

APEC Workshop on Promoting Sustainable Energy Development in Garment and Textile Industry

Summary Report

APEC Energy Working Group

November 2025



**Asia-Pacific
Economic Cooperation**



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APEC Project: EWG 204 2024A

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APEC#225-RE-04.11

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APEC WORKSHOP ON PROMOTING SUSTAINABLE ENERGY DEVELOPMENT IN GARMENT AND TEXTILE INDUSTRY

18 – 19 September 2025

Summary Report

I. INTRODUCTION

On 18 and 19 September 2025, the APEC Workshop on Promoting Sustainable Energy Development in Garment and Textile Industry, initiated by Viet Nam and co-sponsored by Indonesia; Japan; Chinese Taipei; Thailand was held in Ha Noi, Viet Nam. Speakers and participants came from global organizations and research institutions and representatives from APEC member economies' relevant Ministries and government's agencies, companies and business associations that relates to energy and/or garment and textile in APEC economies and across the APEC region.

The Workshop aimed to help stakeholders to share about the experiences, good practices, challenges and recommendations on how to promote sustainable energy development in the garment and textile industry.

II. BACKGROUND

Garment and textile industry is one of the largest and oldest industries in the world. The development of textile market depends on the growth of population, economic development and rapid change of fashion. Garment businesses that pollute during the production process and do not apply solutions to save energy are at risk of having their orders refused. Along with that, consumers around the world are also increasingly concerned about the environmental responsibility of businesses when choosing products. These are the challenges, as well as motivation for textile and garment enterprises to improve themselves, and transform impressively in the future. By using clean and renewable energy and promoting energy efficiency in the "greening" journey also helps reduce energy security pressure, contributing to the overall goal of cutting greenhouse gas emissions.

Therefore, sustainable energy development in this sector is not an option for the multi-billion-dollar industry but a must in the context of increasing requirements for sustainability around the world. Transitioning to renewable energy is crucial for garment and textile industry to reduce its carbon footprint and move towards a sustainable future.

Promoting sustainable energy development in garment and textile industry has significant environmental impacts. In this regards, Viet Nam proposes to hold a 2-day Workshop on Promoting Sustainable Energy Development in Garment and Textile Industry with an aim to help APEC non APEC economies and stakeholders to share about the experiences, good practices and recommendations on how to promote sustainable energy development in garment and textile industry

III. OPENING REMARKS

In the opening remarks, Mr Nguyen Anh Tuan (Vice President, Energy Association, Viet Nam) highlighted that in the context of climate change and the rapidly increasing global energy demand, the search for and application of sustainable energy solutions has become a global trend. As a major energy-consuming industry, the garment and textile industry is no exception. To promote sustainable energy in garment and textile industry, businesses have implemented a range of solutions, such as using renewable energy, improving energy efficiency and applying green product standards and certifications. These solutions not only help reduce input costs and enhance competitive advantages but also help lower greenhouse gas emissions and protect the environment, demonstrate corporate social responsibility, improve brand image as well as contribute to reducing pressure on energy security and moving towards a circular production.

Mr Tuan mentioned that consumers around the world are becoming increasingly aware of the environmental responsibility of businesses when selecting products. This is reflected in the shift in shopping behaviour, as customers are willing to pay more for “green” products that are environmentally friendly throughout the stages of production, consumption, and reuse or recycling. This is both a challenge and a driving force for garment and textile enterprises to improve themselves and strongly transform into green, not only to meet the strict requirements of import markets but also to affirm the value of brands and products, and to build trust among global consumers. Promotion of sustainable energy development, therefore, is both a matter of social responsibility and a long-term strategic competitive advantage.

With that meaning, the Workshop is the contribution of the Government of Viet Nam to the collective APEC effort in implementing the Just Energy Transition Initiative and aiming to achieve the common goal of the APEC region: to double the share of modern renewables in the energy mix by 2030 (relative to the numbers from 2010) as instructed by APEC Economic Leaders. The Workshop is also expected to discuss and propose feasible and applicable initiatives, recommendations and policy solutions for APEC cooperation in the coming time.

IV. KEY ISSUES

1. OVERVIEW ON ENERGY NEEDS IN THE GARMENT AND TEXTILE INDUSTRY

The three speakers in the Session are Dr Rajan Sudesh Ratna, Deputy Head and Senior Economic Affairs Officer, UN ESCAP, South and South West Asia Office; Ms Chia-Yi Lin, Researcher, Researcher, TTRI, Chinese Taipei; Mr Wiwat Hirunpruk, Sustainable Fashion and Lifestyle Industrial Expert, Consultant to Thailand Textile Institute, Thailand.

- Dr Rajan Sudesh Ratna highlighted the global importance of the garment and textile industry, a trillion-dollar sector employing millions through complex, energy-intensive supply chains. Key processes such as spinning, weaving, dyeing, and finishing consume large amounts of energy, with dyeing and finishing alone accounting for about 60% of total use due to water heating. The sector depends on thermal, electrical, and direct fuel energy, mostly from fossil fuels, resulting in a significant carbon footprint and vulnerability to energy price fluctuations and regulatory pressures like the European Union's CBAM¹. Within APEC, major producers such as China; Indonesia; Thailand; and Viet Nam, drive global supply, with China consuming 150-200 TWh annually and Viet Nam 8-12 TWh, mainly from coal. Challenges include high emissions, aging infrastructure, and the water-energy nexus, but opportunities lie in process optimization, technological upgrades, renewable energy integration, waste heat recovery, and digitalization. Case studies show strong results: Crystal International in Viet Nam cut costs and emissions with rooftop solar; Formosa Taffeta in Chinese Taipei reduced its carbon footprint by 22% through solar and heat recovery; and Shenzhou International in China reached 35% renewable energy by integrating solar, wind, and smart grids. Dr Rajan concluded by urging collective action within APEC to accelerate the industry's transition toward sustainability, reduce environmental impact, and enhance competitiveness under tightening international standards.
- Ms Chia-Yi Lin's presentation explored the energy demands and sustainability challenges of the garment and textile industry in Chinese Taipei. The sector contributes 8-10% of global greenhouse gas emissions, and exporters face

¹ Carbon Border Adjustment Mechanism (CBAM)

increasing pressure from international initiatives such as SBTi², CBAM, and the Clean Competition Act of the United States to decarbonize. Although the global textile trade reached USD 872.1 billion in 2023, it showed signs of slowing, with Chinese Taipei ranked ninth in textile exports. Domestically, the industry is well integrated, but dyeing and finishing remain the most energy-intensive stages, relying primarily on natural gas for thermal energy, with only limited use of solar power and waste heat recovery. Rising energy prices and new carbon fees introduced in 2025 have increased cost pressures, while global brands now require renewable energy sourcing and emissions disclosure from suppliers. In response, the government has rolled out comprehensive policies under the Net Zero Roadmap to support energy transition, process upgrades, and circular economy initiatives. Efforts include expanding renewable energy to 20% of electricity by 2025, driven by solar and offshore wind, as well as energy efficiency programs, subsidies for modern equipment, sludge-to-fuel conversion technologies, recycled materials innovation, and the establishment of a NTD 100 billion ESCO³ fund to support green finance. Ms Lin stressed that to remain competitive, Chinese Taipei's textile industry must pursue both digital transformation and green transition. This involves adopting smart manufacturing, developing high-value products, strengthening branding, and building sustainable, digitally enabled supply chains. Training cross-disciplinary talent will be crucial to achieving these goals. She concluded that sustainability, innovation, and international alignment are essential for ensuring the industry's resilience and long-term growth.

- Mr Wiwat Hirunpruk's presentation explored Thailand's energy landscape, key challenges, and strategies to build a sustainable textile and garment industry. The sector employs over 400,000 workers across 2,600 factories and must cut emissions by 40% to meet domestic net-zero targets. However, the energy mix remains heavily fossil fuel-based, with 58% from natural gas and only 10% from renewables, resulting in high costs and a significant carbon footprint. Dyeing and finishing processes are the most energy- and carbon-intensive, and the sector faces additional pressure from trade measures like the EU's CBAM, which could affect export competitiveness. At the policy level, high reserve margins, EGAT's⁴ electricity monopoly, and net billing schemes discourage rooftop solar investment, as producers must sell electricity cheaply and buy it back at higher rates. Mr Hirunpruk proposed reforms including net metering, market liberalization, cancelling unnecessary power plants, incentivizing solar energy, and upgrading the grid with battery storage and smart technologies. He concluded that embracing renewable energy, improving efficiency, and aligning

² Science Based Target Initiative (SBTi)

³ Energy Service Company (ESCO)

⁴ Electricity Generating Authority of Thailand (EGAT)

with global low-carbon standards are essential for Thailand's textile industry to remain competitive. With the right reforms, the sector can transform into a regional model for sustainable and circular production.

2. OPPORTUNITIES IN PROMOTING SUSTAINABLE ENERGY DEVELOPMENT IN THE GARMENT AND TEXTILE INDUSTRY

The three speakers in the Session are Dr Zheng Lei, Senior Associate, CHN Energy Technology & Economics Research Institute, China; Mr Nguyen Hong Long, Chief Advisor, Research and Development, EBG Science and Technology Company Limited, Viet Nam; and Ms Chia-Yi Lin, Researcher, TTRI, Chinese Taipei.

- Dr Zheng Lei's presentation highlighted China's progress in advancing a green and low-carbon transition in the garment and textile industry. He outlined how China has reduced coal's share in its energy mix while rapidly expanding wind and solar power, which by 2024 dominated new capacity additions. Although electricity demand continues to rise, prompting diversification, challenges remain in grid integration, storage, and renewable reliability. In the textile sector, a comprehensive policy framework-including the Implementation Plan for Textile Industry Quality Improvement and Upgrading (2023-2025), regulatory standards, technical guidelines, and tax incentives-has driven cleaner technology adoption. Financial institutions are also promoting green investment through tools such as the Green Transition Industry Guidance Catalogue. China has strengthened carbon footprint accounting across the supply chain and fostered collaborative innovation led by major enterprises. International cooperation through the Belt and Road Initiative supports shared green technologies and harmonized recycling systems. Case studies, including China Energy's coal-renewable integration projects and the Bo'ao Zero Carbon Park, illustrate practical decarbonization pathways. Dr Zheng concluded that with the declining share of coal consumption, the rapid development of renewable energy, and the improvement of a robust governance framework, the low-carbon sustainable development prospects of the Chinese textile industry are promising and full of opportunities.
- Mr Nguyen Hong Long's presentation highlighted opportunities for sustainable energy development in Viet Nam's garment and textile industry, focusing on innovative biomass solutions. He introduced EBG Company which develops biomass gasification and clean energy technologies to cut production costs and support climate goals. The sector accounts for 6.3% of Viet Nam's industrial

energy use-mainly in drying, dyeing, and finishing-and remains reliant on coal, diesel, and LPG. Exporters face rising global pressure to meet ESG standards, while Viet Nam's NDC targets a 27% emissions reduction by 2030. Mr Long emphasized biomass gasification, solar heating, and solar PV as key renewable options. EBG's GaSIO technology converts agricultural residues into syngas for clean thermal energy and biochar for reuse, reducing thermal energy costs by 30-70%, stabilizing fuel prices, and cutting around 1,092 tons of CO₂ annually per system. Additional benefits include lower wastewater treatment costs and roughly 840 carbon credits per model. Socio-economic impacts include improved working conditions, new jobs in biomass collection and system operation, and local income of about VND 420 million per year. With 160 million tons of biomass potential annually, Viet Nam has significant untapped resources. Mr Long concluded that technologies like GaSIO can help the textile industry reduce costs, meet green supply chain demands, and support domestic climate targets while promoting digitalization and community development.

- Ms Lin's presentation highlighted both challenges and opportunities for sustainable energy development in the textile sector. Key challenges include limited real-time monitoring, slow equipment upgrades, high energy costs driven by rising carbon fees, insufficient data integration across factories, and a shortage of professionals in energy management. On the opportunity side, the industry can benefit from smart monitoring systems, digitalization and AI, waste heat recovery, reuse of condensate water, and the adoption of renewable energy such as solar power. Cluster-based shared energy platforms and resource recycling also offer promising solutions. Policy support plays a crucial role. Strategies include carbon pricing mechanisms, subsidies for energy improvements, support for research and development, and the establishment of regional energy management platforms. Governments can assist companies in aligning with international standards such as ISO 50001, GRI, and SBTi. A case study of Fulltide Company demonstrates successful implementation. Through digital transformation, real-time monitoring, and green innovations, the company has improved efficiency, reduced emissions, and upheld environmental responsibility across its value chain. The presentation concluded that energy transition through smart management, renewable energy adoption, and waste-to-energy solutions can deliver both cost savings and ESG benefits. This requires strong collaboration between government and industry, as well as international cooperation, to build a sustainable, low-carbon textile future.

3. OBSTACLES IN PROMOTING SUSTAINABLE ENERGY DEVELOPMENT IN THE GARMENT AND TEXTILE INDUSTRY

The three speakers in the Session are Dr Julius L. Leaño, Jr., Director, Philippine Textile Research Institute, the Philippines; Mr Nguyen Hong Long, Chief Advisor, Research and Development, EBG Science and Technology Company Limited, Viet Nam; and Mr Hu Kehua, Deputy Director of Office for Social Responsibility, China National Textile and Apparel Council (CNTAC).

- Dr Julius L. Leaño, Jr. discussed the obstacles to promote sustainable energy development in the garment and textile industry, focusing on the Philippines context. He emphasized the sector's high energy intensity, emitting nearly 3.99 billion metric tons of CO₂ globally, with dyeing and finishing consuming almost half of all thermal and electrical energy. The Philippines has 33.3 GW of installed capacity but remains dependent on fossil fuels, with coal providing 44% of power and renewables only 31.5%, below the global average. Despite strong geothermal potential and growing solar and wind projects, renewable expansion is slowed by infrastructure and investment barriers. High electricity costs—averaging P5.58/kWh wholesale and P10.95/kWh residential in 2024—undermine export competitiveness compared to India; Indonesia; Thailand; and Viet Nam. The government targets raising renewables to 35% by 2030 and 50% by 2040 through geothermal, solar, wind, hydropower, and microgrids. Dr Leaño concluded that overcoming high energy costs and limited renewable penetration requires scaling up clean energy investment and power sector reforms to make renewables more affordable and accessible, enabling the industry to meet international sustainability standards and align with APEC's green growth agenda.
- Mr Nguyen Hong Long's presentation addressed key challenges in promoting sustainable energy development in Viet Nam's garment and textile industry. Although Viet Nam is among the world's top three textile exporters, the sector is highly energy-intensive, consuming about 6.3% of domestic industrial energy—mainly in dyeing, finishing, and drying—while relying on coal, diesel, LPG, and grid electricity, with renewables below 5%. This dependence leads to high costs, heavy emissions, and rising pressure from global carbon regulations and ESG⁵ standards. Major barriers include high investment costs, outdated infrastructure,

⁵ Environmental, social and governance (ESG)

limited technical capacity, unstable biomass supply chains, weak support systems, and restricted access to green finance, compounded by the absence of technical standards, fiscal incentives, and carbon pricing mechanisms. To address these challenges, Mr Long proposed policy measures such as clear technical standards, tax, or carbon credit incentives, expanded credit guarantee funds, improved climate finance access, capacity building, and public-private partnerships. He highlighted the ESCO model to adopt energy-saving technologies without upfront costs. He also presented GaSIO biomass gasification technology, which uses diverse fuels to generate low-emission energy, reducing costs by 60-85% compared to coal or LPG while producing biochar for soil and water applications. With 160 million tons of biomass potential annually, Viet Nam has vast untapped resources. Mr Long concluded that overcoming technological, financial, and institutional barriers through biomass innovation, supportive policies, and partnerships is essential to build a greener, more competitive textile sector aligned with international climate goals.

- Mr Hu Kehua presented China's strategic roadmap for renewable energy investment in the textile and apparel industry, aligned with 2050 carbon neutrality vision. Since 2005, CNTAC has led sustainability efforts, and while the sector contributes only 0.6% of global emissions-with 65% tied to energy use-decarbonizing energy is crucial. The "30-60 Carbon Neutrality Acceleration Plan," launched in 2021 with 30 brands and 60 manufacturers, aims for full carbon disclosure by 2025. Green electricity use has expanded rapidly, from 1% in 2020 to 24% in 2023, driven by solar-wind hybrid projects and green certificates. In 2024, CNTAC assessed direct investment in renewable assets across eight provinces, identifying Shandong as the most promising location thanks to strong resources and significant cost-saving potential. Direct investment provides stable supply and 15–25% cost savings over 25 years compared to other procurement methods, though it carries policy and market risks. Mr Hu emphasized that this approach transforms manufacturers into energy producers, requiring strong cooperation among brands, suppliers, financiers, and energy stakeholders. He advised prioritizing energy efficiency and green power purchases before investing directly. He concluded by highlighting Asia's, especially China's, central role in global textile decarbonization and its potential to become a renewable energy leader.

4. ENHANCING INNOVATION AND FINANCE TO PROMOTE SUSTAINABLE ENERGY DEVELOPMENT IN THE GARMENT AND TEXTILE INDUSTRY

The two speakers in the Session are Dr Nguyen Van Thong, Member of Board Directors, Viet Nam Textile Research Institute JSC and Mr Galih Prasetya, Quality Inspection Officer, Center for Standardization and Industrial Services for Textile, Indonesia.

- Dr Nguyen Van Thong's presentation emphasized the role of innovation and finance in driving sustainable energy development in Viet Nam's garment and textile industry, defining sustainable textiles as the balance of economic growth, environmental protection, and social equity through green supply chains, businesses, and products. He outlined three key innovation pillars: sustainable materials (organic, recycled, bio-based), clean energy (solar, biomass, wind, heat pumps), and efficient processes (waterless dyeing, microbial dyes, digital printing, low-temperature methods, waste heat recovery), with blockchain and artificial intelligence identified as future competitiveness enablers. Case studies highlighted international progress and domestic advances, such as Thanh Cong and Vinatex adopting rooftop solar and biomass; notably, Thanh Cong's solar system provides 66% of its energy, saving USD 1.9 million and cutting 4,200 tons of CO₂ annually. With over USD 37 billion in FDI and VND 75 trillion in green credit, Viet Nam shows strong momentum, but faces challenges like legal gaps, outdated infrastructure, limited awareness, labor shortages, and high costs. He concluded that stronger legal frameworks, incentives, research and development, infrastructure investment, and diverse green finance tools are crucial to building a green, circular, and competitive textile industry.
- Mr Galih Prasetya Hidayat highlighted Indonesia's textile and garment industry as both a major economic contributor and a significant source of emissions. Employing nearly 3.9 million people, contributing 5% to domestic GDP, and generating USD 11.86 billion in exports (2021), the sector is strategically important but also accounts for around 5% of domestic emissions due to its heavy reliance on fossil fuels in wet processing, spinning, and weaving. He presented Resource Efficiency and Cleaner Production (RECP) as a practical solution to cut emissions and costs through measures like process optimization, equipment upgrades, and recycling, with case studies showing reductions of up to 31% in water use and 10% in GHG emissions. Renewable energy plays a critical role, with companies adopting rooftop solar, biomass, and Renewable Energy

Certificates to meet global buyers' sustainability demands. He emphasized that adopting renewables enhances market access, compliance, and financial resilience, urging a combination of green finance, policy support, and innovation to decarbonize the sector and maintain competitiveness under the "Making Indonesia 4.0" roadmap.

5. CASE STUDIES IN SOME ECONOMIES

The five speakers in the Session are Mr Tran Nhu Tung, Chairman of the Board of Directors, Thanh Cong Textile Garment Investment Trading Joint Stock Company, Viet Nam; Mr Dhanujie Jayapala, General Manager - Environmental Sustainability, MAS Capital Limited, Sri Lanka; Dr Julius L. Leaño, Jr., Director, Philippine Textile Research Institute, the Philippines; Mr Wiwat Hirunpruk, Sustainable Fashion & Lifestyle Industrial Expert, Consultant to Thailand Textile Institute, Thailand; and Mr Galih Prasetya, Quality Inspection Officer, Center for Standardization and Industrial Services for Textile, Indonesia.

- Mr Tran Nhu Tung's presentation underscored the pivotal role of renewable energy in transforming Viet Nam's textile and garment sector toward sustainability. Aligned with Viet Nam's COP26 net-zero by 2050 commitment, Viet Nam aims to become a leading sustainable textile hub by 2030, amid rising global pressures for certified, transparent, and eco-friendly production. Thanh Cong Textile Garment Investment JSC (TC Company) targets USD 200 million in revenue by 2025 and exports to 40 markets through its Vision 2030 strategy. TC Company has installed 2.3 MWP of solar at Vinh Long and 2.8 MWP at Dong Nai and is transitioning its boilers to biomass-reaching 10% in HCMC (2023) with goals of 100% by 2026, and similar plans for Dong Nai by 2027. However, TC Company faces challenges such as high upfront costs, unclear legal frameworks, inability to sell excess solar power, administrative hurdles, unstable biomass supply, and grid limitations. To overcome these, TC Company urges green loans, clearer regulations, streamlined procedures, enterprise-investor collaboration, and tax incentives. Mr Tung concluded that adopting renewable energy is both a moral duty and a strategic move to enhance the industry's competitiveness and ensure a sustainable future.
- Mr Dhanujie Jayapala, presented how MAS Holdings is integrating renewable energy into its long-term sustainability strategy. MAS operates in 13 economies with over 96,000 employees and Scope 1 and 2 emissions of 86,684.49 tons of

CO₂ equivalent. Through its “Plan for Change” strategy-focused on products, people, and the planet-MAS is pursuing science-based targets, aiming for a 25% absolute emissions reduction from the 2019 baseline and Net Zero by 2048. Its renewable energy journey began with Sri Lanka’s first 25 kWp net-metered solar system in 2008, followed by biomass boiler conversions, a 1 MW rooftop solar system in 2015, and two solar phases from 2018-2024 totalling over 21 MWp. The company faced technical challenges such as inverter failures, monitoring costs, roof upgrades, corrosion, and regulatory hurdles including approval delays, complex interconnections, and solar export curtailment. Looking ahead, MAS targets 90% renewable electricity by 2030 and 100% by 2040 by expanding both rooftop and offsite renewable capacity through the grid. However, policy barriers like grid instability, holiday curtailment, and slow regulatory change pose obstacles. Mr Jayapala emphasized the need for strong long-term energy policies, open renewable energy access, independent regulators, fair tariffs, and improved grid stability-showing how a major apparel company can lead a structured and ambitious renewable energy transition despite significant challenges.

- Dr Julius L. Leaña, Jr. presented the revitalization and innovation of the Philippines textile industry through sustainable energy and circular economy practices. As the domestic center for textile science, technology, and innovation, PTRI aims to build a globally competitive and environmentally responsible sector. Through initiatives like FRONTIER, PTRI collaborates with universities and local partners to support weaving communities, create jobs, and produce thousands of natural fiber uniforms annually. In 2025, two Bamboo Textile Fiber Innovation Hubs were launched to unite farmers, designers, artisans, and mills in developing bamboo fabrics for global markets. The Regional Yarn Production and Innovation Center produces cotton and blended yarns, while handloom technologies such as HL Mach 4.0, Theraloom, and GeoLoom enable zero-energy artisanal weaving that benefits hundreds of families, women, and marginalized groups. PTRI promotes natural dye digital printing, expands silk production, and supports the Philippine Tropical Fabrics Law by developing natural fiber-blended textiles for government uniforms. Its upcycling hubs convert textile waste and PET bottles into yarn and uniforms, tapping a PHP 36 billion market. With 98.5% customer satisfaction, PTRI provides technical services for quality assurance, supports domestic infrastructure through geotextiles, and fosters entrepreneurship across 165 sectors. Strategic advocacy, governance strengthening, and global collaborations further enhance the textile innovation ecosystem, demonstrating how science, technology, and

sustainability can drive inclusive growth, cultural preservation, and green industrial development.

- The presentation by Mr Wiwat Hirunpruk examined Thailand's clean energy transition in the textile and garment sector as part of a broader domestic strategy for a greener economy. With a target of achieving carbon neutrality by 2050, Thailand offers a 150% tax deduction on green investments to encourage businesses to adopt sustainable practices. This transition responds to global sustainability demands while boosting economic competitiveness and attracting investment. Thailand's current energy mix is dominated by natural gas (59%) and coal or lignite (19%), with renewables and hydropower each contributing 11%. The energy sector, including power generation and transportation, accounts for 70% of Thailand's greenhouse gas emissions, with electricity costs largely driven by fuel expenses. Opportunities include reducing dependence on imported LNG, encouraging foreign investment in green energy, and fostering a sustainable industrial ecosystem. Four leading companies-Pasaya, VT Garment, LeeVivat, and Thai Taffetas-exemplify diverse sustainability strategies, highlighting the sector's role in driving the transition. Mr Hirunpruk emphasized that government incentives, private sector innovation, and strategic energy planning are essential to achieving Thailand's clean energy goals.
- The presentation by Mr Galih Prasetya focused on Indonesia's efforts to promote sustainable industrial development through the implementation of Green Industry Standards (GIS), with a particular emphasis on the textile sector. Indonesia aims to reduce greenhouse gas emissions by 31.89 percent through domestic capacity and up to 43.20 percent with international support. A "Green Industry" is defined as one that efficiently uses resources, aligns industrial growth with environmental protection, and delivers societal benefits. Supported by laws such as Law No. 3 of 2014 and the RPJMN 2020–2024 plan, Indonesia's green industry principles are based on three pillars: resource efficiency and effectiveness, environmental functions, and societal benefits. These include waste recycling, GHG reduction, renewable energy adoption, circular economy practices, low water and energy intensity, and CSR-based community development. The development framework covers awareness campaigns, technical guidance, formulation of sector-specific standards (SIH), certification, awards, and facilitation measures. Companies can receive support to meet existing SIH or collaborate on developing new ones. To accelerate the transition, Indonesia introduced the Green Industry Service Company (GISCO) model, an expanded version of the ESCO model offering project preparation grants,

technical and financial advisory, standardized contracting, vendor curation, and matchmaking with green credit lines, reducing the need for direct company investment. Case studies in dyeing and finishing show significant reductions in raw material use, energy and water consumption, waste generation, and emissions. Overall, Indonesia's GIS approach integrates fiscal and non-fiscal incentives with stakeholder collaboration to build a comprehensive green industry ecosystem and enhance industrial competitiveness in line with domestic climate goals.

6. DISCUSSIONS

- Policy and regulatory mechanisms paid a lot of attention. The discussion session began with a focused examination of specific policy tools being deployed to incentivize sustainability. A strong policy tool was carbon pricing and incentive structures. A speaker from Chinese Taipei detailed the economy's approach to carbon fees. Regular companies were currently charged a carbon fee of around USD 300 per ton. However, this cost was substantially reduced to USD 52– USD 100 per ton for enterprises that actively participated in government sustainability programs. This policy mechanism was explicitly designed to encourage greater participation in sustainable initiatives.
- Next, the challenges in policy stability and integration were discussed. The Thailand speaker underscored that policies aimed at promoting consumer awareness and addressing the impacts of the fast fashion industry remained unstable and lacked proper integration within the economy. Despite the crucial need to raise consumer awareness to reduce environmental impacts, the lack of a cohesive framework presented a significant barrier. Similarly, while the Thai Prime Minister announced ambitious goals at COP26⁶, concrete, implementable policies in several areas remained still limited.
- The UNESCAP speaker noted two important dimensions: the source of energy supply and the 3Rs (Reuse – Recycle – Reduce). Energy supply is considered the most influential factor for small and medium enterprises (SMEs).
- Related to domestic transition roadmaps and targets, a Vietnamese participant outlined the economy's commitment to achieving net-zero emissions by 2050. The energy roadmap targeted renewable energy (excluding hydropower) to account for 28–36% by 2030 and a long-term goal of 74–75% by 2050. Enabling policies, such as the Decree 56, which focused on self-production and self-consumption, and the Decree 58, which offered special incentives for renewable energy, provided tax reductions and simplified investment procedures. In

⁶ Conference of the Parties (COP)

Indonesia, tax structures, roadmaps, and added values for companies adopting clean energy were also part of transition considerations.

- Energy transition, supply chain, and technology adoption was the next hot topic. The discussion extensively covered the shift toward clean energy sources, supply chain resilience, and the role of technological modernization:
- Related to renewable energy supply and cost the UNESCAP speaker highlighted that the source of energy supply was the most influential factor for SMEs. Subsidies were deemed essential for renewable energy, as green energy often came with higher initial costs, contrasting with the typically low-profit margins in the textile and garment sector.
- In, Thailand, the price of biomass and clean energy for users could be reduced by around 20%. To ensure domestic energy security, electricity reserves must not exceed 0.7 days of outage per year. To ensure domestic energy security, Thailand maintained a large reserve system, with around 47 energy data centers, requiring electricity reserves not to exceed 0.7 days of outage per year. Nuclear power accounted for only 1% of the total supply, equivalent to 35,000–50,000 megawatts. The seasonal nature of biomass posed challenges, yet synchronized planning of maize, cassava, and rice harvests was suggested as a means to predict and manage storage more effectively.
- In Viet Nam, enterprises were considering converting boilers from coal to biomass. However, this transition was challenged by higher costs and concerns over supply security. While biomass accounted for only 6% of total energy use, the economy had approximately 160 million tons of biomass available, compared to over 100 million tons of coal consumed last year.
- A Vietnamese textile enterprise speaker raised the issue of adoption risks and constraints, noting that many businesses adopted ESCO models, which involved leasing rooftops for solar installation. However, businesses remained cautious due to the risks inherent in such long-term contracts. If an enterprise failed to consume all the contracted electricity, it still had to pay. This caution was echoed by a Thai participant, who raised concerns that rooftop solar projects in Thailand faced uncertainties in policy changes and unpredictable profit margins, which challenged sustainable development.
- Mentioning technological advancement and digitalization a Chinese speaker stressed that strengthening supply chain promotion and pricing mechanisms was crucial for advancing green energy. However user-level policies remained limited. The cost of power-to-X (electricity storage and conversion) was still very high. China was making super-large investment in carbon capture and storage (CCS), but scaling up to reduce costs will take time. Furthermore, TTRI in Chinese Taipei supported enterprises by analyzing data, identifying costs, and promoting digitalization.

- In the same topic a participant from the Philippines underlined that the government aims to ensure fairness and provides incentives across all industries, especially the prioritized sectors.
- An Indonesian speaker suggested leveraging third-party mechanisms to foster stronger connections between the financial sector and innovation, which would enable energy efficiency in production while ensuring financial stability.
- Challenges in Accessing Green Finance: Financing remained inseparable from innovation, as SMEs faced substantial challenges in accessing bank loans. Necessary Financial Incentives: A participant from the Philippines emphasized that SMEs required financial incentives, such as tax exemptions and machinery procurement subsidies. As supply chain costs were highly sensitive, public–private partnerships (PPP) were considered crucial for supporting businesses, especially during the early stages of transition³³. Governments were encouraged to unlock green finance mechanisms, attract investment, and expand supportive tax policies.
- The Human and Governance Dimension: The Thailand speaker highlighted that the fast fashion sector employed approximately 300,000 workers, of which 70–80% were women. This necessitated that policies focused more on the human aspect, placing people at the center of the transition.
- A Vietnamese speaker stressed the need for a dynamic balance in competition and technical standards from a governance perspective, avoiding over-reliance on any single player.
- The role of universities, training institutions, and international organizations (IFC, UNDP, ILO, etc.)⁷ in providing technologies and workforce training was underlined. Scaling up innovation needed to be accompanied by the development of "green skills" for workers, requiring skills assessment and capacity-building programs.
- Regional cooperation and policy harmonization: Frequent dialogue and exchanges were considered vital to resolving conflicts before harmonizing standards, reinforcing the importance of multi-stakeholder involvement. The role of APEC was specifically highlighted. Inclusiveness was affirmed, recognizing that without dialogue, standards risked being fragmented, unrealistic, and impractical.

⁷ International Finance Corporation (IFC), United Nations Development Programme (UNDP), International Labour Organization (ILO),

V. RECOMMENDATIONS

During the final session, the three speakers are Dr Rajan Sudesh Ratna, Deputy Head and Senior Economic Affairs Officer, UN ESCAP, South and South West Asia Office; Mr Nguyen Hong Long, Chief Advisor, Research and Development, EBG Science and Technology Company Limited, Viet Nam; and Mr Hu Kehua, Deputy Director of Office for Social Responsibility, China National Textile and Apparel Council.

- Dr Rajan Sudesh Ratna presented key strategies for accelerating the green transition of the garment and textile sector. He emphasized the integration of economic, social, and environmental goals and the need for coordinated action. Governments are encouraged to promote green transition schemes, ensure access to clean technologies, and adopt transparent trade policies. Recommendations include strengthening supply chains by supporting SMEs and women-led businesses, addressing non-tariff measures through APEC eco-labels and CBAM cooperation, and building capacity through training on circular models and digital tools. Financial measures such as green funds, low-interest loans, carbon credits, and tax incentives were proposed, alongside knowledge sharing and technology transfer to scale renewable energy and clean technologies. Overall, he called for a holistic policy, finance, and technology approach to drive the sector's sustainable transformation across the APEC region.
- Mr Hu Kehua outlined three strategic recommendations to accelerate renewable energy development in the APEC textile industry, focusing on standardization, data governance, and mutual recognition. He highlighted key challenges including high energy intensity, inconsistent carbon accounting, lack of certification mutual recognition, unreliable data, and high compliance costs that burden SMEs and hinder green trade. First, he proposed ISO 14064- and 14067-based carbon accounting pilots in key industrial regions to create a methodology mutual recognition whitelist. Second, he recommended establishing a trusted APEC cross-border data governance framework, inspired by the CBPR system, to securely share energy and carbon data. Third, he suggested developing a mutually recognized APEC emission factors database to reduce verification duplication and compliance costs. Mr Hu presented a clear timeline: pilots in 2025–2026, data framework in 2026–2027, and database launch in 2027, with full implementation by 2028. He concluded that coordinated action on these three fronts can build a transparent, efficient, and cooperative system to power the textile industry's green transition across APEC.

- The presentation by Mr Nguyen Hong Long offered a business perspective on APEC's 2024 renewable energy and technology commitments, highlighting opportunities, practical applications, and policy recommendations to accelerate the green transition. It emphasized four global goals: tripling renewable energy capacity by 2030, promoting low- or zero-emission technologies, expanding carbon-free electricity, and prioritizing energy efficiency. Rising demand for affordable clean energy, private investment incentives, and new value chains from agricultural residues create opportunities for green jobs and SME participation. A key case study showcased GaSIO biomass gasification technology, which converts local agricultural and forestry residues into syngas and biochar. This provides clean heat for industries such as textiles while generating environmental and economic co-benefits, including wastewater treatment savings, better working conditions, livelihoods worth about VND 420 million annually, and 1,092 tons of CO₂ reductions per year. Risks related to adoption, regulation, and market acceptance can be mitigated through quality assurance, awareness campaigns, early regulatory engagement, and partnerships. The presentation recommended that APEC support SMEs' access to clean technologies and finance, enable biomass and circular economy policies, recognize biochar in carbon markets, and promote regional cooperation and technology transfer. This perspective underscored how innovations like GaSIO can help meet APEC's renewable energy goals.

The concluding group discussion synthesized the key takeaways into seven priority areas for immediate and long-term regional action.

- **Transformation and Holistic View:** A strong need for transformation in the textile and garment industry, and related supporting services, was identified. This required a holistic view across all segments of the supply chain, considering consumer behavior, past business models, and new technologies. Enterprises should explore alternative options and better understand the value chain's input touchpoints.
- **Green Finance and Regional Mechanisms:** It was essential to establish green finance frameworks within the region. Financial support mechanisms, incentives, and resource-sharing initiatives were needed to ensure all economies could benefit equally from the green transition.
- **Circular Economy and Value Chain Approach:** Promoting the circular economy was a priority. This involved examining the entire supply chain through the lens of resource efficiency, energy use, and sustainability. The concept of a circular textile economy should be further developed and mainstreamed into industry practice.
- **Technology, Equipment, and Skills Development:** Technological upgrades, modern equipment, sustainable materials, and resilient supply chains were crucial. Scaling

these innovations needed to be accompanied by development of "green skills," capacity-building programs, and workforce development.

- **Leadership and Guidance:** Economies needed clear leadership in advancing sustainable development. Comparative studies across economies could help harmonize definitions of concepts like "green technology" and establish a broader framework. Guidance from leading economies and regional organizations would be important to set benchmarks.
- **Regional Cooperation and Roadmaps:** Closer regional cooperation was necessary to advance joint initiatives. Concrete roadmaps should be developed with clear milestones and timelines.
- **Public-private partnerships (PPP) and joint committees** should be established to monitor progress across economies.
- **Knowledge Sharing and Policy Harmonization:** There was a strong need to share knowledge and policy experiences through existing regional platforms. Policy frameworks should be harmonized by adopting best practices or designing economy-specific frameworks that aligned with regional priorities. Effective communication strategies were vital to influence consumer behavior and raise public awareness.

In summary, the Workshop confirmed that the transition to a sustainable textile and garment sector required urgent, coordinated, and multi-faceted action. While ambitious domestic targets and specific incentive policies were emerging (e.g., Chinese Taipei's carbon fee discount and Viet Nam's net-zero targets), challenges related to policy instability, access to finance for SMEs, and the need for standardized regional frameworks remained significant. Future efforts must prioritize green finance access, regional policy alignment to avoid fragmentation, and inclusive approaches that respected the unique conditions of each economy while ensuring equitable growth.

VI. CONCLUSIONS

In her closing remarks, Ms Pham Quynh Mai (Viet Nam's Senior Official to APEC) observed that the garment and textile sector is critical in achieving the Sustainable Development Goals (SDGs), given its significant impact on global greenhouse gas emissions, water consumption, and its reliance on non-renewable resources. Through initiatives like the UN Alliance for Sustainable Fashion, the global community is increasingly focusing on transitioning the industry to cleaner energy and circular economy models. This is essential not only for reducing environmental impact but also for improving social equity and aligning with global climate action goals.

Through the sharing and discussion of speakers/ experts and floor interventions on policies, best practices, case studies and experiences from member economies during 2 days, a number of key findings and recommendations have been highlighted which might include, but not limited to the followings:

- **Awareness and Innovation:** The garment and textile industry is a major energy consumer with a significant environmental footprint. It is critical that we raise awareness about the importance of sustainable transitions, the need for environmental compliance, and the potential of eco-innovation to boost business competitiveness.
- **Policy and Regulation:** Strengthening policies, standards, and regulations to support the transition is essential. This includes developing technical standards for clean energy, reducing taxes for enterprises investing in renewable technologies, and creating tools to monitor and enforce compliance.
- **Green Finance:** Promoting access to green finance, such as through green credit guarantee funds for garment and textile SMEs and connecting businesses to funding sources like IKI, GCF, and Switch-Asia, is critical for scaling up sustainability efforts.
- **Collaboration Across the Supply Chain:** The journey toward sustainability cannot be undertaken alone. Strong collaboration across the supply chain and multi-stakeholder engagement will be key. Public-private partnerships (PPPs), especially those that test and scale innovative technologies, can help accelerate the transition.
- **Capacity Building:** Training and capacity-building initiatives are fundamental to ensuring the successful adoption of new technologies and practices. Providing enterprises with the skills and knowledge to adapt is crucial.
- **Smart Manufacturing & Digital Transformation:** Encouraging enterprises to embrace digital transformation, advance smart manufacturing, and strengthen branding and design will enhance competitiveness and foster a more sustainable and digitally-driven supply chain.

Ms Pham hoped that each and every member economy's participants could have gained valuable insights and are now better equipped to contribute to the shared goal of green and sustainable growth—tailored to your specific domestic contexts and long-term development strategies.

By hosting this Workshop, Viet Nam wishes to join and strongly support APEC's common efforts in pursuing green economy, sustainable and inclusive growth and development.

VII. ANNEX 1: PRE-WORKSHOP SURVEY RESULTS

1. What are the benefits of promoting sustainable energy development in garment and textile industry?

China

- Cost savings and competitiveness: Lower electricity/steam use cuts operating costs; energy-efficiency projects often deliver short paybacks, especially in dyeing/finishing stages.
- Risk management and resilience: Reduced exposure to fuel price volatility and grid curtailment; on-site renewables/storage improve business continuity.
- Compliance and market access: Meets tightening energy and emissions standards and aligns with buyer requirements, protecting export orders.
- Quality and productivity: Better process control (e.g., stable temperatures/airflow) reduces defects, rework, and improves yields.
- Brand reputation and stakeholder trust: Clear climate action strengthens brand equity and supports investor relations and access to green finance.
- Environmental co-benefits: Less air pollution, water/chemical use, and heat loss; improved worker health and safety.

Indonesia:

For Indonesia, promoting sustainable energy in the garment and textile industry brings important advantages. It helps reduce costs over time and improves overall efficiency, which supports the competitiveness of the sector. At the same time, it strengthens access to international markets, as many global buyers now prefer suppliers with sustainable and low carbon production. Beyond business benefits, it also contributes to Indonesia's domestic climate goals and the global transition towards greener supply chains.

- Environmental: Reduce GHG emissions, help meet 2030 NDC.
- Economic: Lower costs for firms (IDR 11.67 trillion saved in 2024).
- Social/Market: Open opportunities in carbon trading and sustainable market positioning.

The Philippines:

- a. It is good for the planet. Fossil-based energy is raw material demanding which jeopardizes future generation to attend to their own need.

- b. It emits lower GHG which is the main culprit in climate change where Philippine tops the vulnerability index
- c. It provides quality job

Sri Lanka:

- Environmental: Cleaner, low-carbon, sustainable products.
- Economic: Enhance brand credibility with international buyers; reduce costs.
- Social: Promote a healthier, safer workplace.

Chinese Taipei:

- Economic: Lower energy costs, reduced carbon fees, stronger international competitiveness.
- Environmental: Better supply chain resilience, resource circularity.
- Social/Brand: Support ESG performance, stronger brand identity, attract sustainability-focused customers.

Thailand:

The benefits of promoting sustainable energy development in the garment and textile industry are numerous and far-reaching. They include environmental improvements, economic advantages, and social benefits.

Environmental Benefits: By reducing reliance on fossil fuels, the industry can significantly lower its carbon footprint and greenhouse gas emissions. This helps mitigate climate change, reduces air pollution from burning traditional fuels, and decreases the consumption of limited natural resources.

Economic Benefits: Sustainable energy practices can lead to substantial long-term cost savings. For example, installing solar panels or using more efficient machinery can reduce electricity bills. Additionally, brands that prioritize sustainability can enhance their reputation, attract environmentally conscious consumers, and potentially access new markets. This can also help them meet the strict sustainability requirements of international buyers and regulations.

Social Benefits: Shifting to sustainable energy can create new job opportunities in renewable energy and green technology sectors. It can also improve the health and safety of workers and nearby communities by reducing air and water pollution associated with traditional energy production.

Viet Nam:

Firstly, promoting sustainable energy in the garment and textile industry can help reduce operational costs in the long run. Although the installation of renewable energy systems such as solar panels or wind turbines requires substantial upfront investment, studies show that these costs are typically recovered within 6 - 8 years depending on the scale and location of deployment. After the payback period, electricity generation from renewable sources becomes almost cost-free, thereby significantly lowering long-term operating expenses, insulating firms from volatile fossil fuel prices, and enhancing energy security.

Secondly, it mitigates environmental impact by substantially lowering greenhouse gas emissions and other pollutants associated with textile manufacturing. This reduction not only supports global climate commitments such as the Paris Agreement, but also aligns with Viet Nam's Climate Change Strategy aiming to reduce emissions by 43.5% by 2030, peak emissions by 2035, and achieve net-zero carbon by 2050. Moreover, adopting sustainable practices in Viet Nam's textile and footwear sector can significantly reduce the industry's environmental footprint, especially as the government targets raising renewable electricity to 10% by 2025 and improving energy efficiency through mechanisms like Direct Power Purchase Agreements.

Thirdly, it enhances competitiveness by enabling companies to position themselves as environmentally responsible brands and meet rising consumer demand for sustainable products. For example, Bangladesh's adoption of over 200 LEED-certified factories has helped transform its image in the global apparel market. At the same time, buyers and regulators increasingly prioritize eco-friendly supply chains, with mechanisms like the EU's Carbon Border Adjustment Mechanism (CBAM) imposing carbon costs on exports with high emissions, pushing firms to adopt greener practices to remain competitive. In Viet Nam, early movers that align with these standards gain a strategic edge, as sustainability credentials are rapidly shifting from being a market differentiator to a prerequisite for global trade and investment.

Finally, it ensures compliance with domestic and international regulations by aligning corporate operations with Viet Nam's legal frameworks for sustainable energy development including the Law on Energy Efficiency and Conservation, the Green Growth Strategy (2021 - 2030, vision to 2050), and the Scheme on Development of Circular Economy, thereby reducing regulatory risks and facilitating smoother market access and trade relations, especially in the context of mechanisms such as the EU's Carbon Border Adjustment Mechanism (CBAM).

2. What are the challenges when promoting sustainable energy development in garment and textile industry?**China:**

- Upfront investment and payback uncertainty: Competing capex priorities,

credit constraints for small and medium-sized enterprises, and uncertainty about utilization and tariff changes.

- Data and measurement: Fragmented metering, limited sub-metering by line/process, and inconsistent baselines complicate decision-making and verification.
- Operational disruption and skills: Retrofitting (e.g., heat recovery, energy management system) requires downtime, new standard operating procedures, and technician upskilling.
- Utility and infrastructure constraints: Grid capacity/quality for electrification; gas availability; roof structural limits for photovoltaic.
- Supply chain complexity and split incentives: Brands set targets while costs sit with tier-1/2 suppliers; contract tenures may be too short to justify investment.
- Policy/market uncertainty: Evolving standards, emission trading system/credit rules, green power availability and pricing.

Indonesia:

In Indonesia, the main challenges are related to the relatively high upfront investment costs for renewable energy and energy efficient technologies, which can be difficult to manage for many companies. There is also room to strengthen technical capacity and awareness so that factories can fully benefit from available solutions. In addition, infrastructure readiness and policy support for renewable energy integration in industrial zones are still developing.

- Companies focus only on equipment replacement instead of holistic approaches.
- Limited number of ISO 50001-certified companies.
- High investment costs for energy-saving technologies.
- Low management awareness about sustainable energy's long-term value.

The Philippines:

- a. High upfront cost.
- b. Limited grid infrastructure.
- c. Low energy conversion efficiency/ technology limitation

Sri Lanka:

- Limited access to finance; high capital costs for sustainable energy projects.
- Physical restrictions for rooftop/off-site renewable installations.

- Lack of renewable power purchase agreements (PPAs) and alternative fuel supply.
- High costs for sustainability certifications.

Chinese Taipei:

- Significant upfront costs in adopting renewable/green tech.
- Operational complexity: manufacturing disruptions and unstable energy supply.
- Gaps in expertise and technology adoption among SMEs.
- Fragmented supply chain and regulatory uncertainty.

Thailand:

The transition to sustainable energy isn't without its challenges. These can be related to financial constraints, technical hurdles, and policy or market barriers.

High Initial Costs: The biggest hurdle for many companies, especially small and medium-sized enterprises (SMEs), is the significant upfront investment required for new technology. This includes the cost of installing solar panels, upgrading machinery to be more energy-efficient, or implementing sophisticated energy management systems.

Lack of Technical Expertise: Many businesses may lack the internal knowledge or access to external experts needed to properly assess, plan, and implement sustainable energy solutions. This can lead to inefficient investments or a failure to realize the full potential of new technologies.

Inconsistent Policies and Regulations: A lack of clear, consistent, and long-term government policies can make it difficult for businesses to justify large investments. Subsidies and incentives may be temporary, and regulations can change, creating an unstable environment for planning.

Viet Nam:

Firstly, the high initial investment costs for renewable energy technologies pose a significant barrier for many garment and textile enterprises in Viet Nam, particularly small and medium-sized enterprises (SMEs), which often lack the financial resources to invest in solar panels, wind turbines, or energy-efficient machinery, thereby hindering the adoption of sustainable energy practices.

Secondly, the limited technical expertise and skilled workforce in implementing and maintaining advanced energy management systems and renewable energy technologies present challenges, as many workers in the textile sector may not possess the necessary training to operate and troubleshoot such systems effectively.

Thirdly, fragmented and inconsistent policy frameworks, coupled with frequent regulatory reversals such as retroactive reductions in feed-in tariffs by Center for WTO and International Trade (VCCI), “Current Status of Green Transition in the Vietnamese Textile and Garment Industry,” WTO Center, EVN affecting 173 solar and wind projects worth approximately USD 13 billion have created an uncertain investment environment that deters long-term commitments to sustainable energy solutions. Industry experts warn that these abrupt changes not only undermine investor confidence but also jeopardize Viet Nam’s renewable energy growth targets.

Fourthly, inadequate infrastructure for renewable energy distribution, especially limited transmission capacity and insufficient energy storage has constrained integration of clean energy into Viet Nam’s grid, leading to frequent curtailments in industrial zones and undermining the reliability needed for textile manufacturing.

Finally, limited access to affordable green finance including concessional loans, targeted incentives, and clear guidelines has constrained textile enterprises, especially SMEs, from investing in sustainable energy solutions. Despite ongoing government initiatives, green credit accounted for only around 4.2% of total outstanding banking loans, and a lack of standardized green project taxonomy and cohesive support mechanisms continues to hamper effective implementation.

3. In your opinion, what solutions do you think are the key for promoting sustainable energy development in garment and textile industry?

China:

- Use renewable energy sources (solar, wind, biomass etc.)
- Use EMS (Energy Management System) or BEMS (Building Energy Management System)

Indonesia:

Use renewable energy sources (solar, wind, biomass etc.) and support from the Government. I believe the combination of renewable energy adoption and strong policy support provides the most effective pathway. Renewable energy offers a direct way to reduce emissions and energy costs, while government policies and incentives can accelerate adoption, especially for small and medium enterprises. Indonesia has already taken important steps in this direction, and continued support will help ensure that the textile sector can fully participate in the energy transition.

- Renewable energy sources → tackle emissions at the root.
- Energy Management Systems (EMS) → systematic monitoring and optimization of energy use.

The Philippines:

- A. Use renewable energy sources (solar, wind, biomass etc.)
- B. Use heat recovery ventilation
- C. Use **EMS (Energy Management System) or BEMS (Building Energy Management System)**
- D. Use Internet of Things
- E. Support from the Government

Sri Lanka:

- Renewable energy sources → critical for emissions reduction and competitiveness.
- Government support → needed to reduce costs and provide incentives.

Chinese Taipei:

- Government support → essential to overcome cost and regulatory barriers.
- Heat recovery ventilation → improves energy efficiency within facilities.

Thailand:

Use renewable energy sources (solar, wind, biomass etc.): Directly shifting the energy source is the most impactful way to reduce the industry's carbon footprint. It tackles the root cause of emissions, unlike efficiency measures that only reduce the amount of energy used. While efficiency is important, replacing fossil fuels with renewables provides a more fundamental and long-term solution.

Support from the Government: This is crucial for overcoming the financial and policy-related challenges. Government support in the form of subsidies, tax incentives, favorable loan programs, and clear long-term policies can significantly reduce the financial risk for companies. This support makes it economically viable for businesses, particularly SMEs, to invest in sustainable energy technology and infrastructure.

4. Please share some policies/ laws/ regulations that your economy is applying to promote sustainable energy development in garment and textile industry.

China:

- Dual-Carbon Goals (Peak before 2030, Neutrality before 2060): Sets domestic direction and sectoral roadmaps.
- 14th Five-Year Plan for the Textile Industry (MIIT, PRC): Emphasizes green manufacturing, energy efficiency, digitalization, and cleaner production in key processes (spinning, weaving, dyeing/finishing).

- Industrial Energy Efficiency Improvement Action Plan (MIIT, PRC): Benchmarks and retrofits for key energy-using industries; promotes advanced efficient equipment and heat system optimization.
- Cleaner Production Promotion Law and sector guidance: Drives audits and upgrades in printing/dyeing, with targets for water, energy, and chemicals reduction.
- ETS (Emissions Trading System): Expanding coverage and establishing carbon pricing signals that influence power and heavy- industry inputs to textiles.
- Renewable Energy Law & Green Power Trading + Green Electricity Certificates (GECs): Enables enterprises to procure certified green electricity through market mechanisms and Power Purchase Agreements (PPAs).
- Green Manufacturing System (MIIT, PRC): Recognition and guidance for “Green Factory”, “Green Supply Chain”, and “Green Industrial Parks”, including many textile firms and parks.

Indonesia:

- Industrial Decarbonization Roadmap (2025–2050): An initiative being developed to guide emission reduction through energy efficiency, fuel substitution, electrification, and process optimization.
- Energy Policy (Kebijakan Energi Nasional): A long-term framework that provides direction for increasing renewable energy use and promoting energy efficiency across industries.
- Gov. Reg. No. 33/2023: mandatory EMS for companies using >4000 TOE.
- MEMR Reg. No. 8/2025: general framework for energy management.
- MEMR Reg. No. 3/2025: specific measures on energy conservation.

The Philippines:

The Renewable Energy Act of 2008 (RA 9513) promotes the rapid development of renewable energy sources to meet the growing demand for environmentally friendly electricity. The law has spurred numerous solar projects economy-wide by offering tax incentives, duty-free importation of renewable energy equipment, and priority grid connections. These measures have significantly contributed to the growth of the solar sector, supporting the transition to sustainable energy solutions.

Sri Lanka:

- Feed-in-Tariff scheme to encourage renewable generation.
- Open Access policies for renewable energy projects.

Chinese Taipei:

- 2050 Net-Zero Roadmap: transition from coal to renewables and gas.
- Energy Management Act: mandates audits, offers subsidies for efficiency projects.
- Circular Economy Plan: promotes reuse/recycling, e.g., sludge use in textiles.
- Green Finance Action Plan 3.0: financial tools for sustainability investment.
- Support for ISO 50001 adoption and Global Recycled Standard (GRS).

Thailand:

- Power Development Plan (PDP) 2024: target 51% renewable share in power mix by 2037.
- Domestic goals: carbon neutrality by 2050; net-zero emissions by 2065.
- External pressures: EU CBAM (fees from 2026), US CCA carbon tariff.
- Government incentives: BCG model, BOI investment support, rooftop solar license removal, proposed Net Metering policy.
- Energy Efficiency Plan: 30% reduction in energy intensity by 2037.

Viet Nam:

Viet Nam has implemented several key policies and legal frameworks to promote sustainable energy development in the garment and textile industry:

- Decree No. 57/2025/ND-CP on Direct Power Purchase Agreements (DPPA): Issued on 03 March 2025, this decree regulates the mechanism allowing large electricity consumers to purchase renewable energy directly from producers. It aims to facilitate the transition to cleaner energy sources and reduce greenhouse gas emissions in industrial sectors, including textiles.
- Decision No. 222/QD-TTg on the Action Plan for Circular Economy by 2035: Approved on 23 January 2025, this decision outlines strategies to establish a sustainable production and consumption system, emphasizing resource efficiency, recycling, and waste reduction across various sectors, including

textiles. 15

- Circular No. 16/2025/TT-BCT on the Viet Nam Wholesale Electricity Market (VWEM): Effective from 01 February 2025, this circular sets regulations for the VWEM, including criteria for large power consumers and procedures for participating in renewable energy transactions, supporting the implementation of DPPAs.

These legal instruments collectively support the adoption of sustainable energy practices in Viet Nam's garment and textile industry, aligning with global sustainability goals and enhancing the sector's competitiveness.

5. If possible, please share a case study/ case studies where a garment and/or textile company successfully promoting sustainable energy development in your economy.

Indonesia:

- One example from Indonesia is Asia Pacific Rayon, an integrated viscose rayon producer. The company has introduced the use of cellulose-based fibers that are renewable and biodegradable, and has developed a blockchain-based traceability system ("Follow Our Fibre") to provide transparency in its supply chain. These initiatives illustrate efforts within Indonesia's textile sector to combine material innovation with energy and resource efficiency in production.
- PT Chang Shin Indonesia (footwear):
 - Certified ISO 50001 for energy management.
 - Focuses on electrification of production lines and efficiency upgrades.
 - Winner of the CEM 2024 Energy Management Award.

The Philippines:

- a. RGC Textiles, also known as RGC Fabrics, is a business unit of the RGC/Uratex Group of Companies in the Philippines. It is a supplier of various types of fabrics for furniture, upholstery, and apparel. It is the only textile company making fabrics for upholstery. The company is known for its focus on quality and innovation, including using recycled materials in its products called Rehibla or Refiber. In 2023 through contracts with Renewable Energy Supplier, 8 of the factories within the Uratex Group of Companies including its textile manufacturing arm, are now powered with clean energy. According to their report 53% of the power used in their operation which includes weaving and textile assembly, are sourced from Renewable Energy. Uratex is also using LED lights and electric vehicle in

its various offices, plants, and factories to conserve energy without sacrificing the quality. They are also a long-time client of the Institute's Testing and Standards Laboratory.

Chinese Taipei:

- *Fulltide Company (founded 1973):*
 - Uses digital manufacturing systems for real-time monitoring.
 - Applies lean production principles to reduce waste.
 - Introduces green innovations in processes and materials.

Thailand:

- *PASAYA (Textile Gallery Co. Ltd.):*
 - Implements on-site renewable energy generation.
 - Promotes innovative material circularity.
 - Seen as a blueprint for the industry's green transformation.

Viet Nam:

a. Dalat Worsted Spinning (Lam Dong Province) - The first worsted spinning mill in Viet Nam deployed a 2.04 MWp rooftop solar system with over 3,400 panels, providing green electricity for production and lowering the factory's carbon footprint in global textile supply chains.

b. Men-Chuen Viet Nam (Dong Nai Province) - Partnering with Total Energies, Men-Chuen installed a 950 kWp solar system that supplies about 1,300 MWh of clean electricity each year. This reduces over 500 tons of CO₂ emissions and lowers electricity costs while strengthening its global sustainability credentials.

c. Song Hong Garment (Nam Dinh Province) - In partnership with CME Solar, Song Hong adopted a no-cost rooftop solar investment model in which CME Solar fully financed, operated, and maintained the rooftop systems. The first two installations generate approximately 1.27 million kWh and 0.83 million kWh annually, respectively. Together, these systems reduce around 2,000 tons of CO₂ emissions per year and preserve the environmental equivalent of 33,000 trees.