Slide 1:

LUCAS: On average, we burn 15 billion tons of fossil fuels per year and as a result, we release 35 billion tons of carbon dioxide into the atmosphere. To put that into perspective, that's equivalent to the weight of 65 million A380s. With these numbers, it seems like everyone would have access to electricity, however, some still live without it, and for those who have it, it is taken for granted. Good morning, Mr Andreas, I am Lucas, and these are my team members Yong Jie, Qing Yang and Faizan.

Slide 2:

In this presentation, we would be addressing the sustainable development goal 7 or SDG 7, how the ai we have researched on contributes to this goal and what other impacts it may have.

**PART 1**

Slide 3:

To start off, SDG 7 ensures access to affordable, reliable, sustainable and modern energy for all, by making clean energy more accessible. The main target we are focusing on is SDG7.2 which aims to substantially increase the share of renewable energy in the global energy mix. This is done by sourcing more energy from renewable sources.

We all know about climate change and its devastating impacts on the environment, the destruction of ecosystems, hotter, extreme weather and increased levels of poverty. One major cause is due to the enhanced greenhouse effect caused by an excessive amount of greenhouse gasses in the atmosphere, mainly from the burning of fossil fuels

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Research has shown that we only have 10 years to prevent irreversible damage. However, with fossil fuels contributing to 80% of the world's energy and 78% of greenhouse gasses produced from 1970 to 2010, it is highly unlikely that we can reverse the effects but the least that can be done is to minimize the impacts.

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With 25% of the world’s energy coming from clean and renewable sources, an increase to 35% can reduce the greenhouse gas emissions by 25-45%. This can greatly reduce the enhanced greenhouse effect and the destructive impacts of climate change.

Slide 6:

About 90% of the population have access to energy, however, about 700 million people do not have access to it. Of these 700 million people, the majority of them live in poverty, without their basic human needs, mainly due to them not having access to electricity. Additionally, everything around us requires some form of energy to be made or powered by. Energy is also the foundation of our society and development. Some examples include transportation, healthcare, clean water, communication, agriculture, and etc. Therefore, it is important that clean and renewable energy is made affordable to provide everyone with basic needs.

**PART 2**

Slide 7:

One way to increase the percentage of renewable energy in the global energy mix, is to improve the efficiency of wind turbines, and optimise the amount of energy being harnessed. On average, a wind turbine can generate over 843,000 kilo watts per hour every month which is more than enough to power more than 940 average households.

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In wind turbine farms, wake effects are trails left by wind turbines. The speed of winds is reduced as it passes through the turbines upstream, due to its energy being transferred to the turbines. However, this causes the wind turbines downstream to receive turbulent and slower winds, resulting in lesser energy being produced.

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So, to prevent this from happening, a method called wake steering is implemented to rotate the blades of the wind turbines, such that it is misaligned with the winds. This causes the wakes of the turbines to be deflected away from those downstream, allowing the other turbines to receive winds with greater speeds that have not been affected. By doing so, each turbine is optimized and can generate more renewable energy as compared to usual.

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However, it is easier said than done as manually controlling the turbines to optimise wind energy can be a very difficult task, as there are many possibilities to explore such as rotation, angle of the blade as well as weather conditions.

Traditionally, simulations would be run by professionals to find the best way to tilt the turbines to harness the most energy for different scenarios, and would later be embedded into the wind turbines system. But, since there are many possibilities to simulate, it could become a tedious task.

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This is where A.I can be applied to automate the task, making it easier and less tedious.

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One example of an existing company implementing A.I. into their wind turbine farm is Vestas, one of the world’s largest wind turbine companies. It partnered with Microsoft Partner Network member, minds.ai, to create an intelligent windfarm controller through the use of reinforcement learning platform DeepSim.

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DeepSim uses reinforcement learning to automate the design process of the controllers by connecting it to the simulation. The experts in the field will then define what could be done by the controllers such as rotating the turbine or tilting the blades. The experts will also define what is the desired outcome of the action, which in this case would be to increase the energy output.

DeepSim then uses the reward feedback, which measures the effectiveness of taking a particular action to find the best solution for the controller. This is then scaled up on the cloud by running millions of simulations with more than petabytes of data, along with a lot of trial and error. This allows Vestas to explore a much wider range of possibilities. Once this process is done, the results are embedded into the wind turbine systems. The controller can still be continuously improved by importing real-life events back to the training in the cloud.

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Intelligence is often referred to having the ability to learn, understand and think. In this case, the AI is intelligent as it is able to learn to tilt the turbine blades based on data and simulations, it is also able to adapt to the surrounding environment by sending data of real-life events back to the training in the cloud, and continue to improve itself in order to increase energy output. Some of the data required are weather conditions such as temperature, the speed and direction of the wind, as well as the location of the wind turbines and how they are allocated relative to one another.

**PART 3**

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So, with wake steering optimization, Vestas claims that the potential energy increase is significant, with the power gain between 2%-4%. So, who will benefit from this optimization? The immediate beneficiaries will be the wind energy users. With reduced wake turbulence, more energy can be generated from the wind turbines, which in turn leads to lower energy costs for consumers and increased revenue for companies.

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However, the benefits of this optimization are not limited to the users and the companies that directly use this technology. Governments and societies can benefit from the use of wind energy, an environmentally friendly source of power that can help reduce greenhouse gas emissions. AI companies can also benefit from the use of AI in wind energy as this provides them with new market opportunities.

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While there are potential benefits to using wake steering AI, there are also some concerns that come with it. One study from PNAS found that there may be a decrease in power production for downstream turbines in certain conditions, leading to a potential loss of energy. Additionally, the use of AI in wind energy systems is a relatively new development, and some experts have raised concerns about the potential security risks that comes along with using such technology. Another concern is the potential impact on wildlife, particularly birds and bats, which could be affected by the changes in wind patterns caused by wake steering.

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While the technology does not inherently raise concerns over bias or privacy, there are ethical concerns that arise with AI in general that may apply to Wake Steering. One major ethical concern with AI is bias, which can arise from human bias and systemic biases, not just bias data. However, there is no evidence that Wake Steering has any inherent bias. Privacy is another major ethical concern with AI, as sensitive data can be collected and used for unintended purposes. While Wake Steering does not inherently raise concerns about privacy, it is important to ensure that any data collected is not used inappropriately.

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Wake Steering can help to address SDG 7 target 7.2, which is to "substantially increase the share of renewable energy in the global energy mix." By increasing energy production from wind turbines, Wake Steering can help to increase the share of renewable energy in the global energy mix, reducing reliance on non-renewable sources of energy, and supporting the transition to a more sustainable energy system.

Slide 20:

With this we have come to the end of our presentation. Thank you