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Gresham House

Specialist asset management

Global Timber Outlook

2020

Table of contents

Executive summary

Over the past 20 years, global timber consumption has increased by 1.1% per annum, driven by increasing urbanisation and global housebuilding requirements.

Over the next 30 years, Gresham House expects timber consumption to rise by 3.1% per annum.

This will be driven by:

1. Urbanisation
2. Decarbonisation
3. Increased housebuilding

Globally, the vast majority of countries have set significant targets to reduce carbon emissions towards net zero by 2050. Timber will play a critical part in this transformation.

The dual effect of urbanisation and decarbonisation will be more new homes and cleaner low carbon intensity buildings being built from timber. Wood will increasingly replace high carbon intensive steel and concrete.

As a result, Gresham House forecasts an almost three-fold increase in timber consumption over the next 30 years, from 2.2 billion cubic metres (m^3) consumed today to 5.8 billion m^3 in 2050.

This forecast rise in timber demand is set against a constrained supply fixed by the long term growth rate of the trees and limited land area. Current forecasts[1] for long term, sustainable timber supply between now and 2050 range between 3.7 billion m^3 and 4.7 billion m^3.

The supply demand imbalance will result in increased timber prices over the medium to long term.

Forestry ownership and returns continue to be underpinned by real income from timber sales, offering inflation protection and asset diversification underpinned by biological growth, uncorrelated to other asset classes. In times of unprecedented volatility, the defensive nature of forestry ownership is particularly pertinent.

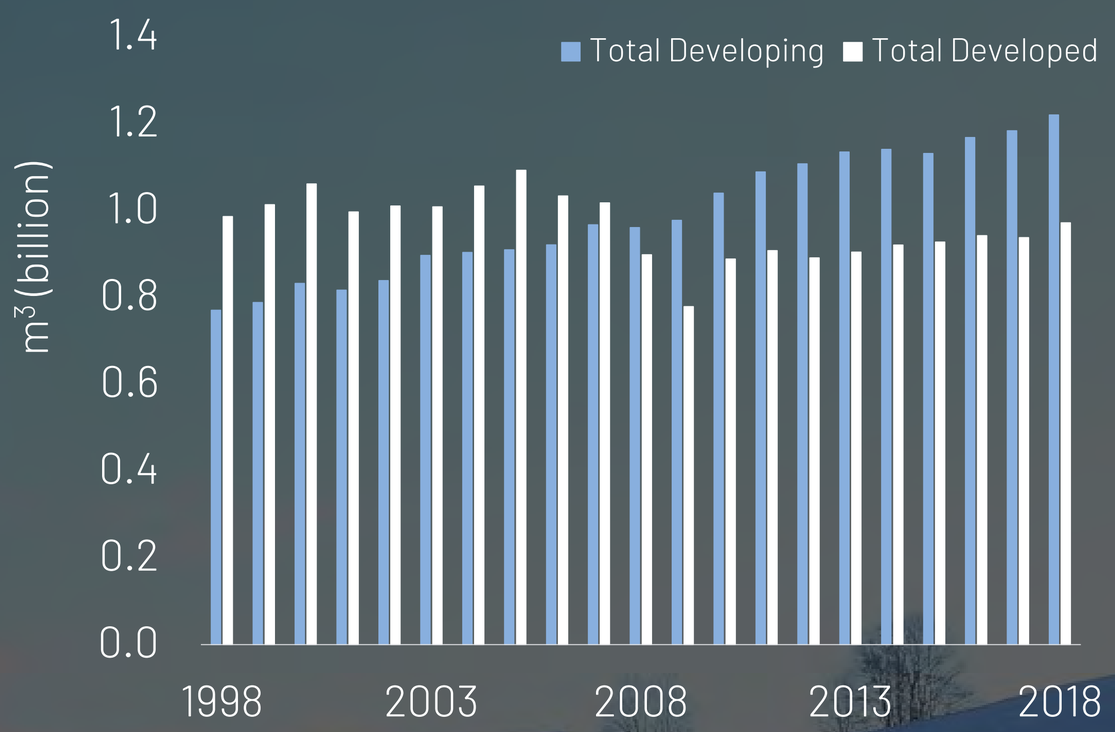
There has never been a more relevant time to add forestry to a diversified investment portfolio.

1. Wuppertal Institute for Climate, Environment and Energy - see p47.

Global industrial roundwood consumption

Source: FAO Forest Product Statistics 2018

Global industrial roundwood consumption



Source: FAO Forest Product Statistics 2018

Global industrial roundwood timber consumption reached a new high of 2.2 billion m^3 in 2018, the latest full year for which figures were produced.

Over the past 20 years it has risen by 25%, a Compound Average Growth Rate (CAGR) of 1.1% per annum, with the only fall of significance occurring in 2008/2009.

During this time there has been a significant change in the source of demand, with the developing world having overtaken the developed world.

Consumption in the developing world has grown rapidly from 770 million m^3 in 1998 to 1.2 billion m^3 in 2018, a CAGR of 2.3% over the past 20 years.

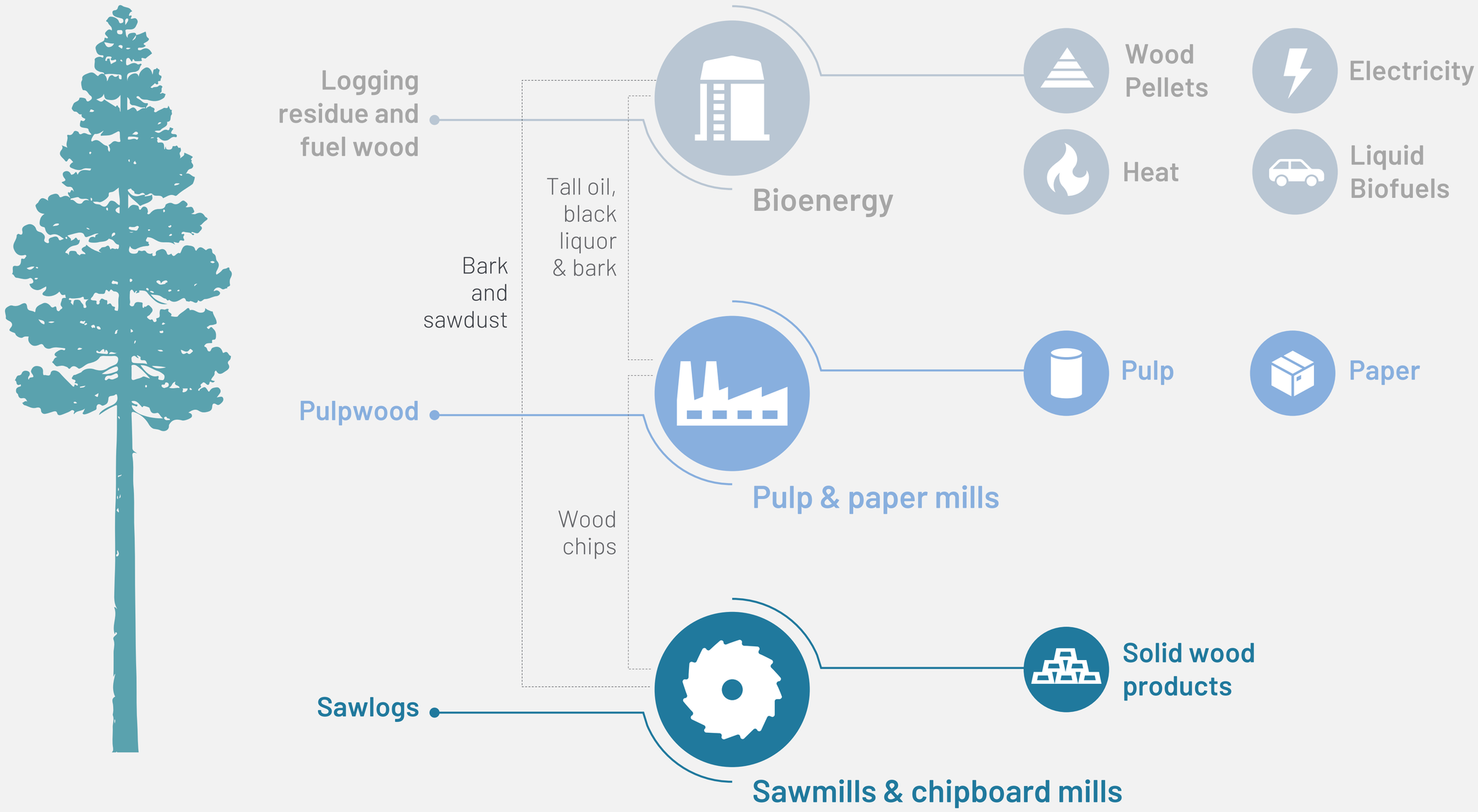
This increase has been driven by China through rapid GDP growth and a substantial rise in urbanisation led construction, a trend expected to continue across emerging market economies.

Growth in consumption in the developed world remains below its previous peak of 1,092 million m^3 recorded in 2005. Timber demand in developed countries has historically been underpinned by housing demand and the amount of timber used in residential and commercial construction.

Developed economies are expected to decarbonise significantly as countries become carbon neutral and meet UN net carbon zero targets, replacing un-replenishable and high carbon emitting resources with wood, a natural and sustainable carbon lock up.

Industrial roundwood here includes 223 million m^3 of wood used for fuel from coniferous trees. This is a production figure as the consumption figure is not possible to derive from the Food and Agriculture Organisation of the United Nations' (FAO) forest product statistics (www.fao.org/home/en/ data) but it is reasonable to assume that in any given year all wood fuel that is produced is consumed.

Uses of timber



Timber Consumption[1]

Construction	35%	Structural timber, joists, plywood and veneers
Chipboard	15%	Particle board, OSB, MDF
Decking / Sheds	10%	Planks, plywood
Fencing	10%	Poles
Pallets	5%	Small cuts of straight wood
Construction & Ancillary Products	**75%**	
Biomass / Energy	15%	Wood chips and pellets burned instead of coal
Pulp - paper & packaging	10%	Paper, tissue, and cardboard
Total	**100%**	

1. Timber consumption is based on the UK sawmill and wood processing industry as a representative guide to commercial temperate forest timber uses

Phraseology

Industrial Roundwood (unprocessed logs) is the raw material for the manufacture of commercial wood products such as sawnwood (construction products, fencing and furniture), pulp (papers, tissue and packaging), wood based panels and wood pellets.

Industrial roundwood can be broadly split between two categories: hardwood and softwood.

Hardwood is generally from broadleaved trees which are deciduous and shed their leaves in winter. The wood is denser but more aesthetically pleasing and is often used in flooring and furniture.

Given the density of hardwoods they are difficult to work with and impractical for many industries, including most of the construction industry.

Softwood is generally from conifer trees which are evergreen. The wood is easier to work with and faster to process and represents circa 80% of timber consumption. Softwood is therefore the focus of this Paper.

Timber uses can be split into three broad categories; Construction & Ancillary Products, Biomass/Energy, and the Paper & Packaging industry.

Sawnwood, or 'lumber' (the logs converted into beams and planks) from sawlogs, is the highest unit value in growing timber and is consumed largely by the construction industry.

Construction can further be broken down into 'pure construction' and 'ancillary products'.

Pure construction includes the structural frame timber used as the skeleton, or carcassing of a building, together with wood-based panels; chipboard and veneers that make up the inner walls of a building.

With correct silvicultural management, circa 70% of the value of a tree is in the sawlog and is thus the main driver of timber prices for plantation owners.

Wood based panels consist of two primary grades: Structural (Plywood, Veneers and Oriented Strand Board (OSB)), and Non-Structural (particleboard and medium density fibreboard (MDF)). Panels are predominantly used in new home construction and repair.

Ancillary products use the rest of the small roundwood and include decking, fencing and pallets, and demand is driven by the construction industry and wider GDP growth in the economy.

Structural lumber and panel board manufacturers are the major consumers of softwood sawntimber. The remainder goes to the energy industry as biomass and to make paper and cardboard packaging as pulp.

Trees are now also being recognised for their environmental benefits. They absorb carbon as they grow, known as 'sequestering' carbon, and in an increasing number of countries this generates carbon credits that can be sold in addition to the timber.

Oslo, Norway
Credit: Anders Vestergaard Jensen

Three key drivers underpin demand for timber going forward

Urbanisation

The global urban population is forecast by the UN to rise by 53% over the next 30 years, driven by both population growth and the move from rural to urban areas to seek prosperity; a job, a better standard of living, better access to healthcare, education, and a longer lifespan. Urbanisation and rising GDP per capita increase timber demand.

Decarbonising economies

Under the 2016 Paris Agreement, signatories are required to keep global warming to "well below" 2°C and, if possible, 1.5 °C above pre-industrial temperature levels. Nearly the whole of the EU and many other countries are targeting a 40% reduction in emissions by 2030 and to be completely carbon neutral by 2050. Timber is the natural and sustainable low carbon substitute product in building and baseload energy.

Housing shortage

Housebuilding, independent of the additional uses of timber, continues to underpin timber consumption.

Urbanisation

Urbanisation drives timber consumption

Residential and commercial construction - the main driver of timber consumption – increases as a result of urbanisation and rising GDP per capita.

In China, which has experienced a 96% increase in urban dwellers over the past 20 years, timber consumption also increased by 96%, driven by the increase in construction and rising incomes per capita.

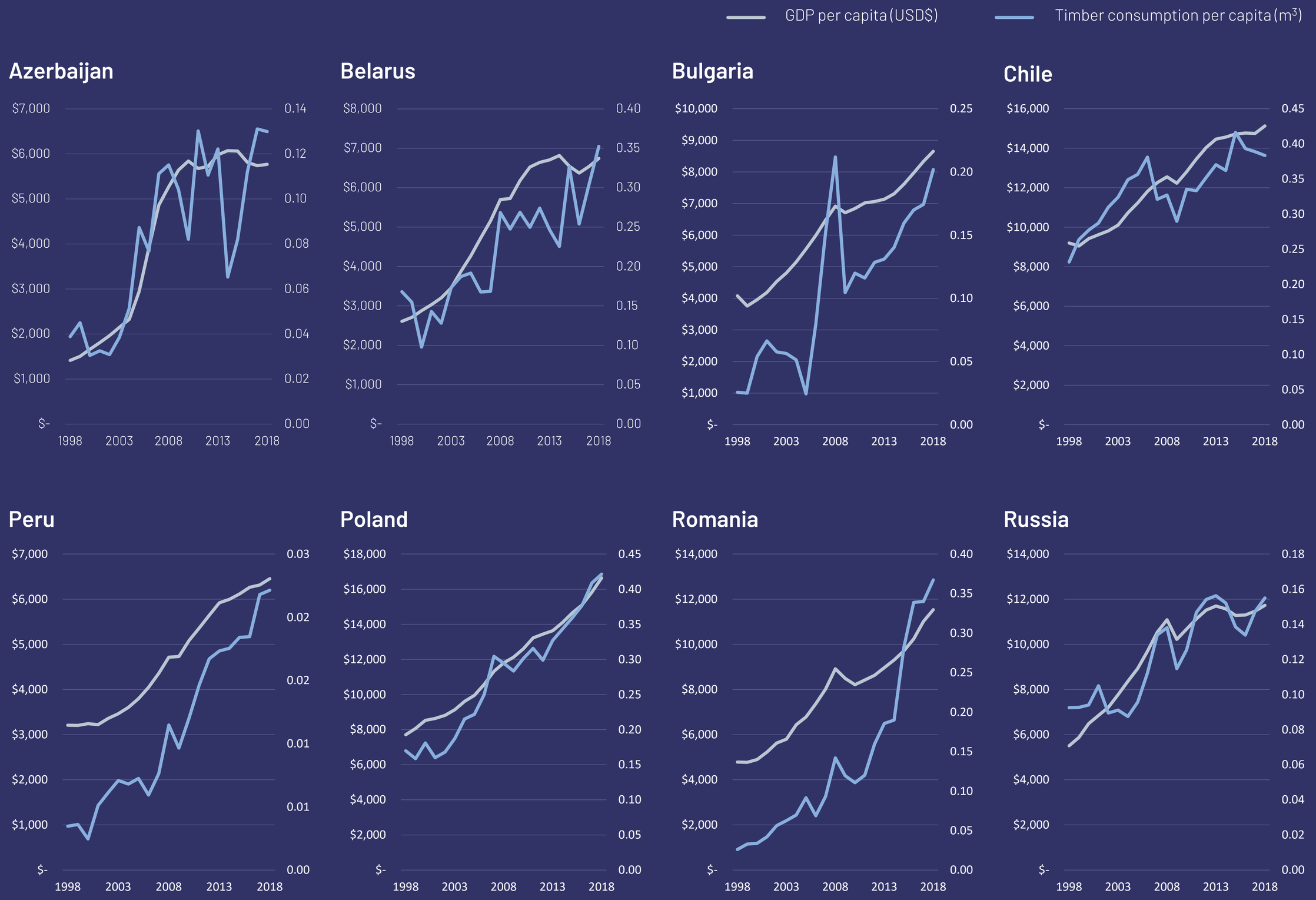
China	Population	Urban dwellers	Industrial roundwood consumption (m^3)	Consumption m^3 / capita	GDP / capita $
1998	1.24 billion	420 million (34%)	113,810	0.09	1,539
2018	1.39 billion	824 million (59%)	223,216	0.16	7,755
Change	+ 12%	+ 96%	+ 96%	+ 71%	

Sources: United Nations World Population Prospects 2019, World Bank national accounts data 2019, OECD National Accounts data 2019, FAO Forest Product Statistics 2018

A similar timber consumption increase has been experienced in other countries which have developed over the past 20 years.

GDP per capita and timber consumption

Countries which have experienced rapid GDP growth over the past 20 years, a period for which reliable timber consumption data exists.



Sources: World Bank national accounts data 2019, OECD National Accounts data 2019, FAO Forest Product Statistics 2018

68%

of the global population is estimated by the UN to be urban dwellers in 2050. It currently stands at 56%.

Urbanisation levels are forecast to continue to increase

The trend in urbanisation is set to continue. The global urban population is forecast to rise by 18% by 2030 and 52% by 2050.

What's more, the role of population growth in determining the pace of urban population growth becomes less important in comparison to migration, with the rate of urbanisation more rapid.

The global population of 7.8 billion is forecast by the United Nations (UN) to grow 1.0% per annum to 8.6 billion in 2030.

The number of urban dwellers, 4.4 billion people, is forecast to grow 1.7% per annum to 5.2 billion in 2030.

This translates to an increase of 800 million over the next 10 years. This is significantly greater than in China over the last 20 years, where an additional 404 million people inhabiting urban dwellings had a major impact on global timber markets.

Over the next 30 years to 2050 the amount of urban dwellers is expected to increase by 2.3 billion, more than the 2.1 billion increase over the past 30 years.

UN population forecast (billions)

	1990	2020	Change	2030	Change	2050	Change
Global population	5.3	7.8	+47%	8.6	+10%	9.8	+25%
Urban population	2.3	4.4	+91%	5.2	+18%	6.7	+52%
Urban composition	43%	56%		60%		68%	

Source: United Nations World Population Prospects 2019

Timber consumption and urbanisation
Under the spotlight

Early stage

The first stage of urbanisation - urban migration – leads to a demand for resources such as timber, concrete and steel in order to provide basic infrastructure and housing.

Urban growth, however, particularly initial urbanisation without growth, often begins to strain the capacity of local and national governments to provide urban residents with even the most basic services of housing, water supply, sewerage and solid waste disposal.

The impact on the physical environment has historically led, in nearly all cases, to governments constructing affordable public housing, generally built en masse, which leads to a second construction boom and another jump in timber demand.

It is at this moment, when the number of dwellings starts to rise significantly, that timber consumption really accelerates.

Housing development in action
Case studies

The United Kingdom first built council homes to deal with the urban poor in 1885 under the Housing of the Working Class Act.[1] Mass council house building then began around 1920 in order to replace older and dilapidated properties[2], following the 1919 Addison Act.[3]

Post World War II, housing was a major policy area under Harold Wilson's Labour government, 1964 to 1970, with an accelerated pace of new building. Tower blocks, first built in the 1950s, featured prominently in this era.[4]

In the United States, the New Deal passed in the 1930s helped to make both housing and home mortgages more affordable.[5]

The Japan Housing Corporation (JHC), now known as the Urban Renaissance Agency (UR), was founded in 1955. During the 1950s, 1960s, and 1970s, the JHC built many danchi in suburban areas to offset the increasing housing demand during the post-war economic boom.[6]

Between 1925 and 1930, Germany was the site of innovative and extensive municipal public housing projects, Siedlungen, mostly in Berlin, Hamburg, Cologne and Frankfurt[7]. The right to healthy housing was written into the 1919 Weimar Constitution.[8]

1. http://www.legislation.gov.uk/ukpga/Vict/48-49/72/enacted
2. Hollow, Matthew (2011). "Suburban Ideals on England's Interwar Council Estates"
3. Geography, Kay's (11 August 2019). "100 years exhibition - the 1919 Act". Newcastle residential areas
4. A Short History of the Labour Party by Alastair J. Reid and Henry Pelling
5. Hyman, Louis (March 2009). "The Architecture of New Deal Capitalism". Reviews in American History. Johns Hopkins University Press
6. Yamashita, Tsutomu (9 December 2007). "Showa 30s Movie Revives Interest in Danchi". Asahi Shimbun
7. Die Splanemann-Siedlung by Herbert Schwenk in 'Berlin im Detail', Berlingschichte
8. A Pledge Unredeemed: The Housing Crisis in Weimar Germany. Cambridge University Press December 2008. Dan P. Silverman

In France, the government launched a series of major construction plans in the 1950s and 1960s, including the creation of new towns (villes nouvelles) and suburbs with HLM (Habitation à Loyer Modéré: 'low-rent housing').[9]

The state had the funds and the legal means to acquire the land and could provide incentives to the companies that then built its huge housing complexes of hundreds of apartments. The construction of HLM was subject to much political debate. This housing is now generally referred to as l'habitat social, a slightly wider sphere than just housing.

In 1978, the Chinese government introduced sweeping reforms to its collective farming system. As more efficient practices were adopted, they exposed a huge surplus of labour that had been masked under the previous system. Much of this excess labour headed to towns and cities, where they were absorbed by the growing industrialisation that began to take place. In 2006, affordable housing kicked off with the targeted construction of 36 million homes to house the urban poor.[10]

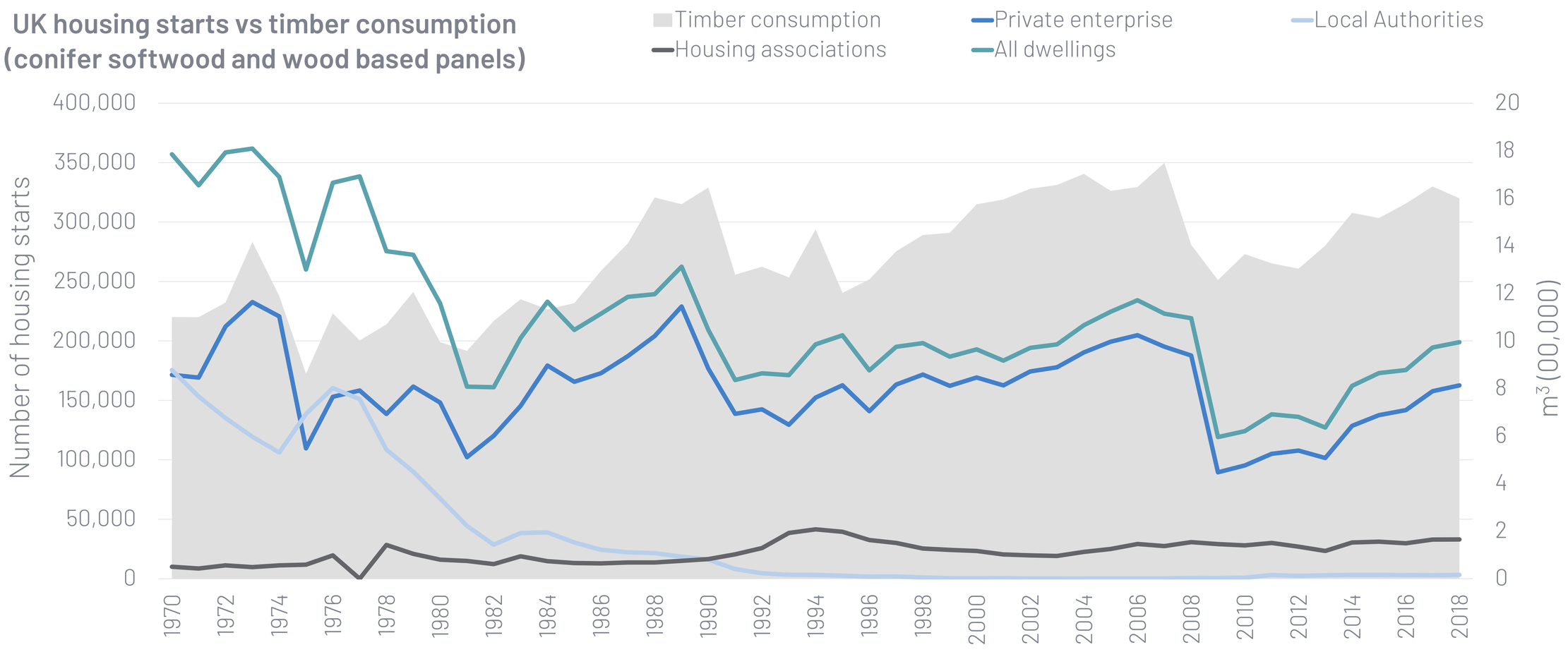
In the Soviet Union, most of the houses built after World War II were three to five storeys high, with small apartments. In these boroughs, the goal was saving space and creating as many apartments as possible.[11]

9. 10 idées reçues sur les HLM Archived 2013-11-26 at the Wayback Machine, Union sociale pour l'habitat, February 2012
10. Sun Jianfang, Will Housing Projects Boost GDP? The Economic Observer Quarterly. 9 December 2011
11. Meuser, Philipp; Zadorin, Dimitrij (2016). Towards a Typology of Soviet Mass Housing: Prefabrication in the USSR 1955 – 1991, DOM publishers, Berlin

After urbanisation comes suburbanisation

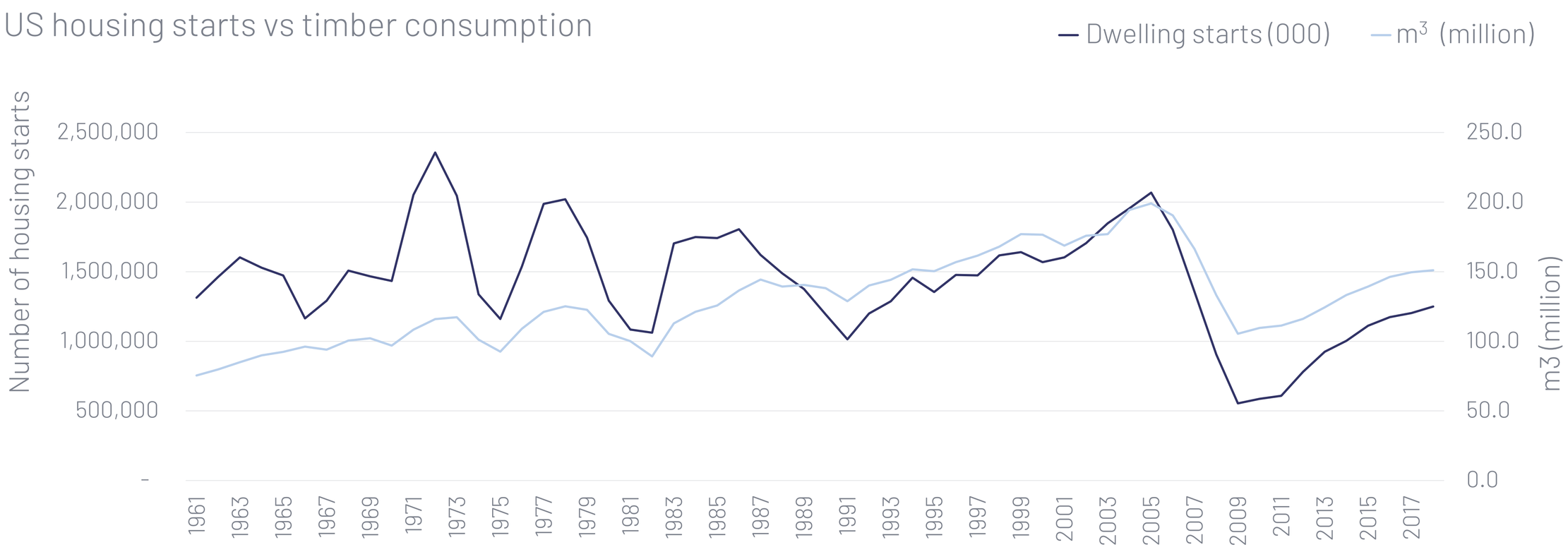
Once countries have basic housing for the poor and an urban economy has installed the infrastructure to begin to grow, there is an increase in wealth, GDP and income per capita. This allows for a move from public housing to suburbanise into single unit family homes, something witnessed in many developed economies across the world.

In the UK, the overall number of 'housing starts' has stayed largely flat since the 1970s, but the housing mix has changed from public to private homes. At the same time, timber consumption has increased as, on average, a single-family suburban home uses around three times the timber of a multi-family unit.



Source: UK Government Department for Communities, UK Housing Statistics, and FAO Forest Product Statistics 2018

A similar story can be seen in other major developed economies, such as the US.



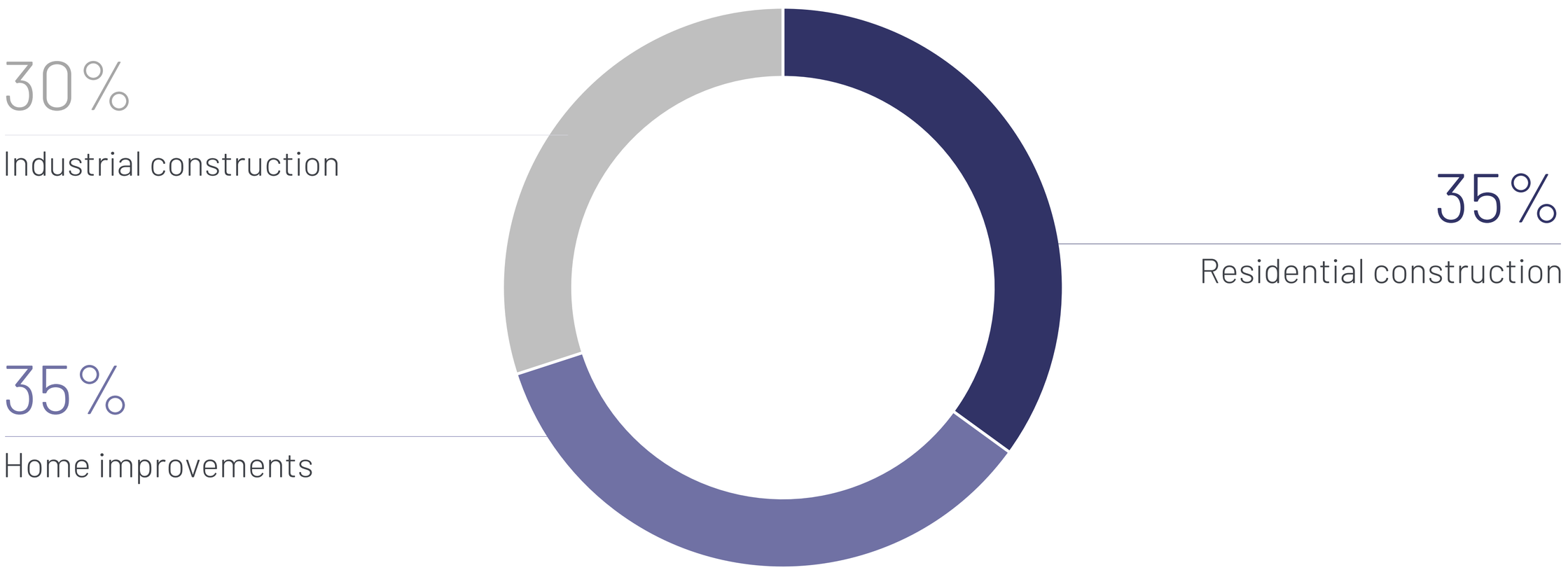
Source: Federal Reserve Economic Data: Housing starts, and FAO Forest Product Statistics 2018

After urbanisation comes suburbanisation

The result is that even when total new housing starts begin to level off, timber consumption increases again in the mature stage of an economy, leading to a third wave of timber construction.

Not only is more timber used in single unit homes, the home improvements sector becomes a significant additional source of timber demand. In the US and developed world it contributes circa 35% of all consumption by the construction industry.

Sawnwood end uses

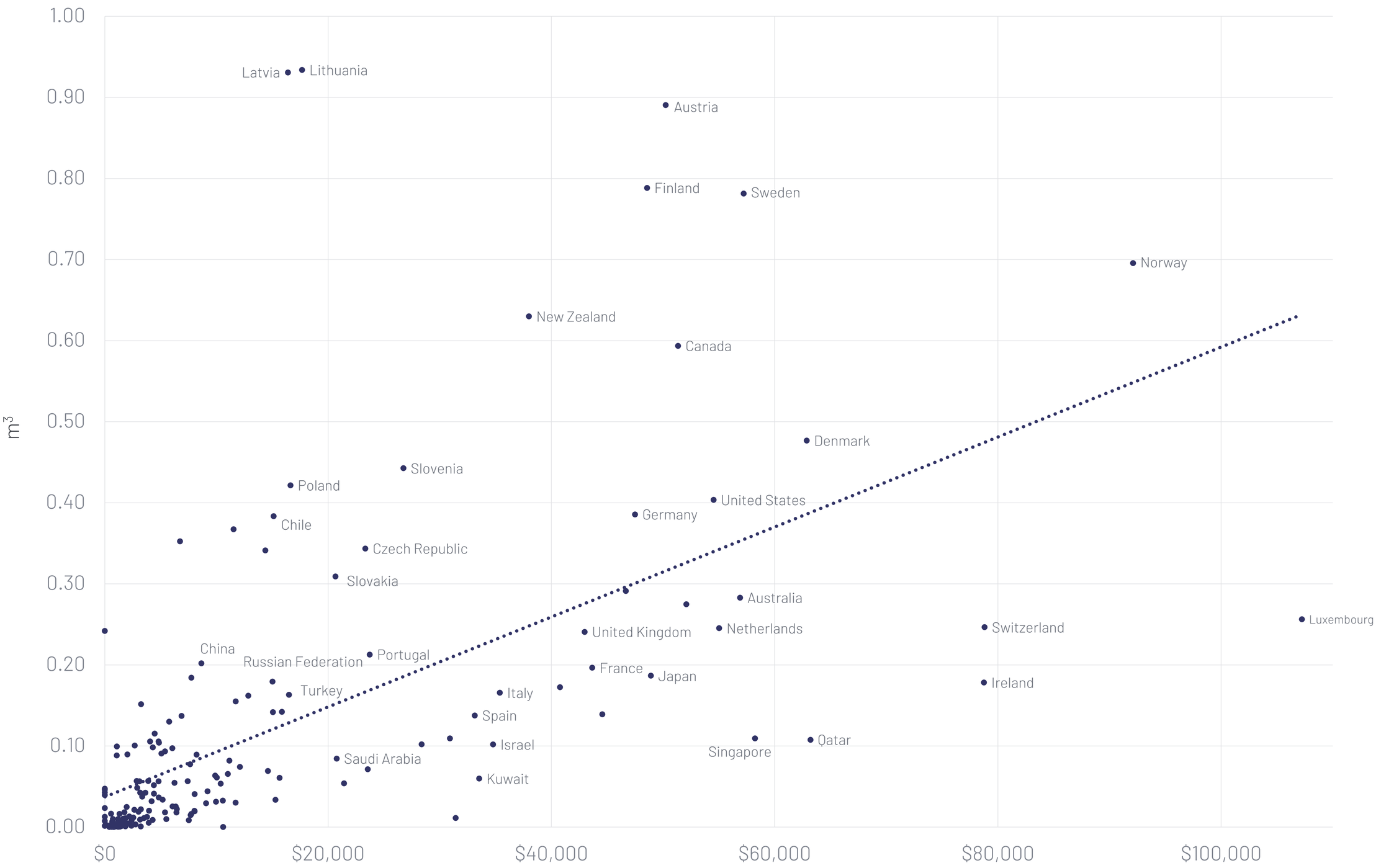


Source: WestFraser, September 2017

The increased timber use trend is seen in the GDP per capita vs timber consumption per capita statistics.

Global GDP is forecast to grow by 2.6% per annum to 2050[1], concomitant to the increase in urbanisation.

Timber consumption per capita vs GDP per capita (US$) - 2018



Sources: World Bank national accounts data 2019, OECD National Accounts data 2019, FAO Forest Product Statistics 2018

Estonia (1.9m³) not included

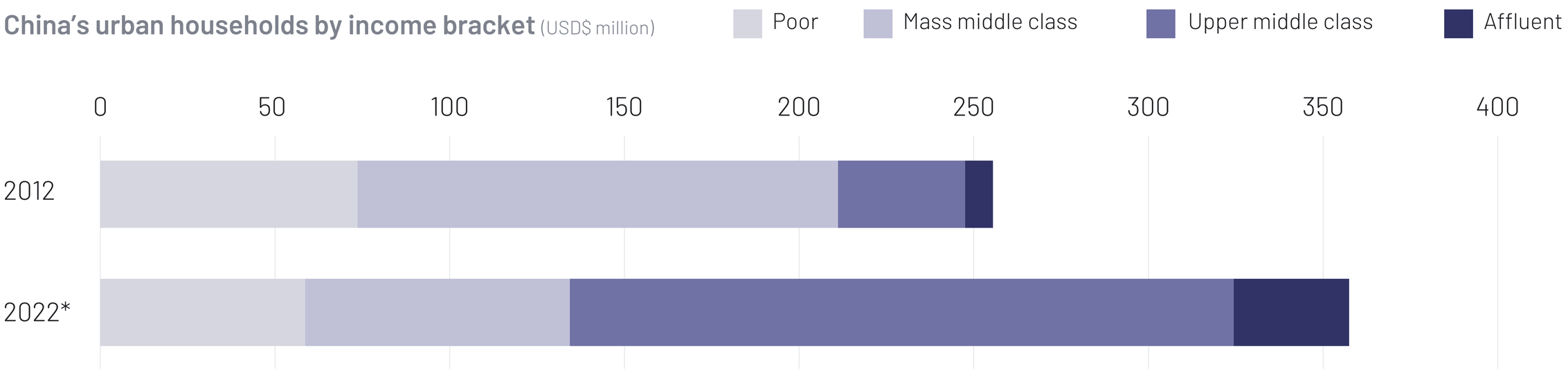
1. PwC - The World in 2050 - February 2017

Suburbanisation is only just starting in China

Following rapid GDP growth, China is just at the beginning of its suburban revolution, with rapid expansion expected.

In 2012, 17% of China's urban families were considered 'middle class' and above. This is expected to reach 63% by 2022.[1]

China's urban households by income bracket (USD$ million)



Source: McKinsey

* Forecast

Chinese timber consumption, as with much of the developing world, remains low at 0.18m^3 per capita.[2]

In May 2017, the Chinese State Council executive implemented a plan to renovate 15 million shanty towns between 2018 and 2020.[3]

Suburbanisation is also being witnessed in the average house size, with housing units becoming larger. Average per capita living space for urban families has increased from 24.5m^2/person in 2010, to 36.9m^2/person in 2017, a rise of 50%.[4]

1. McKinsey & Company; Mapping China's middle class
2. FAO Forest Product Statistics 2018 and UN World Population Prospects 2019
3. Jqknews.com/news/80414
4. Source: https://www.statista.com/statistics/225016/per-capita-living-space-in-china-in-urban-and-rural-areas/

From this:

Housing estate at Ningbo, China
Photo by Klaus Kinner. Fotografie realpicture / Alamy Stock Photo

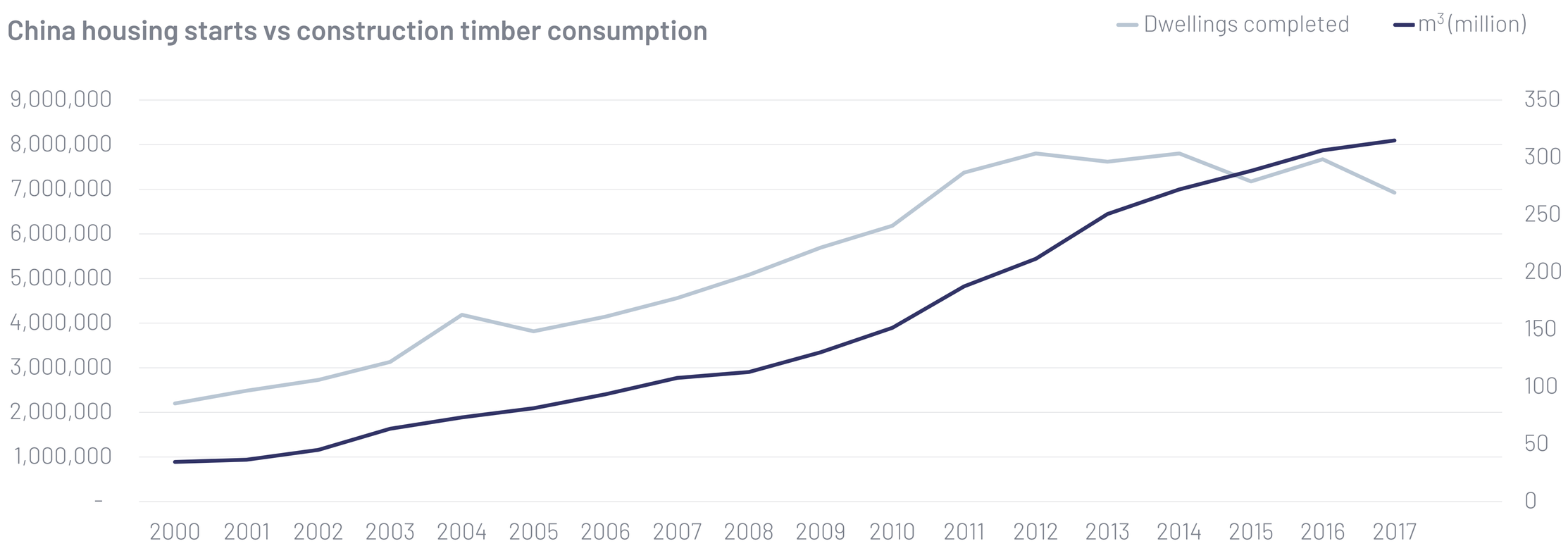
To this:

Suburban housing project in Shenyang, China
Photo by George Steinmetz. First published in National Geographic

Left: A typical current Chinese city. Right: Suburban housing project near Shenyang International Airport.

The Chinese government estimates that the country is adding five to six billion sq ft of floor space to its residential and commercial building stock every year.[5]

The effect on additional timber used in Chinese homes is already being seen:



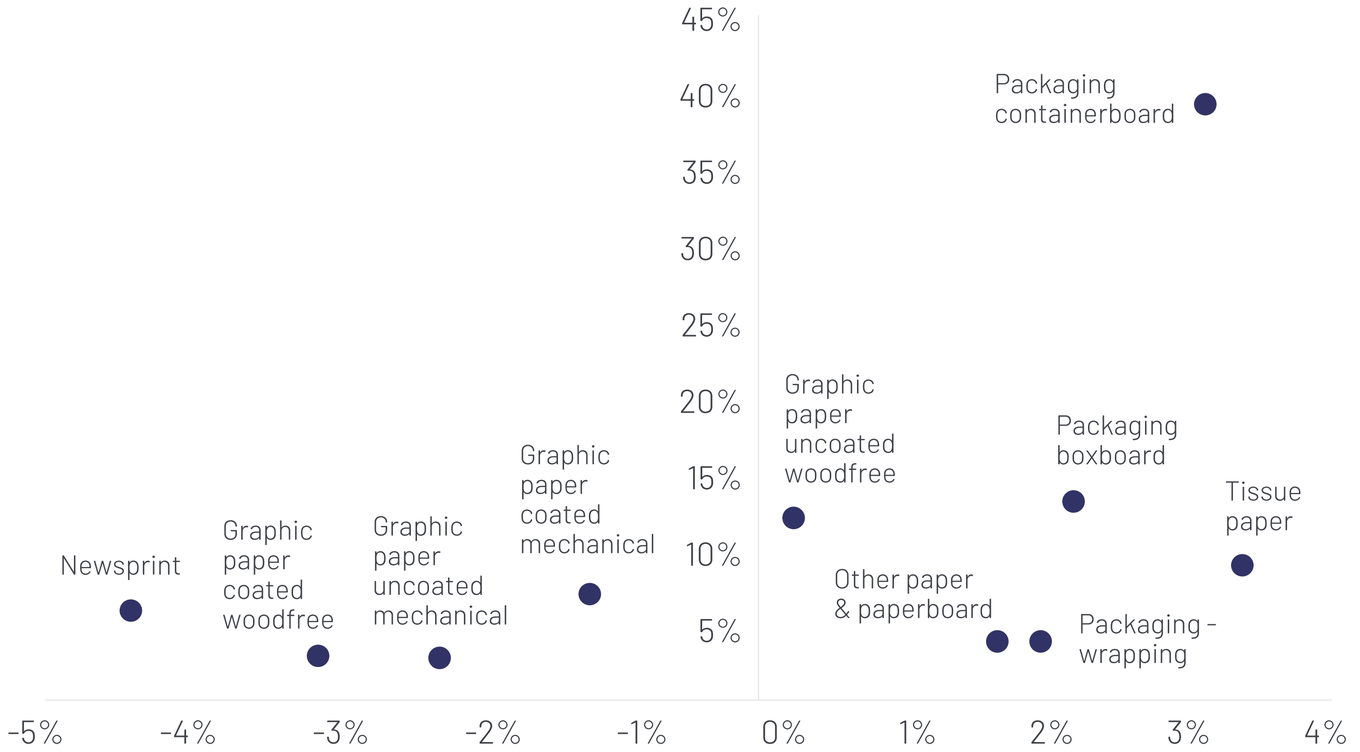
Source: http://data.stats.gov.cn and FAO Forest Product Statistics 2018

5. PRI's The World

Urbanised online communities use more cardboard packaging

Urban communities also use more containerboard, or 'cardboard', driven by the move to online shopping and the resultant retail deliveries.

Share of global paper consumption - 2015 (%)



Global growth in paper consumption - 2006 to 2015 (%)

Source: RISI, Westpac: Industry Insight - Forestry and Wood Products - May 2018

Total global market pulp demand has increased at a CAGR of 2.5% since 1999, driven by the containerboard market, which has grown at 3.3% per annum.[1]

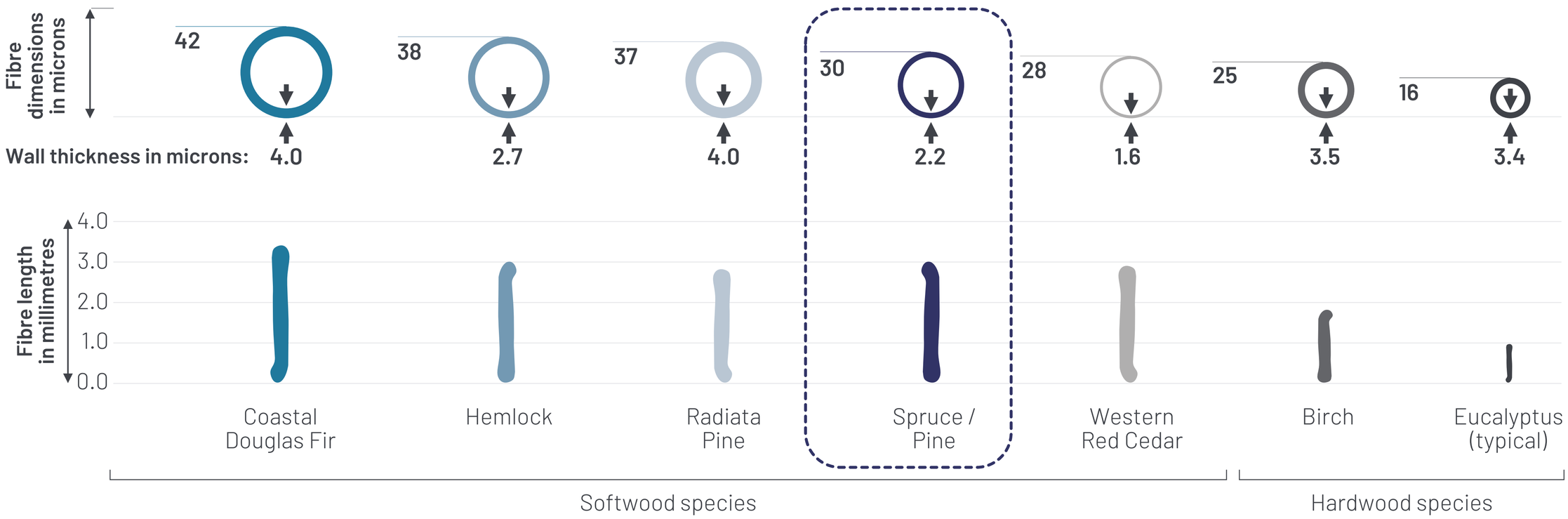
Online sales in China are expected to have grown by **27%** in 2019 to nearly **USD$ 2 trillion,** more than triple the size of the US market which is estimated at **USD$ 587 billion.**[2]

1. BTG Pactual TIG: Dynamics in the Global Pulp Market, 2019
2. https://www.oberlo.co.uk/statistics/ecommerce-sales-by-country

Given its shorter fibres, hardwood pulp is typically used to produce printing and writing paper as well as tissue products, while the longer fibre characteristics of softwood pulp provide strength and durability and it is used to produce packaging materials such as containerboard and paperboard.

Softwood fibres are some of the strongest in the world due to the long, slender fibres. This provides for better softness and strength, ideal for packaging containerboard.

Typical fibre dimensions



Source: Canfor investor presentation: fibre characteristics, November 2008

*Weight weighed lengths measured by Kajaani FS200"

Softwood is therefore well-positioned to benefit from the boom in e-commerce.

As countries continue to urbanise and create more online communities, the outlook for containerboard demand remains very positive.

This should continue to drive demand for wood pulp, which currently accounts for circa **10%** of all softwood timber demand.

Furthermore, the amount of recycled paper being used has plateaued at around **64%** against virgin paper. Recycled pulp can only be reused 5-7x before it breaks down and becomes unusable.[3] As such, wood pulp is still used in products even when recycled pulp is the dominant material, and demand for new pulp is expected to increase in line with demand for cardboard packaging.

3. BTG Pactual TIG: Dynamics in the Global Pulp Market, 2019

Decarbonising economies

Climate change is transitioning from an ecological concern to an economic driver

Climate change is no longer a prediction but a reality.

Both a generational sea change and firm statutory UN and government targets are driving entire economies as well as individual sectors to decarbonise.

Global momentum to decarbonise economies is expected to further accelerate timber consumption, as wood is increasingly seen as a clean and low carbon alternative - underlined by Sir David Attenborough, who advocates the use of more wood as **"an extraordinary renewable resource"** for growing populations.[1]

Timber can support the global transition to a more sustainable, resource-efficient economy, especially in construction, energy, and bioproducts.

The world economy may not grow at previous rates, but it will change significantly, and this is where future positive returns can be achieved.

1. Source: https://www.ourplanet.com/en/video/how-to-restore-our-forests/
"On their own, natural forests cannot provide all the wood we need so we also have to farm trees like any other crop and create a new generation of plantations."

Past performance is not a reliable indicator of future performance.

Decarbonising economies with wood to achieve zero emissions targets

Many developed countries and companies, including nearly the whole of the EU and the UK, have proposed a legally binding target of net zero emissions by 2050.[1]

"Net zero" refers to having an overall balance between greenhouse gas emissions produced and those removed. This is done by halting all avoidable emissions and offsetting the remainder by investing in resources that sequester carbon emissions.

The construction industry is a major source of resource extraction and CO_2 emissions, contributing around 36% of all CO_2 emissions.[2]

As a result, the EU has set a target to reduce emissions from construction by 90% by 2050.[2]

The clearest way to achieve this target is through the use of timber. Wood is a natural and sustainable low carbon alternative construction material with desirable build properties, it helps reduce CO_2 emissions in several ways:

- Timber has equivalent or better building characteristics to traditional materials
- Timber has superior insulation properties, lowering operating emissions
- As an alternative to other construction materials it locks up rather than emits CO_2
- Timber permits off-site prefabrication, reducing building times, deliveries and cost

Bosco Verticale (Vertical Forest) - Milan, Italy

1. European Commission, 2050 long-term strategy, https://ec.europa.eu/clima/policies/strategies/2050_en
2. Wood - Building the Bioeconomy - European Commission - October 2019

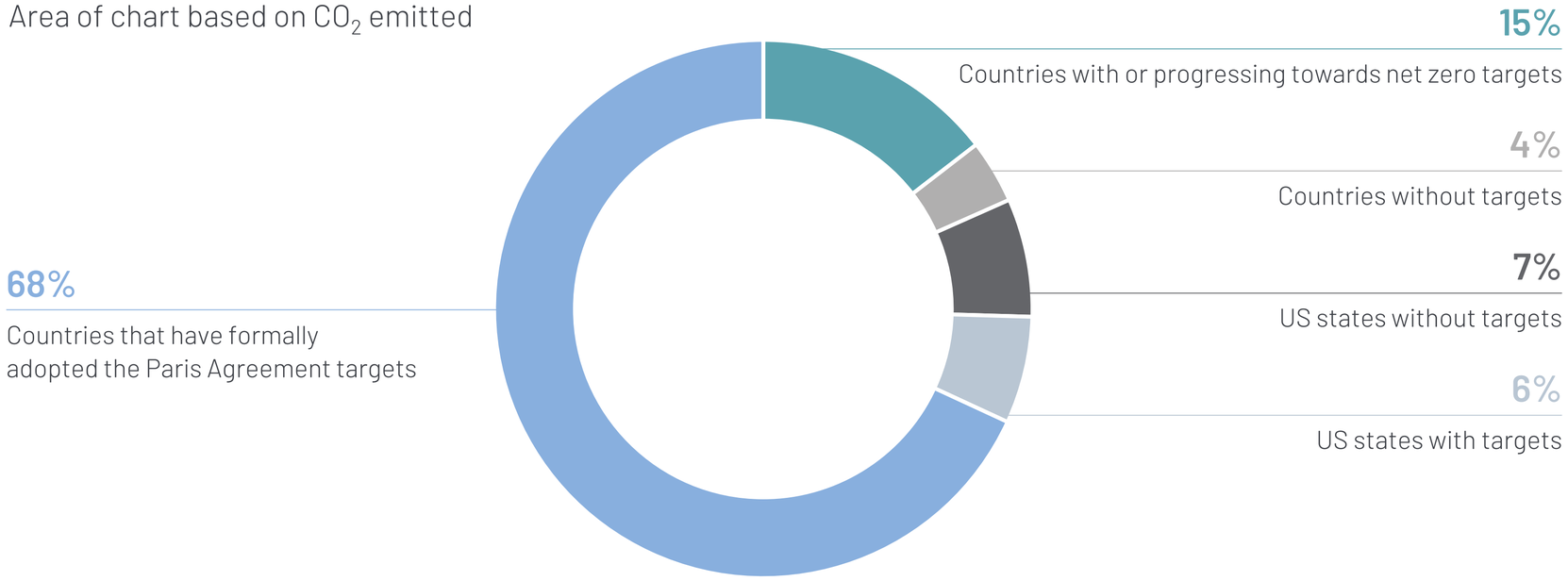
The construction industry in the EU accounts for:

36%	40%	50%	21%
of all CO_2 emissions	of energy consumption	of all extracted materials	of total water abstracted

Source: Wood- Building the Bioeconomy - European Commission - October 2019

Global CO_2 emission targets

Area of chart based on CO_2 emitted



Source: Energy & Climate Intelligence Unit, U.S. Energy Information Administration, Center for Climate and Energy Solutions, United States Climate Alliance, Emissions Database for Global Atmospheric Research, United Nations Treaty Collection

What is 'offsetting'?

Trees sequester CO_2 as they grow, through photosynthesis, and then lock in the greenhouse gas over the lifetime use of the wood (embodied emissions), generating carbon credits.

Carbon credits are a method used to offset unavoidable emissions from other sectors.

This means that industries such as transport and energy can buy carbon credits generated from growing timber to offset the emissions they cannot eliminate.

The International Civil Aviation Organisation (ICAO)'s Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) will from next year require airline emissions above 2020 levels to be offset.[3]

3. https://www.icao.int/environmental-protection/CORSIA/Pages/default.aspx

Wood the only viable alternative

The most effective way to cut emissions and reduce energy consumption is to replace steel, concrete and aluminium with wood.

Reduced emissions

During its production, one tonne of:

- Concrete releases 159 kilos of CO_2 into the atmosphere
- Steel releases 1,240 kilos of CO_2 into the atmosphere
- Aluminium releases 9,300 kilos of CO_2 into the atmosphere

Wood, however, absorbs a net 1,700 kilos of CO_2 from the atmosphere, over and above the energy expended in growing, harvesting and processing.[1]

Reduced energy consumption

Wood also helps reduce energy consumption. Wood's unique cellular structure, which makes it a poor conductor of heat, makes it ten times more insulating than concrete, 400 times more than steel and 1,700 times more than aluminium. A 2.5cm thick timber wall panel provides better thermal resistance than an 11.5cm brick wall.[2]

Superior construction qualities

Engineered timbers such as Cross-Laminated Timber (CLT) and glulam have superior construction qualities and consistency to sawnwood, and are comparable to concrete and steel, allowing bigger buildings, even skyscrapers, to be built of wood. They are lighter than concrete, steel and aluminium and can be built offsite, resulting in fewer site deliveries and reduced construction times.

Quicker construction, fewer deliveries and improved insulation result in lower emissions from transport, congestion and energy consumption. Foundations require a great deal of concrete, and whilst a timber structure does not remove the need for these foundations, the lighter building requires significantly less concrete.

Cost comparable

Higher material costs are offset by quicker build times and faster, simpler fit outs. A CLT structure currently costs circa £250/m^2, compared with circa £170/m^2 for concrete and steel. However, build times are significantly faster and simpler as wood is lighter and easy to work with. The overall impact is cost neutral.

1. New Zealand Forestry Owners Association - Forestry Facts and Figures 2018
2. Wood - Building the Bioeconomy - European Commission - October 2019

The carbon saving figures of using wood can be substantial. The city of Helsinki built four similar five-storey apartment blocks, two in wood, two with concrete. The production of materials used in the timber buildings had a **74%** lower carbon footprint.[5]

France has just enacted a law requiring **50%** wood or sustainable products in public buildings from 2022.[6]

Puukuokka apartment building, Jyväskylä, Finland. Photo Credit: Mikko Auerniitty

5. Wood- Building the Bioeconomy - European Commission - October 2019.
6. The Times 11 February 2020: Macron: Use more wood in our buildings.

Timber buildings and towers - 'plyscrapers' - starting to spring up everywhere


Credit: Daniel Shearin

Dalston Works, Shoreditch, London

A completed 155,000 sq ft, 121 dwelling plus retail, restaurant and workspace CLT construction.

More than 50% less CO_2 emissions of equivalent concrete structure.

3,756 tonnes of CO_2 sequestered.

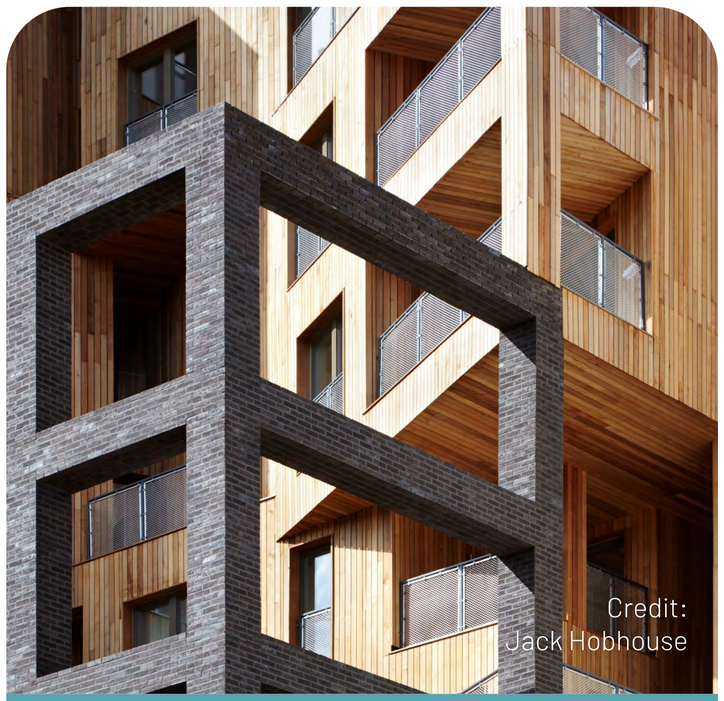
111 deliveries compared to circa 700 for concrete equivalent.

HoHo, Vienna

A completed hybrid wood/concrete 84-metre tower.

Used 3,600m^3 of Austrian timber over 24 storeys.

2,800 tonnes of CO_2 saving compared with pure concrete construction.


Credit: Jack Hobhouse

The Cube, Shoreditch

Hawkins\Brown has completed a 33-metre high apartment block in London's Shoreditch, the tallest building to use structural cross-laminated timber in Europe.

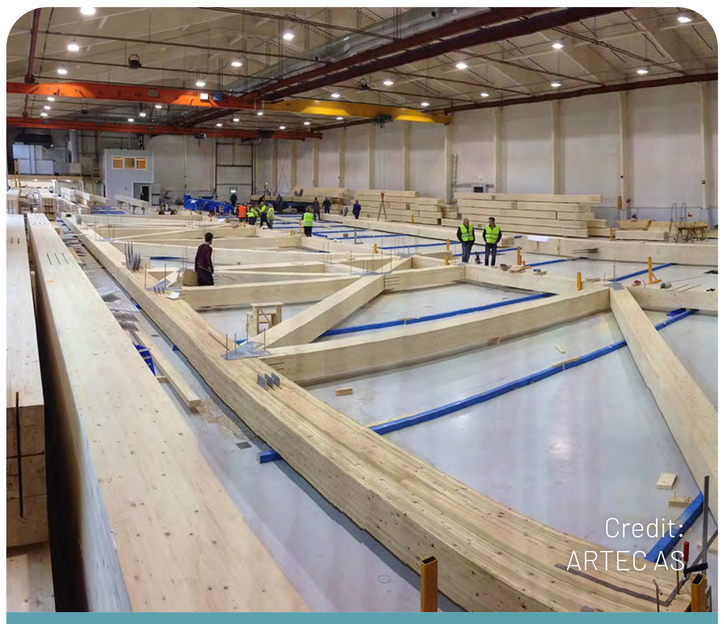

Credit: Pixabay

L&G Modular Housing Factory, Leeds

L&G has invested £55 million into a factory near Leeds, capable of producing 3,500 prefabricated homes per annum.

Barratt Homes estimate that a traditional three-bedroom build takes 40 weeks to complete and a timber framed, modular house only ten days.

The UK has enacted a housing initiative to create a £40 billion "construction corridor" of off-site housing factories across the north of England.

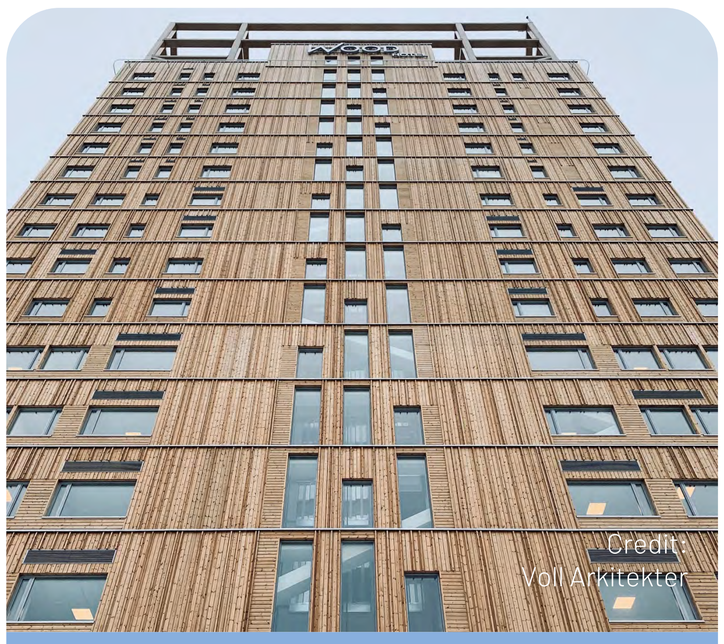

Credit: ARTEC AS

Treet Building, Norway

14 storeys of timber have led to 2,000 tonnes CO_2 sequestered.

The main load bearing frame is handled by glulam wooden truss.

CLT is used in the staircases, elevator shaft, inner walls and balconies.


Credit: Voll Arkitekter

Mjosa Tower, Norway

Currently the world's tallest timber building, at 85.4 metres, using laminated veneer lumber.

And many more...

Including River Beech Tower, Canada Earth Tower, UBC Brock Commons, Barents Secretariat, and Central Park Tower.

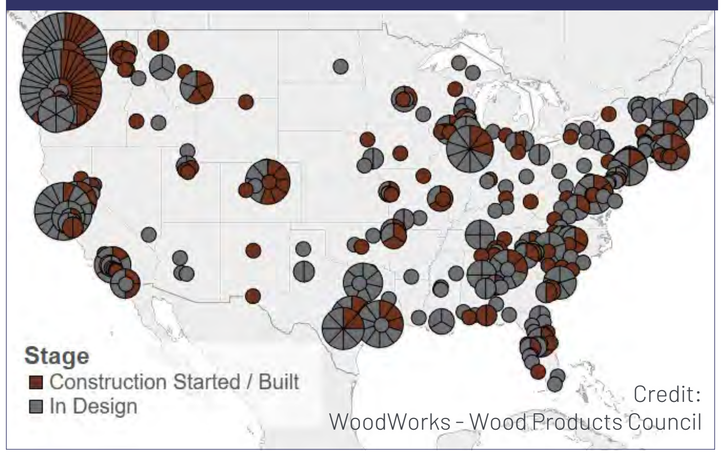
Maierhof, Austria

A completed wood-based hybrid housing estate with a façade of prefabricated wood elements.

Oakwood Tower, London

A 300-metre tall wooden skyscraper is being proposed for central London which would be the capital's second-tallest building after the Shard.

Mass timber projects in design and constructed in the US (June 2019)



Kulturhus, Sweden

White Arkitekter won a competition to design a cultural centre and hotel in Skellefteå with its proposal for the "tallest wooden building in the Nordic countries".

The 76-metre tall construction will be built of locally sourced wood.

24,940m^2 will be timber framed, with a glass envelope.

Sidewalk Lab, Toronto

Google's Alphabet has unveiled its draft plan for the factory-based construction of 35-storey buildings with 100,000m^3 of wood - all of which will be manufactured in a $100 million sawmill it proposes to set up.

Construction timelines are set to be reduced by 35% and emissions by 85%.

Tokyo, Japan

A proposal to build a 350-metre (1,148ft), 70-floor tower.

It is estimated that it will take 185,000m^3 of wood to complete the entire structure.

The effect on timber consumption of moving to a net zero carbon construction industry

If the move towards timber frame constructions continues, the effect on timber consumption will be significant.

To achieve the net zero carbon emissions target in residential construction, the housing mix will have to change to include more timber framed or CLT buildings and fewer brick buildings.

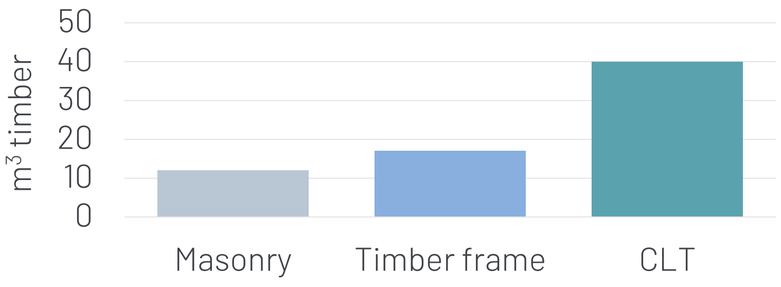
Residential

Estimated housing mix and net emissions - current				Dwelling construction method			Net emissions (tonnes CO_2)			
		%	Dwellings	Non-timber	Timber frame	CLT	Non-timber	Timber frame	CLT	Sum
Housing	2 bedrooms	9	18,179	82%	18%	0%	169,008	23,651	0	192,659
	3 bedrooms	36	72,716	74%	26%	0%	549,345	73,866	0	623,211
	4 or more bedrooms	36	72,716	70%	30%	0%	626,585	104,598	0	731,183
Flats	1 bedroom	5	10,100	62%	38%	0%	110,991	7,246	0	118,237
	2 bedrooms	13	26,259	62%	38%	0%	402,898	25,373	0	428,270
	3 bedrooms	1	2,020	62%	38%	0%	37,633	2,370	0	40,003
	Total	**100**	**201,990**	**71%** (avg.)	**29%** (avg.)	**0%** (avg.)	**1,896,461**	**237,103**	**0**	**2,133,564**

Estimated housing mix and net emissions - net zero target				Dwelling construction method			Net emissions (tonnes CO_2)			
		%	Dwellings	Non-timber	Timber frame	CLT	Non-timber	Timber frame	CLT	Sum
Housing	2 bedrooms	9	18,179	51%	18%	31%	105,158	23,651	-83,266	45,543
	3 bedrooms	36	72,716	42%	26%	31%	312,697	73,866	-516,396	-129,834
	4 or more bedrooms	36	72,716	39%	30%	31%	350,445	104,598	-777,170	-322,127
Flats	1 bedroom	5	10,100	31%	38%	31%	55,669	7,246	-23,732	39,183
	2 bedrooms	13	26,259	31%	38%	31%	202,079	25,373	-86,449	141,003
	3 bedrooms	1	2,020	31%	38%	31%	18,876	2,370	-8,075	13,171
	Total	**100**	**201,990**	**40%** (avg.)	**29%** (avg.)	**31%** (avg.)	**1,044,923**	**237,103**	**-1,495,087**	**-213,061**

Source: The BioComposites Centre, Bangor University and GHAM forecasts

An average four bed house



Source: Structural Timber Association

In the UK, an increase in the use of CLT housing could equate to a circa 72% increase in construction timber. This is significant, but still well below that of many Scandinavian and Alpine countries on a per capita basis.

These figures are just to achieve carbon neutral. House building may be carbon sequestering way beyond this target by 2050.

Today's tower blocks and commercial constructions are of mostly concrete and steel construction.

The below demonstrates the difference in net carbon emissions between a hypothetical conventional tower block and a CLT equivalent, consisting of 24 one bedroom apartments and 24 two bedroom apartments (48 in total), or office / retail space equivalent, over six storeys. The increased timber usage is also displayed.

Commercial

Carbon balance comparison of a six-storey tower block

Construction material	Net emissions	Timber m^3
Concrete	1,016	202
CLT	-437	1,205

Source: The BioComposites Centre, Bangor University and GHAM forecasts

To achieve the net zero carbon emissions target in commercial and apartment construction, the construction mix would have to change to be circa two thirds CLT and one third concrete.

This could result in circa 13x more timber being used than currently.

Construction is already the main driver of timber demand, with about 60% of timber consumption coming directly from the construction industry, so any increases in the use of timber in construction will significantly impact timber demand.

Decarbonising economies
Biomass as a renewable energy source

What is Biomass?

Biomass is organic matter that can be used as an energy source.

Biomass wood pellets are created from sawdust and other residual wood materials, or through chipping small diameter roundwood.

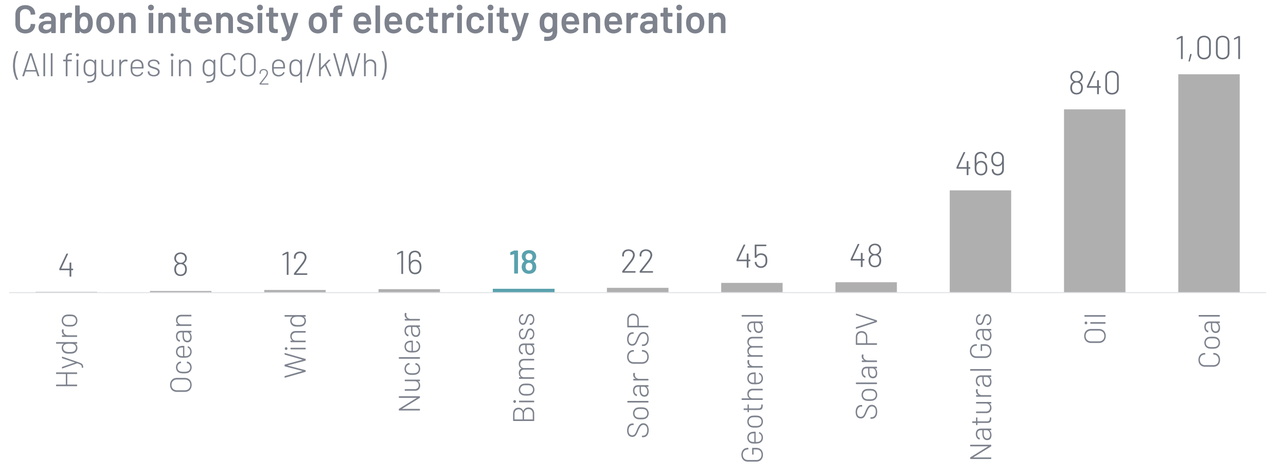
Wood pellet material is typically from low-value wood such as harvest residues, thinnings or sawmill residues, as well as misshapen trees not suitable for other uses.

Wood pellets are burned in boilers, often converted coal boilers, to generate heat and electricity.

Why use biomass for heat and power production?

Clean energy: Biomass is considered to be near carbon neutral even after accounting for transportation emissions.

Carbon intensity of electricity generation
(All figures in gCO_2eq/kWh)



Source: VREC Solar

On demand energy: Increasing deployment of renewable sources has seen annualised growth rates of 39% in Solar and 22% in Wind since 2000. The UK already generates circa one third of its energy needs from renewable energy.[1]

These sources provide an intermittent source of generation and to ensure a secure electricity system, a baseload on demand energy generation source is required.

Traditional baseload generators of coal and gas are carbon intensive. Nuclear electricity production remains unchanged over the last 20 years.[2] Battery storage is useful but is not a generating source.

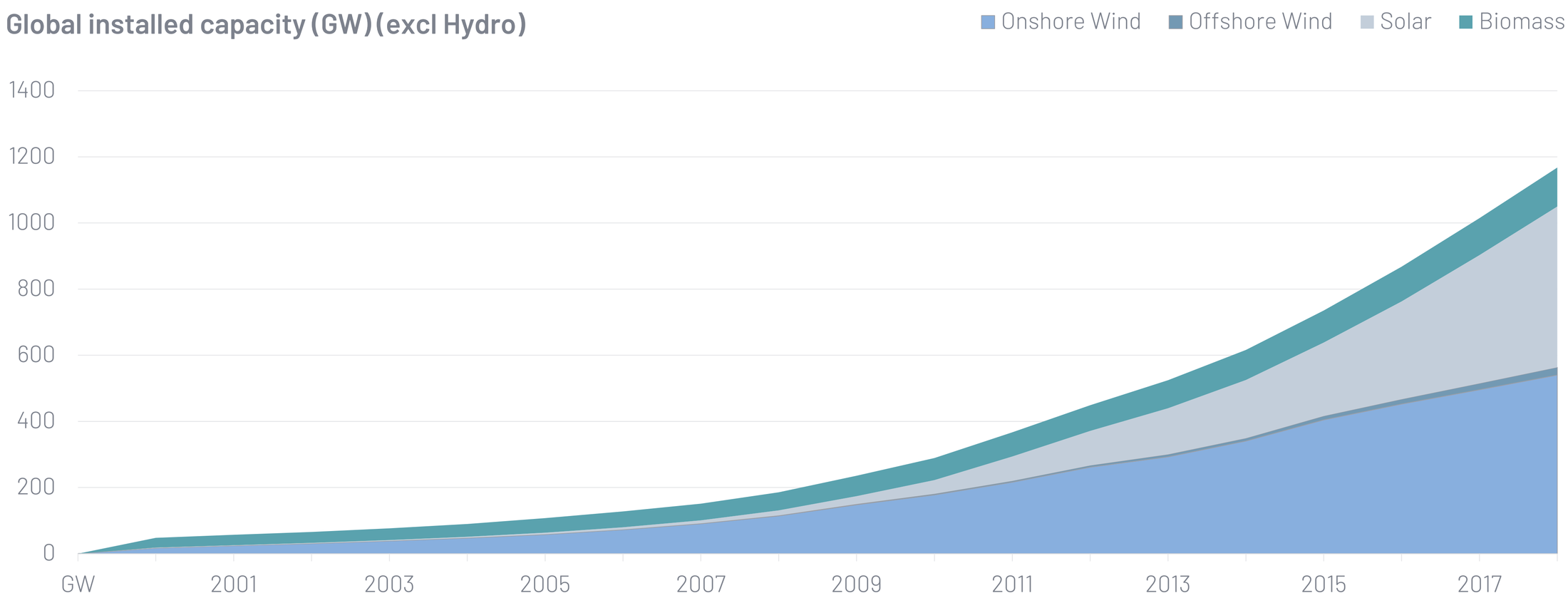
Low carbon baseload generation will be required to help meet the aims of the EU and global emission targets whilst securing baseload energy supply. This is the power of biomass.

1. IRENA (2019)
2. Renewable Energy Statistics 2019, The International Renewable Energy Agency, Abu Dhabi

Electricity generation from biomass

Globally installed biomass capacity has increased fourfold since 2000 from 30 gigawatts (GW) to almost 118GW in 2018 representing an annualised growth rate of 8.0%.

Similarly generation from biomass over the period has increased by around 7.2% annually rising from 142 terawatt-hours (TWh) to 500TWh.



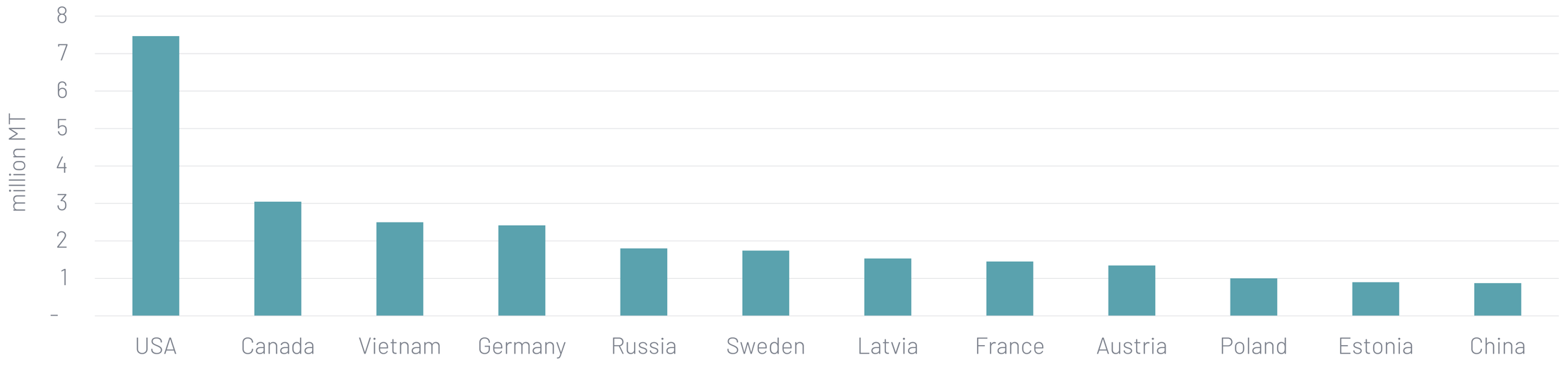
Source: IRENA (2019), Renewable Energy Statistics 2019, The International Renewable Energy Agency

There is global momentum to achieve much higher levels of renewable deployment and decarbonise economies. This will further drive the need for biomass as a baseload on demand energy supply.

Biomass current and future usage

The United States is the largest producer of wood pellets, producing almost 7.5 million metric tonne (MT) per annum, equivalent to 21% of global production.

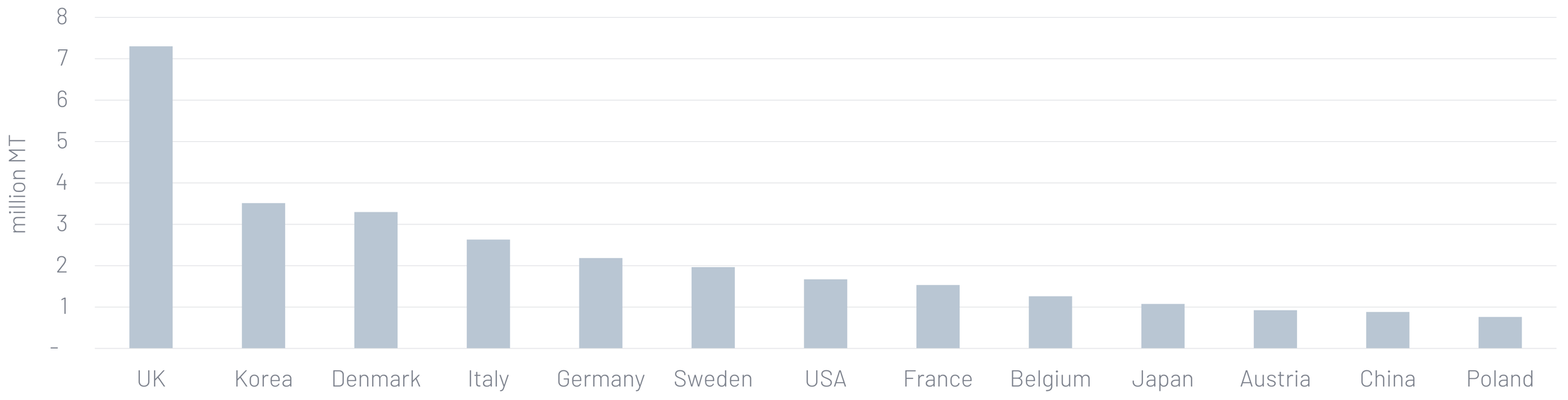
Global producers - wood pellets



Source: FAO Forest Product Statistics 2018

The United Kingdom is the largest consumer of wood pellets, consuming over 7.3 million MT per annum, equivalent to 29% of EU consumption and 21% of global demand.

Global consumers - wood pellets



Source: FAO Forest Product Statistics 2018

Wood pellet demand is expected to increase. Global demand is expected to almost double by 2025 to 55 million MT from 35 million MT today, a CAGR of circa 9%.[1]

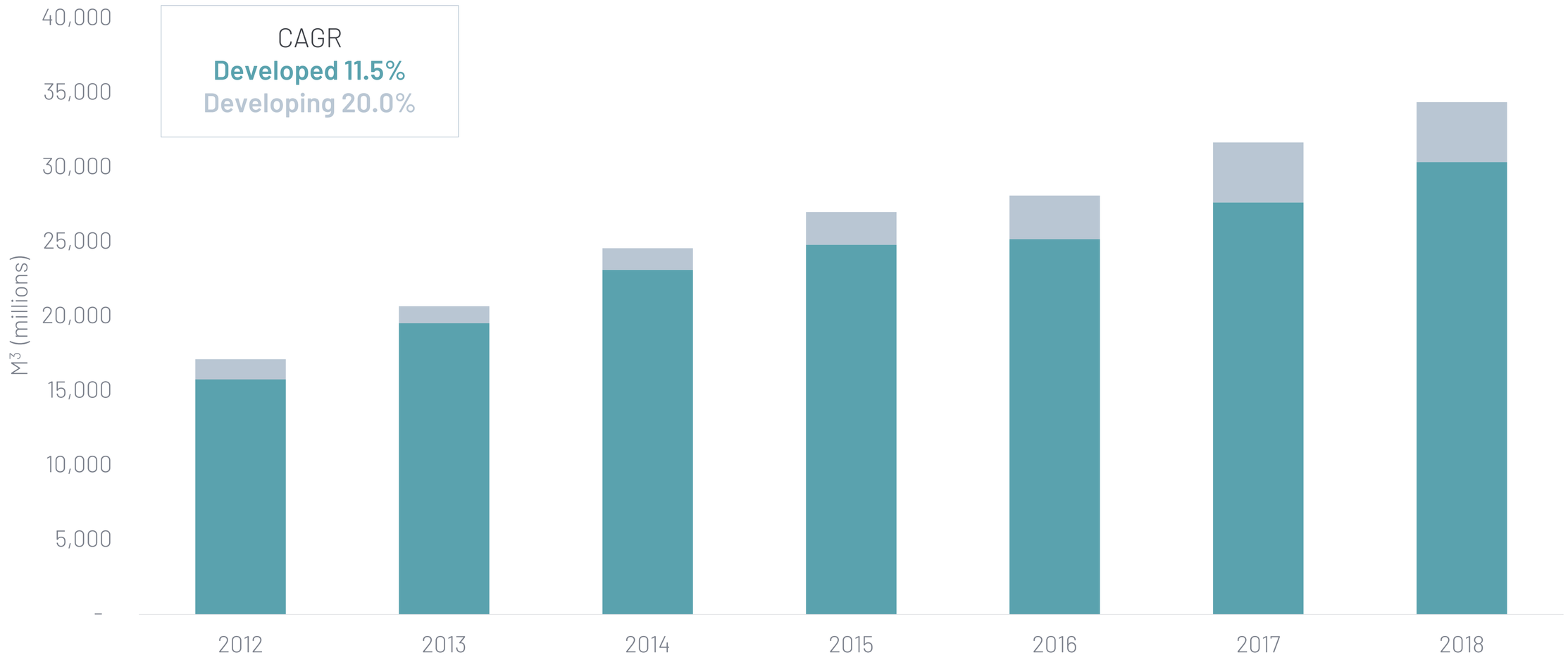
This is driven in Europe by renewable energy subsidies aimed at encouraging biomass production to achieve renewable energy targets.[2]

In Asia, Japan implemented a Feed-In Tariff (FIT) scheme in 2012 to increase the use of renewable energy and move away from nuclear power following the earthquake and subsequent Fukushima nuclear power plant disaster.[2] The Japanese government is targeting 6.0-7.5GW of biomass capacity by 2030, equating to roughly 15-20 million MT of biomass per annum.[2] Biomass pellets already provide 12% of Japan's industrial energy needs, and it is expected that market share will more than double to 31% by 2029.[3]

South Korea has introduced its 'Renewable Energy 2030' plan, which targets 20% power generation from renewable sources by 2030.[4] About one third of this is expected to come from biomass.[5]

Asian industrial demand, driven by Japan and South Korea, is set to average 18% annual growth for the next decade.[6]

Global wood pellet consumption



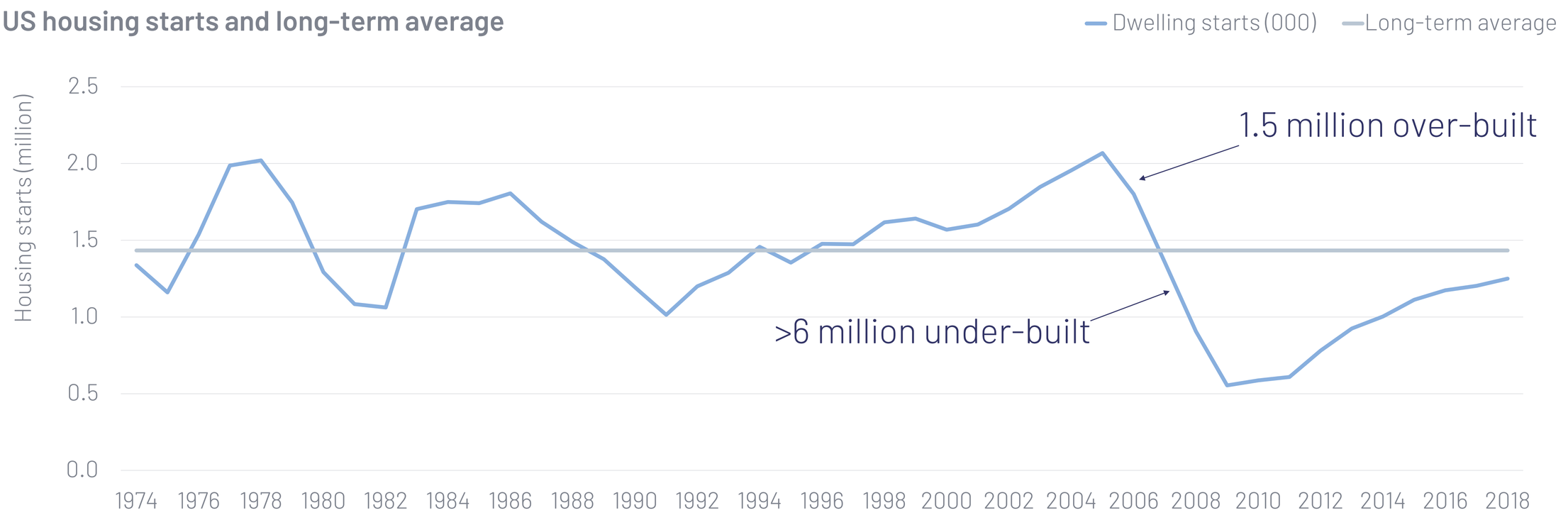
1. RISI and analysis by FutureMetrics, published in Global Wood Market Info: Global wood pellet market outlook in 2018
2. BTG Pactual TIG - Wood Pellet Industry Update Jan 2018
3. GWMI - Main trends of the global wood pellets market in the next decade - 2019
4. https://asian-power.com/project/news/south-korea-could-be-next-biomass-market-leader-report
5. Ahttps://www.asiabiomass.jp/english/topics/1302_05.html - South Korea's Policies for Deploying New and Renewable Energies
6. Fastmarkets RISI - Global Pellet Demand Outlook - 2018

Housing shortage

The housebuilding shortage globally will continue to drive demand for timber, independent of the additional uses of wood

Current levels of housing starts are low by historical standards, as shown by the following chart of the US:

US housing starts and long-term average

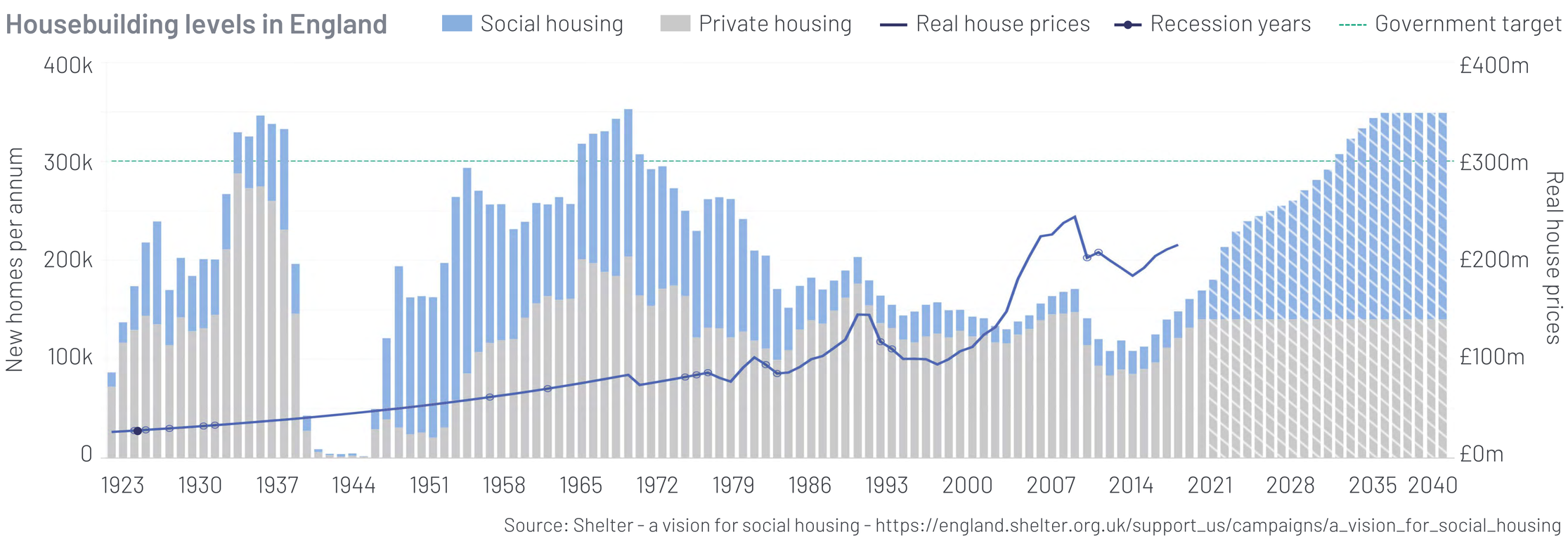


Source: Federal Reserve Economic Data and Norbord, Raymond James Institutional Investors Conference March 2018

The US housing stock continues to age, with the median age of houses now approximately 40 years old, a record high.[1]

1. NAHB, US Census, Hoya Capital. Published in https://seekingalpha.com/article/4274790-housing-sector-leads-stocks-to-record-week

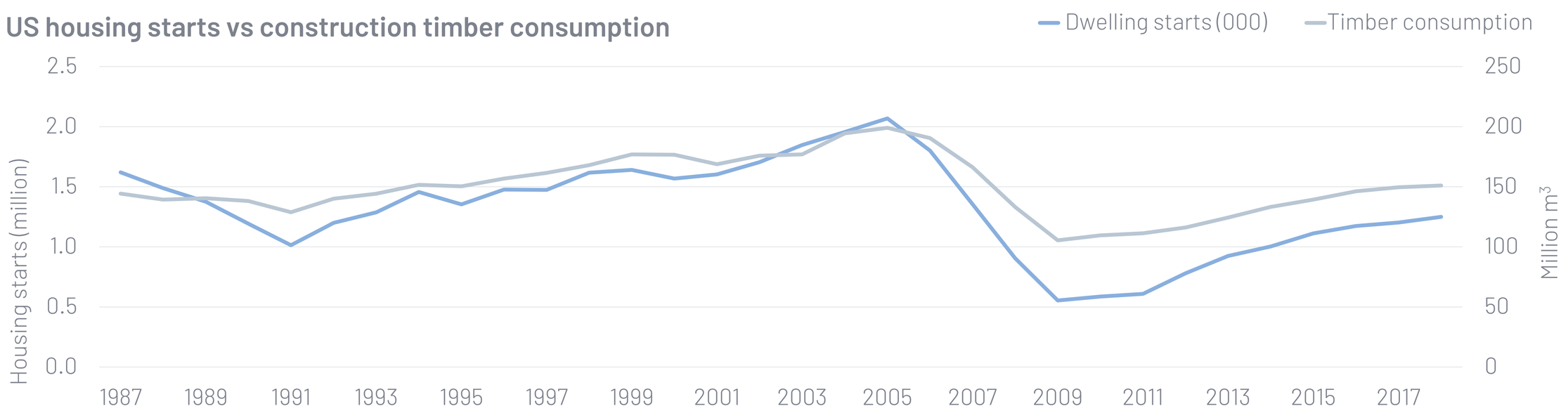
Current housing starts in the UK are at 201,990, well below the 300,000 annual target. All political parties are seeking to increase housebuilding.



Source: Shelter - a vision for social housing - https://england.shelter.org.uk/support_us/campaigns/a_vision_for_social_housing

A similar housing shortage is seen in many developed countries. The number of young adults living with their parents is now at or near an all-time high.[2] Worldwide, the most severe aspect of the global housing crisis is the 850 million people who live in informal settlements - more than the populations of the US and the EU combined.

Housebuilding, independent of the additional uses of timber, continues to underpin timber consumption, as shown by the chart below of the past 22 years in the US:



Sources: Federal Reserve Economic Data and FAO Forest Products Statistics 2019

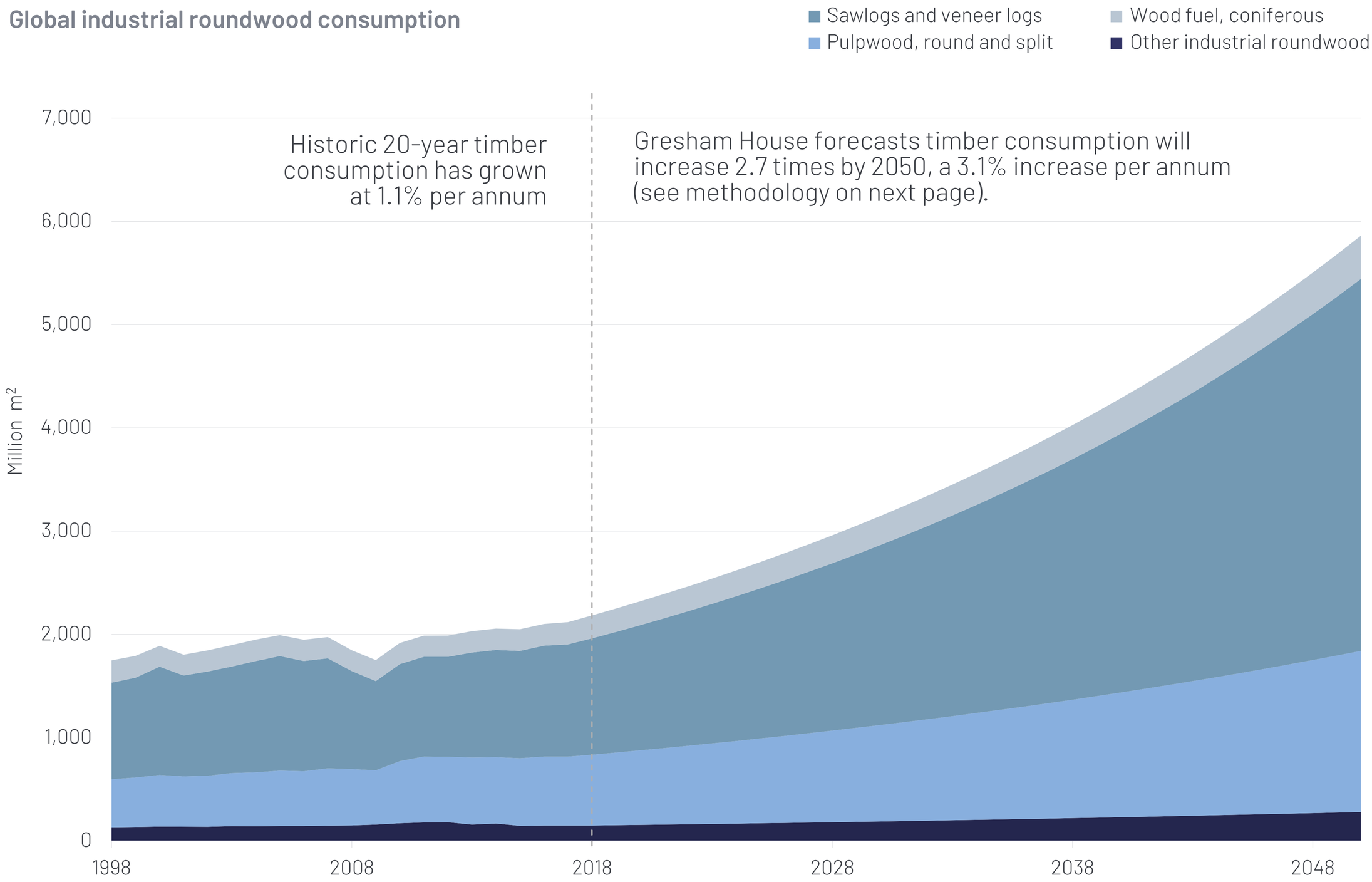
A similar correlation is seen in nearly every other country.

2. PEW Research: Fact Tank: In the US and abroad more young adults are living with their patents. May 2016

Forecast timber consumption to 2050

Driven by urbanisation, decarbonisation and housing demand, Gresham House forecasts global timber consumption to rise by **170%** over the next 30 years.

Global industrial roundwood consumption



Source: FAO Forest Product Statistics 2018

Forecast timber consumption to 2050

Sawnwood

Gresham House methodology

The number of Urban Dwellers and Timber Consumption per Urban Dweller (TCUD) in m^3 have been forecast.

- Urban dwellers in 2050 is given by the United Nations World Population Prospects data.
- TCUD in 2050 has been forecast taking into account GDP growth and decarbonisation, as set out below:

Developing countries

- TCUD in any given developing country is targeted to grow to China's current rate of 0.31.
- Annual TCUD growth per country is capped at 7.8% to avoid unrealistic growth rates. This is China's historic growth rate in TCUD over the past 20 years.
- Countries with a high current level of TCUD - so that forecast growth to achieve the Chinese TCUD level would be less than 2.6% (the long-term forecast for global GDP growth) - are forecast to grow at 2.6%.
- China itself has been capped at a TCUD of 0.60, which is between where Germany and Poland are currently. This gives an annual growth rate in timber consumption of 2.1% to 2050.
- India has been capped at a low TCUD of 0.06 to reflect perceived difficulties in initial urbanisation, resulting in a TCUD growth rate of 5.1% to 2050.
- This gives a weighted average TCUD for developing countries of 0.27 in 2050, an increase of 0.14 over 30 years, or 2.5% per annum. This in turn represents circa 1/3 of the progress China has made in the past 30 years.

These TCUD figures are then multiplied by the UN forecasts for urban populations in 2050, capturing the impact of urbanisation.

- When factoring in urban populations in 2050, the total growth in timber consumption is forecast at 4.2% per annum.
- This compares to an average historical growth rate in timber consumption in developing countries of 4.2% in the past 20 years.

Developed countries

Developed countries' annual growth in TCUD has been set to 2.5%, reflecting a long term timber consumption growth of 1.1%, in line with forecast GDP of 1.5%, plus an additional 1.4% for decarbonisation.

- Given its large proportion to total timber consumption, the 2050 TCUD figure for the US has been capped at 0.90 to match the current level of Scandinavia and The Baltics, up from 0.49 in the US today.
- This gives a weighted average TCUD of 0.82, which is in line with where Scandinavian countries and New Zealand are today.

Output 2050

Urban dwellers to increase to 6.7 billion (+2.3 billion):

- Developed 1.1 billion (+0.1 billion)
- China 1.1 billion (+0.3 billion)
- Developing 4.4 billion (+2.0 billion)

Source: United Nations World Population Prospects 2019

Timber consumption per urban dweller (m^3) to increase to 0.33 (+0.15):

- Developed 0.82 (+0.43, 2.4% p.a.)
- China 0.60 (+0.29, 2.1% p.a.)
- Developing 0.27 (+0.11, 2.1% p.a.)

Source: Gresham House

Total sawlog and wood based panel consumption (m^3) to increase to 3.6 billion m^3 (+2.5 billion, 3.7% p.a.)

Pulp and other roundwood +2.6% per annum

Softwood forest owners may see pulp demand, from cardboard packaging, grow higher than general pulp demand over the medium term, but in the long term, all pulp demand is expected to grow in line with its 20-year historical average and global forecast GDP growth.

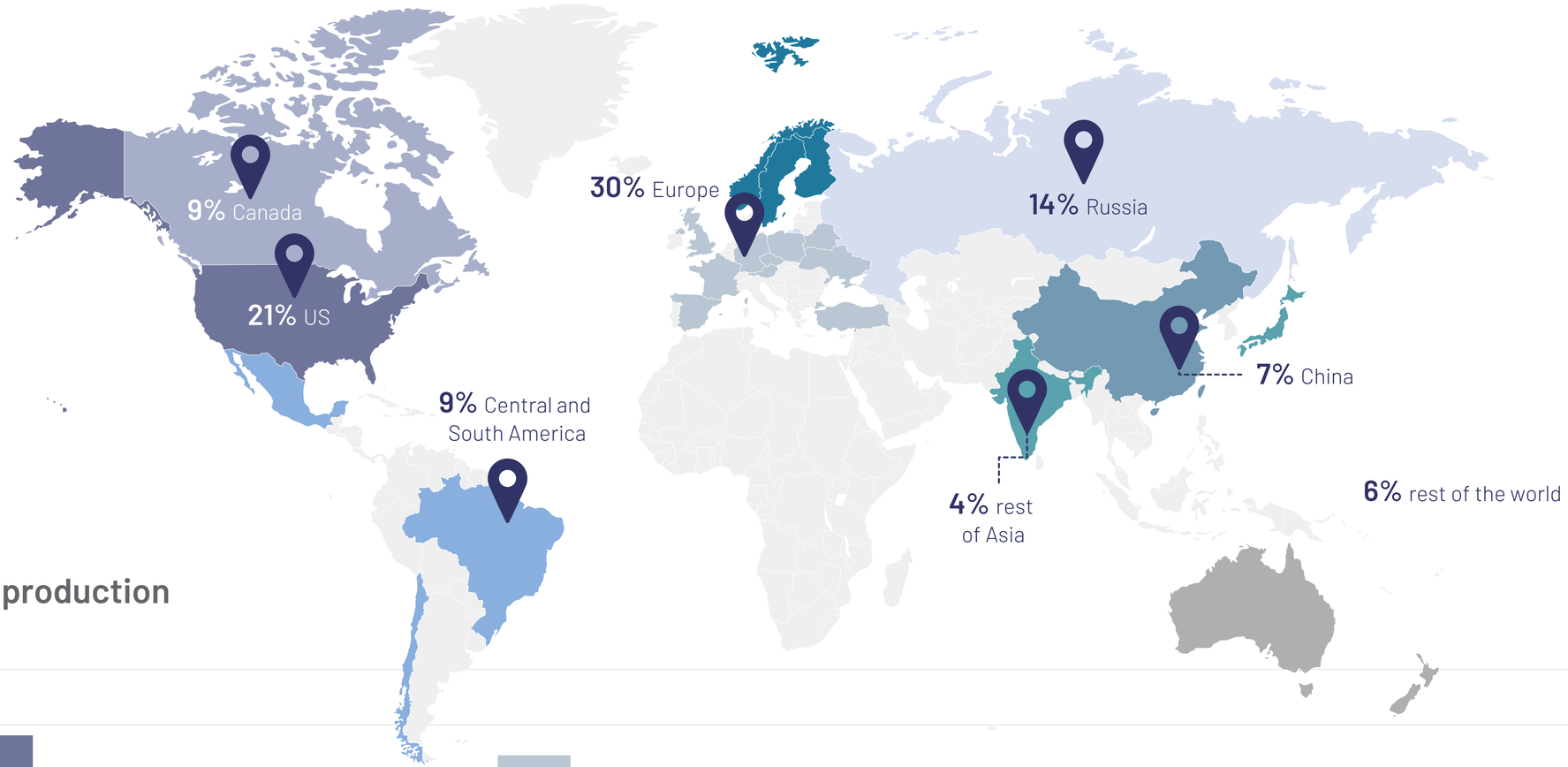
Biomass +2% per annum

Wood pellet demand cited here is deliberately conservative, as the FAO figures used to project forecasts do not allow for the accurate distinction between wood pellets and wood fuel for consumption purposes.

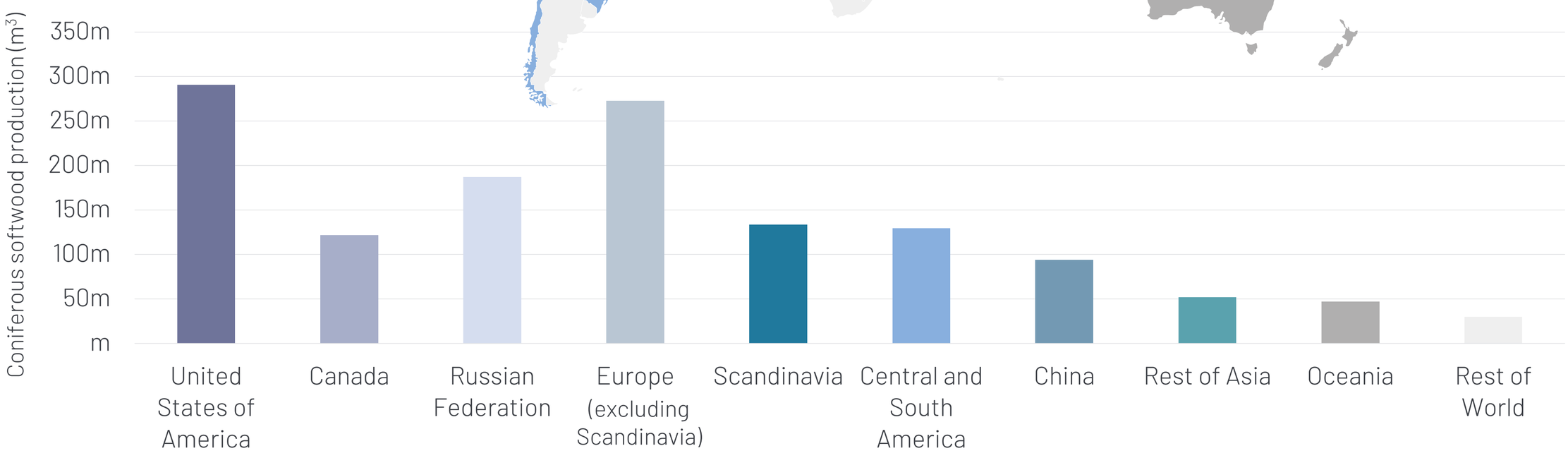
Finite supply

The vast majority of global commercial timber supply is sourced from temperate forests in the northern hemisphere (Canada, US, Northern Europe, Russia) and plantations in Oceania (New Zealand and Australia), where climates permit the growing of softwood timber.

The increase in urban dwellers is concentrated in regions with insufficient resources of mature timber. Consumers from China, India, Indonesia, Asia and Africa drive increased demand on the fixed, traditional sources of supply.



Global softwood production



Source: FAO Forest Product Statistics 2018

Afforestation rates have been low and future afforestation and restocking of commercial plantations will not be able to meet increasing demand.

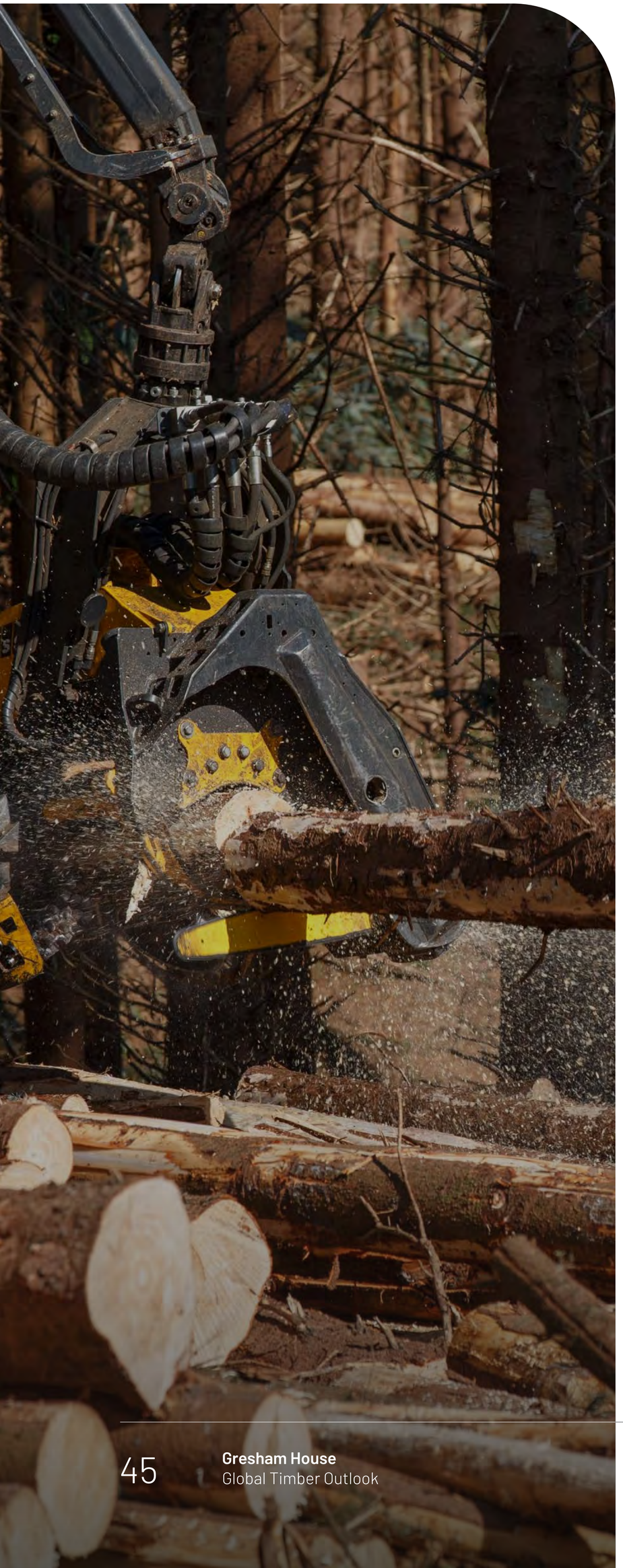
Global growth rates of softwood species range from 30 – 100 years before the timber is considered mature and ready for harvesting. Areas with the wettest and mildest climates, such as New Zealand, Great Britain and Ireland, allow for the highest growth rates.

As such, even if softwood afforestation levels were to increase rapidly, supply would not be impacted for at least 30 years from today at the earliest.

Region	Rotation length (years)
United States of America	30-45
Canada	46
Russia	100
Scandanavia	75
Europe (continental)	70
Chile	22
United Kingdom	35
Ireland	30
New Zealand	28

Sources: Timberland Investment Resources, Thunen Institute of Forest Genetics, Poyry Consulting

Further, most of the current standing stock not yet harvested is located in increasingly inaccessible, cold and hard to reach isolated areas such as North Eastern Russia and Northern Canada.



Commercial timber supply constrained by non-economic factors

Timber accreditation

Companies and consumers are becoming increasingly aware of the source of their products, whether food or raw material, driving an increasing need to verify that products are from sustainable sources. This has been highlighted by scandals such as illegal palm oil plantations, which have resulted in the further decline of the already critically endangered orangutan and the destruction of lowland gorilla habitats in Borneo and the Congo Basin.[1]

The two main international accreditation bodies, FSC and PEFC now certify approaching 500 million hectares, or 13.5% of the total global forest area.[2,3]

Approximately 300 million hectares is under the PEFC scheme. The remainder is certified under the FSC who have issued 36,000 'product chain of custody' certificates so that timber products have a clear audit trail.

Forest certification has grown significantly over recent years with PEFC certified hectares increasing by approximately 100 million hectares every five years since 2000.

Certifying and local regulatory bodies also require that an element of diverse and less productive tree species are used when restocking forests, further reducing future timber supply.

1. Orangutan Foundation: The Effects of Palm Oil
2. Forest Stewardship Council (FSC)
3. The Programme for the Endorsement of Forest Certification (PEFC)

Restricted harvesting

China effected measures to completely ban the harvesting of natural forests in order to promote an environmentally and economically sustainable growth model, reducing circa 50 million m^3 of logs per annum.[4]

This sentiment can also be seen in traditional forestry hubs such as Eastern Canada where the timber supply has declined as the Government of Québec reduced the annual allowable cut by 20% in the mid-2000s to address historic overharvesting.[5]

Carbon offsetting

Carbon credit schemes have been implemented to drive afforestation and allow industries such as transport and non-renewable energy production a route to offset their emissions.

The International Civil Aviation Organisation (ICAO) Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) requires airline emissions to not exceed 2020 levels.

This has led to the funding of new non-commercial forestry plantations to absorb carbon from the atmosphere as the trees photosynthesise in order to grow. Forestry grown for this purpose will not produce significant quantities of timber but will absorb primary planting resources, thereby reducing supply. The effects of the market for this intangible product are already being felt with corporates such as Shell and British Airways partaking in offsetting schemes, with non commercial forestry interests.

Pests

Pests can cause damage to timber. The amount of available timber from Canada, which has historically provided circa 30-35% of all the lumber used in the US, is expected to decline by 10-15% as a result of a reduction in Canadian timber supply due to mortality associated with the mountain pine beetle.

In central Europe, spruce bark beetle has spread across the dry and hot continental climate due to the warm summers of 2018 and 2019. This has caused water levels in the soil to lower, in turn meaning the trees become stressed and unable to fight off attacks.

As a result, large areas of central European forests are dying off without accessibility for harvesting, meaning supply is likely to be constrained going forward.

Furthermore, in order to combat this issue, the forestry industry is suggesting that the planting of a more diverse mix of slower growing species will inhibit such an outbreak in the future. This will again lead to a lower future supply of quality commercial softwood.[6]

Fire

Increasing wildfires, such as those seen in California and Australia, put downward pressure on commercial timber supply.

In 2017, both the US West Coast and British Columbia interior experienced devastating forest fires, impacting circa 0.8 million ha and 1.2 million ha respectively[7,8], much of it forestry, and in 2019/20, over 6.1 million ha of land has been affected in Australia.[9]

This puts further pressure on the global commercial forestry supply chain.

4. Forest Trends: China's Logging Ban in Natural Forests
5. Quebec Forests: Rigorous and Adaptive Forest Management
6. Natural Resources Canada: Mountain Pine Beetle (fact sheet)
7. Daily Mail - Shocking NOAA interactive map reveals two million acres of land is on fire across the United States
8. CBC News - 2018 now worst fire season on record as BC extends state of emergency (August 2018)
9. SF Chronicle - Those big wildfires in Australia look familiar (January 2020)

Sustainable level of timber production and consumption

The demand and supply dynamics raise the question of how much timber is available to sustainably harvest and consume.

To estimate the amount of available timber under sustainable conditions to 2050, a range of national level data was gathered, estimated, and aggregated in a research paper by the Wuppertal Institute for Climate, Environment and Energy, and the University of Kassel.

This was done in three steps, estimating:

- Forest area available for wood supply (hectares (ha))
- Productivity of that area (cubic metres per hectare and year (m^3))
- Rate at which that forest can be expected to sustainably supply timber (sustainable harvest level)(m^3)

The realistic potential ranges from 3,740 million m^3 to 4,670 million m^3.[1]

Range of 'current' sustainability supply capacities (million m^3)

Share of NAI	Low	Realistic	High
		Global	
100%	2,610	4,670	12,330
90%	2,350	4,210	11,100
80%	2,090	3,740	9,860

Explained overleaf

This includes hardwood wood fuel, which still dominates heating across poorer developing nations. At present, hardwood wood fuel consumption is at circa 1,700 million m^3 which, together with current industrial roundwood consumption, makes 3,729 million m^3.

This implies that global production levels, which are equivalent to primary consumption levels at a global scale, are either close to or around the low end of realistic sustainable supply levels.

Industrial roundwood consumption is expected to reach 5,800 million m^3 by 2050, which together with a constant level of hardwood wood fuel would reach 7,500 million m^3.

Timber consumption is therefore expected to overtake realistic sustainable supply. The move into more inaccessible, harder to reach timber supplies will drive up the cost of timber extraction and support increased global timber prices.

Global sustainable supply range under safe operating space scenario, 2020-2050

1. What Is a Sustainable Level of Timber Consumption in the EU: Toward Global and EU Benchmarks for Sustainable Forest Use Meghan O'Brien and Stefan Bringezu, Wuppertal Institute for Climate, Environment and Energy, 42103 Wuppertal, Germany

Historical production of industrial roundwood (softwood and hardwood), excluding hardwood fuel

	Global production (million m^3)					
Region	**1990**	**1995**	**2000**	**2005**	**2010**	**2015**
North America	600	605	629	633	484	516
Change %		0.82%	3.98%	0.60%	-23.56%	6.66%
Europe	721	453	563	622	594	657
Change %		-37.16%	24.20%	10.44%	-4.42%	10.64%
Central and South America	158	183	200	225	247	264
Change %		15.81%	9.33%	12.27%	9.92%	6.99%
Africa	71	81	85	90	88	93
Change %		13.95%	4.90%	6.90%	-2.25%	4.98%
Asia	392	381	366	375	447	456
Change %		-2.79%	-4.05%	2.32%	19.25%	2.21%
Oceania	35	42	47	50	58	63
Change %		20.99%	12.53%	5.16%	16.40%	10.06%
Total	1,977	1,745	1,890	1,994	1,918	2,050
Change %		-11.73%	8.29%	5.50%	-3.81%	6.92%

Source: FAO Forest Product Statistics 2018

Sustainability supply capacities explained

The High level of forest theoretically available for wood supply comprises all forest area (fast-growing plantations, natural and semi-natural forests) minus forest in protected areas. The Realistic potential estimate distinguishes natural and semi-natural forests from fast-growing plantations. It comprises a best estimate based on literature sources and available data on forests realistically available for wood supply. The Low level is the minimum forest available for wood supply, which comprises a modest estimate based on literature sources and available data.

To determine the global threshold for the sustainable supply of primary timber, the forest area available for wood supply (ha) and the productivity of that area (m^3 ha) were multiplied to determine the volume which could be harvested annually (m^3) under different rates of potential sustainability, e.g. 80%, 90%, and 100% of Net Annual Increment (NAI).

The low potential estimate for forest area was multiplied by the low potential estimate for productivity, the realistic potential estimate for area was multiplied by the realistic potential estimate for productivity, and the high potential estimate for area was multiplied by the high potential estimate for productivity. Thus, the calculated potential ranges depict the minimum and maximum possible supply of timber.

Timber substitution:
Price and income elasticity of demand

Key to analysing any commodity-like product is to analyse elasticity; how demand responds to a change in price and/or income.

The demand elasticity relationship is determined by the prices of substitutes and complements, the income of consumers, and the preferences of consumers.

Studies have shown that the price elasticity of demand for softwood lumber has been inelastic. That is, for a given percent change in price, there is a smaller change in consumption.[1, 2, 3]

These results suggest that lumber demand is inelastic to any price changes in the long run. For other wood products, little research has been published.

Price

The number and quality of wood substitutes varies for two reasons:

First, technological progress leads to new products or improvements in existing products. In either case, more competition results from the increase in the number of available substitutes.

Second, technologically superior commodities render inferior commodities obsolete and over time capture their markets. In effect, the number of practical substitutes declines.

With a reduction in the number of substitutes, the competition for the remaining commodities falls, and a higher price can be supported.

The markets for sawnwood have seen several major innovations:

1. The invention and economic use of steel, aluminium and concrete slab foundations replacing traditional timber building in the late 19th century.
2. The improvement in gluing technology enabling exterior plywood use, started in early 1930s, and then the emergence of OSB and MDF, in the 1960s and 1970s.
3. The emergence of pre-engineered woods, both in terms of CLT and glulam.
4. Modular pre-fabricated factory construction - arguably we are just at the beginning of this.

1. US softwood lumber demand and supply estimation using cointergration in dynamic equations, by Nianfu Song (University of Missouri), Sun Joseph Chang (Louisiana State University) and Francisco Aguilar (University of Missouri), published in the Journal of Forest Economics 2011
2. A Product Diffusion Approach to Modeling Softwood Lumber Demand, Henry Spelter, published by the Society of American Foresters 1985
3. Softwood lumber products from Canada, Us International Trade Commission, Publication 4749, December 2017

Consequently, there have been two general waves in timber use.

Firstly, the substitution of timber with extracted metal and concrete materials, and secondly, the replacement of metals with timber as timber products have advanced.

As a result, wood has spent most of the second half of the 20th Century competing with itself.

OSB, MDF and the emergence of pre-engineered woods has substituted plywood and veneers, shifting some value 'down the log' from sawnwood to smaller roundwood. Wood use for appearance as well as its properties has also kept it inelastic.

CLT and glulam, together with modular housing, are relatively recent innovations whose end products; timber frame skyscrapers and houses, are just coming to market and are expected to replace heavier metals and concrete.

Income

Timber consumption increases with GDP. The correlation globally is 0.50.[4]

Thus, as incomes rise, timber consumption is expected to increase, replacing basic tin, brick and concrete-built houses.

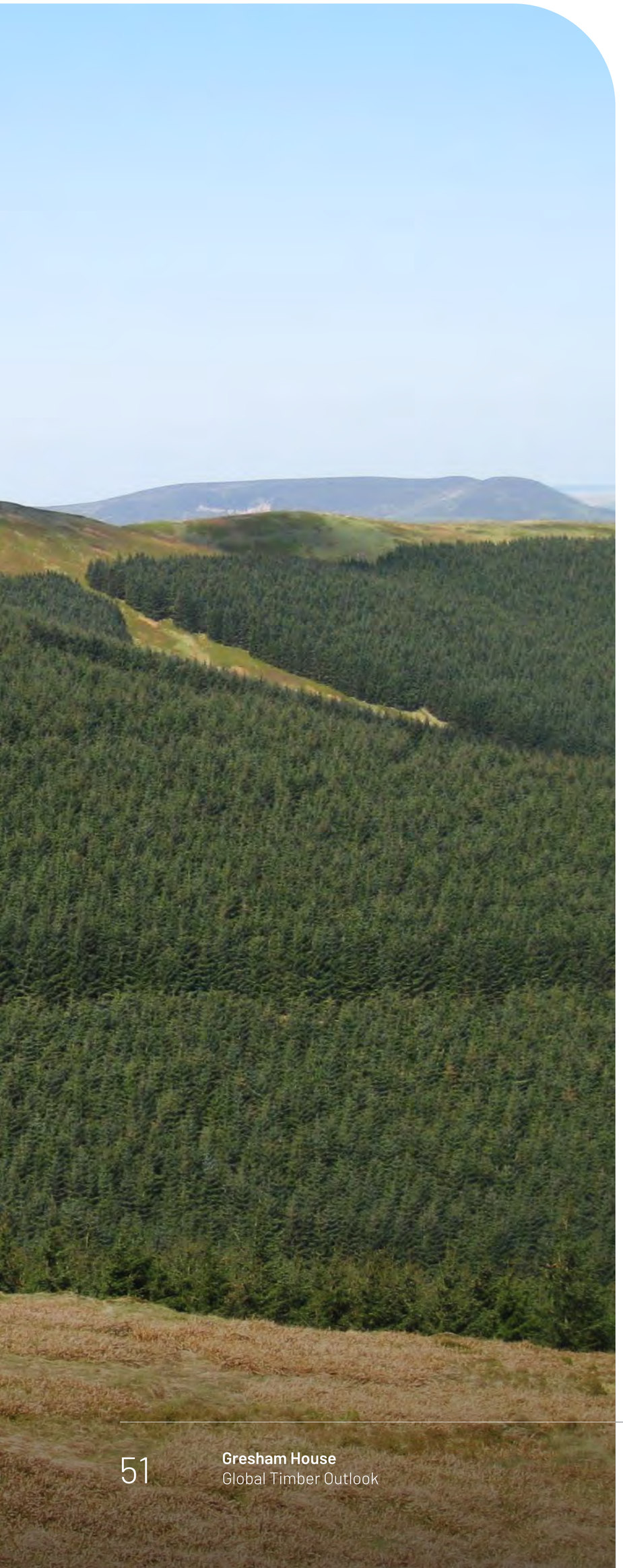
Preference

Most developed countries have mandatory, legislative targets to be completely carbon neutral by 2050 and developing countries are applying increasingly aggressive carbon targets.

High carbon emitting substitutes will no longer be an acceptable alternative, particularly in developed economies.

Carbon reduction will also increase the complementary use of wood; modular pre-fabricated housing and the use of both sawnwood and OSB in greater quantities together.

4. World Bank national accounts data 2019, OECD National Accounts data 2019, FAO Forest Product Statistics 2018



ESG
Classifying green investments

The EU plans to introduce a system for classifying green investments - and this is particularly relevant for asset management firms.[1]

A clear criteria for sustainable investment will be set out, aimed at avoiding greenwashing.

Under these rules, any EU-listed company with more than 500 employees will have to disclose the proportion of its revenues and capital expenditure that is based on environmentally friendly activities.

Fund managers with significant assets under management will also have to calculate how much of their portfolios qualify for the green standard.

Brussels will come up with an eco-label for retail financial products to allow consumers to easily see whether products marketed to them as green are actually sustainable.

It is likely to include renewable technologies and clean energy products such as wind and solar, as well as forestry.

This is expected to further increase the allocation of assets to Environmental, Social, and Governance (ESG) positive assets.

1. How will the EU's system for classifying green investments work - Financial Times December 2019

Forestry...

Certified by FSC and PEFC which ensure timber is harvested and restocked in a sustainable way

Trees absorb and store ('sequester') carbon as they grow, locking it up for their entire product life cycle

Wood products supply a low carbon alternative to mined building materials and the carbon stays locked up in wood products over their lifetime of use

Helps local communities with rural jobs and clean air

Trees have a positive impact on local climate and soils and help prevent flooding

Provides biodiverse rich environments for local wildlife

Provides mental health benefits for local communities

Asset yield compression

In addition to the positive demand–supply dynamics for timber, an increase in alternative investment allocation, especially forestry, is expected to increase asset prices. Forestry asset demand is driven by:

01 The uncorrelated biological growth element behind increasing capital values

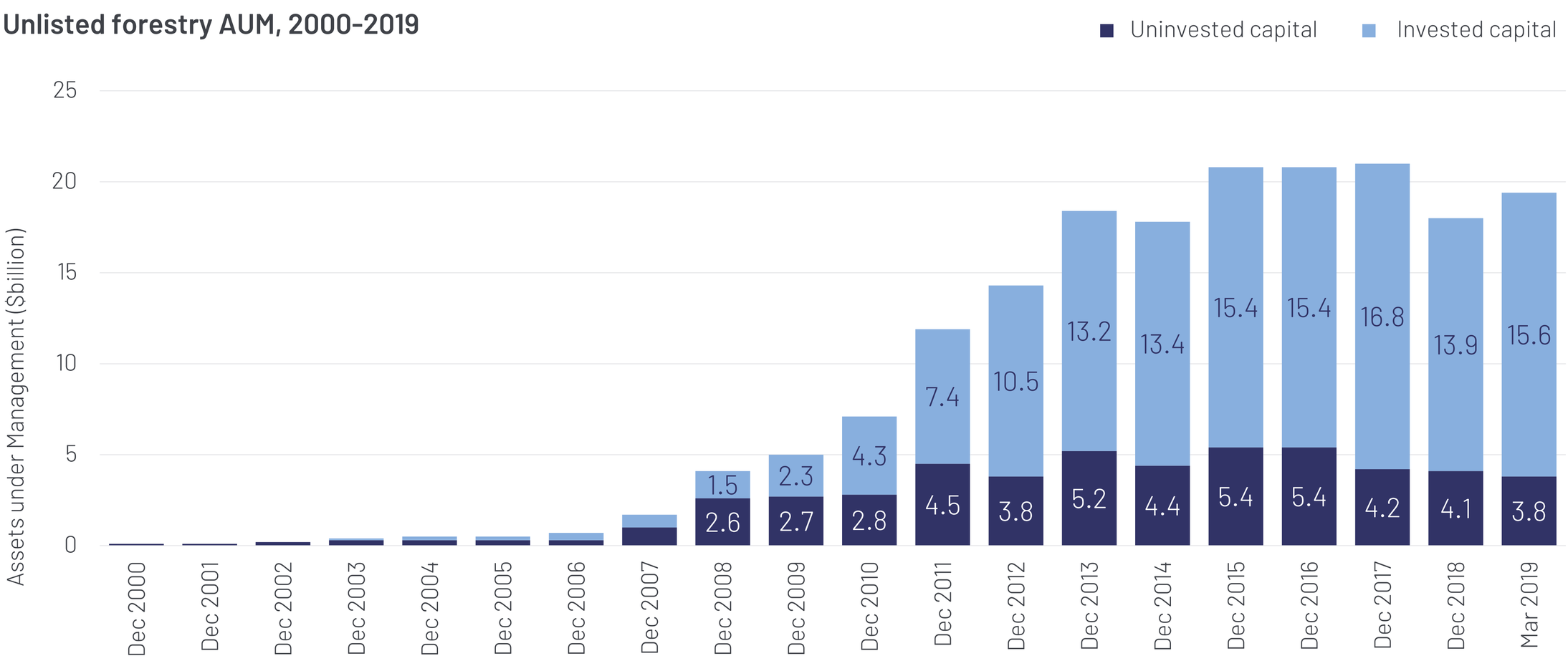
02 The search for diversified income and inflation protection

03 Environmental, Social and Governance (ESG) ambitions

This is expected to lead to a compression in yields over the medium term, further benefiting forestry asset owners.

Forestry assets under management (AUM) has grown significantly over the last decade:

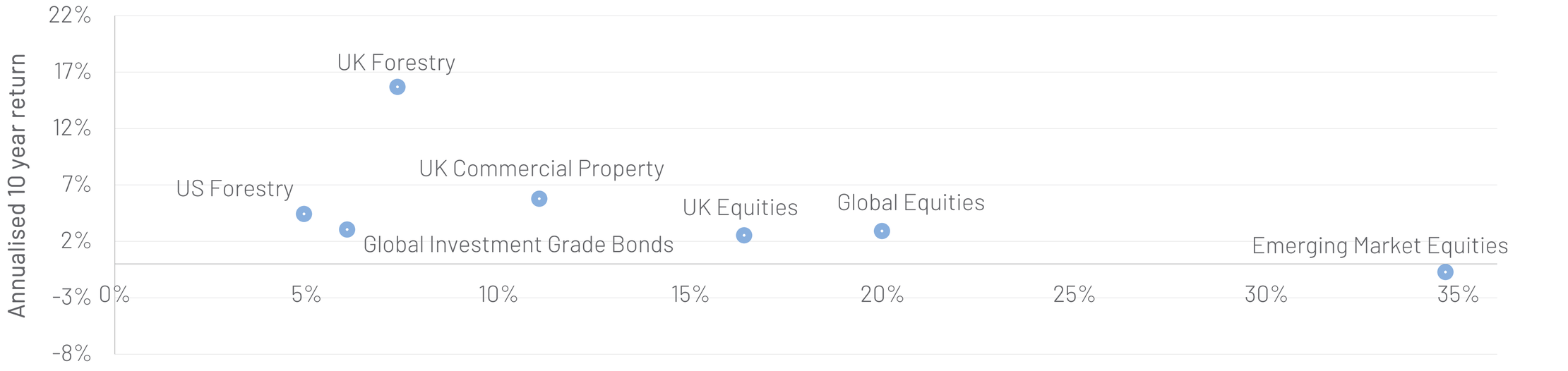
Unlisted forestry AUM, 2000-2019



Source: Preqin Pro. Data as of November 2019

01 The uncorrelated biological growth of timber makes forestry a powerful portfolio diversifier, with a high Sharpe ratio

Return vs Volatility: Ten years (2007 to 2017)

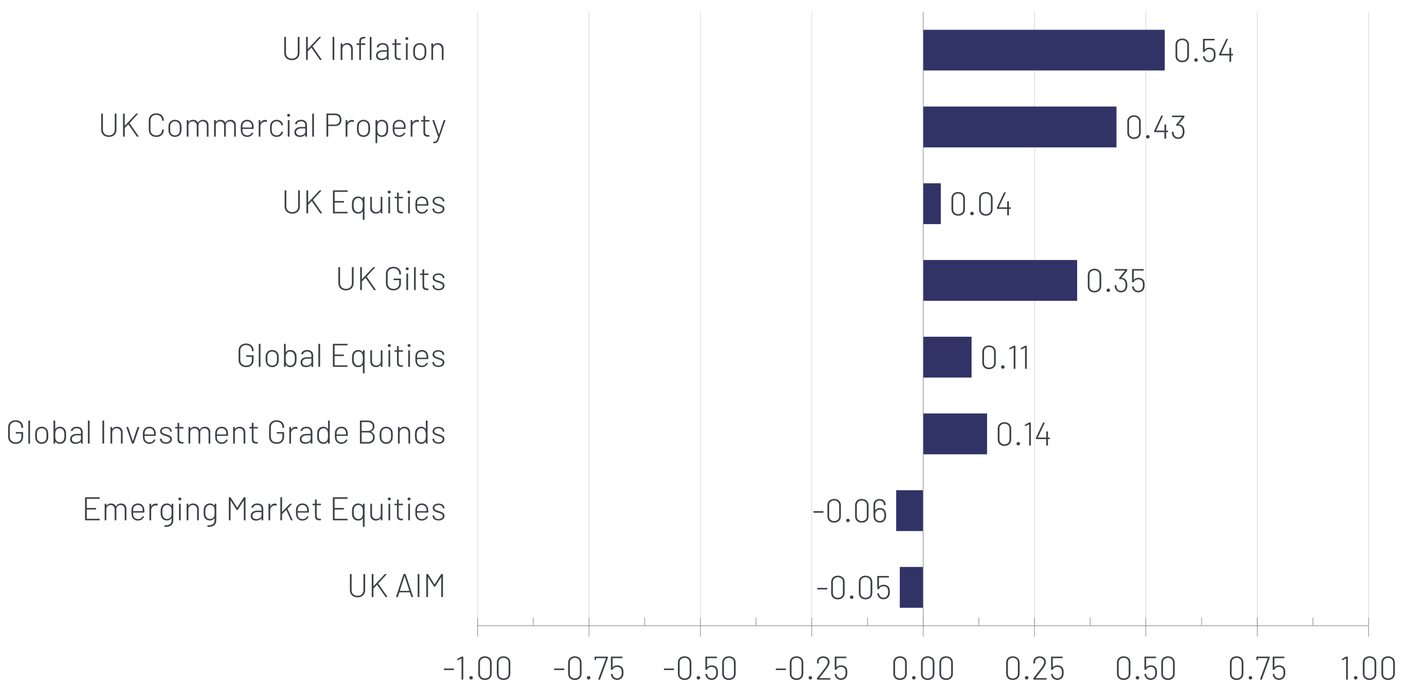


Sources: IPD® UK Annual Forestry Index 2018 - MSCI[1]
https://www.forestresearch.gov.uk/documents/5271/ch8_finance_FS2018.pdf; Gresham House, July 2019

02 Forestry offers diversified income and discretion over when to harvest

Ten-year UK timberland returns correlation coefficients

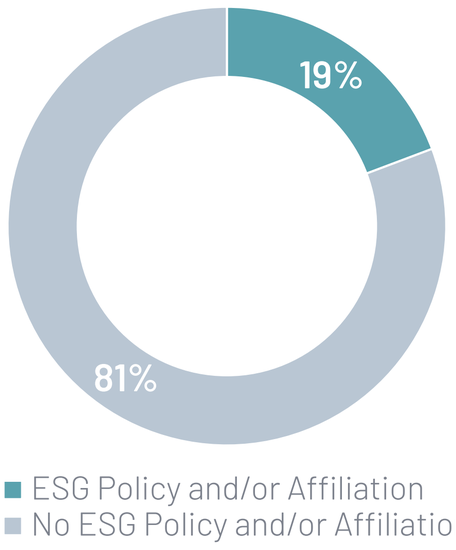
(2007-2017)



Sources: Gresham House, using Bloomberg data. IPD UK Forestry and IPD UK Property Indices, MSCI World / Emerging Markets Indices, FTSE All Share Index, FTSE AIM Index, UK Gilts, UK Inflation, PIMCO Global Bond and NCREIF US Timberland Index. **Past performance is not a reliable indicator of future performance.**

03 ESG targets are driving asset allocation

Proportion of Forestry investors with a confirmed ESG Policy and/or Affiliation



Source: www.unpri.org/investor-tools/forestry

This is expected to continue to increase as ESG concerns become of increasing importance.

The number of Forestry investors globally increased by 58% from November 2016 to November 2019

1. Note the IPD Forestry Index is changing provider and the 2018 and 2019 indices will be available in due course

Conclusion

Gresham House forecasts timber consumption to increase by 3.1% per annum over the next 30 years to 2050, up from 1.1% per annum over the past 20 years.

The world is set to change significantly in the next 30 years. Urbanisation and economic decarbonisation occurring at the same time are forecast to be among the key megatrends between now and 2050. Timber is at the heart of both.

Timber offers a unique way to invest in every part of the new circular clean economy that is set to dominate our lives:

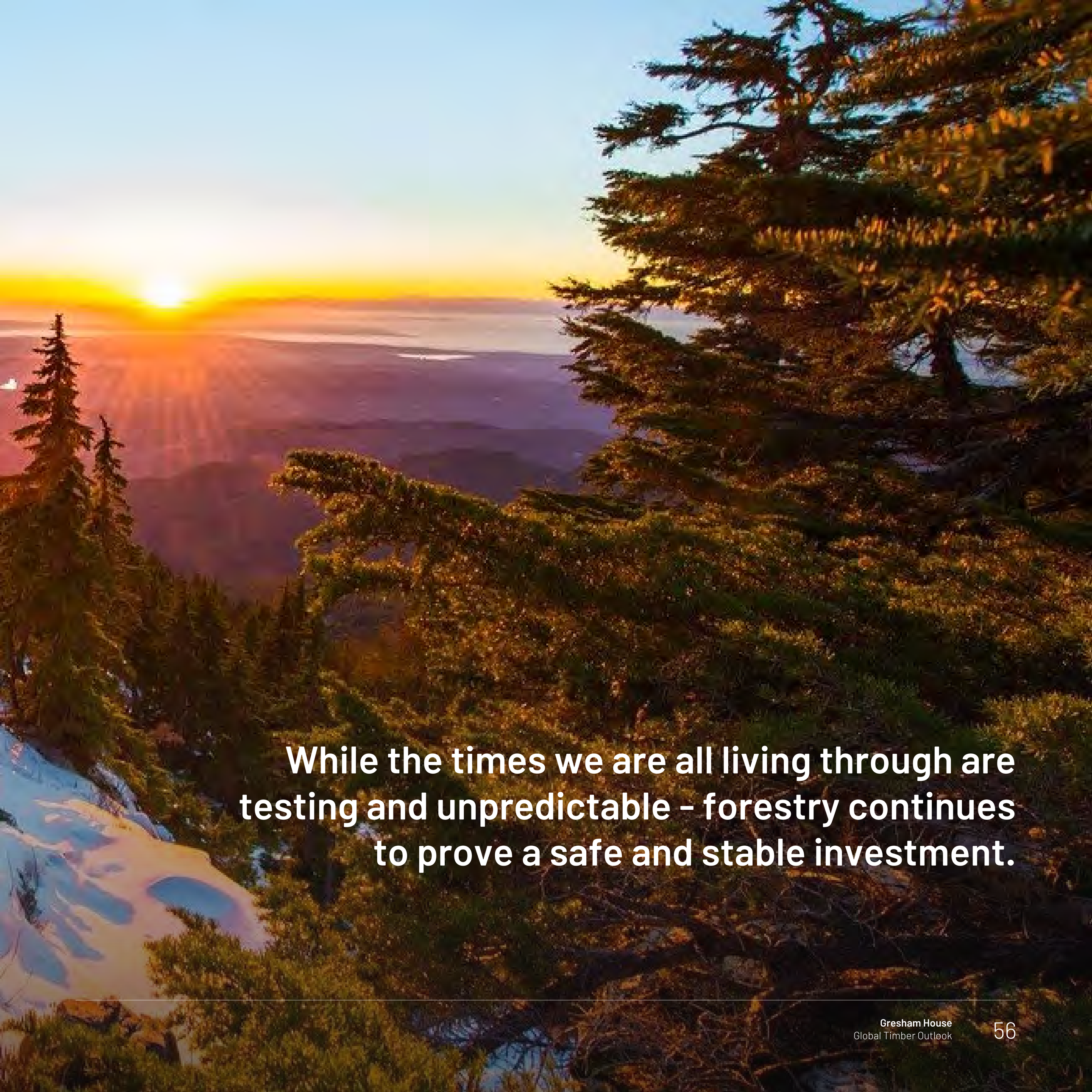
- Wood will increasingly be consumed to build the housing required for a growing urban and suburban global population
- Timber will increasingly be used to build and develop our future in a clean and low carbon way
- A housing affordability crisis will be met with sustained housebuilding levels

Forestry will be coveted as an asset class due to investor focus on ESG, further supporting a sustained increase in forest asset prices.

- Timber provides real income uncorrelated to other major asset classes and underpinned by the biological growth of the trees
- Timber income is positively correlated to inflation, providing a natural inflation hedge
- Forestry is a sustainable real asset class making a positive environmental impact, with trees absorbing carbon as they grow

Set against a constrained supply, timber prices and forest values are predicted to rise between now and 2050, to the benefit of today's forest owners.

There has never been a more relevant time to add forestry to a diversified investment portfolio.



While the times we are all living through are testing and unpredictable - forestry continues to prove a safe and stable investment.

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Izzy leads forestry investment appraisals in the UK and internationally. Prior to joining Gresham House, Izzy worked for over seven years in commercial real estate advisory and equity hedge funds, building out investment teams and executing strategy.

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