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Stimulating Social Application of Energy-Efficient Technology for Climate Change Mitigation

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Abstract

Climate change is a multidimensional problem at the nexus of energy, environment and ecosystems (3E). In order to successfully tackle the issue of climate change, it is essential, as it agree at Conference of the Parties (COP) 21 in Paris, 2015, for both developed and developing countries to attain low-carbon growth by fully mobilizing technological and financial means through public-private cooperation. The Joint Crediting Mechanism (JCM) targets to facilitate the diffusion of advanced low-carbon technologies, products, systems, services and infrastructure, which advance mitigation action and contribution to global sustainable development (MOEJ, 2017). Japan advanced technologies, like high efficiency heat pumps can contribute to low-carbon growth more widely and expeditiously in developing countries. The main purpose of this paper to assess JCM carbon credit mechanism, which designed to allow flexible technology transfer and mitigation measures can potentially reduce the greenhouse gas emissions (GHG) and to promote application of energy-efficient technologies to society of developing countries, leading them to sustainable development. Nevertheless, the consideration of the incentive structures such as markets, rules, norms, and scientific information that can most effectively improve social applications to energy efficiency.

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Keywords: Joint Crediting Mechanism, Energy-Efficient Technology, Mitigation, Developing Countries

1. Introduction

The recent debate on climate change as shifted from an emphasis on how to mitigate the effects of increasing greenhouse gas (GHG) emissions. In order, to address the issue of climate change, it is essential for both developed and developing countries to attain low-carbon growth all over the world by fully mobilizing technology, markets and finance through public-private partnership. An Intergovernmental Panel on Climate Change (IPCC) mitigation assessment and other recent literature emphasis mainly on climate change mitigation as an integral element of development policies. Energy efficiency is an important element that the effective use of resources would lead to lower global greenhouse gas (GHG) emissions (IPCC: Sathaye et al. 2007). For instance, in many countries, energy efficiency has emerged as a substantial means of reducing GHG emissions to support climate change mitigations strategies, in particular lower consumption of fossil fuels is an additional benefit of reduced GHG emissions. The energy efficiency refers to different technologies such as heat pump systems, which are focused at solving problems related to energy use whether at industrial and national capacities so as to minimize emission of greenhouse gases that causes to global warming together with decreasing financial costs (Ganda and Collings, 2014). The key objective of the UNFCCC (stated in its Article 2) for stabilization of GHG concentrations to a level, that evades dangerous interference with the climate system. Although, for successful implementation of sustainable energy, it is necessary to design and implement policies that are responsive to their desires and

constraints for developing countries (Dilip and Marika, 2009). A new market-based mechanism named Joint Crediting Mechanism (JCM) under the guidance and authority of the Conference of the Parties (COP), developed and implemented by parties individually or jointly, to facilitate diffusion of leading low carbon technologies and mitigation actions in developing countries (MOEJ, 2017).

The purpose of this paper is to provide the international dynamics of innovation and market mechanisms of energy efficient technologies in the assessment of climate change mitigation. Secondly, the impacts of mechanisms on new technologies and knowledge on energy-efficient technologies at the regional and global level in the part of sustainable development in developing countries. Therefore, this paper aims to introduce carbon credit mechanism, such as JCM, to promote application of energy-efficient technologies includes heat pump systems, to society of developing countries, leading them to sustainable energy efficiency improvements. The paper is structures as follows: Section 2 introduces mechanisms for climate change mitigation. This is followed by linking Japan and developing countries in Asia, Africa, Pacific, South America and Mesoamerica for emissions reduction. Section 4 presents implementation of integration of 3E nexus applying Japan and other developing countries. Capacity building for energy efficiency services in Section 5. The developments of co-benefits such as social applications through 3E Nexus approach are represented in Section 6. Finally, concluding remarks are presented in the last section.

2. Market Mechanisms for Mitigation Actions

Joint implementation (JI) is one of two offsetting mechanisms under the Kyoto Protocol besides with the Clean Development Mechanism (CDM). Predominantly, it permits countries with emission reduction commitments under the Kyoto Protocol to Emission Reduction Units (ERUs) from greenhouse gas (GHG) abatement projects and transfer them to Annex B countries (Kollmuss et al. 2015). So far, a few studies has been done for JI mechanism compare with the Clean Development Mechanism (Kollmuss et al. 2015, Shishlov et al. 2012, Sterk 2008, Gaast 2002, Jackson 1995). Predominantly, there is a no in-depth evaluation has been done to date for the environmental integrity. It is important that the new international market mechanisms would ensure environmental integrity, in particular for countries with a substantial Assigned Amount Units (AAU) surplus. Several countries agreed to support for continuing to use market mechanisms under the United Nations Framework Convention on Climate Change (UNFCCC), including the existing mechanisms CDM and JI, as well as `new market mechanism` and a `framework for various approaches (FAV`s)` (UNFCCC 2013b, UNFCCC 2012).

The Clean Development Mechanism (CDM) established under the Kyoto Protocol (KP) in 1997 in which the CDM project permitted countries committed to the protocol to make commercial certified reduction credits (CER), KP: Article 12. The carbon credits increase the environment`s capacity to engross carbon, and over investment in sustainable development projects, which reduce emissions in Annex B countries itself (Petersen and Bollerup, 2012). Under the KP, the industrialized Annex A countries can use the carbon credits by trade or sold from the Annex B countries to meet their targets (UNFCCC 2011). The criticism of the CDM includes a broader ethical cynicism differ from how the certified reduction emissions are traded against each other and it leads to resulting in a new carbon colonialism (Blok 2010).

In response, a new market-based mechanism, JCM is developed by Government of Japan under the guidelines of COP, is one of the various approaches based on Decision 1/ CP. 18 developed and implemented by host country and Japan. The JCM aims at facilitating diffusion of leading low-carbon technologies, products, systems, services and infrastructure, which advance mitigation action and contribution to global sustainable development of Annex B countries. Moreover, it boasts advanced technologies like heat pump systems with the world's highest level of energy-efficiency, including in the area of power generation, home electrical appliance, steel and cement (Government of Japan, 2014). Japan's advanced technologies are expecting to contribute to achieving low-carbon growth more widely and expeditiously in the developing countries. By evaluating contributions made by Japan to GHG emission reductions or removals in a quantitative manner through using robust measurement, reporting and verification (MRV) methodologies (Figure-1). However, the intents to use emission reductions attained through the JCM toward it emission reduction target (Government of Japan, 2013).

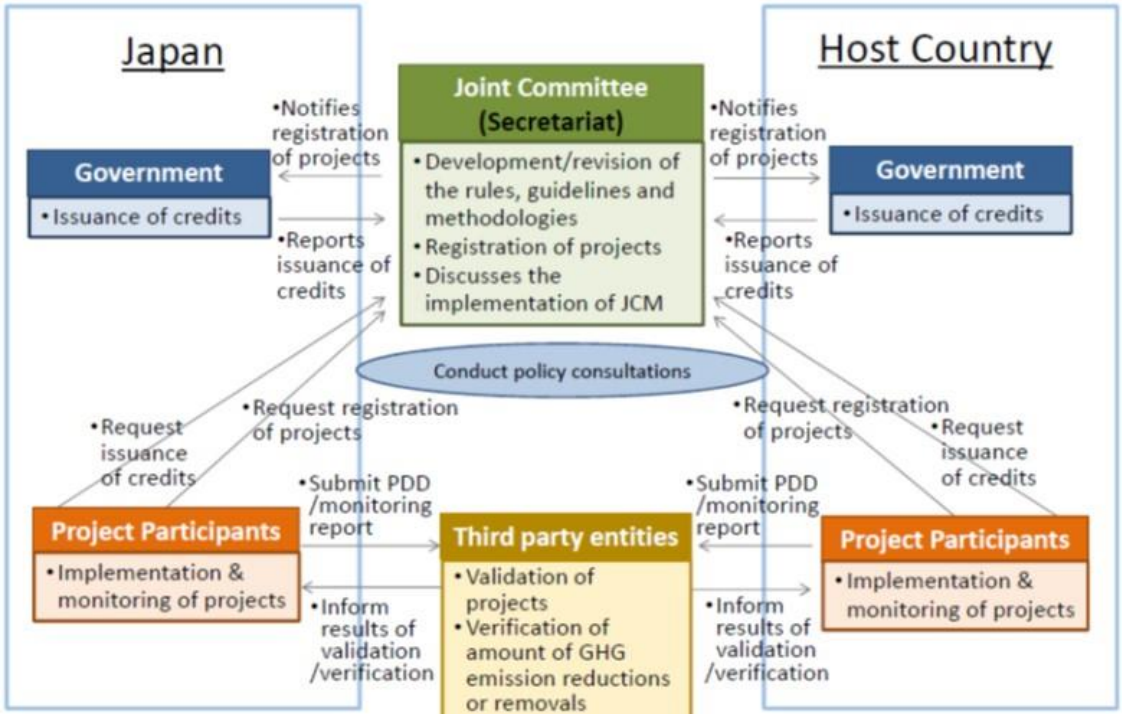

Figure-1: JCM Scheme between Japan and host country adapted from MOEJ, http://www.mmechanisms.org

The JCM is likely a great scheme through which the Japanese industries can contribute energy efficiency and to reduce emissions in developing countries. Notably, the procedures of JCM ensuring environmental integrity, ways to avoid double counting and transparency. A fascinating feature of the JCM is the credits will not be tradable internationally in the initial phase but once the mechanism develops and it`s recognized to be sustainable then the credits might be tradable internationally (Sugino et al. 2015).

3. Linking Japan and developing countries for emissions reduction

The promotion of Joint Credit Mechanism (JCM) technologies with potentially significant long-term impacts on carbon emissions in developing countries, and to provide technical knowledge necessary to implement GHG emissions reduction projects under this mechanism contribute to sustainable development of developing countries (Government of Japan, 2016).The projects included in the Demonstration Studies (DS), Feasibility Studies (FS), Model projects, Planning Studies PS and REDD+ from energy- efficient chillers, boilers, heat pump system with combination of cooling and heating, LED, waste management of power plants, electric vehicles, and biomass-based power generation (Figure-2). Consequently, the wide range of sectors are apparently eligible for the JCM. The Japanese government has officially signed bilateral documents about the JCM with 17 countries includes Asia, Africa, Pacific, South America and Mesoamerica in December 2016. Besides, the first JCM project was Ethiopia, Malaysia, Mexico and Saudi Arabia. This scheme was introduced in 2013 and the scope of financing includes equipment, facilities, and vehicles that reduce CO2 from fossil fuel combination as well as construction cost for installing those amenities. The Ministry of the Environment Japan (MOEJ) supports the initial cost (up to half) on the evidence of seeking to deliver at least half of the issued JCM credits to the Government of Japan (GEC, JCM 2017). In case of feasibility studies (FS), again Indonesia dominates highest projects followed by Vietnam, Mongolia, Myanmar, and other African, South American countries. On the other hand, REDD+ scheme was launched in 2015 and countries involved are Indonesia, Mongolia, Cambodia and Laos PDR, the purpose this scheme is to implement activities of REDD+ contributing to achieve Japan`s emission reduction target through the JCM. As above all, the bilateral joint committee had approved 27 methodologies in 10 countries as of November 2016.

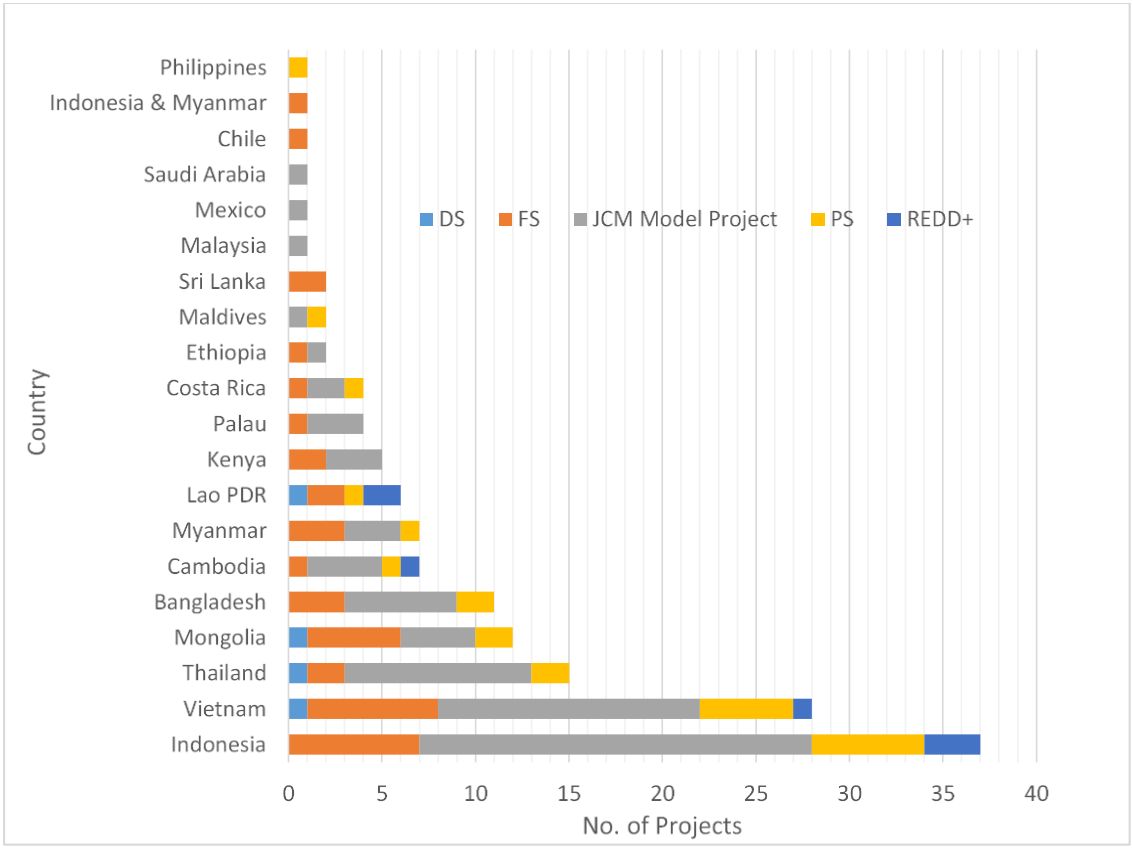

Figure-2: Country-wise JCM (DS, FS, Model, PS and REDD+) Projects in 2013-16

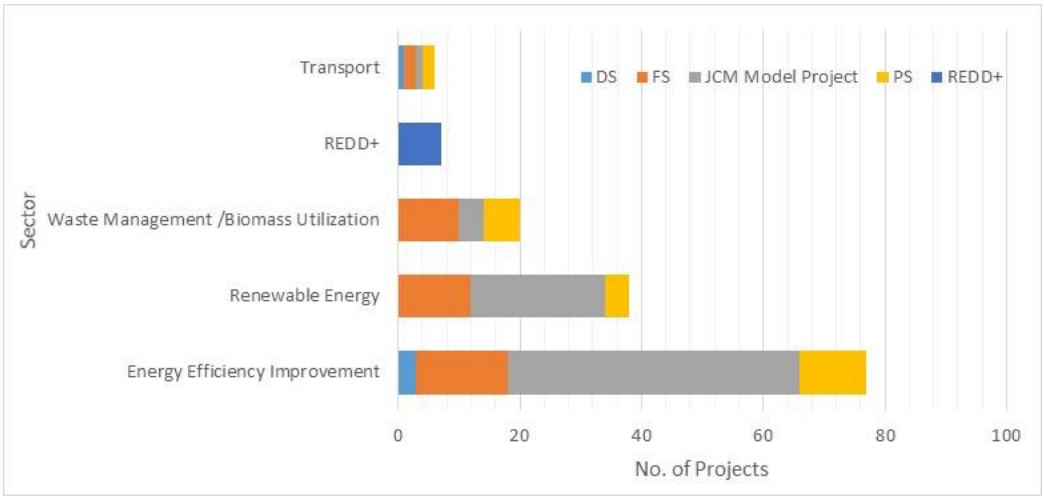

Figure-3: Sector-wise JCM (DS, FS, Model, PS and REDD+) Projects in 2013-16

Most of the JCM model projects were focused mainly on the energy-efficiency improvement (for e.g. heat pump, air conditioning, chiller, LED, boilers, building energy management (BEMS)) followed by the renewable energy (solar power system, hydro power plant etc.), waste management/biomass utilization (waste to energy) and transport (digital tachograph system). However, the number of feasibility studies are accounted higher distribution in energy-efficiency and renewable energy (Figure-3). The contributions of transport and REDD+ projects are still low in this period. Particularly, energy efficient heat pump systems have been adopted a greater scale in Japan for a range of application in residential, commercial and industry etc. However, Japanese heat pump systems has been

successfully implemented under a collaborative JCM model project named "Energy Saving by Installation of Double Bundle-Type Heat Pump" involving between Japanese (Toyota Tsusho Corporation) and Indonesian (PT. TTL Residences) partners. In order to reduce the diesel oil consumption and electricity consumption by using the double bundle-type heat pump system. On the other hand, one of the JCM feasibility studies initiated in Thailand on 2013, which use advanced heat pump systems to improve energy efficiency in food and beverage sector (GEC, JCM, 2017). Promotion and extensive diffusion of advanced heat pump technologies would be beneficial to Japan and host countries through collaborative business models.

4. Capacity Building for Energy Efficiency Services

The implementation of Energy, Environment and Ecosystem (3E) nexus is mainly to establish the formal strategy for project communications and capacity development to disseminate current negotiations on market mechanisms as well as on the JCM project so that the participants from public and private sector can improve their understanding of the climate change mitigations. Hence, the integration of energy, environment and ecosystem (3E) nexus is one of these efforts initiated by Integrated Research System for Sustainability Science (IR3S) to enhance research collaboration on 3E Nexus approaches for sustainable future in targeted Asia and the Pacific countries with reference to Japan. However, the transformations towards sustainability require partnership that engages a wide variety of stakeholders who are working on mitigation actions (Figure-4). Although, to transform society, it is vital to engage with stakeholders and community members to find ways in which science can solve real problems in society. This initiative would contribute to develop knowledge to understand, implement and evaluate these transformations. The innovative long-term transformations required moving towards a sustainable future for combining expertise across disciplinary and sectoral through integration of transdisciplinary approaches such as sustainability science.

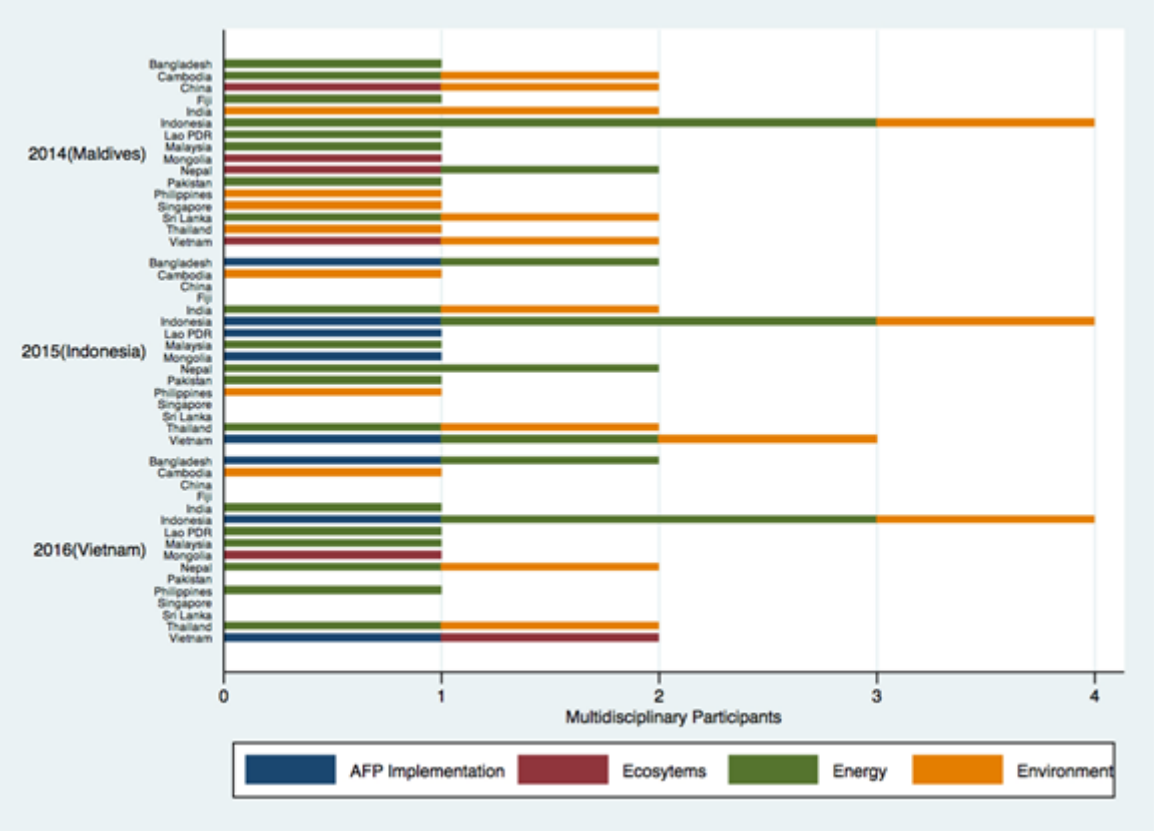

Figure-4: Year-wise transdisciplinary stakeholder meetings in Maldives, Indonesia and Vietnam

Integration of transdisciplinary approach can be bringing together natural, social and human sciences, are key to build the necessary knowledge for sustainable development at all levels. Mutual dialogue between scientists and

policymakers is needed to provide a scientific basis for policymaking. The problems to be solved should not be predetermined by the scientific community, but rather be defined cooperatively by science and society. It is also important to consider the incentive structures such as markets, rules, norms, and scientific information that can most effectively improve social capacity to energy efficiency. A strengthened energy-environment-ecosystem interface is required for ensuring that scientific research; technology development and policy both address the needs of society and respond to climate change mitigation. Furthermore, the capacity of public and private sectors would understand the results and ability to communicate the value that energy efficiency can deliver for economy and society (OECD, 2014). The energy management is a vital issue to disseminate energy efficiency in a suitable platform such as 3E Nexus One Stop Service/ Academic Focal Person (AFP), (for more details http://www.ir3s.u-tokyo.ac.jp/3e-nexus/events/afp/index.html) particularly for high efficient introduction like heat pump systems.

5. Development of co-benefit indicators

Co-benefit indicator is needed in order to objectively compare the additional positive impacts of mechanisms whose main purpose is to reduce GHGs but also aims to achieve sustainable development in an integrated manner in host countries. Co-benefits are expected in sectors like air, water, waste, and energy. Some of the co-benefits are reduction of air pollution from reducing electricity generation and fossil fuel combustion and transitioning from coal to cleaner fuels, reduction of waste from utilization of biomass, reduced costs from increasing energy efficiency technologies, and increased employment from cumulative use of renewable energies. Progress of heat pump performance considered that a reduction in electricity input that specifies rise in captured energy and energy efficiency are achieved simultaneously (Shibata, 2011). For assessing a co-benefit, the above indicators must be evaluated in choosing JCM projects. One of the working groups developed sustainability indicator for biomass utilization in East and Southeast Asia (Kudoh et al, 2015). This group recommended that three-sustainability pillar that consist of main (environmental, economic and social pillars) and for the secondary (co-benefit) indicators are water consumption, soil quality for environmental; net profit, productivity and net energy balance for economic; and finally human development index is for social pillar.

On the other hand, co-benefits are added benefit other than climate change and air pollution-related projects. Palm oil mill industries, energy sectors, industrial sectors, and carbon capture and storage concept are also having potential co-benefits. For instance, in case of palm oil mill industries, utilization of palm oil waste, methane capture is the main benefit that relate to climate change and air pollution. However, other benefits were energy from waste utilization. Methane capture and fermentation of solid waste from palm oil produce sufficient energy to fulfill the plant energy requirement. Predominantly, it will reduce the waste loading to the environment and operational cost of the plant (AFP Indonesia final report, 2016).

6. Conclusions

The selection of qualified Clean Development Mechanism projects is limited (Ellis and Kamel, 2007). For instance, hydropower and winder power projects accounts for 64 per cent of CDM projects, whereas, the energy efficiency projects constitute fewer than 3 per cent. Nonetheless, in the case of JCM, varieties of activities are apparently eligible for the JCM (Sugino et al. 2015).

Most of the JCM model projects were focused mainly on the energy-efficiency improvement, followed by the renewable energy, waste management/biomass utilization, transport and REDD+. The highest number of projects includes feasibility and model in Indonesia, Vietnam, Thailand and other South Asia, Africa, South America countries. Particularly, the procedures of JCM has ensuring environmental integrity and transparency.

The implementation of 3E nexus played a crucial role to disseminate the current negotiations on market mechanisms as well as importance of JCM scheme to contribute climate change mitigations in the public and private sector platform. However, the energy efficiency will improve both the basis of economic analysis and policy options that needs of society and respond to sustainable societies. The co-benefits are predictable in sectors like energy efficient technologies and renewable energy. Some of the co-benefits factors such as reducing costs using advanced technology for increasing energy efficiency and expanding use of renewable energy leads to increasing employment, which are enhancing social applications to climate change mitigation.

Finally, under the JCM scheme, a wide range of projects, which are using higher efficiency of heat pump systems has been initiated and implemented in Indonesia, Mongolia, Thailand, and Vietnam for improving energy-efficiency improvements in residential, commercial and industries includes food and beverages sectors; as well as considerable energy saving and reduction in carbon emissions compared to conventional heating technologies.

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