

FinTech Research & Innovation Roadmap 2022-31



Foreword

This FinTech Research and Innovation Roadmap is a pioneering document. It provides a practical pathway to accelerate the development of FinTech excellence, and to embrace opportunities across the financial services industry and the broader economy in Scotland and the UK.

This Roadmap aligns with the recommendations I set out in the *Review of UK Fintech* in February 2021, and supports our national ambition to encourage growth by creating the right conditions for innovation.

FinTech, the new application of technologies to financial services and products, is already transforming the way that people, communities, and businesses engage with money and finance creating opportunities through sustainable and inclusive innovations which will positively impact the economy. For example, helping to address environmental change; the prevention of fraud; better personal choices in managing money and investments; eliminating financial exclusion; and much else.

All will improve people's lives and the wider digital-enabled economy and so it is critically important that FinTech continues to grow across the UK to secure sustainable economic growth, increase skilled employment, achieve levelling up ambitions, and maintain the UK's position as a leader in the global economy.

Globally, FinTech is evolving rapidly as technology and data capabilities enable innovation at scale. This permanent, technological revolution is giving rise to FinTech-enabled economies around the world that are presenting competition to the standing of the UK's financial services.

The UK can rise to this challenge thanks to its respected and robust financial services industry, its innovative and entrepreneurial tech sector and respected regulators and business laws.

These have enabled record levels of investment in FinTech and this progress could be accelerated by unleashing collaborative innovation and research opportunities as seen in other industries, such as pharmaceuticals and engineering.

This will enable the UK to maintain its coveted status as a world-leading financial centre, as well as adapt to a post-Brexit and post-Covid-19 environment.

For this to be achieved, a more strategic and systematic approach to FinTech research and innovation is required which drives cross- industry collaboration, inclusive citizen participation, and academic engagement across the UK.

Hence the important role of this Roadmap as a FinTech leadership framework and a tool for FinTech Scotland providing a valuable action-orientated foundation to ensure that the opportunities are embraced. It can also act as a template to support the development of FinTech research and innovation across all UK regions.

Recommendations in my *Review of UK Fintech* included increasing research and development investment in FinTech innovation to further accelerate the development of FinTech cluster excellence.



I believe that this Roadmap can act as a stimulus for purposeful collaboration in UK wide FinTech, and I am excited to see the positive impact of this work in the coming years.

Ron Kalifa OBE

FinTech Scotland's 10 year FinTech Research and Innovation Roadmap

Creating environmental, economic and societal value through FinTech research and innovation

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Report authored by Nicola Anderson, Stephen Ingledeu, FinTech Scotland, and Whitecap Consulting.

Nicola Anderson, Chief Executive, FinTech Scotland

Nicola Anderson is a business leader experienced across multiple sectors supporting innovation, business development, strategy, understanding financial regulation. Prior to joining FinTech Scotland, she was a senior leader at the FCA working within Retail Banking Supervision, including contributing to solutions addressing complex industry issues following the 2008 financial crisis, engaging with executives on significant business transformation changes. Nicola's business experience spans start-ups, growth, and maturity through to global corporates. Her sectoral experience includes financial services, retail, hospitality, and the food and drink industries. Nicola is a member of the Scottish Government's Financial Services Growth and Development Board and its Taskforce for Green and Sustainable Finance.



Stephen Ingledeu, Executive Chairman, FinTech Scotland

Stephen Ingledeu led FinTech Scotland since its formation in 2018, initially as Chief Executive, to become recognised as one of Europe's top financial technology (FinTech) economic cluster bodies. Over four decades he has earned a track record and reputation for leading the implementation of customer-focused, technology-enabled initiatives in a wide range of financial organisations, including executive leadership roles with large institutions such as Standard Life and Barclays as well as several early-stage innovative enterprises. Stephen is also Member of the UK Government's Business Innovation Group, focused on the role of innovation improving productivity across all sectors of the economy, as well as co-chair of the Scottish Government Tech Ecosystem Advisory Board.



Executive summary

FinTech is driving change in one of the most important parts of our economy. It presents a significant disruptive force in financial services, and will shape the future of the digital economy. It has the potential to radically change the way people and businesses engage with money, and to create a new financial system that is more effective and resilient.

This Roadmap has been developed as an industry-led and action-focused tool to increase the positive impact of FinTech innovation across Scotland and the UK. It creates a framework and an environment to drive greater collaboration, and to build the connections that will enable responsible innovation for the future of finance.

It builds on the R&I foundations that are already established through the FinTech Scotland cluster, and sets out the cross-sectoral strategic priorities that – through collective and collaborative action – will shape the future of financial services, and enable Scotland and the UK to further advance FinTech innovation.

The financial services industry contributes £132 billion to the UK economy – almost 7% of total economic output. It is an essential part of the full UK economy that enables prosperous outcomes for businesses and people across the UK. Its significance was highlighted by the Chancellor of the Exchequer in the recent HM Treasury report 'A new chapter for Financial Services'.

Working with others across the economy, his vision is for “an agile and dynamic approach, one which enables those in the financial services industry to evolve and thrive as they embrace the new opportunities of the future.”

Research and innovation play a key role in this vision. However, financial services and FinTech have, compared to other industries, generally not been aligned with the academic research communities. Recent analysis highlighted that research funding into these fields is as low as 3% of total UK funding¹ for research and innovation.

In addition, there is a general acknowledgement in financial services, FinTech, and the academic community that current engagement has had a relatively narrow focus. The result is limited exploration of research and innovation.

As a result an important part of the economy is not fulfilling its full potential.

Scotland and the UK economy will benefit by closing the gap between the economic productivity of UK financial services and the current scale of UKRI investment in FinTech and financial services R&I. Now is the time for more strategic and systematic collaboration. This is needed to develop the necessary FinTech innovation between the range of stakeholders.

“Our FinTech sector is a global success story, with record levels of investment over the last year. The Government is committed to supporting UK FinTech as it goes from strength to strength, including by ensuring we draw on the huge amounts of knowledge and expertise across all of the UK. So it is great to see the initiative taken by FinTech Scotland in developing this new industry-led tool, and I look forward to seeing how the Roadmap develops”

John Glen, Economic Secretary to the Treasury and City Minister, UK Government

“Scotland is one of the best places in Europe to start and grow a FinTech firm. The financial services sector is a bedrock of our economy and is constantly adapting to meet customer expectations and capitalise on emerging opportunities. I am delighted to see the industry focusing on research and innovation as we move forward with Scotland’s economic, social and environmental transformation. This Roadmap sets ambitious targets for sectoral growth and job creation, building on the wealth of talent and innovation that exists across the wider tech ecosystem in Scotland.”

Kate Forbes, Scottish Government Finance Secretary

¹<https://www.ukri.org/opportunity/build-research-communities-with-the-uk-financial-services-sector>

It should be driven by a true desire for effective change, and by an industry-first 'real-world' approach to the challenges ahead.

Our initial work on the Roadmap started in 2020, following FinTech Scotland's formal accreditation as a cluster of excellence.² This process confirmed the significance of R&I in cluster development, and the Roadmap builds on the positive progress already made. However, our experience at FinTech Scotland highlights that there need to be more practical ways to build connections between the different communities: FinTech, financial services and research.

This work also supports the strategic HM Treasury *Review of UK Fintech* led by Ron Kalifa OBE. It recognises the value of collaboration, and the leadership that is needed to create the right conditions for FinTech to innovate, accelerate and grow.

In undertaking this work, we engaged extensively across the FinTech Scotland cluster and wider financial services industry. We found a universal recognition of the importance of making better use of expertise, creating the necessary interventions, and developing more collaborative methodologies to influence effective innovation.

The result is a Roadmap driven by industry-led analysis, which highlights priorities for FinTech research and innovation, and builds on FinTech Scotland's January 2021 report on Research and Innovation for UK FinTech.

The Roadmap acts as a foundation to progress specific FinTech innovation with stakeholders. It has four priority themes, which were consistently prioritised by FinTech companies, financial institutions and regulators.

The priority themes form the building blocks of this Roadmap.

They are:

1. Open Finance data
2. Climate Finance
3. Payments and transactions
4. Financial regulation

Research methods used to generate insight:

Stakeholder insight

- 60+ deep dive interviews with Financial Services and FinTech stakeholders alongside many broader consultations.
- 5 external workshops with key stakeholder groups.
- In-depth online survey, with 37 respondents.

Desk Research & Analysis

- Ecosystem analysis of pure FinTech firms in Scotland (statistical analysis of 110+ firms).
- Analysis across 9 research areas in the global, UK and Scotland contexts.
- Discovery and analysis of unmet environmental, economic and societal needs - relating to 9 research areas (117 potential individual FinTech unmet needs, clustered in to 45 overarching problems).
- Linking of unmet needs to R&I opportunities.
- Over 50 intervention or research project scopes identified as Scotland's strategic priorities, including principal strategic bets relating to 4 core themes.
- High level analysis of university courses relating to the 9 research areas (177 courses).
- Categorisation of FCA sandbox participants to date, by the 9 research themes (188 participants).
- Analysis of 60 incubators / accelerators / hubs in Scotland.

²2020. European Secretariat for Cluster Analysis (ESCA)

Actions will be progressed through two key types of activity.

1. Unleashing Innovation

A series of Open Innovation Calls, using technologies and data to develop new and improved financial products and models.

2. Actionable Research

Research, using technologies and data to create actionable insights that can be applied commercially using FinTech.

The actions will be delivered through collaboration. In particular, working across:

- The FinTech Scotland Cluster
- Universities
- The Smart Data Foundry
- The UK FinTech National Network
- UKRI
- UK regulators

Twice a year, the FinTech Scotland Cluster Management Board will measure and review the Roadmap's progress of the Roadmap. This will be reported publicly to stakeholders in Scotland and the UK.

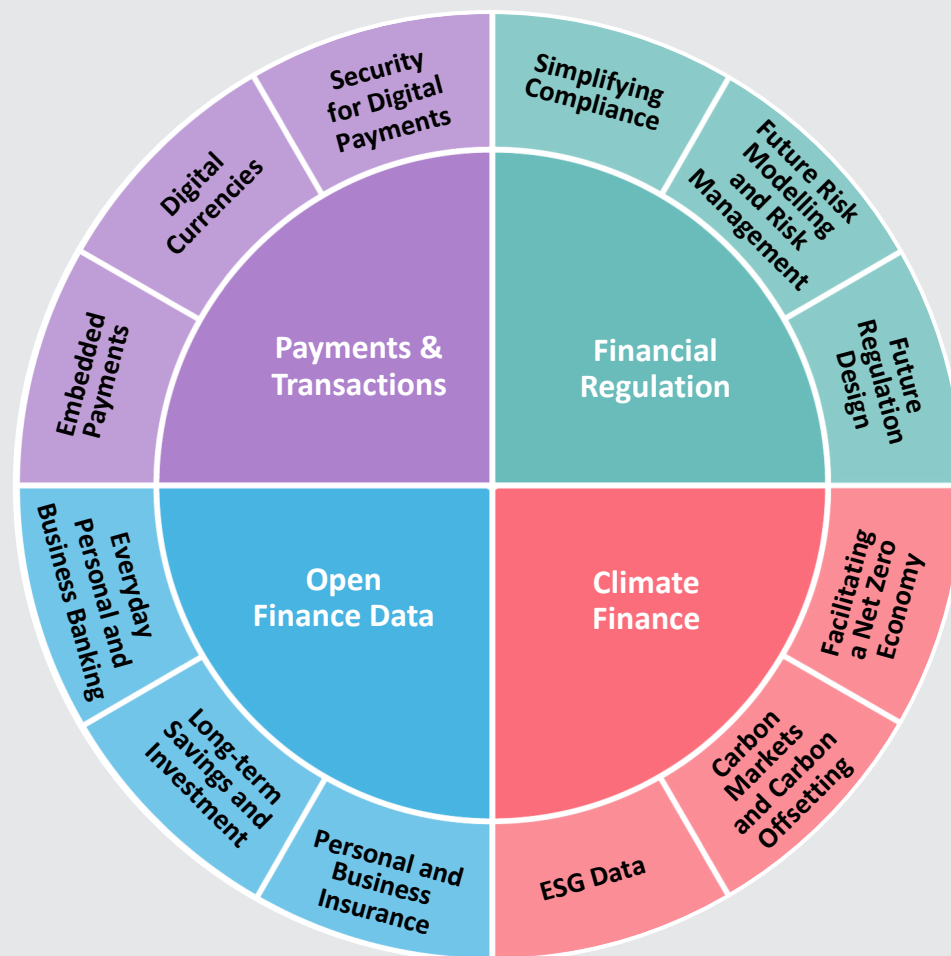
The overarching economic ambition for the Roadmap is to do two things:

- Create up to 30,000 extra jobs in Scotland.
- Increase economic value (GVA) by more than 330% - from £598 million to more than £2 billion – over ten years.

On a broader perspective, the impact of the Roadmap will be:

- To tangibly help improve lives for citizens, by tackling inclusion and health-related issues.
- To further develop Scotland as part of the UK in being a global 'engine room' for FinTech and a desirable location for international FinTech companies.
- To drive innovation, supported by a world-leading reputation in regulation and compliance.
- To use Scotland's and the UK's natural strengths, making them a global enabler of 'greener' FinTech.

The priority themes form the building blocks of this Roadmap:



The four priority themes are linked to secondary themes, which are reflected in the focus and actions of the Research & Innovation roadmap.

FinTech Scotland



FinTech Scotland was founded in early 2018 as a strategic cluster management body focused on leveraging and enabling the potential economic benefits of FinTech innovation in Scotland.

FinTech Scotland's objectives are to develop an innovative community of FinTech SME firms, develop impactful collaborations, and foster an inclusive and globally recognised cluster.

The FinTech Scotland SME community has advanced FinTech innovation in a number of areas such as Payments, Open Finance, Wealthtech and RegTech as referenced in the Kalifa Review.

The cluster is supported by strategic partners across financial services, technology, professional services, regulatory, academia and government agencies, and this enables collaboration and impactful initiatives that advance FinTech innovation to benefit the economy.

In 2020, FinTech Scotland was formally recognised for its excellence by the European Secretariat for Cluster Analysis (which benchmarks economic clusters) in recognition of its innovation, collaboration and inclusion initiatives thereby becoming the first FinTech cluster in the UK to be recognised for cluster excellence and only one of three in Europe.



THE UNIVERSITY
of EDINBURGH

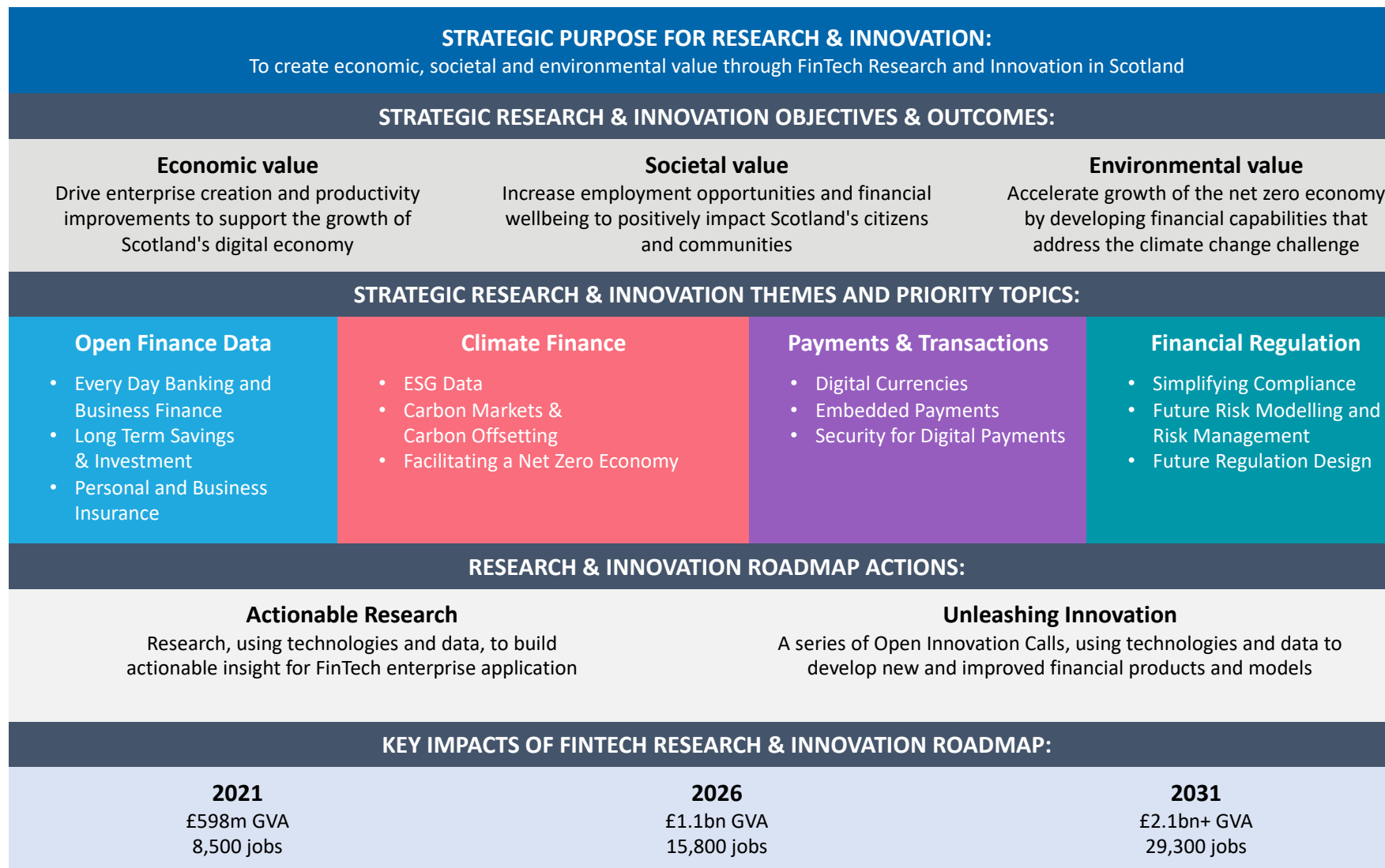
"As one of the founding members of FinTech Scotland, the University of Edinburgh is committed to supporting Scotland achieve its ambition to be a global FinTech leader.

We have academic excellence across many disciplines that are directly relevant to this Research & Innovation roadmap, such as Informatics, Social Sciences and Geosciences. Our mission as a University is the creation, dissemination and curation of knowledge through our world class research and education. This roadmap invites us to harness data-driven innovation and build purposeful collaboration across sectors to meet the challenges of Open Finance, financial inclusion and the transition to Net-Zero."

Peter Mathieson, Principal and Vice Chancellor,
University of Edinburgh

Research and Innovation (R&I) Roadmap

Strategic Overview



Research and Innovation (R&I) Roadmap

Summary of Actions

The following is an overview of the ten-year Roadmap actions, consisting of Actionable Research and Open Innovation Calls across each of the four priority themes:

		Phase One – Year 1 to 2	Phase 2 – Years 3 to 5	Phase 3 – Years 6 to 10
Open Finance Data	INNOVATION CALLS	Banking, customer vulnerability Banking, credit models Banking, future of SME business banking	Banking, financial literacy Savings, financial well-being Savings, retirement planning Insurance, managing risks AI role in insurance Risk Personal data privacy	Finance and health, supporting an ageing population Insurance and social care
	RESEARCH	Role of Gamification in financial services Ethical Data application Practicalities of combining data sets Synthetic Data for innovation Customer digital behaviour AI in Financial Services	Virtual and augmented reality	Banking, future business models Insurance, insights, and advancing data ethics
Climate Finance	INNOVATION CALLS	SME Climate Innovation Investor Confidence SpaceTech and FinTech Innovation		
	RESEARCH	Role of AI in FinTech Climate Innovation ESG Data Plan Green Accountancy Practices	Carbon markets innovation	Climate and Economic Development
Payments & Transactions	INNOVATION CALLS	Finance DLT Lab	Inclusion through Embedded Payments Payment security	
	RESEARCH	SME Payments Accelerator Digital Currencies Regulatory Group	Cyber technologies for embedded payments	Financial fraud and climate payments, supply chain, trade, auditing, and large scale financial crime
Financial Regulation	INNOVATION CALLS	RegTech sandbox Financial crime Regulatory and technology skills Improve public understanding of Ts & Cs	Real-time risk monitoring Push payment fraud Climate change risk Push payment fraud Supervision tech	Enhancing compliance through advanced technologies
	RESEARCH	Advancing risk management	Development of National Institute of Quantum	Financial application of Quantum

Introduction

The economic and social context of FinTech

FinTech is the new application of technologies to deliver financial products and services to consumers, communities, businesses, and public bodies. The result is driving true change in finance and enabling better economic and social outcomes.

FinTech innovation is radically transforming how people and businesses engage with money. It represents a significant disruptive force, both economically and socially, that affects both financial services and the wider economy.

Due to three things – changes in regulation aimed at improving competition, reduced barriers to entry, and significant advances in technologies – FinTech can become a revolutionary enabler in the development of new products and business models.

FinTech innovation is applied in a variety of settings, including:

- Technology that enables improvements in the financial sector, from banking to insurance and from investment to payments.
- New technology entrants to the financial sector offering innovative products and services to businesses and consumers, such as digital banking and peer-to-peer lending.
- New technology-focused entrants using finance and technology to offer new and different processes. These can service all sectors. For example, they can improve both payments and financial data security, and can enable new business models for emerging sectors.

FinTech has evolved into a UK-wide ecosystem. Clusters of communities are developing new business models, best practices, products and services. It has become an umbrella term that encompasses all aspects of technology in finance, and advances the evolution of the digital economy.

“A strong, growing, and innovative financial services sector is vital for our future economy. We must capitalise on our strengths and harness the true potential of innovation to shape the future of finance. Scotland’s heritage in financial services and innovation leaves us well placed to drive the changes needed. Collaboration and clear focus are key as we recover from the COVID-19 pandemic and address issues such as climate change. This Roadmap presents a significant opportunity to focus collaborative efforts and realise the power of FinTech innovation.”

Philip Grant, Chief Operating Officer, Insurance and Wealth Division, Lloyds Banking Group

“Nurturing research and innovation is integral to the success of the UK as a global financial hub. FinTech Scotland’s Roadmap Report highlights the undercurrent of support for the ecosystem and the transformative power that cultivating this sector can have across society. Over the coming years the UK FinTech sector faces many challenges and opportunities. The dynamism of the roadmap will act as a pioneer to address these in Scotland and beyond. A year since the Kalifa Review, The City of London Corporation welcomes the progress made and opportunities for collaboration that this report evidences. We look forward to seeing Scotland yield the benefits of these to drive growth.”

Catherine McGuinness, Policy Chair, City of London Corporation

FinTech in Scotland: Highlights

Scale of FinTech in Scotland

£598m ESTIMATED FinTech GVA

GENERATED BY

startups, scaleups & established FinTechs

FinTech Firms in Scotland

84% B2B

For these firms, finding opportunities to create commercial revenue **generating relationships** can be critical to their success

Scottish FinTech Innovation

76% of survey respondents see

short term thinking as BIGGEST BLOCKER

to Scottish FinTech innovation

This 10 year roadmap addresses this issue directly

Scotland's FinTech Cluster

190+ firms actively participating in the sector

=50%+ increase
since January 2020

c.25 FinTech firms per 1m population

= 60% greater density of FinTechs than non London UK average

14% FinTech founders are female
(higher than any region outside London)

£1.5m raised per FinTech
(in Scotland. Includes funding and grants from internationally headquartered FinTechs)

Scotland's Universities

19 universities

260,000+ students

almost **50,000** graduates per year

5 of the world's top universities
(according to The Times rankings)

c.200 courses related to FinTech (excl STEM)

In 2017 the University of Strathclyde was the first in Europe to launch an MSc in FinTech. Now the University of Stirling, University of Edinburgh and University of Glasgow have developed their own MSc degree programmes in FinTech

Business & Consumer Priorities

Consumers are expected to place a greater short-term urgency (ie in the next 1-2 years) on areas such as

- **mobile money management,**
- **ethical banking and**
- **alternative methods of supporting ESG**

(as well as other solutions that help consumers embrace eco-consciousness)

Businesses are viewed as placing a higher immediate priority on benefits relating to payments and financial regulation such as

- **faster payments,**
- **greater risk detection of fraud,**
- **and use of machine learning & automation to improve compliance and security**

(results from online survey conducted as part of this research)

The imperative of FinTech research & innovation

A focus on FinTech innovation that uses the UK's strengths and capabilities across the UK is imperative to secure future sustainable economic growth, improve productivity, increase social inclusion, and maintain the country's position as a global economic leader.

FinTech innovation will play a significant role in delivering the Government's vision³ for a globally competitive, open, green, and technologically advanced financial services industry. One that acts in the interests of communities and citizens, creates jobs, supports businesses and powers growth across the UK. FinTech's capabilities in data analytics will also be vital, in helping address new and developing business and consumer needs.

However, when compared to other industries, there are few effective mechanisms to encourage collaborative FinTech research and innovation. Short term thinking is seen as the biggest blocker to FinTech innovation in Scotland. In an online survey conducted during this analysis, 76% of the respondents selected this response.

Beginning to create a 10-year R&I Roadmap helps to explicitly address this issue. It is our first step in driving the changes needed for effective research and innovation in FinTech.

This Roadmap draws together the common industry priorities, and identifies the areas in which more will be achieved through industry collaboration than by iterative and individual approaches.

It also shapes a framework for greater stakeholder alignment and collaboration. The aim is to build trust and open access to the right resources, including data, funding, skills, and expertise.

Importantly, this Roadmap builds on the foundations already in place, identifies opportunities for some quick wins, and starts the work of creating a FinTech-focused environment in which research and business can grow together.

Scotland's universities

- With five of the top 200 universities in the world (according to The Times rankings), Scotland has one of the highest rates of world-class universities per capita in the world.
- University of Edinburgh, University of Glasgow, University of Strathclyde and University of Stirling all have MSc Degree programmes. The University of Edinburgh was the first in the world to create an industry-based FinTech programme.
- Universities in Scotland are also leading the way in technology research and innovation.
- The University of Edinburgh is a European leader in AI research.
- Universities of Glasgow, Strathclyde and Edinburgh are all developing and leading fields of Quantum Computing research.
- Edinburgh Innovations, part of the University of Edinburgh, is renowned for supporting research into entrepreneurial development. Named as Tech Transfer Office of the Year in the 2021 Global University Venturing Awards it continues to support startups and university spins outs to build successful businesses.
- The Hunter Centre for Entrepreneurship, part of the University of Strathclyde, has been supporting entrepreneurial development for over two decades. It has been recognised through a variety of awards making it one of Europe's leading centres for entrepreneurship, innovation, and strategy.

"Pushing the boundaries on FinTech research and innovation is vital as we learn about the power of technology and the impact of its application in financial services. We'll get further if we collaborate across the different sectors of the economy and across different research disciplines. I'm looking forward to the impact we can make for future generations by leveraging innovation and focusing research capabilities on industry priorities"

**Mark Napier, Managing Director,
Global Technology, JP Morgan**

"Fast moving trends in technology and banking have altered the landscape for those seeking to make an impact in the world of finance. Our mission at the University of Glasgow and the Adam Smith Business School is to sustain and foster a place of outstanding collaboration, supporting industry-led research and enabling the finance professionals of the future."

**John Finch, Head of School, Adam Smith
Business School, University of Glasgow**

³https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/998102/CCS0521556086-001_Mansion_House_Strategy_Document_FINAL.pdf

There is undoubtedly a need to use the UK research community's skills and expertise to capitalise on the FinTech innovation opportunity by building the right environment, creating a plan, and encouraging stakeholders to contribute.

This will require the development of innovation support. We should learn lessons from the way that stakeholders work together in other innovative industries: they progress initiatives by identifying common goals and objectives, and sharing knowledge and capability.

As the work evolves, this Roadmap will provide the support necessary for further evolution. It will shape the interventions and collaboration required to make the transition from current practices to the mechanisms that are needed to support greater collaboration, delivery and implementation.

This Roadmap builds on FinTech Scotland's January 2021 report on Research and Innovation for UK FinTech.³ This set out how FinTech innovation could be accelerated by unlocking collaborative innovation and research opportunities.

With its industry connections, cluster development and strategic partners, FinTech Scotland continues to execute a FinTech cluster strategy that facilitates integration and collaboration, focusing on priority themes and action-focused initiatives. As the trusted cluster management body, FinTech Scotland will lead and facilitate the delivery of this Roadmap, supported to deliver by FinTech companies, universities, strategic partners and government agencies.

The strategy behind this Roadmap is to build a way of working that enables strategic and industry-led thematic research and innovation. The work supports the broader FinTech Scotland strategy to grow and scale the SME community, enable collaboration with committed stakeholders, drive an innovation roadmap, and develop an inclusive and globally engaged FinTech cluster.

Scotland's FinTech cluster

- Scotland has an established FinTech cluster of over 190 firms that are actively participating in the sector. This number is constantly growing: it has increased by more than 50% since January 2020.
- With nearly 25 FinTech firms per million population, Scotland's density of FinTech companies is around 60% greater than the UK average outside London.⁴
- 14% of Scottish FinTech founders are female, higher than any other UK region outside London.⁵
- Including the funding and grants received by internationally headquartered FinTechs, there has been the equivalent of around £1.5 million raised per FinTech in Scotland.

The Roadmap also supports the development of the Smart Data Foundry, providing clarity on industry R&I priorities and demonstrating the demand for data-driven FinTech research and innovation.

"FinTech is disrupting global financial markets and it is growing. There is still a lot to do to attain the advances that could drive meaningful change. As we look across international developments, Scotland has a lot to offer based on its financial heritage, strength of our universities and culture of entrepreneurship. The FinTech Scotland cluster is a clear demonstration of what can happen through collective action. This Roadmap gives us a framework to move further forward in the right direction."

Yvonne Dunn, Partner, IT, Pinsent Masons

"FinTech innovation presents a serious opportunity for the UK economy. It's happening right across the country and Scotland, home of DirectID, has seen significant SME expansion in the last four years. For FinTech to truly realise its potential it needs the right conditions and support to innovate. This includes investment, skills and policy development. But more importantly it includes a research and innovation environment that helps us to get there faster, support future growth and build greater resilience. I am confident with more focused efforts we can evolve R&I in financial services and enable the full potential of FinTech to be realised."

James Varga, CEO & Founder, DirectID

³FinTech Scotland & FinTech Wales (2021) Research & Innovation for UK FinTech

⁴Whitecap Consulting

⁵Whitecap Consulting

The purpose of a roadmap for FinTech research and innovation

The purpose of this Roadmap is to use and enhance the innovation taking place across the FinTech cluster to deliver positive economic and social impacts.

This is underpinned by the strategic objective to create value through:

- **Economic value.** Drive enterprise, creation, and productivity to support the growth of Scotland's and UK's digital economy.
- **Societal value.** Increase employment opportunities and financial wellbeing to benefit citizens and communities.
- **Environmental value.** Accelerate growth of the net zero economy via financial capabilities that address the climate change challenge.

The progress of the Roadmap against these strategic objectives will be monitored over the ten-year period, using a balanced scorecard which can highlight the impact of key innovation developments and the potential to make further advances.

Scotland generates a strong GVA from FinTech, estimated at £598 million. Half of this is directly generated by startup, scaleup and established FinTech firms, further supporting the scale Scotland has in FinTech. Although the ecosystem is already well established, there is great opportunity to further develop FinTech in Scotland to create economic, environmental, and social value for stakeholders in the ecosystem.

The Roadmap's industry-led priorities

The Roadmap has four strategic themes and two action categories. Together they constitute the framework for executing delivery.

The four strategic themes bring together the industry-led analysis which underpins this roadmap, and which was generated through stakeholder insights. Each of the strategic themes has three priority innovation topics.

As FinTech is such a dynamic field of innovation, many other strategic themes and topics could also have been covered. However, in order to make the Roadmap focused and practical, we have concentrated on the themes identified as priority and where there is the greatest level of stakeholder engagement.

The four themes and their respective priority actions are:

1. Open Finance data. Focusing on covering everyday personal finance, long term savings and investing, personal insurances.
2. Climate Finance. Focusing on covering ESG data, carbon markets and carbon off-setting, facilitating a net zero economy.
3. Payments and transactions. Focusing on covering digital currencies, embedded payments, security of digital payments.
4. Financial regulation. Focusing on simplifying compliance, risk management modelling, regulation design.

"Social inclusion is an important theme to unpack. It's a big theme for innovation. Sitting on the Glasgow City Innovation District (GCID) steering group, we can see how FinTech has a close relationship to other tech-enabled sectors like HealthTech so we are working to make sure it is not siloed. We can have stronger impact with greater cross-sectoral collaboration to build the digital economy."

Professor Eleanor Shaw OBE, Associate Principal, University of Strathclyde

Industry led action to drive the roadmap for FinTech research & innovation

As we mentioned earlier, actions will be progressed through two key types of activity: **unleashing innovation** and **actionable research**.

Actionable research involves insights and problem statements, resulting in the identification of specific research topics for consideration by academics, industry, and research funding organisations. This could be addressed via existing or future research programmes, academic research projects currently in progress, or new research projects.

Unleashing innovation involves industry-led innovation calls to create an opportunity for FinTech innovation to be presented against commercial market opportunities. The collection of innovation calls will be supported by industry and academia. As well as enabling the development of FinTech proposition this provides clear opportunities for future talent, the new application of technologies, investment, and international connections.

Analysis conducted for this report shows that 84% of Scotland's FinTech firms have a B2B proposition.⁶ (Of these, around a fifth are B2B2C.) For these firms, finding opportunities to create commercial revenue-generating relationships can be critical to their success.

Industry dependencies to drive the Roadmap

The Roadmap has two principal industry-led dependencies: the application of technologies and meaningful stakeholder engagement.

Stakeholder engagement

The delivery of the Roadmap is completely dependent on meaningful and continual collaboration by the diverse group of industry stakeholders who constitute the driving forces in the FinTech cluster. These include entrepreneurs, established financial services firms, large global enterprises, academic leaders, enterprise agencies, Government and regulatory officials, citizens and community groups, investors, and professional advisers.

Technologies

The application of technologies and data is critical to the Roadmap being successfully applied in practice to create value. They include:

- Artificial intelligence and machine learning, blockchain, distributed ledger technology, open application programming interfaces.
- Robotic process automation, quantum computing, telematics and sensors, virtual and augmented reality, cloud computing, 5G.

The application of these technologies will require continuing advancement in innovation environments, regulation and policy evolution, transformed business models, and – most importantly – new skills and talent.

"The FinTech R&I Roadmap sets out an ambitious path to establishing Scotland as a global digital economy leader. It creates the foundations for us to work with industry to explore transformational opportunities, building on the wealth of talent and innovation that exists across the wider tech ecosystem in Scotland. Scotland's FinTech sector is already incredibly attractive to global companies and international investors, but the FinTech R&I roadmap sets out even greater ambitions. Our collective efforts will help achieve these ambitions, creating jobs and significant economic contribution over the next decade."

**Adrian Gillespie,
CEO, Scottish Enterprise**

⁶Whitecap Consulting

Smart Data Foundry

- Opening Finance for Good

The economic, social and environmental challenges facing the industry and the economy, including recovery from the pandemic and those identified in the Kalifa Review and by FinTech Scotland, need unprecedented collaborative effort.

In 2018, the University of Edinburgh began work with FinTech Scotland and the Financial Data and Technology Association (FDATA) to create the Global Open Finance Centre of Excellence (Smart Data Foundry) to address industry challenges and accelerate the adoption of Open Finance to bring more jobs and international investment to central Scotland, further enhancing the Financial Services and FinTech cluster.

By September 2020 Smart Data Foundry was up and running with a start-up team and seed funding from UK Research & Innovation. Early successes included working with Banks and FinTechs to deliver economic analysis of the Covid-19 pandemic to departments of UK and devolved Governments, supporting the FCA TechSprint, working with the Information Commissioner's Office and establishing an international working group on technical standards and interoperability. Working with real financial data can help policy makers to understand the dynamics of people's habits with money in order to develop the right policies to make lives better and address societal challenges like the Poverty Premium.

Having completed its start-up phase, The Global Open Finance Centre of Excellence re-branded to Smart Data Foundry in February 2022, and is a mission led organisation to unlock the power of financial data as a force to improve people's lives. Partnering with FinTech Scotland has yielded the Research & Innovation roadmap and a clear agenda for action which will leverage the multi-disciplinary team and data infrastructure investments already underway including a secure research data safe haven, FinTech innovation environment, and synthetic data generation capability. Still closely connected with the University of Edinburgh, Smart Data Foundry's firm foundations, based on trust and ethics, will allow it to bring together partners from across academia, FinTechs, start-ups, entrepreneurs, business, government and the voluntary sector to make a real difference to people's lives.

Smart Data Foundry is now on course to become a neutral, independent, not-for-profit organisation – all the ingredients to make collaboration happen when there's normally a host of reasons for not sharing data.

The range of collaborative programmes is growing as it addresses economic, societal and environmental challenges, underpinned by a growing team drawn from industry and academia helping to accelerate research and drive innovation to prove ideas and get to solutions quicker.



"Traditionally, financial services have often seen universities as a source of graduate talent, rather than supporting their Research & Innovation needs. This is changing. I believe the economic, social and environmental challenges facing the industry and the economy need unprecedented collaborative effort. Working with financial institutions, innovative FinTech SME's, governments, and regulators we are playing our part. I'm proud to partner with FinTech Scotland to help deliver these recommendations and work with universities to meet the increasing demands from the sector."

**Kevin Collins, Interim CEO,
Smart Data Foundry**

INNOVATE
FINANCE

FINTECHNORTH

FinTech
Scotland



FinTech West

FinTech
Wales

SUPERTECH



National Connectivity: FinTech National Network

This roadmap sets out a ten-year roadmap strategy to help stimulate, accelerate and strengthen Scotland's specialist capabilities to support the national effort to retain UK's leadership status across all Financial Services.

FinTech is a national (and indeed international) industry and success for Scotland cannot be achieved in isolation so the role of the wider UK FinTech ecosystem is an important one.

Within the UK there exists demand for FinTech capabilities aligned to Scotland's strengths, and equally there are complimentary strengths in other regions which Scotland will benefit from.

The Kalifa Review highlighted national connectivity as being integral to the UK maintaining its position as a global leader in FinTech. This is an area where Scotland has already made great strides. Via the FinTech National Network, FinTech Scotland has forged active links with other regional FinTech groups within the UK. This group includes Innovate Finance, FinTech Scotland, FinTech North, FinTech Wales, FinTech West, FinTechNI, and SuperTech WM (West Midlands).

In October 2021, FinTech Scotland hosted the 'Accelerating FinTech Across the UK' conference in Glasgow, an event which featured speakers from all the regional groups that make up the FinTech National Network.

1

PRIORITY THEME: OPEN FINANCE DATA

Everyday personal banking and business banking

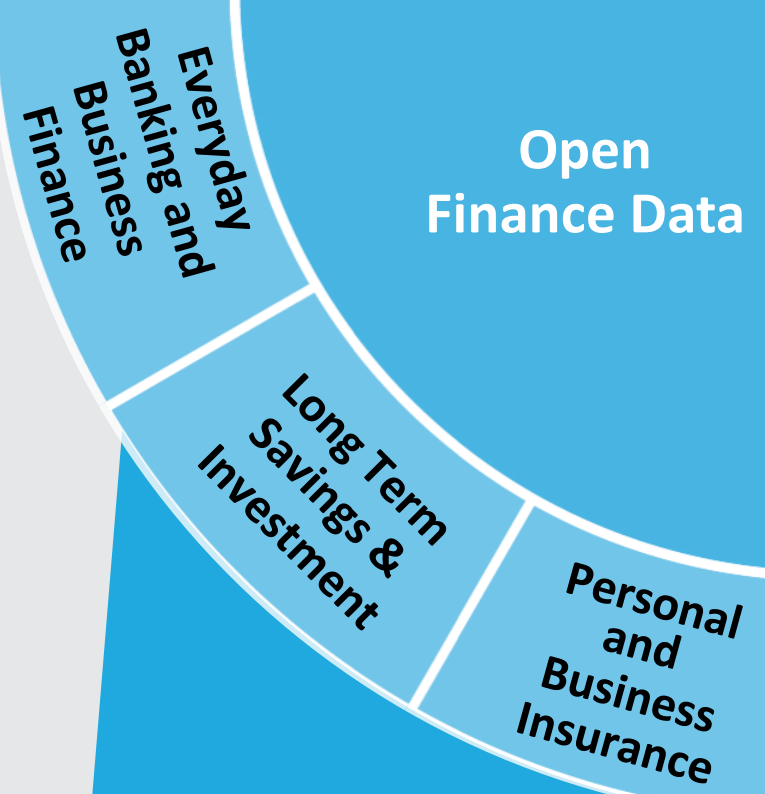
- Insights through Open Banking data
- Future banking business models

Long-term savings and investment

- Financial resilience and wellbeing
- Future living & the ageing population

Personal and business insurance

- New data and insights for insurance
- Data privacy
- Data ethics and governance



“At One Banks Hub we’re using Open Banking to help people connect with the digital world and maintain access to cash. This has been enabled through the developments of Open Banking and our services are helping customers access shared banking solutions that are geared to the needs of local communities. The world of banking is changing and Scotland’s experience in data driven innovation is undoubtedly a strength to be nurtured and advanced.”

Duncan Cockburn, CEO, One Banks Hub

Open Finance data

Finance data is the personal and business information that is created when people buy and use financial products and services. For example: current account payments and transactions, savings, mortgage lending, investments and pensions. It is captured, stored, and managed by financial services firms.

The concept of Open Finance data is founded on the basis that information can, with consent, be digitally shared with others for the consumer's benefit. Open Finance data could be widely used to create new financial products and services.

Open Finance data can enable better services for consumers and businesses

Open Finance data is evolving from Open Banking. This was introduced in the UK in early 2018 by the UK Competition and Markets Authority (CMA) to increase competition in retail banking services. It gives third party providers access to consumers' banking and transactional data (with the consumer's consent). Open Banking relies on appropriate regulation, so consumers know they are protected and can trust the financial services providers.

Open Banking has demonstrated how personal and SME banking transactions data can be unlocked in a safe and secure way to deliver new FinTech products and services. There are now several UK Government led initiatives in flight that could pave the way for Open Finance, including development of the National Data Strategy, Smart Data Review, and the Pensions Dashboard. The key to success is providing a coherent and standardised framework to enable the data to be unlocked safely and securely. The approach to framework implementation is critical. Whilst it has taken significant time to implement a framework and uniform set of standards in the UK for Open Banking

the alternative of bespoke specifications would have added significant overhead and complexity thus reducing competition and stifling innovation.

It is good to see the UK continue to take an interest in progressing towards Open Finance, however, countries across the world are also picking up pace. The UK's initial dominant position has been equalled and could potentially be surpassed. Australia has gone one step further with the introduction of the Consumer Data Right (CDR) and other countries, such as Brazil, are exploring how they can jump beyond Open Banking to Open Finance and more. This could challenge the advances made in the UK position and underlines the imperative for more research and innovation in Open Finance.

Having access to a consumer's data enables the third-party providers to deeply understand the customer's needs, and to develop innovative and frictionless solutions. These can potentially provide better outcomes for customers by increasing choice, giving more access, and deepening customer engagement.

Contributors to the Roadmap stressed that Open Finance data will create more opportunities through the application of emerging technologies, resulting in new data driven innovations, emergence of new business models and significant improvement to customer and business engagement with the financial services industry.

In addition, insights generated from Open Finance data will be useful for policy makers, regulators, and Government. This will allow the legislative and regulatory landscape to evolve, and create the environment needed for the future of finance.

Open Finance data has therefore been identified as a strategic priority for this Roadmap.

"Open Finance to us will more likely be about how we can make it easier for customers to move from one platform to another. How could customers potentially pass us a key of the data they want us to have to speed quotations and onboarding? We are connected with FinTech Scotland, and we do market scanning to see what the FinTechs are doing and what the possibilities are if a product is out there without having to build things ourselves."

**Belinda Munro, Chief Architect,
Royal London**

60%

of UK consumers to be using **Open Banking by 2030⁷**
(other sources expect)

BIG DATA analytics & AI

are seen by online survey participants as **most urgent tech priorities over next two years**
(particularly Open Finance data)

⁷ZOPA (2021) Open Banking to Open Finance: Bringing consumers along on banking's next innovation

Open Finance data - led by the UK and adopted globally

After the UK pioneered the adoption of Open Banking, around 30 other jurisdictions across the world followed its lead. Since then, Open Banking has created a wave of innovation and improvements in payments and transaction banking, affecting both retail and SME consumers. However, this change has taken a significant amount of time. Some industry contributors to the Roadmap questioned whether the UK is moving fast enough.

Open Finance can create progressive change that will move the UK forward significantly, by moving beyond banking and asking other financial institutions (such as pension providers, asset managers and insurers) to enable customers to share their data with others. This would open up a wider range of financial products and services to the transformative impact of third-party innovation through trusted data sharing. For consumers and businesses, it offers new ways to understand their finances, receive financial advice, and compare financial product features and prices.

Research and innovation are needed to facilitate its potential, building economic growth and creating employment opportunities in high value sectors which in turn will make the UK an attractive destination for inward investment. Furthermore, it will help us better understand, measure, and forecast the considerable impact that Open Finance could have on society and to shape future policy.

The UK's Smart Data Foundry (formerly The Global Open Finance Centre of Excellence) has been established in Edinburgh, Scotland to support the understanding and development of the capabilities of Open Finance. It has a leadership role in enabling the necessary research and innovation, and building confidence in Open Finance across the UK.

The Smart Data Foundry can encourage research and innovation by providing a highly secure environment that can host Open Finance data. It also provides the functionality to apply technologies that can analyse, learn, and build models for the development of new finance products and services. This can enable industry, regulators, and consumers to build confidence in Open Finance, which will support the changes to come.

The Open Finance data priority in this Roadmap supports and complements The Smart Data Foundry's agenda. Our analysis has highlighted three industry priorities that will benefit from more focused research and innovation on this topic. They involve shaping the future of:

1. Everyday personal banking and business banking finance.
2. Long-term savings and investments.
3. Personal and business insurance.

We highlight some of the specific industry insights that have shaped our view of the next steps for future research and innovation. These are summarised at the end of the chapter.

DirectID

DirectID has leveraged Open Finance to develop a platform of tools that help businesses understand their customers' financial position. In sharing and enriching bank statement data, the DirectID credit and risk platform gives decision makers a more comprehensive view of applicants and customers.

Historic credit risk data can often be out-of-date and inaccurate, whereas data obtained directly from consumer's bank account (with explicit consent) is real-time, verified, and incorruptible. Applying advanced modelling techniques, DirectID also provides unique insights into customers' financial status, enabling decision makers to accurately gauge affordability, income verification, expense categorisation, cash flow, emerging financial distress, and more.

Founded in Edinburgh, DirectID's reach is global and rapidly growing, with 13,000+ bank connections giving them access to 1.5bn users, in 45+ countries. The FinTech powers some of the world's biggest brands from banking, consumer and SME lending, through to the gig economy, utilities, gambling and more.

Everyday personal banking and business banking finance

Banking is an essential part of everyday life. It enables individuals and businesses to keep money secure and to manage their finances. It centres on the way that people and businesses store money and make payments.

Until recently this would probably have involved a physical bank branch. However, customer expectations of everyday banking are changing, driven by mobile technology and other experiences of personalised, lightning-fast services assisted by the rapid growth of the internet. Customers are now used to enjoying convenient, personalised digital services in most parts of their lives.

Our analysis shows that the general attitude towards digital finance is changing. 76% of UK adults use digital banking services, and 45% of consumers aged 25-34 made a mobile wallet payment in 2020.⁸

Current progressive developments can also be largely be attributed to successes in Open Finance in banking: innovations have created more suitable, user-friendly products. It has enabled third parties from outside the financial services industry to introduce their own financial products and, in some cases, to use their own large user bases (e.g. Apple Pay, Google Pay and others).

As the financial services industry considers the future of everyday banking, our analysis points to two distinct areas of interest for actionable research and leveraging innovation:

1. Solving current problems in delivering banking services using insights from Open Finance data.
2. Creating future banking business models through data and digital capabilities.

⁸<https://cybercrew.uk/blog/digital-banking-statistics-uk/>

Financial Services in Scotland

- Financial services is the biggest single contributor to Scotland's economy. Scotland is the UK's 2nd largest financial cluster after London, worth an estimated £8.8bn. A report by TheCityUK showed it is growing faster than London.
- Financial and related professional services is the biggest sectoral contributor to Scotland's economy, directly employing around 170,000.
- Edinburgh and Glasgow are both ranked in the Global Financial Centres Index (21st and 81st respectively), and 88% of FinTech firms in Scotland are based in these two cities.
- For seven consecutive years, Scotland has attracted the most financial services foreign direct investment outside of London. Three of the UK's top 10 cities (other than London) for attracting FDI projects are Scottish: Glasgow, Edinburgh and Aberdeen.
- Scotland is responsible for 11% of the UK's responsible investing market.

1.1.1 Insights through Open Banking data

Transactional data from current accounts provides privileged and highly valuable insights to an individual's life. These go beyond the person's financial life, and can open a window into more fundamental aspects of how someone is living.

Through the development of the Roadmap and our engagement across stakeholders, including consumer groups, leaders consistently raised the hope and expectation that Open Finance data could help deliver better outcomes for people and businesses.

Currently, there is significant interest in using innovation to:

- Predict potential customer financial vulnerability.
- Facilitate practical ways to increase savings across the UK population.
- Support greater consumer financial awareness, literacy, and education.
- Create the products and services needed for a future workforce, particularly workforces which experience uneven employment income.
- Provide fairer access to mainstream credit creating new models for credit underwriting using Open Finance data.
- Develop the services and support that SMEs need to grow.

- Enable greater access to credit and lending for SMEs, facilitating faster lending decisions and creating new ways to repay.
- Create a standard classification system to enable a consistent taxonomy for spending data.

There is a wider view that Open Finance data has more to offer, especially if the capability emerges to combine it with other types of data from other areas such as health, energy usage, climate, communications, travel and other consumer consumption.

Linking financial transactional data with these other data sets is difficult. It needs careful exploration, including ethical, procedural, and legal considerations. Focused deliberate, and collaborative research is needed to better understand the position. The Smart Data Foundry is working with the Information Commissioner's Office to examine this issue and help clarify how data linking can be navigated. The next step is for more industry participation and collaboration to shape specific actionable research. Specifically: industry-relevant use cases, to test how data can be combined to deliver social and economic benefits while ensuring legally compliant and ethical practices.

"Open Banking has advanced the way things are done in banking, but Open Finance will help us create and advance the digital economy. Retail and business customers will reap the benefits of financial services being embedded into a broad range of digital experiences, businesses will leverage emerging services to adapt to the digital economy more readily, and the entire financial system will become much more personalised, frictionless, and efficient. We're thinking about the future of digital finance and working to optimise the customers experience of digital solutions. Open Finance is an important next step on that journey."

Derek Smith, Head of Digital Engineering, Virgin Money

1.1.2 Open Finance for SMEs

During the development of the Roadmap, there was a strong emphasis on the financial services industry's ambition to deliver more for the SME market through Open Finance data. This is a topic that has been highlighted in previous research.⁹

Open Finance data has the potential to help unlock timely access to credit for SMEs, a group that has historically struggled with manual processes, long timeframes and high rejection rates.

The financial services industry has generally had a relatively limited ability to view an SME's holistic financial position. Open Finance and data sharing functionality can change this, allowing SMEs to share comprehensive financial and non-financial data that allows financial institutions to better understand them and offer more suitable financial products. By using real-time analytics on an SME's current business situation, lending risks could be assessed more accurately and potentially opening new investment and funding opportunities needed to boost the SME market.

Additionally, it would also help FinTech enterprises develop Open Finance-based tools, which help SMEs make business decisions. Combining datasets and using artificial intelligence (AI), for example, can lead to more accurate forecasting and better cash flow management.

Moreover, Open Finance data can enable SMEs to adapt their business and operating models to help with the transition to net zero, by illustrating the true impact of their products, supply chains and business practices. There is significant room for collaboration and FinTech innovation to support SME growth, development, and recovery from the impact of the restrictions through the pandemic.

This creates an opportunity to unleash innovation through specific innovation calls, shaped by collaboration with financial services, FinTechs and end user SMEs.

⁹Oliver Wyman (2020) Open Data Is Essential for Small Business Recovery



1.1.3 Future banking business models

The wide-ranging industry contributions to this Roadmap have emphasised that Open Finance has created an opportunity for innovation to put the customer at the centre of propositions. For example, using banking transactional data to build personalised insights and more effectively meet personal needs.

The financial services industry shared the view that Open Finance will enable new retail banking business models. For example, delivering more sophisticated ways of enhancing customer experience, driving loyalty, and moving from the concept of simply manufacturing and selling a financial product to enabling a fuller customer financial retail experience by working with partners.

Examples ranged from banking-enabled marketplaces, where customers can get access to all the relevant and associated services required to access a frictionless financial experience when, say, buying a house or purchasing a car. To other models with broader partnerships evolving to remove friction for the customer in any type of financial transaction.

Actionable research will help the future of retail banking emerge, embracing potential while balancing the risks of transitioning to new ways of banking. Data and new technologies will significantly change traditional banking models in many ways, from the way banks interact with customers to the way they manage their middle and back-office operations.

Our analysis highlights particular interest in both unleashing innovation and actionable research in open banking data and technologies such as AI, machine

learning and advanced analytics. For example, increasing process automation, which has the potential to reduce large-scale costs while increasing flexibility and accuracy of back-office tasks such as risk and compliance processes.

In addition, our work highlighted substantial interest in how FinTech innovation could unleash innovation from the gaming sector. There was specific interest in how this could enhance customer experiences and create a meaningful connection between customers and the banks of the future.

Some financial institutions are starting to explore the potential opportunity, and others are curious about the possibilities, noting that Generation Z and Generation Alpha are already fully emerged in finance and technology through games and gaming.

The industry also expects a future 'after mobile', showing an increasing interest in immersive technologies such as virtual and augmented reality to deepen customer engagement and understanding. Both the use of AI in banking and more exploration with the gaming sector present exciting possibilities for FinTech research and innovation in Scotland.

Scotland's experience in AI research and innovation is extensive. It includes the School of Informatics at the University of Edinburgh. This hosts one of the UK's largest groups of experienced AI academics.

For the last 20 years, Scotland has been one of the leaders of gaming innovation. Global success has sprung from a culture of innovation and creativity. Institutions such as Abertay University and Glasgow School of Art have supported this. Connecting the expertise from AI academics, and stimulating closer connections between

"At NatWest we're always looking ahead and embracing the future. It's vital that we work openly and collaboratively to bring the future into focus exploring new business models, uses of data and a wide range of technologies that will help us deliver the future of banking enabling customers to thrive. We believe we will get further together through purposeful collaboration and partnerships."

**Kristen Bennie,
Director Partnerships and OX, NatWest**

gaming expertise and FinTech and the financial services industry, will enable progressive action on the future of everyday banking.

Open Finance data presents significant opportunities for further innovation in banking, and there is also significant interest from the asset management, pension, and insurance sectors to understand how these lessons could be applied to the wider industry with the aim of unleashing more innovation.

This provides an opportunity for further collaboration on innovation and research working with the other UK regions, where there is a strong retail banking presence, such as Manchester and Leeds, collaborating with FinTech North.

Long-Term savings and investments

The process of saving money through suitable products to accumulate investments for the future is an important part of personal finance management.

This is especially true as long-term saving and investing can improve people's financial security while also supporting economic growth and financial development. 10% of participants in the first six cohorts of the Financial Conduct Authority sandbox were in some way related to capital markets, investment or asset management innovation.¹⁰

During the development of the Roadmap, the industry highlighted that saving and investing are lagging behind banking in terms of digitisation which could have a significant impact on advancing the potential for Open Finance. Industry incumbents are now starting to consider Open Finance data, and many pension providers and investment management firms describe themselves as followers when it comes to digital transformation.

The industry has acknowledged that FinTech innovation will have a significant role to play in the future and will lead to more personalised products and services. However, there was a strong call for more actionable research regarding useful data, data collection, and analysis techniques. As well as more help to assess the potential risk associated with new technologies and their application.

We identified two specific areas where, as learning and understanding evolve, research and innovation has a role to play to advance the potential for Open Finance data in long-term saving and investing. The first is financial resilience and wellbeing, and the second is connected to supporting the future of living and the aging population.

Pensions Dashboards Programme

A pensions dashboard will show a user their pension information online, securely and all in one place. It sounds simple but multiple parties and technical services need to be connected to make it work. It will require significant collaboration.

Origo Services, a Scottish based FinTech, has been appointed to supply this central digital architecture.

"Open Finance Data will power the future of innovation in financial services. It will enable people and businesses to have more control over their finances by making it easy to access their financial information.

We see the value of this type of access everyday at Origo Services. Our technology enables the industry providers to access pension and investment information. By evolving through Open Finance we can use this capability to enable individuals to directly access their information. Collaboration and initiatives such as The Pensions Dashboards Programme are key. This will enable pension holders to easily access all their pension details in one place. This type of information and easy access to it is vital in planning for the future and planning for retirement. We're proud to be supporting it."

Anthony Rafferty, CEO, Origo Services

¹⁰Whitecap Consulting (2021)

1.2.1 Financial resilience and wellbeing

Having a savings fund creates a financial cushion in the event of unforeseen events, and can play a key role in a person's (or household's) financial resilience and wellbeing. However, current evidence shows that around a fifth of UK adults have less than £100 in savings, and a further 21% are not saving at all.¹¹

People who do save often miss out on higher returns, by relying on traditional savings accounts with low interest rates rather than long-term investments.¹²

Industry feedback was that there was a strong obligation to help address this picture, with significant interest in learning more about new types of actionable research in behavioural economics that could inform better ways to support savings habits, both for those who have access to technology-enabled services and those who do not.

Furthermore, there was a call for research across the UK population to understand the true cost of living across regions, and across an average lifetime, to understand the reality of being able to save for some people.

Innovation to support more general saving

There is a growing view that Open Finance could give rise to some tools that help customers meet new saving goals through optimised budgeting, automatic saving, or automated product switching, potentially helping them to establish financial resilience habits more quickly.

¹¹Yorkshire Building Society (2021) Financial Resilience Survey

¹²Scottish Friendly (2018) Cost of Cash ISAs

¹³<https://www.fca.org.uk/data/retirement-income-market-data>

¹⁴<https://www.pensionsdashboardsprogramme.org.uk>

Advancing innovation to support long-term saving and investing

There is strong industry interest in innovations that enable more saving and investing, allowing people to build wealth and generate a deeper sense of financial resilience. For many people across the UK, long term saving involves products such as a pension or ISA, but evidence from the Financial Conduct Authority's retirement income data highlights that after a lifetime of savings, the average UK pension pot stands at £61,897.¹³

Auto enrolment in employer provided pensions has helped increase the numbers of people saving for their future. However, innovative legislative intervention was needed to initiate this change. This change could also mean that over the course of an average working life an individual will amass a significant number of small pension pots, especially as the workforce becomes more transient. Some Government estimates suggest the number of pensions pots could be as many as eleven over the course of an average working life.

Changes in the investment advice market have also meant that it can be expensive to get access to advice, potentially creating another barrier to helping people save and invest for the future.

Seeking to address a number of these issues the UK Government has developed a plan to introduce Pensions Dashboards Programme.¹⁴ Its aim is to enable individuals to access their pensions information online, securely, and all in one place.

Nude

NUDE is a Scottish-based FinTech on a mission to make the financial system fairer, easier, and more transparent for young people. Customers can save for their first home by opening a Nude savings or investment account. It helps first time buyers boost their deposits in several ways, connecting them with government bonuses or helping with ideas to increase their deposits. It also gives people options to think about sustainable investments.

Nude uses element of gamification in the process, and uses behavioural science techniques to help people get into their home sooner, recommending budgeting areas for example cutting down on online takeaways, coffees or subscriptions.

Delivering this programme will require significant industry collaboration to enable collection of quality and consistent data across a myriad of complex financial products to produce a useful output for consumers. The process will need uniform data standards and technology enabled interfaces into create the Dashboard. The current plan anticipates the Dashboard will go live in 2023. The surrounding technology capabilities to make it possible will provide the necessary infrastructure for responsible innovation in pensions. Thereby supporting better planning for retirement and growing financial wellbeing.

The insight gathered during the development of this Roadmap reinforced the fact that long-term saving and investing have received less attention than other sectors so far. More could be done to leverage and accelerate innovation. For example there is market demand for FinTech innovation to enable different ways of connecting with current and future investors, potentially allowing investors to have more control, to be better informed, and to make their own ongoing changes.

There is a willingness for increased collaboration and more partnerships with FinTechs to help incumbents to innovate.

There was a particular interest in using the AI expertise of FinTech businesses to create automated decision-making processes, more accurate prediction models, and services such as digital financial advice (sometimes referenced as 'robo-advice').

Investments and pensions are products that many consumers find opaque and complex. There is industry demand to enable better transparency across these types of products to increase consumer engagement and understanding. The position could improve through greater insights driven by access to a combination of Open Finance data and other data sets. This would enable providers to tailor future investment products to meet emerging customer needs, and help address previously underserved market segments.

In addition, there is a growing trend to better understand the environmental credentials of underlying companies in investment funds. This is addressed in more detail in the Climate Finance chapter of this Roadmap, and there are potential solutions that link to Open Finance data and the role it could play in future developments. Finding an efficient way forward is complex and will require purposeful collaboration to address the many challenges.

Innovation has historically been slower in this section of the financial services industry, a section that also needs to adapt to varying regulatory changes. There is an increasing openness to engaging in Open Finance data, technology, and digital customer engagement, and to collaborating with FinTech businesses to drive success for all.

"The aging society is a key issue, where we will all benefit from more collaboration. There are a number of different issues to be addressed. We need a much more connected state than we have today. People will have a number of previous pensions pots, investments, some drawdown needs and some periodic new income."

**David McLeay, Innovation Manager,
Lloyds Banking Group**

1.2.2 Future living and the ageing population

Life expectancy in the UK and around the world has increased significantly, and the number of people living into later life has grown rapidly.

Currently, there are around 12 million people aged 65 and over in the UK, and it is estimated that by 2036, 25% of the population will be over 65.¹⁵ The possibility of living to 100 also continues to increase. These factors have an impact on current and future cost of living, with an increased need to be financially secure for longer.

In addition to encouraging increased levels of savings needed to support a longer life, there is also interest across the industry in actionable research into later living. There is a lack of detailed data to help build a clear understanding of how people will live post retirement. Current thinking comes through lifetime surveys from small sample sizes that are highly likely to be unrepresentative of future retirees.

This is of particular interest to the pensions and insurance providers, as all involved consider the future products and services that will prepare people financially for a longer life. Many industry experts stress that finance for ageing is not something that only older people (those approaching retirement) should consider, but rather something that the

population in general should prepare for.

Policy makers will also benefit from research that can assess and forecast the impact of families' and individuals' ability to save for long life, and for society to manage the changing patterns of employment and health in old age.

Many contributors to this Roadmap mentioned the need to build greater incentives into future financial products, to encourage different behaviours from individuals and from consumers. There was interest in the concept of 'abstract value exchange', or 'behavioural currency', and the potential for a positive impact if people are financially rewarded in some way for healthy behaviours and habits. For example, offering a discount on life insurance for being active in certain ways, recorded through an activity tracker and with the data shared continually with the life insurer. This concept already exists today but is not widely adopted.

Across this topic, we found significant industry interest in actionable research that could connect health and financial data can help support the UK's population prepare for a healthy later life.

¹⁵<https://ageing-better.org.uk/ageing-population>



Personal and business insurance

Personal and business insurance products currently act as a way for people to protect themselves from potential future events that could harm them in various ways. Data is an integral part of the insurance industry.

First, people provide data about themselves and the product they want to insure. Then, insurers use a host of data to ascertain potential risk, set prices and manage claims.

Through the contributions to our work, we heard that the insurance sector hopes to benefit from a period of significant disruption enabled by greater access to new data and the resulting data-driven insights.

1.3.1 New data for insurance

Insurance has the potential to move beyond Open Finance and make significant use of other Open Data sources particularly through the development of the Internet of Things (IoT) and the new data available through those technologies .

In considering innovation in insurance, contributors to this Roadmap emphasised the move from protection products to prevention methods across insurance products. Our analysis indicates that data-sharing through open APIs has started to emerge in the insurance industry, along with several new data sources and analysis methods.

For example, in the home insurance market there are typically three major perils, flood, fire, and theft. Prevention can be supported using several different tools, such as improved bluetooth connected fire alarms, security alarms connected to police stations that enable a rapid response, or mini cameras placed around the home that relay information back to a mobile phone app alerting the homeowner while away.

There is also evidence of geospatial data helping identify areas that are prone to flooding and consequently enabling flood prevention measures to be implemented accordingly. All this data helps improve insurers understanding of risk and thus pricing.

In motor insurance, insurers outlined how telematics and sensors that collect data about driving habits can be used to develop a more complete and accurate risk profile of customers.

Life insurance is another product line looking at appropriate data to better identify risk. The emergence of increased health wearables, (such as smart watches), can provide data on various aspects of our physical, and increasingly, mental wellbeing, and the market has the potential to become more innovative. One well known insurer already links the price of insurance to the number of daily steps the insured individual takes, as well as heart rate during exercise. Whilst yet unproven, this does encourage a healthier lifestyle.

“It’s early days but there’s a lot to be done in insurance. It’s massively behind as a sector and we’ll see a lot of disruption in insurance, including more predictive developments about protection and claims. Climate issues are also key.”

Louise Smith, Chair, Innovate Finance

¹⁶McKinsey & Co. (2021) How top tech trends will transform insurance

1.3.2 New data insights for insurance

The insurance industry's view is that AI will be another key component in transformation. While many insurance companies are experimenting with AI however, few have scaled their capabilities across the entire business.

There remains significant interest in realising the potential of AI across new and existing data sets, with many highlighting an interest in actionable research and innovation that will help build an understanding of the use of AI to reshape claims, distribution, underwriting, and pricing.

Many of those contributing to this Roadmap believe that we are close to a tipping point, when changes in technology and consumer behaviour achieve the critical mass required to truly challenge the insurance sector's well-established business model.

In addition, our analysis highlighted industry ambition for more automated customer service applications, to handle more digital and augmented interactions with policyholders through both voice and text.

There is an opportunity for insurance companies to learn from the more advanced areas of Open Finance data. For example, insights on how to build trust with consumers and the role of incentives (including what they should be) in encouraging data-sharing will be particularly valuable.

Creating more collaboration between FinTech and insurers will provide an opportunity for knowledge transfer. It will also help the sector to modernise by using Open Finance and related data and technologies. This could include fully embracing Open Finance data in addressing data privacy, data ethics and data-sharing principles.

While the data we generate can deliver huge benefits to consumers, businesses, and wider society, it can only do so if we can unlock it safely. People need to know their personal information will be safe and their privacy will be protected. Progress is being made but there is still a long way to go before we can realise the full potential of Open Finance data, with questions looming over data and privacy standards, and ethical ways of extracting and analysing personal data.

1.3.3 Data privacy

Data privacy is centred on how data should be collected, stored, managed, and shared with anyone other than the data subject. It is a key part of data protection, which controls how personal information can be used and an individual's rights to ask for information about themselves.

As the potential for Open Finance unfolds, stakeholders consistently mentioned the clear need to respect an individual's data privacy and for more common data and privacy standards. At the same time, there is a need to explore and test data-anonymising techniques.

The call from industry was a recognition that to safely unlock Open Finance data, leadership and actionable research in the management of data privacy and data ethics is required.

This includes the creation of common data and privacy standards, a simplification of governance, and full transparency that allows individuals and businesses to scrutinise who has accessed their data and why.

1.3.4 Data ethics and governance:

Ethical use of data and technology has developed into a key topic in recent years. To reap the benefits of Open Finance, we must ensure that available data is used responsibly, in a transparent way that builds consumer trust.

Research into an ethical and legal framework is required, with the aim of maximising positive social impact and preventing misuse of consumers' data to their disadvantage. For example, ensuring that sharing health data does not make it even more difficult for vulnerable consumers to access credit, and that it does not increase the potential to exclude people from vital services.

Further, since there will always be varying degrees of consumer tech-savviness and willingness to engage with technology, we must ensure that a lack of 'data history' does not create new forms of exclusion.

While the data is currently held in financial institutions such as FinTechs, banks, pension providers and asset managers, Open Finance data will bring into focus the issue of individuals' data rights. As Open Finance data evolves; it will need to consider how customers will have control over how that data can be used. Any access to, or re-use of, that data should be done with the customer's consent and with their best interests in mind. Indeed, there are innovative concepts being explored to give people control and agency of their own data. Sir Tim Berners Lee is working on such a concept through an open-source platform. We might be some time away from what this could look like in reality, but the pace of technology is increasing the potential every day.

As this unfolds and as noted earlier, more actionable research into fair and transparent data sharing principles and ethical ways of combining different data sets is required. This includes the use of synthetic data and its potential to support innovation while limiting potential data privacy and cybersecurity risks.

Actionable research into the effective creation of synthetic data will help to build industry and consumer confidence about the integrity of such data sets, and their ability to maintain the privacy and protection consumer expect.

Another significant topic which increasingly receives industry attention is advanced analytics. Firms are exploring machine learning, predictive modelling, visualisation, sentiment analysis, pattern matching and other AI use cases, but there is a requirement for more research and knowledge exchange on how to build confidence in AI applications and address issues such as AI biases.

Progressing Open Finance

All the different contributors to this Roadmap highlighted Open Finance as a priority topic for the future of FinTech and financial services. Charting a course to success will require determined collaboration. Experiences and lessons learned through the development of Open Banking provide solid foundations. It has helped many across the banking industry understand the value of implementing common interface standards and has emphasised the significant of interoperability to support innovation. But it has not been easy.

"AI ethics, data ethics and fairness will be strong areas of research for a long time to come as they represent an increasingly crucial consideration as well as providing areas of focus where the technologies could be applied to solve problems."

Chris Brown, Senior Manager, Deloitte

The significance of common standards and the value of interoperability is also evident in the approach to achieve The Pensions Dashboard. We can also see examples beyond the financial services industry of similar developments, the energy sector by way of example.

As Open Finance emerges it will be essential that effective common standards are developed to increase the opportunity and to enable responsible innovation.

Roadmap next steps: Open Finance data

Open Finance data has the potential to significantly change consumers' and businesses' engagement with finance, and to deliver better outcomes. It spans the whole suite of financial products and services as we understand them today, including banking, savings, mortgages, pensions, investments, insurance, lending, and payments. To help achieve its potential, more leadership, actionable research, and innovation are required. This Roadmap sets out specific actions to help drive this opportunity – through a collective approach that involves industry, innovators and researchers – to create the future of finance. In addition to being a strategic priority, Open Finance data facilitates FinTech innovation in wider areas, and is an enabler for the three other strategic priority themes.

Theme	Action	Action Type	Timeframe (phase)	Stakeholders
Everyday Personal Banking and SME Banking	Common classification system to enable a consistent taxonomy for spending data.	Innovation Calls	1	PwC, NatWest, Virgin Money, TSB, HSBC, Lloyds Banking Group, Tesco Bank, Smart Data Foundry, Sainsburys Bank, Equifax, Barclays, NCR, University of Edinburgh
	Customer vulnerability - predicting potential financial vulnerability.		1	
	Provide fairer access to mainstream credit creating new models.		1	
	Explore the support needed for the SME market to grow post the COVID-19.		1	
	Facilitate practical ways to increase savings across the UK population.		2	
	Support greater consumer financial awareness, literacy, and education.		2	
	Enable greater access to credit and lending for consumers and SMEs.		2	
Creating future business models for everyday money management & banking.	3			
Long-term Savings and Investment	Financial wellbeing and resilience.	Innovation Calls	2	PwC, M&G, Royal London, Phoenix, Lloyds Bank, Abdrn, Smart Data Foundry, Baillie Gifford, University of Edinburgh
	Encouraging consumer engagement in long-term saving and investing.		3	
	Addressing changing needs of future living and the ageing population.		3	
	Aligning public sector social care with private insurance provision.		3	
Personal and Possessions Insurance	Insurance - data sources to determine insurance risks.	Innovation Calls	2	PwC, Lloyds Bank, Equifax, Smart Data Foundry, NCC Group, University of Strathclyde, University of Edinburgh
	Utilising artificial intelligence in gaining data insights for managing risks.		2	
	Developing new mechanisms for personal data privacy.		2	
	Building understanding of key elements for good data ethics and governance.		3	
Actionable Research in Open Finance Data	Ethical data and addressing AI biases more effectively.	Research	1	University of Edinburgh, University of Glasgow, University of Abertay, University of Strathclyde, Smart Data Foundry, NCR, NCC Group
	Customer digital behaviour and engagement including current and future changes in consumer behaviour with mobile.		1	
	Evaluate the role and application of synthetic data across Open Finance innovation.		1	
	AI in Financial Services - opportunities from Open Finance.		1	
	Gamification and data application to improve consumer engagement.		1	
	Virtual and augmented reality to better understand how people engage with their finances and improve financial outcomes.		2	

Key Priorities:

PHASE ONE: 1-2 years

Banking:
- customer vulnerability
- credit models
- SME business engagement

Ethical Data application
Synthetic Data for innovation
Customer digital behaviour
AI in Financial Services
Gamification

PHASE TWO: 3-5 years

Banking: financial literacy
Savings:
- financial literacy
- financial well-being
- retirement planning

Insurance: data / risks

Virtual and augmented

PHASE THREE: 6-10 years

Banking: future business models

Savings:
- ageing population
- social care

Insurance:
- insights and ethics
- AI in managing risk

KEY:

INNOVATION CALLS

RESEARCH

2

PRIORITY THEME: CLIMATE FINANCE

ESG Data

- ESG reporting
- Investor confidence
- ESG data
- SME market

Carbon markets and carbon offsetting

- Voluntary carbon markets
- Carbon offsetting

Facilitating a net zero economy

- Investment decisions for net zero
- Circular economy
- Housing
- Insurance
- SME market

ESG Data

Climate
Finance

Carbon
Markets and
Carbon
Offsetting

Facilitating
a Net Zero
Economy

"We will need to innovate and evolve our business models in order to finance and enable a greener future that makes a tangible difference to people's lives. This has to be done by industry working together with government, policy-makers and regulators to ensure the UK maintains its position as a global leader of green finance in our rapidly changing world."

Janine Hirt, CEO, Innovate Finance

Climate Finance

The impact of climate change across the world is disrupting national economies and affecting lives. It requires urgent action from all to address the growing issue.

In its 2020 Global Risks report, the World Economic Forum highlights that the risk signals show the horizon for addressing climate risks has shortened. For the first time in the history of the report, the top five risks that it outlines are in a single category: 'climate environmental change'.¹⁷

The change is connected to increased carbon emissions, most notably:

- Significant use of fossil fuels to power energy, manufacturing, and industry.
- Increasingly intensive agriculture and deforestation to support food production and the demands of a continually growing world population.

Science and experience show these carbon emissions are currently inextricably linked across the world's economy.

For this Roadmap, we use the term Climate Finance to describe the role that finance, technology and data can play in addressing the climate change crisis and powering a sustainable future.

Enabling a more sustainable future was a prominent theme throughout the research for the development of this Roadmap. Throughout our analysis, the influence of finance together with the potential for exponential change through technologies was thought to be a

powerful combination to help the necessary transition to a carbon neutral economy.

There is a growing sense of responsibility, a clear sense of urgency and a uniquely practical sense that the recovery plans required following the Covid-19 pandemic could provide the impetus for a positive impact to support a greener economic recovery.

There is also growing certainty that success will depend on significant economic changes, as nations around the world develop and implement plans to reduce CO2 emissions and achieve the Paris Agreement aims of limiting global temperature rises to 1.5°C from pre-industrial levels.

Every company, organisation and sector will need to adjust business and operating models, and implement credible plans for a transition to a low-carbon future. To do this, every business and financial decision will need to take climate into account.

The road ahead will require significant private investment. Some suggest that over the next 30 years, the transition alone will require investment of between US\$92 trillion and US\$173 trillion globally.¹⁸

During COP26, the Glasgow Financial Alliance for Net Zero announced that banks and asset managers, representing 40% of the world's financial assets, have committed to using \$130 trillion of assets, with science-based guidelines, to help industries and economies reach net zero carbon emissions by 2050.¹⁹

11%

of the UK's responsible investing market is in SCOTLAND

(vs 7% of conventional investing market)

"Tackling climate change is one of the biggest challenges of our time. As the leading bank in the UK for business customers, and one of the largest for personal customers, we have a significant responsibility to help people and businesses across the UK to transition to a Net Zero carbon economy. We will play a leading role in helping our customers tackle climate change."

Kristen Bennie,
Director Partnerships and OX, NatWest

¹⁷https://www3.weforum.org/docs/WEF_Global_Risk_Report_2020.pdf

¹⁸<https://about.bnef.com/new-energy-outlook/>

¹⁹<https://www.gfanzero.com>

To support the necessary investments and finance, the market, investors and consumers are also asking for better information underpinned by credible data. This will be key in building confidence in the 'green and ethical' objectives for the different types of investments, insurance, and other financial products that are available to those who want to make more sustainable choices, and can afford to.

In the UK, financial regulators are also aiming to influence positive climate outcomes through a series of new expectations, rules and guidance. The Bank of England is working to encourage an early and orderly transition to a carbon neutral economy and to "play a leading role, through policies and operations, in ensuring the financial system, the macroeconomy, and the Bank are resilient to the risks from climate change and supportive of the transition to a net zero economy."²⁰

The Financial Conduct Authority also has a sustainable finance strategy, aiming to build greater transparency and trust, developing guidance and tools to provide mutual support to address the challenges of climate change.²¹

Climate Finance is a complex matter. Our research showed that it connects many things:

- Investment.
- Regulatory change.
- Better data.
- Advanced analytics.
- A deeper understanding of consumer behaviours and consumer engagement.
- A deeper understanding of new technologies, biodiversity, carbon, and carbon markets.

The challenge ahead is huge. Nevertheless, the research behind this Roadmap pinpointed three key topics where further FinTech research and innovation could advance progress by helping nations adapt to the impact of climate change, manage the risks of transition and lead to them becoming greener, more resilient and more inclusive. All three offer Scotland and the UK an opportunity to use strengths in research and innovation, and to build collaborative action across the FinTech and finance industry and the research community.

The topics focus on:

- 1. Environment, Social, corporate Governance (ESG) data.** Assessing the current situation and outlining the ambition for new data sources, clearer standards and advanced analytics to build greater trust and transparency in the sustainable claims made by finance and business.
- 2. Carbon markets and carbon offsetting.** Considering the role that each plays in realistically transitioning to a net zero low-carbon economy while exploring the technologies and innovation that could drive further progress.
- 3. Investing in a net zero economy.** Moving beyond finance-as-usual practices. Using innovation and technology to reinvent financial markets and stimulate the change needed to support a healthier planet.

The analysis below considers the insights from industry engagement and opportunities for further FinTech research and innovation.

"We can draw on our strengths across different sectors to drive the changes needed and maximise the future of green, sustainable and ethical investment, banking and insurance. Scotland's natural resources provides expertise in sectors that we need to learn from to understand and address the issue in hand.

Omar Shaikh, Managing Director, The Global Ethical Finance Initiative (GEFI)

²⁰<https://www.bankofengland.co.uk/climate-change>

²¹<https://www.fca.org.uk/firms/climate-change-sustainable-finance>

ESG data

Environmental, Social, and Governance (ESG) are three central factors that help to provide a framework to evaluate the impact that business or finance has on the environment or society. This approach is becoming increasingly important and universally accepted.

Across our research, the topic of ESG data was a consistent priority theme. Banks, asset managers, investors, regulators and consumers are all focused on ESG criteria and data. This data needs to enable greater transparency on ESG matters, help to make comparisons easier, and better inform future decisions.

Our analysis highlights industry interest in actionable research and innovation that can enable access to better ESG data, create uniformed standards for ease of reporting and comparison, create investor confidence in ESG claims, and support SMEs in their transition to carbon neutral business models.

2.1.1 ESG reporting

More and more companies are carrying out ESG reporting, driven by regulatory changes and demand from the market. There is a growing number of regulatory frameworks designed to encourage transparency in ESG disclosures within financial markets. Large companies are also increasingly expected to include a non-financial statement in their annual reporting concerning sustainability risks and adverse impacts resulting from their activities.

In 2015, the international Financial Stability Board launched the Task Force on Climate-related Financial Disclosures. This aims to bring clearer standards and consistency on reporting. However, this is only one of many initiatives underway.²² Industry insights highlighted an increasingly fragmented reporting landscape, with large and small organisations having to navigate many different frameworks.

There is an opportunity for actionable research and innovation to:

- Support more accurate disclosures.
- Build consistency across metrics used to assess risk.
- Consider exposures and vulnerability.
- Develop future regulatory and supervisory practices that provide a platform for greater confidence.

“ESG is now one of the most pressing and strategically significant topics in the financial services industry, and a priority area for Baillie Gifford. Actionable research is required to advance this field and we’re very interested in how the research community can help. Baillie Gifford is working with the University of Edinburgh, and we’re keen to see greater collaboration. Getting the foundations right for ESG data will benefit us all across the industry, and this can come through focused collaboration and knowledge sharing.”

**Anurag Agrawal, Head of FinTech,
Baillie Gifford**

²²<https://www.fsb-tcfd.org>

2.1.2 Investor confidence

Investors are demanding increased visibility into how sustainable their investments really are. Current arrangements are complex: different jurisdictions and providers use different classification systems. This makes it difficult to make comparisons, and potentially leaves room for uncertainty about the right approach. There is also a growing concern that greenwashing practices could undermine the impact of ESG claims by eroding confidence in genuine green and sustainable efforts to help reach net zero ambitions.²³

This was further reinforced recently by the Financial Conduct Authority, which highlighted that it had received a growing number of low-quality authorisation applications from ESG-themed funds, many of whose sustainability claims did not stand up to scrutiny.²⁴

Data, standards, and consistent global frameworks are all needed to build greater transparency and trust so investment and finance will have the anticipated impact. Linked to the role of data, and through the evolution of technologies, the ability to create and access new data sets has increased significantly. Technological advances can analyse for potential impact and create more comparable and scenario analysis that could go some way in building investor confidence. There is space for actionable research and innovation to help retail and institutional investors understand their impact, and the potential to support a stable transition to a carbon neutral economy.

2.1.3 ESG data

There are several classification systems available for ESG data. All are designed differently, using different data inputs, so it is difficult to assess and compare them.

Until recently, most of the ESG data used has been historical data that has limited ability to provide a full picture of a company's environmental and social footprint, or an understanding of future trends. In the absence of specific frameworks on what should be included in assessing the ESG metrics, individual organisations are building unique approaches. This further complicates the task of making comparisons across the market. The Taskforce on Nature-Related Financial Disclosures aims to support change through the development of a framework to help build more consistency.

New kinds of data could be invaluable, allowing organisations to differentiate themselves, go beyond any benchmarks and become more forward looking. Our analysis highlighted that there is a growing trend towards real-time data, with significant industry interest in moving towards a more forward-looking approach. Big data technologies can capture and generate new data, such as satellite data, space data, data through the internet of things, and Open Finance data. The first issue is to understand what data is needed, and to define frameworks to analyse and standardise it.

Research is needed to identify relevant data sets and develop a fair, consistent, and measurable approach to their ESG assessment.

"In terms of ESG, everyone is acting in silos and not acting at an industry level. There's no standard reporting, and some data measures don't go deep enough into the supply chain. Some small businesses (eg farmers) in the food sector will currently get multiple data requests from supermarkets etc, but if there was a platform for all then they would only need to provide data once."

Colin Carmichael, Director, PwC

"We have a significant opportunity to deliver the change that's needed through collaborative efforts. Through FinTech innovation we can lead the way for transparent disclosure on climate risk, building investor confidence. Scotland has the tools at its disposal to become a hub for climate finance; natural resources, technology, skills and finance."

Sandy Begbie, CEO, Scottish Financial Enterprise

²³https://www.schroders.com/en/sysglobalassets/digital/institutional-investor-study-2021/assets/SIIS_2021_Sustainability.pdf

²⁴https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1026224/CCS0821102722-006_Green_Finance_Paper_2021_v5_Bookmarked_48PP.pdf

While there is growing focus on the data needed for 'E', the data collection needed to assess the 'S' and the 'G' is less advanced.

Our analysis also identified that further research is needed to understand cross-sector data opportunities and implications, particularly across public and private sectors and including data available from emerging new technologies.

Using objective, forward-looking, data-driven ESG reporting presents a significant opportunity to develop confident outputs that UK and worldwide consumers can trust. This presents a significant opportunity to boost further sustainable investment.

Collaboration and FinTech innovation can build trusted and easily comparable ESG datasets. There is significant industry interest in AI, advanced data analytics, and distributed ledger technologies to create deeper insights and build efficient ways to have auditable supply chains.

There is strong industry demand for more meaningful data sets and for an understanding of how tech can enable the collection of new data.

Scotland has an opportunity to lead the way. Its data and innovation credentials, its existing infrastructure and its leadership in The Data Lab are all strengths.

In addition, the Smart Data Foundry could use its Open Finance experience and its role as a data utility to support research and FinTech innovation, and build confidence in ESG data.

2.1.4 SME market

While large financial services businesses adjust to the changing demands for information by embedding climate risk management in decision-making, many SMEs find such disclosures complicated.

The data SMEs have access to is not standardised. It is subject to interpretation, and there is no universally agreed framework to allow comparable assessments. This is made more difficult by the complexity of supply chains: the end user relies on information from others across the chain, with no ability to easily assess any environmental or broader ESG claims.

SMEs and micro businesses are a key part of the Scottish and UK economies. While many acknowledge the importance of transitioning to more sustainable business models, many are still recovering from the impact of Covid-19. Furthermore, they have limited or no resources, as well as limited expertise and information to comply with the growing ESG demands.

There is room for collaboration and FinTech innovation to simplify the demands made of SMEs, to create products and tools that will support their transition to net zero business models, and to help manage complex supply chain climate risk.

"The Green Finance Institute recently estimated that there is a c.£20 billion funding gap for nature in Scotland over the next decade to deliver our policy ambitions for climate change, clean water, biodiversity, sustainable soil management, flood risk management and recreation/amenity. Three new types of markets must emerge for investors that that want to offset or inset emissions (carbon markets), deliver other public goods (ecosystem markets) or generate a return on investment (green finance mechanisms). This Roadmap and more collaboration can support the emergence of the changes needed."

Dr Hannah Rudman, Co-director of the Thriving Natural Capital Challenge Centre, SRUC

Carbon markets and carbon offsetting

Carbon markets are a mitigation tool that contribute to the efforts to address climate change.

They allow carbon emissions to be traded to help companies demonstrate progress towards net zero outcome. Since they were established, around 120 countries have included carbon markets in their plans to achieve net zero.

During our research, the emergence of carbon markets and their role for the future was a growing topic of interest. It is a new and still unregulated market, and our analysis shows industry interest in credible and reliable information to help develop a better understanding of the impact and potential for the voluntary market. Additionally, there is interest in solutions that can help audit and verify the credentials of carbon reduction or carbon removal units.

2.2.1 Voluntary carbon markets

The UK and other regions across the world have mandatory carbon markets covering specific industry sectors and gases. However, other non-mandatory sectors have started participating in carbon markets voluntarily. These voluntary carbon markets allow carbon trade through carbon credits, which some companies use to help them meet ambitious goals for reducing greenhouse gas emissions.

The Taskforce on Scaling Voluntary Carbon Markets estimates the market for carbon credits could be worth upward of \$50 billion as soon as 2030.²⁵ Given this potential, it is clear there is a need for voluntary carbon markets that are trusted, transparent, certifiable, and environmentally robust.

However, experience is already showing this is not always the case. Today's market is fragmented and complex. Some credits have turned out to be over inflated and inaccurate.²⁶ Experiences like this are shaping changes all the time with developments suggesting carbon credits must be verified against a standard set by a relevant Code to be additional and permanent. (Examples of UK Codes include the Woodland Carbon Code and Peatland Code, international Codes include The Gold Standard Code or Verra.

Whilst experience in carbon markets is starting to grow, there is limited pricing data. This makes it difficult for buyers to know if the price is fair, and challenging for suppliers to manage the risks. In addition, there is currently no way to accurately assess the carbon costs of an initiative or business without double counting. For example, emissions from a barrel of oil could appear in the carbon accounts of the firms that are drilling for it, refining it, and using it.

It is anticipated the majority of financial technologies will be carbon conscious by 2030, due to heightening demand for sustainable banking and investment services.

However, only 1.6% of projects included in the FCA's sandbox cohorts (which ran up to 2021) related to climate change or green finance, highlighting this as an area FinTech innovators were yet to fully embrace, despite the opportunity.

²⁵<https://www.mckinsey.com/business-functions/sustainability/our-insights/a-blueprint-for-scaling-voluntary-carbon-markets-to-meet-the-climate-challenge>

²⁶<https://theconversation.com/us-scheme-used-by-australian-farmers-reveals-the-dangers-of-trading-soil-carbon-to-tackle-climate-change-161358>

Carbon offsetting

Carbon offsetting is a practice being used by some organisations looking compensate for any emissions they are creating. There are different ways to offset carbon emissions including reduction schemes and removal projects.

Reduction schemes, such as renewable energy initiatives, cut emissions by improving processes. Removal projects eliminate or sequester carbon, and are typically nature- or technology-based. Examples include carbon capture solutions or reforestation.

Both reduction and removal methods create carbon credits. Each credit gives the holder the right to offset a measure of carbon or equivalent greenhouse gas. This is a new and developing market, with substantial room for collaboration by connecting climate and FinTech innovation and research.

Contributors to our analysis highlighted a significant need to develop more solutions to audit and verify carbon credits and build confidence in carbon markets. Technology including advanced computing, satellites, drones, and distributed ledger technology will play an important role, alongside data driven innovation.

Sectors including investment, banking, and insurance are interested in research on the potential of unstructured data, and the effect that new data sources could have on carbon pricing and the carbon market.

Our research connected Scotland's natural strengths in biodiversity with the topic of carbon markets. Examples include Scotland's natural carbon sinks in water, and the largest woodland and forest area in the UK.

Expertise, scientists, and researchers from Scotland's Rural College SRUC are already at work looking at future land use, decarbonisation of the natural economy and regenerative agricultural conservation. Using Scotland's biodiversity expertise presents a significant opportunity for cross sector innovation in Climate Finance.

The developments in space data through satellite technologies will also have a role to play, and are already being used in FinTech innovations.

Trade in Space (based in Edinburgh) uses satellite insights and blockchain technology. It surveys tens of thousands of farms around the world, and translates this data into actionable intelligence, providing ways to verify sustainability claims and build confidence in trade.

ACTIONABLE RESEARCH:

Satellite Data for Sustainable Development / ESG

University of Strathclyde is engaged in research aiming to understand the role that satellite data, and big data in general, can play in addressing the UN 2030 agenda to end poverty, protect the planet and improve lives and prospects.

The project specifically seeks to understand the role that satellite data can play in monitoring and quantifying the worldwide effort to advance the UN 2030 agenda for sustainable development. It also seeks to develop, design and build alternative solutions for using satellite data to address the Sustainable Development Goals (SDGs).

Facilitating a net zero economy

Reaching a net zero economy will require a significant transformation of the world economy. To get their fossil fuels need to be replaced as the world's primary energy source, with low carbon sources such as wind and solar.

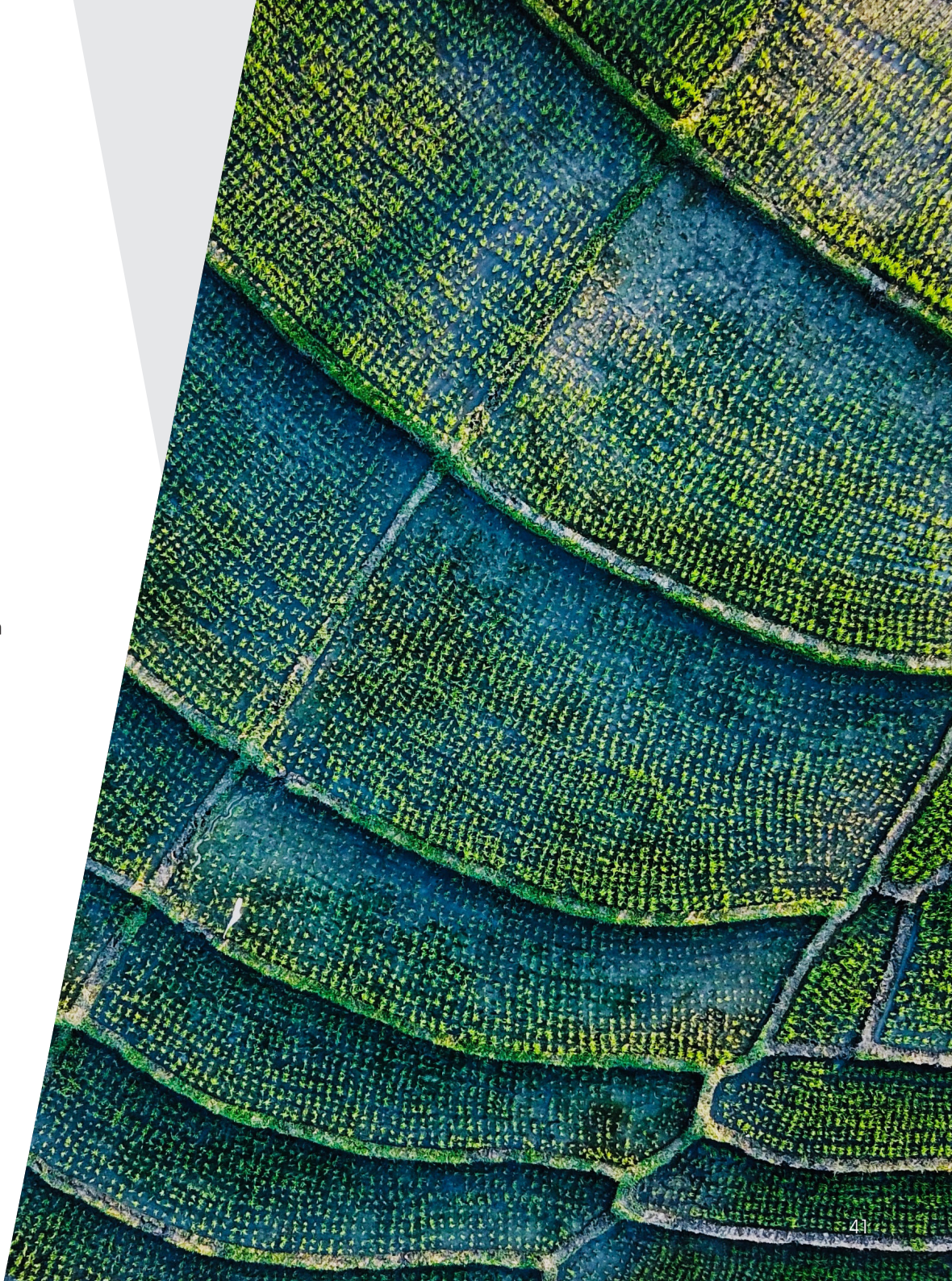
Fossil fuels currently provide 84% of the energy used across the world.²⁷ The road to a net zero economy will require collective responsibility and strong collaboration, enabling every citizen, business, corporation, and government to do their bit to achieve the transition that is needed. While there has been progress in recent years, more urgent action is needed to ensure that the world achieves the goal of limiting temperature increases to 1.5°C above pre-industrial levels.

During COP26, world leaders moved towards closer agreement to end the use of coal and other fossil fuels. Financing the investment needed for this change will require the mobilisation of public and private finance. This provides an opportunity for new products and services, from sustainable investment funds and bonds through to green mortgages, ethical insurance, sustainability ratings and data providers, as well as opportunities to progress new option for a circular economy.

Throughout our research the topic of investing for a net zero economy was prominent: it featured in discussion with representatives across capital markets, asset management, retail banking and insurance. Organisations, businesses, and consumers all recognise the fundamental role that investment decisions will have in the required transition.

In addition, to achieve the step change that is required, our analysis highlighted the role FinTech innovation can play in supporting the changes that are needed. It featured in discussions on the investment market, facilitating a circular economy, the housing market and the SME market. Analysis also highlighted the significant role that FinTech in insurance (InsurTech) will play in the transition to net zero, and in enabling a climate-resilient economy.

²⁷<https://www.blackrock.com/corporate/literature/investor-guide/blackrock-investor-guide-to-net-zero-en-corp-rc-investor-guide.pdf>



2.3.1 Investment decisions for net zero

Banks, insurers, investors, and other financial firms need to commit to ensuring their investments and lending are aligned with net zero ambitions. There is an urgent need to channel more capital towards solutions, businesses and initiatives that help achieve a net zero carbon and a climate-resilient economy. Reports estimate global investment of between US\$92 trillion and US\$173 trillion into green infrastructure is needed to meet the Paris Agreement commitments.²⁸

This cannot be done through public investment alone; it requires significant private investment, and it is important to align the financial system with sustainable development.²⁹ Following the Covid-19 pandemic and given current sentiment, there is significant opportunity to design and reimagine a sustainable financial system to improve the effectiveness in mobilising capital towards a green and inclusive economy. A new approach powered by data, technology and FinTech innovation can enable change, and be the start of a legacy from COP26.

Individual investors also have a significant role to play. According to analysis by Make My Money Matter, UK pensions alone are responsible for enabling 330 million tonnes of carbon emissions every year. The analysis indicates that individuals can cut their carbon footprint by more than 21 times by making their pension green.³⁰

More sustainable investment funds are emerging. However, as outlined earlier, our analysis shows there is a significant need to build greater confidence in ESG sustainability claims, remove any greenwashing practices, and build investor trust. As the Financial Conduct Authority and HM Treasury work on developing a sustainable investment label regime, there is a positive opportunity for more collaboration and actionable research.

This will ensure that future labels relate to scientific research and have the capacity to be monitored and robustly assessed. This will not only create trust, but it will enable effective processes to unleash innovation from the research creating significant opportunity for investment in new FinTech.

In addition, our research highlighted the perceived difficulty of both investor inertia and complexity in persuading individuals, all with different personal values and beliefs, on how different funds and investments could align with their values and have a positive impact on climate change.

Our analysis identified broader interest in behavioural research to evaluate approaches that can incentivise consumer and business adoption of sustainability practices. This could also influence more sustainable investment, including innovations that can incentivise consumers into better climate behaviours. FinTech innovations using advanced data analytics, AI and advanced digital computing have transformative potential across this area.

The development of the Roadmap identified industry interest across these and other technologies. In particular, exploring how virtual and augmented reality and the concept of gamification could help increase consumer engagement with the climate change agenda, and help people connect their personal values to the ESG investment needed to transition to a climate-resilient economy.

²⁸<https://about.bnef.com/new-energy-outlook/>

²⁹https://www.g20-insights.org/policy_briefs/fostering-sustainable-global-growth-green-finance-role-g20/

³⁰<https://makemymoneymatter.co.uk/21x/>

2.3.2 Circular Economy

The circular economy supports sustainability by enabling economic growth without greater resource use. It moves the model away from a linear economy that assumes that our supply of resources is infinite and that the earth can absorb all our waste. In the last 15 years, €5.82 trillion worth of people's belongings have simply been disposed of, and the UK produces around 37 million tonnes of waste per year .

Consumption accounts for over two thirds of Scotland's carbon footprint and so tackling this issue will go a long way to achieving a more climate-resilient economy, while creating jobs for the future. Moving to a more sustainable and circular economy could cut CO2 emissions, save resources, and reduce waste to landfill. It presents an opportunity to empower local communities, minimise waste, and repurpose products and operations to encourage greater use and recycling.

Contributors to the Roadmap provided a view that the transition to a more circular economy could also create compelling long-term opportunities for investors who would also like to deliver a positive impact for the environment . For example, transforming waste into a resource could unlock greater value for businesses, and reduce costs and risk in their supply chain. However, this type of transformation will take more than a change in mindset; it also requires new processes and systems.

Our analysis highlights a demand for more FinTech innovation and actionable research to enable investment and finance that can transition the economy to a more circular model. It also highlighted interest in opportunities for sustainable consumption and production, support for business and operating models that enable greater recycling, and ways to minimise supply chain costs and risks.

³¹<https://www.accountingweb.co.uk/community/industry-insights/why-we-desperately-need-to-move-from-a-linear-to-a-circular-economy>

³²<https://events.holyrood.com/event/future-circular-economy-scotland/>

³³<https://www.mandg.com/investments/private-investor/en-ch/in-the-spotlight/m-g-insights/2020/12/investing-in-the-circular-economy>



2.3.3 Housing

For the UK to be successful with the net zero and renewable energy plans, investment will be needed in UK housing stock, which is responsible for approximately 20% of the country's total greenhouse gas emissions.³⁴ It is estimated that £250 billion needs to be invested in UK home upgrades by 2050, suggesting significant potential for capital into green mortgage finance in the coming years.³⁵

However, the Coalition for the Energy Efficiency of Buildings highlights that change is difficult. Consumers are faced with unclear local and national information, limited understanding of what good outcomes look like, and lack of knowledge on what changes are needed.

Our analysis indicates that there is significant potential for change through FinTech innovation to help stimulate greater demand for the changes needed in UK housing. For example, helping consumers to understand the range of energy saving solutions, retrofitting options, financing options, other incentives, and expected standards. FinTech can also help assess the potential impact of these changes on insurance and lending portfolios.

2.3.4 Insurance

The UK's Insurance and long-term savings sector holds £1.6 trillion of invested assets across the world and pays out £46m in insurance claims every day in the UK.³⁶ As 'society's risk manager', the insurance industry has a critical role to play in enabling mitigation plans and the adaptation necessary to respond to climate change.³⁷ It has a role in assisting the net zero strategy and plans of businesses across Scotland, and the UK, by promoting risk management and supporting necessary transition plans.

The industry anticipates opportunities for FinTech innovation in insurance. These include the use of technology and new data sources that incentivise low carbon choices, and advanced underwriting practices to support and enable net zero business models and decarbonise the claims process.

In addition to the protection role that insurance will play in worldwide net zero transition plans, our research also ascertained the progressive opportunity for innovation and research in insurance using photonics technologies, robotics, and smart machines.

The analysis for this Roadmap also revealed further industry interest in the connection between space data and FinTech innovation in the insurance market. FinTech innovation is starting to use millions of new data points from satellites and space agencies to calculate risks relating to climate change.

Global climate data can enable new innovations in insurance that can help to advance financial inclusion, incentivise better climate related behaviours, and support the climate agenda. Scotland is building significant experience in Space Tech and Space Data, generating alternative data from drones and satellites.

Combined with the strength in FinTech innovation, this offers a substantial opportunity for future FinTech innovation and research. Enabling practical knowledge-sharing mechanisms, and incentivising FinTech innovation that uses existing expertise, could assist our transition to a new zero economy and create quality jobs for the future.

³⁴<https://www.greenfinanceinstitute.co.uk/wp-content/uploads/2020/06/Financing-energy-efficient-buildings-the-path-to-retrofit-at-scale.pdf>

³⁵<https://www.greenfinanceinstitute.co.uk/unlocking-the-potential-of-the-uks-green-mortgage-market/>

³⁶<https://www.abi.org.uk/about-the-abi/sustainability/climate-change-roadmap/>

³⁷https://www.eiopa.europa.eu/media/speeches-presentations/interview/moving-green-how-insurance-risk-manager-of-society_en

2.3.5 SME market

To achieve a sustainable and resilient climate economy investment in the SME market is also required. Throughout the development of this Roadmap, the primary participants referenced the need for FinTech innovation and actionable research to support SMEs. This will require changes to business models and operating models, to prepare SMEs for a digital economy and help them with their transition plans to net zero.

Industry contributors also mentioned:

- Actionable research and innovation using Open Finance data and advanced analytics to help all types of businesses understand the implications of national net zero targets on their business.
- The potential to calculate their current carbon impact to better inform their own targets and plans to achieve net zero.
- Advanced carbon management. This could include the use of technologies such as distributed ledger and blockchain to advance supply chain analysis and supply chain design.

The industry also expects emerging SME business models that will equip the economy to become more climate-resilient. New ways to finance and assess the risks and potential success for these businesses will be required. Without early-stage funding and investment new promising enterprises will struggle.

FinTech research and innovation for new business risk assessments, underwriting assessments, patient capital assessment and credit risk assessment will help to better inform investment and lending decisions.

As highlighted earlier, an important consideration is the role that effective and credible ESG data could have for future investment. The same analysis highlighted a role for credible ESG data in future SME product development and businesses decisions, from supporting the development of a circular economy or anticipating yields, to forecasting quality and value of outputs.

Scotland's strength in agriculture was specifically raised numerous times during this analysis, including in connection with the topic of Climate Finance. A range of stakeholders expressed an interest in being involved in cross-sector collaboration to explore opportunities in the field of 'AgriFinTech', including academics and FinTech entrepreneurs.

The Data Lab

- The Data Lab is Scotland's Innovation Centre for data and AI. Its mission is to help Scotland maximise value from data, and lead the world to a data-powered future.
- It was founded in 2014 as part of Scotland's Innovation Centres programme, and has operational hubs in Edinburgh, Glasgow, Aberdeen, and Inverness. It is one of the eight innovation centres funded by the Scottish Funding Council through the Innovation Centres programme.
- Together with a network of over 1,500 companies, public sector organisations, universities, and data experts, The Data Lab is working to make Scotland a global leader in data innovation. It is focused on giving individuals and organisations the practical skills and hands-on experience they need to apply the latest data science thinking in the real world.
- The Data Lab sponsors a wide range of Masters and Data Science courses, including approximately 160 Masters students and approximately 35 Masters courses. It also works with around 90 industry partners that offer 2- or 3-month placements.

Roadmap Next Steps – Climate Finance

While Climate Finance includes the investment needed in infrastructure to help the transition to a net zero carbon economy, the development of this Roadmap highlighted the industry ambition for Climate Finance to go much further. Finance, technology, and data collectively have a unique role to play to influence positive change, enabling businesses and people to progress towards a more sustainable future. In addition, new ways to encourage and incentivise different consumer behaviours will go further to support an inclusive and just transition. The Roadmap sets out several actions across the short, medium, and longer term to help progress enable more R&I in Climate Finance.

Theme	Action	Action Type	Timeframe (phase)	Stakeholders
ESG	Investor Confidence and Data Innovation - Through the Edinburgh and Southeast Scotland City Deal for Data Driven Innovation and in collaboration with Smart Data Foundry create a series of innovation challenges focusing on building investor confidence in ESG disclosures.	Innovation Calls	1	Smart Data Foundry, Baillie Gifford, Abdrn, M&G, Phoenix, Royal London, University of Strathclyde, University of Edinburgh
ESG	ESG Data Plan - In collaboration with The Data Lab, Smart Data Foundry and the Energy Systems Catapult develop an ESG data plan aligning with Scotland's Council for Development and Industry's climate recommendation to increase open data sharing.	Research	2	The Data Lab, Smart Data Foundry and the Energy Systems Catapult, Fujitsu, PwC, Phoenix, Royal London, University of Strathclyde
Carbon Markets	Carbon Markets - stimulate and accelerate research in carbon markets and develop a knowledge transfer network in collaboration with key stakeholders.	Research	2	Innovate UK, Scotland Rural College, University of Strathclyde. University of Glasgow, University of Edinburgh
Facilitating for Net Zero	SME Climate Innovation - Launch a climate finance innovation challenge to stimulate FinTech innovation to support the SME market and advance Scotland's and the UK's net zero ambitions.	Innovation Calls	1	The Data Lab, Smart Data Foundry, NatWest, Lloyds Banking Group, Virgin Money, TSB, Scottish Enterprise, University of Edinburgh
Facilitating for Net Zero	Space Tech and FinTech Innovation - Collaborate with Scotland's SpaceTech Cluster and Scottish Enterprise to create a Space to FinTech accelerator, stimulating cross sector innovation.	Innovation Calls	1	BT, NatWest, Barclays, Scottish Enterprise, University of Strathclyde, University of Edinburgh
Facilitating for Net Zero	FinTech and Climate AI Focused Innovation - Work on a broader programme of Climate-FinTech innovation with UKRI, focused particularly on AI, Next Generation Services and investing for a climate resilient economy.	Innovation Calls	1	Baillie Gifford, Barclays, NatWest, abdrn, Barclays, Tesco, Sainsburys, University of Strathclyde, University of Glasgow, University of Edinburgh
Facilitating for Net Zero	Climate and Economic Development - Create four industry and academic collaboration programmes to focus on research and innovation that will drive practical change and investment in our net zero economy.	Research	3	Scottish Enterprise, University of Edinburgh, University of Strathclyde, University of Glasgow, University of Aberdeen, Herriot Watt, ScotlandIS
Facilitating for Net Zero	Green Accountancy Practices - Work with the University of Strathclyde to explore how accounting practices can be changed to ensure that the benefit of taking a green approach is appropriately captured on balance sheets	Research	1	University of Strathclyde

Key Priorities:

PHASE ONE: 1-2 years

SME Climate innovation

Investor confidence

AI FinTech Climate innovation

Green Accountancy Research

PHASE TWO: 3-5 years

Space tech and FinTech innovation

Carbon markets information

ESG Data Plan

PHASE THREE: 6-10 years

Climate Economic Development

KEY:

INNOVATION CALLS

RESEARCH

3

PRIORITY THEME: PAYMENTS & TRANSACTIONS

Digital currencies

- Cryptocurrencies and stablecoins
- Distributed ledger technology

Embedded payments

- SME market
- Retail consumers

Security for digital payments

- Cyber security
- Biometrics

Digital
Currencies

Payment &
Transactions

Embedded
Payments

Security for
Digital
Payments

"We have entered a period of significant change as new digital forms of currency have the potential to change how we think about money, how we transact, pay and invest. Digital currencies, including cryptocurrencies are moving towards greater adoption, there is an opportunity to reimagine how the whole financial sector works, how it benefits everyone and how it is regulated.

To achieve this we need to bring together regulators, citizens, the industry and researchers to ask the right questions and inform the way forward. The UK has a significant opportunity to lead the way, and we must collaborate to lead the anticipated changes that will impact us all".

Nick Jones, CEO, Zumo

Payments & transactions

The way we pay for things is changing. Throughout the development of this Roadmap, payments and transactions were referred to as the transfer of value, (either money, goods, or assets) in exchange for good and services.

This Roadmap pinpoints the significant move from physical exchanges to digital transactions, and identifies several significant trends that could mean payments will change significantly in years to come. These changes will have a significant impact on the economy, and could also have a substantial impact on citizens and businesses. That is why the future of payments is a priority theme for the Roadmap.

In 2018, up to 39 billion payments were made in the UK, totalling more than £83 trillion.³⁸ During the Covid-19 pandemic, the necessary restrictions implemented by governments to protect public health changed the operating environment for businesses large and small worldwide. Digital and card payment volumes increased by 50% in the first half of 2020, helped in part by an increase in the limits allowed for contactless payments.³⁹

In person payments declined, as did the use of cash, while online transactions and alternative payments such as mobile payments and peer-to-peer transactions increased.

However, although the trend is towards online and electronic payments, the UK government and regulators have identified that there are still over 5 million adults in the UK who rely on cash.⁴⁰

The pandemic accelerated the move from physical to digital in many aspects of our lives, including how we make transactions. Customers' digital expectations and a shift towards more instant electronic payments are having a significant impact on our economy, and a new digital economy is emerging strongly.

However, during the development of this Roadmap concerns for SMEs were raised as payments innovation and consumer digital expectations further evolve.

Although many SMEs continue to lag in digital transformation, they play an important role in our industrial fabric, including in many regions in Scotland and across the UK. In 2020, the Department for Business, Energy & Industrial Strategy reported that SMEs accounted for 50% of total revenue generated by UK businesses.

Industry contributors highlighted the vital role that SMEs play in the UK economy, and the need to support their business development with practical solutions as payments innovation also evolves.

While consumers increasingly expect payments to be instant, behind the scenes there is a significant payments infrastructure that enables card transactions to be processed and settled. Several parties are involved in the process.

PAYMENTS

is the leading area of innovation

37%

of FinTechs firms in Scotland are represented in this area

"Scotland's strength in payments originates from its long standing banking heritage, but today some of the most innovative developments are coming through the FinTech sector. The fact there are so many FinTech firms in Scotland with payments as part of their proposition illustrates how active we are in this space."

**Fernando Pacheco,
Director of Product, Modul**

³⁸UK Finance (2019) Payments

³⁹UK Finance (2021) The impact of Covid-19 on UK card payments in 2020

⁴⁰<https://www.psr.org.uk/our-work/access-to-cash/>

In the UK, Faster Payments, enabled by regulation and connected infrastructure, is enabling mobile, internet, telephone and bank payments to move quickly and securely between UK bank accounts 24 hours a day.⁴¹

Technological advances have led to step changes in innovation that help the payment process become faster, making it easier and more convenient to pay and transfer money locally and globally.

Regulatory changes have also helped – including the launch of the Payments Services Regulator, Bank of England changes to payment infrastructure, and legislative changes such as the Payments Service Directive (PSD2) and Open Banking.⁴² They have enabled greater flexibility and provided room for innovation and new approaches to paying, transacting, and transferring value.

These changes have also enabled new entrants to the market. This includes the global tech giants Apple and Google, as well as car manufacturers such as BMW, Volkswagen, and Hyundai, and consumer goods companies including Amazon.

Looking beyond the UK, in the past decade China has experienced a retail payment revolution. Businesses such as Alipay and WeChat now provide the capability to complete not only retail payments but also person-to-person payments and many business-to-business transactions. Together these two brands have an

estimated combined payments market share of 94%, and they are giving retailers and tech providers access to significant transactional data sets.

Across the development of the Roadmap, we could not introduce the theme of future payments without considering the topic of digital currencies and crypto currencies.

These innovations present new ways for value to be stored and exchanged. Digital assets such as crypto currencies and stablecoins present more potential disruption in the future of payments.

As we further explored the payments theme, we identified technologies of particular interest, such as AI, blockchain and distributed ledger tools. Industry expressed interest about how these technologies could offer a completely different way to organise and manage payment systems, providing a route to real-time, cross-border payments worldwide.

As a result, our research highlighted payments and transactions as one of the most important themes for future research and innovation.

The industry contributors to this roadmap offered a view that the future looks set for significantly more change. Our analysis highlights three topics of interest:

Payments innovation such as blockchain and digital currencies is perceived by online survey participants as being an immediate tech priority over the next two years.

- 1. Digital currencies.** Potential new ways to pay and transact in the future, with underlying technologies that could provide new foundations for the future of value exchange.
- 2. Embedded payments.** Integrating frictionless payments into everyday activities, enabled by smart technology, and potentially driven by changing consumer expectations.
- 3. Security in digital payments.** Building security, trust, and user protection through cyber security, protecting users from malicious activity, reducing the potential for financial crime, and promoting a secure and trusted digital payment environment.

The analysis from our research is outlined below, along with the actions suggested to advance this opportunity for Scotland and the UK.

⁴¹<https://www.fasterpayments.org.uk>

⁴²EU (2015) Payment services (PSD 2) - Directive (EU) 2015/2366

Digital currencies

Advancements in technology and the ability to transact electronically have created innovations that in the future could be alternatives to physical currency. As we experience them today, we define digital currency as any currency that's available exclusively in digital form.

The key differentiation to money, as we know it currently, is that digital currency does not tend to have a physical form. When exchanged it is done so via digital or electronic means and remains in a digital wallet or computer network. Other terms associated with digital currencies are cryptocurrency, stablecoins, and others such as security token offerings and non-fungible tokens.

3.1.1 Cryptocurrencies and stablecoins

New digital assets can be bought, invested in, or traded. However, cryptocurrencies are decentralised finance: they are not backed by central banks. If they are to be accepted into the UK, then new regulation and legislation will be required.

Crypto currencies have been around for over a decade. Bitcoin officially launched in January 2009, and the crypto asset market has been growing ever since, reaching an estimated value of \$2 trillion in 2021.

Buying and selling cryptocurrencies is becoming increasingly easy, but so far there are limited options to use crypto currencies as mainstream payments. Some UK retailers have started to explore options.

Articles suggest that some in the hospitality industry,⁴³ as well as some big high-street names,⁴⁴ are exploring ways to accept Bitcoin.

However, there is still a lot to learn about the potential, the impact, and the implications of cryptocurrencies as a method for mainstream payments. Stablecoin is a form of cryptocurrency that is linked to an asset that is stable in value, like the US dollar. Stablecoins are generating significant interest for future payments or value exchange.

Some contributions to our research argue that stablecoins could be used seven days a week, 24 hours a day, anywhere in the world, and can complete money transfers in seconds as the underlying technology does not rely on current banking and payments infrastructures.

The UK Government has established a crypto assets taskforce, and the UK regulators are considering the benefits and risks on a range of issues connected to this topic, including a separate digital currency backed by a central bank.

3.1.2 Distributed ledger technology

These emerging crypto currency innovations are enabled by distributed ledger technology. This creates transaction 'blocks' that are linked or 'chained' together, creating a clear record of transactions and connections. Hence, the word 'blockchain' is often used to describe the underlying technology capability for crypto assets.

"Blockchain isn't limited to financial services but there's a widespread opportunity for its application. Barclays has a long history of innovation and is actively investing in and exploring new technologies, while supporting the FinTech community applying these ground-breaking advances to scale. Research, innovation and collaboration will help us advance as the space evolves".

**Charlotte Kanagasabapathy,
Head of Rise, created by Barclays**

This technology, automated with others such as machine learning and AI, has the potential to change many aspects of business. It is fast becoming an exciting market, with \$7 billion invested in blockchain startups in Q1 2021 alone.

Blockchain creates digital records that can be stored, shared, and amended. Each record (normally a transaction) is validated, documented, and encrypted. The process applied is agreed and shared across the chain, and is reportedly highly secured using cryptography.

These developments pave the way for a potentially very different future of value exchange. According to the World Economic Forum, up to 10% of global GDP could be stored on blockchains by 2025.⁴⁵

⁴³<https://www.brewdog.com/blog/bitcoin-cash-and-brewdog>

⁴⁴<https://www.brewdog.com/blog/bitcoin-cash-and-brewdog>

⁴⁵<https://www.weforum.org/agenda/2019/08/blockchain-security-trust/>

The development of the Roadmap highlighted significant industry interest in distributed ledger technology, blockchain and crypto assets. There is much to understand and explore. Current legislation does not account for crypto assets, and regulators are still exploring and evaluating this emerging aspect of financial markets.

There is currently no standardised industry terminology for crypto assets, and participants have developed their own templates, making comparisons difficult. Specific expertise is needed to understand the underlying terminology and approach being used.

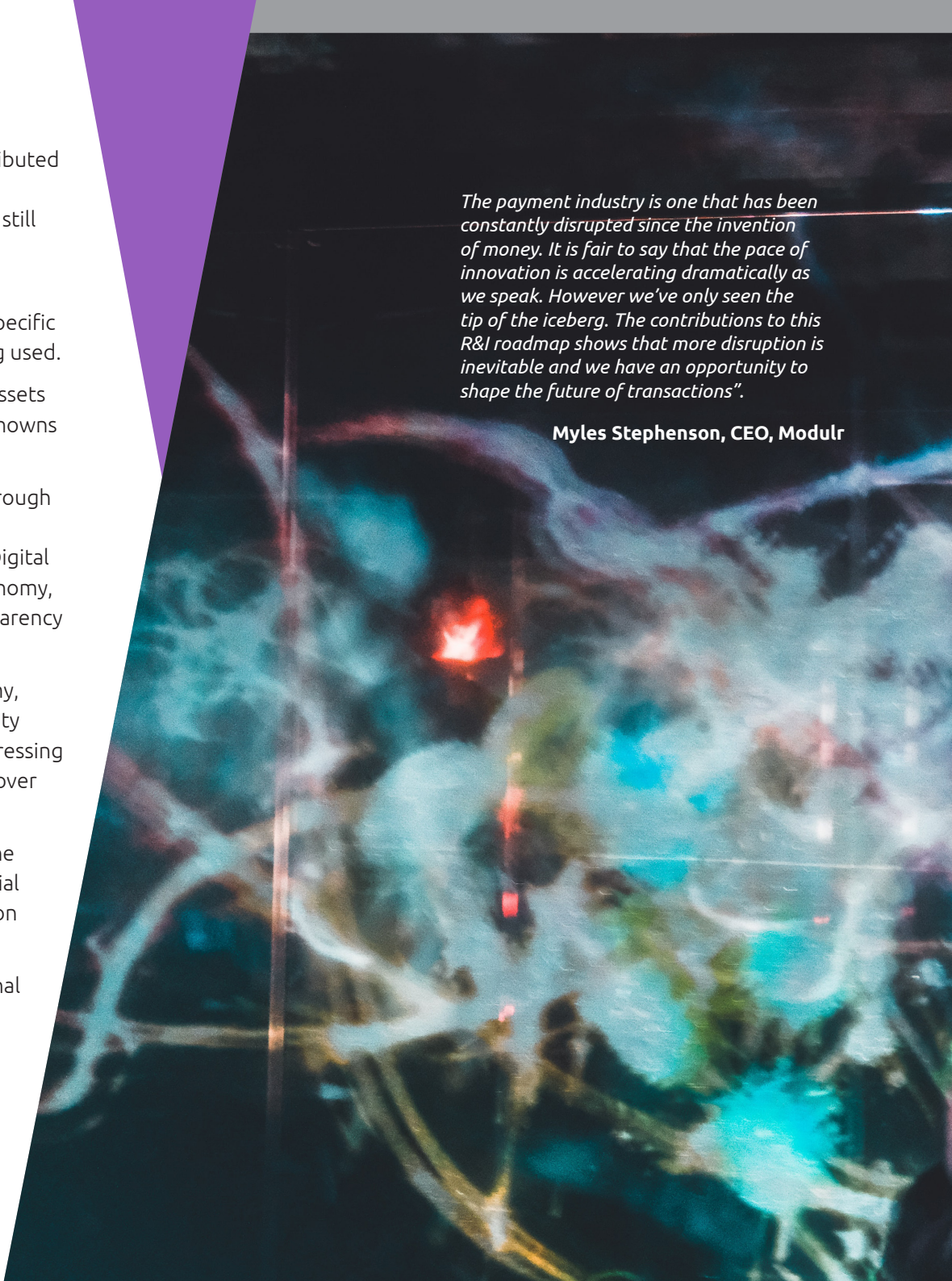
There are also currently no accounting standards that specifically address crypto assets on business accounts and annual financial statements. This creates significant unknowns for businesses and consumers, causing risks and uncertainty.

The UK Govt Innovation Strategy placed an emphasis on stimulating innovation through missions and technologies, with an emphasis on leading the future by creating it. Creating the future of payments and value exchange is an exciting possibility. AI, Digital and Advanced Computing have a significant role to play in optimising a digital economy, by building trust in digital payments. Blockchain offers potential benefits in transparency and security.

Given the growth in this market and the continued evolution of the digital economy, innovative FinTech SMEs are calling for more to be done to advance this opportunity through legislation and regulation. Established and emerging economies are progressing ahead and, in some cases, currently offer more certainty and potential for early mover advantage in this field.

Contributors to the development of this Roadmap identified that, in addition to the consultations on legislation and future regulation of crypto assets, the UK's financial services industry would benefit from more actionable research and collaboration on blockchain and distributed ledger technology.⁴⁶

The development of the Roadmap also noted the potential to enhance international trade through technologies that enabled more direct and transparent processes moving away from the more complex and opaque current practices.



The payment industry is one that has been constantly disrupted since the invention of money. It is fair to say that the pace of innovation is accelerating dramatically as we speak. However we've only seen the tip of the iceberg. The contributions to this R&I roadmap shows that more disruption is inevitable and we have an opportunity to shape the future of transactions".

Myles Stephenson, CEO, Modulr

⁴⁶https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/950206/HM_Treasury_Cryptoasset_and_Stablecoin_consultation.pdf

Embedded payments

The evolving technology is advancing the methods to embed payments in everyday experiences and allow customers and businesses to pay for purchases without entering bank details, credit, or debit card information.

As this capability develops, embedded payments allow any kind of company or online retailer to incorporate payment software directly into their business. This means customers are not redirected to a third party, such as a bank or credit card company.

This is opening a completely new payments experience for customers, and enabling businesses to offer new services such as different payment terms, instalment offers, discounts and loyalty connections. The development of the Roadmap highlighted digital frictionless payments as an emerging market, expected to grow at a CAGR of 13.7% between 2021 to 2026, with new businesses focused on seamless customer centric experiences.⁴⁷

Historically, the payments process has lived at the edges of experience for businesses. Payments were either taken in cash, or offline, with no real lasting insights into the customer and the goods or services they purchased. Technology businesses are fully embedding software that enables a change to this experience. This creates more choice and allows businesses to have a deeper connection with customers. For example, business models such as Uber have been leading the way, with an app that allows customers to order a taxi, track its arrival time and pay for the journey. Many other embedded payment innovations are emerging, such as in-car payments, smart fridges and connected homes.

Connected to the developments in online payments are the evolution of e-commerce business models. One-click shopping and marketplaces such as Amazon have continued to build consumers' expectations of 24/7 shopping and retail experiences. Our Roadmap analysis highlighted that payments made with bank debit and credit cards currently dominate in the UK.

However, there is growing use of mobile payments and wearables (typically a smart watch). Nearly a third of the adult population in the UK was registered for mobile payments in 2020, and 56% of people aged 16-24 use mobile and wearable payments.⁴⁸

Although paying with cash has declined, those contributing to this research continue to see an important role for cash in the near and medium term.

JP Morgan sees a future with more online marketplaces, growth in specific commerce via the Internet of Things and AI, and more use cases for Distributed Ledger Technology in banking.⁴⁹

The Internet of Things revolution is happening fast. Our research contributions highlighted that in the next few years any device that can be connected to the internet could become a platform for purchasing goods and services. It creates a future where the Internet of Things becomes the Internet of Payments, presenting a universal omnichannel network. For example, where payments are fully embedded and simply authorised by unique characteristic of each individual, such as voice, or bio-metric fingerprints or facial recognition.

This change has the potential to dramatically transform the financial services industry and broader economy, with new technologies that drive more connected interoperability at home and in life more generally having a significant role to play in the evolution of the digital economy.

Furthermore, combining the future potential for more online payments with digital currencies further strengthens the industry interest in distributed ledger technologies, and the role that blockchain, machine learning, AI and advanced computing could have on the future of business services.

⁴⁷<https://www.reportlinker.com/p06030471/Digital-Payments-Market-Growth-Trends-COVID-19-Impact-and-Forecasts.html>

⁴⁸<https://www.ukfinance.org.uk/sites/default/files/uploads/SUMMARY-UK-Payment-Markets-2021-FINAL.pdf>

⁴⁹<https://www.jpmorgan.com/solutions/treasury-payments/insights/shaping-the-future-of-FinTech>

3.2.1 SME and business market

During the development of this Roadmap, retail banks and the business community expressed interest in innovations that enable retailers to create a fully customer-centric service experience, while building efficiencies and smarter solutions for business operations. While some payments are becoming increasingly frictionless for consumers, business-to-business payments have not experienced the same change. Enabling businesses to pay employees and suppliers through increasingly frictionless means could open new opportunities. The development of the Roadmap also identified concerns about the current micro and SME market. Industry is keen to explore innovations that could help this population in the immediate and near term, and support their ability to adapt, effectively compete, or augment with emerging online marketplaces.

The wider business community is interested in learning more about how technology and FinTech innovation can help them advance their digital business needs. Some feedback indicated the landscape of digital apps that aim to support SMEs, can often be complex and difficult to navigate.

In the hospitality industry, for example, feedback highlighted that SMEs often need to ask customers to use three or four online applications across reservations, food and drink ordering, and payments. Contributors to the development of the Roadmap, familiar with the SME market, highlight that more engagement is needed to directly share SME business problems with emerging innovators. This will connect real issues with potential solutions, thereby sharing knowledge and enabling inclusive change.

In addition, there is further interest in using the evolution of the Internet of Things and the Internet of Payments to enable businesses that rely on paper-based systems to benefit from the speed and convenience of integrated digital solutions. Such a move would enable them to gain more certainty on cashflow and profitability, by automating other finance-related functions such as payroll, accounts and tax returns. It would also enable a relationship with a retail lender to develop, with quicker and more accurate assessments for lending.

This links to the points in Open Finance data strategic theme section of this Roadmap, where there is a priority for FinTech innovations to support SME businesses. There is also demand for technology and innovation to help create meaningful businesses insights through transactional payment data. This would

enable targeted business decisions, a greater understanding of demand, location hotspots to enable targeted products and services and create value for both the business and its customers.

With developments in the Internet of Things, and more pervasive access to data, there is more interest in research on data ethics, privacy, and global standards (data, privacy, interconnectivity). These would help businesses to build confidence in the application of any insights in business decisions. Retail banks, SME trade associations and Governmental departments have a significant interest in building greener options for businesses through new embedded payment innovations, using less paper, enabling electronic invoices, and eliminating the need for physical exchange of documents. The development of the Roadmap identified significant interest in payments innovation that will support SME and business recovery from Covid-19, build strong digital businesses for the future, and help their transition to a greener business model.

Through collaboration with business trade associations such as CBI Scotland and Business Chambers of Commerce, Scottish Enterprise, and Elevator UK, more could be done to help build closer connections between businesses and innovations to support their moves to digitally enhanced business and operating models.

3.2.2 Retail consumers

The development of this Roadmap also highlighted a developing concern for potential financial exclusion in transitioning to an online or digital first payments system. Industry is calling for further collaborative and actionable research to manage the transition and avoid a 'two-speed' sector'.⁵⁰ Locally and domestically, the industry's view is that this includes continued access to cash for those that do not have a transaction account. It will also require a focus on the 'financial premium' that is imposed on those who cannot pay digitally because they do not have access to online technology, cannot afford access to the internet, and/or do not have a bank account. The Smart Data Foundry has a priority focus on the concept of a 'financial poverty premium'. This work focuses on situations where people who earn less pay more for services or goods, because of the way certain means of paying are currently discounted. If embedded payments become more of the norm there may be unintended consequences for some people and communities of our society.

⁵⁰<https://ci.natwest.com/insights/articles/making-payments-future-fit-how-is-the-payments-ecosystem-rising-to-meet-the-challenges-of-financial-institutions-and-businesses/>

Security for digital payments

Knowing your money is safe is critical to everyone across the economy and society. Financial institutions across the UK who act as custodians of citizens' and businesses' finances must ensure that those funds are protected and are available when needed.

As online payments and embedded payments increase, so too will instances of online fraud, digital financial crime, and cyber-attacks on financial institutions. Criminals will take advantage of vulnerabilities of online systems, and will use different hacking approaches to gain access to information and data that enables them to defraud consumers and businesses.

3.3.1 Cyber security

Cyber security has become a common term used across the FinTech and the financial services industry. It is the application of technologies, processes, and controls to protect systems, networks, programmes, devices, and data from cyber-attacks. The aim is to reduce the risk of cyber-attacks and protect against unauthorised exploitation of systems, networks, and technologies.

The cyber security landscape is complex and constantly changing. Attacks range from phishing emails to sophisticated scams and complex criminal operations. Cyber-attacks can have a devastating consequence on people's lives, on business operations and business reputation, and on the emerging digital economy.

In 2016, 66% of medium/large UK businesses were subject to cyber-attacks, and since 2014 there has been a 1,700% increase in cyber-attacks reported to the Financial Conduct Authority. UK Finance's 2020 report 'Our Fraud – the Facts' highlighted that criminals successfully stole over £1.2 billion through fraud and scams in 2019.⁵¹

The development of this Roadmap highlighted digital security as a top priority for FinTech and financial services. There is a demand to proactively use technology to fight against security issues and protect consumers from crime and fraud. Technology and applications that can identify unusual or suspicious activity were identified as important, as well as tracking technologies that can analyse anomalies and identify linked accounts. Other technologies that can identify customer behavioural changes while using online or mobile systems are also of interest. For example, enabling financial institutions to notice that something is different in the way an individual types or swipes to access systems, and then raising an alert.

"We ran a hackathon with University of Edinburgh and Edinburgh Futures Institute, which focused on the poverty premium. Many of these vulnerable customers are paying more because of the tariffs they are limited to. We could optimise other payment options over Direct Debit."

**Derek Smith, Head of Digital Solutions,
Virgn Money**

3.3.2 Biometrics

The application of biometric capability to strengthen security is also of interest, with many banks leading the way in using fingerprints or facial recognition. With the move to more embedded payments and more ecommerce through the Internet of Things, voice-based authentication and enabling technologies that create secure voice commerce are also increasing important.

While biometrics aim to use unique characteristics, there is growing evidence of biometric spoofing – the practice of fooling a biometric security system using fake or copied biometric information. Fingerprints can be stolen, and facial recognition systems can also be vulnerable: sometimes a photo can be used to gain access.

Our Roadmap analysis highlighted industry demand for actionable research in cyber security to help stay ahead of cyber criminals. Particularly when it comes to biometrics, where there could be significant risk of continued identity theft and deeper potential consequences of fraudulent activity.

The insight from our analysis points to a strong interconnection between FinTech innovation and cyber innovation, with a deep expectation for a security first approach to FinTech research and innovation. There is more to be done to deepen the actionable research connections between cyber, FinTech and financial services.

“There is so much we can learn from our children and how they are currently engaging with digital money through their acceptance of digital devices and access to digital games and online interactions. The process of how they transact or buy things is significantly different to the experiences of other generations.”

**Jake Bailey, Head of
Proposition Development, Tesco Bank**

⁵¹<https://www.ukfinance.org.uk/system/files/Fraud-The-Facts-2020-FINAL-ONLINE-11-June.pdf>

Roadmap Next Steps – Payments & Transactions

The way consumers and businesses transact in the future will have a significant impact on our economy. The approach to making and receiving payments sits at the heart of our future digital economy, and we have just started to understand what is possible. This, along with the increasing ability to pay and transact in new ways has made payments and transactions a priority theme for this Roadmap. There are several short, medium, and longer term actions to help the progress needed. More collaboration across industry, technology, regulation, and cyber experts will help create an understanding of the innovations that will shape the future of secure value exchange and enable the digital economy.

Theme	Action	Action Type	Timeframe (phase)	Stakeholders
Digital Currencies / Embedded Payments	Finance Distributed Ledger Technology (DLT) Lab - A Lab to support DLT finance research and innovations and provide an environment to test ideas, share knowledge and create future talent.	Innovation Calls	1	University of Edinburgh, University of Glasgow, IBM, JP Morgan, Royal London, Phoenix, Sainsburys Bank, University of Strathclyde, Napier University
Digital Currencies	Digital Currencies Regulatory Group – Establish a working group for FinTech innovators working with digital currencies, helping to share knowledge and bring greater regulatory clarity.	Innovation Calls	1	FCA, Barclays, Phoenix, Royal London, M&G, NCR, Napier University
Embedded Payments	SME Payments Accelerator - Implement an accelerator for SME digital FinTech innovation in Scotland, enable direct SME engagement in FinTech payment innovation, creating a two way means to share knowledge and build understanding of SME needs.	Innovation Calls	1	Virgin Money, NatWest, TSB, NCR, Data Lab, University of Edinburgh
	Embedded Payments and Poverty Premium – Develop solutions to address the poverty premium including an element that considers the potential impact of future embedded payments.	Innovation Calls	2	Virgin Money, Barclays, NatWest, Lloyds Banking Group, NCR, Smart Data Foundry
Embedded Payments / Facilitating for Net Zero	<ul style="list-style-type: none"> • Payments and climate change. • Supply chain management. • Future ways to enhance international trade. • Instant auditing. • Detecting large scale financial crime. 	Research	2	University of Edinburgh, University of Glasgow, University of Strathclyde
Security of digital payments	Payments Security - Utilise Knowledge sharing mechanisms to transfer knowledge into FinTech and Financial Services from research on emerging technologies that could: <ol style="list-style-type: none"> enhance payments security (3-5 years) reduce potential for financial crime (years 3-5) 	Research	2	NCR, NCC Group, Napier University, University of Abertay

Priorities:

PHASE ONE: 1-2 years

Finance DLT Lab
Digital Currencies Regulatory Group
SME Payments Accelerator

PHASE TWO: 3-5 years

Embedded Payments & Poverty
Cyber technologies
Payment security
Financial crime

PHASE THREE: 6-10 years

Financial fraud in payments
Supply chain, trade, and auditing

KEY:

INNOVATION CALLS

RESEARCH

4

PRIORITY THEME: FINANCIAL REGULATION

Simplifying compliance

Future risk modelling and risk management

- Reinventing risk management with technology and data analytics
- Enabling new approaches to address fraud and fight financial crime
- Modelling for new and emerging climate risks

Future regulation design

- Regulatory reporting
- Interoperability and data standardisation

Simplifying
Compliance

Financial
Regulation

Future Risk
Modelling
and Risk
Management

Future
Regulation
Design

“As a global bank we work hard to ensure our compliance systems and processes are efficient and effective, this includes thinking about how they can benefit from the latest technology developments. A global business has a significant number of regulations to meet and the key challenges when thinking about new RegTech solutions is practical integration across the business. Regulators play a key role in supporting future changes, the more they can do to collaborate with industry on this issue will be of benefit to us all.”

Jacqui McDonald,
Group Finance CIO, Barclays

Financial regulation

Financial markets in the UK and around the world are subject to financial regulation. This provides the foundations needed to ensure a stable and safe financial services industry. It also ensures an industry that serves the interests of consumers and investors and enables safe open markets providing confidence in our economy and international trade.

Regulation applies to all financial institutions big and small. It is fundamental to their ability to participate in financial markets, with a requirement to comply with the various rules and continually demonstrate their immediate ability to meet the standards of the regulatory authorities worldwide.

The development of this Roadmap highlighted financial regulation as a priority theme because of its fundamental role in FinTech and financial services, as well as the need for financial regulation to support the positive role FinTech innovation could play in the future of finance.

The UK's approach to financial regulation has been key in enabling a dynamic financial services sector that supports and drives the economy, enables a progressive economic outlook, creates jobs, and plays a significant role as a global financial service centre.

The UK regulators have been world-leading with a progressive and proactive approach on the role technology and innovation can have on the future of financial regulation. Both the Financial Conduct Authority and the Bank of England have been pioneering, with collaborative initiatives such as the regulatory

sandbox and new regulations to open the Financial Services infrastructure to aid the application of FinTech innovation.

However, regulation remains extremely complex for all those operating in the finance industry. Depending on the complexity of the financial institution's business model, meeting compliance obligations can mean significant costs. Industry research suggests that some of the largest global financial institutions are spending up to 5% of revenue on regulatory compliance.⁵² Across the UK this could mean the annual cost of demonstrating regulatory compliance is as much as £6.6 billion.⁵³

Meeting regulatory compliance and managing regulatory risks often requires deep expertise, and can be a barrier for new FinTech entrants whose innovation could have a positive impact for consumers, businesses, and financial markets. Financial regulation in the UK is also likely to change as the UK adapts to its departure from the European Union.

The current UK Government's Future Regulatory Framework Review states an intention to ensure the regulatory regime has the agility and flexibility needed to respond quickly and effectively to emerging challenges, to help UK firms seize new business opportunities in a rapidly changing global economy.⁵⁴

"Technology is changing the way businesses assess, monitor and mitigate the risks within their businesses. RegTech goes one step further. It also helps financial institutions meet necessary compliance obligations.

At Autorek we've seen the value in bringing data, technology and regulatory knowledge together to advance solutions in asset management, banking and insurance sectors.

We're a global business because the nature of regulation in financial services is global. We're working in Scotland because of the depth of expertise and available skills both in compliance and risk, as well as technology.

More collaboration and direct involvement from the regulators on this important topic will serve us well in advancing future innovations."

Gordon McHarg, Founder & Managing Director, AutoRek

⁵²<https://www.kroll.com/en/insights/publications/financial-compliance-regulation/global-regulatory-outlook-2020>

⁵³<https://researchbriefings.files.parliament.uk/documents/SN06193/SN06193.pdf>

⁵⁴<https://www.gov.uk/government/consultations/future-regulatory-framework-frf-review-consultation>

There are many known and emerging technologies that can play a significant role as the future landscape of the financial services industry evolves. This will provide solutions to large institutions to help them adapt to an agile regulatory framework, and to authorities to help with effective regulatory oversight.

Ultimately, technology and data-driven innovation specifically applied to financial regulation presents a significant opportunity to support the UK's future ambition for regulation. It can build confidence across the market, and reduce regulatory costs and burden.

Throughout the development of the Roadmap, contributors highlighted their interest in the role technologies could play in future financial regulation. Some examples are AI, advanced analytics, high performance computing including quantum computing, and distributed ledger technologies.

In addition, they identified three key topics that could be advanced through more specific research and innovation:

- 1. Simplifying compliance.** Helping financial institutions create new solutions and use FinTech to help meet current, continuously changing, and global regulatory obligations.
- 2. Future risk modelling and risk management.** Reinventing risk management with technology and data analytics, and enabling new approaches to fight financial crime, address fraud and focus on emerging climate risks.
- 3. Future regulation design.** Enabling an agile regulatory framework that works for all, and developing future regulatory oversight or supervisory technology.

AMIQUS

Achieving and maintaining regulatory compliance are fundamental obligations for businesses across sectors. Amiqus provides a market leading software platform to support digital staff and client onboarding, automating and simplifying complex processes which are typically high risk and time consuming.

Working collaboratively across the FinTech Scotland network, Amiqus has a proven track record of providing business critical support at scale to government, regulators and enabling organisations to adapt in line with the changing landscape of digital identity, pre employment screening and anti money laundering legislation.

Thanks to the unique blend of academic expertise, regulatory engagement and concentration of professional services, we've found Edinburgh to be the perfect location to scale our business globally with the support of FinTech Scotland.

Simplifying compliance

Compliance plays a significant role in financial regulation. It describes the obligation of those working and operating in financial services across the world, to comply with the rules and regulatory frameworks put in place by the different regulatory bodies.

It also covers the responsibility these participants have to demonstrate how they have complied with requirements. These requirements include resource, expertise, understanding, documentation, and reporting to confirm that obligations have been met.

Poor compliance, or indeed non-compliance, can have significant consequences for financial institutions, consumers, and the economy. It can mean significant regulatory fines for institutions, or significant consumer and market mistrust in financial systems.

Complying with worldwide financial regulations requires a significant understanding of the rules themselves and their application to the products, services, business models, and the operating models of individual financial institutions.

It also requires public disclosures in addition to the ongoing reporting required by global regulatory authorities. And it means being constantly aware of regulatory change, addressing new policies, implementing new rules, or adapting current processes to meet amended rules and guidelines.

In developing the Roadmap, contributors pointed to the volume of regulatory change after the 2008 financial crisis. New legislation, regulation and financial reforms were introduced across the world, resulting in an unparalleled level of global regulatory reform.

This volume of regulatory change continues as the UK adapts to its departure from the European Union and the impact of the Covid-19 pandemic.

Regulatory changes are often complex and, in many cases, overlap products and regional jurisdictions. In addition, regulators worldwide used more agile rule-making practices throughout the Covid-19 pandemic as they reacted to help citizens, businesses, and economies with the financial impact of the public health restrictions. However, with as many as 1,300 regulatory changes worldwide in March 2020, it required a significant effort from financial institutions to keep on top of the volume of change, and ensure they were always compliant.⁵⁵

Meeting compliance is a sizeable requirement, and during the development of the Roadmap it was an area where industry identified a significant role for technology. For example, helping to simplify processes such as scanning for regulatory change, managing, and completing regulatory reporting requirements, and keeping public disclosures constantly up to date.

Financial and resource limitations present some hurdles as businesses recover from the pandemic, while at the same time many compliance teams are faced with addressing more stringent regulatory demands and expectations. There was a strong view from the industry that enabling ways to reduce the current cost of meeting regulatory compliance could see the savings redirected to drive more innovation and improve competitiveness of businesses and the UK financial sector.

“We support 11 different industry sectors – all with different regulations – so simplifying the compliance processes to adhere to these different regulatory regimes is key for us. Technologies such as AI will have an important role to play, and the regulators are looking at this. At Equifax we’re developing tools in house that build confidence in explainable AI. It’s important that the application of technologies drive better outcomes and better explainable outcomes for people.”

**Robert McKenzie,
Head of Products, Equifax UK**

⁵⁵<https://www.fca.org.uk/insight/regtech-watershed-moment>

We identified that the use of technology in compliance continues to grow, but the complexity of regulation means it is more likely that technology solutions are being used tactically to address one problem at a time. This limits the potential for a fuller strategic approach.

The development of the Roadmap also highlighted that there is limited industry awareness of available solutions, and that often more than one solution is needed, thus adding further complexities in integration into the organisation. There is significant industry interest in solutions and technologies that enable institutions to link multiple systems, and allow for easier integration across sometimes complex internal systems.

However, many financial institutions face constraints imposed by legacy technology, with difficulties in integrating other technology into existing technology architecture. Some contributors in the development of the Roadmap thought more integrated platforms that allow multiple RegTech products and solutions to sit side-by-side could also go some way to helping this opportunity progress.

There is also significant interest in creating regulatory reporting solutions that have more agility and flexibility, enabling the implementation of strategic end-to-end solutions.

Technologies such as advanced analytics, robotic process automation, distributed ledger technology and cognitive computing are all attracting interest.

In addition, the research highlighted a view that greater use of common standards, including Application Programming Interfaces (APIs) and data standards could also go some way to helping to

drive more efficiencies. There is an opportunity for actionable research in this field to help provide greater clarity, including how regulators could potentially use APIs to capture the information needed to fulfil regulatory oversight obligations.

Finally, through our analysis we also recognised there is also work to do to build industry trust to allow potential technology solutions access to relevant, often sensitive internal data. There is also more to do to subsequently trust the resulting output given the potential high costs of mistakes (potential regulatory fines or sanctions).

Contributors across the development of the Roadmap saw a significant opportunity for the future of finance by using technology to help simplify compliance.

As a starting point, greater awareness is needed on two fronts, creating a need to build an environment where:

- Innovators can gain direct access to the problems faced by industry in meeting current compliance obligations, build a direct understanding of immediate needs, and gain greater clarity to then create relevant and scalable solutions.
- Financial institutions gain greater awareness of the existing and emerging technology solutions that can meet current regulatory compliance requirements.

It presents an opportunity for the work already underway at the University of Strathclyde, using its established RegTech (Regulatory Technology) forum. For example, this could be developed as a vehicle to advance knowledge-sharing, and to enhance the

“AML / KYC are important processes for us, which we would like to be more automated. Regulatory reporting is something else we would like to be more automated. Both are constantly evolving spaces. There could be a sandbox opportunity here?”

**Anurag Agrawal, Head of FinTech,
Baillie Gifford**

current approach through collaboration with FinTech Northern Ireland and the City of London Corporation. Further advances could be made by adding an industry advisory group and creating a RegTech sandbox to explore problems and potential solutions.

RegTech by Design Network Proposal

In considering the evolution of its RegTech forum, the University of Strathclyde is pursuing collaboration to create The RegTech by Design Network. (RDN).

RDN would build on the work of the RegTech Forum, an international community of interest established to share experiences, to consider challenges and to explore developments in financial regulation and compliance.

RDN would be established in the Glasgow City Innovation District (GCID). It would aim to enable a demand led innovation lab to drive responsible innovation and unleash the power of cross sector learning to drive the effective application of RegTech solutions in regulated markets, including financial services.

It would nurture RegTech innovation at scale, supporting pre-competitive ideation and seeding ideas for new startups linking technology across different industry verticals.

It would explore ways to simplify compliance and enable business optimisation by using technology and data analytics to enable faster and more cost-effective regulatory compliance.

RDN would seek to build future confidence by allowing for the development of secure and compliant data-driven RegTech products and services.

“RegTech is already a big strength in Scotland but there is lots of potential too. If we can combine insight with technology we could see some innovative solutions that solve problems we could not previously solve. We have strengths in in accounting, law and finance that are all relevant to RegTech. Additionally, blockchain technology is strong in Scotland and is a key consideration in RegTech too.”

Gavin Littlejohn, Co-Founder, FDATA

Risk management modelling

Financial regulation also expects financial institutions to understand the risks within their business and operating models, and to have effective systems and controls in place to mitigate and manage those risks.

Risks can come from many sources and the risk landscape is often complex, depending on the nature and size of the business. Financial institutions are monitoring and assessing financial, operational, cyber, financial crime, climate, international, and reputational risks, to name just a few.

In addition, the UK regulatory framework also requires financial institutions to be aware of conduct risk: the impact of their actions, products and services on consumers and the UK economy.

Failings in risk management come at a significant cost to the business, including reputational costs and financial implications such as providing compensation to those affected when things go wrong.

There is also the potential for significant regulatory fines. Recent examples include £50bn across the UK retail banking sector for PPI mis-selling in the UK.

Through the development of the Roadmap, we identified that current models to assess and manage risk involve many assessments that require significant manual work and can often lead to issues being missed. In addition, many risks, such as cyber, fraud and conduct risks, are often assessed with a significant focus on post-implementation. In other words, a rear-view mirror assessment. As a result, issues are often identified too late, or sometimes missed completely.

4.2.1 Reinventing risk management with technology and data analytics

Contributors to the development of the Roadmap identified that technology and access to a broader range of data is driving financial institutions' interest in new ways to assess and manage risk. For example, data-driven risk, measurement, and detection tools that could enable real time monitoring, driving efficiencies, removing potential bias, and helping to improve decision making.

This is still a very new concept but it presents a significant opportunity for actionable research and innovation to develop new evidence, and help build the investment case for these changes in approach. As wider pools of structured and unstructured data become available, this opens more potential to create new ways to identify and monitor risks. It also opens possibilities to review entire enterprise-wide risk landscapes, and develop new approaches to financial and non-financial risk management.

At the same time, advanced analytics is creating significant improvements in revealing risks more quickly, reducing false positives and detecting potential operational risks. Real time risk monitoring could create a significant advantage, potentially enabling more stability in financial decisions. This is of particular interest in high-frequency trading environments and capital markets.

Actionable research and innovation are needed to identify how complex data, and large volumes of data, can be handled safely and securely. This would enable decisions based on real-time data, and could enable greater accuracy in calculating market risks and credit value adjustments.

New practices need to be deeply tested to build confidence and trust. Advanced computing, such as quantum computing, will have a role to play given its high computation ability. Investment in this technology is growing: VC investments increased from \$4 million in 2015 to \$300 million in the first half of 2020.

However, with this level of computation there are also risks that need to be addressed to ensure that sensitive data is protected in the future. Both the National Institute for Quantum Integration (NIQI) and the Quantum Computing Application Cluster (QCAC) have roles to play in helping FinTech and the financial services industry consider the applications of quantum computing, and helping researchers to understand the future needs of finance. The University of Glasgow leads the NIQI. The University of Edinburgh and the University of Strathclyde are both members of the QCAC, demonstrating Scotland's strength in this emerging field.

Other UK and Global industry experts such as IBM also have a significant role to play. In recent research, IBM highlighted that experimental quantum systems are already being tested against examples in financial services, and that now is the time to engage.⁵⁶ As this capability evolves, there becomes a significant need to help inform, support, and provide practical plans for application and integration in FinTech.

Regulators too, have a significant role to play in accepting new ways of assessing risk and supporting the industry to adapt new approaches.

Further actionable research and testing are needed to build confidence and help the industry to realise the opportunity for more precision and prediction in managing financial risks, and to deliver better outcomes for markets, consumers, and the economy through move confident real-time risk management.

As well as real-time risk monitoring, industry contributors identified two key priorities for new approaches to help manage and monitor the substantial risks each present.

⁵⁶<https://www.ibm.com/downloads/cas/2YPRZPB3>



4.2.2 Enabling new approaches to address fraud and fight financial crime

Fraud is now one of the most common crimes in the UK, with one in fifteen people falling victim each year. In 2019, the Financial Conduct Authority reported 3.8 million fraud offences. Since then, with more activities being done online, there has been a further rise in identity theft, fraud, and criminal activity. The United Nations estimates that at least US\$1.6 trillion is laundered through the global financial system every year.

In addition, as money or assets evolve to be digital, this creates an increased risk for more prevalent use in criminal activity. This can make it difficult to understand the full extent of the issue, and to manage it.

There is an industry-wide view that greater collaboration is needed to help the broader fight against financial crime.

Overall, current approaches to addressing financial crime risks are siloed, with individual institutions not having the complete picture when searching for patterns in sometimes vast amounts of data. Managing and monitoring financial crime risks is complex and difficult. Typical systems and controls include practices to identify and know customers, and anti-money laundering monitoring practices.

Examples include transaction-monitoring, and some information-sharing using technical tools such as sanctions lists and other privileged information. There are many organisations across the world involved in helping to combat financial crime.

The nature of our global economy often makes it easy to facilitate financial crime such as money laundering through the financial system. Reports outline the projected costs of trying to manage and address financial crime reached \$213.9 billion in 2021.⁵⁷

The development of the Roadmap identified significant industry interest in learning more about technologies and actionable research that could enhance current transaction monitoring practices. These include AI, natural language processing, topic modelling and text analytics, and quantum computing.

There was also an interest in graph and network analytics to more readily identify relationships between entities and support due diligence.

This is a significant issue, and serious efforts are being made by Government and research councils, including UKRI with research and innovation grant funding, innovation investment and knowledge share networks. In addition, industry and regulators can collaborate to create more ways to address the increasing sophisticated scams and fraud that are becoming more commonplace.

For example, Authorised Push Payment (APP) is identified as a key priority. There is a need for immediate intervention and an open innovation call to encourage solutions that address APP fraud.

⁵⁷<https://www.finextra.com/pressarticle/88026/global-spend-on-financial-crime-compliance-at-financial-institutions-reaches-2139-billion>

4.2.3 Modelling for new and emerging climate risks

Climate risk has moved significantly up the agenda across the world and the financial services industry, as explained in the Climate Finance section of this Roadmap. Many financial institutions must build strategies, capabilities and incorporate climate risk into enhanced risk management frameworks.

Addressing this requirement includes the need for relevant domain expertise, skills, and capabilities within the business to identify, understand, manage, and monitor exposure to financial risks from climate change. It also requires developing a business model, strategy, and risk appetite to address and manage these risks.

Banks, insurers, investment firms and the asset management sector need to develop and implement an approach to integrate Environmental Social Governance (ESG) within their financial risks analysis and broader risk management framework.

Many global regulators plan to include climate risk stress testing and scenario analysis as part of their regulatory oversight role, potentially adding pressures to capital and liquidity requirements. This potentially creates a burning platform for banks, insurers, and investment firms to understand their potential exposure to climate change risk.

Assessing, monitoring, and managing climate change risk within financial institutions plays a key role, and creates both opportunities and challenges for the financial services industry to manage the transition risk and potential exposures that are already on their relevant balance sheet.

As the industry continues to explore the data sources needed and available to help size the risk, there is a significant opportunity for Scotland (with its data-driven innovation credentials) to play an important role in helping the UK lead the way in this field.

Technology also has a significant role to play, including AI, satellite imagery and tracking, the Internet of Things, smart sensors, and cloud computing.

From our analysis we identified a need for actionable research to create and implement new approaches that dynamically assess the climate risk position across credit portfolios, lending books, investment portfolios and other assets, leveraging both existing and new sources of data.

It will need multi-disciplinary fields to build progressive change, including open finance data, space data, agriculture, retail, energy, manufacturing, and other disciplines. This presents a further opportunity for the Smart Data Foundry, in collaboration with others, to use its Open Finance data innovation environment and create a means to support more actionable research to help inform and develop means to assess financial institutions' exposure to climate risk.

“Scotland over-indexes in three skills domains: RegTech & FinTech, Data science & analytics, and compliance & risk transformation. We need to keep delivering at scale. There’s a lot of regulatory risk and compliance skill in Scotland. These skills along with our strengths in data and technology positions Scotland well to advance the opportunity for RegTech. The University of Strathclyde is already building momentum with the RegTech Forum. The next step is to build industry collaboration and think about how to pool our strengths to drive lasting change in managing risk”.

**Kent Mackenzie, Partner,
Global Head of FinTech & RegTech,
Risk Advisory, Deloitte**

Digital enabled regulation design

The development of the Roadmap involved asking industry to identify the potential for technology in the future of finance. Many offered a view that it could play a significant role in the application of financial regulation.

Informed by what is currently known about technological capabilities, existing research papers already point to the potential for technology to “lead to a paradigm shift in regulation.” For example, in enabling real-time surveillance of the financial markets. In future, it may even be possible to predict where risks and problems will emerge. This would move us from a position of reactive supervision to preventative interventions.⁵⁸

As the UK builds its global role outside of the EU, the approach taken to financial regulation can affirm it as a financial centre and provide an opportunity to lead on key priority areas. This includes priorities identified throughout the development of the Roadmap such as open finance data, financial inclusion, Climate Finance, the future of payments, financial crime, and recovery post Covid-19.

Recognising their influential position in finance, both the Bank of England and the Financial Conduct Authority are working on a range of initiatives. These include regulatory data strategies, a digital first strategy at the BoE, work to improve and digitise the rule book, and ways to make regulatory reporting more efficient.

4.3.1 Regulatory reporting

Regulatory reporting plays a significant role in how regulators in the UK and across the world fulfil their oversight role. The information enables regulators to complete in-depth analysis and understand a variety of risks across the financial services industry. This helps to shape future policy, and implement appropriate rules to maintain the integrity of financial markets and protect consumers. However, it is a rear-view mirror look, with data that is out of date, albeit sometimes only by days. Also, gathering this data comes at a significant cost.

Technology used for regulatory oversight could present a pivotal change and a shift in regulation, providing a significant foundation to underpin the future of the finance sector.

⁵⁸https://www.researchgate.net/publication/320109794_FinTech_regTech_and_the_reconceptualization_of_financial_regulation



4.3.2 Interoperability and data standardisation

Contributors to the development of the Roadmap identified interoperability and data standardisation as having a significant role to play. Open Banking already shows the success that can be achieved by API standardisation. Significant innovation has grown through the APIs and access to data.

These experiences have shown how effective standard APIs are in capturing very specific data from banking systems, and offer a useful case study to explore API viability for other functions such as supervisory oversight. This is called 'SupTech'.


Technologies, such as cloud, AI and advanced analytics have a role to play to help advance this opportunity. However, there is a practical realisation that reforms cannot be achieved quickly or easily, with technical difficulties acknowledged across legacy systems, and cultural difficulties in a financial services industry that holds risk management and oversight at its centre.

With the right leadership, more can be done at a UK level to enable greater standardisation and take the steps that will support improved connectivity. Actionable research is needed to understand the inhibitors and the enablers to help advance the future regulatory approach.

This would support the delivery of the UK's ambition for "a regulatory regime that has the agility and flexibility needed to respond quickly and effectively to emerging challenges as well as to support UK firms seize new business opportunities in a rapidly changing global economy."⁵⁹

In the meantime, it would be useful to explore how the data already collected by the regulators could be used for SupTech innovation. This could be done by a series of Tech Sprints and innovation calls that can help the UK advance the drive for efficiencies across the industry. This presents a potential call to action for the UK regulatory authorities.

From our analysis we can see that there is a growing shift in thinking about the role technology could play in shaping the future design of regulation and regulatory oversight. It leads us to ask: is the vision set out by Andy Haldane, then Chief Economist at the Bank of England, possible through progressive leadership, actionable research, and innovation through the application of technology?



"I have a dream. It is futuristic, but realistic. It involves a Star Trek chair and a bank of monitors. It would involve tracking the global flow of funds in close to real time (from a Star Trek chair using a bank of monitors), in much the same way as happens with global weather systems and global internet traffic. Its centrepiece would be a global map of financial flows, charting spill-overs and correlations."⁶⁰

**Andy Haldane, Chief Economist,
Bank of England (2014)**

⁵⁹https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/927316/141020_Final_Phase_II_Condoc_For_Publication_for_print.pdf

⁶⁰<https://www.bankofengland.co.uk/speech/2014/managing-global-finance-as-a-system>

Roadmap Next Steps – Financial Regulation

Financial regulation plays a highly significant and fundamental role in enabling the finance industry. It is understandable that industry has identified this as a priority for this Research & Innovation Roadmap. As with the other priority Roadmap themes, our analysis highlights that advances in technology and better access to data will play an important role. This Roadmap presents several immediate and medium term actions, and invites more collaboration across the industry and research community to support the UK in maintaining and further enhancing its progressive regulatory position.

Theme	Action	Action Type	Timeframe (phase)	Stakeholders
Simplifying Compliance	<ul style="list-style-type: none"> An industry led knowledge exchange programme enabling interaction and exchange of RegTech knowledge and industry demand. A sandbox for leveraging RegTech innovation. Supporting the public's understanding of disclosures and in particular product terms and conditions through virtual and augmented reality technologies. Real-time risk monitoring. Addressing push payment fraud payment fraud. Assessing climate change risk and the potential exposures for financial institutions – working in collaboration with Smart Data Foundry and utilising its innovation environment and secure data capability for Open Finance Data. Enhancing compliance using advanced analytics, robotic process automation, distributed ledger technology and cognitive computing. 	Innovation Calls	1	NatWest, HSBC, Lloyds, Tesco Bank, Barclays, JP Morgan, Lloyds Banking Group, Baillie Gifford, University of Strathclyde, University of Glasgow, BT, NCC, Sainsburys Bank, Deloitte
			1	
			1	
			2	
			1	
			2	
			3	
Future Regulation Design	<ul style="list-style-type: none"> Regulatory & Technology Skills - Develop skills and education programmes to support the development of regulators, and risk and compliance professionals in building their understanding of technologies and the potential application in finance. Supervision Tech – A series of innovation challenges working in to help advance the role of Supervision Tech, including means to safely utilise relevant data already collected by the UK regulators. 	Innovation Calls	1	University of Strathclyde, Smart Data Foundry, Sopra Steria, IBM
			2	University of Strathclyde, Smart Data Foundry, Sopra Steria, IBM, University of Edinburgh
Future Risk Modelling and Risk Management	<ul style="list-style-type: none"> Financial Crime – Progress the industry's initiatives and efforts in addressing financial crime with an intervention programme of activity to enable more collaborative research to address financial crime. Quantum - finance application – Support development of the National Institute of Quantum Integration to facilitate more interaction across the finance industry on the potential opportunities and risks for this Develop and lead a series of FinTech investigations on the role of Quantum in finance as a technology to improve business and consumer outcomes technology. Advancing Risk Management – Work with the University of Strathclyde to research how management science, electrical and electronic engineering, computer and Information services and industrial informatics can be utilised to advance risk management. 	Innovation Calls	1	University of Strathclyde, Smart Data Foundry, BT, NCC Group, Sopra Steria, Barclays, NatWest, Lloyds Banking Group, HSBC, University of Edinburgh
			2	University of Glasgow, University of Edinburgh, University of Strathclyde, NCC Group, IBM, University of Edinburgh
		3	University of Edinburgh	
		Research	1	University of Strathclyde, JP Morgan, Barclays, FCA, Deloitte

Key Priorities:

PHASE ONE: 1-2 years

Centre for Financial Regulation & Innovation
 Authorised Push Payment FraudFinance
 Real time risk monitoringFinance
 Regulation & Financial Skills

PHASE TWO: 3-5 years

RegTech Innovation Sandbox
 Enhancing compliance processes through advanced analytics and automation
 Supervision Tech
 Quantum Institute

PHASE THREE: 6-10 years

Public disclosure communication
 Quantum - finance application

KEY:

INNOVATION CALLS

RESEARCH

Next steps

This Roadmap outlines actionable research and innovation activities that can help develop economic, environmental, and societal value for Scotland and the UK through FinTech.

Successful implementation will require the engagement and co-operation of key stakeholders within the FinTech Scotland cluster, and stakeholders from across the UK and internationally.

The key next steps are outlined below.

Implementation & Governance

The roadmap will be led and facilitated by FinTech Scotland. However, wider stakeholder participation is required to implement the R&I actions set out in this Roadmap.

FinTech Scotland will lead the arrangement of:

- Key dates for actions to be initiated and completed.
- Reviews of progression throughout the 10-year roadmap and alignment to the overarching purpose
- Measurement against the objectives, with a scorecard of KPIs such as GVA, employment and number of organisations.
- Facilitating collaboration on innovation calls and actionable research

Actionable Research:

FinTech Scotland will engage with academic community in respect of the research topics proposed. FinTech Scotland will also engage with research funding organisations such as UKRI / Innovate UK to ensure this roadmap is fed into future funding calls.

The initial steps for research topic actions presented in this roadmap include:

1. Work with university leaders to generate research briefs that directly respond to the actions identified in the roadmap.
2. Establish relevant steering groups demonstrating collaboration across industry and the research community.
3. Monitor and review progression (including the KPI scorecard).

Leveraging Innovation

A rollout plan will be developed to implement a programme of innovation calls. This will include developing a sponsorship proposition to maintain the commitment for an industry-led programme.

The initial steps for the Roadmap innovation calls include:

1. Work with the Smart Data Foundry to start the implementation of the priority innovation calls identified in the Roadmap.
2. Continue the work with industry stakeholders to refine a series of problem statements for each theme, ensuring industry value in the future solutions.
3. Market the innovation calls across UK and international FinTech clusters, raising the profile of FinTech innovation in Scotland.

Further information

Methodology and definitions

Initial research topics

As part of the development of the Roadmap process, an in-depth analysis into Scotland's strengths across nine potential areas for FinTech research and innovation was conducted, working in partnership with Whitecap Consulting.

This considered Scottish-led research and innovation actions that could stimulate, accelerate, and strengthen the most environmental, economic, and societal value for the UK between 2021-2031 and positively impact all seventeen United Nations Sustainability Development Goals (SDGs).

This analysis built on the January 2021 UK Research and Innovation paper, which was authored by FinTech Scotland and FinTech Wales.

The nine key research and innovation themes initially explored were:

1. Data analytics and AI innovation
2. Open Finance innovation
3. Regulatory technology (RegTech) innovation in financial services
4. Payment and embedded FinTech innovation, including digital currencies
5. Capital markets and asset management (including trusted automated systems)
6. Finance in energy transition and climate change – 'green' economy'
7. AgriFinTech and natural assets
8. Financial and social inclusion (including health and wellbeing)
9. Customer digital transformation (end-to-end customer experience)

Research methods used to generate insight:

Stakeholder insight

- 60+ deep dive interviews alongside many broader consultations
- 5 external workshops with key stakeholder groups
- Online survey, with 37 respondents

Desk Research & Analysis

- Ecosystem analysis of pure FinTech firms in Scotland (statistical analysis of 110+ firms).
- Analysis across 9 research areas in the global, UK and Scotland contexts.
- Discovery and analysis of unmet environmental, economic, and societal needs - relating to 9 research areas (117 potential individual FinTech unmet needs, clustered in to 45 overarching problems).
- Linking of unmet needs to R&I opportunities.
- Over 50 intervention or research project scopes identified as Scotland's strategic priorities, including principal strategic bets relating to 4 core themes.
- High level analysis of university courses relating to the 9 research areas (177 courses).
- Categorisation of Financial Conduct Authority sandbox participants to date, by the 9 research themes (188 participants).
- Analysis of 60 incubators / accelerators / hubs in Scotland.

As the development of the Roadmap analysis progressed, three categories of value creation became increasingly appropriate to use: Environmental, Economic, and Societal.

FinTech is often an ambiguous term and therefore needs to be defined within the context of this report. We define it as *'the application of technology to improve financial products and services'*. This is a very broad definition, so the following list elaborates on how organisations are categorised in this analysis:

- **FinTechs / FinTech firms** are organisations that offer tech enabled Financial Services or are suppliers of tech but only to the financial sector. They are often focused on disrupting the sectors they work in.
- **Financial services organisations** are typically more established entities and offer financial products or services. This may include a tech-enabled service, such as a retail bank with a mobile application. However, as this is not their main proposition, this does not categorise them as a FinTech firm.
- **Technology firms** are categorised as sector-agnostic providers of tech. This may include a specific service positioned to the financial sector, along with other tech products and services positioned to other markets.

Scotland's FinTech cluster / GVA calculations:

FinTech Scotland's cluster includes a range of firms operating in FinTech, which can include FinTech SMEs, financial institutions and tech firms, as well as other organisations. The cluster works with those 'committed participants' in FinTech in Scotland, meaning that there is ongoing potential for both new and existing established organisations to be added.

To calculate the size of the FinTech market in Scotland, we determined the number of workers in FinTech related roles (including FinTech firms themselves and 5% of the FS and Tech workforces (a calculation Whitecap Consulting used across a number of previous regional FinTech analysis reports) and multiplied this by the average GVA per worker in Scotland.

This gave us a market size of £598 million. It is a calculation used in multiple published regional FinTech reports, and proves a consistent method to compare FinTech ecosystems and markets.

This was then projected with an annual growth 13.2% to reach £2.0 billion in 2031, based on The Kalifa Review which states that the UK FinTech sector could grow from £11 billion to £38 billion in 2030, assuming that the UK can maintain its global market share.⁶¹

Economic policy alignment

This roadmap aims to create economic, environmental, and societal value through FinTech research and innovation. The actions delivered in the roadmap are designed to align with existing FinTech related strategies across Scotland and the rest of the UK.

These strategies include:

Scotland's Digital Strategy, which sets out how digital will become the heart of everything in economic growth, reforming public services, and preparing children for the workplace of the future.⁶² This includes ensuring Scotland is well positioned to support innovation through data, developing best practice standards and digital skill adoption. All of these are similar or aligned to actions and economic enablers set out in this roadmap.

⁶¹https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/978396/KalifaReviewofUKFinTech01.pdf

⁶²<https://www.gov.scot/publications/a-changing-nation-how-scotland-will-thrive-in-a-digital-world/>

Scottish Enterprise's 2021-22 Business Plan, which lays out how Scotland will create more, and better jobs that nurture shared wealth and collective wellbeing.⁶³ Increasing the numbers of tech-skilled workers is important for the growth of FinTech in Scotland, and represents one of this Roadmap's economic enablers.

UK Government's Innovation Strategy, which aims to make the UK a global hub for innovation. It calls for more industry led actionable research to unleash innovation and create the future. Similarly to other strategies, it postulates a need to upskill talent, introduce efficient regulation standards, and have greater interactions in international markets.⁶⁴

FinTech Scotland's UKR&I Proposal, which asked Innovate UK to work across UK regions, utilising regional capabilities and developed ecosystems to advance business-led research to create economic development through regional success, enterprise and future skills.⁶⁵

The Kalifa Review, which outlines a strategy and delivery model for the UK's continued leadership in FinTech. Many of the actions put forth in this Roadmap are aligned those outlined in The Kalifa Review, particularly in terms of accelerating R&D and collaborating nationally to support the UK's competitive advantage.

Scotland's Financial Services Strategy, which is a 5-year strategy for the financial services sector, establishing a range of proposals to drive collaboration across the industry and with both the Scottish and UK Governments.⁶⁶ Its four themes are: leading the journey to net zero, supporting economic recovery, responding to changing customer needs, and developing skills and inclusion. All of these have featured heavily throughout this Roadmap, with multiple actions and enabler recommendations.

The Smart Data Foundry's Research Roadmap, which identifies researchers working in areas relevant to the Smart Data Foundry's mission with the research topics and themes it is working on. Smart Data Foundry's Research Roadmap is particularly aligned to this Roadmap in areas of risk governance, consumer behaviours, Open Banking in relation to carbon footprints, long-term saving and investments, financial wellbeing and financial security, and ethics relating to data.

The Scottish Tech Ecosystem Review (Logan Review), which reviewed Scotland's tech ecosystem with the aim of increasing the creation rate of profitable, scaled tech businesses and to reduce the time taken for viable individual startups to reach scale.⁶⁷

The UK's AI Strategy, which lays out actions across three themes: investing in the long-term needs of the AI ecosystem, ensuring AI benefits all sectors and regions, and governing AI effectively.⁶⁸ Additionally, Scotland's AI Strategy aims to make Scotland become a leader in the development and use of trustworthy, ethical, and inclusive AI.⁶⁹ This Research & Innovation Roadmap complements these, with actions directly relating to artificial intelligence in addition to data trust and ethics, specifically concerning personal finance and financial data security.

⁶³<https://www.scottish-enterprise.com/our-organisation/what-we-do/our-business-plan>

⁶⁴https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1009577/uk-innovation-strategy.pdf

⁶⁵<https://www.FinTechScotland.com/media/2021/01/RandInUKFinTech-FullPaper.pdf>

⁶⁶<http://www.sfe.org.uk/news/sfe-launches-five-year-strategy-for-the-financial-services-sector/>

⁶⁷<https://www.gov.scot/publications/scottish-technology-ecosystem-review/>

⁶⁸<https://www.gov.uk/government/publications/national-ai-strategy/national-ai-strategy-html-version>

⁶⁹<https://www.scotlandaistrategy.com>

Key stakeholder groups

Six overarching stakeholder groups within the FinTech Scotland cluster were identified at the outset of this analysis. During the course of the project, consistent themes were heard in relation to the needs of these key stakeholder groups:

KEY STAKEHOLDERS	NEEDS IDENTIFIED (AREAS TO FOCUS ON)
Entrepreneurs and innovative enterprises (most notably, FinTech Startups & Scaleups)	<ul style="list-style-type: none"> • Improved access to funding (Scotland & UK) and to skills & talent (UK & globally). • Meaningful access to the established FS sector (and data from this sector). • Better support to help firms scale up (including ecosystem and mentoring).
Financial Services institutions	<ul style="list-style-type: none"> • Establishing how FinTech can help achieve Net Zero (links to green finance, ESG). • Improving financial health (financial inclusion, literacy and wellbeing) for consumers and businesses. • Supporting the digitisation / modernisation of the long-term savings and investment sector. • Preparing the insurance sector for significant disruption by Open Finance and data. • Use gamification to enhance design and delivery of Financial Services propositions.
Global technology and services firms	<ul style="list-style-type: none"> • Seeking FinTech applications for broader technology developments. • To understand FinTech and tech opportunities through research projects. • Interested to understand the tech related skills and talent of the tech labour markets.
Academia and innovation centres	<ul style="list-style-type: none"> • Identifying research opportunities (and funding) aligned to industry needs. • Gaining access to industry data. • Understanding future FinTech / FS skills and talent requirements. • Enhancing student awareness of FinTech career opportunities. • Exploring FinTech links to climate, renewable energy and agriculture/land use.
Government, economic agencies and public sector	<ul style="list-style-type: none"> • Understanding the role of FinTech in driving economic growth. • Utilising FinTech to support societal needs (e.g. ageing population, vulnerable customers, SMEs). • Leveraging FinTech to help the move to Net Zero (green finance, natural resources & strengths). • Clarifying Scotland's national / international positioning. • Creating stronger trade links and increased collaboration.
Communities and citizens	<ul style="list-style-type: none"> • Improving access to financial products and services for individuals and businesses. • Improving financial literacy.

Participating organisations

abdrn	FinTech Wales	NatWest	Sustainably
Access FinTech	FinTech West	NCC Group	Tesco Bank
Advice Direct Scotland	Fresh Start	NCR	The Data Lab
Amicus	Fujitsu	Newcastle University	Thriving Natural Capital Challenge Centre, SRUC
Autotrek	GEFI	Nude	Trustable Credit
Aveni	Global Open Finance Centre of Excellence (GOFCoE)	One Banks Hub	TSB
Baillie Gifford	Google Cloud	Origo	UK Government
Barclays	Hampden & Co.	Pinsent Masons	University of Aberdeen
Barclays Rise	Hays	PwC	University of Abertay
BT	Highlands & Islands Enterprise	RBS	University of Edinburgh
CAS	HSBC	Royal London	University of Glasgow
City of London Corporation	IBM	Sainsburys Bank	University of Leeds
ClearGlass	Innovate Finance	Scotland IS	University of Stirling
Deloitte	Innovate UK	Scottish Development International	University of Strathclyde
DirectID	Interface Online	Scottish Enterprise	Virgin Money
Edinburgh Innovations	JP Morgan	Scottish Financial Enterprise	Visible Capital
Edinburgh Napier University	Lending Crowd	Scottish Government	Vistal Works
Eeden Bull	Level E	ShareIn	Vivolution
EIT Digital	Lloyds Banking Group	Skills Development Scotland	Xdesign
Elevator	Lloyds of London	Smart Data Foundry	Zumo
Equifax	M&G	Soar	
Ethical Finance Hub	Money And Pensions Service (MAPS)	Social BD	
Exizent	Merkle	Sopra Steria	
FCA	Modulr	South of Scotland Enterprise	
FData	Money & Pensions Advice Service	Standard Life/Phoenix Group	
FinTechNI	Money Advice Scotland	StepChange	
FinTech North	Napier University	SuperTech WM	
FinTech Scotland		Support in Mind	



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