combustion technologies will play an important role in decarbonizing parts of the energy sector.

Transport

For transport and industrial applications that cannot be directly electrified, switching away from legacy fossil fuels can help reduce emissions progressively, from natural gas and first-generation biofuels to green hydrogen produced with renewable electricity, as well as sustainably produced fuels, including next generation biofuels. US companies have helped pioneer the development and manufacture of electric vehicles, and although electric vehicles currently make up 0.76 percent of overall stock compared with

1.38 percent in Germany and 1.73 percent in China, these numbers are expected to continue to grow rapidly as the cost of batteries continues to drop and more traditional vehicle manufacturers bring their electric vehicle solutions to market. Electrification will remain a substantial trend.

Agriculture

The US is ranked third in the Index on agriculture, land use, and forestry due to a strong policy response to food waste and clean technology innovation, although this sector is responsible for just 7 percent of national emissions. American consumers prefer a high calorie diet, which includes large volumes of meat and dairy, as well as fresh fruit and vegetables transported large distances to satisfy demand regardless of season. The food system also generates high levels of end-user waste. All of these issues will pose challenges in decarbonizing the sector.

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Singapore



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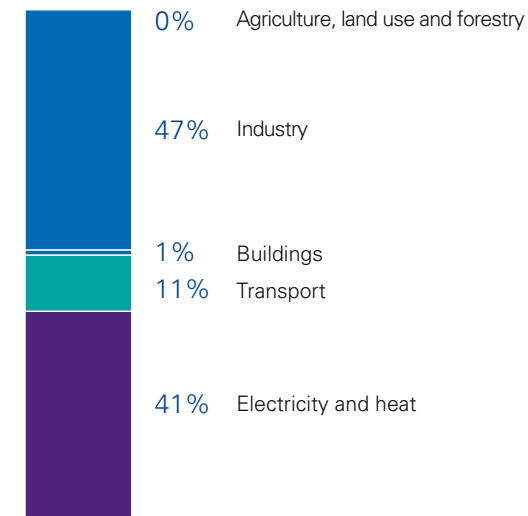
The city-state faces challenges such as space constraints for renewable energy generation. To advance the national agenda for sustainable development, it has announced a wide-ranging Green Plan covering finance, transport, energy efficiency and vertical farms for local agriculture.

Economic exposure

The Singapore government has not set a formal target date for achieving Net Zero emissions, although it aims to halve emissions from an expected 2030 peak by 2050, with Net Zero following as soon as viable.⁹² It faces specific challenges as a city-state, such as having little space for renewable energy generation and a significant manufacturing sector, as well as being a hub for shipping, aviation and tourism. Oil and gas refining and petrochemical processing generate around three-quarters of industrial emissions.⁹³

However, it does have transformative plans for change. In February 2021, the government published a 2030 Green Plan which seeks to tackle climate change through a wide-ranging set of initiatives covering areas developing carbon services and green finance, planting one million trees and opening new parks. "As a low-lying island, Singapore remains fundamentally vulnerable to the impact of climate change, which poses an existential threat to us," said Senior Minister Teo Chee Hean in a speech in March. "We take a considered, committed and collective approach to the global climate crisis."⁹⁴

Sector emissions shares and performance



Increasing order of maturity



Source: KPMG International (2021)



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“Singapore has turned its natural disadvantages like lack of land, water and natural resources into opportunities by focusing on building capabilities, harnessing technology and innovation and being relevant to global value chains,” says Satya Ramamurthy, Head of Infrastructure, Government and Healthcare, KPMG in Singapore. “It is putting sustainability at the heart of its new economic strategy to emerge stronger from the pandemic. Singapore can also play a role in reducing other countries’ emissions by developing green financial and logistical services.”

Energy transition

The city-state is planning to quadruple its solar power generation by 2025 and has deployed floating panels on reservoirs.⁹⁵ It is considering imports of green electricity from Malaysia and even Australia, although the latter would require the world’s longest undersea power cable.⁹⁶ It is developing use of liquid natural gas as a transitional fuel and the Green Plan includes commitments to improve energy efficiency in homes, schools and offices. Cherine Fok, Director of Sustainability Services, KPMG in Singapore, says the government is taking a leadership role, including on procurement. “The signaling for the market is very strong,” she says.

Singapore is ranked eighth on the transport sector, partly due to very low transport emissions per person, incentives for electric vehicles and an active clean technology industry in the sector. Although it was

later than some countries in starting to adopt electric vehicles, new diesel cars and taxis will be banned from 2025, with further road tax incentives to adopt electric vehicles and a plan to phase out all internal combustion engine vehicles by 2040.⁹⁷ It is also a leading developer of clean shipping fuels including liquefied hydrogen, liquid ammonia and synthetics as part of its ambition to remain the world’s biggest maritime fuel hub and a leading port.

Singapore ranks fifth on agriculture, land use and forestry and plans to produce 30 percent of its food locally by 2030, including through vertical farms which grow food in towers. However, this will require a significant cost reduction or subsidization of electricity to do this at the scale required.

Holistic approach

The government will encourage industries to continue to shift toward lower-energy advanced manufacturing, including through high prices for water usage, and has paused the development of new datacenters given their high power use.⁹⁸ Singapore has also implemented a carbon tax and new mandates to reduce waste. The government launched a Towards Zero Waste plan in 2019 to address food, electronic and packaging waste, adopting new technologies and circular measures. It is encouraging green financial solutions through increased reporting requirements and the development of green bond markets.

“Singapore has turned its natural disadvantages like lack of land, water and natural resources into opportunities by focusing on building capabilities, harnessing technology and innovation and being relevant to global value chains,” says Satya Ramamurthy, Head of Infrastructure, Government and Healthcare, KPMG in Singapore.

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Chile



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A leader among developing countries, Chile is taking advantage of its abundant solar resources with infrastructure and mechanisms to decarbonize electricity, although, work remains on increasing adoption of electric vehicles and investing in green technologies.

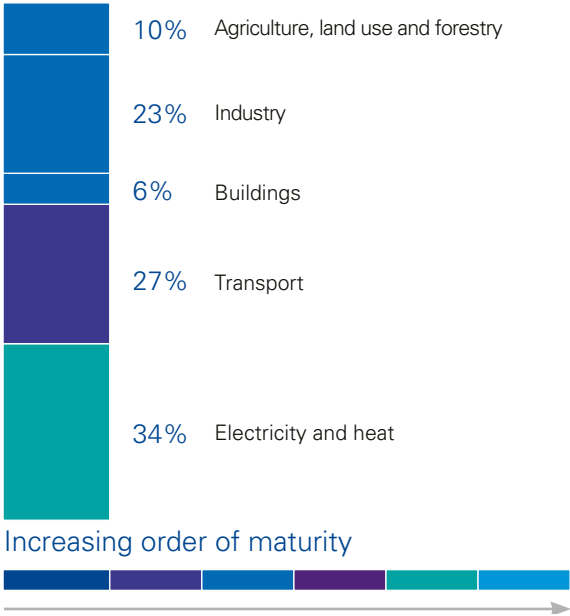
Political momentum

Chile is a leader among developing countries in its commitment to moving to cutting emissions, with a target of reaching Net Zero by 2050. In April 2020, it published detailed plans that would cover 93 percent of the reductions required, with a focus on energy generation. The plan commits Chile to decarbonize electricity generation by 2040, including the closure of 10 coal-fired plants, although this could be brought forward.

The environment ministry said that meeting the Net Zero goal would create investment opportunities of USD27–49 billion by 2050, while research has suggested a move to renewable energy could save the country more than USD5 billion annually, as well as reducing deaths from air pollution and creating 11,000 new jobs.⁹⁹

However, Karin Eggers, Sustainability, Climate Change and Human Rights Director, KPMG in Chile says that Chile faces some challenges in meeting its decarbonization targets. These include the need to increase co-operation between government, international organizations, academia, civil societies and businesses. The country also needs to invest more in science and innovation, with

Sector emissions shares and performance



Source: KPMG International (2021)



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it currently spending less than other OECD member countries, and needs to develop better monitoring processes, among other changes. “This requires transformative action in society and the economy,” she says.

Renewable energy abundance

The Atacama desert in northern Chile is among the best places in the world for solar power, with its dryness leading to very high levels of irradiation.¹⁰⁰ In April 2021, the Cerro Dominador concentrated solar power plant was linked to Chile’s electrical system, following 7 years of construction. Unlike conventional photovoltaic solar power that works only during the day, the plant generates power continuously by using 10,600 giant mirrors to focus sunlight on a receiver on the top of a tower, super-heating molten salts that are stored then generate electricity by driving steam turbines.¹⁰¹ Southern Chile has strong potential to increase wind power generation and the country plans to develop industrial capacity to generate green hydrogen from renewable electricity. “Our geography gives us big opportunities to produce renewable energy,” says Eggers.

In July 2021, the government announced it will close four coal-fired power plants which generate pollution in populated areas by 2025, earlier than previously planned. This reduces the number of coal stations the country will continue to run until 2040 to 10, compared with 28 at present.¹⁰² Overall, Chile is ranked third in the electricity and heat sector as a result of renewable energy obligations for utilities, availability of tradeable renewable energy certificates, net metering, a strong investment pipeline for the grid and existence of a low-carbon hydrogen roadmap.

Transport, industry and buildings


Chile published a national electromobility strategy in 2017, again seeing the potential for economic development as it tackles climate change. This has a focus on public transport, with a plan that services will be 100 percent electric by 2050 with Santiago already having 200 electric buses in operation. However, Chile currently has low use of electric vehicles and low availability of electric charging infrastructure. In other sectors there is work to introduce low-carbon technologies in industry and mining, and make buildings more sustainable.


In July 2021, the government announced it will close four coal-fired power plants which generate pollution in populated areas by 2025, earlier than previously planned. This reduces the number of coal stations the country will continue to run until 2040 to 10, compared with 28 at present.

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Australia

17th

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19th

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18th

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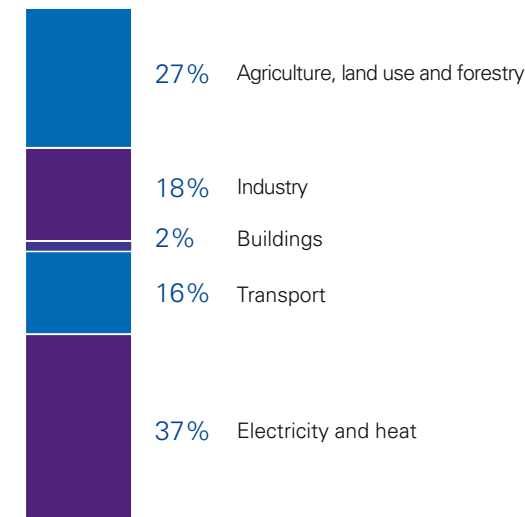
Australia has not yet confirmed a national target date to achieve Net Zero and still relies heavily on coal. However, state governments, the private sector and the public are pushing to accelerate the transition with heavy investment in the development of clean hydrogen.

Political pressure

Australia ranks fifth on the policies and enabling environment category, in part due to the strength of the federal government's legal and regulatory infrastructure, which will help it to tackle climate change and strong reporting requirements that are in place and provide a very clear picture of emissions.

In April 2021, Prime Minister Scott Morrison said the country would move to Net Zero "as quickly as possible and preferably by 2050," but has not committed to this.¹⁰³ "The interjection of climate policy into many other elements of foreign policy — including free trade agreements with the EU, the proliferation of proposed carbon border adjustment mechanisms or critical mineral cooperation strategies with the US — has raised the pressure on Canberra to make deeper, more credible climate commitments," says Henning Gloystein, Director, Energy, Climate and Resources, Eurasia Group. "2021 will prove to be a pivotal year to understand if the EU, as well as countries like the US and UK, will use carrots or sticks to exhort further emission reductions from Australia."

Sector emissions shares and performance



Increasing order of maturity



Source: KPMG International (2021)



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Many businesses are showing greater willingness than the federal government to join states in setting emission reduction and Net Zero targets, influenced by customers locally and internationally as well as investors. “It’s a pretty obvious direction of travel, and so even in the absence of strong federal policy direction they are getting on with it,” says Adrian King, Partner in Charge, Climate Change and Sustainability, KPMG Australia.

Sectoral exposure

Agriculture, land use and forestry is currently the country’s second-largest sector for emissions with a high emissions intensity and high dependence on meat and dairy in the country. Meat and Livestock Australia, a trade body, has said that red meat production can be carbon neutral as early as 2030 through changes including feed and farm management.¹⁰⁴ It has collaborated with the national science agency CSIRO and James Cook University to develop FutureFeed, a seaweed-based dietary supplement that could greatly reduce methane emissions from cows and other ruminants.¹⁰⁵

The country also continues to rely on coal, both for power and exports from its large mining industry, which will challenge its decarbonization efforts. However, there are significant investments being made in the production of clean hydrogen and export plans in collaboration with Japan and the EU.

State level activity

All of Australia’s states plan to get at least half their electricity from renewables by 2030, as part of the targets each has set to reach Net Zero by 2050, with energy primarily a state rather than federal responsibility. “The consensus across the states is influencing the way businesses are approaching this in Australia,” says Barry Sterland, National Lead on Energy Transition, KPMG Australia.

New South Wales’s electricity infrastructure roadmap plans five renewable energy zones in rural areas that will use wind, solar, battery storage and high-voltage grids to replace capacity ahead of the closure of thermal power stations.¹⁰⁶ Victoria’s recently-announced emissions target to halve emissions by 2030 incorporated the outcome of the negotiated closure of a major coal-fired power station. Beyond that many commentators consider further penetration of renewable energy and emissions reductions towards Net Zero look likely to lead to the early closure of the state’s coal-fired power stations.¹⁰⁷ Other states also have ambitious plans, with both South Australia and Tasmania planning to generate all the electricity they need from renewables and sell surpluses.¹⁰⁸

Despite legislation being in place, Australia has not enacted regulations that would enable an emissions trading system and it repealed a carbon pricing system for industry. Sterland says that transport, where responsibilities for what is currently a very carbon-intensive sector are split between federal and state governments, lacks a coordinated national approach despite action by states such as New South Wales and Victoria to promote electric vehicle adoption.

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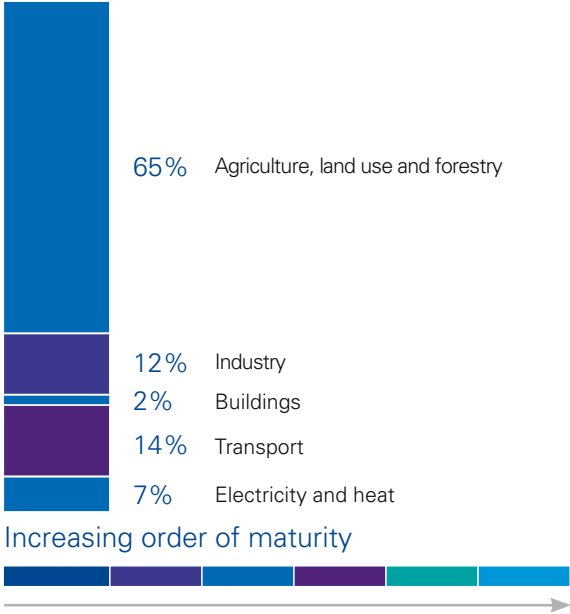
Brazil plans to become climate neutral by 2060. It makes strong use of hydropower and is developing other reliable renewable energy sources, but deforestation and forest fires are strongly limiting its ability to reach Net Zero.

Developing renewable capacity

For decades, Brazil has made extensive use of hydroelectric power for electricity. This gives it a head start on the road to Net Zero, which its government plans to meet by 2060 with an interim reduction of 43 percent on 2005 levels by 2030.¹⁰⁹ However Manuel Fernandes, Energy and Natural Resources Co-Lead for the Americas, KPMG in Brazil, says that the country is working to diversify its green energy sources, given the massive land requirements of hydroelectric reservoirs and their unreliability in dry seasons.

Norwegian energy group Equinor, which has been involved in oil and gas exploration and production in Brazil for 2 decades, made Brazil the site of its first solar energy farm which opened in 2018¹¹⁰ and has applied to build an offshore wind farm near Rio de Janeiro.¹¹¹ In March 2021, hydrogen energy company Eneix announced it would build the world’s largest green hydrogen plant in Ceara in Brazil, which will use solar and onshore wind to create hydrogen.¹¹² But the country is also likely to continue to exploit its oil reserves along with natural gas as a cleaner interim option. “We cannot give up fossil fuels until we have trusted sources of renewables,” Fernandes says.

Sector emissions shares and performance



Source: KPMG International (2021)



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Deforestation and carbon sink opportunity

Brazil relies economically on agribusiness and is working to adopt technology that would reduce its emissions. However, such work is undermined by deforestation and wildfires in recent years across the Amazon rainforest, which are hugely detrimental to the country’s ability to reach Net Zero. A study published in the scientific journal Nature in April 2021, found that some areas of the world’s largest tropical forest are net emitters of carbon dioxide due to tree loss, and that the Amazon region was a net contributor to climate change between 2010 and 2018.¹¹³ Resulting lower precipitation levels are leading to higher prices of electricity from hydropower, leaving the country to rely increasingly on liquid natural gas imports. Brazil could see commercial, as well as environmental benefits, if it reversed course and undertook significant afforestation and reforestation to sequester CO₂ in carbon sinks.

Sectoral transformation

Brazil performs relatively well on transport where it is rated 12th of the countries in the NZRI, partly due

to relatively low emissions per person, low-carbon fuel mandates and obligations to blend biofuels with standard vehicle fuels. The country mainly uses sugarcane to produce ethanol and soybeans for biodiesel, and around 70 percent of gasoline vehicles can run on ethanol alone.¹¹⁴ However, growing the crops for biofuels has been linked to deforestation. Another issue is that many trucks, which the country relies on for freight, use diesel and more investment will be needed to change this, Fernandes says.

There are significant challenges for businesses in Brazil given its reliance on energy-intensive sectors. Many companies are making commitments to reduce emissions, but while some including Brazilian mining group Vale have detailed plans — in its case to become carbon neutral by 2050, partly through the use of an internal carbon price¹¹⁵ — others are less clear. “These commitments from big companies are important, but we still need to see much more detail on how they are doing this,” Fernandes adds.

Brazil relies economically on agribusiness and is working to adopt technology that would reduce its emissions. However, such work is undermined by deforestation and wildfires in recent years across the Amazon rainforest, which are hugely detrimental to the country’s ability to reach Net Zero.

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Poland



**Net Zero
Readiness Index**



Sector
readiness



National
preparedness

The country has not committed to a Net Zero target and faces a huge challenge to shift away from coal, including softening the impact on mining areas. It has adopted an energy strategy to escalate the shift to renewables including wind power.

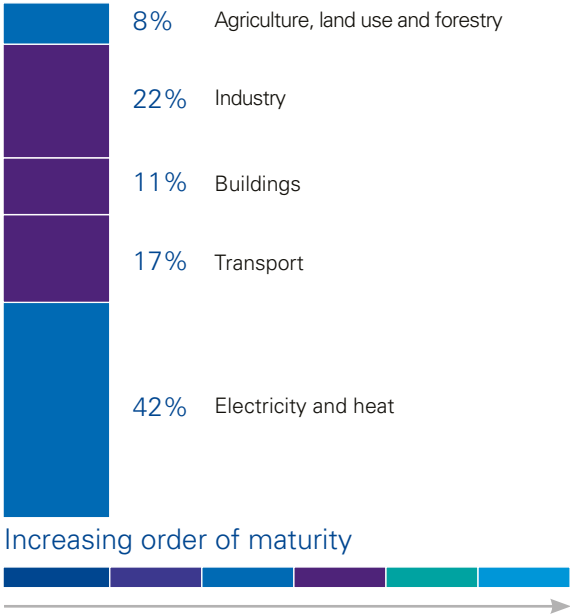
Energy transition

Awareness of climate change and the work required to tackle it has risen over the last decade, according to Kiejstut Żagun, Partner Associate, Tax, Innovation, Grants and Incentives, KPMG in Poland: “This makes change possible,” he says, adding that the country is making incremental progress in a number of areas.

However, the country is currently the lowest-placed EU nation in the NZRI. This is partly because of its heavy use of coal, used to generate 52 percent of electricity, the same proportion as Indonesia with only India and South Africa higher. “This is the biggest challenge we have at the moment, to transfer to more renewable energy,” Żagun adds.

With the majority of Polish power plants over 3 decades old, there are opportunities to replace them when they are decommissioned with alternative sources, including nuclear and renewables. In February 2021, the government adopted PEP2040, an energy transformation strategy for the next 2 decades that will reduce use of coal, establish a new nuclear plant and introduce more renewable energy.¹¹⁶

Sector emissions shares and performance



Source: KPMG International (2021)



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Poland already makes use of onshore wind generation and is looking to develop offshore wind, with the government passing legislation in early 2021 that is designed to help promote its use in the Baltic Sea.¹¹⁷ Solar power is less effective than in other countries but is being installed by some homeowners along with heat pumps, partly in response to increasing energy prices.

Transport

City transport is decarbonizing with increasing adoption of electric buses and cars, as well as the continued use of electric trams, but there is less progress on travel outside urban areas. Poland has the joint oldest average passenger car age of 14 years of the countries in the NZRI, and many cars run on diesel or have higher emissions than newer vehicles. However, the government is providing support for transport to move away from fossil fuels, including through subsidies and legislation for electric charging and hydrogen refueling infrastructure.¹¹⁸


Industry


Many of Poland’s industrial plants have been built over the 3 decades since the end of Communism and are relatively carbon-light as a result. In 2019, the government adopted a roadmap to move toward a circular economy model. It includes 41 measures across environment, education, energy, infrastructure, social policy, agriculture and public health which aim to minimize waste and use it as a raw material. As well as lowering emissions, the model aims to be resource-efficient and support innovation.¹¹⁹

New industry could help with the transition away from coal, which will have a major impact on communities that currently depend economically on it. Żagun says that the process should be eased by EU funds dedicated to supporting such regions and the growing Polish economy creating new industrial jobs in sectors, such as vehicle manufacturing.


Poland already makes use of onshore wind generation and is looking to develop offshore wind, with the government passing legislation in early 2021 that is designed to help promote its use in the Baltic Sea.

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China



**Net Zero
Readiness Index**



Sector
readiness



National
preparedness

China is the world’s largest emitter of greenhouse gases with a reliance on coal for energy, however, it is rapidly developing renewable generation. The government has set a 2060 Net Zero emissions target and launched a carbon emissions trading scheme.

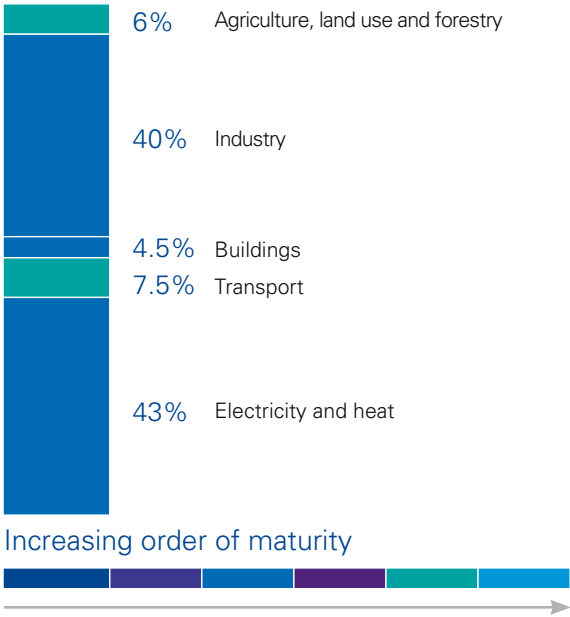
Political will

China, which has both the world’s largest population and largest manufacturing sector, is also the largest emitter of greenhouse gases in total, although levels per person are lower than many other countries. It is dependent on coal for much of its energy but is actively promoting a clean energy strategy to lower the carbon intensity of power generation. In July 2021, it opened a national carbon emissions trading scheme covering more than 2,000 power plants, with plans to add other industrial sectors.¹²⁰

In September 2020, Chinese President Xi Jinping informed the UN General Assembly that the country would aim for peak carbon emissions before 2030 and would reach carbon Net Zero by 2060.¹²¹ These dates are later than those pledged by many other countries in the NZRI. However, they mean the country would move from peak carbon to Net Zero in three decades, about half the time of countries which made progress with decarbonization long before China, says Daisy Shen, Partner, Climate and Sustainability, KPMG in China.

She adds that Xi’s announcement has also given new momentum to public and private sectors efforts to decarbonize: “We are seeing that ESG demands are transitioning from regulator-driven to enterprise-driven,” she says.

Sector emissions shares and performance



Source: KPMG International (2021)



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Uptake of renewable energy

China already has the world’s highest level of renewable energy capacity of 925GW in 2020, around three times as much as the US.¹²² It added 72GW of wind and 48GW of solar in 2020, both big increases on 2019.¹²³ Despite this effort only 33 percent of its electricity came from low-carbon sources in 2018, highlighting the need for the country to continue its rapid expansion of renewable generation.

The country’s National Energy Administration recently published policies on minimum proportions of solar generation on roof areas in pilot cities and counties for different types of buildings, including 50 percent for government buildings, 40 percent for schools and hospitals and 30 percent for commercial buildings. In response to the policy, provinces including Fujian, Guangdong, Jiangxi, Shaanxi and Shandong have accelerated the installation of solar rooftop generation.

Industry and financial sectors

Some key companies in high-emission sectors have announced timetables and goals to achieve carbon neutrality through measures covering energy consumption, energy efficiency and increasing use of renewables. International measures including the EU’s proposed carbon border adjustment mechanism that impose a cost on certain carbon intensive goods are contributing pressure to decarbonize.

In March 2021, a Chinese government consultancy said that steel production, which makes up 15 percent of emissions, will peak in 2025 along with emissions from the sector.¹²⁴ In January 2021, Baowu, the country’s largest steelmaker, said it will aim for carbon neutrality by 2050, a decade ahead of the national target and matching commitments by its international competitors, with peak emissions in 2023 and a cut of 30 percent by 2025.¹²⁵ And Sinopec, the country’s largest oil company, has set up an investment unit that includes new energy as well as conservation and environmental protection.¹²⁶

Shen says that the development of green finance will increasingly affect Chinese companies. Financial institutions are required to factor climate risks into credit and lending policies, optimize business structures and reduce high carbon emission projects in portfolios. Businesses that comply with green finance standards and relevant regulations will receive more incentives and financial support. “Green finance is causing a lot of changes in what Chinese banks and their clients are doing,” she says.

Agriculture, land use and forestry

China is rated second among the 32 countries in this research on agriculture, land use and forestry, due to factors including relatively low consumption of dairy per person, strong performance on limiting food losses and waste. The area of land covered by forest is calculated by the UN Food and Agriculture Organization as increasing at 0.85 percent annually, the highest figure of the countries covered by the NZRI. While trading for carbon sinks is yet to be introduced in China, the development of a carbon market would be the next step for the sustainable development of the forestry industry.

Transport and buildings

The country is ranked fourth in the transport sector, partly due to the high availability and use of public transport, having developed the world’s longest high-speed rail network over recent decades. China also has the world’s largest electric vehicle market, with 5.4 million in use in 2020¹²⁷ — nearly half of the global fleet — leading to local carmakers entering the market. In addition, the country is investing heavily in the development of battery manufacturing technology and building electric vehicle production capacity. China’s national target is to have ‘new energy’ vehicles making up 20 percent of new car sales by 2025.

In the buildings sector, Shen says that technology is seen as a way to reduce emissions, including through use of green energy, effective energy management and applying green building standards in property development.

Chinese President Xi Jinping informed the UN General Assembly that the country would aim for peak carbon emissions before 2030 and would reach carbon Net Zero by 2060.

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Malaysia



**Net Zero
Readiness Index**



Sector
readiness



National
preparedness

The country produces oil, liquid natural gas and palm oil, uses coal in power generation and subsidizes gasoline, giving it a lot to do to reach Net Zero. But it has some strong initiatives in place including its Green Technology Financing Scheme.

Political direction

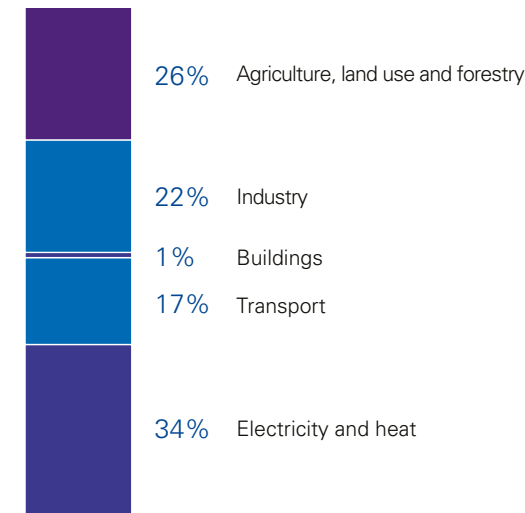
In response to the threats of global warming, Malaysia has adopted the Paris Agreement and committed to a 45 percent reduction in emissions intensity of GDP by 2030 compared to a 2005 baseline.¹²⁸ As of 2019, the country was able to reduce its carbon emissions intensity rate to 33 percent¹²⁹ but additional support in the form of climate finance and technology transfer could drive further decarbonization.

In September 2021, following the release of the 12th Malaysia Plan, Malaysia's prime minister announced a carbon-neutrality target of 2050. The government will no longer build new coal-fired power plants and a comprehensive National Energy Policy will soon be introduced. Carbon pricing and carbon tax will be introduced alongside other carbon reduction measures after a review of the low-carbon development strategies by the end of 2022.

Malaysia primarily uses coal and natural gas to generate electricity. The installed capacity of coal power plants forms approximately 40 percent of the total capacity.

"Malaysia's challenge is to decarbonize its energy-centric economy in the face of population growth pressures and poverty outside of urban areas. The transition to net carbon

Sector emissions shares and performance



Increasing order of maturity



Source: KPMG International (2021)



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zero will require not just political will but also significant structural and legislative reforms on a national scale,” says Phang Oy Cheng, Executive Director of Sustainability Advisory, KPMG in Malaysia.

One of the government’s strengths is introducing the Green Technology Financing Scheme (GTFS), which is to subsidize work in sectors including renewable energy, buildings, transport and manufacturing.¹³⁰ Through this scheme, the government is able to facilitate more green projects and businesses.

Policy signals

Malaysia published a national electric mobility blueprint in 2015, which aimed for 100,000 electric cars by 2020¹³¹ but Phang says that implementation has been slow with low uptake of electric vehicles and little availability of electric vehicle charging infrastructure. The country also subsidizes gasoline.

The outlook on buildings is brighter, with GTFS funding and tax incentives for green development. New buildings typically meet standards for energy and water-use efficiency due to the implementation of appliance and efficiency standards, although these do not cover construction and materials. Malaysia also has some buildings that meet the World Green Building Council’s platinum standard.

Malaysia has also established the Energy Audit Conditional Grant, an energy efficiency program under the 12th Malaysia Plan, for implementation between 2021–25.¹³² It is supported by grants for organizations in the commercial and industrial sectors to help them collaborate with local energy service companies registered with the Energy Commission to conduct energy audits in their buildings.

Tenaga Nasional Berhad (TNB), the government-owned monopoly utility, buys renewable power from independent producers and offers customers rooftop solar panels with the option of selling excess power back

to the company.¹³³ There have been some progression toward its green agenda where TNB has stated that its Jimah East electricity generation facility, commissioned in 2019, will be its last new coal-fired power plant, as it has pledged not to invest anymore in greenfield coal-fired power plants. This is in line with the company’s transition to cleaner and more sustainable energy.¹³⁴

Currently, it is observed that the main drivers of climate change action are largely by private initiatives from the business sector. In October 2020, PETRONAS, the Malaysian oil and gas group, set an aspiration to achieve Net Zero emissions by 2050, partly by making existing operations more efficient but also by developing low and zero carbon fuels and carbon capture technologies.¹³⁵

Around three-quarters of Malaysia’s industrial output is from small and medium enterprises, which will typically need government guidance and regulation to decarbonize, but at present this is lacking although there is evidence of circular economy incentives. Similarly, a well-run carbon market and pricing would provide companies with a standard way to measure their progress and help them access green capital, underlining the need for these to be introduced.

From the investors’ perspective, sustainable investing is viewed as pivotal to climate change action. The country’s pension fund, the Employees Provident Fund, has announced its aim to having a fully ESG-compliant portfolio by 2030, through its sustainable investment policy and became the signatory of the UN Principles of Responsible Investment.¹³⁶ With that, there is likely to be more inflow of funds towards the ESG agenda, including Net Zero.

As for the financial services sector, financial institutions are under increasing pressure by investors, regulators and other stakeholders to mitigate the possible risks arising from climate change. However, the challenge is in assessing, quantifying and managing those risks. Bank Negara Malaysia, Malaysia’s central bank,


has implemented initiatives for the financial sector to address issues on climate change, which include the Climate Change and Principles-based Taxonomy (CCPT) and the Value-based Intermediation Guidelines (VBI). The CCPT aims to classify activities based on their impact on climate change and to steer financial flows toward activities that promote the transition to a lower carbon economy.¹³⁷ The VBI is aimed to provide the outcomes of Islamic financing to generate positive and sustainable impact to the economy, community and environment.¹³⁸


On agriculture, some palm oil plantations have used waste biomass to provide electricity for several years, although mills tend to be relatively old and could be more efficient. Palm trees are not currently recognized as a way to lock up carbon, but Phang says this could be explored.

While Malaysia scores high on forestry as a proportion of total land area, more work could be done to certify and protect these forests. According to the Plantation Industries and Commodities Ministry, Malaysia, through the Malaysian Sustainable Palm Oil, is committed to limit the total oil palm cultivated areas at 6.5 million hectares, to halt deforestation and ensure its oil remains sustainable. This means that the industry must accelerate its productivity through technology.¹³⁹


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Argentina



Net Zero
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readiness



National
preparedness

Argentina has recently committed to a 2050 Net Zero target but faces major economic challenges in the wake of COVID-19. The country is still heavily reliant on fossil fuels and has progress to make on reducing car use and deforestation.

Political priorities

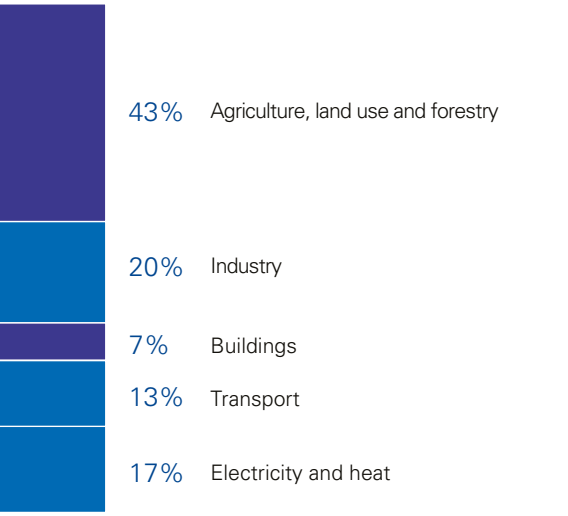
In December 2020, Argentina committed to reaching Net Zero by 2050 along with a new interim absolute emissions reduction target that would limit emissions to 359MtCO₂e annually by 2030, 25 percent lower than its previous target set in 2016.¹⁴⁰ It has established a national climate change council, an information system to track greenhouse gas emissions and committed to zero net deforestation by 2030.

But despite these announcements, the government faces major, unexpected economic and social challenges. It is focused on restructuring the country’s sovereign debt with external creditors, getting out of default and supporting its vulnerable population. Tackling the COVID-19 pandemic crisis has reshaped and redefined the government’s public priorities, according to Romina Bracco, Governance, Risk and Compliance Services and ESG Partner, KPMG in Argentina.

Sectoral transition

Energy production remains heavily reliant on fossil fuels, with renewables, including solar, wind, geothermal and biomass, making only small contributions despite the country having significant knowledge in this area.

Sector emissions shares and performance



Source: KPMG International (2021)

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The government has pledged to undertake an energy transition by 2030, but Bracco says it should speed up the transition by resuming previous initiatives to promote renewable production or encouraging industries to report on climate change risks and mitigation, and decarbonization plans.

On transport, the government is looking to improve electric rail networks in cities and move to electric buses, but Bracco says it could do more to discourage car usage — for which fossil fuels are currently subsidized — and encourage the use of public transport and help to make freight transportation more efficient. Adoption of electric vehicles and provision of charging infrastructure remains very low.

Much deforestation continues to take place and there are few measures in place to manage, protect and verify the extent of forests in the country. There is also scope to incorporate more sustainable production practices across agricultural industries.

Private sector and public support

At present, only a few companies publish standardized data on greenhouse gas emissions, often because they are subsidiaries of foreign groups that are required to do this by their home governments. Bracco says that Argentinian companies tend to publish only good news about their environmental work: “There has to be a requirement locally for companies to start talking about how they impact our environment,” she says. “It’s very difficult to reinforce or put pressure on private entities, such as for more information on their emissions, or considering penalties for not being compliant.” Without such data, she adds, it is questionable whether the 2030 targets will be met.

As well as enabling better tracking of companies’ performance, better data would allow consumers to make choices that take into account environmental impacts. It would also help in supporting long-term plans to raise Argentinians’ awareness of climate change, something the government pledged to do in its 2030 commitment.

Tackling the COVID-19 pandemic crisis has reshaped and redefined the government’s public priorities, according to Romina Bracco, Governance, Risk and Compliance Services and ESG Partner, KPMG in Argentina.

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Mexico



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readiness



National
preparedness

Mexico has yet to set a Net Zero target but it has a solid regulatory framework, including reporting requirements for heavy producers of greenhouse gases. Good progress is being made, although more cooperation between public and private sectors is still needed.

Energy sector

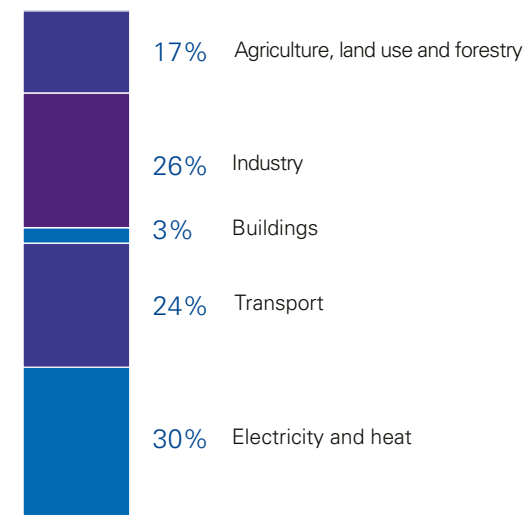
Mexico's government is aiming for both sustainability and self-sufficiency based on energy sovereignty, according to its National Development Plan's energy sector program. To achieve this, it plans to increase the productivity and efficiency of the current hydrocarbon-based energy system, as well as to construct a new, sovereign energy system that incorporates clean and renewable energies in a meaningful and orderly manner.

This will require the government to establish coordinated integration, organization and strengthening of capacity for scientific research, technological development and engineering, and capital goods industries and other producers of goods and services, which allow increases in productivity and efficiency. Importantly, strategies to promote renewables need to be strongly grounded on clear actions.

Laws and government action

The country passed its General Law on Climate Change in 2012 and more specific rules have followed. "Mexico has a solid regulatory framework in this area," says Alicia Moreno, Senior Manager, KPMG in Mexico.

Sector emissions shares and performance



Increasing order of maturity



Source: KPMG International (2021)



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The government has established a mandatory reporting and verification system for facilities with annual emissions over 25,000tCO₂e.

In December 2020, Mexico updated its UN climate change nationally determined contributions. It made unconditional pledges to reduce greenhouse gas emissions by 22 percent and black carbon emissions (soot generated by incomplete burning of fossil fuels) by 51 percent by 2030 compared to its business-as-usual baseline, with conditional contributions of reducing up to 36 percent of greenhouse gases and 70 percent of black carbon.¹⁴¹

The government is currently piloting an emissions trading system, which Moreno sees as a promising development. However, she adds that it could do more to back up its climate change commitments with further action and financing while enhancing private-public collaboration efforts. As an additional challenge, developing and maintaining energy infrastructure can be difficult as a result of high levels of organized crime in the country.

Overall, Mexico’s work to move towards Net Zero requires increasing support for emissions reduction projects as well as larger incentives for voluntary action. “It is essential to promote and reward the companies that reduce, avoid or remove emissions,” Moreno says, including through tax breaks, enhanced investment in emissions capture, offset and reduction projects and lower interest rates on loans among other actions.

Public-private engagement

Some of Mexico’s companies are undertaking ambitious plans to cut emissions, both domestically and around the world. In transport, private sector organizations are undertaking decarbonization projects such as the promotion of electric, hybrid and biomass-driven vehicles, as well as more efficient conventional ones. However, these initiatives are largely voluntary efforts because there is no ban on combustion engines in place, uptake of electric vehicles is low and there is a lack of availability of electric vehicle charging infrastructure. Similarly, in the building sector the government promotes efficiency improvements but further attention and investment from both the private and public sectors should be encouraged.

In agriculture, there are strong projects in areas including the use of solar-thermal energy, biodigesters, network interconnected photovoltaic systems, energy efficiency and monitoring. The government supports such work, but it could do more to strengthen it. Organic waste loss in general and end-user waste could be significantly improved through stronger collaborative action.

Overall, public, private and third sectors are working together toward achieving the aims of the UN’s 2030 Agenda for Sustainable Development, which includes specific targets in the promotion of emissions reductions. However, Moreno says that strategic decision making, further financing, stronger collaboration and support should be encouraged in promoting renewable and clean energy, as well as in carbon capture projects to pursue deep decarbonization targets.

Overall, Mexico’s work to move towards Net Zero requires increasing support for emissions reduction projects as well as larger incentives for voluntary action.

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Turkey



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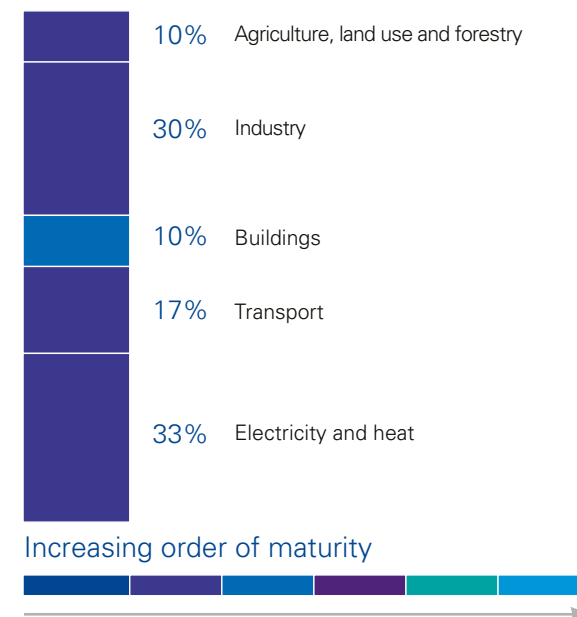
Despite its present low level of readiness, a focus on energy security and determination to use coal reserves, Turkey is moving in the right direction through private sector and investor pressure and its links with the EU.

EU alignment

Turkey is technically an official candidate country to join the EU,¹⁴² with ongoing negotiations that started in 2005, although these stalled in 2016.¹⁴³ "EU directives are broadly transplanted into Turkish legislation," says Sirin Soysal, Partner, Audit and Assurance, KPMG in Turkey, as a result of this status.

This has led to Turkey introducing a version of the monitoring, reporting and verification of large greenhouse gas emitters used in the first phase of the EU's emissions trading system, established with support from the German federal government, which covers more than 700 industrial sites.¹⁴⁴ The country recently introduced requirements for large Turkish companies to publish annual data on greenhouse gas emissions, based on an EU financial reporting directive, although some already did this voluntarily.

Sector emissions shares and performance



Source: KPMG International (2021)



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Private sector and energy demand

In general, Soysal says that companies in the financial, telecoms, and food and drink sectors are among those spearheading national efforts to reduce emissions. This is partly because they are consumer-facing companies subject to customer and investor pressures, but partly because many are subsidiaries or joint-ventures of multi-national groups that have made global commitments on climate change.

Turkey’s need for energy is growing with its population and economy, and its focus is on security of supply rather than emissions. It does not have significant sources of oil and natural gas but does have large coal reserves, which it exploits as an important part of its energy supply.

The government’s long-term energy strategy includes big increases in renewable sources including solar and wind, but with coal continuing to provide a similar proportion of energy as it does now. However, the EU’s plans for a carbon border adjustment mechanism

as outlined in the ‘Fit for 55’ package could have a significant impact on Turkey’s energy plans and export industries, some of which are particularly hard to decarbonize. The EU is a significant and growing trade partner of Turkey, buying nearly 40 percent of its total exports. Steel is the fourth largest sector with exports worth USD3.27 billion from January to June 2021.¹⁴⁵

Transport and buildings

The country has one of the lowest scores on transport sector readiness. At present, there is very little use of electric vehicles, very limited infrastructure, no tax incentives to support their adoption and no plans to ban internal combustion engines. Soysal says that heavy taxes on vehicle imports, which can exceed the original cost, provide further discouragement to adopt low-emission vehicles. It ranks relatively well at 13th on buildings, due partly to a good national preparedness score from the International Energy Agency for use of heat pumps and the use of mandatory building energy certification.

Turkey’s need for energy is growing with its population and economy, and its focus is on security of supply rather than emissions. It does not have significant sources of oil and natural gas but does have large coal reserves, which it exploits as an important part of its energy supply.

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United Arab Emirates



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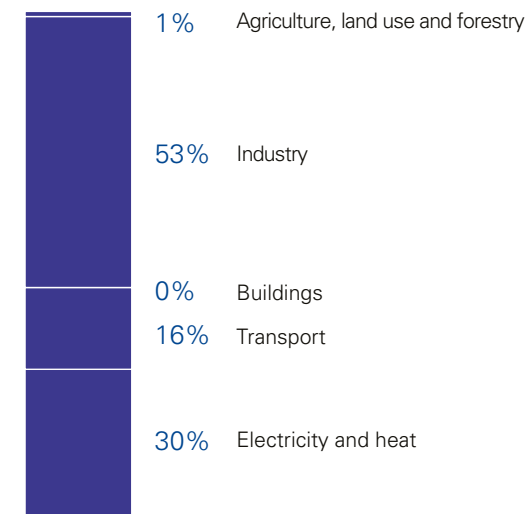
One of the biggest oil exporters is working to diversify energy production, including major solar installations, a green hydrogen demonstration plant and new nuclear power stations.

Energy transition

The United Arab Emirates (UAE) has in the past built its wealth on revenues from oil production, being the sixth largest producer of petroleum in 2019, with a quarter of its GDP coming from the export of oil.¹⁴⁶ Over recent years it has diversified its energy production, while relying on oil revenues to fund these efforts. In 2017, it published an energy strategy that would see the contribution of clean energy rise to 50 percent by 2050, with a 70 percent reduction in carbon emissions from power generation.¹⁴⁷ It is aiming for 20 percent of its installed electricity capacity to be from renewable sources within 3 years.¹⁴⁸

Much of the UAE's wealth in the recent past has been generated by its oil and gas exports, more than most other comparable producers, however the UAE has for many years made strong progress to diversify its industry and reduce its overall greenhouse gas footprint. UAE's work to develop renewable energy includes the Shams 1 solar power plant in Abu Dhabi and the work underway on what will be world's largest concentrated solar power project at the Mohammed bin Rashid Al Maktoum solar park in Dubai.¹⁴⁹ The park is also the site of a demonstration solar-powered green hydrogen plant, built by Siemens Energy.¹⁵⁰

Sector emissions shares and performance



Increasing order of maturity



Source: KPMG International (2021)



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The country started a nuclear energy program in 2009 and in 2020, it opened the first of four reactors that will supply around a quarter of the Emirates’ electricity.¹⁵¹ It is also adopting waste-to-energy generation, with plants in Abu Dhabi, Dubai and Sharjah.¹⁵²

Siddharth Behal, Partner and Head of Governance, Risk and Compliance, KPMG Lower Gulf, says there is a need to develop this work into setting tangible goals towards Net Zero, including for specific organizations including utilities. “This should involve policies, implementation commitments and concrete plans from individual companies and government,” he says.

Circular economy

The UAE’s government approved a circular economy policy earlier in 2021, a framework that aims to set the country’s approach for achieving sustainable governance and better use of natural resources.¹⁵³ It covers areas including manufacturing, infrastructure, food production, transport and consumption. On manufacturing, it aims to encourage repair, reuse and recycling of items which would reduce greenhouse gas emissions, as well as creating a more innovative manufacturing sector with higher levels of employment.

On buildings, circular economy strategies include minimizing material and resource use as well as pollution. The UAE ranks 14th in the buildings sector, with the highest score on prevalence of energy efficient buildings of all of the countries in the NZRI, as well as having mandatory building energy certification. The Masdar Institute, a graduate technical university, has collaborated with the Massachusetts Institute of Technology in the US in researching Abu Dhabi’s heat island urban temperature effect, which increases the need for air conditioning.¹⁵⁴

Less than 10 percent of food consumed in the UAE is produced locally, but the circular economy policy aims to cut emissions both by reducing wastage and making productive use of remaining organic waste.

Transport and financial sectors

The transport sector is currently dominated by personal car use and passenger vehicles are responsible for approximately 15 percent of the UAE’s carbon emissions. The government is encouraging use of low-carbon vehicles, integrated inter-modal transport, public transport and ride-sharing.


Public-sector organizations have invested in electric vehicle charging, with the Dubai Electricity and Water Authority having installed chargers since 2015 with nearly 300 available across the Emirate city-state.¹⁵⁵ Dubai also hosts an early example of a hydrogen refueling station, opened in 2017 at a Toyota showroom.¹⁵⁶ However, there is still a need for a comprehensive electric vehicle policy across the UAE’s states.


There is potential for the financial sector to play a major role in moving towards Net Zero by embedding ESG considerations in corporate and capital market reporting, accelerating the introduction of carbon credits and trading schemes, and offering insurance and financial products that help organizations to decarbonize.¹⁵⁷

Since circular economy projects apply new technologies and business models, many in the financial sector argue that their projects are inherently risky. Consequently, inadequate access to financing poses a potential barrier to the widespread adoption by the private sector of more circular practices. The government could play a key role in removing these barriers by collaborating with the finance industry to identify specific barriers and potential solutions, and also through public-private partnership arrangements.


The UAE’s government approved a circular economy policy earlier in 2021, a framework that aims to set the country’s approach for achieving sustainable governance and better use of natural resources.

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India

The country's emissions per person are low but rising standards of living could challenge its ability to meet Net Zero. India is however developing solar and onshore wind production, as well as energy efficiency work.

Socioeconomic development

With the second-largest population and fourth-largest economy, India is the third-largest emitter of greenhouse gases globally. While emissions per person are relatively low, the country has also seen the second largest growth in the overall volume between 2010 and 2018. There is no clear date for when greenhouse gases from the country are expected to peak.

Improvements to the standards of living and continuing rise of India's middle class could create tensions with decarbonization. On agriculture, land use and forestry, the country gets credit for low levels of food waste, and low consumption of meat and milk per person. However, the latter two are increasing with milk availability per person more than doubling since the early 1990s¹⁵⁸ and consumption of both is likely to continue to increase along with incomes.

Like other developing countries that are addressing both socioeconomic development and climate change mitigation and adaptation, India has advocated for and been a large beneficiary of funding from developed countries to help offset the costs of the transition.¹⁵⁹ In July 2021, Environmental Secretary Rameshwar Prasad Gupta said: "We are not anti-Net Zero. But without adequate climate finance being definitively available, we can't commit on that part."¹⁶⁰

State-directed investment

However, India is undertaking a number of significant decarbonization projects which add up to one of the fastest programs among its peers, according to



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Anish De, Energy Sector Lead, KPMG in India. Given that energy access and security remains a key priority, this includes targets made under the country’s UN climate change nationally determined contributions to expand renewable energy capacity to 175GW by 2022 and 450GW by 2030.¹⁶¹ The latter would be nearly five times the capacity of the 97GW available in June 2021, a level which has more than tripled since 2014.¹⁶²

Solar and on-shore wind generation are the leading renewable sources, with many projects commissioned by the government-owned Solar Energy Corporation of India (which also covers wind) then built and operated by the private sector. One of its projects, the Bhadla Solar Park in Rajasthan, may currently be the world’s largest single solar project with an installed capacity of over 2.2GW as of early 2020.¹⁶³ India’s states are active both in procuring projects and in supporting small-scale solar installations used domestically and in agriculture.

No new coal-fired power stations have been announced in recent years and financing no longer looks possible, De says, meaning coal will decline over coming decades as existing plants are decommissioned.

Energy efficiency and sector transition


The country is also working to improve energy efficiency in areas including lighting, electrical appliances and in industry. “On the demand and the supply side, India has some very interesting projects,” says De. A strong policy framework has laid the foundations for its emission reduction program, but he adds: “The comprehensive plan is not there.” There is no single energy ministry and in some cases policies conflict. India has an energy conservation building code, but there is a lot of ground to cover with many small-scale builders. Similarly, large industrial power users in the steel and cement sectors, as well as big data center operators are taking significant steps to decarbonize, but there is less progress among smaller businesses.


On transport, adoption of electric vehicles has been slower than expected for standard four-wheelers, but many operators of India’s tuk-tuk motorized rickshaws are switching to electricity with companies setting up subscription schemes that let drivers swap batteries to minimize downtime.¹⁶⁴ India is extending electrified urban rail networks and there is early-stage work on converting buses to use electricity and hydrogen.

Solar and on-shore wind generation are the leading renewable sources, with many projects commissioned by the government-owned Solar Energy Corporation of India (which also covers wind) then built and operated by the private sector. One of its projects, the Bhadla Solar Park in Rajasthan, may currently be the world’s largest single solar project with an installed capacity of over 2.2GW as of early 2020.


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Despite Indonesia’s exposure to physical impacts of climate change, the prioritization of socioeconomic development means it will continue to increase emissions for some years and its 2060 Net Zero target will require greater urgency if it is to be met.

Economic imperative

With much of its population living in low-lying coastal areas and high levels of air pollution, Indonesia is highly exposed to climate change risks. Yet with less than 4 percent of the world’s population, the country is the fifth largest producer of greenhouse gases in the Index.

Its government has set a Net Zero target with cross-party support. However, the target date is 2060 and the government expects significant growth in emissions from many sectors over the next few years, requiring very steep cuts in the second half of this century. “The government’s plans need more urgency to achieve the 2060 target, far out as that is,” says Michael Horn, Head of Sustainability Services, KPMG in Indonesia.

As the world’s largest exporter of thermal coal by weight,¹⁶⁵ Indonesia is continuing to build coal-fired power stations to take advantage of its national reserves, with the last one planned for decommissioning in 2058. While these often replace diesel generation, these will contribute to accelerating growth in emissions over the next few years. Indonesia also expects transport emissions to rise by 50 percent between 2015 and 2030, then do the same again over the following two decades, with industrial emissions peaking in 2030 at the earliest.

Land use

Emissions from agriculture, land use and forestry have almost tripled since 1990, now making up more than two-fifths of Indonesia’s total, and these, too,



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are expected to increase for several years. However, the country has had some success in reducing deforestation, which reduced sharply in 2020 to its lowest level since this was first recorded in 1990. Much of this has taken place to increase production of palm oil. Because of foreign opposition reducing its export potential, the Indonesian government plans to make more use of palm oil in vehicle biofuels.

Horn says there is potential to monetize ‘carbon sink’ work where landowners would be paid to not cut down trees. But with clearance of naturally occurring primary forests already illegal, it would be hard to set up markets in this.

Incremental change












Indonesia has strong potential for renewable energy, including 40 percent of the world’s potential for geothermal generation, but this has high upfront costs.

The government has introduced net metering so owners of solar panels can sell excess generation to the country’s state-owned electricity utility, but with poor returns for doing so, few have taken advantage. New construction has to comply with a green building code, but there are no requirements to refit existing ones, even when they are undergoing renovation.

Horn says there are grounds for optimism, including pressure from other countries to decarbonize supply chains, the recent creation of an agency to restore peatlands that act as natural carbon stores and an innovative private sector. But he warns that, understandably as a developing nation, Indonesia tends to prioritize economic growth: “That can easily cut across Net Zero goals,” he says. “The journey’s started, but there is an awful long way to go.”

Indonesia is continuing to build coal-fired power stations to take advantage of its national reserves, with the last one planned for decommissioning in 2058. While these often replace diesel generation, these will contribute to accelerating growth in emissions over the next few years.

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Nigeria

Innovative technologies and multilateral support will be critical to helping the country reach Net Zero given Nigeria’s economic reliance on fossil fuels, high population growth and the need to connect tens of millions to reliable electricity supplies.

Economic exposure

The UN expects Nigeria to become the world’s third most-populous country by 2050, with its 2019 population projected to double to around 400 million.¹⁶⁶ It is reliant on fossil fuels at present and other countries’ race to meet Net Zero commitments, particularly the adoption of electric vehicles, may paradoxically impact the ability of Nigeria to achieve its targets, if falling oil exports reduce government revenues.

However, Segun Sowande, Head of Management Consulting and Lead Partner for Energy and Natural Resources, KPMG in Nigeria, says the government has set clear targets for reducing emissions and has tried to integrate these with economic recovery plans. The country has committed to reducing greenhouse gases by 20 percent by 2030, with the aspiration to increase this to 45 percent with international support.¹⁶⁷ “How does Nigeria create an economy where renewable energy and Net Zero initiatives become catalysts for lifting people out of poverty?” he asks. “It will be a game changer if that happens, but that is going to require disciplined internal alignment alongside external, multilateral support.” Nigeria could serve as a test case for the rest of Africa given the likely impact, he adds.

Energy security

More than 90 million of Nigeria’s 210 million population have no access to electricity¹⁶⁸ and tens of millions more suffer from unreliable connections. “Solving these fundamental issues of energy access come ahead of Net Zero but are not mutually exclusive,” says Sowande.



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For example, the country could ‘leapfrog’ energy technologies by moving straight to cleaner energy and renewables. For example, Lumos, a Dutch-headquartered company, offers Nigerians a home solar panel and battery pack system with payments made by text message through the MTN mobile network.¹⁶⁹ The government has also established Solar Naija as part of its work to support the economy’s recovery from COVID-19. The purpose of this program is to provide cheap credit to install solar systems in 5 million homes that are currently not grid connected.¹⁷⁰

Nigeria has committed to ending gas flaring, where natural gas that can be collected from petroleum production is instead burnt, with fines for this increased by up to a factor of 80. In March 2021, the country pledged to further accelerate the move of home cooking from kerosene and charcoal to cleaner fuels such as cooking gas. For this purpose, the Nigeria Liquefied Natural Gas company (NLNG), which is jointly owned by the government and three international oil companies, has committed to increase domestic liquefied petroleum gas supply to 450,000 million tonnes annually, an increase of over 60 percent.¹⁷¹

Industrial use of natural gas, which has been limited by pipeline vandalism, is also being encouraged by ‘virtual pipelines’ through which gas is compressed or liquefied and transported to sites by road for regasification and use.¹⁷² NLNG is transforming this space with three new agreements to supply 1.1 million tonnes of liquefied natural gas to the domestic market, marking a significant shift from its previous export-only LNG supply market.

Agriculture and transport

On agriculture, land use and forestry, Marilyn Obaisa-Osula, Associate Director, ESG and Sustainability, KPMG in Nigeria, says that there has also been an increased push for diversification of a heavily fossil fuel

dependent economy. Agriculture supports the majority of Nigerian people and it is the largest contributor to its GDP, accounting for 22 percent in the first quarter of 2021.¹⁷³ Increased focus on the sector will not only reduce fossil fuel dependence, it will also lead to opportunities for climate-smart agriculture practices.

This trend is being embraced by emerging agritech startups, donor-funded and government-supported farm businesses, and selected small and medium sized enterprises in the sector. They have been able to use practices such as agroponics, a type of hydroponics, to grow vegetables; integrated farming that promotes a circular economy, used in the resuscitation of Nigeria’s Songhai farms project;¹⁷⁴ sack farming which uses drip irrigation; and the use of smart devices to evaluate the state of a farm, such as from Nigeria-based service Zenvus.¹⁷⁵

Transport is currently reliant on private cars and buses, including many second-hand imports, which are less efficient than newer models. However, Nigerian conglomerate Stallion recently started assembling Hyundai Kona electric cars in the country, with the Vice-President taking one for a test drive in June 2021.¹⁷⁶ KPMG in Nigeria believes that, given the current lack of charging infrastructure and the country’s access to and reliance on fossil fuels, hybrid vehicles may be favored over all-electric vehicles in the short to medium term. Better public transport services are also under development with Lagos, Nigeria’s largest city, due to see two lines of a long-planned urban rail system opening at the end of 2022.¹⁷⁷

Nigeria has committed to a wide range of sectoral adaptation and mitigation plans under its climate change policy and response strategy. However, the country’s success will largely be dependent on disciplined execution and sustained international support in the face of many competing economic and social priorities.

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Russia

Russia has seen its emissions intensity by GDP increase while many countries have cut it, but has major opportunities to improve through modernization and efficiency. Its single electricity grid can help balance supply and demand over most of the country.

Baseline emissions

Russia is the fourth-largest emitter of greenhouse gases, producing 1,992MtCO₂e in 2018. It performs poorly on emissions intensity momentum scaled by GDP in the NZRI, having seen this rise by 3 percent between 2010 and 2018, while best-placed Sweden almost halved it. But this unsustainable growth gives it opportunities to make relatively swift progress.

Vladimir Lukin, Director in Operational Risk and Sustainability Group at KPMG in Russia, says the country could reduce its greenhouse gas emissions by around 700MtCO₂e annually (35 percent of the current level) through modernization and efficiency measures in industry, transportation and in forestry. “It’s a great opportunity for the Russian Federation,” he says, as well as the difference it would make to global emissions. “It might take three, five or 10 years, but this potential really exists.”

Lukin adds that improved forestry management could make up a big part of Russia’s contribution to tackling climate change, given the very large areas of forest and its potential to lock away carbon naturally.

Electricity and heat

Russia has a single electricity grid covering most of the country, which can be used efficiently to balance supply and demand across a very large area. Although hydroelectric and nuclear power make significant contributions, gas is the largest source with coal also



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significant. Russia’s Energy Strategy 2020 sets out a plan to scale up liquid natural gas to sufficient levels to cover 25 percent of global demand. Lukin says that moving away from coal in particular requires economic and societal transformation in some communities that currently rely on it for jobs.

There may be opportunities to expand use of renewables, particularly in western Russia, although installing equipment in remote locations can make such generation uneconomical. In January 2021, a pilot carbon emissions trading scheme was given the go-ahead on the country’s largest island of Sakhalin as part of a roadmap to achieve Net Zero carbon emissions by 2025.¹⁷⁸

Renewables mix

Transport is currently fossil fuel-based, but in December 2020, Russian President Vladimir Putin set a target for the development of hydrogen-driven buses by 2023,












followed by trains.¹⁷⁹ The country has already established a research program in this area. Lukin says that electric vehicles could also be useful, but their contribution to decarbonization depends on whether electricity generation has moved away from fossil fuels.

Hydrogen also has potential in removing emissions from energy-intensive industries such as metal production, with use of the direct reduced iron process replacing blast furnaces as an interim step. The EU’s plans for import taxes based on carbon intensity are likely to act as a driver for Russian industrial companies to cut emissions. This does not apply to construction companies, but they are seeing increasing demands for green buildings from clients, with improved insulation paying strong dividends given wide temperature ranges.

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Saudi Arabia

At present fossil fuel reliant, Saudi Arabia is developing several flagship clean energy and industrial projects but the country is still in the process of converting decarbonization ambitions into federal policy that impacts the entire economy.












Economic transition

Saudi Arabia is at present heavily reliant on the production and use of fossil fuels. It is one of the top three oil producers globally, and even in 2020 when prices were depressed by the impacts of COVID-19, oil generated 53.5 percent of the government’s revenues.

The country has plans to diversify away from oil to exploit strong potential for solar and wind generation, as well as developing capacity to produce clean hydrogen. By doing so, the government aims to improve both environmental and economic sustainability: “It understands this is the solution for Saudi Arabia as a country, rather than slowing down this substitution,” says Oliver Gawad, Senior Director, Economic Development, Strategy and Sustainability, KPMG in Saudi Arabia. “There has been a clear change of mindset.”

State-directed investment

The National Renewable Energy Program, part of the country’s Vision 2030 strategy, includes plans for Saudi Arabia to generate half of its electricity from renewables by 2030. This aspiration is supported by favorable climate conditions for solar and wind energy projects. In April 2021, the country signed long-term agreements to buy power from seven new solar projects, adding to the previously announced Sakaka solar project, the country’s first, and the Dumat Al Jandal wind farm.¹⁸⁰

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Although investments in oil and gas continue and Saudi Arabia is unlikely to fully transition away from a reliance on fossil fuels any time soon, the country's ambition long-term is reflected through the fact that it has joined a Net Zero Producers Forum led by the US and also involving Canada, Norway and Qatar that will develop technologies including carbon capture and storage.¹⁸¹

The country's new Giga project Neom city on the Red Sea coast will use only renewable energy and will include what is planned to be the world's largest renewable hydrogen project.¹⁸² The associated Red Sea tourism development, which is due to open by the end of 2022, plans to use only sustainable energy, with cleantech and biofuel specialist Neutral Fuels setting up a biofuel refinery to run its transport.¹⁸³

Capital city Riyadh has built a six-line, 85 station metro system which it plans to open during 2021 and will integrate with a bus network, providing an alternative to driving.¹⁸⁴ The city also has a Green Riyadh project which involves planting 7.5 million trees, with the national Saudi Green Initiative targets announced in March 2021, including a target to plant 10 billion trees planted over the coming decades.¹⁸⁵

Gawad says that some of Saudi Arabia's potential for reducing emissions comes from existing inefficient practices, such as poorly insulated buildings that require powerful air conditioning at present.

Transparency

As one of the wealthiest countries in the NZRI, international pressure on Saudi Arabia to provide greater transparency on climate targets and emissions will be likely to continue to grow. The country has not yet published a 'business-as-usual' baseline or an official set of projections for its emissions as part of the Paris Agreement process.¹⁸⁶

Gawad adds that Saudi Arabia would likely benefit from extending its targets beyond 2030, setting up structures to support these and strengthening legislation, including through legally binding targets. "There needs to be another step on institutionalizing and getting a regulatory framework around these ideas," he says.

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South Africa

Like many developing countries in the NZRI, South Africa’s race towards Net Zero will be pushed by investors and tempered by the perceived social cost of the transition, with the country planning to continue its reliance on fossil fuels.

Energy mix

South Africa is the most coal-reliant country in the NZRI, using the fuel for around three-quarters of its electricity. Coal is also responsible for many jobs, and in a country with unreliable power supplies and high rates of unemployment, this makes it hard to give up. Although the government is strengthening its emissions ambitions, its current plan to hit carbon neutrality by 2050 still includes coal.

There are signs of change. South Africa has strong opportunities to develop renewable generation in solar and wind power, and in June 2021, President Cyril Ramaphosa announced that embedded electricity generation projects of up to 100MW could in future be established without energy regulator licensing, up from 1MW at present.¹⁸⁷ “It’s a hugely welcome move and a step in the right direction,” says Poogendri Reddy, Senior Manager, Sustainability Services, KPMG in South Africa. Demonstrating the potential, mining company Gold Fields had already announced it will build a 40MW solar plant at its South Deep mine, providing about a fifth of the electricity needed to run the facility.¹⁸⁸

Private sector pressures

The country is in the process of splitting its electricity company Eskom into three separate businesses running generation, transmission and distribution, which should encourage new production. With three of South Africa’s four major banks refusing to fund



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new fossil fuel plants, renewable sources provide the obvious options, although the country will have to overcome a lack of manufacturing capacity for generation equipment. More broadly, investor pressure on environmental issues is leading fossil fuel-focused companies to diversify, with coal and mineral miner Exxaro publishing a climate change response strategy in 2020 that highlights its ownership of two large wind farms.¹⁸⁹ Jyoti Vallabh, Associate Director, Sustainability Services at KPMG in South Africa, says that awareness of ESG has greatly increased over the last 18 months and has become an important issue on many board agendas.

Most sectors are ready to change as the power supply decarbonizes, such as through increasing use of electric vehicles and work on adopting hydrogen as a fuel. There is also potential to adopt circular economy models used widely in Europe to reduce emissions from waste, as well as adding better environmental disclosure to the country's already good reputation for corporate financial reporting. However, agriculture is

moving much more slowly, with little policy focus on the sector given it is a large source of jobs and exports. The sector is outside the initial phase of the South African carbon tax, introduced in June 2019.¹⁹⁰

A just transition

The government has talked about "a just transition" that protects jobs and sees domestic coal supplies being exploited as they have been in many developed countries, says Reddy. She adds that it will be crucial for South Africa to reskill workers to take advantage of green opportunities.

Similar to India, particularly given its vulnerabilities to the physical impacts of climate change, climate financing will be likely to play a crucial part in accelerating South Africa's transition towards Net Zero. An example is the UK government's Climate Finance Accelerator technical assistance program, with South Africa selected as its first country for applications in June 2021.¹⁹¹

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Thailand

Thailand has plans in place on energy efficiency and developing alternative power sources, and aims to sell only zero-emission vehicles in the country from 2035. However, it has yet to say when it will reach Net Zero.

Public-private cooperation

Although the country has not yet adopted a Net Zero target, the Thai government has set out its approach to tackling climate change in plans on energy efficiency, alternative energy development and power development, all published in 2015. The Climate Change Master Plan runs until 2050¹⁹² and Ganesan Kolandavelu, Advisory Partner, Climate Change and Sustainability, KPMG in Thailand, says steps envisaged in the plan are currently in progress.

The government is aiming to work in tandem with the private sector on climate change work. BTS Group Holdings has used green bonds to finance new lines for Bangkok’s Skytrain metro system which it operates, while several Thai companies have issued green bonds to raise money for renewable power generation, including Global Power Synergy and Energy Absolute.¹⁹³

In harder-to-decarbonize sectors, the government has adopted green industry standards developed by the UN Industrial Development Organization (Unido) as a certification scheme that all of the country’s 71,000 factories will have to meet by 2025.¹⁹⁴ But Ganesan says that progress in reducing emissions from the agriculture, land use and forestry and industrial sectors could be enhanced by improving research capacity, including technology that can measure the production of greenhouse gas. This is likely to require more investment and support from other countries, he adds.



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Green transport

Ganesan says that new public transport services, which are currently being developed, are a tangible example of change linked to the government’s 2015 transport infrastructure development plan. This includes Bangkok’s Mass Rapid Transport train network, which has been extended outside the city.

The Thai government has an aim to sell only zero-emission vehicles in the country from 2035, but there are currently limited numbers of electric vehicles or charging stations to support them. To address this, the government has set a target to have 1.2 million such vehicles in use by 2036, along with 690 charging stations.¹⁹⁵ Through the Board of Investment, the government offers significant tax exemptions to vehicle makers setting up manufacturing electric vehicles


in Thailand. In November 2020, the Board said it has already approved 26 projects to produce hybrid and electric vehicles with a combined production capacity of more than 566,000 units annually, involving companies including BMW, Honda, Mercedes Benz, Nissan and Toyota.¹⁹⁶


Public support

The last few years have seen increasing public awareness of climate change in Thailand, partly due to the government adding the subject to the education curriculum. “You are creating a generation that is fully aware of the importance of climate change and what its impacts are going to be,” says Ganesan. Universities have also added material on the topic to relevant modules.


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Methodology

The 32 countries have been assessed on 103 different indicators. In each case, the data for each indicator is normalized using the min-max method. This converts the variables to a range between zero and 100 by subtracting the minimum value, dividing by the range of the variable values and multiplying by 100. If a lower number represents greater progress towards Net Zero, the result is then subtracted from 100. This means that for each indicator the top-ranked country receives 100 and the bottom country zero.

The indicators are split into two groups: **national preparedness** and **sectoral readiness**. The national preparedness score is calculated from three sub-groups of equal weight: **contribution to global Net Zero, performance in reducing emissions intensity of GDP** and **policies and enabling environment**.

Each country is also assessed on the five sectors which globally make the greatest contributions to climate change: **electricity and heat, transport, buildings, industry, and agriculture, land use and forestry**. Each is assessed based on indicators of decarbonization status, government action and delivery capability. These sector-specific scores are then weighted based on that sector's contribution to the country's emissions to provide an overall sector score.

The overall NZRI score for each country is obtained by multiplying the national preparedness readiness score by the overall sector score and dividing this by 100.



Illustrative example: How the NZRI is calculated for Norway

National preparedness score

Contribution to global Net Zero (based on four indicators): **99**

This is the weighted average of 100 (Norway has the lowest level of greenhouse gas emissions of the 32 countries) — 50 percent weighting factor; 94 (Norway's score for emissions reduction between 2005 and 2018) — 50 percent weighting factor; 100 (it will have the lowest level of emissions in 2030 based on NDC targets) — 50 percent weighting factor; and 100 (Norway has a Net Zero target) — 100 percent weighting factor.

Performance in reducing emissions intensity of GDP (two indicators): **67**

Policies and enabling environment (11 indicators): **81**

Average of three sub-groups: 82

Sector score

Electricity and heat (based on 17 indicators): **57**, weighted based on 32 percent share of national emissions

Transport (16 indicators): **57**, weighted based on 27 percent share

Buildings (12 indicators): **58**, weighted based on 3 percent share

Industry (12 indicators): **72**, weighted based on 26 percent share

Agriculture, land use and forestry (29 indicators): **48**, weighted based on 11 percent share

Weighted average of five sectors: 60

The sector indicators are comprised of three groups paralleling three aspects of transition — decarbonization status, government action and delivery capability.

The weight distribution among the scores for the three groups for a country is based on decarbonization progress of that country for those sectors.

If a country's percentage reduction in emissions from a sector between 1990 and 2018 is better than the median emissions reduction for that sector among NZRI countries during the same period, then decarbonization status, government action and delivery capability receive 50 percent, 25 percent and 25 percent weights, respectively.

For countries that did not make significant progress, the same weight (1/3) applies for the three aspects.

NZRI score

$$82 \times 60 \div 100 = 49$$



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Limitations

The selections of indicators utilized in the methodology are finally subject to availability of data in a manner that is comparable across the NZRI countries. Some areas material to the global decarbonization effort excluded from this iteration of the NZRI include:


- Population and population growth, though mathematical drivers of emissions, are excluded since NZRI countries are at different stages of their demographic transition.
- GDP per capita and GPD per capita growth are also mathematical drivers of emissions, but are excluded since higher incomes and growth rates can function as important enablers of decarbonization.
- Emissions intensity of imports and exports are excluded to avoid penalizing any country for existing import dependency and economic structures.
- Cross border shipping and aviation owing to challenges in assigning such emissions to a country.
- Presence of carbon markets, carbon pricing and carbon taxes owing to varying sector and commodity coverage across countries.
- Emissions from road and rail freight since these emissions are not tracked in a comparable manner across countries.

Subsequent iterations of the NZRI will attempt to consider the areas mentioned above as data availability and comparability across countries improves and will also attempt to track any additional drivers outlined in the IPCC’s sixth report released in 2021.







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National preparedness

All indicators have a weight of one within their group unless otherwise stated.

Contribution to global Net Zero

Present emissions (1/2 weight, the other half assigned to emissions to decarbonize after meeting nationally-determined contribution (NDC) targets since there is a high degree of statistical correlation among both indicators): figures for 2018 measured in millions of tonnes of carbon dioxide equivalent (MtCO₂e) from World Resources Institute (WRI) Climate Watch.¹⁹⁷ Norway, which emitted 28MtCO₂e that year, scores highest while China, emitting 11,706MtCO₂e, scores lowest.

Emissions to decarbonize after meeting nationally-determined contribution (NDC) targets (1/2 weight, the other half assigned to the indicator above): projected emissions in 2030 based on these declarations, using standardization methods from Australia's Climate Change Authority.¹⁹⁸ Norway, which is projected to emit 14MtCO₂e in 2030, scores highest while China, emitting 12,628MtCO₂e, scores lowest.

Emissions reduction progress (1/2 weight, the other half assigned to progress in emissions intensity reduction): change in emissions between 2005 and 2018 using Climate Watch data. The UK scores highest, having reduced emissions by 61 percent over this period.

Presence of a Net Zero target: based on Climate Watch research, with seven countries awarded 100 for having such a target in law; 11 getting a score of 50 for

having a target in a policy document or political pledge, and 14 given zero for no documented target. Climate Watch data is supplemented by KPMG research.

Performance in reducing emissions intensity of GDP

Emissions intensity of GDP (present): overall 2018 emissions from Climate Watch divided by 2018 gross domestic product in constant 2010 US dollars from the World Bank.¹⁹⁹ Sweden scores highest with an intensity of 0.05MtCO₂e/USD.

Emissions intensity of GDP (growth) (1/2 weight, the other half assigned to emissions reduction progress in contribution to net zero): as above, but measuring change between 2010 and 2018. Sweden again scores highest, having reduced emissions intensity by 48 percent over this period.

Policies and enabling environment

Presence of agency: KPMG research on whether countries have a dedicated climate ministry or department at national or federal level, which all 32 countries do.

Transparency on emissions: using OECD research on climate change disclosure, with six countries (Australia, France, Mexico, New Zealand, South Korea and the UK) scoring 100 for mandating corporate disclosure of both direct and indirect emissions; 13 scoring 50 for mandating disclosure of direct emissions only; and 13 scoring zero for not mandating disclosure, supplemented by KPMG research.

Enabling environment for climate finance: KPMG research on whether countries have a sustainable finance policy. China and France score 100 for having such a policy, while the UK scores 50 as it does not have a policy but has published a climate finance strategy document. The other 28 countries receive zero on this indicator.

Availability of climate finance (market size, 1/2 weight): the size of a country's climate finance market relative to its population, using data from the Climate Bonds Initiative.²⁰⁰ Sweden scores highest with a climate bond volume of USD1,054 per person.

Availability of climate finance (growth, 1/2 weight): compound annual growth rate (CAGR) of the above measure between 2014 and 2019. China scores highest with a CAGR of 175 percent, while 18 countries did not see any growth.

Fossil fuel subsidies: post-tax subsidies as a percentage of GDP, measured by the International Monetary Fund.²⁰¹ Italy and Sweden score highest with the lowest subsidies of 0.99 percent.

Carbon capture and storage policy: global policy indicator rating of the development of national plans in this area by the Global CCS Institute.²⁰² Norway scores highest, while six countries receive zero.

Planned carbon capture and storage capacity: planned capture and storage capacity as a percentage of national emissions, collated by the Global CCS Institute. Norway scores highest with planned capacity equivalent to 2.8 percent of national emissions, while 23 countries have no significant plans.



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Transformation readiness: aggregated economic transformation readiness score from the World Economic Forum’s Global Competitiveness Report 2020.²⁰³ Countries not assessed by WEF receive the average score of their income group.

Public belief in climate change (1/2 weight): based on a poll of 1.22 million players of mobile gaming apps in 50 countries between 7 October and 4 December 2020 run by the UN Development Programme (UNDP) and partners including the University of Oxford.²⁰⁴ Countries that were not included in the polling receive the average percentage for their region. Italy and the UK gain the highest scores, with 81 percent of respondents expressing belief in a climate emergency, while Argentina gets the lowest with 58 percent agreeing with this.

Public support for climate action (1/2 weight): also from the UNDP mobile gaming poll, the percentage of those who believe in a climate emergency who agree that the country should urgently do everything necessary to respond to this. Italy scores highest with 78 percent agreeing. Countries that were not included in the polling receive the average percentage for their income group.



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Electricity and heat

Electricity and heat related emissions account for greenhouse gas emissions from entities whose main activity is electricity and heat production; emissions from internal use of electricity and heat within the energy industry; and emissions from ‘unallocated autoproducers’, in other words, entities that produce electricity and heat for self-consumption, but are not allocated to their respective sectors such as industry, transport and buildings. Definitions for all five sectors are based on those used by the World Resources Institute.²⁰⁵



Decarbonization status

Emissions per capita: emissions from electricity and heat per capita in 2018 calculated using emissions data from Climate Watch and population data from the EIU.

Share of low-carbon electricity in overall electricity: share of low-carbon electricity (renewable and nuclear) in overall electricity consumption in 2019 from Our World In Data.²⁰⁶ The underlying data is from the BP Statistical Review of World Energy and Ember.²⁰⁷

Access to electricity: share of population with access to electricity in 2019 from UN Sustainable Development Goals indicators database.²⁰⁸

Gross electricity consumption per capita: calculated using electricity consumption data and population estimates, both from the EIU.

Transmission and distribution losses: percentage of electricity output lost in these ways in 2014 from the International Energy Agency (IEA), reported by the World Bank.²⁰⁹

Dependence on coal for electricity generation: share of coal in overall production from the EIU.



Government action

Mid-term renewable energy target: percentage renewable energy target for 2030 from Ren21²¹⁰ supplemented by KPMG research.

Renewable energy obligations for utilities: countries score 100 if a national target is in place, 50 for sub-national targets and zero if none, from Ren21, supplemented by KPMG research.

Availability of tradable renewable energy certificates: countries score 100 if a scheme is in place and zero if not, from Ren21, supplemented by KPMG research.

Net metering: countries score 100 if a scheme is in place and zero if not, from Ren21.

Other support mechanisms for renewable energy: a composite score for renewable energy incentives and support mechanisms, based on number available up to four, from Ren21.

Presence of low-carbon hydrogen strategy or roadmap: countries score 100 if such a document has been published, 50 if it is in development and zero if none can be found, from KPMG research.



Delivery capability

Renewable energy project pipeline (1/2 weight): aggregate transaction size of renewable energy relative to the transaction size of fossil fuel-based generation from research company Inframation.²¹¹

Nuclear energy pipeline (1/2 weight): nuclear power capacity under construction relative to a country's total installed electricity generation capacity from the World Nuclear Association²¹² (total capacity from the EIU).

Planned investment in the grid: transaction value of planned transmission and distribution projects from Inframation relative to gross energy consumption from the EIU.

Low-carbon electricity and heat patents: number of patent family entries from January 2010 to April 2021 for renewable energy and clean energy technologies from research company PatSeer,²¹³ scaled by national population.

Clean energy companies: emerging clean electricity and heat technology companies scaled by population from Cleantech Group.²¹⁴



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Transport

Transport accounts for greenhouse gas emissions from fossil fuel combustion in road, rail, pipeline transport, domestic navigation, domestic aviation and unspecified transportation. It also accounts for non-energy use of fossil fuels in transport. The NZRI has consciously chosen to exclude marine and aviation-related emissions since, as of 2019, aviation and international shipping amounted to a smaller part of human-generated global emissions — 2 percent and 2.8 percent respectively — and data for tracking these sectors at a national level is limited.



Decarbonization status

Inland transport activity: passenger kilometers from the OECD scaled by population from the EIU.²¹⁵ Where no data is available, the measure from the country with the closest GDP per capita in the region has been used.

Emissions per capita: emissions per capita from transport sector calculated using emissions data from Climate Watch and population data from the EIU.

Adoption of electric vehicles: percentage of electric vehicles in overall stock from the IEA.²¹⁶ For countries not covered by either source, the measure from the country with the closest GDP per capita has been used.

Availability of public transport: rail's share of inland passenger kilometers from the OECD.

Prevalence of vehicle sharing: online ride-hailing market penetration measure from KPMG's 2020 Autonomous Vehicle Readiness Index,²¹⁷ using data from research company Statista.

Availability of electric vehicle charging infrastructure: chargers per kilometer of road using charger numbers from the IEA and European Alternative Fuels Observatory²¹⁸ and total road network length from the CIA World Factbook.²¹⁹ For countries not covered by

either source, the measure from the country with the closest GDP per capita has been used.

Average age of passenger cars: from country-specific KPMG research.



Government action

Ban on sale of internal combustion engines: number of years from 2021 until ban takes place, with 29 years (number of years between 2021 and 2050) used if no ban has been proposed, from country-specific KPMG research.

Incentives for electric vehicles: the number of different forms of incentives given to electric passenger car owners, from country-specific KPMG research. The incentive types considered are direct grants, tax credits, parking incentives, registration benefits, infrastructure incentives (such as home charging and communal charging) and other incentives (such as import tax exemption).

Electric vehicle charging legislation: countries score 100 for legislation that regulates charging infrastructure operation, payments and interoperability, 50 if such legislation is planned but not enacted and zero if none is planned, from country-specific KPMG research.

Low-carbon fuel mandates: countries score 100 if they have low-carbon or renewable fuel standards and zero if not, from country-specific KPMG research.

Biofuel blending obligations: percentage of biofuel that must be blended with conventional fuel, from Biofuels Digest²²⁰ and Ren21.



Delivery capability

Planned investment in public transit: infrastructure investment between 2010 and 2018 in road, rail and inland waterways in USD per capita from the OECD, considered indicative of planned investment in public transit.²²¹ Population data from the EIU.²²²

Electric vehicle charging infrastructure market size: projected market size in 2027 in USD scaled by population from research company Grand View Research, scaled by population data from the EIU.

Clean transport patents: number of patent family entries from January 2010 to April 2021 for vehicle charging station and similar from research company PatSeer, scaled by national population.

Clean transport companies: emerging clean transport companies scaled by population from Cleantech Group.



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Buildings

Buildings account for greenhouse gas emissions from the combustion of fossil fuels in residential and commercial buildings. While this accounts only for direct emissions from buildings with indirect emissions from commercial electricity and heat production accounted under electricity and heat, the NZRI accounts for appliance energy efficiency under this sector, since appliances are ultimately owned and operated by residences and businesses.

Decarbonization status

Prevalence of energy efficient buildings: built area of green buildings calculated using data from the US Green Building Council²²³ as a proportion of total built area since 1990 reported by the OECD.²²⁴

Appliance energy efficiency standards: countries score 100 if they have appliance energy efficiency standards and labelling requirements and zero if not, from country-specific KPMG research.

Energy security of households: proportion of population with primary reliance on clean fuels and technology from UN Sustainable Development Goals indicators database.

Emissions intensity of heat pumps: Heat Pump Readiness Index scores from the IEA. If this equals 0.8, a typical heat pump would be around 20 percent less carbon-intensive than a condensing boiler using natural gas.²²⁵

Emissions intensity of cooling: emissions from cooling in all sectors scaled by population. The modelling was carried out by the German

government-supported Green Cooling Initiative and was based on the equipment stock at the time and predictors including population, GDP, temperature index, urbanization and electrification rates, scaled by population data from the EIU.²²⁶

Government action

Mandatory building energy certification: countries score 100 if they have a mandatory rating policy and zero if not, from the Institute for Market Transformation's Building Rating initiative.²²⁷

Retrofit and weatherization incentives and support mechanisms: average of national scores for retrofitting of existing buildings and policies related to near zero energy new buildings, from campaign group Climate Transparency.²²⁸ For countries that are not rated, the scores of regional peers have been used.

Building emissions covered in national decarbonization commitments: coverage in NDC documents from 2018 to 2020, reported by the UN Environment Programme.²²⁹

Delivery capability

Retrofits market size: projected market size in 2027, relative to built area between 2000 and 2014 in USD per square kilometer from Grand View Research.

Green buildings market size: projected market size in 2027, relative to built area between 2000 and 2014 in USD per square kilometer from Grand View Research.

Building energy efficiency and carbon management patents: number of patent family entries from January 2010 to April 2021 for technologies relating to energy efficient and zero carbon buildings from research company PatSeer, scaled by national population.

Clean technology companies in the building sector: emerging clean commercial buildings companies scaled by population from Cleantech Group.



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Industry

Industry accounts for greenhouse gas emissions from manufacturing, construction, industrial processes, other fuel combustion, fugitive emissions and waste-related emissions.

Decarbonization status

Carbon intensity of industrial energy consumption: emissions from industry scaled by total industrial energy consumption, from Climate Watch and the EIU.

Productivity of industrial energy consumption: gross domestic product of industry scaled by industrial energy consumption, from the World Bank and the EIU.

Industrial recycling rates: GDP per direct material input in 2010 purchasing power parity (US dollars) from the OECD.²³⁰ Material productivity is considered to be representative of industrial recycling rates since recycling rates are not tracked in a comparable way across countries.

Non-CO₂ greenhouse gas emissions: non-CO₂ emissions scaled by GDP from industry, from Climate Watch and the EIU.

Greenhouse gas emissions from waste: emissions from waste scaled by GDP, from Climate Watch and the EIU.

Government action

Options for corporate sourcing of renewable energy: availability of up to six specific options in countries from the International Renewable Energy Agency (IRENA).²³¹

Industrial decarbonization legislation: rating of industrial energy efficiency policies from Climate Transparency Report 2020.²³² For countries that were not rated, the scores of regional peers have been used.

Circular economy incentives: countries score 100 if they have a circular economy or resource recovery law, policy or action plan and zero if not, from country-specific KPMG research.

Fluorinated greenhouse gas replacement policies: countries score 100 if they have ratified 2016's Kigali amendment to the Montreal protocol on ozone depletion, which called for the phasing down of hydrofluorocarbons which were used to replace ozone-depleting gases and have implemented a

hydrofluorocarbons licensing system. They score 50 if one of these applies and zero if neither, from the UN Environment Programme.²³³

Delivery capability

Low-carbon industrial clusters in development: countries score 100 if they have advanced plans to develop low-carbon industrial zones, 50 if plans are at an early stage and zero if none were found, from country-specific KPMG research.

Industrial decarbonization technology patents: number of patent family entries from January 2010 to April 2021 for terms relating to low-carbon and energy efficient industrial techniques from research company PatSeer, scaled by national population.

Clean technology companies in industry: emerging clean companies working in low-carbon hydrogen, carbon capture and storage and carbon capture, usage and storage technologies scaled by population from Cleantech Group.



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Agriculture, land use and forestry

Agriculture, land use and forestry includes methane and nitrous oxide from agricultural activities, and greenhouse gas emissions and removals from organic soils and biomass fires. For the purpose of weighting sectors using their share in total emissions, land use and forestry emissions are considered only for countries where they are a net positive.

Decarbonization status

Annual forest area change (percentage); **Above ground forest biomass** (tonnes per hectare); **Forest area as proportion of total land area** (percentage); **Protected, managed and certified forests located within legally established protected areas** (1/3 weight, percentage); **Protected, managed and certified forests under long-term forest management plan** (1/3 weight, percentage); and **Protected, managed and certified forests** (1/3 weight, 1,000 hectares): all six indicators from UN Food and Agriculture Organization's Global forest resource assessment.²³⁴

Food produced per unit land area (USD value of food per hectare); **Emissions intensity of agriculture** (emissions from agriculture and agricultural soils per USD of agricultural value produced); **Dependence on dairy** (1/2 weight, annual consumption of milk excluding butter in kilograms per person); **Dependence on meat** (1/2 weight, annual consumption of range of meats in kilograms per person); **Excess calorie supply** (calories consumed annual per person in excess of UN FAO's recommended dietary energy supply);

End-user waste (annual food waste per person) and **Food loss** (as percentage of total national food production): all seven indicators from UN Food and Agriculture Organization's FAOStat service.²³⁵

Government action

Meat and unsustainable food taxes: all countries currently score zero as none levy such taxes, from KPMG research.

Environmental accounting mandate: countries score 100 if they have implemented the UN Statistics Division's System of Environmental-Economic Accounting, 50 if they plan to do so and zero if they are not implementing this, from the UN Statistics Division.²³⁶

Policy response to food loss — strategy (1/2 weight) and **storage solutions** (1/2 weight): scores from the Barilla Centre for Food and Nutrition and EIU's 2018 Food sustainability index.²³⁷

Policy response to food waste — strategy, targets, market-based instruments, legislation, regulatory agency, voluntary agreements,

private institutions, research and prioritization framework (each of nine indicators having 1/9 weight): scores from the Barilla Centre and EIU's 2018 Food sustainability index.

Delivery capability

R&D funding into sustainable agricultural practices: government spending in this area as percentage of GDP from the Barilla Centre and EIU's Food sustainability index.

Emissions reduction patents in agriculture: number of patent family entries from January 2010 to April 2021 for topics relating to agricultural emissions reduction from research company PatSeer, scaled by national population.

Clean technology companies in agriculture and food: emerging clean companies working in agriculture and food scaled by population from Cleantech Group.



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KPMG IMPACT is the accelerator for KPMG’s global ESG strategy. It is the platform which supports and empowers KPMG professionals as they assist clients in fulfilling their purpose, achieving their ESG goals, and supporting the world’s attainment of the UN Sustainable Development Goals. It helps clients across ESG & Sustainability, Economic & Social Development, Sustainable Finance, Climate Change & Decarbonization, and Measurement, Assurance & Reporting. For more information, visit home.kpmg/IMPACT.

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