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INTRODUCTION

This eBook features Mitsubishi Power's thought leadership content on the energy transition ranging from power plant optimisation to decarbonisation. These aim to provide insights on the region's energy sector and highlight Mitsubishi Power's industry-leading solutions and commitment to partners and customers.



TABLE OF CONTENTS

2

**POWERING UP ON
MAINTENANCE TO
OPTIMISE POWER
PLANTS**

12

**FLEXIBILITY IS
CRUCIAL FOR A
SUSTAINABLE
ENERGY TRANSITION**

5

**TOWARDS A CARBON-
ZERO FUTURE: THE
ROLE OF NATURAL
GAS IN REDUCING
CO2 EMISSIONS**

14

**PATH TO
SUSTAINABLE
SINGAPORE STARTS
WITH CLEANER
ENERGY**

8

**INDONESIA'S
EVOLVING ENERGY
SECTOR**

10

**SETTING THE PACE
FOR A CLEANER 2022**

POWERING UP ON MAINTENANCE TO OPTIMISE POWER PLANTS

Asian Power spoke to Ziad Khalaf, Senior Vice President, Operations for Mitsubishi Power Asia Pacific for insights into how after-sales and maintenance services benefit power plant operators. (Published May 24, 2022)



After-sales and maintenance services are crucial for power plant optimisation

How have after-sales and maintenance services evolved over the years?

For the services and power plant sectors, we need to keep up with advancements in technology. When you install something for the first time, there is a learning process which involves a collaborative effort between equipment manufacturers and operators to identify problems and find solutions. We leverage our extensive experience to find these solutions efficiently, and any learnings end up being shared within the industry.

The equipment manufacturer has the main responsibility to evolve and develop improved solutions for the equipment. For example, gas turbines used to be maintained following a certain number of operating hours. Over time, we develop enough operating experience and knowledge of the behaviour of the machine and can stretch the maintenance cycle which reduces the downtime of the equipment. This saves money and avoids unnecessary maintenance.

How has Mitsubishi Power powered deep innovation in after-sales and maintenance service?

Technology advancements allow us to maintain power plants faster and cheaper through solutions such as robotic inspections of generators. Rather than having to disassemble the generator and spend a month crawling around in it, inspecting it, and risk causing damage, we use robots. These are little measuring instruments that can go into the generator, crawl on their own, and do the inspection. This can be done in three to four days, which saves a lot of money and avoids a month-long disassembly. We've done robotic inspections in Singapore and other parts of the world.

What stands out about your after-sales and maintenance service in Asia?

We are a leading service provider with a strong presence and commitment in Asia. In the Philippines, we have capabilities that service the region and

provide services to other parts of the world. This includes remote monitoring of power plants, advanced technologies of data collection, analytics and artificial intelligence. It's a self-learning system that monitors the power plant and gives feedback on how to improve the operation maintenance in the plant. It is therefore a system that learns, evolves, and provides additional information to the power station.

Do you have data-based solutions?

We have TOMONI[®], which is a package of different modules that leverage remote monitoring, advanced digital control systems, predictive analytics, and AI to optimise plants. We collect the data from the plant, monitor it remotely, analyse it; and then we provide customers with different services that come out of this data collection and analysis process. It helps plants operate more reliably and achieve efficiency improvements. To execute this, we have a global network of TOMONI HUBs with these services, including one in Alabang, Philippines.

How can a power plant operator justify the costs of after-sales services to their stakeholders?

The biggest cost in operating a power plant is the fuel consumed. Previously, in a plant I managed, about 80% of the cost of operating it came from the fuel. So even if you take 50% to 60% of the operating cost of a plant which is fuel cost, and you can save 1% or 2% of that fuel you're consuming, that is a lot of money. It will also lead to a significant reduction in CO₂ emissions. When you do good service planning and execution, you can save money by improving efficiency. You're saving on fuel consumption, saving money, and still producing the same energy that you're expected to sell. Less fuel

burned also means reduced emissions.

The maintenance, it's always tied to the economics of the power plant and compliance with regulations and policies.

How do you help power plants in the region improve reliability?

Reliability of a power plant means that the plant can keep running well and not unexpectedly shut down and be forced to stay down. We recommend for our customers to have good operating maintenance practices to improve and keep their plant reliability high. If we have a new product learning from our experience in a power plant somewhere in the world, we issue bulletins to all our customers worldwide to inform them of key updates.

We also have a global users group meeting that provides members with an opportunity to learn about new improvements or changes to improve reliability. We're learning from each other and sharing information. Customers may be sharing information with one another. But if they send it back to us, we have access to all of these plant operators. When someone raises an issue about a problem in their plant and there is no solution for it yet, we take it on and solve it, and share the solution. That helps improve the reliability of power plants.

How does Mitsubishi Power encourage technology and skills transfer?

Skills transfer is happening at different levels of the business. A power plant operator that has our equipment needs to know how to operate it. We work with our customers to teach them and train their operators on how to operate the plant through the

construction, warranty and troubleshooting phases. The customer may assign their operators to work with our technical experts across the lifecycle of the plant.

We also offer training opportunities, and it's up to the customer to decide what they need. It's a combination of technology transfer and the development of skills amongst people.

In the Philippines, we have training centres with hundreds of engineers and people with



Mitsubishi Power's TOMONI HUB helps make power plants more reliable and profitable



Mitsubishi Power supports the region's transition towards cleaner energy sources

different skill sets working in our facilities. They're all learning the technology. In Indonesia, we are hiring and training local engineers to become technical advisors to support the local market. We have a large installed base in Indonesia and manufacturing facilities in the Philippines. We invest a lot in local manpower in these countries to help them become skilled at solving problems. That includes technology transfer such as teaching new technical skills.

We also do a lot of research. In Indonesia, we work with PLN Group and the Institute of Technology in Bandung, Indonesia, to conduct feasibility studies and research on alternative energy technology and uses.

How can you support the energy transition?

Mitsubishi Power is helping to develop solutions for the energy transition. One major clean fuel that the company is focusing on to help customers transition to net-zero emissions is hydrogen. Emissions from producing hydrogen can vary, with green hydrogen producing zero emissions. Hence, we are advancing our natural gas turbine technology to co-fire with hydrogen, which will lower the overall emissions of gas-fired plants. For example, we are increasing the ratio of hydrogen co-firing into gas turbines – our J-series gas turbines are already capable of operating on a gas and hydrogen mix of 70% and 30% respectively, which helps reduce around 10% of CO₂ emissions. We have plans that by 2025, hydrogen firing will reach 100% commercially.

Can you talk about your regional presence?

We've been in the region for more than 50 years, providing equipment which ensures the stable, reliable and efficient supply of energy to countries around the Asia Pacific.

We have taken significant steps and increased our local support network – hiring people in each country to be closer to our customers. We stand by our equipment and spend a lot of effort in our production and research facilities to improve existing technologies or develop new technologies to improve plant performance.

We know what our customers need – efficiency, availability and reliability are important. They also have to save costs and produce as much energy as possible to meet demand. With time, there will be new needs for these power plants, whether it's additional environmental enforcement or the impact of upcoming climate agreements. We can provide solutions to keep the plants running whilst reducing emissions – you don't have to tear them down to put in something new. For example, you can clean up the gas coming out of the plant to comply with standards. All of that can fall into the service side of things. Also, we are a major player in new technology solutions. So, as power plants transition to more advanced technologies, whether it's renewable or hydrogen-based, we can help.

In Indonesia, we're planning to help customers integrate biomass burning into their thermal plants. There is a limit to how much you can do without changing anything in the power plant. Later, if you want to introduce more biomass or other clean fuels such as ammonia, you might need to make modifications. This falls into after-sales services. So you have the immediate needs of reliable operation and efficient operation and the future needs, which is the energy transition that Mitsubishi Power can support.

TOWARDS A CARBON-ZERO FUTURE: THE ROLE OF NATURAL GAS IN REDUCING CO2 EMISSIONS

Mitsubishi Power has advocated the use of natural gas in lowering carbon emissions whilst ensuring energy security and flexibility. (Published February 4, 2022)

Demand for natural gas has seen an increase in recent years amidst environmental concerns around more traditional sources of power such as coal or oil. As many corporations and countries alike have pledged to be carbon-neutral from 2050 onwards, searching for alternative sources of energy has been more critical than ever.

Natural gas, fortunately, just might be one of the keys to gradually transitioning towards net-zero emissions. It provides opportunities and benefits against other sources of energy that produce more carbon emissions and it offers a transitional solution for the region to explore more zero-carbon sources like hydrogen in the coming decades.

The "Natural Gas and the Clean Energy Transition" report from the International Finance Corporation (IFC) pointed out that gas can be economical even when the capacity is utilised flexibly, leaving room for more renewables.

"PV solar, wind, and natural gas-fired turbines and engines have lower unit capital costs than coal-fired equipment, and there are natural incentives to combine solar, wind, and gas such that the required capital expenditure is least-cost compared to a coal-heavy mix," the report stated.

IFC's report also mentioned that total fuel costs can be minimised since the all-in cost of PV solar and wind in many markets is below the marginal cost of natural gas.

Natural gas emits about 50 to 60% less carbon dioxide (CO₂) when combusted in a new, efficient natural gas power plant compared with emissions from a typical new coal plant.

A report from the IEA stated that the flexibility of the global gas market in the coming years will continue to be crucial, as natural gas will play a critical role in the transition towards a cleaner and more sustainable energy system.

This sentiment is echoed by Malakoff Corporation Berhad, Head of Special Projects, Renewable Energy, **Ashwin Narayanan**.

Citing Malaysia as an example, Narayanan mentioned that there are plans for 2.4 GW of gas power plants planned between 2025 and 2026 to replenish the retiring older plants, together with another 3.3 GW for the years 2029 and 2030.

Gas would be the fuel for APAC's net zero target



“There is no doubt that gas would be the fuel for (the) energy transition, and APAC’s best bet to meet the net-zero target in 2050,” Narayanan said.

He added that there would be a combination of combustion technologies coupled with air quality systems within the natural gas power plant to address the transition.

Gavin Thompson, Asia Pacific vice-chairman at energy consultancy Wood Mackenzie, mentioned in his opinion article “What a difference a year makes – Asia’s energy leaders discuss an uncertain future” that whilst support for the acceleration of renewables and a consensus around the role of natural gas in reducing coal demand in Asia are deemed positive signs in the energy transition, the overall pace of change across the region remains “far too slow”.

“Over 70% of the region’s emission footprint is coal-based and with electrification the cornerstone of the energy transition, Asia’s rising power demand risks prolonging dependence on coal for the next decade at least. And the current power crunch is not helping, reminding Asia’s leaders of coal’s dependability in ensuring energy security and grid stability,” Thompson said.

NATURAL GAS ‘IN THE MIX’

Despite these projections, many countries are incorporating more natural gas in their energy mix amidst its proven contributions to reducing carbon emissions and ensuring a stable power supply.

Narayanan noted that when the 1990s approached, it brought with it a natural gas bubble within Southeast Asia. Malaysia, Thailand, Indonesia, Singapore, and Vietnam were amongst the beneficiaries of the grid system, coupled with various gas to power projects.

“These plants were not only cost-effective given the low cost of natural gas but also extremely flexible to operate. Natural gas formed the backbone of energy as industrialisation was at its peak,” he said.

Meanwhile, Mitsubishi Power Asia Pacific Managing Director and CEO, **Osamu Ono** pointed out that whilst coal has dominated the Asian market over the last two decades, natural gas is already a critical component of Asia Pacific’s energy mix. This is particularly so

in countries such as Singapore and Thailand – with demand growing and new liquefied natural gas (LNG) terminals picking up as more markets make the transition toward a more sustainable energy future.

“Under the same power output, combusting natural gas produces less carbon dioxide emissions than coal. The efficiency of gas turbines has also improved over the years – this helps reduce direct emissions from natural gas combustion and lowers costs involved with meeting energy demand,” Ono said.

He added that combusting natural gas also enables the rising adoption of cleaner fuels, such as hydrogen and ammonia, with new innovations that allow gas turbines to utilise these fuels and support the region’s energy transition.

Some Southeast Asian countries are now making commitments towards increasing the share of natural gas in their energy mix.

Indonesia, which has large reserves of natural gas, recently approved plans to develop the Ubadari natural gas field and raise output at the Vorwata gas field using carbon capture utilisation and storage as it continues efforts to reduce carbon dioxide emissions. This has an estimated potential additional recovery of 1.3 trillion cubic feet of gas in total from the new Ubadari field and the enhanced Vorwata field.

Meanwhile, Malaysia is committed to operating gas power plants to replace coal power plants and Malaysian LNG imports are projected to increase by more than 1 million tons annually to reach 4.8 million tons in 2022.

A look into Mitsubishi Power’s expertise

To address carbon reduction goals, energy solutions company Mitsubishi Power combines cutting-edge engineering with its deep knowledge of local needs to accelerate decarbonisation and deliver reliable and affordable power around the world.

The company works closely with power producers in the region to best address their needs.

“Our work in countries across the region has helped guide a shift away from coal to natural gas, and our gas turbine installations have helped reduce carbon emissions in power plants by up to 65% when



compared with coal power plants,” Ono said.

To date, Mitsubishi Power has delivered more than 1,600 gas turbine power generation systems globally, with over 650 gas turbines installed in Asia.

Amongst these projects include Southeast Asia’s first M701 JAC gas turbines, which commenced operation in Thailand as part of an order of eight turbines for a power plant in Chonburi Province. This is said to help produce more reliable, stable and cleaner energy for the country.

Mitsubishi Power also completed the installation and commission of a 500 MW natural gas-fired GTCC power generation system for the Muara Karang Power Plant – the most efficient in Indonesia and part of the government’s project to boost power supply capability to 35 GW. It will help meet the rising demand for electricity across the West Java region and facilitate infrastructure development for urban transport systems.

Furthermore, the company has all its J-Series gas turbine designs tested at a grid-connected T-Point 2 facility in Japan before commercialisation, to ensure world-class reliability. They undergo a long-term operation of at least 8,000 hours of validation, equivalent to nearly one year of normal operation. These turbines have amassed over 1.6 million operating hours with 83 units sold worldwide, enabling power plants to achieve the world’s highest power generation efficiency of greater than 64% and offer a reliability of 99.6%.

To further support the energy transition, its heavy-duty gas turbines can now also operate on a mixture of up to 30% hydrogen and 70% natural gas with the necessary equipment modifications, and this can be increased to 100% hydrogen in the future.

“This technology is compatible with the use of existing facilities without large-scale modification of power generation facilities, which helps lower costs and ensures a smooth transition to a hydrogen society,” Ono said.

Meanwhile, ammonia has also gained traction as a future fuel in the energy transition as it is a highly-efficient hydrogen carrier and can be directly combusted as a fuel. It is also easier to liquefy than hydrogen and therefore much easier to store and transport.

Leveraging this carbon-free fuel, Mitsubishi

Power has commenced the development of a 40 MW gas turbine fueled by 100% ammonia and is targeting commercialisation around 2025. As the firing of ammonia produces no CO₂, carbon-free power generation is achieved. “It will also aid in decarbonisation whilst addressing smaller-scale energy needs, such as small to medium-scale power stations for industrial applications, remote islands and more,” Ono said.

Ono also recognises the challenges that come with the production of NO_x emissions during the direct combustion of ammonia. To address this, Mitsubishi Power aims to combine selective catalytic reduction with a newly developed combustor that reduces NO_x emissions.

Transitioning to a carbon-zero future

Mitsubishi Power acknowledges that the Asia Pacific is home to a diverse and unique mix of people, infrastructure and economic potential, which makes the energy transition a complex one that calls for market-specific approaches to decarbonisation.

In this regard, Mitsubishi Power is a power solutions brand of Mitsubishi Heavy Industries, one of the founding members of the Asia Natural Gas and Energy Association, which is actively helping Asian nations lower carbon emissions by promoting natural gas. The association advises governments as they develop energy policies and solutions vital for a stable, consistent and affordable transition.

The company is also exploring cleaner, alternative fuels to promote a further reduction in carbon emissions.

It has partnered with Indonesia’s Bandung Institute of Technology (ITB) to research next-generation clean energy technologies, as well as how AI and big data analysis can enhance technologies used to diagnose the operation of power plants in Indonesia. Mitsubishi Power also promotes the adoption of biomass co-firing at Indonesia’s thermal power plants.

“A variety of approaches should work in parallel for the region to viably decarbonise, progressively introducing more renewable sources into the mix, whilst reducing carbon footprint in existing plants,” Ono said.





▶ INDONESIA'S EVOLVING ENERGY SECTOR

(Published June 9, 2022)

Home to over 278 million people, Indonesia has seen rapid urbanisation and economic development in the last decade. With those came increased pressure on the national grid. Since 2010, primary energy demand has increased by 3% per year. In 2019, the country recorded a record-breaking 2,404 TWh of primary energy usage.

Against this backdrop, Indonesia has overcome regulatory and geographical bottlenecks to accelerate its renewable energy capabilities, and recently announced bilateral initiatives that will help shore up resources to fulfill its clean energy ambitions. Earlier this year, Singapore and Indonesia signed a memorandum of understanding to channel billions of dollars towards the development of renewable energy projects and a logistics port hub in Indonesia. In the same month, Japan and Indonesia agreed to cooperate in the development and deployment of technologies to boost decarbonisation efforts.

International events in the last few months have further complicated the energy landscape. The crisis in Ukraine has seen global natural gas supplies disrupted and prices spiking, making the need for countries to keep power generation cost-efficient greater than ever.

Under all these circumstances, part of what Indonesia needs to do is to diversify its energy mix and invest in the domestic production of various cleaner energy sources such as biomass, geothermal and zero-carbon fuels.

Increasing Bioenergy Production

A renewable source of energy, biomass can be used as a standalone fuel or co-fired in fossil fuel-fired

plants. Combined with carbon capture and storage (CCS), biomass offers an alternative renewable fuel that Indonesia can harness as it continues its energy transition.

In 2020, experts cited that Indonesia's bioenergy capabilities have the potential to deliver around 50 GW of power to the country, with palm shells, pellets and wood chips widely available for domestic use. The country plans to make biomass co-firing in power stations mandatory as part of its efforts to reduce reliance on fossil fuels.

Mitsubishi Power has long been working to ramp up biomass usage in Indonesia's power generation and developed a power generation system capable of 100% biomass firing. Together with various local partners, we recently submitted a policy proposal on biomass co-firing at thermal power plants to the Indonesian government. Our hope is that this proposal will spur greater adoption of this key fuel for the country. We will continue to lend our expertise in biomass co-firing technologies to help select the appropriate biomass fuel components and assess the extent of upgrading that power plants need to undergo.

Tapping Geothermal

Besides biomass, another renewable energy source that will play an increasingly critical role in Indonesia's energy sector is geothermal. Located along the Pacific Ring of Fire, Indonesia is a geothermal energy hotspot with an estimated potential of 29 GW of geothermal energy resources and so far, less than 2.3 GW has been tapped. Plans have been made to transform

the country into a geothermal powerhouse, with an additional 3.3 GW planned to be added to the grid by 2030.

Utilising highly pressurised steam and hot water produced by molten-hot magma beneath the earth's surface to generate power, geothermal power generation does not require any combustion on the ground. Geothermal power also complements other renewable power generation as it is unaffected by weather conditions.

Mitsubishi Power has been a part of the journey to utilise geothermal energy sources in 13 countries around the world. In Indonesia, we have geothermal units installed in Darajat and Kamojang, both on Java island. As an EPC services provider, our strength in the optimisation and integration of power plants ensures the maximum output from geothermal energy in different regions in Indonesia, increasing power generation capacity to meet the country's power needs.

Charting the Future with Zero-Carbon Fuels

In the long run, Indonesia will need to transition using more zero-carbon energy sources such as hydrogen and ammonia.

The country has the potential to produce hydrogen from renewable energy sources such as wind and solar, which have been estimated to have a potential capacity of up to 9.5 GW and 32.5 GW respectively. We have observed a growing appetite for hydrogen in Indonesia, with companies such as Pertamina exploring the production of green and blue hydrogen to increase its clean energy power generation capacity by 2026.

We at Mitsubishi Power have been helping to build a hydrogen society in Indonesia and around the world. To date, we have successfully demonstrated more than 3.5 million hours of hydrogen co-firing and have achieved 30% hydrogen co-firing in our advanced-class gas turbines. But our capabilities do not stop there; we are working hard to achieve the commercialisation of 100% hydrogen firing gas turbines by 2025.

In addition to hydrogen, ammonia is another

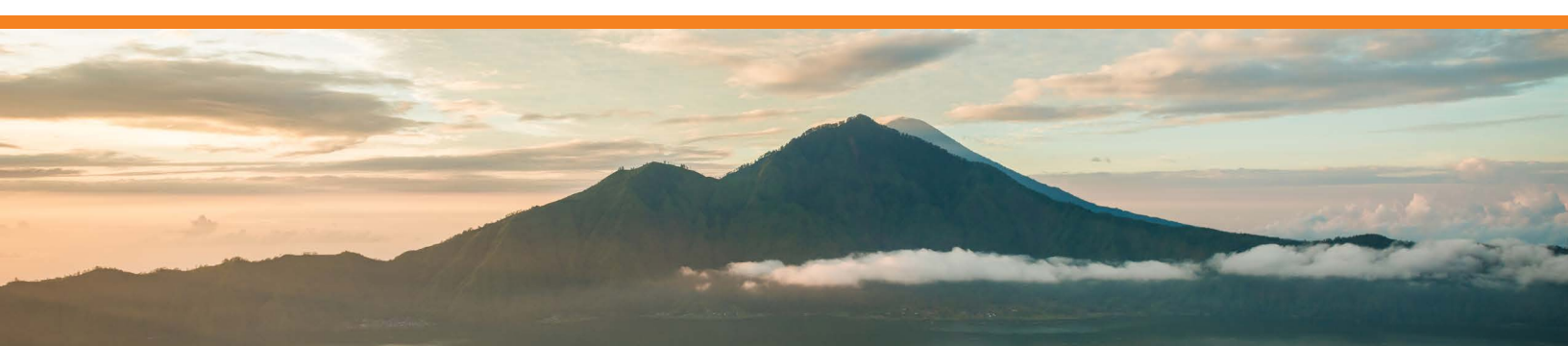
zero-carbon fuel option that Indonesia is looking to incorporate into its energy mix, and we at Mitsubishi Power have been developing power generation solutions that will ease the adoption of the zero-carbon fuel. We have conducted combustion tests for ammonia and coal co-firing and ammonia-exclusive firing using a small-scale combustion test furnace. In March 2021, we announced the start of the development of the world's first 100% ammonia-fired 40MW class gas turbine system. By the time that this technology is commercialised around 2025, it will mark the world's first commercialised gas turbine to make exclusive use of ammonia as fuel in a system of this scale.

To expand Indonesia's hydrogen and ammonia capabilities, collaboration with local partners will be crucial. Since 2020, we have been conducting joint feasibility studies with the Institut Teknologi Bandung on these alternative energy sources and have been providing lectures to train Indonesia's future engineers. We have seen fruitful outcomes from this partnership, and we will continue to conduct joint research on various clean energy solutions to decarbonise Indonesia. For instance, we are currently exploring a feasibility study on the use of ammonia sourced from a local fertiliser company to power a combined cycle gas turbine power plant which utilises two units of our H-25 gas turbines. All these lay the foundation for the potential establishment of a joint R&D centre, enabling local innovation efforts that will hopefully lead to greater adoption of these zero-carbon energy sources.

Our Unwavering Commitment

For over 50 years, Mitsubishi Power has been a significant contributor to Indonesia's energy sector. As Indonesia forges forward in its energy journey, I am excited to see what is in store. Regardless of what happens, one thing is for sure: Mitsubishi Power will continue to support the country's efforts to evolve its energy sector and create a cleaner future for the people of Indonesia.

Written by: Osamu Ono, Managing Director and Chief Executive Officer at Mitsubishi Power Asia Pacific





➤ SETTING THE PACE FOR A CLEANER 2022

(Published March 3, 2022)

“Let’s have no illusions: if commitments fall short by the end of this COP, countries must revisit their national climate plan and policies. Not every five years. Every year. Every moment.” Those words by UN Secretary General Antonio Guterres echoed through the hallways of the COP26 climate conference in November 2021.

Climate action cannot be carried out by a single nation, or a handful; it requires the commitment and action of the entire world. In partnership with these nations, businesses must also step up to help these nations fulfil their commitments and their transition to clean energy.

This transition, however, involves a long process that includes using less pollutive carbon fuels such as natural gas in the interim, as well as more zero-carbon fuels such as hydrogen.

Fossil fuels will continue to be an important source of the energy mix, but there has been much effort to reduce complete dependence on it. Hailed as a milestone in global climate efforts, COP26 witnessed different nations renew or announce new commitments to cut emissions with countries in APAC such as Indonesia and Malaysia pledging to phase down the use of coal power by 2040.

This is a major development from the 2019 Climate Action Summit, where similar commitments were last made. Although we experienced some setbacks in 2020 due to the global pandemic, the return to openness is promising.

It is also heartening to see the younger generation being more vocal about taking climate action. I believe that in years to come, we will see both the young and old coming together to tackle climate issues.

Making Strides in 2021

In the last year, Mitsubishi Power has successfully navigated new challenges brought about by the pandemic to deliver reliable and decarbonised power in the region.

As part of the Mitsubishi Heavy Industries (MHI) Group, we strengthened our commitment to [“Mission Net Zero”](#). With this pledge, we aim to achieve carbon neutrality by removing all carbon dioxide (CO₂) emissions from our operations and achieve Net Zero emissions from the entire value chain of power generation by 2040. To do this, we are working together with other MHI companies to utilise carbon capture, utilisation and storage facilities to reduce our emissions.

Cleaner fuel sources such as liquified natural gas (LNG) have become increasingly important to meet new demands and requirements. To facilitate this, we are actively introducing and advancing gas turbine technologies.

One of the milestones we have achieved in 2021 is the commercialisation of Southeast Asia’s first two M701 JAC gas turbines in [Thailand](#), which in combined cycle achieves 65% less carbon emissions that coal-fired power plants. In [Singapore](#), we completed upgrade works for two gas turbine combined cycle (GTCC) power plants at Senoko Energy with the same line of gas turbines, resulting in a reduction of 15,000 tonnes of emissions annually. We also commissioned a natural gas-fired GTCC power generation system in [Indonesia](#), the most efficient power plant of its kind in the country.

We also continue to advocate the use of zero-carbon fuels. We will introduce the regions’ first hydrogen co-firing gas turbines in [Australia](#), a step in ushering

this new zero carbon fuel to our range of gas turbines. We are also developing [H-25 gas turbines](#) to run on hydrogen and ammonia.

Keeping with our enhancements in gas turbines technology and cleaner fuel combustion, we have continued to help our partners maximise the efficiency of power generation in a time of digitalisation. In August, we established [a global network](#) of TOMONI HUBs, with one situated in the Philippines. These HUBs use artificial intelligence to provide real-time, cyber-secure support to plant operators across all types of energy systems. By doing so, we are paving the way for smarter, more responsive and resilient power plants.

At the start of 2021, I highlighted that the road to cleaner power requires time and collaboration across public and private sectors. Within the Asia Pacific, I had the opportunity to sit amongst esteemed government leaders from countries such as Singapore, Malaysia and Indonesia to learn about their aspirations – and I look forward to more of such dialogue.



Forging Ahead to 2022

Looking ahead to 2022, I am eager to bring Mitsubishi Power to greater heights. Leveraging the momentum created by COP26, we aim to help deliver cleaner power and support the region in efforts to achieve the commitments made at the summit.

We continue to aspire toward the approach outlined in our [white paper](#) entitled “Designing Roadmaps for Growth and Decarbonisation”. For countries to decarbonise and achieve economic development, they need to have existing power generation systems that are flexible, use decarbonised fuels and acquire low- and zero-carbon energy solutions.

To achieve this, we should partner with countries that have announced energy development plans and supply them with clean power solutions to address their needs. One such solution is our battery energy storage systems (BESS) that serve as reliable power backups to support the grid and renewables during seasonal intermittencies. Another solution that we are enhancing are our solid oxide fuel cells (SOFC), small-scale distributed power generation systems that have achieved 72% efficiency and can accommodate a range of fuels.

In addition, we will work alongside MHI Group company Turboden to supply and maintain Organic Rankine Cycle (ORC) systems that can support multiple energy sources for distributed generation. This can help countries diversify their avenues to cleaner power, including the use of geothermal in countries such as Philippines and Indonesia that have rich natural resources to tap on.

Also, our commitment to scale hydrogen usage in power generation remains strong. We have our highly efficient world-class J Series gas turbines which can co-fire hydrogen, and are set to achieve 100% hydrogen firing in large-scale gas turbines within the decade.

As the pandemic wears on into 2022, digitalisation will remain a key focus. We will continue to innovate and enhance our digital solutions – not only to help operators achieve optimal efficiency, but also create autonomous power grids that maximise power output whilst minimising manpower needs.

The final ingredient to successfully make progress and execute cleaner efforts is private-public collaboration. Mutual respect and understanding that we are at different points of transition can help us learn from each other and solve problems.

As we march into the new year, trust will be critical. The need for all of us to work together is greater than ever and I invite everyone to join me to create an energy future that is beneficial for all.

Written by: Osamu Ono, Managing Director and Chief Executive Officer at Mitsubishi Power Asia Pacific



FLEXIBILITY IS CRUCIAL FOR A SUSTAINABLE ENERGY TRANSITION

(Published January 17, 2022)

There has been a constant refrain in my conversations with customers and partners from around the APAC region: keeping electricity supply stable and affordable for end users is the top priority. From there, the chats often turn to how we can achieve this whilst also heeding growing calls to make power generation cleaner.

Countries are on their own unique journeys, and their ability and timeline for addressing the intricately intertwined issues related to the energy transition vary widely, in part due to their differing access to natural resources and capital. Indeed, there is no one-size fits-all approach to the energy transition, and we need to have solutions that can meet communities where they are.

I was reminded of these challenges when I spoke at an Enlit Asia Plus event about the need for power generation to be flexible. Although flexibility is often seen in terms of fuel flexibility – which is the ability of power systems to accommodate different types of energy sources – this is not the only type of flexibility that is important. I believe that making power systems more operationally flexible – more agile in addressing changes in load and demand – will be key for countries to progress in their own energy transition journeys.

Keeping the lights on – under all circumstances

As countries strive to increase the proportion of low and zero-carbon energy sources such as renewables in the mix, relevant infrastructure and fuel supplies will not always be immediately ready. Systems with fast start up and ramp up rates therefore become especially important to ensure the power supply is not disrupted.

After all, electricity still needs to be delivered to homes and workplaces even as countries calibrate their fuel mixes.

Operational flexibility enables grid stability, and the good news is that there exist technologies to ensure power systems can withstand fluctuations.

Gas-fired power systems are particularly flexible. Compared to coal-fired systems with ramp up rates of 3-5% per minute, gas-fired power systems can ramp up at 8-12% per minute. We at Mitsubishi Power are already bringing our world-class gas turbine technologies to the region. Just this April, a new M701 JAC gas turbine went live in a power plant in Thailand operated by Gulf SRC. The gas turbine – with an industry-leading efficiency approaching 65% – is the first to be installed in Southeast Asia and is also the first of eight such gas turbines that will be delivered to Thailand as part of a long-term project with the customer.

From a fuel supply perspective, gas power is a viable option for Asia Pacific, with its abundant natural gas reserves, two-thirds of which are in Indonesia and Malaysia. Amongst the challenges now is to enhance the infrastructure, such as pipelines and LNG terminals, to deliver this natural gas to end users such as power producers.

Creating backup power supply

Part of building operational flexibility is ensuring that there are smaller, fast-reacting systems that can be easily scaled to support major grid infrastructure. Systems for on-demand power and energy storage can provide the flexibility needed for backup power

whenever there is grid instability or intermittencies.

Available in stationary and mobile package sizes from 30 up to 140 megawatts, Mitsubishi Power Aero's aero-derivative gas turbines can begin producing power in as little as two minutes and are able to reach full output in under 10 minutes. Amongst its products is the FT8® MOBILEPAC® 30-megawatt mobile gas turbine package, which has been extremely effective at improving grid stability and eliminating blackouts particularly in remote or isolated areas. For example, all throughout Algeria, over 50 of these units have been installed, providing critical power during the peak summer months and year-round support of the national grid.

With solid oxide fuel cells, flexibility comes from their ability to run with different types of fuels, including natural gas, methane from sludge, food waste and agricultural waste, and ultimately even hydrogen – making them suitable for decentralised power generation. They are also useful for industrial power generation. Case in point is our demonstration project with Asahi Breweries using our MEGAMIE SOFC to create electricity from bio-methane gas derived from the brewery's wastewater.

Finally, energy storage systems are crucial not just for backup power but also to help solve challenges related to oversupply from renewable power generation. In the United States, Mitsubishi Power is working on a project to build electrolysis facilities capable of producing more than 450 metric tonnes per day of green hydrogen. This hydrogen will then be stored in salt caverns for quick deployment as fuel for gas turbines, with the potential to serve the needs of 150,000 households in the Western United States for an entire year. Here in APAC, we can start with smaller systems such as rechargeable lithium-ion batteries, flywheels, superconducting magnetic energy storage and ultracapacitors for shorter term storage needs.

Investing to build flexible power systems

Making power systems more flexible is necessary to improving power generation overall and paving the way for an effective energy transition. Still, the efficacy of our power systems is dependent on having a viable supply chain for necessary fuels, and power producers being incentivised to make investments in necessary technologies.

At the end of the day, understanding the needs of each country in Asia Pacific is crucial to tailoring flexible solutions. Asia Pacific's energy future remains bright, and I am keen and open to discussing how we can do better together.

Written by: Osamu Ono, Managing Director and Chief Executive Officer at Mitsubishi Power Asia Pacific





PATH TO SUSTAINABLE SINGAPORE STARTS WITH CLEANER ENERGY

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Climate action took centre stage in Singapore's recently announced budget, an acknowledgement by authorities that true societal progress can take place only when we care for the planet. A major item on the agenda, the Singapore Green Plan 2030 is a mandate for everyone with implications across businesses, communities and each of us as individuals.

This renewed sustainability commitment shows that things cannot operate in silo – transportation, energy, agriculture, environment, people are all interconnected. Singapore too is part of a growing region with collective sustainability goals achievable only by multilateral collaboration.

One critical focus area within the plan – the energy reset – looks at Singapore's energy sources, tackling decarbonisation at its root by encouraging greater usage of cleaner fuels, accelerating deployment of solar, increasing power generation efficiency with new generations of hydrogen gas-fired plants, and ramping up clean electricity imports.

Organisations powering the nation need to progressively adopt a new mentality and make conscious decisions around the energy production value chain. Where does electric power come from?

How efficient are power plants? Where do the by-products go? Every step should be mapped and optimised for decarbonisation, with support and collaboration of the wider industry.

Tax and tech will shape tomorrow

Singapore contributes a total of 0.1 per cent of global emissions today, and to reduce overall emissions and pave a more sustainable pathway ahead, the Government is looking to gradually increase carbon taxes from \$5 per tonne to between S\$10 and S\$15 per tonne by 2030.

This will provide the impetus for change. As alternative energy sources such as hydrogen, biomass, ammonia, and more are still being developed and scaled, power providers will need to reduce their emissions to minimise upcoming tax burdens. Carbon capture technologies would help in managing this. Apart from power plants, other large direct emitters such as refineries and petrochemical plants would also benefit from implementing a more sustainable approach.

In addition, intelligent solutions powered by artificial intelligence and data analytics can provide power

plants the ability to reduce fuel costs, lower emissions and raise plant efficiency. Mitsubishi Power has taken this approach by validating TOMONI[®] digital solutions and gas turbines for power plants at our [T-Point 2 facility in Japan](#). This allows us to monitor utilisation rates, provide O&M support, enhance performance, and automatically identify and address reliability issues to make power systems more resilient, cost efficient and fuel efficient.

The constant upgrading of solutions and technologies will continue to give us creative ways to reduce emissions, especially when renewable solutions are still limited in scale.

Partnerships critical to introduce low-carbon alternatives into the grid

Singapore has seen success in transitioning to liquefied natural gas as its main fuel source by increasing its imports from neighbouring countries. As it looks to the next phase of the energy transition to support Green Plan 2030, potentially pursuing hydrogen as a fuel source, these relationships will remain crucial. Building on our strategic location, Singapore must continue to increase cooperation and partnership with neighbouring counterparts and the region at large to explore cleaner energy options that make up for its lack of wind, geothermal and hydroelectric power. This will also mitigate any future energy crunches that could occur either from political or climate related challenges.

One way is by uncovering solutions with this “ultimate clean fuel”, hydrogen, through greater public-private partnerships and increased collaboration with the government. Trials have already kickstarted at [SP Group’s concept lab in Woodleigh](#), where green hydrogen is generated through electrolysis and powered by solar energy. Singapore can also consider enhancing current gas power infrastructure that supports the country’s journey towards sustainable power generation: for example, utilising advanced class gas turbines that can transition to run with other cleaner fuel options. We are seeing progress in this area in other parts of the world such as the United States where facilities such as the [Intermountain Power Plant in Utah](#) which is sequentially transitioning capabilities from coal to natural gas and finally to renewable hydrogen fuel for power generation. Such innovative experimental trials and energy infrastructure development will support the introduction of the fuel source to the grid – and are essential to achieving long-term sustainable development.

Whilst hydrogen is for the future, there is also potential for Singapore to generate more power in the near-term from ammonia and biomass. Just look

at how Singapore’s shipping industry is exploring a whole supply chain for [sea-based ammonia refuelling operations to reduce emissions](#). On top of that, with the country’s goals of reducing waste sent to landfill by 30%, biomass and waste-to-energy solutions have many benefits for the city-state. Not only will they support sustainable power generation but they also address growing concerns of waste generated from the country. Case in point is the [Tuas South power plant](#), which combines waste collected from Nanyang Technological University and biomass charcoals, to produce electricity by test-bedding different aspects of gasification technology.

The country’s ability to push for home-grown innovation and greater partnerships will spur the development of decarbonisation technologies and drive emerging clean energy solutions under the [Research, Innovation & Enterprise Plan 2025](#).

It is imperative that Singapore’s sustainability journey incorporates decarbonised energy solutions. The energy reset provides us a pathway on how we can positively impact society by addressing emissions and exploring cleaner energy options. With creative ideas, new technologies, and a variety of public-private alliances, significant decarbonisation; sustainable living and a green economy are within reach. What do you think are the opportunities and challenges facing Singapore and could its approach provide a blueprint for others around the region?

Written by: Osamu Ono, Managing Director and Chief Executive Officer at Mitsubishi Power Asia Pacific



ABOUT MITSUBISHI POWER

Mitsubishi Power Asia Pacific Pte. Ltd., a subsidiary of Mitsubishi Power, Ltd., designs, manufactures and maintains power generation systems that enable decarbonisation whilst delivering reliable power to over 30 countries globally. Mitsubishi Power is a power solutions brand of Mitsubishi Heavy Industries, Ltd. (MHI)

The Asia Pacific headquarters in Singapore supports key markets like Bangladesh, Indonesia, Malaysia, the Philippines, Thailand, and Vietnam. With over 50 years of experience and more than 2,000 employees, the company applies its innovative technologies and deep knowledge of Asia Pacific's evolving energy needs to pave the way for the region's sustainable energy future.

Media Contact:

Sophia Wee

M: +65 9112 4325

E: sophia.wee.3z@mhi.com

ABOUT ASIAN POWER

Asian Power (AP) is the definitive quarterly publication for the power generation, transmission, and distribution industry in the Asia Pacific region. Each issue is packed with the latest news, innovative software and IT solutions, market trend analyses, expert insights on pertinent issues, columns, and special country reports.

The print magazine is published quarterly and covers in-depth issues and stories within a longer time frame. It has a circulation guaranteed at 6,250 copies reaching 25,000 readers, comprised of senior management in Asia's power industry. The website asian-power.com is refreshed daily and covers daily news and stories with immediate relevancy. Each year, Asian Power holds the Asian Power Awards, the region's most acclaimed awards programme for Asia Pacific's power industry.

Media Contact:

Reiniela Hernandez

+65 3158 1386 ext. 214

reiniela@charltonmediamail.com

