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3keel

Global Retrofit Index

An assessment of the performance of G20 countries to reduce emissions from buildings

in association with

Kingspan®

Report Information

Disclaimer

The Global Retrofit Index, the second in a series of construction sector reports from 3Keel, assesses how well G20 countries (and 2 non-G20 countries) are meeting the retrofit challenge and progressing towards net zero missions in the buildings sector. The index scores countries on their emissions performance, government action being taken, and the performance of their existing building stock.

3Keel LLP have prepared this report using publicly available data on each of the countries assessed. 3Keel have exercised due and customary care in preparing the report but have not, unless explicitly stated, verified the input data included in this report beyond what has been publicly stated.

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Foreword

Energy use in buildings is responsible for more than a quarter of global GHG emissions. To achieve Net Zero by 2050, we will need to upgrade (retrofit) hundreds of millions of buildings to be more energy efficient and operate without fossil fuels.

We already have the ability to do this, thanks to established technologies such as insulation, heat pumps and solar panels. But it is still an enormous challenge to retrofit the global building stock in the next 25 years or so.

This *Global Retrofit Index* assesses how well G20 countries (and 2 non-G20 countries) are meeting this challenge. The performance of these leading economies will to a large extent determine global success in decarbonizing buildings.

Our hope is that this index will be useful for governments, companies, NGOs and citizens to understand and evaluate how their country is performing, compared with what's required, and compared with other countries.

While we have found some evidence of progress and bold policies, the index suggests that countries are largely failing to take the steps required to eliminate emissions from existing buildings. 3Keel plans to update the Global Retrofit Index annually, and we hope it provides a spur to greater action in this area.

Michael Lord
Principal Consultant, 3Keel

Foreword - continued

Decarbonising the built environment is a critical issue that must be addressed to help limit global temperature rise to 1.5°C by the end of this century and should be one of the planet's most urgent climate policy goals. We hope this study gives policymakers and the construction industry a useful tool to benchmark progress.

It is clear that without major improvements in energy efficiency we will be unable to achieve the emissions reductions required to support the achievement of the goals of the Paris Agreement.

Humans need to consume less energy and fewer resources. Rapidly reducing the energy used to heat, cool and light buildings is an essential part of the puzzle.

While some countries perform better than others, no G20 country in this study scored well across all the criteria and even the best performing European countries have a long way to go to meet the IEA's target retrofit rate of at least 2.5% per year by 2030.

We have the tools, solutions and technologies needed to improve energy performance in buildings. We now need to apply these at scale. We must work together locally and globally to increase the pace of building refurbishments. That means finding innovative models for funding, supporting policy changes, minimising disruption for the public and ensuring high levels of energy savings over the lifetime of the retrofitted buildings.

This isn't just a problem for world leaders and governments. The onus is on all of us across the built environment value chain to engage positively and proactively.

Collectively, we have the capabilities and solutions to drive change. Now is the time to put it into action.

Bianca Wong

Global Head of Sustainability, Kingspan Group

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Key takeaways

1. To meet global climate goals existing buildings must become zero carbon by 2050. The International Energy Agency says 20% of existing buildings should have an energy retrofit by 2030.[1]

2. In recent years many G20 countries have achieved some reduction in building-related emissions. However, they are all failing to reduce these emissions at the speed and scale required.

3. In most countries retrofit policy and strategy is piecemeal and inadequate. However, EU countries have adopted wide-ranging policies on building retrofits that other countries can learn from.

4. Even in the EU building emissions are falling too slowly, suggesting the need for more radical measures to transform this sector.

5. Countries are not widely applying minimum standards of energy performance for existing buildings. Retrofit rates could get a major boost if such standards were required when buildings are rented, sold or renovated.

6. Governments are under-investing in building energy and efficiency - on average they spend only $30 per person per year.[2]

7. Building retrofits can bring an impressive range of benefits, including: energy savings; poverty alleviation; job creation; improved human health and greater energy security.[3] Countries should take full account of these when preparing building strategies and allocating funding.

1.0 Executive Summary

The operation of buildings accounts for 30% of global energy consumption and is responsible for 27% of greenhouse gas emissions. To achieve net zero emissions, most buildings must be carbon neutral by 2050.[4] This will require a transformation in the way buildings use energy. The greatest challenge is to upgrade existing buildings, many of which are highly energy inefficient. Tackling climate change therefore heavily depends on hundreds of millions of successful building retrofits.

We have developed the Global Retrofit Index to assess countries' performance in reducing emissions from existing buildings. We analysed all G20 countries for which sufficient information was available, plus two non-G20 countries with noteworthy building retrofit policies. The aim of the index is to show how well major economies are progressing towards net zero emissions in the buildings sector. We also want to show how countries are performing compared to others.

The index scores countries on 11 criteria across three categories: existing stock; emissions performance and government action (Table 1.1). These categories correspond to three time periods: today; the recent past and the near future. We gave the highest weighting to government action because this is the best indication of the progress expected in the next 10 to 20 years. (It is important to note that a scorecard of this type is limited to assessing criteria where comparable information exists for all countries.)

Table 1.1
Overview of the country scoring methodology

Time period	Category	Weighting	Question assessed
Today	Existing stock	25%	How important are building retrofits to this country based on current energy and emissions?
Recent past	Emissions Performance	25%	How well is the country performing on emissions reduction in buildings?
Near future	Government action	50%	Likely effectiveness of government action to improve emissions performance of existing building stock?

Scorecard findings

No countries in this index scored well across all criteria. We consider a score above 80 to reflect a good performance. However, even the top ranked country, Germany, received only 62/100. Most countries scored less than 50. This indicates a need for far greater action to reduce emissions from buildings. The best performers in the index are European. This reflects long-standing EU policies on renewable energy and the energy performance of buildings. However, even the best European countries have a long way to go to meet the International Energy Agency's (IEA) target retrofit rate of at least 2.5% by 2030.

Table 1.2
The Global Retrofit Index

Rank	Country	Total score (/100)	Rank	Country	Total score (/100)
1	Germany	61.5	=9	Brazil	29.0
2	Netherlands*	56.3	=9	Canada	29.0
3	France	55.5	=9	Republic of Korea	29.0
4	UK	52.8	=12	Japan	28.8
5	Croatia*	52.0	=12	United States	28.8
6	Italy	51.8	14	Turkey	26.0
7	Australia	32.5	15	Saudi Arabia	23.0
8	Mexico	32.3	16	China	21.5

Existing stock - current energy and emissions from buildings
No country is close to achieving a net zero building sector, so all have an urgent need to retrofit more buildings. Most countries scored badly in this category with only four scoring 3 or more out of 5. Interestingly the best performing countries were developing countries with warm climates – presumably because there is little demand for heating systems and cooling systems are generally unaffordable.

Recent performance on building energy and emissions
Perhaps the most hopeful finding is that most countries in the index are showing signs of recent improvement. Three countries, Germany, Croatia and the Netherlands, scored 4 out of 5 in this category. In most countries the emissions intensity of buildings is declining. While we did not analyse the reasons for this decline, the main reason is likely to be the decarbonisation of electricity grids. Most countries are also reducing direct emissions from fuel combustion in buildings. This indicates that action is occurring to improve efficiency and switch to renewable energy and less carbon intensive fuel – albeit not quickly enough overall.

Government action on building energy and emissions
This category assessed a range of government actions such as target setting, retrofit strategy, public investment and energy performance standards. It was in this category that European leadership was clearest, with most European countries scoring at least 3 out of 5. This reflects two decades of EU policies and legislation, in particular the Energy Performance in Buildings Directive. Despite these efforts, most buildings in the EU are still highly inefficient and retrofit rates are far short of what's required. Nevertheless, the EU has established some of the foundations of a good retrofit policy such as good data, mandatory energy certification and long-term strategies. This provides valuable experience that other countries can learn from and build on.

Best practice and recommendations

Many of the technological solutions to building emissions already exist. Buildings' thermal efficiency can be radically improved with simple measures such as insulation, draft exclusion and better glazing. Rooftop solar panels and batteries have become mainstream. Electric heat pumps offer highly efficient heating and cooling. The challenge is to roll out these technologies at sufficient speed and scale despite barriers, such as the high upfront cost of building retrofits.

Overcoming these barriers will require countries to implement bold ambitious action. Chapters 5 & 6 sets out some examples of such action, as well as the following high-level recommendations for country-level action in this space..

1. Targets – countries should set clear targets for reducing emissions from buildings. This should include a target for achieving a net zero building sector, as well as interim targets consistent with 1.5C warming.

2. Strategy – countries should set out a comprehensive long-term retrofit strategy, which includes a roadmap with measurable targeted actions and quantified milestones.

3. Investment – governments should invest far more in building retrofits. The scorecard awards top marks for public investment of US$150 per person per year which for many countries equates to around 10% of per capita energy bills in 2022. Such a level of investment would amount to $700 billion in annual spending on retrofits across the 21 countries included in this report.[5]

4. Regulation – buildings should be required to meet minimum standards of energy performance under some circumstances, for example when they are rented, sold or renovated. The minimum standard should be raised over time, in a similar way to energy standards for electrical appliances. Governments should also set a timeline for a ban on fossil fuel heating in buildings.

Governments will need to make the case for implementing bold action on retrofits, particularly when it requires public money. In an era of rising energy costs for many, this case has become easier. However, the real justification for such investment goes well beyond lower energy bills. Many countries are currently finding out the risks of relying on foreign fossil fuels to heat buildings. It is now clear that efficient buildings running on renewable energy can improve national security. What's more they can help to tackle climate change, alleviate poverty, create jobs and improve human health and well-being. Once countries consider this extensive range of benefits, it is likely that investments in building energy performance will seem like a bargain.

2.0 The Global Picture

2.1 Global building emissions

Globally, buildings are responsible for 37% of energy-related carbon emissions: 27% from operational emissions - the emissions from heating, cooling and electricity, and 10% from embodied emissions - the emissions from construction and maintenance.[6]

Figure 2.1 shows the global breakdown of operational emissions by residential and non-residential buildings, and direct and indirect emissions. Overall 33% of operational emissions from buildings are direct - the result of burning fossil fuels for heating, cooking and hot water.[7] The remaining 67% are indirect emissions from buildings' use of electricity.[8]

In 2020, 37% of operational building energy use was derived directly from fossil fuels, including natural gas, oil, and coal as figure 2.2 shows.[9] Renewables, such as geothermal and solar thermal, have gradually increased their share as a source for building energy use in the last 5 years, reaching almost 6% in 2020.[10] An increasing, but still small, share of electricity used in buildings is also sourced from renewables.

Figure 2.1

Operational emissions by use (United Nations Environment Programme, 2021)

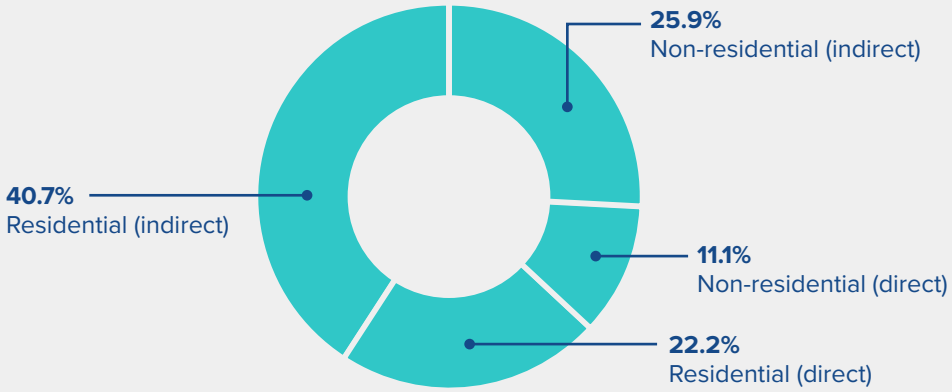
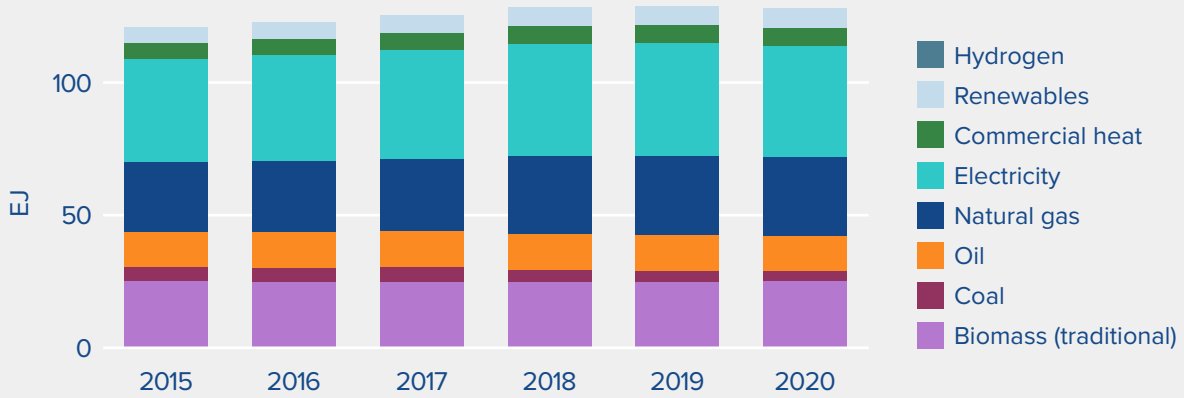


Figure 2.2

Global building energy use by source (IEA, 2021d)



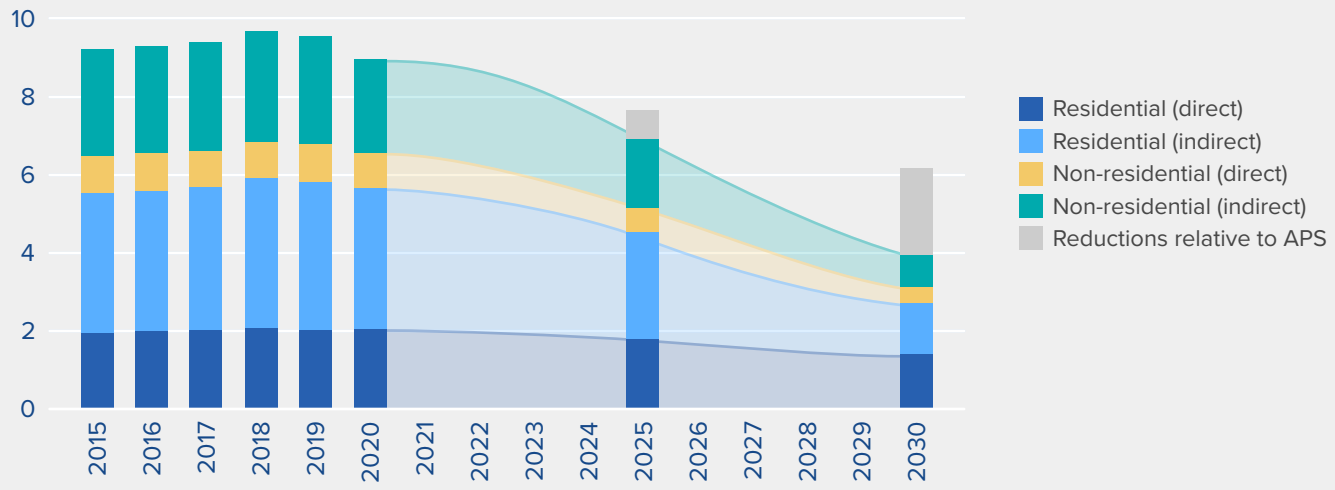
2.2 Decarbonising for Net Zero in 2050

The building sector is currently not on target to achieve net zero by 2050. To get on track the sector's energy intensity must drop 5 times quicker this decade than it did between 2015 and 2020.[11]

The sector will need to achieve a 45% reduction in energy consumed per square metre by 2030 from a 2020 base year.[12] This will mean achieving a 50% cut in direct emissions and 60% cut in indirect emissions by 2030 to get on track (Figure 2.3).[13]

Figure 2.3

IEA (2021b) projection of a net zero scenario for global CO2 emissions from building operations



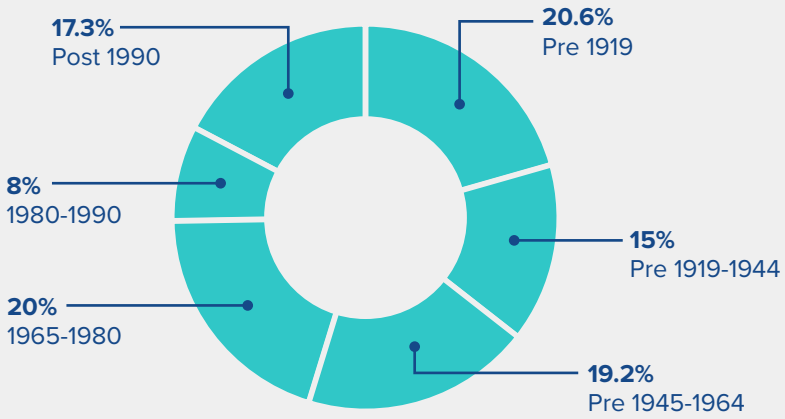
To achieve this level of reduction the energy performance of existing building stock will need to be significantly improved. Reducing operational emissions will be driven by action on two fronts: (1) reducing energy demand and (2) decarbonising electricity supply.[14] The IEA estimates the reductions required will be:[15]

- a 6% reduction in emissions every year between 2020 and 2030
- an increase in the average retrofit rate of the building stock from 1% a year to at least 2.5% by 2030
- improvement in the average energy intensity reduction achieved by energy retrofits (currently less than 15%)
- trebling spending on efficiency improvements by 2030.

This urgent need to significantly increase the retrofit rate globally is being reinforced by the emerging consensus that the demolition of existing building stock is a poor choice as a result of the amount of embodied carbon locked up in existing building stock.[16] In countries with older building stocks, the need for retrofits will be even greater. Amongst IEA member countries, there is a wide range in the age distribution of the existing building stock but the majority of buildings have been built since the 1950s.[17] Some countries have particularly old building stocks. Analysis, conducted across the UK's housing stock, has found the age of a property is the single biggest factor in determining energy efficiency.[18]

Figure 2.4

Share of UK dwelling stock by age in 2017 (%) (Piddington et al., 2020)



As Figure 2.4 shows, in the UK over 10 million dwellings - 36% of the total stock - were built before 1945, well before the first national building standards were introduced in 1965.[19] The majority of these homes need energy efficiency improvements, as well as many of the 13.5 million dwellings - 47% of the total stock - built between 1945 and 1990.[20] Most of Europe also has old building stock and will need to rapidly increase the building retrofit rate to achieve net zero by 2050. The EU has set a 3% target for the retrofit of public buildings, and will need to achieve this rate for all buildings to meet its climate targets.[21]

2.3 Meeting growing demand

The significant step up in retrofitting will need to be achieved, while global demand for new buildings continues to grow. The IEA has projected that by 2050, there will be demand for double the global floor space, and nearly double the current energy services in buildings.[22]

Deep energy retrofits will therefore be needed to achieve the deep cut in emissions as they deliver both improved energy efficiency and remove fossil fuels from the energy mix. For example, the innovative Energiesprong approach can deliver an average reduction of 80% in a home's total energy demand through a whole home retrofit (see page 39).[23] Such a retrofit relies on mature technologies, including thermally efficient insulation, photovoltaic roofing and air or ground source heating solutions. Increasing renewable energy supply in national grids will also play a significant part in decarbonising building stocks.

These changes to national building stocks are systemic, transformative and will represent a significant challenge as the need for rapid decarbonisation must be achieved while meeting demand for rapid expansion. Significant levels of investment, both public and private, and innovation will also be needed to deliver these changes, with the payback period often spanning decades.

It is therefore clear that ambitious government action will be required to support the building and construction sector, and property owners, to deliver on this agenda. This is especially the case for countries with older building stocks, where retrofit needs are even greater.

3.0 Global Retrofit Index methodology

3.1 Purpose of the Index

We developed the global retrofit index to assess the progress, and expected development, of different countries in reducing emissions from their existing buildings stocks. The index evaluates the current need for building retrofits, recent progress and relevant policy. Our aim is to give countries a better understanding of how well they are doing compared to other countries and best-practice benchmarks. We also want to show how well major economies are performing relative to action needed to achieve climate goals and a net zero emissions buildings sector.

3.2 Country selection

We have assessed countries in the G20 – a group that includes the world's major developed and emerging economies, representing more than 80% of global GDP.[24] The actions of this group of countries in the next two decades will, to a large extent, determine the success of the world's response to climate change.

We were not able to fully assess the following G20 members: Argentina, India, Indonesia, Russia, and South Africa due to a lack of publicly available information on their building sector and/or retrofit policies. We also added two non-G20 countries with interesting retrofits policy: the Netherlands and Croatia.

3.3 Principles of the Global Retrofit Index

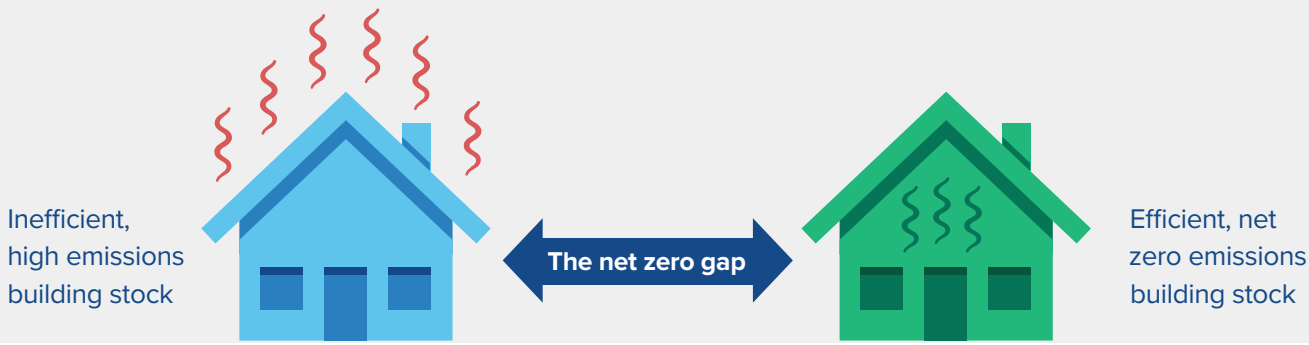
The index uses 11 scoring criteria across three categories: existing stock, building performance, and building policy. Each category evaluates a different aspect of the "net zero gap" between inefficient, high-emissions buildings today and efficient, net zero buildings needed in the future (Figure 3.1):

Existing stock measures country's current energy use and emissions from buildings (representing the size of the gap to a net zero building stock)

Building performance measures recent progress on energy use and emissions from buildings (representing how the net zero gap is closing (or widening))

Building policy measures effectiveness of government planning to close the net zero gap.

Figure 3.1
The net zero gap



We chose criteria to evaluate different aspects of each category against best practice and give a fair assessment of each country. We restricted the number of criteria in the interests of practicality and readability. However, building energy policy is a complex, multi-faceted area and there are many other criteria that could potentially be included. We also applied three principles which further restricted our selection of criteria:

- **Availability of data** – we included criteria only where we could find evidence to evaluate every indexed country. We rejected several criteria where we could not find adequate information – for example, countries' rates of energy retrofits or low-carbon heating installations.
- **Comparability of data** – the quantitative criteria relied on access to comparable data where we could be reasonably sure the same methodology had been used to calculate the data for different countries.
- **Objectivity** – while there is inevitably some level of subjectivity in this index, we tried to choose criteria that lent themselves to objective assessment. We also defined each score 0-10 within a criterion to assist objective scoring.

3.4 Summary of assessment criteria

For each of the 11 scoring criteria, we have awarded a score out of 10 based on performance relative to best practice (Table 3.1). These scores are weighted and converted to an overall score out of 100. This weighting reflects the relative importance of the various criteria. Criteria in Existing stock and Performance each get a total weighting of 25%, whereas the Policy category counts for 50%. This emphasis on policy reflects our assumption that no country is close to solving the issue of emissions from buildings, so closing the net zero gap will depend above all on effective government action.

Table 3.1

The assessment framework for the Global Retrofit Index

Category	Criteria	Explanation & justification	%
1. **Existing stock** (25%)	1a. Availability of data on emissions and energy use in buildings	Country publishes comprehensive data on building floor space, building energy use and emissions by building type, building energy and emissions intensity and rates of low carbon heating and insulation.	5
	1b. Average energy use in buildings per m2	Average annual energy to heat residential buildings is <40 kWh/m2/yr | Average annual energy use intensity in commercial buildings is <60 kWh/m2/yr	10
	1c. Average building emissions per capita	The average annual emissions from buildings is <100 kg CO2e/capita.	10
2. **Performance** (25%)	2a. Change in buildings emissions intensity 2015-20	Buildings emissions intensity has decreased by >25% in the last 5 years	12.5
	2b. Change in emissions from heating buildings 2010 - 2019	Buildings emissions intensity has decreased by >35% in the last 5 years	12.5
3. **Policy:** Government retrofit policy and initiatives (50%)	3a. Ambition of national targets to reduce energy use and/or emissions from buildings	There is a national target to reduce emissions from existing buildings at a rate and scale consistent with 1.5C targets - e.g. at least an 80% reduction in direct emissions from the buildings sector by 2040, and net zero by 2050.	10
	3b. The existence and level of ambition of a national retrofit strategy	There is a national strategy on energy retrofits in buildings which includes a long-term roadmap for the retrofit of existing buildings into energy efficient and decarbonised buildings by 2050, with milestones and progress indicators and measurable targeted actions.	10
	3c. Public investment	Public investment in energy retrofits in buildings is over US$150 per capita per year.	10
	3d. Policies to phase out fossil fuels in heating and cooling in buildings	There are clear and ambitious policies and measures which target the phase-out of fossil fuels in heating in buildings, and there is a ban on new fossil-fuel heating in buildings before 2030.	7.5
	3e. Certification of building energy performance	There is a national system of certification for the energy performance of buildings with some best practice characteristics.	5
	3f. Minimum energy performance standards	Existing buildings are required to meet Minimum Energy Performance Standards in a range of situations.	7.5

4.0 Country Scorecards

This section presents the analysis for the assessed countries. This includes scorecards, listed by ranking, for the 16 countries for which there is enough public information for a full analysis. Following the scorecards, we also provide summary information of five G20 countries for which we found insufficient information to include in the index.

Each scorecard represents a summary of the analysis carried out to determine a country's performance, as of August 2022. As set out in the methodology, each country is scored out of 100 and ranked amongst peers that have also been assessed.

The scorecards provide a summary of a country's overall performance, including any notable elements of policy, alongside summaries for the performance of a country in each of the three categories: (1) Existing stock, (2) Building performance, and (3) Building policy. In each of these categories, a country's performance is summarised by a score out of 5. This score represents the proportion of the total points available in each category that a country has received. A score of 5 is therefore equal to 100% of points being awarded for that category to a country. A further breakdown of the score received by a country across the 11 criteria is also provided.

4.1 Assessment summary

No countries in this index scored well across all criteria, and none achieved our 'sufficient' rating. The top ranked country (Germany) received only 61/100 making it 'almost sufficient'. All other countries scored less than 60, meaning we rate their performance as 'insufficient' or worse. This suggests that the global effort to decarbonise buildings is falling well short, and it is likely no country is on track to meet the IEA's target retrofit rate of at least 2.5% by 2030.[25]

The best performers in the index are in the European Union. This has been driven by the long-standing European Union retrofit policies that member states are required to comply with, including the Energy Performance of Buildings Directive. While such policies are commendable, their implementation within member states is far from perfect with the legislation allowing for varying levels of compliance. Consequently, while some countries have used the EU's push for retrofits to drive their own ambitious national agendas, others have set out far less detailed strategies and policies that fall short of what is needed.

Outside the EU, global performance is generally poor with very little evidence of concerted policy, or fiscal, action on building retrofits despite the evident need. The performance of countries is characterised by either a patchwork of policies and financial incentives to promote retrofits, or their complete non-existence. This represents a concerning trend and it is even evident in nations where retrofits have been identified as part of a national climate strategy.

In terms of areas of poor performance across the index, the implementation of minimum energy performance standards (MEPs) represents an area where most countries are currently failing. MEPs are non-existent for many countries and, where they have been put into place, they are typically extremely limited in their coverage. This is despite MEPs representing a powerful lever for change for governments in their national building stocks.

A brighter spot for many countries in the index was their recent performance in terms of emissions reductions in the building sector in the last decade. However, in most cases this is the result of decarbonisation efforts in the power generation sector rather than improvements in energy efficiency in the building sector.

Overall performance across the index is a cause for concern with the lack of coherent, detailed national retrofit strategies and policies, with appropriate fiscal support, representing a real blind spot in global climate action. It is clear that national governments must begin to take concerted action through policy and fiscal support to set out detailed and ambitious roadmaps for retrofitting their national building stocks to enable them to meet net zero in 2050.

Table 4.1

League table showing scores of all G20 members assessed in this index

Rank	Country	Existing stock (/25)	Retrofit performance (/25)	Retrofit policy (/50)	Total score (/100)
1	Germany	6.0	18.8	36.8	61.5
2	Netherlands*	8.0	20.0	28.3	56.3
3	France	9.0	16.3	30.3	55.5
4	UK	8.0	16.3	28.5	52.8
5	Croatia*	6.0	20.0	26.0	52.0
6	Italy	8.0	12.5	31.3	51.8
7	Australia	11.5	7.5	13.5	32.5
8	Mexico	18.5	8.8	5.0	32.3
=9	Brazil	14.0	11.3	3.8	29.0
=9	Canada	6.0	5.0	18.0	29.0
=9	Republic of Korea	7.0	5.0	17.0	29.0
=12	Japan	8.0	7.5	13.3	28.8
=12	United States	7.0	7.5	14.3	28.8
14	Turkey	9.0	0.0	17.0	26.0
15	Saudi Arabia	6.5	12.5	4.0	23.0
16	China	9.0	0.0	12.5	21.5
	South Africa	Insufficient data			
	Argentina	Insufficient data			
	Indonesia	Insufficient data			
	India	Insufficient data			
	Russia	Insufficient data			

**Croatia and the Netherlands are not G20 countries, but have been included as case studies representing EU performance (It was not possible to assess the EU, a G20 member, as a whole)*

Table 4.2

League table showing scores of all G7 members assessed in this index

1	Germany	6.0	18.8	36.8	61.5
3	France	9.0	16.3	30.3	55.5
4	UK	8.0	16.3	28.5	52.8
6	Italy	8.0	12.5	31.3	51.8
=9	Canada	6.0	5.0	18.0	29.0
=12	Japan	8.0	7.5	13.3	28.8
=12	United States	7.0	7.5	14.3	28.8

Interpreting the score received

We have given each country an overall score out of 100. This table explains how to interpret these scores.

Sufficient

A score above 80 reflects a **sufficient** performance on building retrofits. By this, we refer to a country having in place the policies necessary to begin delivering on the retrofit agenda and demonstrating in recent energy use and carbon emissions trends that progress is already underway in its building stock. Scores below this should be considered inadequate to deliver building retrofits at the scale and rate required.

Almost Sufficient

We consider a score between 60 and 80 to be an **almost sufficient** performance, but nevertheless inadequate to meet the retrofit need. While a country in this band is likely to show moderate ambition towards building retrofits, have delivered some reductions in energy use and emissions, and implemented foundational policy measures, its performance will fall short of delivering retrofits in line with a 1.5°C scenario.

Insufficient

We consider a score between 40 and 60 to be an **insufficient** performance that will not meet the retrofit need. A country in this band will have demonstrated limited ambition towards building retrofits, delivered some reductions in energy use and emissions, and implemented some foundational policy measures. Retrofit rates will fall significantly short of what is required in a 1.5°C scenario as a result.

Highly Insufficient

We consider a score between 20 and 40 to be a **highly insufficient** performance that will not meet the retrofit need. A country in this band will have demonstrated a wanting ambition towards building retrofits, delivered only very limited reductions, if at all, in energy use and emissions, and implemented few, if any, policy measures.

Critically Insufficient

We consider a score between 0 and 20 to be a **critically insufficient** performance that will not meet the retrofit need. A country in this band will not have demonstrated any real ambition towards building retrofits and its score is likely based on reductions in energy use and emissions or severely limited policies that qualify in a limited way for promoting building retrofits.

Germany

RANKING **1**

SCORE **61.5**

Germany has a broad programme of policies, initiatives and support to renovate national building stock. In recent years it has reduced emissions from buildings, but its annual retrofit rate is stuck at around 1% per year.[26] Recently the German Government has proposed measures which could greatly accelerate the decarbonisation of buildings. This includes a commitment to phase out fossil fuel heating by 2024, and to invest around EUR 20 billion per year on building retrofits.[27]

EXISTING STOCK — Highly Insufficient

PERFORMANCE — Almost Sufficient

POLICY — Almost Sufficient

Scores?

		MAXIMUM POINTS
EXISTING STOCK		
A measure of the gap between best practice energy performance of buildings and the status quo		
Building data	5	5
Building energy use	1	10
Building emissions	0	10
PERFORMANCE		
How well is the country performing on emissions reduction in buildings?		
Change in emissions intensity over last 5	12.5	12.5
Change in emissions heating 2010 to 2019	6.3	12.5
POLICY		
How robust and ambitious are national government plans to renovate buildings to address renovation need?		
Target setting	8	10
Strategy	6	10
Public investment	8	10
Low carbon heating and cooling	6.8	7.5
Certification of energy performance	5	5
Minimum energy performance	3	7.5
TOTAL	61.5	100

EXISTING STOCK 1 out of 5

Germany's buildings have high energy use and emissions, partly due to the fact that around two-thirds of buildings were constructed before 1970.[28]

PERFORMANCE 3.5 out of 5

Germany has received a top score of 10 for reducing buildings emissions intensity by 27% over the last 5 years. Much of this was due to reduction in the carbon intensity of electricity generation.[29] Germany has performed only moderately well in reducing emissions from fuel combustion in buildings.

POLICY 3.5 out of 5

As an EU member Germany has built some of the foundations of a successful retrofit policy, including a building certification scheme and Long-Term Renovation Strategy. It has also provided consistent public funding for energy-efficiency retrofits. To date Germany's policies do not add up to a comprehensive roadmap for the decarbonisation of buildings and is particularly lacking a strategy beyond 2030. However, the German Government's recent commitments on investment and heating (see summary above) have the potential to transform its building energy performance.

Netherlands

RANKING **2**

SCORE **56.3**

The Netherlands, performs well on the scorecard, partly due to EU policies on renovation strategies, EPC systems and targets. Recent developments in Europe, with conflict in Ukraine, have led the Netherlands to commit to end new fossil fuel heating systems from 2026.[30] The Netherlands has also established incentive schemes to support building retrofits and has detailed a roadmap for establishing more stringent building standards to drive more retrofits by 2050.

EXISTING STOCK — Highly Insufficient

PERFORMANCE — Sufficient

POLICY — Insufficient

Scores?

		MAXIMUM POINTS
EXISTING STOCK		
A measure of the gap between best practice energy performance of buildings and the status quo		
Building data	4	5
Building energy use	2	10
Building emissions	2	10
PERFORMANCE		
How well is the country performing on emissions reduction in buildings?		
Change in emissions intensity over last 5	10	12.5
Change in emissions heating 2010 to 2019	10	12.5
POLICY		
How robust and ambitious are national government plans to renovate buildings to address renovation need?		
Target setting	4	10
Strategy	7	10
Public investment	4	10
Low carbon heating and cooling	5.3	7.5
Certification of energy performance	5	5
Minimum energy performance	3	7.5
TOTAL	56.3	100

EXISTING STOCK 1.5 out of 5

The Netherlands publishes good data on its building stock. These show that energy use and emissions are well above levels needed for decarbonisation. Most of the building stock's direct emissions are driven by gas heating and older buildings.

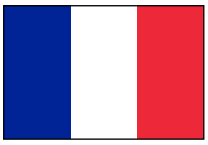
PERFORMANCE 4 out of 5

In the last decade, the Netherlands has achieved impressive reductions in both direct and indirect emissions from buildings. Between 2010 and 2019, emissions from fuel combustion in buildings decreased by 31%.[31]

POLICY 2.5 out of 5

The Netherlands has set out a retrofit plan with a key target to renovate 1.5 million homes and other buildings by 2030 to make them natural-gas free.[32] There are also minimum energy performance standards and government retrofit incentives.

However, plans for setting future minimum buildings energy standards are not ambitious or comprehensive, and overall public investment is below what will likely be required.



France

RANKING **3**

SCORE **55.5**

Despite recent success in reducing their energy use and emissions, France's buildings are still inefficient and carbon intensive. Recent improvement looks likely to continue given France's retrofit strategies. French policy has a particular focus on eradication of the least efficient buildings, through incentives and regulation. France scores well in several policy areas due to EU law compliance. However, it needs to increase its level of investment and develop a plan to end fossil fuel heating.

EXISTING STOCK — Highly Insufficient

PERFORMANCE — Almost Sufficient

POLICY — Almost Sufficient

Scores?

EXISTING STOCK

A measure of the gap between best practice energy performance of buildings and the status quo

		MAXIMUM POINTS
Building data	5	5
Building energy use	2	10
Building emissions	2	10

PERFORMANCE

How well is the country performing on emissions reduction in buildings?

Change in emissions intensity over last 5	7.5	12.5
Change in emissions heating 2010 to 2019	8.8	12.5

POLICY

How robust and ambitious are national government plans to renovate buildings to address renovation need?

Target setting	8	10
Strategy	7	10
Public investment	2	10
Low carbon heating and cooling	3	7.5
Certification of energy performance	5	5
Minimum energy performance	5.3	7.5
TOTAL	**55.5**	**100**

EXISTING STOCK 1.5 out of 5

France publishes good data on building energy use and emissions. These show that energy use and emissions are well above levels needed for decarbonisation. This is due partly to France's old, leaky building stock: 17% of homes are in the worst efficiency bands (F & G).[33]

PERFORMANCE 3 out of 5

France has made good progress in reducing buildings emissions intensity. Its 27% reduction in emissions from fuel combustion in buildings suggests they are becoming more thermally efficient.[34]

POLICY 3 out of 5

France has stated an ambition to make building retrofits a national priority. France is banning the sale or rental of the most inefficient homes, with a timeline based on energy performance ratings G (2025), F (2028) and E (2034).[35] It also has a comprehensive national system of certification for building energy performance, as required by the EU Energy Performance of Buildings Directive. The government offers grants to encourage the replacement of fossil fuel heating, but there is no target for a complete phase out.

United Kingdom

RANKING **4**

SCORE **52.8**

The UK's existing building stock is highly inefficient and reliant on fossil fuel heating. Due to fairly rapid decarbonisation of electricity supply, good progress has been made on indirect building emissions but far less on emissions from fuel combustion in buildings. The UK retains the foundations of good policy that were implemented during its membership of the EU. In addition it has made some important commitments to improving energy efficiency in buildings and eliminating gas boilers. However, there is much room for improvement in its policies and performance.

EXISTING STOCK — Highly Insufficient

PERFORMANCE — Almost Sufficient

POLICY — Insufficient

Scores?

		MAXIMUM POINTS
EXISTING STOCK		
A measure of the gap between best practice energy performance of buildings and the status quo		
Building data	5	5
Building energy use	2	10
Building emissions	1	10
PERFORMANCE		
How well is the country performing on emissions reduction in buildings?		
Change in emissions intensity over last 5	12.5	12.5
Change in emissions heating 2010 to 2019	3.8	12.5
POLICY		
How robust and ambitious are national government plans to renovate buildings to address renovation need?		
Target setting	6	10
Strategy	6	10
Public investment	4	10
Low carbon heating and cooling	4.5	7.5
Certification of energy performance	5	5
Minimum energy performance	3	7.5
TOTAL	52.8	100

EXISTING STOCK 1.5 out of 5

The UK publishes good data on buildings. It has one of the oldest building stocks in Europe, so its retrofitting need is high. The UK Government has stated that by 2035 it wants households to have an EPC rating of 'C' although little progress has been made.[36]

PERFORMANCE 3 out of 5

The UK has achieved top marks for reducing the emissions intensity of its buildings - largely thanks to electricity grid decarbonisation. However, emissions from fuel combustion in buildings are falling slowly, suggesting a lack of action on improving their thermal performance.

POLICY 2.5 out of 5

The UK has set some national targets for buildings (residential and commercial) focussing on achieving higher energy efficiency. However, there is no target retrofit rate, and the target for household energy ratings lacks incentives and net zero ambition. It has previously had commendable funding, but these schemes have now largely lapsed and replacements are insufficient.

Croatia

RANKING **5**

SCORE **52**

Croatia's buildings are highly energy intensive, but the country has achieved impressive reductions in direct and indirect emissions from buildings. Croatia has a clear long-term strategy for retrofitting buildings and has introduced many of the foundations of a successful retrofit policy. Croatia could improve by increasing public investment, maker greater use of minimum energy standards and setting firm targets for emissions reduction in the building sector.

EXISTING STOCK — Highly Insufficient

PERFORMANCE — Sufficient

POLICY — Insufficient

Scores?

		MAXIMUM POINTS
EXISTING STOCK		
A measure of the gap between best practice energy performance of buildings and the status quo		
Building data	5	5
Building energy use	0	10
Building emissions	1	10
PERFORMANCE		
How well is the country performing on emissions reduction in buildings?		
Change in emissions intensity over last 5	10	12.5
Change in emissions heating 2010 to 2019	10	12.5
POLICY		
How robust and ambitious are national government plans to renovate buildings to address renovation need?		
Target setting	6	10
Strategy	8	10
Public investment	4	10
Low carbon heating and cooling	1.5	7.5
Certification of energy performance	5	5
Minimum energy performance	1.5	7.5
TOTAL	52	100

EXISTING STOCK 1 out of 5

Croatia publishes good data on buildings energy use and emissions, showing that the country's buildings are energy intensive with high emissions. Most of Croatia's buildings were built before 2005.[37]

PERFORMANCE 4 out of 5

Croatia has achieved significant recent reductions in emissions from buildings. It has seen the largest drop in emissions from fuel combustion in buildings in this index.

POLICY 2.5 out of 5

Croatia has implemented some of the foundations of a rigorous retrofit policy. Its Long-term Renovation Strategy includes a timeline with milestones, and is in line with the EU's targeted 80-95% reduction in the building sector. Croatia has a comprehensive energy performance certification scheme and it has set out some minimum performance standards for existing buildings. The Croatian Government offers grants for building retrofits and plans to invest millions in retrofitting buildings.[38] However, Croatia has not set a hard long-term target for emissions reductions in the building sector and has no plan to end fossil fuel heating systems.

Italy

RANKING **6**

SCORE **51.8**

Italy's buildings are energy inefficient and emissions intensive. Its recent performance shows some improvement, albeit at a slower rate than other European countries in this list.

Italy scores well in several policy areas due to compliance with EU law such as the Energy Performance of Buildings Directive. Its standout policy is the generous and ambitious home retrofits 'Superbonus'. However, in other areas such as minimum energy performance standards, Italy's retrofit policies are insufficient.

EXISTING STOCK — Highly Insufficient

PERFORMANCE — Insufficient

POLICY — Almost Sufficient

Scores?

		MAXIMUM POINTS
EXISTING STOCK		
A measure of the gap between best practice energy performance of buildings and the status quo		
Building data	5	5
Building energy use	2	10
Building emissions	1	10
PERFORMANCE		
How well is the country performing on emissions reduction in buildings?		
Change in emissions intensity over last 5	6.3	12.5
Change in emissions heating 2010 to 2019	6.3	12.5
POLICY		
How robust and ambitious are national government plans to renovate buildings to address renovation need?		
Target setting	6	10
Strategy	6	10
Public investment	9	10
Low carbon heating and cooling	1.5	7.5
Certification of energy performance	5	5
Minimum energy performance	3.8	7.5
TOTAL	51.8	100

EXISTING STOCK 1.5 out of 5

Italy publishes good data showing high building energy use and emissions, partly due to the fact that <80% of dwellings were built before 1980 and 30% before 1945.[39] The energy performance of over half of existing buildings falls into the worst categories of the EU's Certificate system.[40]

PERFORMANCE 2.5 out of 5

Like most countries Italy is failing to reduce emissions from buildings quickly enough to decarbonise by 2050. However, Italy did manage to decrease its building emissions intensity by roughly 15% (2015-2020).[41]

POLICY 3 out of 5

Italy lacks a hard target for reducing building sector emissions. As an EU member Italy has a Long-Term Renovation Strategy, although this does not amount to a comprehensive decarbonisation strategy. The Superbonus scheme, which allows homeowners to recover 110% of improving building retrofit costs, is genuinely world-leading.[42] Italy has a comprehensive building certification scheme, but few minimum energy standards for existing buildings. It also lacks a policy to end fossil fuel heating.

Australia

RANKING **7**

SCORE **32.5**

Australia has a very high level of per capita GHG emissions related to energy use in buildings. Moderate recent reductions are due to the decarbonisation of electricity generation and not energy retrofits. Australia is currently showing little ambition to improve the energy efficiency of its existing buildings. Only one Australian state, Victoria, is investing significantly in building retrofits. However, Australia's long-standing incentives for residential renewables have contributed to the country having the world's highest levels of rooftop solar panels.[43]

EXISTING STOCK — Insufficient

PERFORMANCE — Highly Insufficient

POLICY — Highly Insufficient

Scores?

		MAXIMUM POINTS
EXISTING STOCK		
A measure of the gap between best practice energy performance of buildings and the status quo		
Building data	3.5	5
Building energy use	8	10
Building emissions	0	10
PERFORMANCE		
How well is the country performing on emissions reduction in buildings?		
Change in emissions intensity over last 5	7.5	12.5
Change in emissions heating 2010 to 2019	0	12.5
POLICY		
How robust and ambitious are national government plans to renovate buildings to address renovation need?		
Target setting	2	10
Strategy	3	10
Public investment	4	10
Low carbon heating and cooling	1.5	7.5
Certification of energy performance	3	5
Minimum energy performance	0	7.5
TOTAL	32.5	100

EXISTING STOCK 2 out of 5

Australia publishes good building energy and emissions data, although data on commercial buildings is out-of-date. The energy intensity of Australia's buildings is low, due to lower heating needs and the large size of Australian homes. Conversely, average building emissions per capita are very high.

PERFORMANCE 1.5 out of 5

Australia has performed moderately in reducing buildings emissions intensity between 2015 and 2020. These reductions are probably due to increasing levels of renewables in the electricity grid and high levels of rooftop solar PV. However, it has performed very poorly on emissions from heating in buildings, with a 16% increase over 2010-2019.[44]

POLICY 1 out of 5

Australia has little policy in place for buildings emissions reductions. It has no sector-specific target, and no plan to phase out fossil fuel heating. One world-leading programme is the National Australian Built Environment Rating System, which measures the energy performance of commercial buildings, on sale or rental.[45]

Mexico

RANKING **8**

SCORE **32.3**

Mexico's buildings are relatively low in their energy intensity and per capita building emissions are among the lowest in this index. Direct and indirect emissions from buildings have been falling in recent years, albeit slowly.

However, Mexico's policies in this area are among the weakest in this index. The country has no targets or incentives for energy efficiency or building stock retrofits, and little public investment. With existing policies it is unlikely Mexico's building sector will be able to make substantial cuts in emissions.

EXISTING STOCK — Almost Sufficient

PERFORMANCE — Highly Insufficient

POLICY — Critically Insufficient

Scores?

EXISTING STOCK

A measure of the gap between best practice energy performance of buildings and the status quo

		MAXIMUM POINTS
Building data	2.5	5
Building energy use	10	10
Building emissions	6	10

PERFORMANCE

How well is the country performing on emissions reduction in buildings?

Change in emissions intensity over last 5	5	12.5
Change in emissions heating 2010 to 2019	3.8	12.5

POLICY

How robust and ambitious are national government plans to renovate buildings to address renovation need?

Target setting	0	10
Strategy	2	10
Public investment	0	10
Low carbon heating and cooling	0	7.5
Certification of energy performance	0	5
Minimum energy performance	3	7.5
TOTAL	**32.3**	**100**

EXISTING STOCK 3.5 out of 5

Mexico publishes good data on its building stock and energy use. This data shows that the energy use of Mexico's building sector is significantly lower than other G20 countries. This is perhaps partially reflective of low heating needs.

PERFORMANCE 1.5 out of 5

Mexico has achieved consistent reductions in building emissions with a decrease of almost 12% between 2015 and 2020.[46] However, the country's building policies do not seem designed to prolong or accelerate this reduction.

POLICY 0.5 out of 5

Mexico has very little policy in place or strategy to tackle emissions from buildings. We have also found no good evidence of public investment in retrofitting buildings. Mexico's energy performance certification and energy efficiency policies are voluntary and rely on states making them mandatory. This general lack of policies and national targets make it clear that significant changes must be made for Mexico to reach net zero by 2050.

Brazil

RANKING
=9

SCORE
29

Brazil's need for building retrofits is lower than most countries in this index. It has low building emissions per capita and relatively low energy intensity buildings. However, the country will still need to improve the energy performance of existing buildings to align with the Paris climate agreement. Unfortunately, Brazil has little policy in place to require or incentivise building retrofits. Unless this changes, Brazil is unlikely to substantially reduce its building emissions.

EXISTING STOCK — Insufficient

PERFORMANCE — Insufficient

POLICY — Critically Insufficient

Scores?

		MAXIMUM POINTS
EXISTING STOCK		
A measure of the gap between best practice energy performance of buildings and the status quo		
Building data	1	5
Building energy use	5	10
Building emissions	8	10
PERFORMANCE		
How well is the country performing on emissions reduction in buildings?		
Change in emissions intensity over last 5	11.3	12.5
Change in emissions heating 2010 to 2019	0	12.5
POLICY		
How robust and ambitious are national government plans to renovate buildings to address renovation need?		
Target setting	0	10
Strategy	1	10
Public investment	1	10
Low carbon heating and cooling	0	7.5
Certification of energy performance	2	5
Minimum energy performance	0	7.5
TOTAL	29	100

EXISTING STOCK 2.5 out of 5

Brazil publishes little data on building energy and emissions. The data that is available indicates that Brazil has the lowest building emissions per capita of countries in this index. This is likely due to low heating requirements and a high proportion of renewable energy in its electricity supply.

PERFORMANCE 2 out of 5

Brazil achieved a 24% reduction in emissions from the building sector (2015-2020).[47] However, emissions from fuel combustion in buildings have increased recently. This suggests that recent reductions are the result of decarbonisation in the power generation sector, and buildings are not becoming more efficient.

POLICY 0 out of 5

Brazil has some of the weakest policy on building retrofits in this index. The country has not set out any targets, strategies or policies on building retrofits and energy efficiency. Brazil's energy performance certificate scheme and minimum energy performance standards only apply to federal buildings. Other limited policies include some public sector procurement rules and some financial support for construction.

Canada

RANKING
=9

SCORE
29

Canada's buildings are highly energy intensive and emissions intensive, and the country has made little progress in improving building energy performance. Emissions from fuel combustion have actually been rising.

Canada has introduced some components of a retrofit strategy, such as financial incentives, but there are major gaps including a lack of energy performance standards. The Canadian Government has recognised the need for more comprehensive policy and has committed $150 million to develop a national net zero by 2050 buildings strategy - the Canada Green Buildings Strategy.[48]

EXISTING STOCK — Highly Insufficient

PERFORMANCE — Highly Insufficient

POLICY — Highly Insufficient

Scores?

		MAXIMUM POINTS
EXISTING STOCK		
A measure of the gap between best practice energy performance of buildings and the status quo		
Building data	5	5
Building energy use	1	10
Building emissions	0	10
PERFORMANCE		
How well is the country performing on emissions reduction in buildings?		
Change in emissions intensity over last 5	5	12.5
Change in emissions heating 2010 to 2019	0	12.5
POLICY		
How robust and ambitious are national government plans to renovate buildings to address renovation need?		
Target setting	4	10
Strategy	6	10
Public investment	4	10
Low carbon heating and cooling	1.5	7.5
Certification of energy performance	1	5
Minimum energy performance	1.5	7.5
TOTAL	29	100

EXISTING STOCK 1 out of 5

Canada publishes good data, which show that its buildings have very high emissions and energy-intensity. 80% of Canadian buildings in 2030 will be existing buildings, highlighting the need for retrofitting.[49]

PERFORMANCE 1 out of 5

Building emissions decreased by 11% (2015-2020). However direct emissions from combustion in buildings have increased by 17% (2010-2019).[50,51] Canada will need to substantially improve this performance to achieve its net zero emissions target.

POLICY 1.5 out of 5

Canada has a net zero target (by 2050) and an emissions reduction plan for 2030. This plan includes projections for reductions from building emissions but no formal targets. It flags the development of a Canada Green Buildings Strategy, but this is not yet in place. The building sector is integrated into Canada's net zero targets. There are significant public funds available for retrofits and heat pump installation, although not enough for the scale of retrofits needed. There are also no mandatory energy certification schemes or minimum energy performance standards.

Republic of Korea

RANKING
=9

SCORE
29

The Republic of Korea's buildings are highly energy and emissions intensive, and recent improvements have been small. The Republic of Korea's Green New Deal allocates major investment to transform the economy to make it greener. Unfortunately, this contains only minor provisions related to buildings. The Republic of Korea has no emissions target for the buildings sector, and insufficient policy and incentives to reduce emissions from buildings in line with its net zero target.

EXISTING STOCK — Highly Insufficient

PERFORMANCE — Highly Insufficient

POLICY — Highly Insufficient

Scores?

EXISTING STOCK

A measure of the gap between best practice energy performance of buildings and the status quo

		MAXIMUM POINTS
Building data	5	5
Building energy use	2	10
Building emissions	0	10

PERFORMANCE

How well is the country performing on emissions reduction in buildings?

Change in emissions intensity over last 5	2.5	12.5
Change in emissions heating 2010 to 2019	2.5	12.5

POLICY

How robust and ambitious are national government plans to renovate buildings to address renovation need?

Target setting	2	10
Strategy	6	10
Public investment	4	10
Low carbon heating and cooling	0.8	7.5
Certification of energy performance	2	5
Minimum energy performance	2.3	7.5
TOTAL	**29**	**100**

EXISTING STOCK 1 out of 5

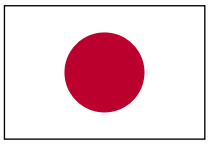
The Republic of Korea publishes some good data on building stock energy use and efficiencies. This data reveals high energy and emissions intensity in the country's buildings.

PERFORMANCE 1 out of 5

The Republic of Korea has achieved small reductions in direct and indirect emissions from buildings in recent years. However, these reductions fall short of the rate required to achieve Net Zero by 2050.

POLICY 1.5 out of 5

The Republic of Korea picks up points on this scorecard through their ambitious Green New Deal, which details plans for many sectors to become more sustainable. While the Green New Deal contains few specific actions on buildings, it does encourage a switch to renewable energy with substantial public funds available. The Green Buildings Construction Support Act introduces some limited energy certifications. However, there are shortcomings in terms of inadequate funds for retrofits to reach net zero, and no plan to phase out fossil fuel heating.



Japan

RANKING
=12

SCORE
28.8

Japan has introduced some energy efficiency and retrofit policies through its Green Growth Strategy and commitment to be carbon neutral by 2050. However, this formal pledge has not led to a robust roadmap or targets for buildings, and regulations on energy standards and performance certification remain patchy and voluntary. Japan's retrofit performance remains relatively poor. The Japanese government set a target that all new constructions must be net-zero energy by 2030, although the 2020 target was not met.

EXISTING STOCK Highly Insufficient

PERFORMANCE Highly Insufficient

POLICY Highly Insufficient

Scores?

		MAXIMUM POINTS
EXISTING STOCK		
A measure of the gap between best practice energy performance of buildings and the status quo		
Building data	3	5
Building energy use	5	10
Building emissions	0	10
PERFORMANCE		
How well is the country performing on emissions reduction in buildings?		
Change in emissions intensity over last 5	5	12.5
Change in emissions heating 2010 to 2019	2.5	12.5
POLICY		
How robust and ambitious are national government plans to renovate buildings to address renovation need?		
Target setting	2	10
Strategy	5	10
Public investment	1	10
Low carbon heating and cooling	3	7.5
Certification of energy performance	1.5	5
Minimum energy performance	0.8	7.5
TOTAL	28.8	100

EXISTING STOCK 1.5 out of 5

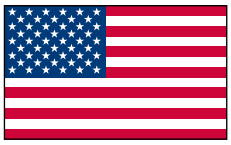
The Japanese building stock is relatively unusual in that buildings have short lifespans of on average 30 years.[52] While retrofitting will be important, given buildings built in 2020 will likely be around in 2050, the emphasis will be on implementing stringent building codes.

PERFORMANCE 1.5 out of 5

Japan is currently failing to reduce emissions in line with a 1.5°C pathway in its buildings. Reductions in indirect emissions have been hampered by restrictions on nuclear power following the Fukushima disaster.

POLICY 1 out of 5

While Japan has recognised the importance of retrofitting, the current policy framework is patchy in coverage. The country has no clear targets or strategy for reducing building sector emissions, and is allocating few funds to retrofits. With current policy it seems unlikely Japan will reduce emissions from buildings in line with its net zero by 2050 target.



USA

RANKING
=12

SCORE
28.8

The US building stock is energy inefficient and emissions intensive, and buildings are responsible for nearly one-third of US emissions. The Biden Administration has made it clear that action on building energy use is a vital part of achieving the country's net zero target. Federal funds have been made available to improve building energy efficiency, including through the Inflation Reduction Act 2022. However, the amounts are too small to make a significant impact, and there is a lack of regulation to require retrofits. Some US states and cities are introducing more ambitious regulation and incentives for retrofitting existing buildings.

EXISTING STOCK Highly Insufficient

PERFORMANCE Highly Insufficient

POLICY Highly Insufficient

Scores?

		MAXIMUM POINTS
EXISTING STOCK *A measure of the gap between best practice energy performance of buildings and the status quo*		
Building data	4	5
Building energy use	3	10
Building emissions	0	10
PERFORMANCE *How well is the country performing on emissions reduction in buildings?*		
Change in emissions intensity over last 5	7.5	12.5
Change in emissions heating 2010 to 2019	0	12.5
POLICY *How robust and ambitious are national government plans to renovate buildings to address renovation need?*		
Target setting	2	10
Strategy	4	10
Public investment	2	10
Low carbon heating and cooling	2.3	7.5
Certification of energy performance	1	5
Minimum energy performance	3	7.5
TOTAL	28.8	100

EXISTING STOCK 1 out of 5

The US publishes good data on building energy. It shows its buildings to be energy-intensive with high related emissions. This partly reflects outdated building codes, and a widespread lack of home insulation.

PERFORMANCE 1.5 out of 5

The US is failing to reduce emissions from buildings at the rate required to achieve Net Zero by 2050. The US has achieved a 16.6% reduction in per capita emissions from the building sector (2015-2020), but direct emissions from fuel combustion have remained static.[53]

POLICY 1 out of 5

The US policy for energy efficiency and building retrofits suffers from a lack of mandatory legislation. There is no national long-term target for building emissions reductions nor targets for energy efficiency improvements or retrofit rates. Public investment has been poor with major legislative setbacks. Policies to implement energy performance certificate schemes, minimum energy performance standards and phase out fossil fuel heating and cooling are currently limited to a small number of US states.

Turkey

RANKING **14**

SCORE **26**

The Turkish Government has recognised the importance of reducing building emissions and the need for retrofits. However, beyond this headline recognition and initial proposals for action, very little has been formalised or achieved. Turkey scores poorly across performance and policy due to increases in buildings emissions and patchy policy coverage. Some progress has been made as a result of moves by Turkey to align with the EU regulations on energy performance in buildings.

EXISTING STOCK — Highly Insufficient

PERFORMANCE — Critically Insufficient

POLICY — Highly Insufficient

Scores?

EXISTING STOCK

A measure of the gap between best practice energy performance of buildings and the status quo

		MAXIMUM POINTS
Building data	3	5
Building energy use	4	10
Building emissions	2	10

PERFORMANCE

How well is the country performing on emissions reduction in buildings?

Change in emissions intensity over last 5	0	12.5
Change in emissions heating 2010 to 2019	0	12.5

POLICY

How robust and ambitious are national government plans to renovate buildings to address renovation need?

Target setting	4	10
Strategy	4	10
Public investment	2	10
Low carbon heating and cooling	0	7.5
Certification of energy performance	4	5
Minimum energy performance	3	7.5
TOTAL	**26**	**100**

EXISTING STOCK 1.5 out of 5

Turkey publishes good data on its building stock, which is relatively young, with approximately two thirds built since 1990.[54] Nevertheless Turkish buildings are emissions intensive.

PERFORMANCE 0 out of 5

Turkey is failing to reduce direct or indirect emissions from buildings, in fact both have increased slightly in recent years. The building sector is responsible for about 30% of Turkey's GHG emissions.[55]

POLICY 1.5 out of 5

Turkey has introduced some of the components of an effective retrofit strategy. For example, in 2020 it introduced a mandatory energy performance certification system. Turkey also has some relevant targets in place, having committed to decarbonising existing buildings by 2050. For example, there is an ambition to convert one quarter of buildings to sustainable buildings by 2023.[56] However, Turkey's retrofit policies and commitments remain rather patchy in nature and unlikely to drive significant retrofits.

Saudi Arabia

RANKING **15**

SCORE **23**

Saudi Arabia is a very poor performer with very little in place to promote energy efficiency or retrofitting of its building stock. Recent improvements in emissions intensity are unlikely to be sustained without a better buildings policy and a rapid move to renewable energy. With significant gaps in Saudi Arabia's policies and targets across the board, the country has one of the lowest scores in this index.

EXISTING STOCK — Highly Insufficient

PERFORMANCE — Insufficient

POLICY — Critically Insufficient

Scores?

		MAXIMUM POINTS
EXISTING STOCK		
A measure of the gap between best practice energy performance of buildings and the status quo		
Building data	1.5	5
Building energy use	5	10
Building emissions	0	10
PERFORMANCE		
How well is the country performing on emissions reduction in buildings?		
Change in emissions intensity over last 5	12.5	12.5
Change in emissions heating 2010 to 2019	0	12.5
POLICY		
How robust and ambitious are national government plans to renovate buildings to address renovation need?		
Target setting	0	10
Strategy	1	10
Public investment	1	10
Low carbon heating and cooling	0	7.5
Certification of energy performance	0.5	5
Minimum energy performance	1.5	7.5
TOTAL	23	100

EXISTING STOCK 1 out of 5

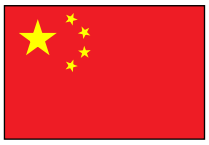
Saudi Arabia publishes poor data on its building stock, energy use and emissions. The data available suggests the building stock in Saudi Arabia is relatively inefficient despite a relatively young building stock.

PERFORMANCE 2.5 out of 5

Direct emissions from buildings in Saudi Arabia increased between 2010 and 2019.[57] Building emissions intensity, however, fell dramatically by 40% in the 5 years to 2020.[58] This was likely due to natural gas replacing some oil in electricity generation. Saudi Arabia uses little renewable energy, although does have a target for 50% of electricity to be generated by renewables by 2030.[59]

POLICY 0 out of 5

Saudi Arabia appears to have few policies related to energy use or emissions from existing buildings. It does have some minimal energy performance standards. However, the country lacks targets for energy efficiency or retrofits, and has no national system to certify energy performance in buildings. This will need to improve if Saudi Arabia is to meet its relatively unambitious national target of net zero by 2060.



China

RANKING **16**

SCORE **21.5**

China's performance on emissions from buildings has received the joint-lowest score in this index. It has some policies to address this, but so far they have been insufficient to stop the rise in building emissions. China's 14th Five Year Plan includes commitments to retrofits and green buildings, indicating the issue is rising up the agenda. The country is targeting energy-saving retrofits of existing buildings with an area of <350 million m^2 by 2025.[60] Building retrofits will need to increase rapidly if China is to meet this target, or its targets of emissions peaking in 2030 and net zero by 2060.

EXISTING STOCK — Highly Insufficient

PERFORMANCE — Critically Insufficient

POLICY — Highly Insufficient

Scores?

EXISTING STOCK

A measure of the gap between best practice energy performance of buildings and the status quo

		MAXIMUM POINTS
Building data	3	5
Building energy use	5	10
Building emissions	1	10

PERFORMANCE

How well is the country performing on emissions reduction in buildings?

		MAXIMUM POINTS
Change in emissions intensity over last 5	0	12.5
Change in emissions heating 2010 to 2019	0	12.5

POLICY

How robust and ambitious are national government plans to renovate buildings to address renovation need?

		MAXIMUM POINTS
Target setting	2	10
Strategy	4	10
Public investment	2	10
Low carbon heating and cooling	2.3	7.5
Certification of energy performance	1.5	5
Minimum energy performance	0.8	7.5
TOTAL	**21.5**	**100**

EXISTING STOCK 1.5 out of 5

China publishes mediocre data on its building stock and energy consumption. China's emissions and energy use are subpar and not aligned with a 1.5°C pathway. The building sector is responsible for about a fifth of China's emissions.[61]

PERFORMANCE 0 out of 5

China's emissions have continued to increase in recent years with emissions from buildings increasing by about 29% (2015-2020), whereas the G20 average has fallen.[62]

POLICY 1 out of 5

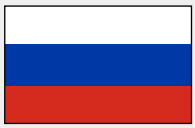
China has some policies for energy efficiency and retrofits. However, they are relatively piecemeal and patchy in coverage. For example, China's energy performance certificate scheme is voluntary for certain public and private buildings. Public investment in retrofits and energy efficiency also appears to have remained limited, with some incentive and grant schemes in place for certain climatic regions and government buildings.

4.2 G20 countries not included in the scorecard

We have endeavoured to assess all countries in the G20 against our scorecard using publicly available data. However, in some cases, this has not been possible due to a lack of data and this has prevented a credible, and complete, assessment from being performed. The following G20 countries have therefore not been included with full scorecards, but a summary of any notable developments related to retrofits has been provided.

South Africa

South Africa has improved the energy efficiency of buildings per square metre, but buildings emissions intensity per capita is only slowly decreasing – by less than 1% over the last 5 years.[63] The country has a net zero target, but no explicit emissions reduction targets related to buildings. The National Development Plan sets an ambitious goal for new buildings to be net zero emissions by 2030, but this does not apply to existing buildings. However, the National Energy Efficiency Strategy foresees reductions in final energy consumption of 33% in the residential sector and 37% in the public and commercial sector by 2030. Many types of public buildings and some private ones have a deadline to undergo Energy Performance Certification by the end of this year.[64] But accelerating the rate of retrofits will require much greater regulation and investment. Data on the national building stock, energy use and carbon emissions is limited and this represents a barrier in pursuing a net zero agenda in the building sector.



Russia

Russia's building emissions intensity has increased by 19% over the last 5 years, to a level nearly double that of the rest of the G20.[65] This rise is in the context of unambitious climate targets: net zero by 2060 and expected emissions peak in 2030. It appears that Russia has no strategy to reduce emissions from buildings. In 2020 it abolished minimum energy performance standards for new buildings. These were replaced with standards for the mandatory installation of automated heating controls and a ban on some inefficient heating systems. However, the limited public information on Russia's buildings indicates that most buildings lack thermostats that enable consumer control.[66]

Indonesia

Indonesia publishes little data on its housing stock, which acts as a barrier to assessment. Indonesia's emissions from buildings are less than half of the G20 average, but have been rising sharply in the last five years. [67, 68] To combat this rise, the Indonesian government has set targets to reduce energy consumption in the buildings sector (both commercial and housing) by 15% compared to business as usual by 2025. It has also introduced mandatory green buildings standards, with monetary incentives. There are also now Minimum Energy Performance requirements for both new and existing homes. Occupants of commercial buildings with high energy use are required to obtain an Energy Performance Certificate. This includes commissioning an energy audit and implementing its recommendations.

Argentina

Argentina's action on building retrofits has thus far been very limited with some piecemeal policies in place. These policies do not go beyond what is considered the minimum in terms of performance and there are no national targets or strategies in place to encourage or support building retrofits. A lack of data on energy use and carbon emissions from the building sector renders any complete assessment of performance challenging. With Argentina's assessment characterised by limited evidence of action on retrofits and poor data, it is clear that significant action will be needed to move Argentina towards alignment with the Paris Agreement.

India

India's buildings are currently responsible for 20% of its total carbon emissions and use a third of its energy.[69] It is expected that in the next three decades, India's building stock will grow rapidly with the potential for carbon emissions from buildings to increase sevenfold by 2050, compared to 2005 levels, if no action is taken. Action from the Indian government is therefore vital to support the building sector in achieving emissions reductions. And yet, the absence of data and policies in India related to the building sector and energy efficiency mean that it has not been included in the scorecard. In fact, India has only committed to achieving net zero by 2070 with very little detail provided beyond this headline target in terms of how the government envisions that India will achieve this target. Further, India generally lacks relatively basic building retrofit policies, including a mandatory energy performance certification system.

5.0 Best Practice

This section presents some of the best retrofit measures and policies that we found as part of our research for the Global Retrofit Index.

Target setting

France – Under the National Low-Carbon Strategy (SNBC), the French government has set an ambitious target - France needs to achieve a 49% reduction in greenhouse gas (GHG) emissions by 2030 compared to 2015 levels in the building sector.[70] Target achievement is expected to accelerate towards later carbon budgets. Within the next ten years, a 22% drop in energy consumption in the building sector is required.[71] By 2040, this decline reaches 29% and by 2050, 41%, compared to 2015 levels.[72]

Germany – Germany's Climate Action Plan 2050 has ambitious emissions reductions targets for key sectors of the economy. For building energy use (not including electricity) the target is a 66-67% reduction by 2030 compared to 1990.[73] And, by 2050, the plan sets out the ambition to achieve a nearly climate neutral building stock.[74] The German government plans to set further long-term emissions reductions targets for buildings in the mid-2020s.

Strategy

EU Long Term Renovation Strategies (LTRS) – The Long-Term Renovation Strategies set out by EU member states are mandated by the EU's Energy Performance of Buildings Directive. These strategies outline how member states will transition their national building stocks to being energy efficient, decarbonised and aligned with net zero in 2050. An LTRS must set out in detail the policies and actions required to enable this transition, alongside key performance indicators and a timeline with milestones to track progress. It is also expected that an LTRS provides detail on how these plans will be fiscally supported by governments.[75]

Croatia – The Long-Term Strategy for National Building Stock Renovation by 2050 (required by EU law) has been built on Croatia's existing commitment and policies, including the Integrated National Energy and Climate Plan. It sets out how Croatia intends to retrofit its existing building stock and includes a quantified timeline of milestones and KPIs that will be monitored to ensure Croatia is on track for the overall EU commitment to cut emissions from the building sector by 80-95% by 2050.[76]

Public investment

Italy – The Italian Superbonus scheme is a world-leading programme to support the retrofitting of properties. Through a tax credit, property owners are able to recover 110% of the costs of qualifying work to improve the energy efficiency of their property, whether that be installing thermal insulation or rooftop solar photovoltaic systems.[77] This scheme, launched in June 2020, has been remarkably successful with huge uptake from property owners to the extent that the €33.3 billion budget allocated to cover costs up to 2025 has already been exceeded.[78]

Low carbon heating and cooling

United Kingdom – The UK Government's Clean Growth Strategy and Heat and Buildings Strategy set out its ambition to phase out the installation of new gas boilers in existing residential properties by 2035. It is also expected that the UK Government's proposed Future Homes Standard will ban the installation of gas boilers in new residential properties from 2025.[79]

Similar ambitions have been set out for commercial and public buildings, with a heat pump first approach adopted and a limited allowance for the use of alternative low carbon systems, such as biomass, where heat pumps are unsuitable. These targets have been supported by various funding programmes from the UK Government, including the Boiler Upgrade Scheme announced in 2022, which provides households with £5000 or £6000 of funding for the installation of air source or ground source heat pumps respectively.[80]

Australia - Despite a 'highly insufficient' rating in this index, Australia is a global leader in rooftop solar, with 30% of homes having a solar photovoltaic system.[81] This equates to more than 3 million rooftop solar photovoltaic systems, or 27 gigawatts of capacity, and demonstrates the scale of change possible within a short time period with the vast majority installed in the last 5 years.[82]

Energy performance certification & minimum energy standards

EU - EU member states must comply with the Energy Performance in Buildings Directive (EPBD) and the Energy Efficiency Directive (EED).[83] The EPBD requires a national system of certification for the energy performance of buildings, which should set out, in detail, the performance of an individual property. Combined, the EPBD and the EED will be key policies in achieving a highly energy efficient, and decarbonised, European building stock by 2050 and they will be instrumental in enabling individuals, and businesses, to make energy efficient choices.

Further measures under EU directives include requirements that countries set cost-optimal minimum energy performance requirements, for all new, existing, and under renovation buildings. Energy certification on sale or renting of a building is also mandatory. Additionally, since 2021, all newly constructed buildings must be nearly zero-energy buildings (NZEB), with public buildings included under this requirement since 2019.[84]

California - The California Energy Commission updates the state's Building Energy Efficiency Standards every 3 years.[85] The 2022 Energy Code, which will apply to all new building permits from January 2023, sets out ambitious new standards that make all new homes electric-ready; encourages the installation of heat pumps; updates requirements for solar photovoltaic and battery storage standards; and, improves efficiency standards for building envelopes.[86]

An innovative model for retrofitting: Energiesprong

An Energiesprong retrofit is designed to make existing homes net zero in their energy consumption as homes, retrofitted under the scheme, should generate enough energy to meet their needs for heating, appliances and hot water.[87] Such a retrofit is achieved through technologies such as thermal insulation, modern heating systems, and prefabricated facades. What makes the Energiesprong programme unique is its use of relatively standard, well-developed approaches at a large scale, which brings the associated costs down.[88]

The upfront cost of an Energiesprong retrofit is paid back over the long-term. Typically, the repayment is spread over 30 years and funded through both savings on energy bills and typical maintenance costs.[89] This model allows homeowners, landlords, and housing associations to keep living costs the same as prior to the retrofit and therefore, removes the affordability barrier often associated with energy efficiency retrofits.[90]

The concept remains in development, but it has already either been trialled, or used as inspiration, globally with the approach being iterated and adapted for local market contexts.

In France, analysis showed that the EnergieSprong approach resulted in higher carbon reductions over 30 years, compared to other retrofit approaches. An individual house EnergieSprong retrofit can reduce emissions by up to 70%, while an Energiesprong retrofit of a group of houses can achieve a reduction of up to 85%.[91]

Figure 5.1:
The first homes retrofitted by Vilogia in Hem, France.

Vilogia, a housing association, has trialled the Energiesprong approach using 10 houses in Hem, France (Figure 5.2).[92] These 10 houses had their exteriors retrofitted with wood frame panels, briquette cladding, polystyrene and foam insulation, triple-glazed windows with roller shutters, and new insulated roofing with solar panels.[93] Their energy system was also changed from a gas-based system to a heat pump system. It is estimated that the completed project will deliver a 75% reduction in emissions over the next 30 years and the cost will be funded by the retrofit halving the households' energy bills.[94]

6.0 Recommendations

Tackling emissions from buildings is a significant global challenge, but it nevertheless remains surmountable if appropriate action is taken by governments to support, and promote, retrofits throughout the building stock. Governments must therefore be ambitious and set out long-term commitments on retrofits that are commensurate with the task that they are facing. We therefore set out four high-level principles that we recommend all countries follow in developing, or improving, their net zero building strategy.

1. Set ambitious targets

Countries should set clear targets for reducing emissions from buildings. This should include a target for achieving a net zero building sector, as well as interim targets consistent with a 1.5 degree pathway. There should also be targets for different sub-sectors (such as residential and commercial) and for the annual retrofit rate required.

2. Develop a long-term strategy and roadmap

Countries should set out a comprehensive long-term retrofit strategy. The strategy should include a roadmap with quantified milestones and progress indicators, as well as measurable targeted actions.

This strategy should include measures to tackle the barriers to mass retrofits, emphasise deep energy retrofits, leverage private investment, and prioritise the least energy efficient buildings. It should also make provision for skills and training within the workforce, as well as educating the public about the benefits of energy retrofits.

3. Invest

The private sector alone is unable to deliver building retrofits at the speed and scale required. Rapid progress will require significant public investment. This fiscal support should be designed to stimulate private investment and provide long-term support to the retrofit industry. This scorecard awards top marks for public investment levels over US$150 per person per year, which for many countries represents less than 10% of their energy bills in 2022.[95]

Assessments of the cost-effectiveness of such public investment should consider the full range of benefits of efficient buildings. These benefits include: long-term (e.g. 30 year) energy savings; poverty alleviation; job creation; improved human health and well-being, and greater energy security.

4. Regulate

Regulation has a crucial role to play in overcoming some of the barriers to retrofits. Buildings should be required to meet minimum standards of energy performance when rented, sold or renovated. The minimum standard should be raised over time, in a similar way to energy standards for electrical appliances to push for ever greater energy efficiency in the building stock. It is also incumbent on governments to set out a timeline for a ban on fossil fuel heating in buildings.

7.0 Appendix A - Scoring Criteria

This section outlines the principles, scoring framework and relative weighting of each criterion.

7.1. Existing Stock (25% weighting)

The Existing Stock category assesses countries' building stocks today compared to a net zero future.

i) Availability of data on emissions and energy use in buildings (5% weighting)

The World Green Building Council underlines the importance of good data for reducing building emissions.[23] Countries need to understand their building floor space, energy use and emissions in order to develop and evaluate policy. Countries are awarded 10 points where they publish comprehensive data on building floor space, building energy use and emissions by building type, building energy and emissions intensity.

Table 7.1:
Scoring framework for availability of data on emissions and energy use in buildings

Rank	Criteria	Score
Sufficient	Country publishes comprehensive data on building floor space, building energy use and emissions by building type, building energy and emissions intensity and rates of low carbon heating and insulation	10
Almost sufficient	Country publishes extensive data on building floor space, building energy use and emissions by building type, building energy and emissions intensity and rates of low carbon heating and insulation	8
Insufficient	Country publishes good data on building floor space, building energy use and emissions by building type, building energy and emissions intensity and rates of low carbon heating and insulation	6
Highly insufficient	Country publishes patchy data on building floor space, building energy use and emissions by building type, building energy and emissions intensity and rates of low carbon heating and insulation	4
Critically insufficient	Country publishes little data on building floor space, building energy use and emissions by building type, building energy and emissions intensity and rates of low carbon heating and insulation	2
	Country publishes no useful data on emissions and energy use in buildings	0

ii) Average energy use in buildings per m2 (10% weighting)

This metric gives separate scores (with equal weighting) for energy intensity to heat residential buildings and energy use intensity in commercial buildings. It provides an indication of the efficiency of the national building stock. Warmer countries will tend to get higher scores, particularly for residential buildings. One drawback of the metric is that it favours countries with larger homes which use more energy overall, but less per square metre.

Table 7.2:
Scoring framework for average energy use in buildings per m2

Energy intensity of residential space heating

Ranking	Criteria	Score
Sufficient	The average annual energy to heat residential buildings is <40 kWh/m2/yr	10
Almost sufficient	The average annual energy to heat residential buildings is <60 kWh/m2/yr	8
Insufficient	The average annual energy to heat residential buildings is <80 kWh/m2/yr	6
Highly insufficient	The average annual energy to heat residential buildings is <110 kWh/m2/yr	4
Critically insufficient	The average annual energy to heat residential buildings is <140 kWh/m2/yr	2
	The average annual energy to heat residential buildings is >140 kWh/m2/yr	0

Energy use intensity in commercial buildings

Ranking	Criteria	Score
Sufficient	The average annual energy use intensity in commercial buildings is <60 kWh/m2/yr	10
Almost sufficient	The average annual energy use intensity in commercial buildings is <80 kWh/m2/yr	8
Insufficient	The average annual energy use intensity in commercial buildings is <110 kWh/m2/yr	6
Highly insufficient	The average annual energy use intensity in commercial buildings is <140 kWh/m2/yr	4
Critically insufficient	The average annual energy use intensity in commercial buildings is <170 kWh/m2/yr	2
	The average annual energy use intensity in commercial buildings is >170 kWh/m2/yr	0

iii) Average building emissions per capita (10% weighting)

This metric measures a country's emissions from buildings divided by its population. This includes direct emissions, from burning fuels such as gas in a building, as well as indirect emissions from buildings' electricity use. In a future net zero world they can be very few remaining emissions from buildings.

Table 7.3:
Scoring framework for average building emissions per capita

Ranking	Criteria	Score
Sufficient	The average annual emissions per capita is <100 kg CO2e	10
Almost sufficient	The average annual emissions per capita is <300 kg CO2e	8
Insufficient	The average annual emissions per capita is <600 kg CO2e	6
Highly insufficient	The average annual emissions per capita is <1000 kg CO2e	4
Critically insufficient	The average annual emissions per capita is >1000 kg CO2e	2
	The average annual emissions per capita is >2000 kg CO2e	0

7.2 Building performance (25% weighting)

The Building performance category assesses countries' recent progress on energy use and emissions from buildings.

i) Change in buildings emissions intensity (12.5% weighting)

This criterion assesses a country's change in total emissions from buildings between 2015 and 2020. The top score of 10 is awarded to countries whose emissions intensity has fallen by over 25%. Continuing this rate of reduction would allow a country to reduce building emissions by 75% by 2040.As this metric includes indirect emissions from electricity used in buildings, it incorporates any changes in the emissions intensity of electricity grids.

Table 7.4:
Scoring framework for the change in buildings emissions intensity

Ranking	Criteria	Score
Sufficient	Buildings emissions intensity has decreased by >=25% in the last 5 years	10
Almost sufficient	Buildings emissions intensity has decreased by >=20% in the last 5 years	8
Insufficient	Buildings emissions intensity has decreased by >=15% in the last 5 years	6
Highly insufficient	Buildings emissions intensity has decreased by >=10% in the last 5 years	4
Critically insufficient	Buildings emissions intensity has decreased by <10% in the last 5 years	2

ii) Change in emissions from heating buildings (12.5% weighting)

This criterion assesses a country's change in emissions from heating buildings between 2010 and 2019. This metric includes only direct emissions from burning fuel in buildings – e.g gas boilers but not electric heaters. The metric was chosen because heating which is the main use of energy in buildings in many countries.

Table 7.5:
Scoring framework for the change in emissions from heating buildings

Ranking	Criteria	Score
Sufficient	Emissions from heating in buildings decreased by >35% over 2010-2019	10
Almost sufficient	Emissions from heating in buildings decreased by >30% over 2010-2019	8
Insufficient	Emissions from heating in buildings decreased by >20% over 2010-2019	6
Highly insufficient	Emissions from heating in buildings decreased by >15% over 2010-2019	4
Critically insufficient	Emissions from heating in buildings decreased by >10% over 2010-2019	2
	Emissions from heating in buildings decreased by <10% over 2010-2019	0

7.3 Building policy (50% weighting)

The Building policy category assesses the level of ambition and effectiveness of countries' policy planning to close the net zero gap in the existing building sector.

i) Ambition of national targets to reduce energy use and/or emissions from buildings (10% weighting)

A national target to reduce emissions from buildings acts as a focus point for action. It also provides a metric against which governments can be evaluated and critiqued. This scorecard awards points for targeted reductions in building emissions consistent with a 1.5C target, and which aim for net zero by 2050.

Table 7.6:
Scoring framework for ambition of national targets

Rank	Criteria	Score
Sufficient	National target to reduce emissions from existing buildings at a rate and scale consistent with 1.5C targets - e.g. at least an 80% reduction in direct emissions from the buildings sector by 2040, and net zero by 2050.	**10**
Almost sufficient	National target to reduce emissions from existing buildings at a rate and scale consistent with 1.5C targets - at least a 60% reduction in direct emissions from the buildings sector by 2040	**8**
Insufficient	National target to reduce emissions from existing buildings at a rate and scale consistent with 1.5C targets - at least a 40% reduction in direct emissions from the buildings sector by 2040	**6**
Highly insufficient	National target to reduce emissions from existing buildings at a rate and scale consistent with 1.5C targets - at least a 20% reduction in direct emissions from the buildings sector by 2040	**4**
Critically insufficient	National targets exist but: - have an uncertain or obscure status OR - do not explicitly mention improving the building energy/emissions performance of existing buildings OR - target is unambitious - less than 20% reduction in direct emissions from the buildings sector by 2040	**2**
	No national level targets for (existing) building sector emissions.	**0**

ii) National retrofit strategy (10% weighting)

Reducing emissions from existing buildings is a complex area requiring multiple barriers to be addressed. To achieve the required levels of building retrofits, countries are likely to need coordinated long-term national strategies. Such strategies should include milestones, progress indicators, and measurable targeted actions.

iv) Public investment in retrofitting buildings (10% weighting)

Building energy retrofits tend to be expensive with long payback periods. Decades of experience in many countries has shown that public funding of grants and other financial incentives are vital to overcoming financial barriers.

Table 7.7:
Scoring framework for national retrofit strategy

Rank	Criteria	Score
Sufficient	There is a national strategy on energy retrofits in buildings which includes a long-term roadmap for the retrofit of existing buildings into highly energy efficient and decarbonised buildings by 2050. The roadmap includes quantified milestones and progress indicators, as well as measurable targeted actions.	10
Almost sufficient	There is a national strategy on (or incorporating) energy retrofits in buildings but it lacks a long-term roadmap for the decarbonisation of existing buildings by and/or quantified milestones and progress indicators and measurable targeted actions.	8
Insufficient	There is a national strategy with some good policies but they are piecemeal and do not represent an effective roadmap for the decarbonisation of buildings.	6
Highly insufficient	There are some national policies that relate to energy retrofits but they are piecemeal, unambitious and unlikely to catalyse action on the level required	4
Critically insufficient	There are some national policies that relate to energy retrofits but they are piecemeal, unambitious and unlikely to catalyse much action	2
	There are no national policies that relate to energy retrofits	0

Table 7.8:
Scoring framework for public investment in retrofitting buildings

Ranking	Criteria	Score
Sufficient	Public investment in energy retrofits in buildings is over US$150 per capita per year	10
Almost sufficient	Public investment in energy retrofits in buildings is over US$100 per capita	8
Insufficient	Public investment in energy retrofits in buildings is over US$50 per capita	6
Highly insufficient	Public investment in energy retrofits in buildings is over US$20 per capita	4
Critically insufficient	Public investment in energy retrofits in buildings is less than US$20 per capita	2
	There is no public investment in energy retrofits in buildings	0

v) Policies to phase out fossil fuels in heating in buildings (7.5% weighting)

In many climatic regions it is not practical or affordable to retrofit most existing buildings to the level that they do not need heating. Therefore, to reach net zero, countries will need policies and measures to phase-out the use of fossil fuels for heating (of space and hot water) in buildings. As heating equipment such as gas boilers, lasts for 10 years or more, it is important that the installation of new fossil fuel heating is banned this decade.

vi) Certification of building energy performance (5% weighting)

Prospective buyers and renters of property need information on the energy performance of buildings to inform their decisions. Governments also need information to formulate and assess their building energy policy, and set minimum energy performance standards. This requires a standardised and compulsory national system of certification for the energy performance of buildings.

Table 7.9:
Scoring framework for policies to phase out fossil fuels in heating and cooling in buildings

Rank	Criteria	Score
Sufficient	There are clear and ambitious policies and measures which target the phase-out of fossil fuels in heating in buildings, and there is a ban on new fossil-fuel heating in buildings before 2030.	10
Almost sufficient	There are clear and ambitious policies and measures which target the phase-out of fossil fuels in heating in buildings	8
Insufficient	There are policies and measures to encourage the replacement of fossil fuel heating in buildings, but they do not target complete phase out.	6
Highly insufficient	There are policies and measures to encourage the replacement of fossil fuel heating in buildings, but they do not target complete phase out and they are limited in scope.	4
Critically insufficient	There are policies or measures to encourage the replacement of fossil fuel heating in buildings, but they do not target complete phase out and they are very limited in scope.	2
	There are no policies to encourage the replacement of fossil fuel heating in buildings.	0

Table 7.10:
Scoring framework for certification of building energy performance

Criteria	Score
10 points will be awarded to countries with a national system of certification for the energy performance of buildings with the characteristics listed below.	10
0-9 points will be awarded if where a system has some of these characteristics. Points will be deducted where application of the system is limited - e.g. doesn't apply to most buildings. • the energy performance certificate is required on construction, sale, rental or major renovation • applies to all buildings (with very limited exceptions) • certificate must be updated every 10 years or less • certificate shows energy use per unit of floor area • includes recommendations for the improvement of the energy performance and reduction of operational GHG emissions • is prepared by an independent assessor • certificates are publicly available and, for public buildings, are clearly displayed within the building	0-9

vii) Minimum energy performance standards (7.5% weighting)

Minimum standards for the energy performance of buildings are a highly effective means of stimulating energy retrofits. These standards need to apply and certain trigger points, such as sale, rent or renovation of a property.

Table 7.11:
Scoring framework for public investment in retrofitting buildings

National policy	Score	Notes
Public buildings must achieve Minimum Energy Performance Standards by a given date	2	Only 1 point awarded if limited in scope or unambitious standard or date
Private buildings must achieve Minimum Energy Performance Standards by a given date or will be incentivised to do so	4	Points awarded based on scope, standard and target date
Buildings must achieve Minimum Energy Performance Standards when rented.	2	Only 1 point awarded if limited in scope or unambitious standard
Buildings must achieve Minimum Energy Performance Standards when undergoing extension, conversion or major renovations	2	Only 1 point awarded if limited in scope or unambitious standard

Endnotes

1. IEA, 2021b
2. This figure has been calculated using the an estimation of the total spending of countries identified in this study on building energy efficiency in a year and adjusted for the total population in this group.
3. Cambridge Econometrics, 2015
4. IEA, 2021b
5. This figure was calculated using up-to-date estimations for the populations of the countries included in this report and a per capita spending figure of US$ 150.
6. United Nations Environment Programme, 2021
7. ibid
8. ibid
9. IEA, 2021d
10. Ibid
11. IEA, 2021b
12. IEA, 2021b
13. United Nations Environment Programme, 2021
14. ibid
15. IEA, 2021b
16. Historic England, 2019
17. Jennings et al., 2011
18. ONS, 2022
19. Piddington et al., 2020
20. ibid
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22. United Nations Environment Programme, 2021
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24. G20, 2021
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26. Federal Government of Germany, 2020
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28. Federal Government of Germany, 2020
29. Climate Transparency, 2021d
30. Kurmayer, N.J., 2022b
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32. Netherlands Enterprise Agency, 2020
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38. E3G, 2021 p.41
39. Ministry for Ecological Transition, 2021
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42. Giuffrida, A., 2022
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62. Climate Transparency, 2021c
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68. Ibid
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71. IEA, 2021a
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75. ibid
76. European Commission, n.d.-a
77. European Commission, n.d.-b
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79. Dipartimento Unità Per L'Efficienza Energetica, 2022
80. Ministry of Housing, Communities & Local Government, 2021
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82. Department of Climate Change, Energy, the Environment and Water, 2022a
83. Australian PV Institute, 2022
84. European Commission, n.d.-b
85. Ibid
86. California Energy Commission, n.d.-a
87. California Energy Commission, n.d.-b
88. Energiesprong, n.d.-a
89. ibid
90. ibid
91. GreenFlex, 2021
92. Energiesprong, n.d.-b
93. Peraudeau, N., 2019
94. Marx, W., 2021
95. For example, in the UK, the Government has capped the unit cost of electricity and gas meaning that an average household's energy bill will be approximately £2500. In the US the average annual household bill for electricity alone is over $1500 (Save on Energy Team, 2022)

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