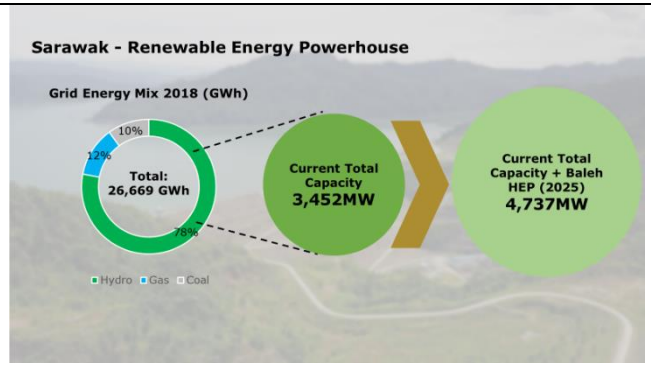
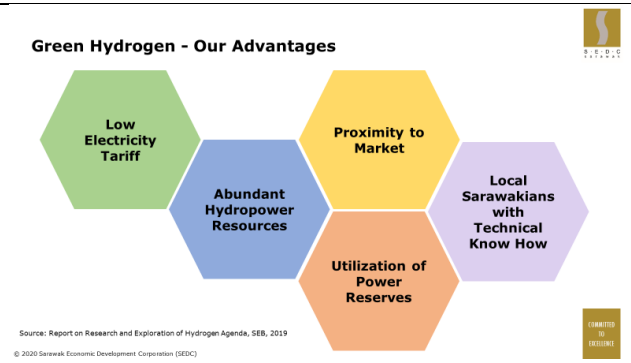
YBHG. TAN SRI DATUK AMAR (DR.) HAJI ABDUL AZIZ BIN DATO HAJI HUSAIN
CHAIRMAN, SARAWAK ECONOMIC DEVELOPMENT CORPORATION
PRESENTATION DECK FOR WEBINAR ON SHAPING THE FUTURE OF GREEN HYDROGEN ECONOMY

No	Slides	Speaker Notes
1		Assalamualaikum Warahmatullahi Wabarakatuh and a very good afternoon to all. 1. **Ir. Dr. Sanjayan Velautham, CEO, SEDA;** 2. **Dr. Wei Nee Chen, Chief Strategic Officer, SEDA cum the moderator for today's webinar;** 3. **Distinguished fellow speakers – Prof. Chinho Park, Mr. Osamu Ikeda, and Prof. Pierluigi Mancarella;** 4. **Ladies and Gentlemen.** I am honoured to be invited as one of the speakers for today's webinar on **"Shaping the Future of Green Hydrogen Economy"** organised by Sustainable Energy Development Authority (SEDA). I believe this is an excellent platform for the exchange of ideas and collaboration in pursuing the Green Hydrogen Agenda. The topic of my presentation for today is **"Sarawak Hydrogen Agenda – Building Futures… Now!"**

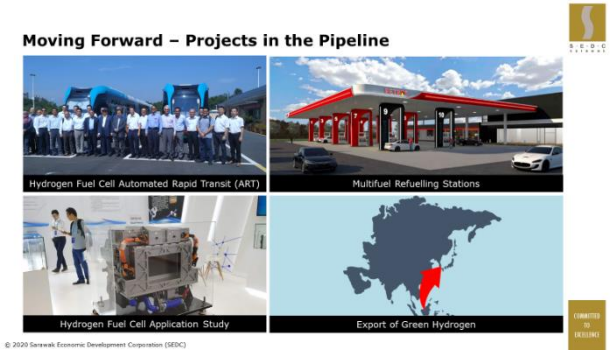
2		Ladies and Gentlemen, My presentation will cover three parts. First, will have an overview of the hydrogen economy from Sarawak's perspective. Secondly, our achievements thus far and our plans for the future. Finally, the way forward on how Sarawak will move towards a Green Hydrogen Economy, given the challenges that we faced.
3		The Sarawak Hydrogen Agenda was mooted by the Right Honourable Chief Minister of Sarawak in November 2017. In his speech, the Chief Minister stated that: "With abundant clean hydroelectric power resources, Sarawak provides an ideal setting for enabling the Hydrogen Economy in the State". He went on to say that the State should be taking pioneering steps to explore the commercial and public applications of hydrogen and fuel cell technology. With the vision of the Chief Minister in mind, SEDC has been actively pursuing the Sarawak Hydrogen Agenda in collaboration with other agencies such as Sarawak Energy Bhd to explore the potential of hydrogen gas development in the State.

4		Hydropower is the world's largest source of green energy, accounting for 70 per cent of global renewable energy generation. In Sarawak, renewable energy accounted for 78 per cent of Sarawak's energy mix in 2018. Currently, the total installed capacity of our large hydro plants is 3,452MW. By 2025, we will have an additional 1,285MW available from Baleh HEP, which is still under construction, bringing our total installed capacity to 4,737MW. With its abundant source of renewable energy, Sarawak is able to provide low tariffs for electricity and these two combined made the Sarawak Hydrogen Agenda an attractive preposition.
6		Sarawak has several key competitive advantages as a potential hydrogen producer. Firstly, it has very affordable energy resources which are far greater than its own domestic requirement. Secondly, most of those resources are renewable, in the form of high levels of current hydropower generation capacity and future hydropower generation potential.

		Finally, as with any power generating system, Sarawak power company SEB, has to maintain a reserve margin in order to ensure uninterrupted supply to their customers. This margin is anywhere between 14% to 19% of the annual peak load. In most cases this power is wasted. However, current technology has enabled the production of H2 by electrolysis from intermittent power supply, making it possible to use the reserve energy for large scale hydrogen production. Thus It makes both economic and environmental sense, for Sarawak to follow the electrochemical route, using green electricity from hydropower to produce green, guaranteed carbon-neutral hydrogen. Hydrogen used as an energy carrier and mobility fuel, will provide a pathway for servicing both domestic and overseas demand for green energy. Sarawak has the potential to become a significant exporter of green energy due to our geographical advantage, as we are located close to existing energy-hungry markets. Markets with existing or near-future demand for green energy include Japan, Korea and China. In the longer term, Southeast Asian neighbours such as Indonesia, Thailand, Singapore, the Philippines, Vietnam and Peninsular Malaysia would be potential markets for our green hydrogen.

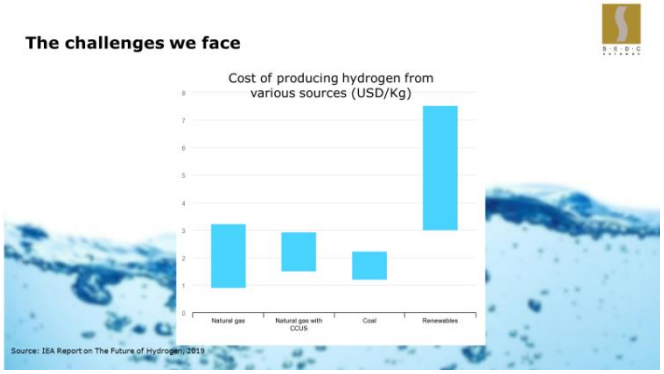
		In addition, green hydrogen may also provide a valuable boost to Sarawak's existing chemical sector through its value as an industrial feedstock.
8		Ladies and Gentlemen Today, we are proud to be the first in the South East Asian Region to have our integrated hydrogen production, storage and refuelling plant to enable us to conduct a pilot project on the operation of hydrogen buses in Kuching and provided hydrogen fuel for FC cars. **<u>Integrated Hydrogen Production, Storage, and Refuelling Plant</u>** The integrated hydrogen production, storage, and refuelling plant was successfully launched by the Honourable Chief Minister of Sarawak on 27th May 2019. The construction and operation of the hydrogen plant and refuelling station was undertaken by Sarawak Energy Bhd with Linde EOX Sdn Bhd, (a subsidiary of Linde Malaysia) as the technology provider and contractor. The plant is able to produce 130kg of hydrogen per day at a purity of 99.999 per cent and is capable of supporting and fully refuelling up to five fuel cell buses and 10 fuel cell cars per day.

		The plant's medium pressure storage tank is able to store up to 150kg of hydrogen at 500 bar while the high-pressure storage tank is able to store up to 19kg of hydrogen at 900 bar.
9		**<u>Hydrogen Fuel Cell Buses Projects</u>** SEDC had secured three units of hydrogen fuel cell buses from Foshan Feichi Automobile Manufacturing Company Limited of China. The buses are part of a pilot project to demonstrate the capabilities of hydrogen fuel cell technology as a viable form of public transportation in the state and introduce hydrogen driven vehicles to the public. Upon obtaining all relevant permits from the authorities, the buses were successfully flagged-off for operation on 21st January this year. The buses currently cover two (2) routes; the 14km Downtown Heritage Loop; and the 67km Damai Loop that covers the tourist attractions in the seaside resort area of Damai. The Damai Loop is operational only on weekends, while the Downtown Heritage Loop operates daily from 7 a.m. to 6 p.m. Our Hydrogen Buses are capable of travelling over 300km and can achieve 15 round trips for the Kuching city route on a single refill.

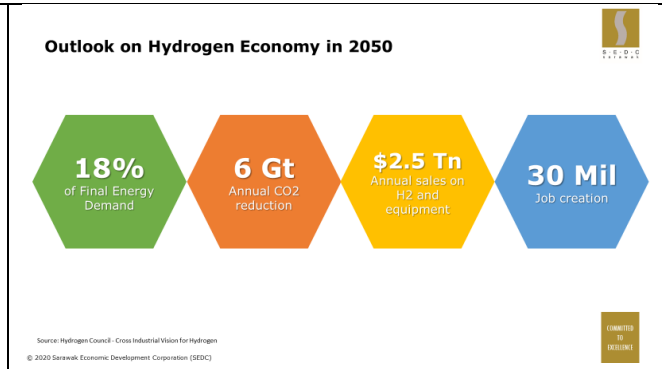
		Ladies and Gentlemen These two projects are small but showed that we are capable of driving the Green Hydrogen Agenda as aspired by the Sarawak Government.
		Moving forward, we are looking to undertake more strategic projects in enhancing the Green Hydrogen Agenda for the State. Projects in the pipeline include the Automated Rapid Transit (ART) system for our Urban Transportation project, the multi-fuel refuelling stations across Sarawak, large scale production of hydrogen to meet both domestic and export demand and building a hydrogen trade network. We are also starting a research project in the practical applications of fuel cell in the State. **<u>Hydrogen Fuel Cell ART</u>** Under the Kuching Urban Transportation System (KUTS) project, we are adopting the Automated Rapid Transit (ART) system, which will utilise hydrogen fuel cells to power our trackless rolling stock. The ART network targeted to start its revenue service in 2025 will initially cover a total distance of over 50 kilometres in its phase 1 development, and will be supported by feeder buses powered by hydrogen fuel cell.

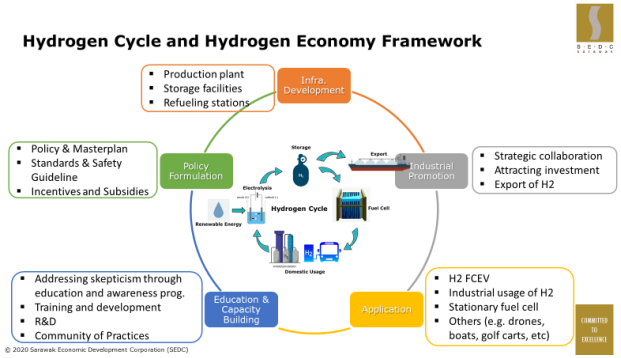
		If successful, the system will be extended to cover other parts of Kuching making public transport available to residents in Kuching and its suburbs. Plans are also being made to develop the ART system in other towns in Sarawak. The project is being undertaken by SEDC's wholly owned subsidiary, Sarawak Metro Sdn Bhd. **<u>Multifuel Refuelling Stations</u>** As part of our strategy to create the refuelling infrastructure to promote the usage of more fuel cell vehicles, we will construct six multifuel refuelling stations in Sarawak. The multifuel refuelling stations will carry our partner's brand name, PETROS and will provide conventional fuels, electric cars charging facilities, and hydrogen refuelling kiosk. The first station is set to be constructed this year in Kuching and the others in the next two years. The facilities for hydrogen supply component will be planned for all the stations and will be installed when there is demand for the fuel. As car manufacturers in Korea, Japan and China started to mass produce EVs and Fuel Cell vehicles, the price of such vehicles will come down drastically, and may even be more competitive than the traditional internal combustion engine. By the time FC vehicles

		are available to the public in Sarawak, we would be able to supply them with the required green hydrogen fuel. This project is under the purview of SEDC Energy Sdn Bhd. **<u>Export of Green Hydrogen</u>** SEDC Energy Sdn Bhd is also studying the feasibility of large-scale Hydrogen production to meet both domestic and export market. Together with our prospective partner and investor, we are planning a 1000 tons per year facility in Bintulu which would be ready in 2023 to meet the needs of potential buyers. This plant is scalable and can be expanded to 10,000 tons per year in the future. Recent developments in the industry have shown how Sarawak could benefit from the international green hydrogen trade as we are not the first to venture into this area. Both Australia and Brunei have exported hydrogen to Japan using the using toluene as the carrier. (Hydrogen is added to toluene to create methylcyclohexane [C7H14), a liquid that can be shipped safely in containers at room temperature to Japan where hydrogen is extracted at their dehydrogenation plant. As the project is are still under R &D, there would be further development especially in cost reduction.) As stated by our Right Honorable Chief Minister, Sarawak should reduce its dependency on oil and gas sector and commercialisation

		of green hydrogen as an export commodity will help us to achieve this target. **<u>Hydrogen Fuel Cell Application Study</u>** We have received a grant from the State to start the study together with our consultants, AVL from Austria on the feasibility of setting up facilities for the integration and assembly of fuel cells in various mobile applications such as in vehicles, carts, tractors, boats, ships and other mobile apparatus. We will also be looking at the development of self-contained stationary power generator integrating solar panels, with electrolysers and fuel cells which can be used in areas where electricity from the grid is not available. This study is expected to be completed next year and it will help to chart our next steps in expanding the application of hydrogen fuel cell in Sarawak.
		Ladies and Gentlemen I have briefly indicated the various initiatives that Sarawak is planning to implement in the future to achieve the green hydrogen agenda. The challenge is to build a pure hydrogen economy that is technologically viable, financially attractive and socially acceptable and environmentally beneficial.

		Important decisions will have to be made if Sarawak is to surmount the challenges and participate successfully in the hydrogen economy. These decisions will affect and be affected by every stage of the hydrogen value chain. These include production; storage and transport; application and utilisation by customers locally and globally; safety and public perception. (I saw my first fuel cell in 2009 in Houston, Texas, for a 10Kw cell. It was huge compared to the FC used in vehicles today which has many times more power and produced at a much less cost. Since then tremendous technological development and improvement had been achieved making the technology more viable.) In addition, increase in electrolysis efficiency help to further bring the cost of green hydrogen production down to a competitive level. Today, we are using less power to produce hydrogen compared to few years ago. I am optimistic that in near future green hydrogen can be as competitive as those produced from other sources of production.

10		The Hydrogen Council, a grouping of some of the world's largest companies in energy, transport and manufacturing, was formed at the World Economic Forum at Davos in 2017 to promote hydrogen as a key component of the transition to sustainable energy. Based on Hydrogen Council - Cross Industrial Vision for Hydrogen, in 2050, the Hydrogen Economy is expected to: ▪ Achieve 18 per cent of final energy demand; ▪ Reduce 6 Gigatonne of annual carbon dioxide emissions; ▪ Achieve 2.5 Trillion US Dollars in annual sales of hydrogen and related equipment; and ▪ Create 30 million job opportunities worldwide Hydrogen has the potential to be not only the Fuel of the Future but provide employment and economic opportunities as well.



Sarawak is on the right path to capitalize on this opportunity and become a pioneer in advocating the Green Hydrogen Agenda.

What we need now is to establish a solid framework of policies and hydrogen infrastructure development plans, education and promotion, and capacity building to ensure that we can successfully undertake this agenda. This framework will serve as a guide for us in achieving our aspiration towards a green hydrogen economy.

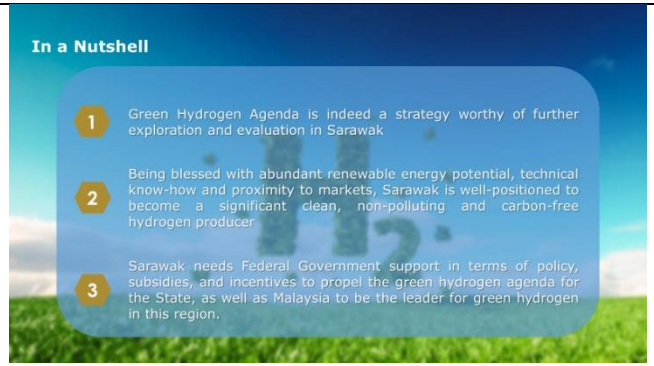
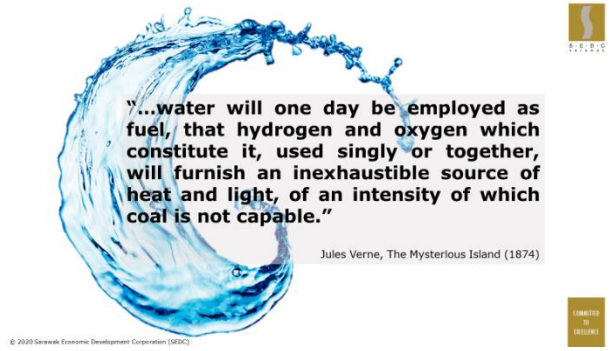
Policy Formulation

To move forward we need government support and policies which will encourage and promote the Green Hydrogen Agenda. We are looking forward to collaborate and work together with SEDA and other relevant agencies to:

1. Include hydrogen economy/agenda as part of the national policy objectives for renewable energy and to provide the budget for hydrogen R&D, subsidies for hydrogen production facilities and infrastructure and the abolition or reduction of import duties for FC vehicles imported into Malaysia.
2. Support the State government in promoting, stimulate, facilitate the development of hydrogen as the renewable energy of choice; and
3. Formulate laws and guidelines on hydrogen standards and regulations for the production, storage and

		distribution of hydrogen and to recommend reforms to existing non-compatible standards. **Infrastructure Development** Most of the developed countries have started to build the infrastructure in order to meet demand of consumers who have made the changeover to FC vehicles. In Sarawak we already have started the initiative by piloting an integrated hydrogen production, storage, and refuelling stations. These infrastructures are not cheap compared to traditional fuel's facilities. Thus, to encourage private sector investments in the building of this new infrastructure, subsidies from the government would be required, especially in the early stage. **Industrial Promotion** We are also looking forward to welcome interested investors to participate in our hydrogen production projects. To encourage private sector participation in new ventures we would have to provide tax incentives, customs and excise duty exemptions, and other fiscal incentives applicable to such investment. These incentives coupled with easy access to funding will create favourable investment climate to attract industry players to participate in hydrogen economy development. **Application of Hydrogen and Hydrogen Technologies**

		To ensure that the hydrogen agenda will benefit the general public including those in the rural area, we need to diversify the application of FC and hydrogen technologies in a number of areas. For instance, the ART transportation system will benefit the urban population. Developing FC to power small boats and express boats will benefit users of the riverine transport. On the other hand, the development of the stationary power generator by integrating Fuel cells with solar panels will benefit people living in isolated areas not served by the grid. **Education & Capacity Building** Finally, we need to educate our people to embrace on the ideas of green hydrogen economy. People must be made aware of its benefit especially to the environment, and that hydrogen is safe to use in vehicles. In Sarawak, we have started this process by making our hydrogen fuel cell buses available to the general public since January 2020. However more promotion and awareness are needed to garner public support for the green H2 agenda. In term of capacity building, we should have a dedicated training and development centre to cater for developing our talents in this new field. It should cover tertiary education institution as well as vocational and technical school. For R&D, we require more grant to conduct research on Fuel cell and electrolysis development and FC application and integration.

		This includes the establishment of community of practices and centre of excellence comprising of people from various background such as government agencies, private sectors, academia, etc.
12		With the framework in place, we can aspire to be a powerhouse for green hydrogen economy in this region. However, Sarawak needs support from all stake holders, more so from the Federal Government in terms of policy formulations, subsidies, and incentives to propel the green hydrogen agenda for the State, as well as Malaysia to be the leader for green hydrogen in this region.
13		To end my presentation, I would like to share with you a quote from one of my favourite science-fiction writer, Jules Verne. In his book, the Mysterious Island, published in 1874, he wrote: **"…water will one day be employed as fuel, that hydrogen and oxygen which constitute it, used singly or together, will furnish an inexhaustible source of heat and light, of an intensity of which coal is not capable."** Today, nearly 150 years later, Hydrogen derived from water, used as a fuel is no longer a fantasy but a reality. By advancing its Green Hydrogen Agenda, Sarawak will play a role in the reduction of carbon emission to reduce greenhouse effects and helps save the planet

		Thank you. **Over to you Dr Chen**

Author and Presenter:

Tan Sri Abdul Aziz Husain

Assisted by:

Awang Nasfuddin Bin Awang Hassan

Alexius Barieng

Robert Hardin