October 2023
APPG AI Evidence Meeting

BIG INNOVATION CENTRE

AI & Sustainability:
UN Sustainable Development Goals: Where are we now? Where can AI help?

PARLIAMENTARY BRIEF

AI & Sustainability: UN Sustainable Development Goals: Where are we now? Where can AI help? is a Parliamentary Brief based upon the All-Party Parliamentary Group on Artificial Intelligence (APPG AI) Evidence Meeting held in House of Lords: Committee Room 4A on the 23rd of October 2023.

This APPG AI is co-Chaired by **Stephen Metcalfe MP** and **Lord Clement-Jones CBE**.

We would like to express our appreciation to the following people for their oral evidence:

- **Matt Armstrong-Barnes,** Chief Technology Officer - Artificial Intelligence, **Hewlett Packard Enterprise**
- **Hugh Eaton OBE,** Former Vice President - Worldwide Government at Microsoft
- **Prof. María Pérez-Ortiz,** Associate Professor of AI & Sustainability, **UCL**
- **Tarun Rishi,** AI Innovation Consultant, **About Alpha Limited**
- **Buffy Price,** Co-Founder, **CarbonRe**

Big Innovation Centre is the appointed Secretariat for APPG AI

- CEO, **Professor Birgitte Andersen**
- Rapporteur, **George Farrer**

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All Party Parliamentary Group on
Artificial Intelligence

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1. Introduction

This APPG AI meeting featured important discussion regarding artificial intelligence's (AI) potential to address pressing global issues highlighted by the **United Nations Sustainable Development Goals (UN SDGs)**[1]. Expert speakers offered diverse outlooks on leveraging AI to tackle Sustainability objectives, while cautioning about attendant risks surrounding factors like job loss, inequality, bias, and unintended impacts demanding consideration.

There was agreement that AI holds sizable promise for accelerating progress across spheres like health, energy, infrastructure, and responsible consumption central to the SDGs. However, speakers emphasised that realising benefits demands responsible design and governance of AI systems grounded in Sustainability principles – not short-sighted optimisation disregarding broader consequences. Mainstreaming ethics into computer science education and establishing cooperative agendas for technological accountability were cited as routes towards materialising AI's advantages through accountable innovation. With AI's influence intensifying, expert speakers agreed that Sustainability should be an integral priority guiding AI advancement, not an afterthought. Discussing AI's multifaceted implications is thus essential given its disruptive capacity across social, economic, and environmental dimensions.

Main questions:

- *How can AI help to achieve the UN's Sustainable Development Goals? Which ones can mostly be applied to the power of AI?*
- *Where does AI create a problem for SDGs? For example, does the computing power required to help AI function effectively counteract the ambitions of the SDGs? Other examples, does AI create economy inequality?*
- *What global agreements and measures are required in order to enable Sustainable Development?*

List of panellists:

- **Matt Armstrong-Barnes,** Chief Technology Officer - Artificial Intelligence, **Hewlett Packard Enterprise**
- **Hugh Eaton OBE,** Former Vice President - Worldwide Government at Microsoft
- **Prof. María Pérez-Ortiz,** Associate Professor of AI & Sustainability, **UCL**
- **Tarun Rishi,** AI Innovation Consultant, **About Alpha Limited**
- **Buffy Price,** Co-Founder, **CarbonRe**

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[1] **United Nations Sustainable Development Goals.** https://sdgs.un.org/goals

(From L-R: Matt Armstrong-Barnes, Tarun Rishi, Prof. Maria Perez-Ortiz, Hugh Eaton OBE, Lord Clement-Jones CBE, Buffy Price, Prof. Birgitte Andersen)

This meeting was chaired by Co-Chairs **Lord Clement-Jones CBE** and **Stephen Metcalfe MP.**

Parliament has appointed Big Innovation Centre as the **Secretariat of the APPG AI**, led by **Professor Birgitte Andersen (CEO)**. The Project Manager and Rapporteur for this meeting is **George Farrer**.

2. United Nations Sustainable Development Goals

The UN SDGs are part of the 2030 Agenda for Sustainable Development, adopted by all UN member states in 2015. The SDGs are a call for action by all countries, in a global partnership. The goals consider that ending poverty and other deprivations, must be combined with strategies that that enhance education and health, reduce inequality and kickstart economic growth. These, in tandem, with combating climate change and preserving forests and oceans.

Click on the image below to find out more about each of the Goals.

3. APPG AI Pavilion Survey

Prior to the APPG AI meeting, a survey was issued on the **APPG AI's Pavilion Platform**.

Which of the following UN SDGs stands to gain the most from the implementation of AI?
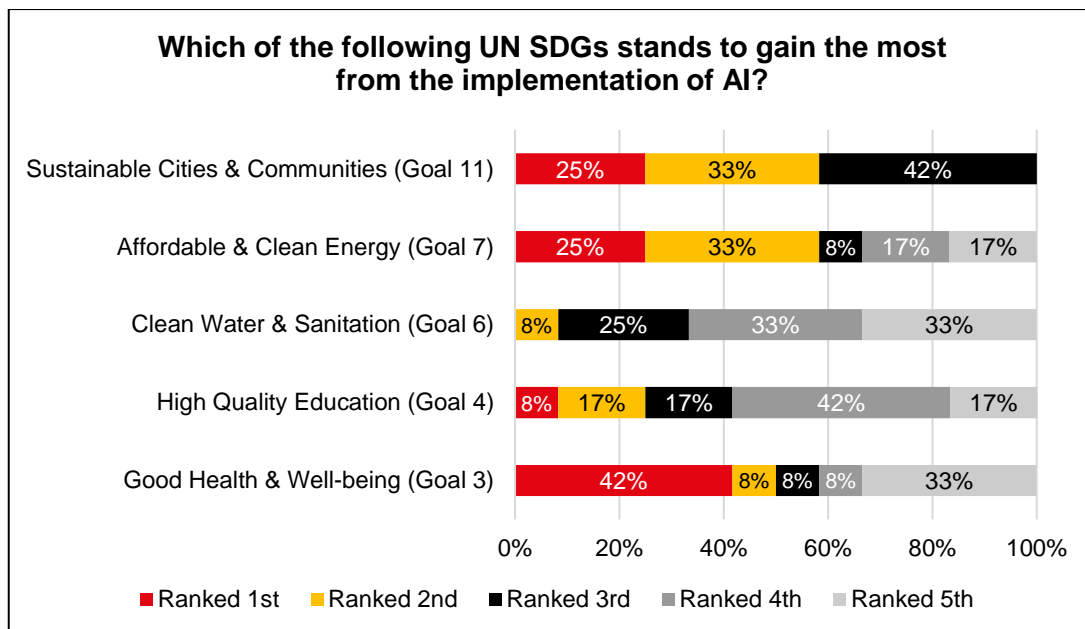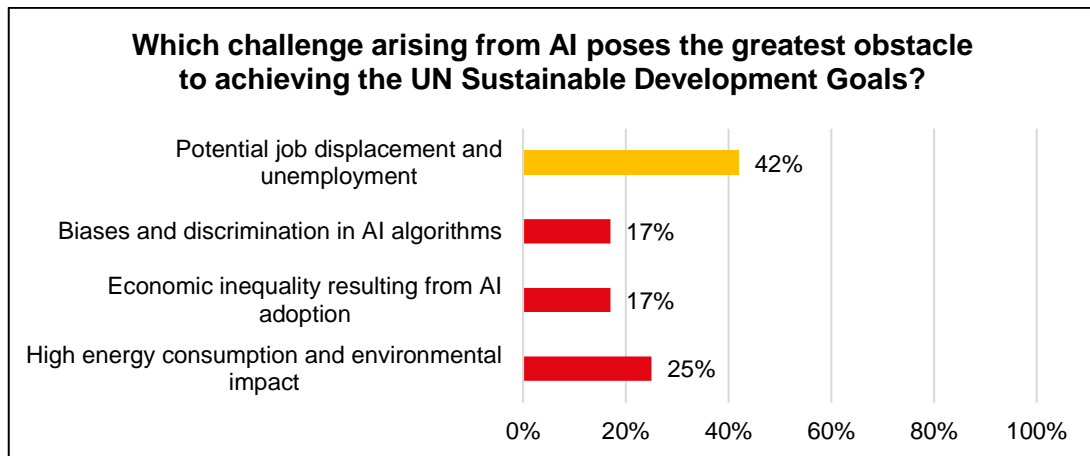
Question 1 asked members of the APPG AI Community to rank the *UN Sustainable Development Goals in order of which will gain the most from the implementation of AI*. Notably, **'Good Health & Well-being'** emerges as the top choice for 42% of respondents. This substantial endorsement underscores the paramount importance of health and well-being within the context of Sustainable Development. Additionally, **'Sustainable Cities & Communities'** and **'Affordable & Clean Energy'** both were ranked 1st by 25% of respondents, and 33% ranked both of these goals as their second choice.

These choices emphasise the critical need for accessible and clean energy sources in the pursuit of Sustainability and underscore the importance of fostering Sustainability in urban development. Furthermore, **'Clean Water & Sanitation'** and **'High Quality Education'** received the lowest number of first ranked votes (8% each), showing that the APPG AI Community consider that these goals stand to gain the least from the implementation and introduction of AI.

Which challenge arising from AI poses the greatest obstacle to achieving the UN Sustainable Development Goals?

Category	Value
Potential job displacement and unemployment	42%
Biases and discrimination in AI algorithms	17%
Economic inequality resulting from AI adoption	17%
High energy consumption and environmental impact	25%

Question 2 asked respondents to consider the *greatest obstacle arising from AI, to achieving the UN Sustainable Development Goals*.

A substantial 42% of respondents pointed to **'potential job displacement and unemployment'** as the most formidable obstacle. This indicates a prevailing worry about AI's impact on employment and its potential to exacerbate job displacement. **'High energy consumption and environmental impact'** was identified by 25% of respondents as a noteworthy challenge. This emphasises concerns regarding AI's environmental footprint, particularly its energy consumption, and its implications for Sustainability.
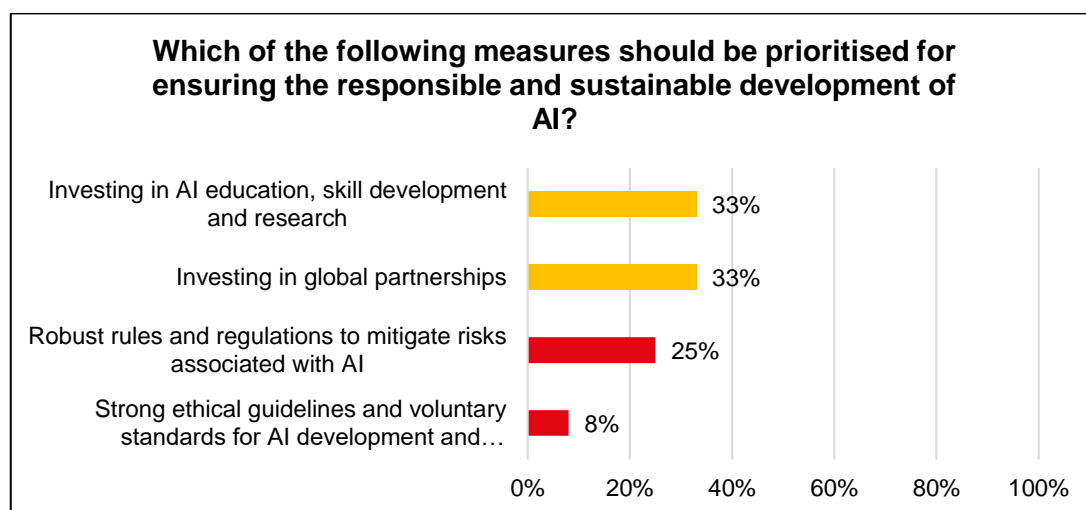
Simultaneously, **'Economic inequality resulting from AI adoption'** and **'Biases and discrimination in AI algorithms'** as being the greatest obstacles, both received votes from 17% of respondents. This reflects shared concerns about the potential for AI to perpetuate economic disparities and biases, impacting the pursuit of the UN SDGs. The survey shows concerns about AI's impact on Sustainable Development, including job displacement, energy consumption, economic inequality, and algorithmic biases, highlighting the complex challenges it poses.

The advantages of using AI to realise the UN SDGs outweigh the potential challenges and risks.

Category	Value
Strongly Disagree	0%
Disagree	25%
Agree	42%
Strongly Agree	33%
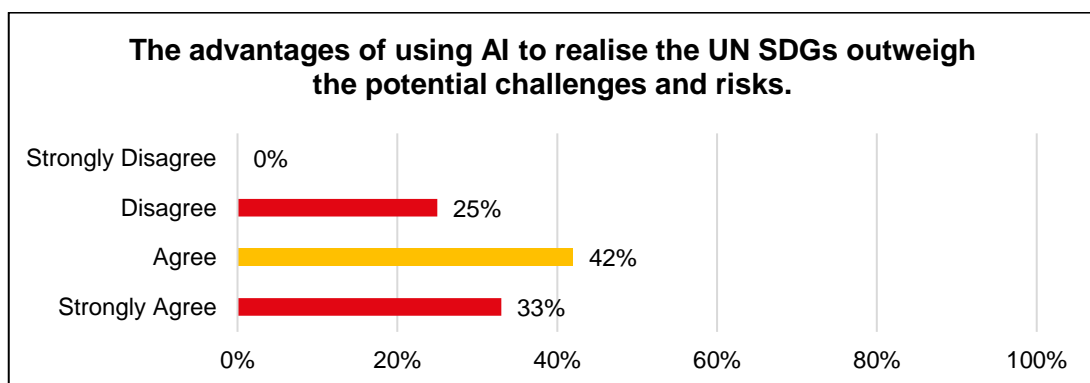
Question 3 proposed the statement that *the advantages of AI to realise the UN SDGs outweigh the potential challenges and risks*. The majority of respondents hold an optimistic view regarding the benefits of AI in realising these goals. A significant 42% **'Agree'** indicating that

they see the advantages of AI as outweighing the potential challenges and risks associated with its implementation. Furthermore, an additional 33% **'Strongly Agree'** underscoring a robust consensus that AI's positive impact can significantly contribute to the attainment of the SDGs.

This collective agreement among a substantial portion of respondents highlights a prevailing sentiment that AI holds great potential for making a positive and transformative contribution to the pursuit of Sustainable Development. While 25% **'Disagree'**, the substantial support for the benefits of AI suggests a general sense of optimism regarding AI's capacity to address the challenges and complexities surrounding the UN SDGs.

Which of the following measures should be prioritised for ensuring the responsible and sustainable development of AI?

Measure	Percentage
Investing in AI education, skill development and research	33%
Investing in global partnerships	33%
Robust rules and regulations to mitigate risks associated with AI	25%
Strong ethical guidelines and voluntary standards for AI development and…	8%

Question 4 inquired about the *prioritisation of specific measures for ensuring the responsible and Sustainable Development of AI.* A notable 33% advocate for **'Investing in global partnerships'** as a priority, underlining the importance of collaborative efforts on an international scale to address the challenges and opportunities presented by AI. Equally, another 33% emphasise the significance of **'Investing in AI education, skill development, and research'**. This reflects a consensus on the necessity of fostering education and skills in the AI domain to ensure responsible development and deployment.

Meanwhile, 25% prioritise the establishment of **'Robust rules and regulations'** to mitigate risks associated with AI. This suggests a recognition of the need for clear and enforceable guidelines to govern AI development and usage. However, only 8% support the notion of **'Strong ethical guidelines and voluntary standards for AI development and deployment'**. While a minority view, this indicates a perspective valuing ethical considerations and voluntary standards in the responsible development of AI.

4. Recommendations for policymakers

1. **Increase funding to rapidly scale deployment of climate tech innovations,** prioritising solutions with tangible 2030 emissions reductions. Provide incentives for industrial producers to implement AI process optimisations. Shift funding support beyond long-term innovations to realise near-term planet-scale impact.

2. Adopt a **holistic national approach to responsibly scaling high-impact AI solutions** across all 17 SDGs. Conduct gap analysis to **identify priorities and imbalances in existing initiatives**. Take an ambitious strategy targeting areas of greatest need and potential based on evidence over pursuing diffuse objectives.

3. Construct international frameworks facilitating open AI research collaboration, data sharing, and public participation. **Establish governance norms addressing risks around privacy, security, and algorithmic biases**. Such cooperation can increase access to AI benefits most in countries where solutions are needed most. Global accords can also minimise cross-border compliance burdens.

4. **Transform STEM curriculums by mainstreaming topics like ethics, unintended consequences, and biases.** Embed these dimensions across institutions globally to **equip the next generation of engineers and researchers with responsible innovation toolkits**. Studies show even basic exposure significantly builds student confidence in addressing ethical issues.

5. **Invest in partnerships between government, academia, and industry to** develop talent pools specialising in ethical and trustworthy industrial AI. One model could be establishing a centre of excellence on applied industrial AI ethics overseen by BEIS. Such efforts can nurture competent governance and unlock innovations.

6. Safeguard emerging climate tech firms through weighted public procurement schemes, reimbursement of compliance costs, and ring-fenced innovation financing. **Ensure seed funding for high-risk, high-reward technologies with Sustainability promise**. Protecting British AI startups future-proofs cutting-edge R&D critical to prosperity.

7. Expand regulations classifying sustainable industrial techniques to include AI process optimisation software. **Update definitions of best available practices guiding emitters to recognise such AI techniques**. Signalling policy priorities through standards can incentives rapid adoption across manufacturers.

The speakers agreed on the immense potential of AI to help address critical global issues and advance the UN Sustainable Development Goals (UN SDGs). Whether it is combating human trafficking, accelerating drug discovery, increasing agricultural productivity, or optimising industrial processes, AI offers transformative solutions to tackle Sustainability challenges. However, the experts cautioned that realising this potential requires responsible development and deployment of AI systems.

There was consensus on the need for Sustainability principles to be embedded into AI systems, education, and policy frameworks. Speakers emphasised that short-term AI deployments which squander resources or have unintended planetary consequences should be avoided. Instead, AI systems must be engineered for efficiency, reusability, and alignment with long-term strategic Sustainability goals. Mainstreaming ethics and unintended consequences into computer science curriculums and establishing international agendas for technological stewardship were highlighted as ways to drive progress. The experts agreed that Sustainability should not be an afterthought but a guiding priority in how AI is developed and governed.

Matt Armstrong-Barnes, Chief Technology Officer at **Hewlett Packard Enterprise** (HPE)[2], started by stating that AI presents immense potential to address critical global challenges, as demonstrated through applications combating human trafficking, accelerating drug discovery, and enabling sustainable agriculture. However, Armstrong-Barnes caveats by arguing that the substantial energy consumption and carbon emissions stemming from complex AI systems may engender massive unintended consequences. Therefore, is imperative that we construct sustainable AI systems focused on long-term strategic objectives, maintainability, and adaptability to change. Rather than transient successes, our approach must consider the full implications of AI deployment to realise truly transformative and responsible innovation.
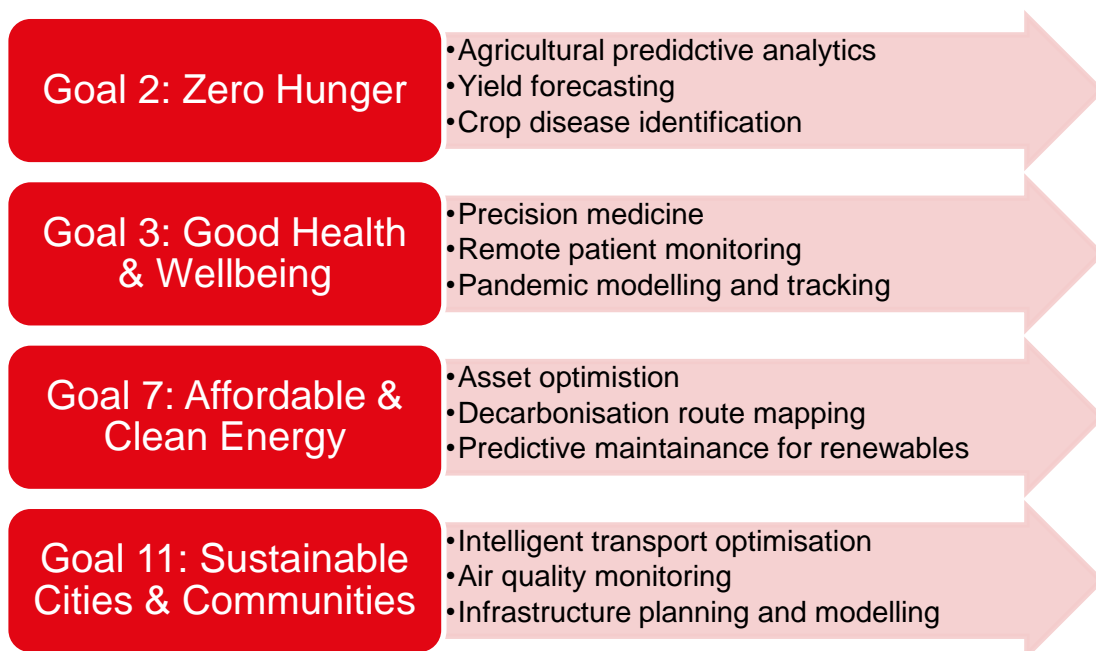
Continuing, Armstrong-Barnes states that the significant energy utilisation and carbon emissions resulting from sophisticated AI models can lead to major negative ramifications. The electricity required for training and operating advanced neural networks generates heat that necessitates additional cooling systems, further escalating energy requirements. It is remarkably easy to develop extremely inefficient AI frameworks because foundational engineering principles are frequently disregarded in the AI field. Armstrong-Barnes contends that we risk promoting a technology with massive planetary impacts without fully contemplating critical dimensions of Sustainability.

Armstrong-Barnes suggests that it is essential that we develop maintainable and adaptable AI systems supporting long-term strategic goals. Sustainability reaches beyond carbon emissions, to encompassing approaches that avoid short-sighted AI implementations which squander resources. From a policy perspective, Armstrong-Barnes believes this mandates constructing frameworks and engineering disciplines that deter inefficient AI development. Academia and industry already possess techniques to build efficient models, which we must

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[2] **Hewlett Packard Enterprise.** https://www.hpe.com/uk/en/home.html

leverage to deliver AI's benefits responsibly.

Hugh Eaton OBE, Former Vice-President of Worldwide Government at **Microsoft**[3], starts by positing that UK has an opportunity to demonstrate global leadership in AI by adopting a more comprehensive and ambitious approach to achieving the UN SDGs. For Eaton, this necessitates optimising partnerships with technology corporations to upskill the national workforce, while also safeguarding innovation financing in vital areas such as healthcare and defence. With confidence and vision, the UK can harness AI to pioneer world-leading solutions, as exemplified by the nation's immense contributions to computing history. However, Eaton maintains that success requires unified strategy across autonomous regions, unambiguous commitments from collaborators, and protecting emerging technology enterprises critical to future prosperity.

Goal 2: Zero Hunger	• Agricultural predidctive analytics • Yield forecasting • Crop disease identification
Goal 3: Good Health & Wellbeing	• Precision medicine • Remote patient monitoring • Pandemic modelling and tracking
Goal 7: Affordable & Clean Energy	• Asset optimistion • Decarbonisation route mapping • Predictive maintainance for renewables
Goal 11: Sustainable Cities & Communities	• Intelligent transport optimisation • Air quality monitoring • Infrastructure planning and modelling

Where can AI help with specific SDGs?

Following on, Eaton makes the case that the UK must enhance relationships with major technology firms to optimise education, reskilling, and upskilling to cultivate AI talent. Rather than isolated training programs, governments must spearhead partnerships tailored to workforce requirements. Eaton justifies that technology companies should pledge transparent reskilling levels for employees displaced by AI and automation. Accountable relationships will enable the UK to leverage stranded value and lead in developing inclusive AI talent pools.

Eaton proposes that the UK ought to safeguard innovation and investment into AI, including in key spheres such as healthcare and defence. Trailblazing technologies mandate early-stage financing, but investment in AI lags other industries. By protecting AI startups and seed

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[3] **Microsoft.** https://www.microsoft.com/en-gb

funding, Eaton declares that the UK can pioneer in areas from climate tech to next-generation defence systems. This encompasses securing AI innovation itself, the lifeblood of advancement.

Prof. Maria Perez-Ortiz, Associate Professor of AI & Sustainability at **UCL**[4], starts her evidence by expressing that fundamental deficiencies exist in how we educate AI scholars and engineers today, failing to equip them to tackle unintended consequences of bias and exclusion in AI frameworks. Transforming mainstream computer science curriculums globally to incorporate ethics and accountable innovation is imperative for Prof. Perez-Ortiz. Students' confidence in raising ethical concerns sees significant improvement when exposed to these subjects in-course. Prof. Perez-Ortiz articulates that we urgently require a global agenda to direct technological progress towards equitable outcomes, akin to the UN's Sustainability program. Education reform is an indispensable component in driving responsible innovation.

Moreover, for Prof. Perez-Ortiz, education around AI risks and biases ought to be embedded into core computer science curriculums worldwide. Most programs omit ethics, biases, and risk assessment. Even with increasing awareness, students remain ill-prepared to address AI's unintended consequences. Prof. Perez-Ortiz states that studies clearly demonstrate students' capacities to discuss ethical matters improve markedly when presented with these topics through coursework. Mainstreaming this material is vital for responsible innovation.
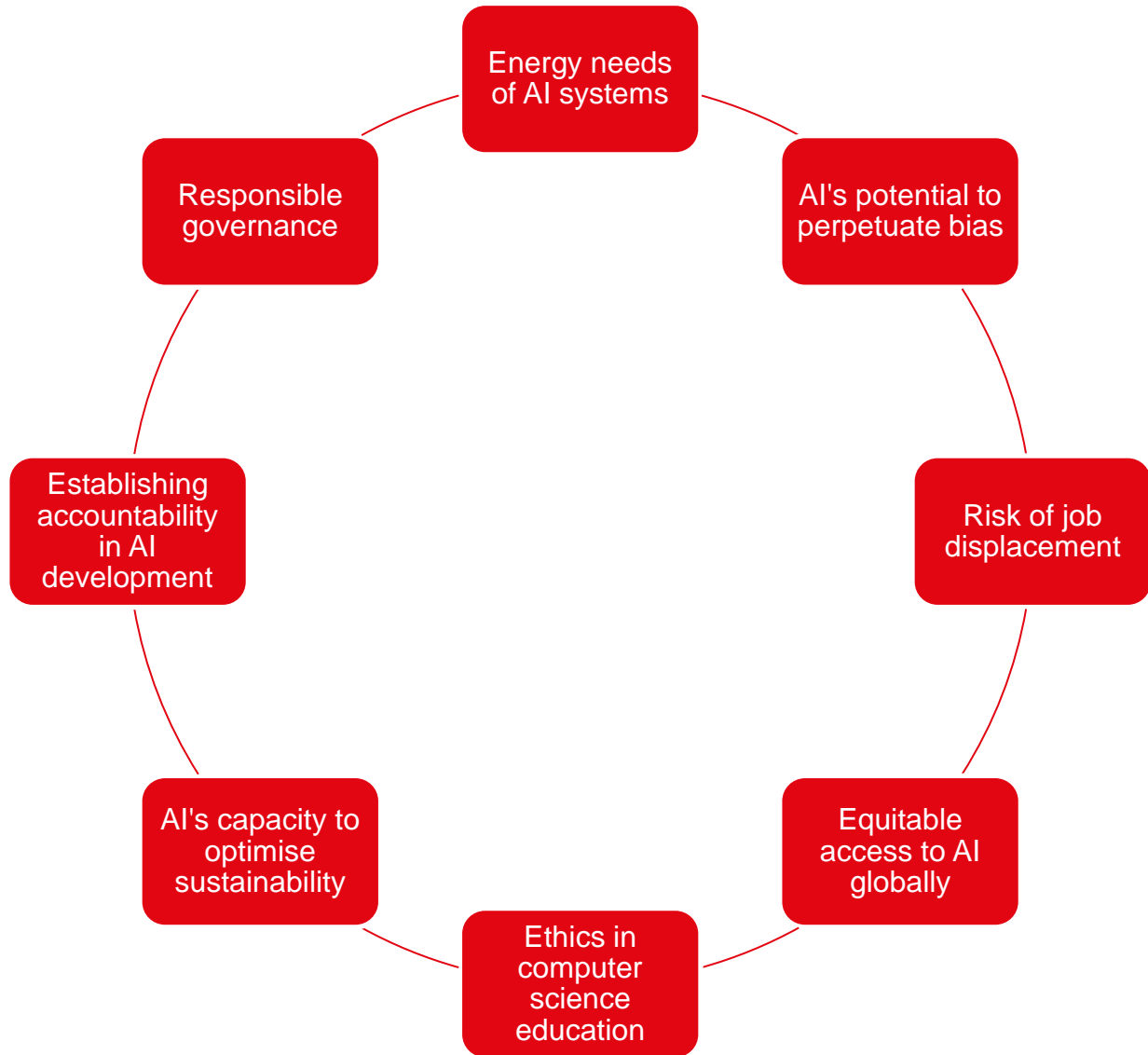
Finally, Prof. Perez-Ortiz concludes her evidence by making the case for a global agenda to steer technological advancement towards desirable, ethical endpoints. Like the UN's declaration on Sustainability, Prof. Perez-Ortiz justifies that we need a collective vision for AI's impact on people and the planet. This can motivate progress on accountable innovation and help nations align policy and investments with shared objectives for inclusive progress.

Tarun Rishi, AI Innovation Consultant at **About Alpha Limited**[5], starts by asserting that AI can tackle the fragmentation of information between the SDGs, illuminating interconnections, unintended consequences, and opportunities. However, despite this, immense concealed waste exists in AI's environmental footprint, from energy-intensive data centres to complex models. While AI is invaluable to increasing productivity, Rishi demonstrates that it's true costs are obscured, therefore international collaboration and public trust are fundamental to successfully deploy AI for Sustainable Development globally. This necessitates data sharing frameworks, transparency, and participation of developing nations where AI solutions are most needed but least accessible. Rishi makes the case for a holistic global strategy to minimise duplication of efforts across borders.

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[4] **UCL Centre for AI**. https://www.ucl.ac.uk/ai-centre/ucl-centre-artificial-intelligence

[5] **About Alpha Limited.** https://www.aboutalpha.com/

Energy needs of AI systems

Responsible governance

AI's potential to perpetuate bias

Establishing accountability in AI development

Risk of job displacement

AI's capacity to optimise sustainability

Equitable access to AI globally

Ethics in computer science education

Rishi articulates that there are massive hidden waste and environmental costs from AI systems, data centres, and complex models. This is emphasised by the fact that the cloud has a larger carbon footprint than airlines, with data centres refreshed regularly and exorbitant electricity needs. Demand is skyrocketing, further obscuring Sustainability. Rishi maintains that we need tracking of supply chains and carbon costs, plus efficiency standards to illuminate the genuine impacts.

Progressing forward, Rishi closes his evidence statement by conveying that international collaboration and public trust are essential for successfully achieving SDGs globally. This requires data protections, transparency on data usage, and eliminating biases. For Rishi, with restricted transparency, public participation will falter in countries that stand to benefit most from AI. Global agreements can broaden access while minimising compliance costs.

Buffy Price, Co-Founder of **Carbon Re**[6], kickstarts her evidence by describing how AI can optimise intricate industrial processes like cement production to reduce associated carbon emissions by up to 10% per cement plant. This represents a major opportunity, as cement accounts for 8% of global greenhouse gases. AI digital twins of plants can identify the most efficient processes to minimise fuel utilisation and CO_2 output; with over 3,000 plants worldwide, AI adoption could significantly impact climate change goals if actualised rapidly by 2030.

Price continues by declaring that significant emissions reductions by 2030 are critically needed to achieve climate change objectives. Research shows accomplishing major cuts by 2030 is considerably more impactful than distant net-zero goals. Price affirms that we cannot await future innovations; immediate action is imperative, and AI can deliver tangible optimisations today.

Finishing her evidence, Price concludes that AI can simulate and optimise elaborate industrial processes to minimise fuel employment and associated CO_2 emissions. By modelling physical and chemical dynamics, AI will pinpoint the most efficient methods to generate materials like cement using current infrastructure. This can reduce fuel-derived CO_2 by up to 20%, granting precious time until new technologies emerge and scale.

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[6] **Carbon Re.** https://carbonre.com/

5. Evidence statements

Matt Armstrong Barnes, Chief Technology Officer – Artificial Intelligence, Hewlett Packard Enterprise

Introductory Remarks

Sustainability and AI are two enormous topics. I thought, I could talk about what AI is, but we don't really have a clear definition as soon as we get into the detail as to what AI is in the first place. It's still being massively debated by academics and philosophers, and we only really have the broadest of definitions. I'm an engineer, so I'm going to talk about why we need AI.

Why we need AI?

Can AI spot illegal brick-making factories, using satellite imagery in Asia? Illegal brick-making factories are staffed by either slave labour or, in lots of cases, child slave labour? Yes, we can.

Can we use AI to spot the difference between a weed and a wheat? So that instead of mass spraying of crops, we can individually target weeds and reduce the number of herbicides that we're using massively. Yes, we can.

Can we use AI techniques to take imagery of people who may well have been human trafficked and age them to allow law enforcement to work out who those people are? Yes, we can.

Can we use AI as a way of accelerating drug discovery using chemical bindings? Yes, we can.

Consequences of using AI

However, with great power comes great consequences.

There is a worrying trend where we are running towards this technology, both AI and general AI, without understanding the ramifications. Building complex AI models needs lots of electricity, and the by-product of that use of electricity is that it creates lots of heat, which you then need to cool, which uses more power or geothermal energy depending on what you're doing.

These are the ramifications of what we're doing, and it is surprisingly easy to build massively inefficient AI systems.

Because some of the core disciplines that we aren't employing in the AI space, that we would in other IT-based disciplines, aren't being employed, that means we are potentially starting to push on a technology where there are significant ramifications for the planet.

Sustainability in AI

When we talk about Sustainability in AI, it's not just about the carbon, the power that it produces. It's about building sustainable systems - what do we mean by that?

Are they maintainable? Are they supportable? Do they adapt to change? Are we building a strategic objective that fundamentally means we're going to bring this technology in, against the right use cases, and in the right way that it's going to drive our agenda forward?

That's one of the things I think we need to consider when we start to look at the UN's objective. What is Sustainability from an AI perspective? It's not just about the environment, it's about stopping short-term use of AI techniques, where the carbon used to create them is massively offset by the benefit that you're going to get.

From a policy perspective it's about Sustainability in terms of how we build long-term plans, how we put the right engineering discipline in place that means that we build AI systems that ultimately are not going to be inefficient. There's huge amount of work in academia and industry to build very, very efficient techniques that we can apply to this. Let's leverage all of that, stand on the shoulders of giants and make sure that we are building long-term plans that drive the innovation agenda forward.

Hugh Eaton OBE, Former Vice President – Worldwide Government at Microsoft

Introductory Remarks

I spent 18 years in government and defence, 18 years in big tech, principally with **Cisco**[7] and **Microsoft**. Firstly, I really want to commend the work that you guys are doing because it is probably painful at this stage. I was involved in the first **UK National Cyber Security Strategy** [8]and setting up the **National Cyber Security Centre**[9] and providing UK advice into NATO and the UN, on cyber, which is something at the time that people barely understood, which is where we are with AI at the moment, with the many different interpretations. To misquote, JFK, *"the only way you get hard things done is to go at them".* So, keep going, and something good will come out the end.

There are four real components to AI. Data, computing power, talent by which I mean the workforce, and institutions. I'm going to talk about talent and institutions. I'm going to talk about governance, and there's two recommendations I have for members and people to think about: One is about being holistic and the second is harnessing potential.

Holistic

On holistic, with respect to the UK's contribution to the UN SDGs, I have seen other countries

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[7] **Cisco**. https://www.cisco.com/site/uk/en/index.html

[8] **Cyber Security Strategy of the United Kingdom** (June, 2009).

https://assets.publishing.service.gov.uk/media/5a7c69fb40f0b62aff6c17fc/7642.pdf

[9] **National Cyber Security Centre.** https://www.ncsc.gov.uk/

be more holistic in the way that they approach the application of AI, in terms of the identification of benefits, and the mitigation of challenges across a national strategy. The UN, in my experience, aren't massively interested in an idea from the UK, unless it has got evidence. They're not going to say, "ok, that's a good idea, we're going to do that", they're going to say, "that sounds interesting, where can you show us that you have led the world in this area?" I think the UK can do this; it is a country that produced Alan Turing[10], Tim Burners-Lee[11] and Geoffrey Hinton[12]. We managed telephones and steam, and there's every good reason with our academic institutions that we can contribute to leadership in the AI government space across the SDGs. We need to do that with confidence, with ambition, and with vision.

To give you a data point on taking a holistic approach, countries like Germany, Saudi Arabia or France are better at taking things like the components of critical national infrastructure and then joining those together for a more collective, coherent, holistic response. I think the UK needs to work a little bit harder on that.

Harnessing Potential

The second thing is about harness, it's about institutions again, and it's about the organisations and the countries, whether that's the UK or the UN that can optimise AI best, are those that stitch together, data compute power, talent, and institutions. That means a different sort of relationship with big tech, and a couple of data points. I'll talk about Microsoft, but there's lots of big tech companies that have been involved in the AI conversation, which sounds sexy, futuristic, and good, but the companies have also made lots of their staff redundant. There's 10,000s of people who've been made redundant by these technology companies producing this good stuff in the world. So, when governments or supranational organisations go to these big tech companies, they need to say, help us in terms of upskilling and reskilling, but help us in the way that we need and can define that support to the national workforce. Not the offer of education on your platform, whichever technology company that is.

Then there needs to be what I would call some uncomfortable honesty. For example, Microsoft, have let 10,000 people go, 10,000 people are now redundant, how many of those did you reskill and upskill? I doubt really that it is higher than 500, which is about 5%. So, I think an honest conversation is needed, and then we harness those offerings. At the moment they are stranded value, they collectively constitute millions of pounds worth of educational opportunity for the workforce, but they will just be stranded, unless a person and an

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[10] **Alan Turing** was a pioneering computer scientist who made major contributions to theoretical computer science and codebreaking during World War II.

[11] **Tim Berners-Lee** invented the World Wide Web, developing the first browser and server software along with the key technologies like HTML, HTTP, and URLs that remain central to the web today.

[12] **Geoffrey Hinton** is a cognitive psychologist and computer scientist who made groundbreaking contributions to Machine Learning through his work on neural networks, bolstering the technique called "deep learning" that now dominates the field.

organisation owns that relationship. That's the governance piece.

Health

I would just like to say two brief things on specific goal areas. One is in health, and again I talk about the UK leading the way, but we need to optimise the way we approach our own health service, I think, before going and providing advice to the UN. I spent three months during the pandemic every day at Skipton House[13], working with Simon Stevens[14] and Amanda Pritchard[15]. Amanda has gone on to do a fabulous job in incredibly difficult conditions. If you've got seven highly autonomous regions who do pretty much precisely what they want with their budgets, because the health economies are different, you're not going to get coherence or a world leading national service, that won't happen in the world of AI.

So again, somebody needs to be responsible for driving that.

Defence

There is something similar in the defence environment, I think that your defence leaders are working hard on providing sensible AI leadership and vision, but we need to protect the AI innovation.

To my final point, if you can imagine in front of you a spectrum of warfare, there's nuclear war at the right-hand side and we come left through high intensity conflict, counterterrorism, counterinsurgency, influence operations, financial sanctions. Right over on the left, where we haven't really been thinking, is the innovation, it's the seed funding for AI companies. Forbes magazine, reviewed the top 50 AI companies in the world, how many of those were in defence? One. [16]

If we consider national defence, I mean that in a positive way for international order to be important, we need to protect that investment. Somebody needs to put effort into that because I love defence and I love all the people in defence, but they're not really experienced or competent at this. To take on that pretty specialised conversation with fund managers, vice stock, and making sure that the next time **Silicon Valley Bank**[17] goes down, the next person on the phone is not from China, it's from a slightly friendlier country.

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[13] **Skipton House** is the headquarters of the Department of Health and Social Care.

[14] **Simon Stevens, Lord Stevens of Birmingham,** is the Chair of Cancer Research UK, and was the Chief Executive of NHS England from 2014 to 2021.

[15] **Amanda Pritchard** is the current Chief Executive of NHS England.

[16] **Forbes, AI 50** (April, 2023). https://www.forbes.com/lists/ai50/?sh=694de87e290f

[17] **Silicon Valley Bank.** https://www.svb.com/

Prof. Maria Perez-Ortiz, Associate Professor of AI & Sustainability, UCL

Introductory Remarks

My name is Maria Pérez-Ortiz, I am an Associate Professor in AI at **UCL** and **UNESCO**[18] Co-Chair in AI, so I interact with policymakers in terms of regulating AI. At UCL I have recently co-founded the very first postgraduate programme on **AI for Sustainable Development**[19], where I teach two courses at the intersection of AI, responsible innovation, and Sustainability.

In the last 13 years I have developed a lot of new AI models in diverse domains, including climate, biomedicine, agriculture, neuroscience, education, and conservation.

I am here today because I believe that there is one single thing that we can do for AI to have a positive impact across all the SDGs. Like Nelson Mandela, I believe that education is the most powerful weapon which you can use to change the world.

AI-based Transplantation System

One of my first experiences with research was creating an AI-based transplantation matching system. The system received information of a donated organ that arrived at a hospital, and each patient in the waiting list. Through training, the system could predict which transplants were going to be most successful, with success defined as the time that the organ survived once transplanted. The use of the system allowed to maximise the utility of every donated organ, helping to do more transplants with high success rates, which would mean a significant

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[18] **UNESCO – Artificial Intelligence**. https://www.unesco.org/en/artificial-intelligence

[19] **Artificial Intelligence for Sustainable Development MSc.** https://www.ucl.ac.uk/prospective-students/graduate/taught-degrees/artificial-intelligence-sustainable-development-msc

reduction of mortality in waiting lists. The system was deployed in Spanish hospitals as a way to support decision making 10 years ago.

However, there is another side to the story. Later, doctors noticed that the AI system was assigning women significantly less transplants. With time we discovered that this issue was probably inevitable. Transplantation matching systems where either humans or medical indexes were taking those decisions, were also assigning less transplants to women. It was a worldwide systemic issue, as we had not even begun to understand how male and female physiology and blood biomarkers differed, as often clinical trials in the past did not involve women.

The unintended consequences of technology and science is something I am fascinated about. This is just one example of the negative unforeseen impacts that we could see in the future.

Education & Training in AI

This was not a participation issue. I am a female computer scientist, and I built that system. So, what exactly went wrong? I feel that the education I received as a computer scientist never actually prepared me for this. I had neither the awareness nor the tools to have done differently.

This was before the conversation on AI risks and biases started. However, even now, topics such as risk assessment and ethics are often still nowhere to be found in our taught computer science curriculums globally. This is where new technologies such as **ChatGPT**[20] brings new risks. Last week, we released with **UNESCO** a report that states that ChatGPT perpetuates gender stereotypes[21].

We are still failing to prepare many AI researchers and engineers to deal with these consequences.

In the last few years, I have tried to change that, starting with UCL. I have introduced in our incredibly specialised educational systems an understanding of global planetary challenges, e.g., through the SDGs, and the potential impact of the science and technology we develop as on the SDGs.

I have also embedded frameworks of responsible innovation, promoting critical thinking that will support students to become leaders that innovate responsibly in AI, building designs that mitigate the unintended risks and enabling a chain reaction of positive impact through the next generation of students. The result has been cohorts of tech innovators, that feel more confident in tackling world Sustainability challenges with technology, and that create ethical solutions

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[20] **ChatGPT**. https://chat.openai.com

[21] **"I don't have a gender, consciousness, or emotions. I'm just a machine learning model"**
(October, 2023). https://unesdoc.unesco.org/ark:/48223/pf0000387189

that impact multiple SDGs positively.

The responses to these trainings have been overwhelmingly positive, with students agreeing that any technologist would benefit from learning about these topics. Other researchers have already done studies that clearly find that: Students' confidence in identifying, raising, and discussing ethical issues, increased significantly after introducing them into the curriculum.

Recommendations

It's clear that we urgently need to steer AI technologies towards our collective vision of desirable futures.

We need to transform computer science undergraduate curriculums, discussing dimensions such as reliability and safety, privacy and security, fairness and inclusiveness, transparency, and accountability. This is imperative if we are to realise a positive impact with AI. Stanford University is one of the very few universities worldwide that has already done so, the last few sessions of each course always discuss the material through the lens of ethics and responsible innovation.

We also require accessibility to the discussion. If the public does not follow the debate, they cannot contribute. Multiple schools in the US are starting to use short courses that help all students understand AI.

Finally, science and technology will be called on to inform decision making at an unprecedented scale and we need to be ready to rise to the challenge. Many other high-stake domains will also require responsible AI. My recommendation is that we design together a global agenda for technological development with specific goals and targets, the same way we have an agenda for Sustainable Development. The agenda will serve as a global incentive and as a way to track progress on the impact of AI.

More than 10 years ago, the UN published a declaration for Sustainable Development named "The future we want". We need now to decide on the technological future we want, and how we are to realise it. In my view, transforming AI education is one of the missing pieces in our technological stewardship.

Tarun Rishi, AI Innovation Consultant, About Alpha Limited

Introductory Remarks

I am excited to talk to you about the potential of AI in achieving SDGs. I am an AI Innovation Consultant helping businesses accelerate their goals using AI. I also help businesses align with SDGs.

So where are we with AI and SDGs? The explosion of AI and automated technologies has given us a perception of rapid progress.

This is a problem as the reality is very different. **The UN's July Special Report on Sustainable Goals**[22] highlighted issues across all 17 goals. Of 140 targets, 50% are behind, 30% have no progress or regress, and data inadequacy is a problem. Without significant acceleration, it is unlikely that even critical SDG can be achieved by 2030.

So where is it going wrong and how can AI help?

I want to draw your attention to three of areas:

- Fragmentation of information makes it difficult to connect all the dots.
- Waste in the use of AI impacts Sustainability.
- Collaboration is essential to impact SDGs globally.

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[22] **The Sustainable Development Goals Report – Special Edition** (July, 2023).
https://unstats.un.org/sdgs/report/2023/The-Sustainable-Development-Goals-Report-2023.pdf

Fragmentation (and why it is important in AI achieving the UN SDGs)

Information sharing is heavily fragmented. Do you understand all the frameworks and policies in the UK and internationally? Do you have visibility of solutions worldwide? Can you access common standards, models, and data? What about the results and insights generated? Can you keep up to date with it?

AI can help in this complex network with up-to-date analysis of gaps, synergies, and opportunities. It can spot difficulties and recommend approaches or re-use of solutions for specific problems.

Analysis of metadata shows a surge in AI publications for SDGs particularly in Good Health & Well Being (SDG3) and Affordable and Clean Energy (SDG7), with US, the UK and China as the closest partners. AI can be used to highlight research imbalances like these and advise governments on adjusting policies and programmes.

SDGs are interconnected and challenging for policy integration. AI can identify disconnects and unintended consequences. An example is choices on Zero Hunger (SDG2) intensifying use of agro-chemicals to increase yields but jeopardising goals such as Clean Water and Sanitation (SDG6), Life under Water (SDG14) and Life on Land (SDG15).

By helping stakeholders understand the network of information AI can accelerate progress of the UN SDGs.

Waste (and the problem AI creates for Sustainability)

The Cloud's environmental cost is hidden – this is the key problem.

The Cloud carbon footprint is greater than the airline industry. Electricity use is 0.3% of carbon emissions, mostly not from clean sources, and 40% is for air conditioning. Data centers add to waste by regularly refreshing infrastructure.

Demand will only increase exponentially over the next 10 years. For example, AI is vital in increasing farm yield, but the average farm can generate half a million data points per day with diverse applications from microbiome soil research to precision and prediction farming, this is only going to go up significantly.

AI can streamline tracking of the carbon value and closed-loop supply chains and through regulatory integration aligning with SDG agendas. It can also join up the dots so that we can start enforcing that, with data centres.

Cloud alternatives need to be promoted. 40% of people in most countries have smart phones allowing more low-tech "citizen science" solutions run locally on IoT devices.

AI needs to be efficient. So, another area that we can look at is model efficiency and

computation "price tags" help as training just a few models emit as much CO_2 as five cars over their lifespans. Efficiency ratings promote smaller, reusable models. AI can identify re-use opportunities and the environmental cost for a project or specific task in advance. AI efficiencies, monitoring and standards can reduce the environmental cost of AI.

Collaboration (and the global agreements required to ensure Sustainable Development)

Collaboration internationally is essential to significantly impact SDGs globally. It's not a "zero-sum game" but allows scaling of initiatives with mutual benefits and reduced duplication of effort and costs.

Lack of data, computing capacity, and knowledge affects regions where AI and technology solutions can be most impactful. Collaboration needs common international regulatory frameworks addressing digital ownership and providing commercial and ethical protections. This would result in lower compliance costs and increased innovation.

Cooperation is needed from the public for AI solutions to be effective. Only 39% of people worldwide think AI will help them and two thirds think their personal data is not safe.

Trust needs data protection, understanding what is collected and how it is used. The reality is you are not anonymous anymore and even in an anonymised dataset individuals can be re-identified with only a few attributes. Trust is also dependent on addressing bias in the data, training, and results.

Collaboration and transparency constrain AI solutions for SDGs where they are needed most and need to be addressed in any global agreements.

Concluding Remarks

In the UK we aspire to become a global superpower in AI. Leadership in solving SDGs using AI is the opportunity.

We need to re-reprioritise initiatives to have a meaningful impact on the UN SDGs by 2030. Looking at which are the most important SDGs where AI would help the most and have the most impact globally. Pursuing too many goals puts at risk overall success.

Before I finish, here are my recommendations on how to accelerate:

- Unify Information so stakeholders can understand the interconnected network of regulations, policies, and solutions and see gaps, synergies, and opportunities.
- Eco-Friendly Cloud by effective measurement and monitoring of carbon value and closed-loop supply chains to reduce the environmental cost of AI.
- Promote cloud alternatives using "citizen science" and smart phones.

- Efficiency and re-use standards in ai with visibility of the real environmental cost.
- Gain public trust with data and ai safeguards and transparency in global agreements.
- Global collaboration agreements to minimise compliance costs with countries where AI can have the most impact on SDGs.

Buffy Price, Co-Founder, CarbonRe

Introductory Remarks

Carbon Re is an AI and climate tech company on a mission to reduce carbon emissions by gigatonnes every year. We are a joint spin-out of UCL and Cambridge University, and we are focusing on decarbonising cement and other foundational materials (such as steel and glass) which are responsible for more than 20% of global greenhouse gas emissions.

We have built a world-class interdisciplinary team with expertise in AI, Machine Learning, industrial processes, mathematics, chemistry, and software engineering. We are based here in London.

Prior to moving into the technology and startup sector, the majority of my career was spent working in the NGO sector and my personal interest is firmly rooted in making positive and equitable change for people and the planet. I am very much focused and driven by solutions that make change happen for people and the planet.

Carbon Re

We chose to found **Carbon Re** because we saw an opportunity to make significant impact on carbon emissions in the short term by targeting the biggest global emitters of CO_2 using AI solutions to improve process efficiency. Our first focus is on cement production, which accounts for 8% of global greenhouse gas emissions, and our models can reduce fuel consumption in cement production by 5-10% - for each plant this is equivalent to removing 11,000 cars off the road, every year. There are 3,000 cement plants globally, so the opportunity here is significant.

Specifically, our solution relates to the at least 3 of the SDGs:

- Goal 9: Industry, Innovation & Infrastructure.
- Goal 12: Responsible Consumption and Production.
- Goal 13: Climate Action.

Cement is essential for how we make homes, and roads and schools, and demand is increasing - especially in developing countries. Today, cement is still the best and most ubiquitous material, despite other emerging alternatives, for the job so it is vital that we can continue production in the most efficient way possible - and this is the focus of the AI software that we are deploying at Carbon Re.

Climate Action

We also need urgent climate action. Waiting until 2030 (or 2035!) to start reducing carbon emissions is not an option if we want to avert the worst impacts of global warming. This is supported by research published in Nature in 2021 - also picked up by the new head of the **Intergovernmental Panel on Climate Change (IPCC)**[23] on the Today Programme this morning - shows that achieving large emissions reductions by 2030, without ever reaching net-zero, delivers a significantly better result than reaching net-zero through a big improvement between 2040 and 2050[24]. This in terms of the global warmth and the impact that we are seeing.

What can AI do to aid Climate Action?

Today **Carbon Re is** focused on reducing fuel derived emissions. In order to make cement, we need to generate extremely high temperatures of 1500°C and this requires energy dense fuel which most often comes from fossil fuels. While 60-70% of emissions from cement production comes from the calcination process, the rest of the emissions are produced by the burning of these fuels.

The PhD research carried out by my cofounder **Dr. Daniel Summerbell** at the Institute for Manufacturing at Cambridge University showed that there is potential to reduce these fuel-derived carbon emissions by up to 20% through process efficiency alone[25]. By process efficiency we can make significant inroads on the amount of fuel that we are burning and associated carbon emissions, which can be achieved using existing infrastructure and hardware - without fundamentally changing how we are producing these materials today. We are taking existing data and making sure that these cement plants operate more efficiently.

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[23] **Intergovernmental Panel on Climate Change**. https://www.ipcc.ch/

[24] **Path to Net Zero is Critical to Climate Outcome** (November, 2021).
https://www.nature.com/articles/s41598-021-01639-y

[25] Dr. Daniel Summerbell, **Environmental Performance Improvement in the Cement Industry**
(June, 2017). https://www.repository.cam.ac.uk/items/318d94f4-c9b6-4ef2-a660-0b7b44c00759

Combining this research with the AI expertise of our CTO, **Dr. Aidan O'Sullivan**[26], we are building cloud-based digital twins of cement plants by analysing sensor data from each plants. By modelling the production environment in real time, our models can identify the optimal process for the lowest possible carbon dioxide output and fuel use. AI is ideal for simulating these highly complex, interconnected chemical and physical processes, and can enable cement producers to reduce over 50 kilotonnes of annual CO_2 emissions per plant. There are approximately 3000 plants globally, so the opportunity for impact is substantial.

<u>Concluding Remarks</u>

So not only can we have an impact today, buying us time to develop and scale new and emerging technologies. We also see ourselves as part of the longer-term solution by developing technologies that understand the complexities of production environments and the fundamentals of how these materials are made from scratch. We can make cutting edge advances in materials development a possibility and we believe that an AI transformation will be a game changer for cement, steel & glass production.

My specific asks for Government are threefold:

Prioritise funding to support climate tech companies to develop and deploy solutions at speed and scale, now. Also, to help industrial producers to implement short-term decarbonisation measures (the majority of funding is focused on Carbon Capture Utilisation and Storage (CCUS) - which is crucial, but we should also be looking at other measures such as AI deployment).

Update the definitions of best available techniques methodology, which is best practice guidance from Government, used by industrial producers to reduce pollution. At the moment it is focused on hardware, but it should include software solutions for process optimisation.

Invest in education and training in Industrial AI - to build the necessary technical expertise and to foster collaboration between government, industry, and technology providers to drive innovation and adoption of AI. Perhaps a **Department for Business & Trade**[27] sponsored Centre for Industrial AI?

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[26] **Dr. Aidan O'Sullivan.** https://www.ucl.ac.uk/bartlett/energy/people/dr-aidan-osullivan

[27] **Department for Business & Trade.** https://www.gov.uk/government/organisations/department-for-business-and-trade

6. Speaker Bios

Matt Armstrong-Barnes, Chief Technology Officer, Hewlett Packard Enterprise

Matt is Chief Technology Officer at Hewlett Packard Enterprise with a passion for Artificial Intelligence & Data Science. As a strategic leader he works to drive innovative technical solutions across industries and technology trends. He has a diverse background with 10 years at HPE and 25+ years in the industry. His history includes numerous senior leadership positions, winning, architecting, and delivering sizable, complex transformation programmes.

He has a Degree in Computer Science, a Masters in AI, is a Fellow of the Institute of Engineering and Technology, a Chartered Fellow of the British Computer Society, Chartered Engineer, Chartered IT Professional and Chair of Smart Cities at TechUK.

Publications:

- **Matt Armstrong-Barnes** (2023). *'Sustainable AI: An Introduction'*

Hugh Eaton OBE – Former Head of Government, Microsoft

Hugh led the Global Government business for Microsoft, based in London and Vancouver with a focus on Digital Transformation and Critical National Infrastructure. He is currently consulting into the UK and Saudi Arabian Governments on Digital Transformation and emerging

technology.

Hugh has a formal advisory role to the UK Government, and NATO, on Organisational Design and Technology Advantage. He joined Microsoft after 14 years of Global sales and strategy leadership at Cisco, before which he commanded soldiers on combat missions for 16 years, earning both an MBE and an OBE from her late Majesty, Queen Elizabeth the Second. Hugh Eaton is a leading global expert on digital transformation and cognitive government.

With 28 years of deep experience, he is a recognised global leader in:

- The efficient creation of sustainable and successful Digital Delivery Strategies within international and national policy and regulatory environments.
- The performance enhancement of existing infrastructure and policies, organisation and resourcing.

Hugh has a Masters Degree in International Security and is taking a Masters Scholarship in International Resilience at Hertford College, Oxford. His deep global expertise draws on maximising human and technology capital in Government, Critical National Infrastructure, and Sustainability. Hugh has extensive experience in the international arena, particularly with US and European Governments, the UN and EU bodies and funding agencies.

Examples of Digital Advisory thought leadership:

- Digital Plan 2020 for UK National Health Service.
- Lead Industry Adviser to Saudi Arabia's Vision 2030.
- Technology Adviser to UN COP climate series.
- Critical National Infrastructure - UK Government Non-Exec Director.

Examples of Strategy innovation:

- Created the Microsoft Sustainability offer across Public Sector and Energy Industries.
- Co-developed the UK MODs Future Operating Concept in NATO.
- Redesigned the Cisco Health and Public Safety coverage model and GTM.
- Built both the Cisco and Microsoft Country Coverage Models.

Dr. Maria Perez-Ortiz, Associate Professor, UCL

Dr Maria Perez-Ortiz is Associate Professor at the Centre for Artificial Intelligence and the Department of Computer Science at University College London (UK). She is co-founder and Director of the first MSc programme on Artificial Intelligence for Sustainable Development, which trains AI engineers and researchers on emerging AI technologies and frameworks to tackle the United Nations Sustainable Development goals. She serves as UNESCO Co-Chair

in AI and is leading the work to bring sustainability and responsible innovation into computer science education.

Perez-Ortiz calls her line of work "Planet-centered AI", developing responsible AI technologies for people, the planet and tackling the challenges of the Anthropocene. Her vision for this field is that AI technologies bring specific possibilities and risks to our sustainability agenda, and we need to urgently align technology developments with our most important international social and environmental aims, through a novel and global technological agenda. Her career is focused on creating the technical foundations for these AI technologies to truly support Sustainable Development. Perez-Ortiz is currently interested in how AI could support and enrich the different stages of the policy making cycle.

Publications:

- **Maria Perez-Ortiz.** *'Publications'*

Tarun Rishi, AI Innovation Consultant, About Alpha Limited

Tarun is an AI Innovation Consultant committed to harnessing the transformative power of AI for the greater good. Over decades, Tarun has held multiple leadership roles in financial services, fintech, techbio, and non-profit organisations. Tarun's journey has revolved around unlocking the potential of data with a focus in the last decade in AI and in more recent years delving extensively into Generative AI. Tarun actively advises companies on harnessing innovation and AI to accelerate the achievement of their goals. Tarun specialises in aligning businesses with Sustainable Development Goals (SDGs) through innovative AI strategies, paving the path to a more sustainable future. Tarun is driven by a deep commitment to making a positive impact on our world. Tarun's work, both professionally and as a co-CEO of Humans For AI, is rooted in a vision of AI that champions diversity, ethics, and societal benefit.

Buffy Price, Co-Founder, CarbonRe

Buffy is co-founder and COO of Carbon Re, an AI and climate tech company developing the world's most advanced AI-powered platform for decarbonising energy-intensive industries, such as cement, steel, and glass. A joint spin out of the University of Cambridge and University College London, Carbon Re combines world-class artificial intelligence and industrial sustainability expertise. Prior to Carbon Re, Buffy was the AI for Climate Partnerships Manager at Element AI, and a Senior Advisor at Amnesty International working closely with the Amnesty Tech team. Buffy has extensive experience in change management, organisational development, and project management.

Publications:

- **CarbonRe** (2023). '*Three technologies to reduce climate change'*.
- **CarbonRe** (2022). *'Carbon Taxes set to revolutionise cement production'*.
- **CarbonRe** (2022). *'How AI is helping cement plant operators reduce energy consumption and carbon emissions.'*

7. Contact

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