

Advancing AI for Scotland

Independent Review

Initial Report

January 2024

Contents

Foreword	3
Executive Summary	4
Background	5
Methodology	6
Observations	7
Recommendations & Next Steps	10
Thematic Evidence Synopses	14
Acknowledgments	34

Foreword

“Q: Please write me a sonnet on the subject of the Forth Bridge.

A: Count me out on this one. I never could write poetry”.

At first glance, these might look like a question put into one of the many chatbot tools available today, and the answer produced in response.

They were in fact written over seventy years ago by Alan Turing, one of the founders of Artificial Intelligence (AI), in a paper¹ considering the question “can machines think?” and how it might be possible to test whether a computer is intelligent.

In outline, the ‘Turing test’ sees a human asking the same questions of both a computer and a human, with the computer deemed to be intelligent if the questioner cannot tell the difference between its answers and those provided by the human.

Why Turing suggested asking for a poem about the Forth Bridge is lost in the mists of time. However, given that the bridge is both a global engineering landmark and iconic of Scotland, both computer and human would have plenty of inspiration to help inform their response.

What is here and now are technologies and tools that could be said to pass the test – computers that can think for themselves. Since Scotland’s AI Strategy was launched the development and use of such applications, particularly those termed ‘generative AI’, has increased considerably, a trend seemingly set to continue. This has sparked much debate on the wider impacts and risks of AI and calls for these to be considered and addressed appropriately.

This report does not include sonnets, poems or indeed any type of creative writing about the Forth Bridge or other Scottish landmarks. What it does provide are the outputs of a review by the Scottish AI Alliance’s Leadership Group, which leads on delivery of the Strategy, and recommendations on what Scotland should do to build on its successes to date. Or perhaps, to put it just a bit more creatively, how it might realise the AI of the possible.

¹ [A. M. Turing, I.—COMPUTING MACHINERY AND INTELLIGENCE](#), *Mind*, Volume LIX, Issue 236, October 1950, Pages 433–460

Executive Summary

A vision that “Scotland will become a leader in the development and use of trustworthy, ethical and inclusive AI” is set out in Scotland’s AI Strategy², published in March 2021.

Led by the Scottish AI Alliance³, significant progress has been and is being made towards realising this vision, in an open, transparent, and collaborative way.

However, recent developments, particularly the advent of ‘generative AI’ tools such as OpenAI’s ChatGPT, have prompted and continue to catalyse much discussion around AI’s possible implications for economies, societies, and humanity as a whole.

As 2023 progressed so did this debate, providing a particularly salient backdrop given that we were nearing the halfway point of the Strategy, at which it had always been planned to review its approach to ensure its continuing relevance.

In light of this the Scottish Government commissioned the Alliance’s Leadership Group to explore what Scotland needs to know and do to harness the potential of AI and minimise its risks. Evidence was evaluated to help gain insights and then shape recommendations on how to move forward in a way that enables AI to benefit all.

In short, Scotland has a successful track record and many strengths in AI. These stand it in good stead to address the challenges and harness opportunities that have arisen since 2021.

Recommendations on what Scotland should do to build on its achievements to date are on page 10. They will be the focus of consultation and engagement to help refine them and inform the Scottish Government’s formal response to the review, which it is anticipated will be announced in spring 2024.

² [Scotland’s AI Strategy](#)

³ [About the Scottish AI Alliance](#)

Background

AI is not new: what is are growing public interest in and discussion of the opportunities and risks it presents, and how these can be harnessed and addressed respectively.

In 2019, the Scottish Government committed to develop a strategy⁴ to help ensure that Scotland maximised the potential economic and social benefits of AI and sent a strong signal to the world about our ambition.

Published in March 2021, Scotland's AI Strategy ('the Strategy') sets out a vision and actions to realise this, with a focus on enhancing the AI ecosystem and creating the right environment for people in Scotland to benefit from AI.

Since then, under the leadership of the Scottish AI Alliance ('the Alliance'), much has been achieved^{5,6}. However, the recent proliferation of increasingly powerful AI tools, especially 'generative AI', has prompted concerns that the pace of AI usage could outstrip that of governance and regulation to provide protection. AI's potential impacts need further consideration, as do the wider societal implications that could arise from its growing usage.

Given this, it was felt appropriate to consider changes since the Strategy was launched and explore how to realise the benefits of AI while mitigating risks. In June 2023 the Leadership Group of the Alliance was commissioned by Richard Lochhead MSP, Scottish Government Minister for Small Business, Innovation, Tourism and Trade, whose portfolio includes AI, to conduct an independent review into what Scotland needs to know to maximise the benefits of AI while controlling risks.

The approach taken to conducting the review, key observations, recommendations on what Scotland should seek to do going forward, and the next steps in the process, are set out below, followed by summaries of the evidence.

⁴ [Programme for Government 2019 to 2020](#)

⁵ [State of AI Report, 2022-2023](#)

⁶ [State of AI Report, 2021-2022](#)

Methodology

Having considered several potential approaches, the Alliance Leadership Group decided to convene a project group, comprised of volunteers from its membership, to take the review forward.

Recognising the volume of evidence that this group would require, and drawing on prior experience from the process of developing the Strategy, the Scottish Government's Digital Directorate provided officials to support its work.

For consistency with the Strategy's vision, "trustworthy, ethical and inclusive" were the lenses through which the review explored seven themes, each with various sub-topics:

- People and society
- Public sector
- Business
- Research
- Leadership
- Skills
- Tech Infrastructure

Alongside retrieving that obtained during the development of the Strategy, evidence was gathered via web and literature searches, attendance at conferences and events, and contributed by members of the wider Alliance Leadership Group.

Material was collated, triaged, and synthesised into a working dialogue paper. This aimed to provide a high-level overview of the evidence gathered for each theme, grouped by sub-topic, followed by provocations for the project group to consider.

The outputs from this were distilled and refined into observations, which formed the basis for working up recommendations as to what Scotland should look to do to build on its successes to date in harnessing AI and address emerging challenges.

Observations

“There is nothing either good or bad, but thinking makes it so.”

Written over 400 years ago by Shakespeare – though not in a sonnet⁷ – perhaps this could be read as a rather succinct conception of the importance of the thinking, and by extension the inputs to this, to the outputs of AI technologies.

The genie of generative AI is out of the bottle, and the power, capability and usage of it and other AI technologies are growing at pace. But where is Scotland in this race?

The Strategy acknowledged that AI would evolve, meaning it would be necessary to review the approach to ensure it reflected developments and emerging good practice.

The Alliance Leadership Group welcomed being asked to conduct the review, which allowed it to both reappraise the Strategy and deepen its understanding of Scotland’s AI ecosystem; key insights and reflections are set out below.

Observations

The Strategy acknowledged that AI could have positive impacts and help to realise economic and social benefits. It recognised that Scotland was building on strong foundations, not starting from scratch, but also that we needed to consider what kind of AI we want to see, and the importance of securing and sustaining public trust on the journey towards achieving this.

This is reflected in its vision and guiding principles, which include the OECD’s AI Principles, and UNICEF’s Policy Guidance on AI for Children – the inclusion of the latter being an internationally distinguishing feature. It also noted that there is more to AI than the technologies themselves, and that their place and purpose in our economy and society need to be considered appropriately, more so given the pace of change.

One highlight is the value of the Alliance itself as a focal point for those active in AI, advocating and helping to promote alignment with the trustworthy, ethical, and inclusive tenets of the Strategy’s vision and underpinning principles. This has highlighted the importance of taking an integrated approach, fostering more collaboration within and between the AI and relevant sectors.

Other strong points include the increasing provision of AI-related courses at both undergraduate and postgraduate level at institutions across Scotland. It is encouraging to see how much this has expanded over the last few years, alongside the growth of specialist AI research centres. The Alliance welcomed AI-related actions being taken forward from the Digital Economy Skills Action Plan, and the recommendations set out in the Independent Review of the Skills Delivery Landscape.

⁷ Scene 2, Act II, *Hamlet*, William Shakespeare

Challenges include the need to recognise the complexities of AI systems and the rate at which they can be developed, along with the pace and scope of governance mechanisms. Furthermore, the international scope of AI development and usage can make it difficult to assign accountability and implement and uphold frameworks to guide its use. There is also increasing public awareness and dialogue of the potential risks and harms that could arise from use of AI and calls for these to be recognised and addressed. Whilst there is limited Scotland-specific data on these issues, it would be reasonable to infer that Scottish public opinion will be broadly like that elsewhere.

The value of strengthening both the Scottish AI ecosystem – visualised below – and the links that it has to the wider data and digital ecosystems here and elsewhere have been noted, as well as the potential to place the Alliance on a more substantive footing.

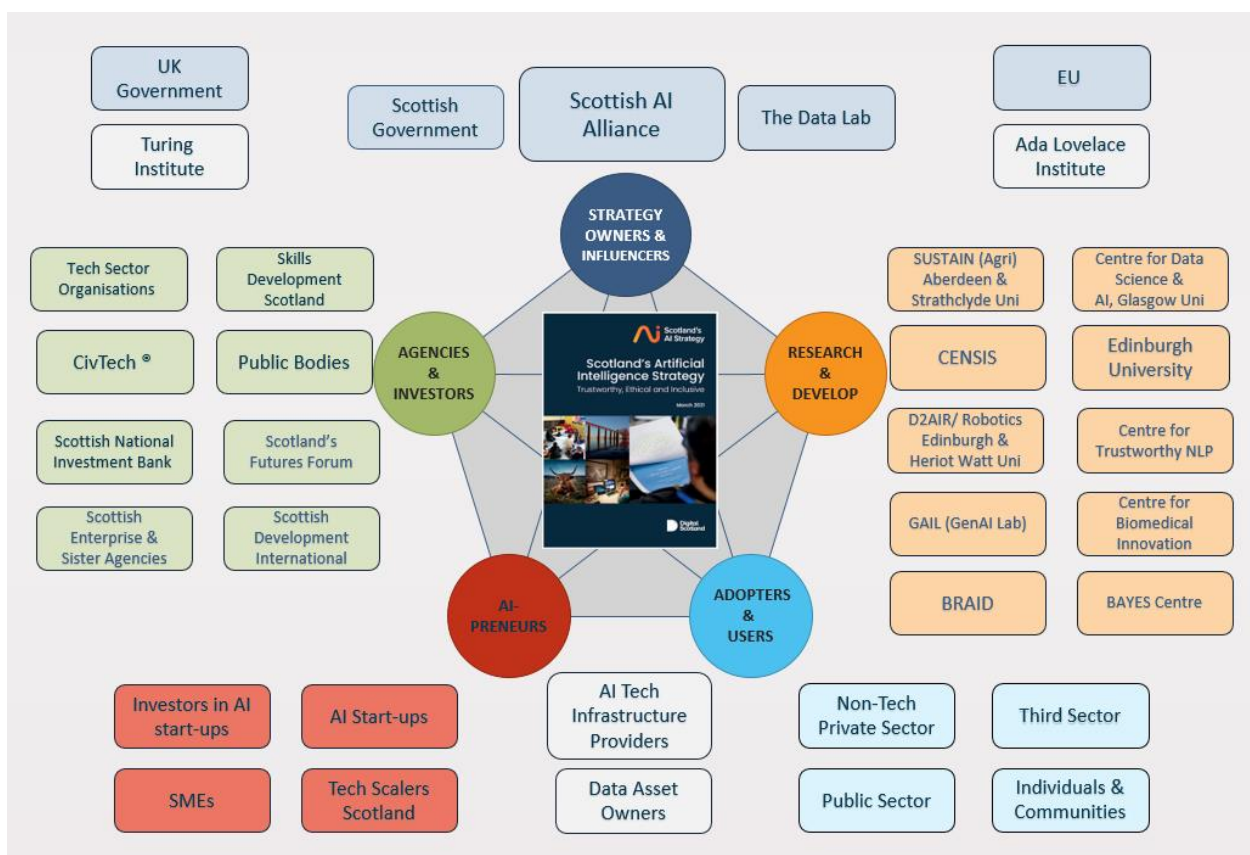


Figure 1 – High-level outline visualisation of Scotland's AI ecosystem

What is also clear is that more could be done to ensure that taking forward the actions of the Strategy better complements that on those for both the Scottish Technology Ecosystem Review and the Digital Strategy for Scotland, as well as those launched since 2021. These include the Innovation Strategy, New Deal for Business, the National Strategy for Economic Transformation, and other initiatives⁸.

⁸ [Entrepreneurial Campus Report](#)

Whilst the Strategy acknowledged that our universities, research institutes and tech businesses are world-class, it also noted that this should not be taken for granted. Since 2021, whilst much has been done to develop and deepen Scotland's AI research and development base, some issues remain, including the need to develop a better understanding of what capabilities there are and ensure details of these are accessible for both Scottish stakeholders and those further afield. There is also scope to learn from experiences elsewhere of unlocking the potential and addressing the challenges associated with AI.

Scotland's enterprise agencies remain keen to support the growth of the AI sector, alongside wider data-driven innovation, though there may be scope to better coordinate and orchestrate work by all the relevant players. Linked to this is the importance of exploring how AI firms seeking to start, grow and scale-up can access venture capital in Scotland or via inward investment; there may also be scope to make more of our values-based approach to AI, perhaps as part of a refresh of Scotland's brand and pitch on AI.

The Strategy also promised that Scotland would be outward-looking to the UK, Europe and beyond. Whilst there are relationships with the UK Government, these need to be deepened and strengthened to ensure greater mutual benefit. There has also been some good engagement with those working on AI in the EU and elsewhere in the world, and there is scope to build on this – something which could be particularly valuable given that the challenges of AI governance and regulation, and recognising and managing its potential impacts, are international. Beyond complementing work to secure and sustain public trust in AI, this could also help to support the inward investment and trade related challenges noted above.

Recommendations & Next Steps

Recommendations

Having considered the evidence and reflected on its observations, the review project group formulated recommendations for further consideration.

The first to crystallise was that the Strategy’s vision – “Scotland will become a leader in the development and use of trustworthy, ethical and inclusive AI” – remains relevant and should be retained as the overarching focus.

After this came those for each theme – an overview visualisation is presented below.

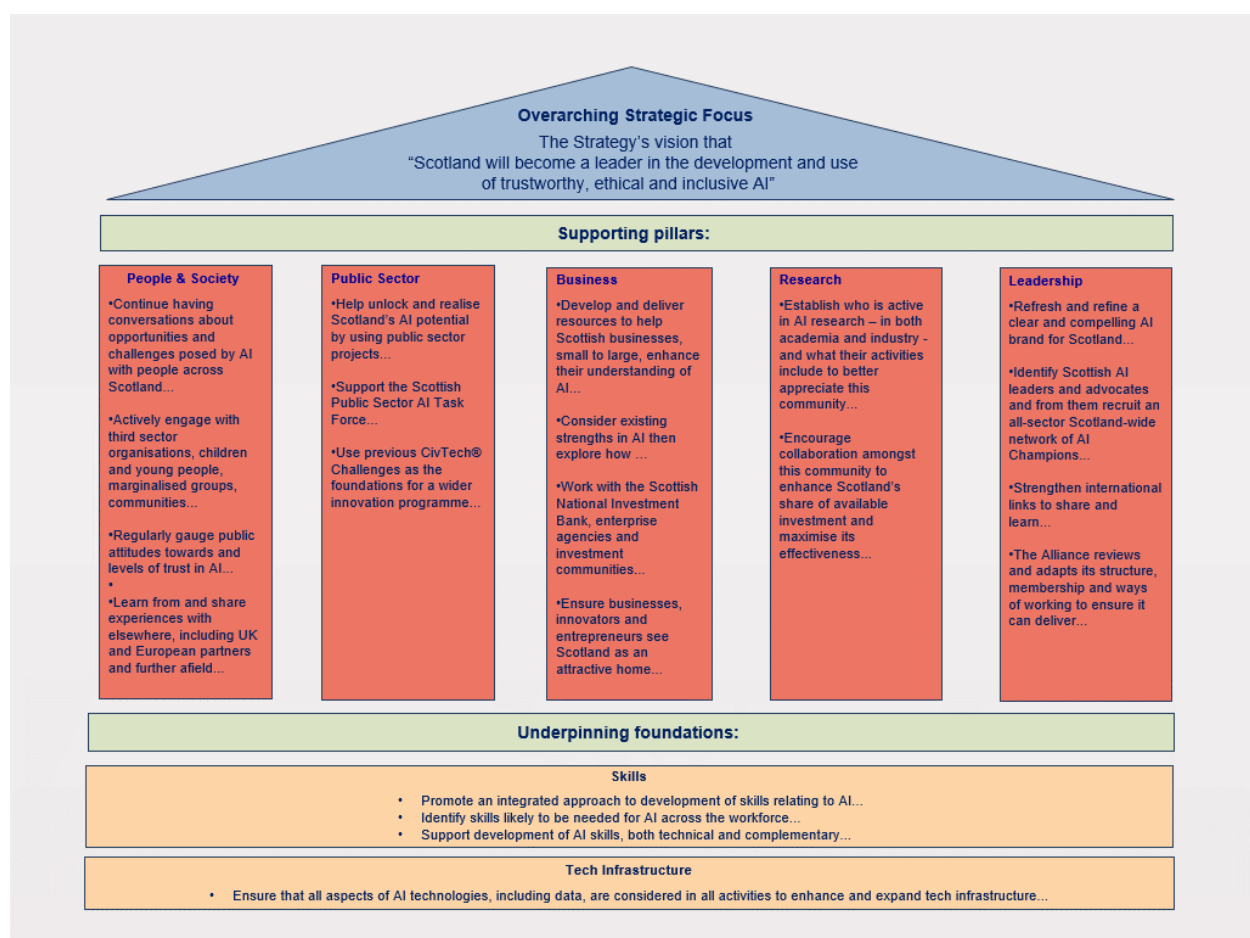


Figure 2 – Review recommendations construct visualisation

Though many of the recommendations – set out in full below – would, if taken forward, be realised by the Strategy’s fifth anniversary in March 2026, some would take longer due to their scale or interdependencies. Given this, the horizon used to help shape thinking stretched to 2030.

People and society

- Continue having conversations about opportunities and challenges posed by AI with people across Scotland and beyond, to raise knowledge and understanding of AI and secure interest and support for its development and use in line with the vision.
- Actively engage with third sector organisations, children and young people, marginalised groups, communities and the bodies that represent them, who may be less aware of but more likely to be affected by AI, to discuss what it might mean for them, and use feedback to help inform further work.
- Regularly gauge public attitudes towards and levels of trust in AI to help improve understanding, measure progress and inform future work, perhaps through developing an AI Trust Index for Scotland.
- Learn from and share experiences with elsewhere, including UK and European partners and further afield, to inform future activities and ensure Scotland keeps pace with developments and good practice.

Public sector

- Help unlock and realise Scotland's AI potential by using public sector projects to nurture the talent pipeline and grow the AI technical and complementary skills and experience base.
- Support the Scottish Public Sector AI Task Force to become the forum for sharing and learning good practice, such as use of the Scottish AI Register, to ensure AI is used to best effect in Scotland's public services.
- Use previous CivTech® Challenges as the foundations for a wider innovation programme focused on developing and using AI in line with the vision to help improve public service delivery.

Business

- Develop and deliver resources to help Scottish businesses, small to large, enhance their understanding of AI and how it could help both their operations and employees, and make strategic decisions about its use and deployment if this would be appropriate, taking account of potential impacts and risks.
- Consider existing strengths in AI then explore how a few of these could be supported to develop and grow into strategic AI capabilities, e.g. skills, expertise, investment, taking into account other relevant initiatives.

- Work with the Scottish National Investment Bank, enterprise agencies and investment communities to identify, promote and prioritise accessible investment for ambitious AI companies based in Scotland.
- Ensure businesses, innovators and entrepreneurs see Scotland as an attractive home on account of its infrastructure, workforce and values-based strategic approach to AI, and engage with leading AI tech companies to explore interest in creating regional offices and incentivising talent to relocate to Scotland.

Research

- Establish who is active in AI research – in both academia and industry – and what their activities include to better appreciate this community and how it might be supported by and provide support to the Alliance.
- Encourage collaboration amongst this community to enhance Scotland's share of available investment and maximise its effectiveness, and ensure other needs are identified and advocated appropriately, perhaps via a new section in the Alliance.

Leadership

- Refresh and refine a clear and compelling AI brand for Scotland, highlighting strengths and strategic capabilities.
- Identify Scottish AI leaders and advocates and from them recruit an all-sector Scotland-wide network of AI Champions to help promote the Alliance's work and its delivery of strategic objectives.
- Strengthen international links to share and learn, enable comparison and collaboration, promote Scotland's AI brand and strengths, and help attract AI businesses, investment and talent.
- The Alliance reviews and adapts its structure, membership and ways of working to ensure it can deliver recommendations taken forward dynamically and sustainably.

Skills

- Promote an integrated approach to development of skills relating to AI, from schools to universities to workplace and lifelong learning, within work to deliver initiatives such as the Digital Economy Skills Action Plan.
- Identify skills likely to be needed for AI across the workforce using existing UK and globally available resources, such as the National Foundation for Educational Research's 'Skills Imperative 2035', and channels.

- Support development of AI skills, both technical and complementary, via work to implement initiatives such as the Scottish Technology Ecosystem Review and relevant others.

Tech Infrastructure

- Ensure that all aspects of AI technologies, including data, are considered in all activities to enhance and expand tech infrastructure, and continue to support proposals for improvements and investments in Scotland, such as cybersecurity, energy efficient data centres and supercomputer facilities.

Next Steps

Much has been achieved but there is scope, opportunity and motivation to build on previous successes and bolster Scotland's reputation for 'doing AI well'.

It is intended that the recommendations set out above will be the topic of dialogue in early 2024. The Alliance Leadership Group is keen to hear from as many perspectives as possible and would like to encourage everyone with an interest to reflect and comment on them.

Somewhat like AI itself, the Alliance wants the approach to be dynamic, learning and improving, and would welcome all's contributions as it continues to strive towards achieving this and making Scotland an attractive exemplar in AI.

Synopses of evidence for each theme can be found in the next section of the report.

Thematic Evidence Synopses

1. People & Society

1.1 Harms, hype, and narrative shift

The narrative around AI has shifted since the publication of Scotland's AI Strategy, becoming more consumer-driven and newsworthy. This has particularly been the case since the launch of OpenAI's ChatGPT⁹ in November 2022, something in which Scottish public interest peaked quite some time later, in March 2023¹⁰.

Advances in such powerful applications and subsequent media coverage could be said to have blurred lines around real technological capabilities, prompting understandable but potentially unrealistic speculation as to what their use could lead to. The more tangible harms of AI can be less obvious, but not necessarily less serious or real.

Views on the potential implications of AI vary considerably, though there are more calls for reflection and caution than otherwise. Spring 2023 saw 17% of over 2000 adults surveyed by YouGov put AI/robots in their top three threats most likely to cause human extinction, rising 10 points in the last year^{11,12}, and public statements from groups of experts regarding the potential risks of AI¹³. Concerns over harms and risks¹⁴ have been widely voiced, as have calls to triage risk¹⁵, for more regulation and a moratorium on AI development¹⁶, with even ChatGPT creators OpenAI having entered the debate¹⁷.

However, it has also been observed that there may be a need to reflect on dreams versus reality, with Gartner® placing generative AI at the peak of inflated expectations on their AI Hype Cycle, the stage before the trough of disillusionment¹⁸. In similar vein the importance of appreciating the real capability and power of AI, as opposed to how it may be projected and sold, has been noted^{19,20}, including by the Scottish AI Alliance²¹.

In July 2023, the UK Parliament's Science, Innovation and Technology Committee published its '12 Challenges of AI' in respect of governance and public confidence. In November the UK Government acknowledged that this report had made clear risks that they would consider in developing a framework to support responsible use of AI. They also cited work to date, such as the consultation on an AI Regulation White Paper²², the creation of the Frontier AI Taskforce, which has since established an AI Safety Institute, and the global AI Safety Summit held at Bletchley Park on 1 and 2 November 2023.

⁹ [Greg Brockman, President and Co-Founder of Open AI, tweet on ChatGPT users](#)

¹⁰ [Scottish Public Interest on ChatGPT – Google search trends](#)

¹¹ [YouGov Poll on Human Extinction Threats](#)

¹² [YouGov Analysis on the Human Extinction Threats Poll](#)

¹³ [Center for AI Safety, Open Letter on Statement of AI Risk](#)

¹⁴ [On the Dangers of Stochastic Parrots: Can Language Models Be Too Big?](#)

¹⁵ [An Overview of Catastrophic AI Risks](#)

¹⁶ [Future of Life Institute, Open Letter on Pause Giant AI Experiments](#)

¹⁷ [Open AI, Blog on the Governance of superintelligence](#)

¹⁸ [What's New in Artificial Intelligence From the 2023 Gartner Hype Cycle™](#)

¹⁹ [Financial Times Letter, AI's God-like power is a Big Tech narrative that needs calling out](#)

²⁰ [Thinking Digital Conference, What we're getting wrong about the real threats of AI](#)

²¹ [Scottish AI Alliance Blog piece, Demystifying AI - Separating Fact from Fiction](#)

²² [UK Government White Paper, AI Regulation: a pro innovation approach](#)

1.2 Perception, understanding and trust in AI

While emerging technologies are not amongst the top issues identified in YouGov's weekly tracker of the most important issues facing the country²³, in May 2023 a survey of 2011 adults across the UK found that 19% were optimistic, 35% pessimistic and 34% neutral about potential impacts of AI. A 31-country IPSOS Global Advisor survey^{24, 25} conducted 23 May – 9 June 2023 found almost as many people said products/services using AI made them nervous (average 52%, UK 65% - second to Australia, 69%) as said they were as excited by them (average 54%, UK 42%), with nervousness rising over the last eighteen months. It also found differences in levels of trust and excitement between generations, income and education, and concerns about job displacement.

An Edelman Trust survey²⁶ in 2022 identified concerns over AI, including data privacy, misinformation and deepfakes, and fears that it could worsen job losses and income inequalities. The majority were convinced that tech could help solve societal challenges, make work more meaningful (63%), that tech firms should contribute towards reskilling workers displaced by tech (68%), and that regulators do not have adequate understanding to regulate emerging tech effectively (56%). Robotics and AI did not appear to enjoy the same level of trust as tech in general, at 59% versus 76% respectively. The need to promote tech's benefits and downsides was cited as important to increasing trust, likewise, control over data collection and use.

The UK Centre for Data Ethics and Innovation (CDEI) runs a biennial study of public attitudes to data and AI; the first report²⁷ from this was published in March 2022. Whilst most respondents were comfortable with personal data being used to help improve services, the majority knew little or nothing about how data is collected and used; data security was also a concern. There were also concerns that the benefits of data and AI use will not be felt evenly across society. Whilst 31% thought they would be shared equally, 31% disagreed; more believe that AI will have a positive impact on large businesses (48%), compared to smaller businesses (39%) and minority groups (26%). An Office for National Statistics (ONS) survey²⁸ in May 2023 also found divergent views: 21% thought AI would have a negative impact, 62% moderate, and 18% positive. Another ONS survey²⁹ in November 2023 found 26% thought there are more risks than benefits, 46% equal benefits and risks, and 16% that there are more benefits than risks.

Various organisations have explored public views on AI. Starting with the tech sector itself, the British Computer Society has responded to consultations, fostered discourse on aspects such as data and ethics, ran initiatives aimed at increasing awareness and understanding, and produced learning resources for its members³⁰. The Alan Turing Institute (ATI), the UK's national institute for data science and AI, works to advance research, build skills, and drive public dialogue³¹; several universities in Scotland are

²³ [YouGov Poll, The most important issues facing the country](#)

²⁴ [Ipsos Global Advisor survey report, Global Views on AI 2023](#)

²⁵ [Ipsos Global Advisor survey report summary](#)

²⁶ [Edelman Trust Barometer Special Report: Trust in Technology](#)

²⁷ [Centre for Data Ethics and Innovation, Public attitudes to data and AI survey](#)

²⁸ [ONS, Dataset on the use of AI and how people feel about its uptake in today's society](#)

²⁹ [ONS, Dataset on public opinions and social trends on AI](#)

³⁰ [Artificial intelligence \(AI\) | BCS](#)

³¹ [About us | The Alan Turing Institute](#)

members of or affiliated with the ATI, with whom the Alliance and the Children's Parliament have been working on the AI for Children project³². The Royal Society explored public views and portrayals of AI and ran an AI for Social Good programme³³. The Royal Society of Edinburgh responded to the consultation on the Strategy, and has produced briefings and papers since^{34,35}.

A June 2023 World Economic Forum (WEF) report cited AI as a top emerging technology. Key points included recognition of growing public excitement and concern, particularly around generative AI, and the value of such tools meeting agreed standards to help build public trust. Also highlighted were the need to ensure bias is not built into systems, the importance of having transparency, privacy and ethical safeguards in place, and copyright attribution³⁶.

Whilst media coverage of AI has increased significantly in recent years, particularly over the last eighteen months, there has been limited systematic evaluation or scrutiny exploration of how the media itself presents and discusses the topic³⁷. It has been suggested that the prisms through which AI is depicted are influenced by wider political and economic aspects³⁸, with detail and nuance in the margins.

1.3 Education on AI

The need for education appropriate to users' needs will be considered as part of the 'Skills' theme. However, AI's potential to support in various areas of education, from administration to classroom advice and tuition, has been noted³⁹. Education Scotland, the national body for supporting quality and improvement of learning and teaching in Scottish education, is now building a suite of resources relating to AI⁴⁰. Improving awareness of AI has long been an active area of work for the Alliance, and is becoming so for other organisations, including academic, civic, community and the third sector.

1.4 Future of work

In a YouGov study in May 2023, almost two thirds (64%) of respondents felt more jobs would be created than lost due to automation by robotics/AI, but fewer were concerned about the impact on their own job (82% not worried). The survey⁴¹ included a weighted sample of 158 Scottish responses, with results broadly in line with overall UK views.

The Institute for the Future of Work⁴² has conducted several projects that consider the potential impacts of AI in the workplace and on the workforce, including on issues such as governance and regulation, and auditing AI use. Key outputs are guidance on how to assess impacts of algorithms, and reports on the use of AI in recruiting and the pace of

³² [Exploring Children's Rights in AI — Scottish AI Alliance](#)

³³ [Artificial intelligence | Royal Society](#)

³⁴ [RSE and partners provide briefing ahead of Scottish Government-led debate on AI - RSE](#)

³⁵ [RSE blog, Artificial Intelligence doesn't yet exist, optimised search does](#)

³⁶ [WEF, Top 10 Emerging Technologies of 2023, Flagship Report](#)

³⁷ [Newspaper coverage of artificial intelligence: A perspective of emerging technologies - ScienceDirect](#)

³⁸ [Reuters Institute, An Industry-Led Debate: How UK Media Cover Artificial Intelligence](#)

³⁹ [Out of the laboratory and into the classroom: the future of artificial intelligence in education](#)

⁴⁰ [Teaching and Learning with Artificial Intelligence \(AI\) | Resources | Education Scotland](#)

⁴¹ [Britons think artificial intelligence will cost jobs... but not their own | YouGov](#)

⁴² [Institute for the Future of Work](#)

legal framework and regulatory regime change in relation to that of AI development. Organisation for Economic Cooperation and Development (OECD) research⁴³ noted similar issues, as well as the potential for AI to have more profound impacts in some sectors compared with others, prompting calls for the urgent development of policies to enable AI's benefits to be harnessed whilst mitigating risks.

The UK Trades Union Congress has conducted several studies as part of a project on AI and the employment relationship⁴⁴. The Scottish Trades Union Congress worked with the Scottish Government to produce a report⁴⁵ into potential impacts of automation, including AI, on employment; this was completed prior to development of the Strategy.

1.5 Third/voluntary sector

Recent surveys have identified several pressures affecting Scotland's third sector, key being financial constraints and running costs^{46,47} but also scope to use tech such as AI⁴⁸ in responding to such challenges. Hurdles have been highlighted, including data, and reacting to urgent needs impinging on longer-term strategic planning.

The Alliance⁴⁹ and others⁵⁰ have considered what AI could do for the sector, such as freeing capacity for higher value tasks and informing service design and delivery⁵¹, but citing the need for human oversight⁵². In keeping with apparent links between age and trust in tech noted above Young Scot, Scotland's advocacy and advice hub for young people, established an advisory group in 2021 to help inform work to make better use data in delivery of services⁵³.

1.6 Inclusivity

The importance of ethics to underpin the safe and responsible use of AI has been highlighted since work to develop the Strategy began in 2019. The consultation and engagement conducted as part of the development process invited views on the topic, and there was also a thematic working group on ethics and regulatory frameworks. Experiences from these activities were used to help inform strategic work elsewhere within the Scottish Government, such as the Ethical Digital Nation programme. Since 2018 the OECD AI Policy Observatory Portal has collated detail on AI strategies and work around the globe and set out the OECD's core principles for AI⁵⁴. The latter were transposed into the Strategy, and guide work to realise its vision. A June 2021 paper reported on implementation⁵⁵ of the principles; Scotland is not discussed as the Strategy was only published three months previously. Since the Strategy's launch the

⁴³ [OECD, Findings on AI and jobs](#)

⁴⁴ [Work and the AI Revolution | TUC](#)

⁴⁵ [Technical change and the Scottish labour market](#)

⁴⁶ [OSCR, Scottish Charity and Public Surveys](#)

⁴⁷ [Fraser of Allander Institute, Economic Commentary](#)

⁴⁸ [SCVO, Scottish Third Sector Tracker](#)

⁴⁹ [Scottish AI Alliance, AI in the third sector podcast](#)

⁵⁰ [NPC, Rhodri Davies: Would AI be good or bad for philanthropy? Will AI replace grant-makers?](#)

⁵¹ [Volume II: A Changing Third Sector Research Landscape—Progress or Pitfall? | SpringerLink](#)

⁵² [What a time to be sentient! – an early look at the potential and pitfalls of chat-based AI tools - SCVO](#)

⁵³ [Data Advisory Group supporting Young Scot on our data journey - Young Scot Corporate.](#)

⁵⁴ [OECD AI Policy Observatory Portal](#)

⁵⁵ [State of Implementation of the principles](#)

topic has been returned to many times, including at the 2023 Festival of Politics⁵⁶, DataFest and opinion pieces⁵⁷.

Fairness and bias are key spokes in the umbrella of ethics that covers AI, with questions over the extent to which it is possible to ensure AI is equitable⁵⁸, has robust ethical and risk safeguards integrated and the approach to using it. Myriad frameworks and guidance⁵⁹ have been or are being developed worldwide, and the topic is the subject of much academic evaluation and research⁶⁰.

It is important to acknowledge the potential impacts of AI on particular communities. Close the Gap, a policy advocacy organisation working on women's labour market participation, responded to the consultation on the Strategy⁶¹. Their response noted AI's positive potential, but that it also presented challenges around inequality, built-in discrimination and bias, and future skills challenges. It observed that women are currently under-represented in Scotland's tech sector, including in the AI field, and noted data issues that lead to AI that discriminates against women. It discussed the risk of AI accelerating disruption in the jobs market and projections that this would have a gendered impact. It also highlights the commitment in A Fairer Scotland for Women⁶², Scotland's first gender pay gap action plan, to ensuring that addressing the causes of the gap are central to policies on automation and AI. AI could be used to help improve the experiences of other marginalised communities, such as the Protecting Minority Ethnic Communities Online (PRIME) project⁶³, led by Heriot-Watt University, and The Data Lab's work with LGBT Youth Scotland⁶⁴.

1.7 Democracy and AI

There is interest in the potential for AI to be used to influence political debate and manipulate elections^{65,66,67}, and its place in wider geopolitical debate⁶⁸. There has been discussion of its potentially positive use in politics⁶⁹, and increasing interest amongst parliamentarians on what AI might mean for democracy, the economy and society^{70,71}. The UK Parliament has had an All-Party Parliamentary Group on AI since 2017, focusing on education, adoption of AI, citizen participation, and governance⁷².

Whilst the Scottish Parliament does not have a Cross Party Group on AI, that on Science and Technology has considered some salient issues. In June 2022, the

⁵⁶ [Where are the ethics in Artificial Intelligence? | Scottish Parliament TV.](#)

⁵⁷ [Rachel Aldighieri comment, The importance of showcasing artificial intelligence's ethical integrity](#)

⁵⁸ [Global Government Forum, Can governments ensure AI is equitable?](#)

⁵⁹ [AI Risk Management Framework](#)

⁶⁰ [CDEI, Holistic AI: Risk Mitigation Roadmaps](#)

⁶¹ [Close the Gap response to the Scottish-Governments AI Strategy Consultation](#)

⁶² [A fairer Scotland for women: gender pay gap action plan](#)

⁶³ [PRIME](#)

⁶⁴ [Supporting the LGBTI community with data: LGBT Youth Scotland](#)

⁶⁵ [The Guardian, Elections in UK and US at risk from AI-driven disinformation](#)

⁶⁶ [The Guardian, AI watch: UK electoral warning and OpenAI's move into London](#)

⁶⁷ [MI5, Partnership between MI5 and The Alan Turing Institute revealed](#)

⁶⁸ [Stay ahead in AI race, tech boss urges West - BBC News](#)

⁶⁹ [Holyrood Article, Programmed to serve](#)

⁷⁰ [The Guardian, Artificial Intelligence powering politics](#)

⁷¹ [Digit News, What do MP's trust AI to do and not do](#)

⁷² [All Party Parliamentary Group on AI, \(APPG AI\)](#)

Scottish Futures Forum held a seminar⁷³ in the Parliament to discuss some of the opportunities and challenges associated with AI and wider innovation. The Forum also conducted a study into parliamentary responses⁷⁴ to AI that considered how AI can be assessed during development, incorporation of a human rights-based approach into regulation, and resource to develop and maintain a regulatory approach.

2. Public Sector

2.1 Regulation, Standards and Transparency

As noted, the UK Government has produced guidance on the use of AI in the public sector, including generative AI. The Royal Society has explored issues relating to the use of AI in public services, particularly the need for a collaborative, cross-sectoral approach to deliver to best effect. Given that the final report⁷⁵ was published in 2018, the underpinning research was likely conducted some time prior to that.

The Strategy commits to the public sector leading by example in using AI responsibly in delivering services. A key action⁷⁶ is the creation of the Scottish AI Register⁷⁷, an open online resource that provides details and invites feedback on AI systems in development or use in the Scottish Government and wider public sector. Those registered at present include the ‘Connecting You Now’ tool⁷⁸ being developed as part of a CivTech® Challenge, whilst more are in the pipeline. Enhancing the Register is a key task of the new Scottish Public Sector AI Taskforce.

The importance of being open and transparent about the use of AI in public services has long been recognised, with guidance and other resources produced by the UK Government and other bodies^{79,80,81} some on its second or third iteration⁸².

2.2 AI's Potential to help with Public Service Reform

Scotland-specific evidence is limited, but in spring 2023 the Scottish Parliament's Finance and Public Administration Committee discussed opportunities to use data and AI as part of public service reform⁸³, and the Auditor-General for Scotland highlight the need to improve public bodies' data maturity to help improve readiness for use of technologies such as AI⁸⁴. The Scottish Government has been exploring making use of AI for some time, forming an Automation Centre of Excellence to support this work⁸⁵.

⁷³ [Artificial Intelligence and Accountability | Scotland's Futures Forum](#)

⁷⁴ [Parliamentary Responses to Artificial Intelligence | Scotland's Futures Forum](#)

⁷⁵ [The Royal Society, AI for the public sector: opportunities and challenges of cross-sector collaboration](#)

⁷⁶ [Scotland's AI Strategy - Track 3](#)

⁷⁷ [Scottish AI Register](#)

⁷⁸ [Dynamic page for all systems - Scottish AI Register](#)

⁷⁹ [CDEI, Independent Report about algorithmic transparency in the public sector](#)

⁸⁰ [The Alan Turing Institute, Understanding artificial intelligence ethics and safety](#)

⁸¹ [Toward Meaningful Transparency and Accountability of AI Algorithms in Public Service Delivery](#)

⁸² [CDDO and OAI, A guide to using artificial intelligence in the public sector](#)

⁸³ [Inquiry into the Scottish Government's Public Service Reform programme](#)

⁸⁴ [Radical action needed on data | Audit Scotland](#)

⁸⁵ [EY with the Scottish Government - MCA](#)

2.3 Procurement frameworks

Building on prior guidance on the use of AI in the public sector, the UK Government has issued advice for officials on the use of generative AI⁸⁶, but it does not yet extend to procurement considerations. In developing the Strategy there were suggestions that procurement requirements be reviewed to oblige acquisition of AI developed and deployed in line with the vision, but this was not taken forward due to uncertainties over the post-EU Exit public sector procurement landscape at the time.

2.4 Public support

The UK Government has explored public views on the use of AI in public services, albeit focused on specific tools such as foundation models⁸⁷. This found that public trust will be fundamental to successful use of such models, which participants were open to the use of provided they were reliable, accurate and appropriate accountability and governance arrangements were in place. These points have also been cited in public calls for more openness around the use of such tech⁸⁸. There is likely to be an increasing amount of research and evaluation in this area, building on that of the CDEI et al, and more so given the foci of the AI Safety Summit in November 2023.

2.5 Case studies of deployment

There have been evaluations of AI use, mainly conducted by academia^{89,90}, but also by the UK Government⁹¹. In July 2023, the UK Government signalled interest in proactively engaging with the tech sector⁹² to help upskill officials to improve usage of AI. Though they emerged after gathering of evidence for this paper had drawn to a close, The Guardian has run several articles^{93,94} - part of a wider series entitled 'The AI Race' - looking at the use of AI in UK public services, including benefits administration and policing. These have highlighted concerns over accountability and explainability, as well as the potential for AI systems to give rise to or reinforce discrimination.

2.6 Healthcare

The refreshed Digital Health and Care Strategy⁹⁵ has a commitment to equip staff with skills to enable them to understand and interrogate data-driven recommendations and decision support tools, including those powered by AI. This maps into the Data Strategy for Health and Social Care⁹⁶, which notes that AI-powered solutions and products will be at the core of data-driven innovation and sets out related aims. These include working in partnership across the UK to explore AI and what it means for the workforce,

⁸⁶ [Guidance to civil servants on use of generative AI](#)

⁸⁷ [CDEI Report, Public perceptions towards the use of foundation models in the public sector](#)

⁸⁸ [UK government must be more open on use of AI, say campaigners - BBC News](#)

⁸⁹ [Overcoming the challenges of collaboratively adopting artificial intelligence in the public sector](#)

⁹⁰ [Ada Lovelace Institute, Foundation models in the public sector](#)

⁹¹ [AI chatbots do work of civil servants in productivity trial - BBC News](#)

⁹² [The National article, Government aims to boost AI skills](#)

⁹³ [The Guardian, UK risks scandal over 'bias' in AI tools in use across public sector](#)

⁹⁴ [The Guardian, UK officials use AI to decide on issues from benefits to marriage licences](#)

⁹⁵ [Scot Gov, Digital health and care strategy](#)

⁹⁶ [Scot Gov, Strategy for data-driven care in the digital age](#)

managing risks, and developing regulatory approaches to the use of software and AI as a medical device.

Developing AI for use in health and social care is one of Scotland's existing strengths, exemplified by the University of Aberdeen, NHS Grampian and Kheiron Medical Technologies GEMINI project, which showcased the potential to harness AI in clinical diagnosis⁹⁷, and the acquisition of medical AI imaging firm Blackford Analytics⁹⁸. For reference, NHS England has a strategy for the use of AI in health and social care⁹⁹, with relevant work being taken forward by the NHS AI Lab¹⁰⁰.

2.7 AI in education

The potential use of AI in various areas of education – from back-room administration to learner support – has been noted and discussed for some time¹⁰¹. These include the need to recruit teachers¹⁰² to better enable the teaching of computing in schools, and the implications of AI for the examination system¹⁰³. The Scotland's Futures Forum has been exploring questions around education and skills¹⁰⁴ as part of a wider programme of work relating to AI. A debate in June 2023, held in partnership with the Goodison Group¹⁰⁵, concluded that whilst AI has potential it will require careful management, and raises ethical and moral issues, as well as questions over the future purpose of schools.

2.8 AI in sensitive areas (e.g., policing)

Police Scotland conducted a series of events to discuss the potential implications of AI for policing, including governance and oversight¹⁰⁶. This helped to inform the force's Digital Strategy¹⁰⁷, published in September 2023, which has aims relating to various technologies including AI. It notes that on more advanced AI capabilities e.g., machine learning and facial recognition "it is essential that these are only considered for introduction into operational policing after the appropriate Data Ethics assessments have taken place". At the time of writing in November 2023 arrangements for these were still in development. Of related interest is the Scottish Biometrics Commissioner, who backed calls from the Scottish Government for a four nations summit on AI¹⁰⁸, and whose Code of Practice¹⁰⁹ includes various provisions relating to AI.

⁹⁷ [The University of Aberdeen, Grampian team pioneers breast screening Artificial Intelligence](#)

⁹⁸ [Bayer acquires British medical imaging AI developer Blackford | Reuters](#)

⁹⁹ [NHS England, The National Strategy for AI in Health and Social Care](#)

¹⁰⁰ [The NHS AI Lab - NHS Transformation Directorate](#)

¹⁰¹ [Out of the laboratory and into the classroom: the future of artificial intelligence in education](#)

¹⁰² [Holyrood, Tech experts wanted to help tackle digital skills gap in Scottish schools](#)

¹⁰³ [Scot Gov, Independent review of qualifications and assessments](#)

¹⁰⁴ [Artificial Intelligence and Skills | Scotland's Futures Forum](#)

¹⁰⁵ [AI and Education with the Goodison Group in Scotland | Scotland's Futures Forum](#)

¹⁰⁶ [Artificial Intelligence in Policing | Scottish Police Authority](#)

¹⁰⁷ [Police Scotland Digital Strategy published - Police Scotland](#)

¹⁰⁸ [Scottish biometrics commissioner backs proposal for four nation summit on AI | FutureScot](#)

¹⁰⁹ [Scottish Biometrics Commissioner, Code of Practice](#)

3. Business

3.1 Engagement with government

The potential value of AI, alongside data-driven innovation more broadly, was noted by the Scottish Council for Development and Industry (now ‘Prosper’ – see paragraph 3.2) et al in a paper¹¹⁰ that helped to inspire development of the Strategy. An initial proposal was advocated in early 2019 by The Data Lab to the Data Delivery Group¹¹¹, a strategic forum convened by Scottish Government to help realise Scotland’s potential in data. The group endorsed the proposal, which led to the inclusion of a commitment to develop an AI Strategy in the Programme for Government 2019-2020, published in September 2019.

Subsequent business engagement directly with Scottish Government on issues relating to AI has been limited. Several businesses, ranging in size from Big Tech firms to SMEs, and business representative bodies, responded to the initial consultation on the Strategy, whilst all working groups convened in the development process included several members from the business sector. The Alliance, particularly the Leadership Group, was designed to attract and sustain representation from different business perspectives, and this has been the case since its formation in spring 2023.

3.2 Landscape

August 2020 saw publication of the Scottish Technology Ecosystem Review (STER) conducted by Mark Logan¹¹². It sets out recommendations aimed at stimulating and accelerating the maturity of Scotland’s “Technology Ecosystem”. In its widest sense, this means supporting and nurturing technology businesses, from the early start-up phase through to fully scaled maturity. Although the STER acknowledged many positive aspects to the ecosystem, it set out the case for interventions and support across three fundamental supporting areas – education and talent, infrastructure, and funding – that, taken together, could help to substantially improve its performance. Of note are actions to strengthen the ecosystem’s social infrastructure – bringing stakeholders together – and address challenges around access to venture funding.

Though AI is not discussed in detail in the STER, the Strategy acknowledged it as one of its key backdrops. Progress towards realising STER recommendations was the focus of a report¹¹³ published in November 2022. Whilst there are no specific outputs relating to AI, a number are indirectly related, such as improving computing science provision in schools, building links between the tech sector and education establishments, and development of a network of Tech Scalars – the first of which opened in late 2022 – aimed at creating, developing, and scaling tech startups.

¹¹⁰ [SCDI, Building a World-Leading Ai and Data Strategy for an Inclusive Scotland](#)

¹¹¹ [Scot Gov, Data Delivery Group](#)

¹¹² [Scot Gov, Scottish technology ecosystem: review](#)

¹¹³ [Scot Gov, Technology ecosystem review - Towards the Tipping Point: progress report](#)

Several bodies aim to bring together those active in the digital economy space and wider business sector, including ScotlandIS¹¹⁴, CodeBase¹¹⁵, Technology Scotland¹¹⁶, and Prosper¹¹⁷ (formerly the Scottish Council for Development and Industry).

Whilst there is appetite among Scottish businesses to use AI¹¹⁸, it has been discussed more broadly, including by the CDEI, that such interest can be inhibited by uncertainties over ethical and legal issues, and ambiguity over good practice¹¹⁹.

3.3 Private Sector Investment

Having grown significantly in recent years, digital technology has been cited as Scotland's fastest-growing sector for inward investment¹²⁰, with centres of excellence across a range of areas. A long history of innovation is cited as a key strength in attracting such investment¹²¹; the tech ecosystem contributed £4.9 billion Gross Value Added (GVA) to the Scottish economy in 2019, 3.5% of total GVA. Whilst tricky to quantify how much of this is accounted for by businesses focused on AI, it has been suggested that delivering the Strategy, alongside other initiatives such as City and Region Deals, has the potential to generate £13 billion in additional economic output¹²². UK Government funding has also been received by projects based in Scotland, including iCAIRD¹²³ and research to improve the energy efficiency of AI systems¹²⁴.

There have been calls for fiscal action to help stimulate Scotland's tech sector. In August 2023, an Oxford Economics report for The Hunter Foundation advocated introducing a 15% corporation tax rate for specific sectors that show high global growth potential, with one being Big Data and AI¹²⁵. The Scottish Government later wrote to the UK Government advocating more joint working to support the sector, though did not call for a reduced rate of corporation tax. This was advised in the 2023-2024 Programme for Government¹²⁶, which also set out a commitment to work with enterprise agencies on a reform programme to ensure a clear focus on shared priorities, including making best use of AI, digital and data, and making it easier for businesses to get support.

A PwC report¹²⁷ suggested that AI could create more jobs in Scotland than it displaced, though it is worth noting that this report was published well before the Covid-19 pandemic. PwC have revisited the wider topic of AI more recently, citing the need^{128, 129} for business leaders to re-evaluate workforce development and foster innovative cultures to harness AI.

¹¹⁴ [Home - ScotlandIS](#)

¹¹⁵ [CodeBase - The UK's largest Technology Incubator, based in Edinburgh](#)

¹¹⁶ [Technology Scotland](#)

¹¹⁷ [Scotland's most influential business network - Prosper](#)

¹¹⁸ [Scottish Financial News, AI and tech investment on the rise](#)

¹¹⁹ [Public Technology, Inside government's data ethics hub](#)

¹²⁰ [Scotland's digital and technology industries](#)

¹²¹ [Invest and Trade Scotland - Scottish Development International](#)

¹²² [How Scotland's AI strategy will carve out an ethical £13 billion economic niche](#)

¹²³ [iCAIRD – Industrial Centre for Artificial Intelligence Research in Digital Diagnostics](#)

¹²⁴ [Gov.UK, Glasgow AI experts receive UK Government funding](#)

¹²⁵ [Scottish entrepreneur Sir Tom Hunter reveals investment plan | The Herald](#)

¹²⁶ [Scot Gov, Programme for Government 2023 to 2024](#)

¹²⁷ [Holyrood Article, Artificial intelligence to create more jobs in Scotland than it replaces](#)

¹²⁸ [UK Hopes and Fears Survey 2023 - PwC UK](#)

¹²⁹ [Is the workforce ready for AI? - PwC UK](#)

3.4 Support

Now on its seventh iteration, the University of Edinburgh AI Accelerator¹³⁰ supports firms from across Scotland and beyond to explore the potential of AI in several areas. The Accelerator programme encompasses three themes - AI for climate change, AI for health, and AI for good – and previous cohorts have seen projects to apply AI in a broad range of sectors, including agriculture, finance, and health.

The Innovation Accelerator in Glasgow¹³¹ includes several projects relating to AI, whilst the forthcoming innovation and research centre in the city may also play host to similar. Several of the City and Region Deals now in place across Scotland have aims relating to data driven innovation, including AI; these are discussed below.

3.5 Exploration and Adoption

Several sectors in Scotland are exploring, developing and deploying AI. These include FinTech^{132,133}, where there is significant appetite, and which is an area of real strength alongside health and care. Another that shows promise is Law Tech – the Law Society of Scotland has a working group¹³⁴ on the potential use of data and AI in legal services. AI also has potential for use in other areas, such as the creative industries¹³⁵, cybersecurity¹³⁶, sport¹³⁷ and even Scotch whisky production¹³⁸. AI is recognised as an enabling technology sub-sector in the Scottish Government's Technology Sector Export Plan¹³⁹, developing which was a commitment in A Trading Nation: A Plan for Growing Scotland's Exports¹⁴⁰, which recognised the technology, digital and media industries are some of Scotland's top five strategic sectors.

4. Research

4.1 Gamut

A key umbrella group for the AI research community is the Scottish Informatics and Computer Science Alliance (SICSA), a collaboration of 14 universities and 3 innovation centres. One of seven SICSA research themes¹⁴¹, one of the main aims of the AI theme is to bring together researchers across Scotland to advance the overall area. To help achieve this theme events aim to strengthen cooperation between SICSA members working in AI and related disciplines, stimulate collaboration between sub-groups to identify new and emerging research topics, and share knowledge, expertise, and tools.

¹³⁰ [AI Accelerator | The University of Edinburgh](#)

¹³¹ [Glasgow City Region, Innovation Accelerator Projects](#)

¹³² [How Scottish Mortgage and other trusts are playing the AI revolution | Trustnet](#)

¹³³ [SDI, How data and AI are fuelling Scotland's fintech boom](#)

¹³⁴ [LawscotTech boosted with new expertise to lead on legal technology innovation | Scottish Legal News](#)

¹³⁵ [Creative AI Demonstrator Project - Creative Informatics](#)

¹³⁶ [Scottish AI Alliance Podcast: AI and the Future of Cyber Security](#)

¹³⁷ [Artificial intelligence will 'increase the standard' of sport – expert | The Herald](#)

¹³⁸ [The Scotsman, How AI is being used in the whisky industry](#)

¹³⁹ [Scot Gov, Technology sector export plan](#)

¹⁴⁰ [Scot Gov, Scotland: A Trading Nation](#)

¹⁴¹ [Artificial Intelligence - SICSA - The Scottish Informatics & Computer Science Alliance](#)

4.2 Facilities

The University of Edinburgh is home to the longest-established AI research centre in the UK¹⁴², with this now part of the School of Informatics, the largest in Europe. It is also home to EPCC (formerly ‘Edinburgh Parallel Computer Centre’), which offers a range of high-performance computing systems, data storage and support services¹⁴³. It was recently announced that the EPCC had been selected as the preferred location for the Exascale supercomputer, construction of which will begin in 2025¹⁴⁴. Another recent announcement was that of Edinburgh University’s Generative AI Laboratory (GAIL), an initiative to unite world-leading AI research and innovation to push the forefront of AI, develop safe solutions for industry and government, and realise societal benefits of AI.

There is also significant activity in the west of Scotland. Summer 2023 saw the University of Glasgow - already home to the Urban Big Data Centre¹⁴⁵ - open its new Centre for Data Science and AI¹⁴⁶, whilst the University of Strathclyde installed new supercomputer facilities to support drug discovery and development research¹⁴⁷. Glasgow Caledonian University and the University of the West of Scotland are also active in AI, whilst the National Manufacturing Institute for Scotland, Digital Health and Care Institute and CENSIS (Scotland’s Innovation Centre for sensing, imaging, and Internet of Things (IoT) technologies), also undertake work relating to AI.

Though much of the sector is located within the Central Belt, key centres outside this include St Andrews¹⁴⁸ and Aberdeen¹⁴⁹ – home to the recently opened Interdisciplinary Centre for Data & AI, and the Aberdeen Centre for Health Data Science¹⁵⁰, a collaboration supported by the University of Aberdeen, NHS Grampian, and NHS Research and Development North Node¹⁵¹. Another is Dundee¹⁵², host to an innovation hub set up by the Scotland 5G Centre¹⁵³ and a lynchpin in the Tay Cities Deal.

4.3 Funding

There has been significant investment in AI research and wider data-driven innovation research in recent years. Some of this has been in the form of city and/or region deals, such as the Edinburgh and South East Scotland City Region Deal¹⁵⁴. Worth over £1.3 billion in total over fifteen years, this aims to drive productivity and growth while reducing inequalities and deprivation, with activities across five key themes. One being research, development, and innovation, nested in which is the Data-Driven Innovation (DDI) Initiative¹⁵⁵, within which there are some projects involving AI. Other ‘Deals’

¹⁴² [Artificial Intelligence at The University of Edinburgh](#)

¹⁴³ [Delivering UK supercomputing and data science excellence to the world | EPCC](#)

¹⁴⁴ [Edinburgh to lead new era of UK supercomputing | EPCC](#)

¹⁴⁵ [Urban Big Data Centre | Urban Big Data Centre](#)

¹⁴⁶ [University of Glasgow - launches new Centre for Data Science and AI](#)

¹⁴⁷ [Holyrood, Scottish university installs AI supercomputer for pioneering medicines research](#)

¹⁴⁸ [University of St Andrews Blog. AI Research Theme](#)

¹⁴⁹ [Data and Artificial Intelligence | Research | The University of Aberdeen](#)

¹⁵⁰ [The University of Aberdeen, Centre for Health Data Science](#)

¹⁵¹ [North | NHS Research Scotland | NHS Research Scotland](#)

¹⁵² [Computer Science and Informatics | University of Dundee, UK](#)

¹⁵³ [Dundee to be hub of innovation | The Herald](#)

¹⁵⁴ [The Edinburgh and South East Scotland City Region Deal](#)

¹⁵⁵ [Data-Driven Innovation | Innovation & Collaboration](#)

whose aims include fostering DDI, including work relating to AI, are in place in Glasgow City Region, Inverness and Highlands, and more¹⁵⁶.

4.4 Talent

Scotland's strong research and development base has been acknowledged, as has its importance to optimally harnessing the potential of AI¹⁵⁷. Perhaps overlooked is the extent of the Scottish R&D network – mapping conducted for the Alliance in early 2023 by Optimate, supported by Scottish Enterprise, found that the AI landscape is home to some 220 companies and 70 research, academic and other supporting stakeholders¹⁵⁸. Scotland has good foundations on which to build in capitalising on AI opportunities, though the importance of taking a holistic approach is highlighted.

4.5 Reputation

The AI research landscape¹⁵⁹ report prepared for the Alliance notes that Scotland has an internationally respected research community supported by a wider ecosystem. This includes the Innovation Centres, AI Accelerator at the University of Edinburgh, and the developing network of Tech Scalars, as well as access to funding and support via Scottish Enterprise, Innovate UK, and Horizon Europe. This ecosystem has resulted in a strong track record of industrial research and development activity. Examples include £2.6 million from Scottish Enterprise to support research and development of world-first AI project management software¹⁶⁰, and the £10 million from Innovate UK (then known as UK Research and Innovation) for the now completed iCAIRD¹⁶¹ initiative.

There are also discrete programmes that cover specific areas, such as the BRAID programme¹⁶², focused on better integrating arts, humanities, and social science research into the Responsible AI ecosystem, funded by the Arts and Humanities Research Council, and the Trustworthy Autonomous Systems Programme¹⁶³, funded by the Engineering and Physical Sciences Research Council.

4.6 Profile

Scotland's AI research base has long had a considerable profile. In autumn 2023, the UK Government announced a £118m support package for 12 Centres for Doctoral Training (CDT) in AI. Three of these are based exclusively in Scotland – two at the University of Edinburgh, for Responsible and Trustworthy in-the-world Natural Language Processing, and Biomedical Innovation, and one for Dependable and Deployable AI for Robotics, which will be a partnership between the University of Edinburgh and Heriot-Watt University. The CDT for Sustainable Understandable Agri-Food Systems Transformed by AI will see the Universities of Aberdeen and Strathclyde partner with the University of Lincoln, and Queens University Belfast.

¹⁵⁶ [Scot Gov, City Region Deals](#)

¹⁵⁷ [Scotsman Article, We must zero in on skills to harness ai technology](#)

¹⁵⁸ [Optimat Report, AI Research and Landscape Mapping](#)

¹⁵⁹ See reference 158.

¹⁶⁰ [Research and development \(R&D\) grants - Scottish Enterprise](#)

¹⁶¹ [University of St Andrews, £15m new Artificial Intelligence Health Research Centre for Scotland](#)

¹⁶² [Braid UK - BRAID UK](#)

¹⁶³ [EPSRC, Making Systems Answer, Details of Grant](#)

SICSA, as well as several of its individual member organisations, do much to promote their work in Scotland, the UK and further afield. The profile and quality of AI research activities in Scottish universities has been recognised by various Research Excellence Framework exercises in recent years, and previous Research Assessment Exercise¹⁶⁴.

4.7 Collaboration outside Scotland (with academia in Scotland, UK and beyond, business, and public sectors)

The AI landscape report mentioned previously (see paragraph 4.4) also notes the diverse linkages within the academic, research and support ecosystem. On translating research into business, the Royal Academy of Engineering Beauhurst Spotlight on Spinouts¹⁶⁵ placed three Scottish universities - Edinburgh, Strathclyde, and Glasgow - in the top twenty in the UK by number of equity deals, though it is not clear how many involved AI-focused spinouts. A key finding was that AI is the top emerging sector.

5. Leadership

5.1 Scottish AI Alliance role and structure

The Strategy cites collective leadership as one of the practices central to its delivery and posits that its vision will be achieved under the leadership of the Alliance. This is introduced as “an open-to-all stakeholder group with representation from across society. The group will provide a focus for dialogue, collaboration and, above all, action on all things AI in Scotland, allowing businesses, economists, trade unions and our UK and international partners to come together and help to shape our AI future.”¹⁶⁶

The Strategy suggested the Alliance comprise four ‘Circles’ – Leadership, Delivery, Community and Support. Over time it evolved into a Leadership Group, with a joint team from the Scottish Government and The Data Lab taking on most of the proposed responsibilities of the Delivery, Community and Support Circles, drawing on input from elsewhere as necessary. In late 2021, individuals and groups who had noted interest in joining the Community Circle were signposted to the then newly launched The Data Lab Community platform¹⁶⁷, which has a segment for AI.

5.2 Synergies across entire ecosystem

To an extent, the Scottish AI Playbook was intended to identify synergies across the ecosystem: “a shared and living asset, which will evolve as society and technologies change, and we learn what works best. Through the AI Alliance, everyone will have opportunities to contribute, develop their AI skills and receive the support they need” Work to develop the Playbook brought together many stakeholders from the AI and wider tech ecosystem and beyond, as have various events run by the Alliance, key amongst these being the Scottish AI Summit.

¹⁶⁴ [Research Excellence Framework](#)

¹⁶⁵ [Royal Academy of Engineering, Spotlight on Spinouts](#)

¹⁶⁶ [Scotland's AI Strategy - Track 1](#)

¹⁶⁷ [The Data Lab Community: Online Community for Data and AI](#)

There has been and continues to be engagement with various parts of the UK Government, including the Department for Science, Innovation and Technology, Central Data and Digital Office, Office for AI, AI Council (now no longer extant), and the CDEI.

5.3 Scotland's AI narrative and branding

The Strategy's vision, particularly its key tenets – trustworthy, ethical, and inclusive – was positively received at launch^{168, 169, 170}. The continuing relevance of the vision was noted in a Ministerial statement on Scotland's strategic values for AI¹⁷¹ that was published to coincide with the Parliamentary debate on the topic on 1 June 2023.

In autumn 2021, Forbes' magazine subsidiary Cognitive World published a spotlight article on AI in Scotland¹⁷², focused on how it sat relevant to other nations. It set out key aspects of the Scottish approach to AI, as well as highlighting other data and digital work in progress.

Echoing anecdotal feedback, a recent observation piece in FutureScot discussed the complexity of Scotland's tech ecosystem from a health innovation perspective¹⁷³. It cited the need for strengthening partnerships, dynamic leadership across the triple helix (in this instance the NHS, industry, and academia), openness to new opportunities, and that decluttering could help better capitalise on Scotland's relatively small size and clusters of capabilities.

Messaging of data innovation and AI in Scotland at an event in the margins of CogX in September 2023 was also discussed in the FutureScot article, followed by a suggestion to further highlight Scotland's many capabilities in extant and emerging areas.

5.4 Exemplar AI ecosystems (national or regional)

Models to promote and guide work within AI ecosystems vary considerably. Shortly after work to develop Scotland's AI Strategy began there were bilateral and multilateral discussions with several countries.

Some Scandinavian ones are members of the Nordic AI Council, which brings together stakeholders collaborating on several initiatives¹⁷⁴; there is also a more informal Northern AI Network. AI Sweden¹⁷⁵ has been suggested as a model which Scotland could learn from. This is due to it resembling the Alliance in several ways, such as its focus on partnership working, but it also having more input from business, as well as more sustainable resourcing.

¹⁶⁸ [Trust and ethics at the core of Scotland's new AI strategy](#)

¹⁶⁹ [Launch of Scotland's AI Strategy | Brodies LLP](#)

¹⁷⁰ [Holyrood Article, Trust and ethics placed at heart of Scotland's artificial intelligence strategy](#)

¹⁷¹ [Scot Gov, Ministerial Statement](#)

¹⁷² [Forbes, Is Scotland a major contender in the AI Space](#)

¹⁷³ [FutureScot, Scotland's 'cluttered' innovation ecosystem needs greater clarity](#)

¹⁷⁴ [AI and Data | Nordic Innovation](#)

¹⁷⁵ [AI Sweden | Advancing AI in Sweden](#)

In the United States there has been much activity at the federal level, with the National AI Initiative¹⁷⁶ recently launched as the main forum for those involved with work to deliver the US National AI Strategy.

The Australian Government is progressing work relating to AI¹⁷⁷, though a formal national strategy appears to still be in development. The National Science and Technology Council commissioned a study of Generative AI, the report¹⁷⁸ of which was published in March 2023. It sets out opportunities, risks, and suggested actions, similar to the intended product of this review.

5.5 International governance

As noted previously, there has been discussion of taking an international approach to governance and regulation of AI, taking account of the cross-border nature of the technologies, and the possibility of significant divergence between the legislative approach of different countries. Potential constructs vary but suggestions include a supranational organisation that would evaluate compliance with international standards, along the lines of the International Atomic Energy Agency¹⁷⁹, or similar.

There is an increasing amount of work in the US, with the White House recently engaging with tech leaders¹⁸⁰ on the need to mitigate current and potential risks to realise the prospective benefits of AI. The UK Government has noted a keenness to work with the US on AI issues¹⁸¹, building on prior engagement, including the keynote global AI Safety Summit held in November 2023.

5.6 EU governance

The EU has taken a keen interest in AI for several years, evidenced by its publication of a coordinated plan in 2018, refreshed in 2021¹⁸², that sets out a strategic approach to AI¹⁸³, including support for investment, research and development, and coordination of AI policy across the bloc. Key to the EU's regulatory approach to AI has been the development and progression of the EU AI Act, now in the final stages of its passage through the so called triad process. The ethos and approach that the Act's provisions set out and how these compare with others has elicited debate, with some observations that they might inhibit the development and adoption of AI, though they have also influenced the development of regulatory regimes elsewhere.

5.7 UK governance

The UK's first national AI strategy¹⁸⁴ was published in autumn 2021, building on several years' work by the Office for AI, AI Council (now no longer extant) and CDEI, much

¹⁷⁶ [United States Government, Making AI work for the American people](#)

¹⁷⁷ [Australian Government, ensuring all Australians share the benefit of AI](#)

¹⁷⁸ [Australia's Chief Scientist, Information report on Generative AI](#)

¹⁷⁹ [International Governance of Civilian AI: A... | Oxford Martin School](#)

¹⁸⁰ [Readout of White House Meeting with CEOs on Advancing Responsible AI Innovation](#)

¹⁸¹ [Britain, U.S. to work together on AI safety, says Sunak | Reuters](#)

¹⁸² [Coordinated Plan on Artificial Intelligence | Shaping Europe's digital future](#)

¹⁸³ [European Approach to AI](#)

¹⁸⁴ [UK Gov, National AI Strategy](#)

relating to the AI Sector Deal¹⁸⁵ that was launched in spring 2018. Progress and next steps for delivering the UK strategy were set out in an action plan¹⁸⁶ published in summer 2022. A high-level overview of the UK AI sector, though with little specific data relating to Scotland, was published in March 2023¹⁸⁷.

Soon after the UK strategy was launched the report of an independent review¹⁸⁸, setting out steps to developing an effective AI assurance ecosystem, was published. Complementing an initial roadmap developed by the CDEI, this aims to provide for an approach that helps inculcate mature ecosystems of assurance products and services (such as standards, audits, certifications, advisory systems etc.) to enable people to understand whether systems are trustworthy, in turn enabling AI development and deployment for economic and social gain.

The UK Parliament's Science, Innovation and Technology Committee has been exploring the impact of AI on society and the economy, regulation of its usage, and the UK Government's governance proposals. An interim report¹⁸⁹ set out initial thinking on topics including regulation, where it suggested that the UK Government should, as part of its implementation of its proposals, undertake a gap analysis of the UK's regulators, considering resource, capacity and whether any require new powers to implement and enforce the principles outlined in the AI White Paper¹⁹⁰. The latter sets out proposals for a proportionate, future-proof, and pro-innovation framework for regulating AI and was the subject of consultation over summer 2023. Once analysis of feedback has concluded the UK Government will publish its formal consultation response.

5.8 Scottish Government guidance

As most legislative provisions relating to AI are reserved, the Scottish Government has sought to influence AI development and usage through the activities of the Strategy. These include supporting the Alliance in promoting the Strategy's vision and principles, resources such as the Scottish AI Playbook, Scottish AI Register and Living with AI course, and ongoing dialogue with people across Scotland. It continues to engage with the UK Government to ensure that Scotland's voice is heard, including calling for a four nations summit¹⁹¹ in view of the increasing concerns about AI and the pace and direction of emerging regulation¹⁹².

5.9 Regulation and standards

The relative paces of AI development and regulation, and the need to balance opportunity with risk, continue to elicit discussion. In spring 2023, the 'Helping AI grow up – without pressing pause' report¹⁹³ by the British Computer Society discussed

¹⁸⁵ [UK Gov, AI Sector Deal](#)

¹⁸⁶ [UK Gov, National AI Strategy - AI Action Plan](#)

¹⁸⁷ [AI Sector Study - 2022](#)

¹⁸⁸ [UK Gov, The roadmap to an effective AI assurance ecosystem](#)

¹⁸⁹ [UK Parliament, The governance of artificial intelligence: interim report](#)

¹⁹⁰ [UK Gov, AI regulation: a pro-innovation approach](#)

¹⁹¹ [Scottish Government, Artificial intelligence: letter to UK Government](#)

¹⁹² [Scottish Government concerned over 'hands-off' approach to AI laws | HeraldScotland](#)

¹⁹³ [BCS, Helping AI to grow](#)

regulation and the pace of development of AI, after the latter gave rise to calls for a pause^{194,195}, including from leading tech figures^{196,197}, to consider next steps.

Nearly all current legislation and relevant powers are reserved, but possible regulatory approaches were discussed during development of the Strategy. Echoing conversations elsewhere, it was suggested that regulation could be ‘hard’ e.g., formal legislation, or ‘soft’, e.g., codes of practice or guidance, grounded in a set of ethical principles.

How to operationalise any regulatory approach and set standards for AI technologies have both been extensively discussed. The AI Standards Hub¹⁹⁸ within the ATI helps stakeholders to navigate and engage with the work on standards development worldwide. It aims to shape debate about standards and provides a collaborative platform for industry, government, regulators, civil society, academia, and others. Several institutions in Scotland are members of or affiliated with the Institute.

6. Skills

6.1 Basic digital

The Digital Strategy for Scotland includes several commitments relating to skills development¹⁹⁹. These include implementing relevant recommendations in the Scottish Technology Ecosystem Review; supporting digital training, upskilling, and reskilling initiatives; measures to improve the diversity of those working in data and digital; developing the data skills base in the public sector, and communities of practice.

6.2 Progressive awareness and understanding of AI

Amongst 19 institutions of higher education in Scotland, 12 offer AI courses at undergraduate and/or postgraduate level. Provision has increased significantly in recent years – when the Strategy was in development (2019-2021) only two offered undergraduate courses, and seven postgraduate; these figures are now six and nine respectively. Of note is that a significant proportion of students on many courses are international, and many do not stay in Scotland once they complete their studies.

The Digital Economy Skills Action Plan²⁰⁰, developed by Skills Development Scotland with the Federation of Small Businesses Scotland and published in March 2023, sets out work to be taken forward by several partners to develop digital skills, from basic literacy through to specialisms. It recognises the potentially disruptive impacts of AI and acknowledges the importance of developing the AI skills base to meet demands, particularly for green jobs, and has a commitment to support achieving activities of several complementary initiatives, including the Strategy. In summer 2023 the report of James Withers’ Independent Review of the Skills Delivery Landscape was published. Taking forward the recommendations that this sets out is under consideration, and

¹⁹⁴ [BBC News, Stay ahead in the AI race](#)

¹⁹⁵ [WEF, AI leaders call for pause](#)

¹⁹⁶ [The Guardian, Elon Musk joins call for pause in creation of giant AI ‘digital minds’](#)

¹⁹⁷ [The Guardian, Letter signed by Elon Musk demanding AI research pause sparks controversy](#)

¹⁹⁸ [AI Standards Hub | The Alan Turing Institute](#)

¹⁹⁹ [Scot Gov, Digital Education and Skills - A changing nation: how Scotland will thrive in a digital world](#)

²⁰⁰ [Skills Development Scotland, Digital Economy Skills Action Plan](#)

something that the Alliance will need to monitor and engage with to ensure that actions relating to AI are informed and influenced accordingly.

Launched in September 2023 by the Alliance, the 'Living with AI' online course aims to increase awareness and understanding of AI²⁰¹. Around 300 people signed up for the course within the first month of it being available; enrolments were later paused to allow for system development work and evaluation, but it is hoped to reopen applications in early 2024. Feedback from the initial cohort was positive, with many participants praising the quality and presentation of the material and for it helping to improve their confidence when approaching the topic. Some also noted its highlighting that AI is part of a much wider piece, and for inspiring them to explore further learning opportunities.

7. Tech Infrastructure

7.1 Data

In May 2023, the Scottish Government published a detailed study²⁰² of frameworks and practices of providing access to personal data by public sector organisations to private organisations. It acknowledges the increasing calls for more data-sharing that are arising from the application of AI and discusses creating possible pathways for this, taking account of legal developments such as the EU AI Act. To date the area of public services that has considered data viz. new technologies such as AI in most detail is health and social care, as previously discussed.

Scotland's strengths in data have been highlighted by enterprise bodies^{203, 204} and by consortia such as that for Data-Driven Innovation under the Edinburgh and SE Scotland City Region Deal²⁰⁵ and the Glasgow Innovation Accelerator²⁰⁶. As noted above, amongst projects being taken forward is research to improve the energy efficiency of AI²⁰⁷. This topic is also addressed in the green data centres action plan²⁰⁸, which acknowledges the importance of quick and cost-effective data storage and transfer to ensure that the full economic and social potential of tech such as AI are realised across Scotland.

August 2019 saw the publication of a report²⁰⁹ aimed at catalysing discussion of the implications for Scotland's infrastructure of technological change and innovation. It notes the potential of AI to help improve energy management and smart manufacturing, as well as to support the adoption of Automation, IoT and Robotics. It also notes that governments are likely to be heavily impacted by the adoption of AI, and that efficient mechanisms for the management and maintenance of the increased amount of data it will generate for public services will have to be put in place to safeguard it.

²⁰¹ [Scottish AI Alliance, Free Online Course "Living with AI"](#)

²⁰² [Scot Gov, Public sector personal data sharing: framework and principles](#)

²⁰³ [Data driven innovation in Scotland - Scottish Enterprise](#)

²⁰⁴ [SDI, Innovation support in Scotland for your business](#)

²⁰⁵ [Data-Driven Innovation | Innovation & Collaboration](#)

²⁰⁶ [Glasgow's Innovation Accelerator moves forward with share of £100 million project](#)

²⁰⁷ [UK Gov, Glasgow AI experts receive UK Government funding](#)

²⁰⁸ [Scot Gov, Green datacentres and digital connectivity: vision and action plan for Scotland](#)

²⁰⁹ [Scot Gov, Implications of future technological trends on Scotland's infrastructure](#)

7.2 Hardware and Platforms

The Digital Strategy for Scotland sets out aims for data and digital infrastructure. These include development of 5G networks, supporting rollout of 'IoT' technologies, working with the private sector to help improve data infrastructure, particularly inter-city connectivity, and to implement the Strategic Framework for a Cyber Resilient Scotland²¹⁰. There are also commitments on data in public services, including to use common standards and operating platforms, developing a data-driven approach, and stimulating innovation by facilitating access to appropriate data for research.

The EPCC, outlined above, also underpins the Edinburgh International Data Facility²¹¹, which provides a range of data infrastructure-related services. Similar provision is offered by other universities and centres that support data-driven innovation and research, some of which may involve AI. .

7.3 Portals

August 2023 saw the publication of the final report of an independent review²¹², commissioned by the Scottish Government, to explore how the value of Scotland's public sector personal data can be unlocked in ethical, transparent ways, to realise social, economic, and environmental benefits. It sets out a Policy Statement, Guiding Principles and Recommendations to steer implementation of this work by various public bodies; Scotland's AI Strategy is cited as one of the initiatives to support.

7.4 Connectivity

Several City and/or Region Deals aim to improve this, such as the Forth Valley 5G Hub²¹³, key to the Forth Environment Resilience Array, and Tay Cities Region Deal²¹⁴.

²¹⁰ [Scot Gov, Cyber Resilient Scotland: strategic framework](#)

²¹¹ [University of Edinburgh, Edinburgh International Data Facility](#)

²¹² [Scot Gov, Unlocking the value of data - Independent Expert Group: final report](#)

²¹³ [Forth Valley 5G hub to enhance major University project | About | University of Stirling](#)

²¹⁴ [Connected Tay | Tay Cities Deal](#)

Acknowledgments

The Alliance would like to acknowledge all the following for their contributions to the review process:

Scottish AI Alliance Leadership Group – Review Project Group:

Rachel Aldighieri, Christopher Austin, Michael Boniface, Catriona Campbell, Brian Hills, Sam Rhynas, Dilraj Sokhi Watson

Scottish AI Alliance Delivery Team:

Katie Garden, Dawn McAra-Hunter, Calum McDonald, Steph Wright

Scottish Government Digital Directorate:

Jeremy Darot, John Fotheringham, Louise Meikleham, Chris Rodger, Carolyne Thomson, Tom Wilkinson

The Alliance would also like to thank all of those who provided informal feedback and support during the process.