

[MUSIC PLAYING]

**NOR AISHAH** Since the Industrial Revolution began 250 years ago, people have been burning fossil fuels like coal and oil to generate electricity.

**SAIDINA AMIN:**

Hi, I'm Professor Nor Aisha Saidina Amin, professor of chemical engineering, and a visiting fellow with the MIT UTM Sustainable Cities Program. My research is focused on renewable energy, and today I am going to talk about climate change and renewable energy.

The primary product of burning of fossil fuels is carbon dioxide. For centuries, the amount of carbon dioxide emissions in the atmosphere was 300 parts per million. But carbon dioxide have increased dramatically and reached an unprecedented value of about 400 parts per million. High levels of carbon dioxide emissions are linked to climate change, which has led to increasing temperatures, melting glaciers, rising sea level, changing rain and snow patterns, and also drought, floods, and other extreme events.

Climate change is an important issue, and reducing carbon emission is a challenge. In December 2015, world leaders convened in Paris to discuss the reduction of carbon emissions and climate change impacts at a United Nations Global climate conference.

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**SPEAKER 1:** There is no doubt that the global climate change agreement we seek must be part of what Paris has become.

**NOR AISHAH** Even Hollywood is taking a public stand on this issue.

**SAIDINA AMIN:**

**SPEAKER 2:** And the Oscar goes to Leonardo DiCaprio.

[CHEERING]

**LEONARDO DICAPRIO:** Climate change is real. It is happening right now. It is the most urgent threat facing our entire species.

**NOR AISHAH** One of the ways to address climate change is to replace fossil fuels with renewable energy for electricity production. Carbon emissions from renewable energy power plants are much lower compared to those that run with fossil fuels. According to the Energy Information Administration, although there are plenty of renewable resources available on Earth, only 10% of the world's energy output is from renewable sources. Types of renewable energy include solar, geothermal, wind, and biomass.

**SAIDINA AMIN:**

There are many lessons that can be learned from Malaysia's success with using renewable energy. Given Malaysia's tropical biodiversity, conversion of biomass to energy is a promising approach to establishing sustainable energy production.

**JOHN WOODLEY:** Malaysia will also be an excellent example where there is plenty of agricultural waste. And it could be a wonderful idea to try to use that waste in a way which brings a little bit of value to your community, to the country, but at the same time, can help us to reduce carbon dioxide emissions.

**NOR AISHAH** Situated in Johor, the most southern state in peninsula Malaysia, Iskandar, Malaysia is a new development region  
**SAIDINA AMIN:** that advocates low carbon emission. Most of its carbon dioxide emission are from the electricity and heating sector. As documented in their low carbon plan. Iskandar, Malaysia is projected to be a sustainable city by 2025 with only 18.9 million tons of carbon dioxide emissions, a 40% reduction from 2005 levels.

How can this Iskandar, Malaysia achieve this target? One of the methods is to utilize waste from the oil palm industry to generate heat and electricity. Iskandar, Malaysia is easily accessible to large areas of oil palm plantation. The oil palm industry produces waste such as empty fruit bunch and palm oil mill effluent. Empty fruit bunch is the residue you produced when palm fruit is taken from a fresh fruit bunch in the initial process of a palm oil production. Palm oil mill effluent is the voluminous liquid waste that comes from the sterilization and clarification processes in milling oil palm.

By utilizing waste, carbon dioxide emissions can be significantly reduced and make the air in the region cleaner and healthier. One way to measure carbon dioxide emissions is to use an integrated model that takes into account direct and indirect carbon dioxide emissions. The concept of the model used to probe quite a systematic and comprehensive carbon accounting to evaluate carbon performance, as well as to determine the potential carbon emission reduction in the process. The model calculates carbon dioxide emissions from three biomass power plants-- the bio-xcell plant, Kulim group plant, and Ronser biogas plant.

Initially, carbon accounting centers for each process is divided into smaller units. Next, the total monthly carbon emission equivalent is determined, followed by calculation of the carbon dioxide emissions and carbon emission index across the carbon performance indicators. Strategies for reduction of carbon emissions are then implemented.

The five main emission contributors are identified as carbon performance indicators. These are fuel, water, and electricity consumption. And also waste water and solid waste generation.

Empty fruit bunch is fed into Bio-Xcell Plant to generate steam and electricity. Empty fruit bunch is shredded and then formed as solid pellets. The pellets are used as fuels for the boilers to produce steam. The steam turbine then generates electricity. Meanwhile, Kulim and Ronser utilize palm oil mill effluent. The effluent is retained in an anaerobic digester to produce bio gas. The gas runs the turbine to generate electricity. The total monthly carbon dioxide emissions before and after the implementation of the reductions strategies are exhibited in figure one, showing a 27% emissions reduction at Bio-Xcell, 15% at Kulim, and 41% at Ronser.

Figure two compares the carbon emission index after implementing the reduction strategies. In general, all performance indicators show reduced emissions after innovative strategies are implemented. In Bio-Xcell, the carbon emission index for fuel and water consumption decreased significantly after solid, empty fruit bunches replaced the shredded ones. In addition, a reduction of solid waste generation in runs of bio gas was also registered after water from the effluent is recycled.

Carbon dioxide emissions can be easily predicted using the income model. A power plant that utilizes biomass contributes less to climate change since the carbon dioxide released is absorbed by trees through photosynthesis. The process is cyclical. The industry could play a big role in reducing carbon dioxide emissions by switching to renewable energy for generating electricity.

[MACHINERY MOTOR]

**HO CHIN** The key players-- the key players for CO2 reduction has to be also from the private sector.

**SIONG:**

**NOR AISHAH** Globally electricity generation from renewables, and particularly from biomass, is increasing. Biomass supplies  
**SAIDINA AMIN:** such as pump or mill effluent is steady due to the number of oil pump mills in the region as stated by Dr. Azhar Aziz of Gait Rungkai company.

**AZHAR AZIZ:** I will say it's very, very valuable Very significantly valuable because based on the number of palm oil mills in the country, as of 2014, there are at least 480 mills in the country, including [INAUDIBLE]. So from this huge number of oil mills, there are [INAUDIBLE]. It's just a matter of how we are going to maximize this. Because to me, it's not being maximized in terms of effort to reducing the carbon emission in the country.

**NOR AISHAH** The significant decline in capital costs for electrical generation suggests that investment in renewable energy is  
**SAIDINA AMIN:** economically viable. The utilization of renewable energy waste for re-powering power plants could help realize Iskandar, Malaysia's low carbon goals. Since biomass emits less carbon dioxide compared to fossil fuels, the move to clean energy could reduce the magnitude of climate change risks. Renewable energy is the way forward to a wonderful more sustainable world.

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