# Leveraging AI in the Fight Against Climate Change

## How AI can help monitor and mitigate the impacts of climate change

Artificial Intelligence (AI) stands as one of the most powerful tools of our era, offering unprecedented potential for the benefit of humanity. As we confront the urgent and escalating challenge of climate change, the innovative applications of AI become increasingly critical. This paper looks into some of the many ways in which AI can be harnessed both in reducing the emissions linked to climate change as well as monitoring and mitigating the impacts of climate change. By exploring these applications, we aim to shed light on the transformative role AI can play in mitigating one of the greatest threats to our planet.

Climate change is quite possibly the major challenge facing the global community today. We have already seen average global temperatures rise by more than 1 degree [1] since pre-industrial levels with the majority of this warming occurring in the past 50 years. This trend seems set to continue with current forecasts that we are likely to see an increase of significantly more than 2 degrees by the end of this century [3]. This is beyond the target set by the Paris climate agreement [2] in 2015 which was put in place to ensure prevent major harm to the planet. This is expected to cause major impacts to global communities through rising sea levels, increasing natural disasters, changes to rainfall patterns, extinction of species and shortages of water and food [3].

Technology has long been recognised as a key tool in the fight against climate change. Direct technologies such as renewable energy generation are already making a significant positive difference to our climate. AI technologies can also have a major impact in the fight to reduce the impact of climate change and mitigate or manage the impacts that do occur.

AI tools have long been used to model how the climate is changing and forecast future change. In this paper we look at some of the ways in which AI can reduce both severity of climate change and mitigate some of the challenges of the changing climate.

## AI solutions to Reduce Greenhouse Gas Emissions

There are many ways in which global greenhouse gas emissions can be reduced. These are largely through moving away from fossil fuels, the use of more efficient solutions designs. However, AI solutions can also contribute in a number ways.

The following are some of the ways in which AI solutions can reduce emissions from the sectors that are the major greenhouse gas producers [4].

 

## Energy Production

Energy production is consistently cited as the major cause of global greenhouse gas emissions. Any reductions in this area can have a major impact on overall emissions.

As with the industrial sector described below, modern power stations make extensive use of telemetry and data in their operations. The utilisation of AI algorithms can help optimise the operations of these plants and lead to more efficient use of resources.

AI solutions are also able to ensure that power stations continue to run smoothly. Algorithms can detect and alert on abnormal conditions enabling operators to resolve issues before they have a chance to become more significant. This can help reduce inefficiencies in power production and ensure that resources are best used.

### Case Study - Optimising Energy Generation

Fujitsu has worked with Meridian Energy to develop a number of AI models to improve reliability and efficiency of energy generation at their hydroelectic plants in New Zealand. The use of these models enables issues to be identified and resolved before they become major problems which results in more reliable power generation and significant cost reductions.

Fujitsu Meridian_Energy_case_study_Jan_2024

Wind farms are becoming a key feature in renewable energy production in many countries. It is essential that these resources operate effectively to ensure that they produce the maximum output available. Predictive AI models can detect defects in turbine blades allowing them to be resolved before causing costly issues.

### Case Study – Ensuring the reliability of renewable energy sources

Siemens is one of the largest produces of wind turbines globally. It is essential for them to maintain strict quality control standards as any flaws in a blade I operation could have catastrophic consequences. Fujitsu have been their long-term partner and together we created an AI model that was able to automatically detect flaws through deep learning models.

Fujitsu Siemens AI Turbine Defect Analysis

It is also important for energy generators to have reliable estimates of how much energy will be required in the future. AI forecasting models help in predicting future load and ensuring there will be sufficient capacity to meet demands without generating excess capacity.

## Industry

As well as being a major contributor to climate change, energy use by industry is also a major cost to organisations. The utilisation of AI technologies can therefore benefit the bottom line in addition to improving the environment.

 

In modern factories, sensors can monitor all aspects of production processes and feed this detailed information in real time back to AI models which can optimise production and reduce costs. Some examples of this are:

- Optimisation of energy consumption – adjusting energy consumption up or down based on production needs
- Optimisation of production job schedules to improve efficiencies and reduce energy consumption

AI technologies can also predict and detect when machinery is starting to wear out and becoming less efficient. This can result in unnecessary energy consumption. Predictive maintenance algorithms can identify machines that are becoming less efficient and enable preventative maintenance to be scheduled.

**Case Study - Sustainable Manufacturing**

Fujitsu has been working with a New Zealand based manufacturer to reduce both costs and carbon emissions of their productions processes through more efficient boiler control. Details of current performance and future scheduled jobs are fed into a model which optimises the output from a boiler to match the requirements of the jobs being processed. This is expected to result in a dramatic decrease in energy consumption.

## Buildings

AI is increasingly being used to improve energy efficiency and reduce carbon emissions in buildings both in the construction phase and once the building is occupied.

Some examples of the use of AI to reduce emissions from buildings include:

- Utilising AI solutions to optimise building designs to ensure that they are energy efficient – e.g. in modelling the thermal properties of insulation or window to wall ratios
- Optimisation of heating, cooling and lighting based on predicted building occupancy to provide maximum comfort for occupants whilst minimising climate impacts

## Transport

Transport is another area that has a major environmental impact. As with other sectors, the use of AI solutions can help reduce carbon emissions as well as reducing overall costs.

The use of AI based navigation tools has been established for many years now. These enable more efficient route planning that can reduce emissions and save fuel-costs. In recent years, these have been extended to identify where delays are occurring and provide alternative routes for vehicles that will avoid the delays. This results on fewer cars being stuck idling in traffic jams needlessly consuming fuel.

 

AI solutions also help transport and logistics organisations plan deliveries in the most effective way to minimise travel whilst still meeting delivery deadlines.

AI solutions are also good at optimising traffic management. Intelligent signal controls can keep traffic flowing more effectively that traditional systems resulting in reduced fuel consumption and shorter travel times.

The development of autonomous vehicles based on AI is increasing rapidly. These vehicles are designed to utilise more efficient driving styles than human drivers resulting in reduced fuel costs and emissions.

### Agriculture and Water

Agriculture is another emission-heavy sector accounting for up to 22% of global greenhouse gas emissions[5]. As global population growth continues, it is becoming essential to farm smarter to get the most out of increasingly limited resources.

AI can optimise farming practices through precision agriculture, using data to improve crop yields, reduce the use of fertilizers and pesticides, and manage soil health sustainably.

Maintaining good soil health is another key ingredient in modern farming. Data from moisture sensors in the ground combined with weather forecasts and drone or satellite imagery can be used by AI models to determine optimal watering strategies for crops resulting in reduced water consumption and increased crop yields.

## Monitoring and Mitigating Climate Change Impacts

In addition to reducing the impact of climate change, AI solutions can also be used to monitor and predict environmental changes, helping us to better understand and address environmental issues. For example, AI can be used to monitor and predict weather patterns, allowing us to better prepare for extreme weather events and reduce their impact on the environment and society. AI can also be used to monitor and analyse environmental data, such as air and water quality, to identify areas of concern and develop targeted solutions.

**Case Study - Tsunami Inundation Forecasting**

Fujitsu in collaboration with several educational and disaster management partners has developed a real-time tsunami inundation forecasting solution. This solution has the capability to deliver fast and detailed tsunami forecasts that can be used to alert communities that would be at risk from inundation. The newly developed approach utilises AI, which has been pre-trained on large amounts of synthetic tsunami simulations, enabling it to predict a tsunami inundation waveform at a forecasting site from various observation data. The trained AI can generate a forecast extremely quickly even when using a personal computer. As a result, the newly developed method offers a great advantage for practical disaster management in terms of the required computational resources.

Fujitsu Real-Time Tsunami Inundation Forecasting

 

### R&D – Using AI to predict weather patterns in an inexpensive way

Water-related disasters account for the majority of natural disaster deaths, especially in low-income countries[7] lacking access to expensive weather radar systems. Fujitsu is embarking on an R&D project to apply diffusion models from Gen AI on satellite imagery, combined with geographic and demographic data, to create an affordable early warning system for these.

AI can also be used to help manage the threat to species from climate change. Species across the globe face threats from changes to climate, deforestation and increased urbanisation. Sensors and drone imagery combined with AI solutions can help monitor the impact on species as well as whether mitigation activities are being effective.

### Case Study - Digital Owl

Working with the NSW Government's 'Saving our Species' program, the 'Digital Owl' project uses Fujitsu's high-performance computing, video analytics and drone technology to capture and analyse video information over a broad geographic area. The information can then be used to help locate endangered species for management, and invasive plant species for eradication purposes. Digital Owl provides conservation teams with better quality data than ever before, obtained faster, at lower cost, and with fewer carbon emissions; harnessing the power of technology to provide a ground breaking solution for on-the-ground conservationists to protect precious biodiversity under threat from climate change.

Fujitsu NSW Government Digital Owl Case Study

## Climate impact from training of AI solutions

Any discussion of AI and climate change would be incomplete without mentioning the environmental impact of AI solutions. The training and deployment of AI models can have a significant negative environmental impact. Modern AI models such as the large language models which have driven the boom in AI over the past 2 years undergo a training process that is extremely resource intensive both for power and water which is used by cooling systems. As an example, training of Open AIs GPT3 model is estimated to have produced the equivalent of more than 500 tons of carbon dioxide [6].

Many of the large tech companies that run the data centres powering modern AI models have set themselves high targets for climate neutrality or better [8], [9], [10]. This is leading to a drive in renewable energy sources powering data centres which makes sense for organisations both from a sustainability perspective as well as commercially. This helps offset some of the environmental impacts from AI model training. However, it is recognised that there is an impact from AI on the climate which needs to be offset against the benefits that it can bring.

 

## Conclusion

AI solutions can have a major role in helping the world deal with climate change by both helping reduce carbon emissions which cause climate change as well as through monitoring and mitigation of the impacts of climate changes.

If you would like to know more about how Fujitsu can help utilise AI to improve help your organisation run more efficiently and sustainably, please email us for more information.

### References

[1] NASA Earth Observatory World of Change: Global Temperatures
[2] United Nation Climate Change The Paris Agreement
[3] United Nations Climate Summit Comparing climate impacts at 1.5°C, 2°C, 3°C and 4°C
[4] Our World in Data Sector by sector: where do global greenhouse gas emissions come from?
[5] IPCC Climate Change 2022: Mitigation of Climate Change
[6] Arxiv Carbon Emissions and Large Neural Network Training
[7] World Metrological Organization Weather-related disasters increase over past 50 years, causing more damage but fewer deaths (wmo.int)
[8] Microsoft Measuring energy and water efficiency for Microsoft datacenters
[9] Google 24/7 Clean Energy – Data Centers
[10] Amazon 8 takeaways from Amazon's 2023 Sustainability Report

 