Tailwinds hasten hydrogen's cost-competitiveness, but demand is lagging

Jess Williams
Senior Thematic Investment Analyst, Responsible Investment

Natalia Luna
Senior Thematic Investment Analyst, Responsible Investment

Our original research review of the hydrogen economy a few years ago led us to conclude that hydrogen would play a key role in decarbonisation. A key conclusion for us was that where electrification is possible it will be the dominant technology, and that hydrogen will help fill some of the carbon-intensive gaps that electrification cannot reach. Key areas of opportunity in our view are fertilisers, steel production, aviation, long-term seasonal energy storage and heavy-duty trucks.

To continue to effectively monitor the progress and potential of the hydrogen economy in the future, we think there are three main catalysts to look out for: policy, cost declines and infrastructure development (Figure 1), which we will now address.

Policy

More and more countries are adopting hydrogen strategies, with recent examples being the EU, the US and China. The global energy crisis has further bolstered momentum for the fuel because, apart from the decarbonisation angle, energy security has brought an exponential boost to hydrogen due to a desire to reduce dependence on gas.

The US has the most aggressive long-term target to reduce hydrogen cost production down to $2/kg by 2025 and $1/kg by 2030.[1] This commitment has been demonstrated by the introduction of the Inflation Reduction Act (IRA), which we think represents a game-changer for the development of green hydrogen (see the article "US Inflation Reduction Act: a strong force to accelerate energy

Figure 1: catalysts for conversion to hydrogen

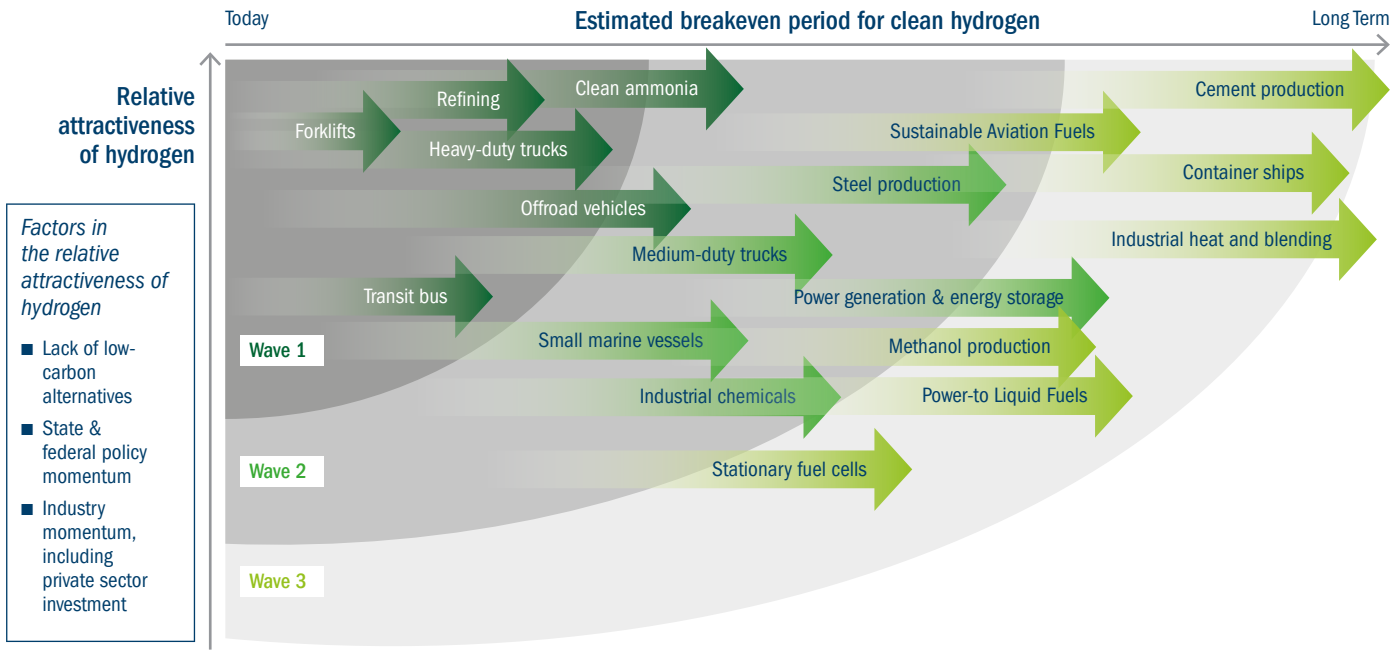
Policy	■ Continued policy development in alignment with Net zero ■ Hydrogen specific policies at national/regional level ■ Higher carbon prices to make hydrogen more cost competitive
Cost Declines	■ Technology advances to increase efficiency and bring costs down ■ Renewables scale up and cost declines
Infrastructure Development	■ On both the demand and supply side

transition technologies" elsewhere in this report). The IRA,[2] passed in August, includes a $3/kg tax credit for green hydrogen, which could effectively bring the cost down to the target and make it cost-competitive with grey (hydrogen produced with natural gas) and blue (grey with carbon capture) earlier than expected. In addition, a hydrogen project can benefit from tax credits applicable to renewables – investment tax credits and production tax credits for solar and wind – thus potentially resulting in a meaningful total tax support for a full hydrogen project.

In September, the US Department of Energy (DOE) released a draft of its Hydrogen Strategy and Roadmap[3] under which $9.5 billion will be deployed, mostly to develop hydrogen hubs and regional networks. The strategy also reflects the adoption of hydrogen by different industrial segments in waves over the next few decades: the first by 2030 will include oil refining and ammonia production where hydrogen is already being used as a feedstock, and heavy transport with the scale of fuel cells; the second will be applications such as steel making, sustainable aviation and shipping, which we view as sensible given the different level of complexity required to make hydrogen scalable and commercially available across sectors; and finally the third wave which will include container ships and cement production (Figure 2).

In the EU, the European Commission presented its Repower Package[4] in March, designed to ensure energy independence and security from Russia. The plan also includes substantial support for green hydrogen and an increase in its

Figure 2: hydrogen adoption projections



Source: US Department of Energy, Draft Hydrogen Strategy, 2022.

hydrogen capacity targets by four times. The most important element is the proposal of hydrogen-specific contracts for difference (CfD), which will provide subsidies worth 100% of the additional cost of using green hydrogen over fossil fuel alternatives. This should enable more hydrogen producers to make a final investment decision by 2023 when the next round of contracts are available.

Furthermore, the EU announced funding amounting to €5.2 billion for an array of hydrogen infrastructure projects which will involve the construction of large-scale electrolysers and production, storage and transport infrastructure, as well as plans for a €3 billion Hydrogen Bank[5] intended to "guarantee" purchases of hydrogen to create certainty of demand.

All these policies represent a major support for the development of hydrogen. We think the key milestone to look out for is rules for faster permitting for renewables, because in order to scale hydrogen a major increase and acceleration in renewable capacity will be needed.

Nonetheless, we note that policies in the EU and the US are focusing mainly on the supply side, and there is still not enough policy for creating hydrogen demand which is critical for project developers to secure financing.

We think more regulatory initiatives such as creating mandates, imposing quotas and proposing incentives for end-use sectors are needed to bolster the adoption of green hydrogen.

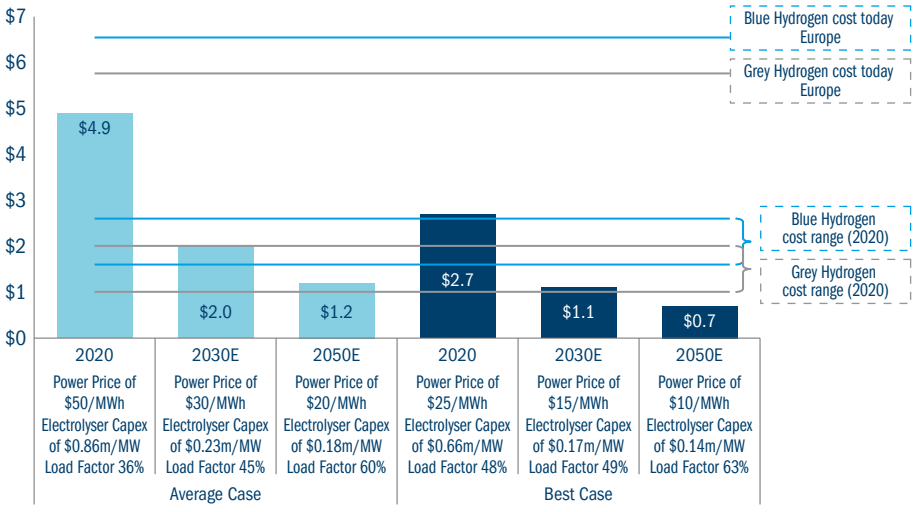
China also released its Hydrogen Industry Development Plan this year. The country represents 30% of global hydrogen demand[6] and as such could have a powerful impact on the development of hydrogen projects in the coming decade, particularly in electrolysers and fuel cells given its current domination of those sectors.

Cost declines

The cost of producing green hydrogen is mainly driven by the cost of electricity (accounting for around 70% of the total cost) and of electrolysers (around 30%).[7] Both these inputs are on a downward trend: the cost of renewable energy has declined substantially, with solar down 80% and wind down 60% versus 2010,[8] which has lowered operating expenses; and electrolysers continue to become cheaper, lowering the capital expenditure needs for green hydrogen.

Data from BNEF (Bloomberg New Energy Finance), a strategic research provider on the future of the energy

Figure 3: levelised cost of hydrogen ($/kg hydrogen) – average and best-case scenario



Source: Bernstein, Hydrogen Highway 2022.

economy, shows that unsubsidised green hydrogen costs declined from $4.5/kg in 2019 to $3.81/kg in 2022, and predicted further declines to $1.15/kg in 2030.[9]

The International Energy Agency (IEA) estimates that costs for electrolysers could fall substantially, achieving learning rates between 7% and 18%. Given the current pipeline of projects, this could reduce the capital cost of electrolysers by around 70% by 2030. Combined with the expected drop in the cost of renewable energy, this could bring the cost of hydrogen to around $1.3-$4.5/kg, with regions with good access to renewable energy – for example, southern Europe, the Middle East and Australia – at the lower end of this estimate.[10]

Where does this leave blue and grey hydrogen? Low emission hydrogen production coupled with carbon capture usage and storage (CCUS) is increasing in Europe, particularly in the UK and the Netherlands. However, the competitiveness of blue hydrogen hinges on the availability of relatively low-cost gas, which is currently challenged by high prices in the EU. We think the current energy crisis could lead to structurally higher gas prices while at the same time lower the cost of renewables, which could question the future of blue hydrogen (Figure 3).

In terms of grey hydrogen, those same abnormally high gas prices are making grey around three times as expensive as it was in 2020.[11] As a result, green hydrogen is today the cheapest option in many countries, particularly in Europe. If we had the required electrolysers and renewables capacity to produce it now, green would be the most competitive form of hydrogen. We think this is a major development that could incentivise end-users to start considering using green hydrogen earlier than envisaged.

Infrastructure

The pipeline of hydrogen projects continues to grow, but actual deployment is lagging. So far, 680 large-scale project proposals worth $240 billion have been put forward, but only about 10% have reached a final investment decision, according to the Hydrogen Council[12] (Figure 4).

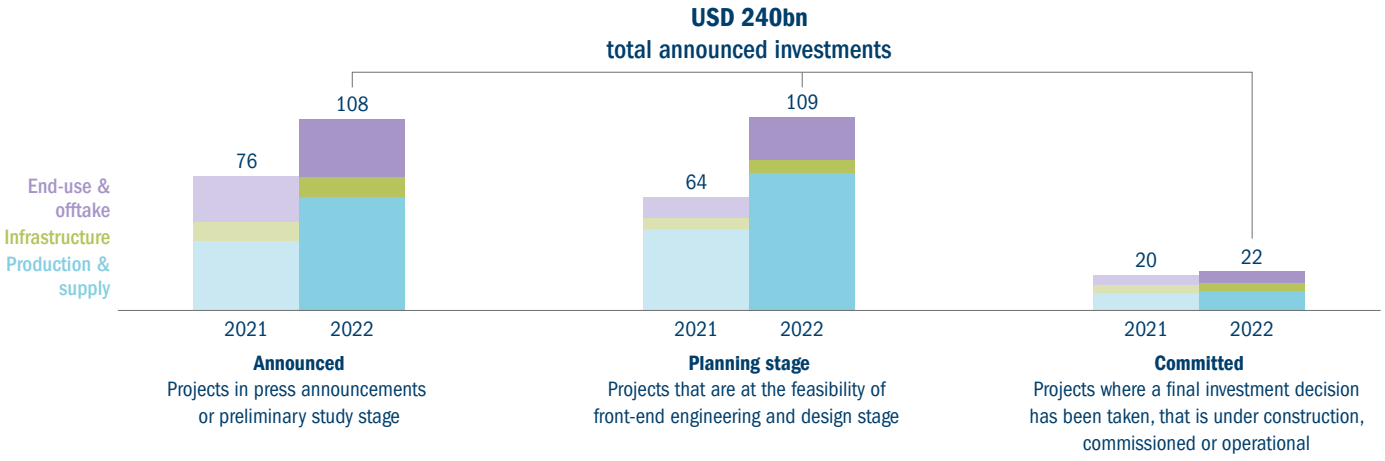
Most announced end-use investments target traditional applications such as oil refining and ammonia where hydrogen is already used. The number of announced industrial projects, such as steel making and mobility, continues to grow, most of which are supported by high carbon prices and strong decarbonisation policies.

For the transport sector, the main feasible application is heavy-duty vehicles. The largest market for fuel cell trucks and buses is currently China,[13] which accounts for most of the sales in this area, though the market remains very small.

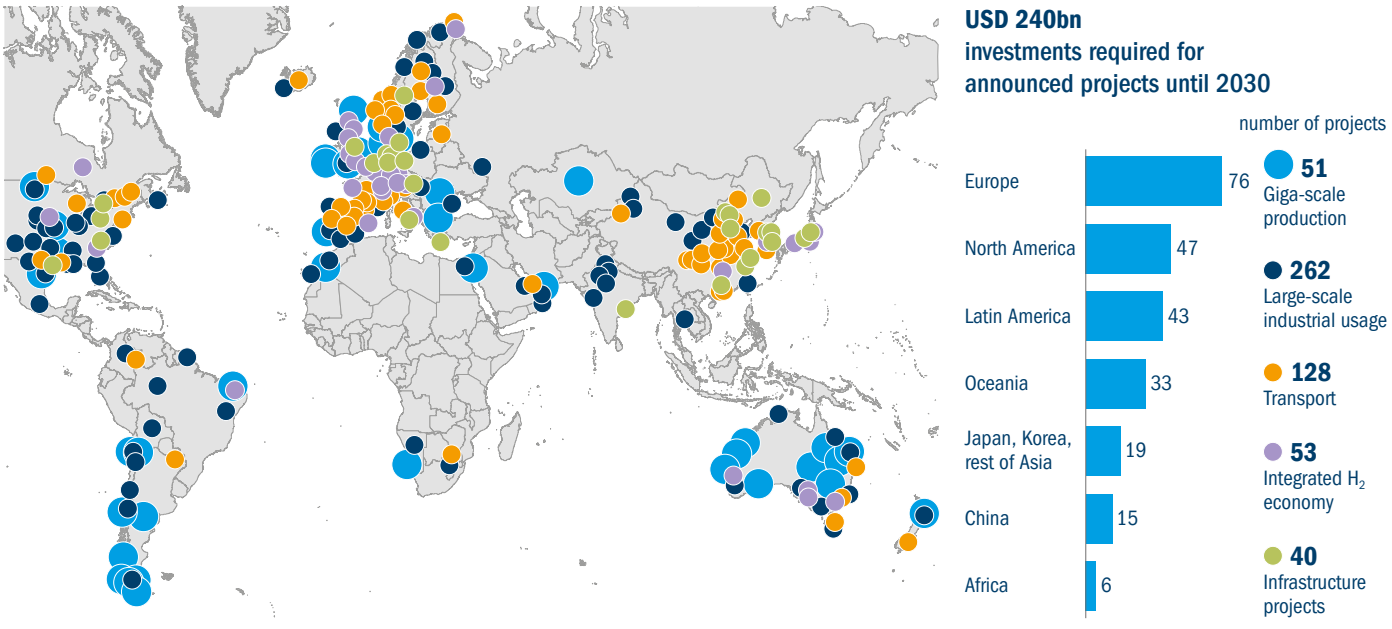
On the other hand, we think fertilisers could become a sector adding demand for hydrogen in the future. With the price of fertilisers heavily influenced by the price of gas, and with Ukraine and Russia being key producers,[14] the cost of these inputs has rocketed this year, highlighting the need for more diversified production.

An illustration of this potential trend is a recently announced partnership between Total Energies and Adani who will manufacture green hydrogen in India for use in fertilisers,[15] among other things. With India being one of the top fertiliser importers, this partnership takes advantage of a clear opportunity for green hydrogen.

Figure 4: hydrogen pipeline projects



Source: Hydrogen Council, 2022.



Source: Hydrogen Council.

Conclusion

Since last year there have been material policies implemented to accelerate the development of green hydrogen, and we see this regulatory support as the most important catalyst to accelerate this market over the coming years.

In addition, the energy crisis has made green hydrogen the cheapest option versus fossil fuel alternatives in many places. This, coupled with expected rapid cost declines fueled by innovation and scale coming from electrolysers and renewables, have improved the cost competitiveness of green hydrogen hugely. The expectation of lower costs might reduce demand for hydrogen as end-users could decide to wait a few years until prices become more competitive. This could be offset by the need to deliver on companies' net zero targets, particularly in the EU where there is higher scrutiny by investors and consumers on this front. Nevertheless, this lack of demand visibility is often mentioned as a key barrier that project developers face in unlocking the long-term funding for long-term hydrogen projects.

Despite this positive progress and strong momentum there remain challenges and hurdles to overcome. We see the lack of policies that encourage demand, particularly in key industrial sectors, as a weakness that must be overcome if we are to stimulate the necessary investments in infrastructure and innovation to scale and make green hydrogen commercially available.

With many projects not coming into fruition until 2025/30 or so, we believe more near-term investment opportunities can be found in renewable energy developers, integrated players along the clean hydrogen supply chain, and in leading electrolyser suppliers.

1 Senate.gov, Summary of the Energy Security and Climate Change Investments in the Inflation Reduction Act of 2022, August 2022.
2 https://www.energy.gov/lpo/inflation-reduction-act-2022
3 Bloomberg Law, White House Launches 'Generational' $7 Billion Hydrogen Plan (1), 2022.
4 European Commission, REPowerEU: affordable, secure and sustainable energy for Europe, 2022.
5 European Commission, State Aid: Commission approves up to €5.2 billion of public support by thirteen Member States for the second Important Project of Common European Interest in the hydrogen value chain, 21 September 2022.
6 IEA, Hydrogen Global Review, 2022.
7 Bernstein, Hydrogen Highway 2022.
8 IEA, World Energy Investment, 2022.
9 BloombergNEF, 1H2022 Hydrogen Levelized cost update, 2022.
10 IEA, Hydrogen Global Review, 2022.
11 BloombergNEF, 1H2022 Hydrogen Levelised cost update, July 2022.
12 Hydrogen Council, Hydrogen Insights 2022.
13 BNEF, Hydrogen Market Outlook.
14 Russia exports 11% of the world's urea, and 48% of the ammonium nitrate. Russia and Ukraine together export 28% of fertilisers made from nitrogen and phosphorous, as well as potassium, according to Morgan Stanley.
15 Energy Voice, TotalEnergies, Adani team up for multi-billion dollar Indian hydrogen plans, 15 June 2022.

Energy transition engagement:
Green hydrogen

Company

Air Liquide

Sector and country

Industrial Gas, France

Why we engaged

We wanted to get better insight on the investment and growth plans around hydrogen and, more broadly, energy transition technologies. We also sought an update on progress towards net zero targets.

How we engaged

A call with the CEO was organised by a portfolio manager and the RI analyst. This was attended by other portfolio managers.

What we learnt

The company continues to make improvement in its climate targets without having any negative impact on their financials. It is well positioned to increase its exposure on hydrogen and is part of numerous hydrogen projects in the EU. The company is focused on providing a full range of products to its customers that add value across the value chain of the energy transition, from carbon capture projects and uses of carbon capture, to green hydrogen production etc.

Outcome

The call provided valuable insight on how the company is enabling different energy transition technologies and maximising the growing opportunities.

Content originally appeared in Responsible Investment Quarterly Q3 2022

To find out more, visit **columbiathreadneedle.com**

COLUMBIA THREADNEEDLE INVESTMENTS

Important information:

For use by professional clients and/or equivalent investor types in your jurisdiction (not to be used with or passed on to retail clients). This is an advertising document. This document is intended for informational purposes only and should not be considered representative of any particular investment. This should not be considered an offer or solicitation to buy or sell any securities or other financial instruments, or to provide investment advice or services.

Investing involves risk including the risk of loss of principal. Your capital is at risk. Market risk may affect a single issuer, sector of the economy, industry or the market as a whole. The value of investments is not guaranteed, and therefore an investor may not get back the amount invested. International investing involves certain risks and volatility due to potential political, economic or currency fluctuations and different financial and accounting standards. Risks are enhanced for emerging market issuers.

The securities included herein are for illustrative purposes only, subject to change and should not be construed as a recommendation to buy or sell. Securities discussed may or may not prove profitable. The views expressed are as of the date given, may change as market or other conditions change and may differ from views expressed by other Columbia Threadneedle Investments (Columbia Threadneedle) associates or affiliates. Actual investments or investment decisions made by Columbia Threadneedle and its affiliates, whether for its own account or on behalf of clients, may not necessarily reflect the views expressed. This information is not intended to provide investment advice and does not take into consideration individual investor circumstances. Investment decisions should always be made based on an investor's specific financial needs, objectives, goals, time horizon and risk tolerance. Asset classes described may not be appropriate for all investors. **Past performance does not guarantee future results, and no forecast should be considered a guarantee either.**

Information and opinions provided by third parties have been obtained from sources believed to be reliable, but accuracy and completeness cannot be guaranteed. This is an advertising document. This document and its contents have not been reviewed by any regulatory authority.

In Australia: Issued by Threadneedle Investments Singapore (Pte.) Limited ["TIS"], ARBN 600 027 414. TIS is exempt from the requirement to hold an Australian financial services licence under the Corporations Act 2001 (Cth) and relies on Class Order 03/1102 in respect of the financial services it provides to wholesale clients in Australia. This document should only be distributed in Australia to "wholesale clients" as defined in Section 761G of the Corporations Act. TIS is regulated in Singapore (Registration number: 201101559W) by the Monetary Authority of Singapore under the Securities and Futures Act (Chapter 289), which differ from Australian laws.

In Singapore: Issued by Threadneedle Investments Singapore (Pte.) Limited, 3 Killiney Road, #07-07, Winsland House 1, Singapore 239519, which is regulated in Singapore by the Monetary Authority of Singapore under the Securities and Futures Act (Chapter 289). Registration number: 201101559W. This advertisement has not been reviewed by the Monetary Authority of Singapore.

In Hong Kong: Issued by Threadneedle Portfolio Services Hong Kong Limited 天利投資管理香港有限公司. Unit 3004, Two Exchange Square, 8 Connaught Place, Hong Kong, which is licensed by the Securities and Futures Commission ("SFC") to conduct Type 1 regulated activities (CE:AQA779). Registered in Hong Kong under the Companies Ordinance (Chapter 622), No. 1173058.

In Japan: Issued by Columbia Threadneedle Investments Japan Co., Ltd. Financial Instruments Business Operator, The Director-General of Kanto Local Finance Bureau (FIBO) No.3281, and a member of Japan Investment Advisers Association and Type II Financial Instruments Firms Association.

In the USA: Investment products offered through Columbia Management Investment Distributors, Inc., member FINRA. Advisory services provided by Columbia Management Investment Advisers, LLC.

In the UK: Issued by Threadneedle Asset Management Limited. Registered in England and Wales, Registered No. 573204, Cannon Place, 78 Cannon Street, London EC4N 6AG, United Kingdom. Authorised and regulated in the UK by the Financial Conduct Authority.

In the EEA: Issued by Threadneedle Management Luxembourg S.A. Registered with the Registre de Commerce et des Societes (Luxembourg), Registered No. B 110242, 44, rue de la Vallée, L-2661 Luxembourg, Grand Duchy of Luxembourg.

In Switzerland: Issued by Threadneedle Portfolio Services AG, Registered address: Claridenstrasse 41, 8002 Zurich, Switzerland.

In the Middle East: This document is distributed by Columbia Threadneedle Investments (ME) Limited, which is regulated by the Dubai Financial Services Authority (DFSA). For Distributors: This document is intended to provide distributors' with information about Group products and services and is not for further distribution. For Institutional Clients: The information in this document is not intended as financial advice and is only intended for persons with appropriate investment knowledge and who meet the regulatory criteria to be classified as a Professional Client or Market Counterparties and no other Person should act upon it.

Columbia Threadneedle Investments is the global brand name of the Columbia and Threadneedle group of companies.