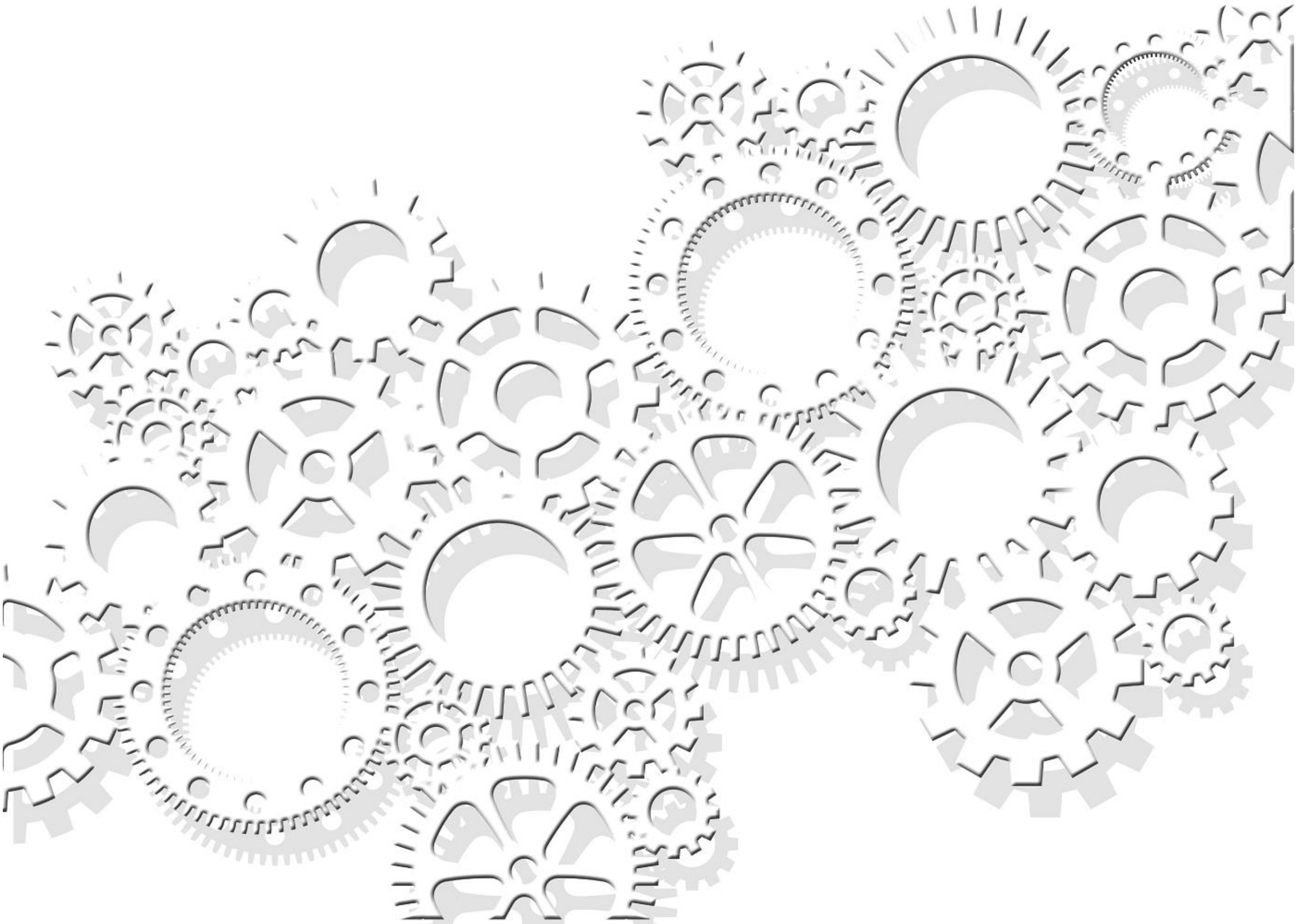
Potential Advantages of the JCM (Joint Crediting Mechanism) Implementation in India - Benefits and Contributions towards the Achievement of NDCs



Naoki Torii, Abdessalem Rabhi

IGES Institute for Global Environmental Strategies
公益財団法人 地球環境戦略研究機関

IGES Discussion Paper

Acknowledgment

This paper is produced as a part of the commissioned work "Implementing research on major countries actions related to climate change and conducting strategic dialogue in FY2019" [1] from the Ministry of the Environment, Japan. The authors would like to thank The Energy and Resources Institute (TERI India), which is a long-standing research partner of IGES, for giving valuable comments and inputs on this paper.

[1] Tentative translation by authors

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Naoki Torii, Abdessalem Rabhi

Institute for Global Environmental Strategies (IGES)
2108-11, Kamiyamaguchi, Hayama, Kanagawa,
240-0115, Japan
Tel : +81-46-855-3700 (General), 046-855-3828 (Direct)
Fax : +81-46-855-3709 E-mail: iges@iges.or.jp URL: www.iges.or.jp

Summary

The Government of Japan, together with its 17 partner countries, has been implementing mitigation actions through a market-based mechanism called the JCM (Joint Crediting Mechanism) since 2013 (GoJ 2018). Currently, there are over 150 ongoing projects in these partner countries, in various fields, including renewable energy, energy efficiency, transport, waste management, F-gas countermeasures, and forestry.

Japan and India have long considered the possibility of establishing the JCM as has been stipulated in joint statements between these two countries (MOFA 2014, 2016, 2017 and 2018). However, an official bilateral document to start the JCM has not yet been signed.

The JCM is one of the market-based mechanisms which involves Internationally Transferred Mitigation Outcomes (ITOMs) utilised by Parties as stipulated in Article 6 of the Paris Agreement. Each Party has set a mitigation target in a nationally determined manner, so it is important to gain a better understanding of how this type of cooperative approach can contribute to a country achieving such targets.

This paper aims to capture what kind of benefits and contributions can be achieved through the implementation of the JCM between Japan and India by introducing the current progress, basic structure and good practices of the JCM so far, as well as identifying technology needs and potential project types and sectors in India. The target audience consists of policymakers and private sector entities in both countries. Taking into account this information and analysis, the paper proposes a possible way forward towards operationalisation of the JCM between Japan and India.

To that end, the paper overviews the current progress of the JCM under which there are 67 approved methodologies, 45 registered projects, and 21,608 t-CO_2 issued credits from 19 projects (JCM website 2019). The accumulated mitigation impact from the 100 JCM model projects which were selected by 2017 is estimated to be nearly 8 million t-CO_2 by 2030 (MOEJ 2019). The JCM is steadily growing, and there are already good practices which can contribute to emission reductions even beyond the JCM through the horizontal expansion of low-carbon technologies triggered by a JCM project. Such good practices include technology transfer such as localisation of production processes and spec-in of technical advantages for highly efficient technologies in procurement processes. Other practices are the development of businesses based on a model project under the JCM through showcasing advantages of advanced technology incentivising private sectors for replication of the same type of projects, and projects based on city-to-city cooperation between Japan and a partner country facilitating multilateral cooperation including government-to-government, government-to-private, and private-to-private collaborations. There are also practices such as projects implemented in conjunction with a regional economic development plan, including the promotion of job creation and cleaner energy and integrated approaches, including policy

measures such as standardisation for low-carbon technology.

The paper also overviews mitigation potential in India. India has tremendous potential for emission reductions in those industries targeted under the Perform, Achieve and Trade (PAT) scheme as well as in the SMEs sector, along with promoting waste-to-energy projects if appropriate finance and technologies are provided.

The JCM can be one way to facilitate the transfer of finance and technologies and can contribute to achieving the NDCs set by both Japan and India. Implementation of the JCM is beneficial for both countries even under the Paris Agreement, as the conservative nature of the methodologies can ensure a win-win situation for both Japan and India, whereby trade-offs are not created by pure offsetting but rather, merits of emission reductions are always given to the host country even by transferring credits under market mechanisms through realisation of “net emission reductions”. The mechanism’s effectiveness can further be enhanced in conjunction with several other channels for cooperation, including actions for the catalisation of business-to-business matchmaking such as JITMAP (Japan–India Stakeholders’ Matchmaking Platform).

In joint statements of summit meetings between Japan and India, the possible establishment of the JCM between the two countries was touched upon several times (MOFA 2014, 2016, 2017 and 2018). Taking this into account, expectations are high to further accelerate the consultation process in the near future. To expedite the process to establish the JCM, this paper proposes taking a two-track approach whereby consultations/seminars for government officials are organised on the one hand, while workshops for potential project participants are also carried out to familiarise them with the mechanism and ensure that they are ready for early project development and implementation, which is the most important aspect of the JCM. This two-track approach would enhance understanding of the JCM as a whole package among the public and private sectors in the country and confirm the benefits for establishing the mechanism to contribute to actual emission reductions.

Table of Contents

List of Abbreviations

ADB	Asian Development Bank
BAU	Business as usual
BOP	best operating practices
COP	Conference of the Parties
COP	coefficient of performance
CPCB	Central Pollution Control Board
DCs	Designated Consumers
GDP	Gross Domestic Product
GoI	Government of India
GoJ	Government of Japan
IGES	Institute for Global Environmental Strategies
IoT	Internet of Things
ITMOs	internationally transferred mitigation outcomes
JCM	Joint Crediting Mechanism
JPY	Japanese Yen
METI	Ministry of Economy, Trade and Industry
MNRE	Ministry of New and Renewable Energy
MOEJ	Ministry of the Environment, Japan
MRV	measurement, reporting and verification
NDCs	Nationally Determined Contributions
PAT	Perform Achieve and Trade
PDD	Project Design Document
SDGs	Sustainable Development Goals
SMEs	Small and Medium-sized Enterprises
TERI	The Energy and Resources Institute

1. Background and objective of the paper

The Government of Japan, together with 17 partner countries[2], has been implementing mitigation actions through a market-based mechanism called the JCM (Joint Crediting Mechanism) since 2013 (GoJ 2018). Currently, there are over 150 ongoing projects in these partner countries, in various fields, including renewable energy, energy efficiency, transport, waste management, F-gas countermeasures, and forestry.

Japan and India have long considered the possibility of establishing the JCM as has been stipulated in joint statements between these two countries (MOFA 2014, MOFA 2014, 2016, 2017 and 2018)[3]. However, an official bilateral document to start the JCM has not yet been signed. For example, the JCM between Japan and India have been touched upon several times in the joint statement of the summit meeting between two countries. Japan- India Vision Statement, which was adopted after the latest summit meeting in 2018, stipulates as follows:

"21. The two Prime Ministers underlined the importance of their growing collaboration for achieving the Sustainable Development Goals (SDGs). They committed themselves to strengthen environmental partnership in areas such as pollution control, sustainable biodiversity management, chemical and waste management, climate change, and wastewater management, utilizing the cooperation framework between their relevant authorities. Underscoring the need for concerted global action to combat climate change, in line with the Paris Agreement adopted under UN Framework Convention on Climate Change (UNFCCC), they shared the view to play a leading role in this field, and reiterated their commitment to finalising the work programme for implementation of the Paris Agreement and accelerate further consultations for establishing the Joint Crediting Mechanism." (MOFA 2018)

The JCM is one of the possible market-based mechanisms which involves Internationally Transferred Mitigation Outcomes (ITMOs) utilised by Parties as in Article 6 of the Paris Agreement which stipulates that "*Parties recognize that some Parties choose to pursue voluntary cooperation in the implementation of their nationally determined contributions to allow for higher ambition in their mitigation and adaptation actions and to promote sustainable development and environmental integrity*" and "*Parties shall, where engaging on a voluntary basis in cooperative approaches that involve the use of internationally transferred mitigation outcomes towards nationally determined contributions, promote sustainable development and ensure environmental integrity and*

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[2] According to the JCM website <https://www.jcm.go.jp/> partner countries as of April 2019 are Mongolia, Bangladesh, Ethiopia, Kenya, Maldives, Viet Nam, Laos, Indonesia, Costa Rica, Palau, Cambodia, Mexico, Saudi Arabia, Chile, Myanmar, Thailand and the Philippines.

[3] For example, in the joint statement in 2014, it is mentioned that (the two Prime Ministers) "shared the view to continue consultations regarding the Joint Crediting Mechanism."

transparency, including in governance, and shall apply robust accounting to ensure, inter alia, the avoidance of double counting, consistent with guidance adopted by the Conference of the Parties serving as the meeting of the Parties to this Agreement" (UNFCCC 2015). Each Party to the Paris Agreement sets a mitigation target in a nationally determined manner, so it is important to gain a better understanding of how this type of cooperative approach can contribute to a country achieving such targets.

This paper aims to capture what kind of benefits and contributions can be achieved through the implementation of the JCM between Japan and India, especially regarding efforts towards the achievement of the NDCs (Nationally Determined Contributions) under the Paris Agreement. The target audience consists of policymakers and private sector entities in both countries. To that end, the paper introduces the current progress, basic structure, and good practices of the JCM so far, as well as identifying technology needs and potential project types and sectors in India. Taking into account this information and analysis, the paper proposes a possible way forward towards operationalisation of the JCM between Japan and India.

2. Basic concept and the current progress of the JCM

The JCM is one of the cooperative approaches involving transaction of ITMOs utilised by Parties to the Paris Agreement, as mentioned in Chapter 1 above. Each Party to the Paris Agreement sets a mitigation target in a nationally determined manner, so it is essential to deepen understanding of how this type of cooperative approach can contribute to a country achieving such targets. In this section, the basic concept of measurement, reporting, and verification (MRV) methodologies and current progress of the JCM are overviewed.

2-1. Approaches for crediting through MRV methodologies in the JCM

The JCM introduced the concept of "net emission reductions" in line with the Conference of the Parties (COP) decision 1/CP.18[4] for a framework for various approaches (UNFCCC 2012), which is also included in the COP decision 1/CP.21[5] for a mechanism to contribute to the mitigation of greenhouse gas emissions and support sustainable development (UNFCCC 2015). The concept of "net emission reductions" is understood, under the JCM, as the amount of emission reductions that occurs by implementing JCM projects but not to be credited, hence not to be used as credits towards mitigation obligations. The realisation of this portion of emission reductions which are not to be credited is

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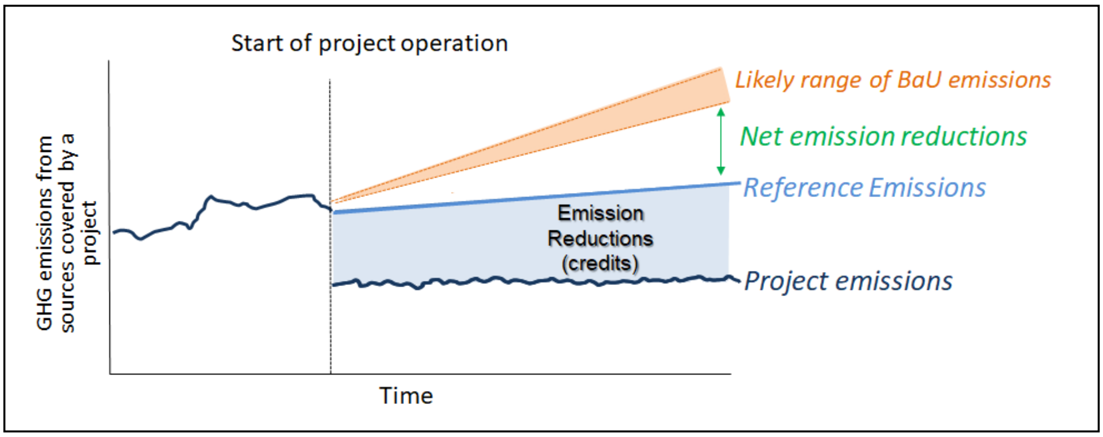
[4] *"all such approaches must meet standards that deliver real, permanent, additional and verified mitigation outcomes, avoid double counting of effort and achieve a net decrease and/or avoidance of greenhouse gas emissions"*

[5] *"To deliver an overall mitigation in global emissions."*

ensured under the JCM, by applying MRV methodologies. These enable a conservative calculation of emission reductions by establishing reference emissions below BAU emissions as a crediting baseline, as shown in Figure 1 below.

Figure 1 Basic Concept for Crediting under the JCM



(Based on figures from GoJ 2018)

For example, when installing a high-efficiency chiller, reference emissions are set based on the catalog data of the performance indicator, or the coefficient of performance (COP), which are higher than those values based on the conventional models generally used in a host country. This higher COP is usually set as the value of the most efficient model which is commercially available, but not yet widely disseminated in a host country. Identification of the COPs is based on, for example, outcomes of research and interviews regarding the market in the host country. Another example is the case of introducing renewable energy, for which the methodology establishes a conservative emission factor which is below the figure made available by a host country government for the calculation of emissions from consuming electricity in that country. Such values are typically established by identifying the most efficient thermal power generator in the host country and calculating the emission factor based on its efficiency. This is not based on the operating margin of the grid, considering all the power plants connected. The concept is further explained in the explanatory note in the annex of this document.

2-2. Current progress of the JCM

The JCM started operations in 2013 when Japan and Mongolia signed a bilateral document (GoJ 2019). Since then, the number of partner countries has increased to 17[6] (GoJ 2019). According to

[6] as of April 2019

the JCM website[7], there are 67 approved methodologies, 45 registered projects and 21,608 issued credits from 19 projects (JCM website 2019). Aside from these projects, there are a number of pipeline projects implemented with financial support from the GoJ for facilitating development and operationalisation of JCM projects. These include projects currently in the planning or installation stage but which have yet to go through the JCM project cycle including methodology development, preparation of PDD (Project Design Document), validation, monitoring, and verification. The Government of Japan has various financial support schemes such as the JCM Model Project and Japan Fund for the JCM (ADB Trust Fund) which are financed by the Ministry of the Environment, Japan (MOEJ), as well as the JCM Demonstration Project which is financed by the Ministry of Economy, Trade and Industry (METI). In total, there are over 150 ongoing projects (GoJ 2018; GEC 2019). Indonesia and Thailand are the most successful host countries in terms of pipeline projects, with more than 40% of the pipeline projects being implemented in these two countries (GoJ 2018, GEC 2019). There are also several activities implemented in these two countries on knowledge-sharing and capacity-building to facilitate private sector investment in low-carbon technologies under the JCM (GoJ 2018). For example, the success of Indonesia and Thailand seems to rely on active support from the partner countries themselves, to a certain extent. This support includes organising business matchmaking events involving private sector entities both from Japan and the partner countries, where participants can communicate with each other to exchange information on potential technology providers and technology needs towards possible project implementation[8].

As mentioned above, there is still only a limited number of JCM credits already issued at the current time. However, if we take into account the potential number of credits to be issued from pipeline projects, it is projected that there would be a much larger reduction in emissions. For example, MOEJ analysed the potential emission reductions to be credited under the JCM from the 100 JCM model projects selected by 2017 and found that the amount would come to nearly 8 million t-CO_2 by 2030 (MOEJ 2019).

It has also been observed that the public finance granted for the implementation of the JCM projects then mobilised a much larger amount of private sector investment as co-finance for the projects. For example, MOEJ estimated the total investment for the above-mentioned 100 JCM model projects selected by 2017 would come to JPY 121.2 billion[9] (MOEJ 2019). The amount of public finance granted to these projects is estimated to be JPY 26 billion (MOEJ 2016 & 2017), which means

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7 https://www.jcm.go.jp/

8 GEC website: "Result of Seminar on the JCM Implementation in Indonesia (2018)" <http://gec.jp/jcm/news/seminar2018jakarta/> and "Result of Seminar on the JCM Implementation in Thailand (2018)" <http://gec.jp/jcm/news/jcm2018thailand/>

9 Nearly equal to USD 1.1 billion Calculated with exchange rate of USD 1 = JPY 110

that the private funding mobilised for these projects is estimated to be about four times larger than the amount of public funding.

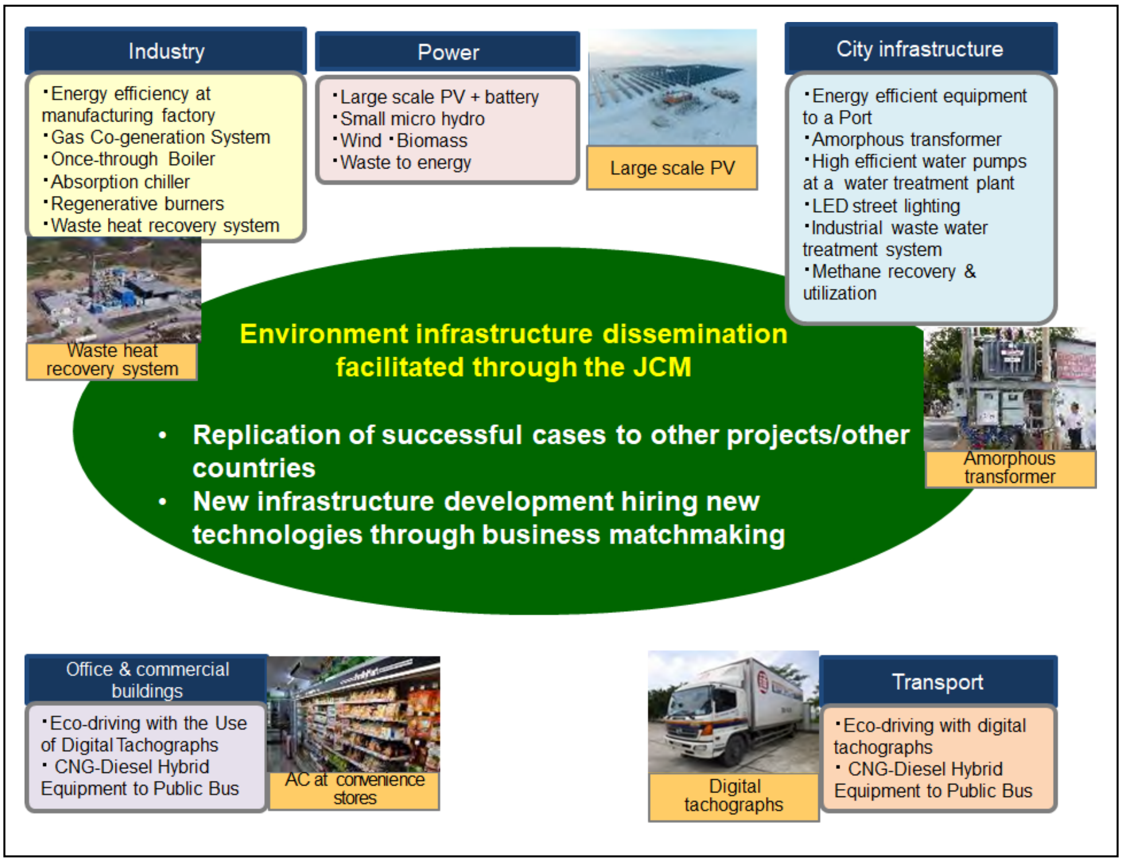
These JCM projects are mainly implemented in the energy-related sector, i.e., energy efficiency and renewable energy, accounting for about 90% of the projects. Other projects also implemented in the field of transport, waste management, F-gas countermeasure, and forestry (GoJ 2018, MOEJ 2018). Various technologies are applied under the JCM from demand-side energy-saving technologies to supply-side clean energy technologies. It can be noted that the JCM is implemented in line with the Government of Japan's overall strategy to promote infrastructure development overseas. Under this strategy, the dissemination of advanced low-carbon technologies is regarded as one of the key measures for actions against climate change.[10&11] The JCM projects have already contributed to infrastructure development, for example, in industry, power generation, city infrastructure, office and commercial buildings and transportation as explained in

[10] インフラシステム輸出戦略(平成 30 年度改訂版) (Japanese only)
https://www.kantei.go.jp/jp/singi/keikyou/dai37/siryou2.pdf

[11] 海外展開戦略（環境）(Japanese only) <http://www.env.go.jp/press/files/jp/109298.pdf>

Figure 2 below.

Figure 2 Dissemination of Environmental Infrastructure through the JCM



(based on MOEJ 2019)

3. Potential advantages of implementing the JCM towards the achievement of the NDCs

The Government of Japan has submitted its NDC to the UNFCCC in which it commits to a 26% emission reduction target by 2030 compared to 2013. The NDC mentioned the JCM by stipulating "*The Joint Crediting Mechanism (JCM) is not included as a basis of the bottom-up calculation of Japan's emission reduction target, but the amount of emission reductions and removals acquired by Japan under the JCM will be appropriately counted as Japan's "reduction*" and "*accumulated emission reductions or removals by FY 2030 through governmental JCM programs to be undertaken within the government's annual budget are estimated to be ranging from 50 to 100 million t-CO_2*" (GoJ 2016). The NDC is understood to mean that Japan will basically achieve its emission reduction target of 26% through domestic mitigation actions and it will use credits acquired through the JCM on top of these domestic actions, thereby enhancing its mitigation ambition.

The Government of India has set a target of reducing its emission intensity towards GDP by 33-35% by 2030 compared to 2005 (GoI 2016). In its NDC, it stipulates the aim "*to achieve about 40 percent cumulative electric power installed capacity from non-fossil fuel-based energy resources by 2030 with the help of the transfer of technology and low-cost international finance including from*

Green Climate Fund (GCF)". It also points out the importance of reducing energy demand through the dissemination of advanced low-carbon technologies (GoI 2016).

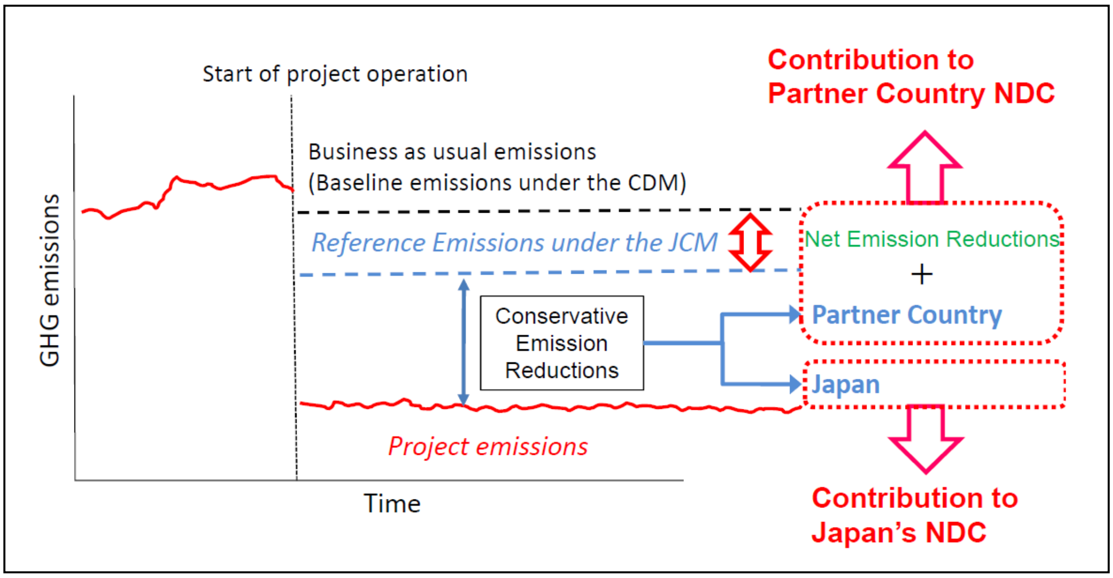
The JCM, in general, can contribute to achieving the NDCs of both Japan and India through the transfer of finance partly through public sources as well as technologies on both the demand and supply side for the implementation of mitigation projects. The mechanism can also produce credits based on the emission reductions realised in India as can be seen in Chapter 2 above. Moreover, the conservative nature of the methodologies can ensure a win-win situation for both Japan and India whereby trade-offs are created not by pure offsetting but rather, by using credits under market mechanisms.

This chapter will examine what kind of benefits can be gained by implementing the JCM so that both countries can achieve their NDCs.

3-1. Benefits and contribution in terms of emission reductions

As mentioned in Chapter 2-1 above, there is a specific portion of emission reductions known as "net emission reductions" occurring in India through the implementation of JCM projects which will not be credited by methodologies under the JCM. The value of these emission reductions cannot be transferred anywhere outside India and are automatically be regarded as benefits to India in terms of domestic emission reductions. Furthermore, after a conservative calculation of the emission reductions, the issued credits are going to be allocated not only to the project participants but also to the governments in both countries, taking into account the contributions made for project implementation. Therefore, the allocated amount of credits to the Government of India together with the portion of net emission reductions can be regarded as benefits gained by India due to implementing the JCM projects, as shown in Figure 3 below.

Figure 3 JCM's Contribution to NDCs



(Excerpt from GoJ 2018)

For example, if we calculate BAU and reference emissions when the methodology is applied for a chiller project and renewable energy project as mentioned above, the results are estimated as shown in Table 1 and Table 2 below. For a chiller project, therefore, the methodology evaluates estimated emission reductions to be about 33% more conservative than the calculation for BAU emissions, and in the case of a renewable energy project, the methodology evaluates estimated emission reductions to be about 61% more conservative than the calculation towards BAU emissions. These differences between BAU-based emission reductions and reference-based emission reductions are regarded as benefits for the host country.

Table 1 Comparison of BAU and Reference Emissions/Emission Reductions for Chiller Projects

Emissions:	
BAU emissions	1,272.4 t-CO_2
Reference emissions	1,220.9 t-CO_2
Project emissions	1,116.9 t-CO_2
Emission reductions:	
Emission reductions towards BAU emissions	155 t-CO_2
Emission reductions towards reference emissions	104 t-CO_2
Assumptions: -Activity data from a registered JCM project VN011[12] -Appling the business as usual COP at 5.46 for the range of 450≤x≤550 as explained in the annex of this paper	

[12] https://www.jcm.go.jp/vn-jp/projects/54

Table 2 Comparison of BAU and Reference Emissions/Emission Reductions for Renewable Energy Projects

Emissions:	
BAU emissions	864.9 t-CO_2
Reference emissions	333.0 t-CO_2
Project emissions	0 t-CO_2
Emission reductions:	
Emission reductions towards BAU emissions	864 t-CO_2
Emission reductions towards reference emissions	333 t-CO_2
Assumptions: - Activity data for generating 1000MWh in a certain period of project operation - Applying the latest national grid emission factor of 0.8649 t-CO_2/MWh in Viet Nam for calculating BAU emissions	

3-2. Benefits and contribution in terms of technology transfer and dissemination

There are already several good practices seen in the implementation of the JCM projects which can go beyond emission reductions realised by the JCM. These can be achieved through the horizontal expansion of low-carbon technologies triggered by a JCM project, thereby creating positive economic and environmental impacts. Such good practices include technology transfer such as localisation of production processes and spec-in of technical advantages for highly efficient technologies in procurement processes. Other practices are the development of businesses based on a model project under the JCM through showcasing advantages of advanced technology incentivising private sectors for replication of the same type of projects, and projects based on city-to-city cooperation between Japan and a partner country facilitating multilateral cooperation including government-to-government, government-to-private, and private-to-private collaborations. There are also practices such as projects implemented in conjunction with a regional economic development plan, including the promotion of job creation and cleaner energy and integrated approaches, including policy measures such as standardisation for low-carbon technology. Actual examples of these good practices include: 1) introduction and expansion of amorphous high-efficiency transformer usage in power distribution systems in Viet Nam; 2) introduction of high-efficiency LED lighting utilising a wireless network in Cambodia; 3) introduction of high-efficiency water pumps in Da Nang City, Viet Nam; 4) renewable energy development projects in the Philippines; and 5) promotion of green hospitals by improving efficiency and environment in national hospitals in Viet Nam (GOJ 2017 & MOEJ 2019).

In example 1) above, more than 13,000 units of high-efficiency transformers have been installed in southern, central and northern Viet Nam. This was enabled through steady outreach to the local power companies, including the dispatch of technical officers, which eventually led to spec-in of the technical features of the equipment in the tenders for transformers. Meanwhile, there has also been general support from the Government of Viet Nam to improve energy efficiency in the country (GoJ 2017). The localisation of manufacturing processes for the transformers also contributed to the success of the projects, and based on the implementation of the projects in Viet Nam; the business model was replicated in Lao PDR. There are now plans for further dissemination of the technology to other countries (MOEJ 2019).

In the case of 2), the project was implemented within a broader perspective of creating a “smart city” in Cambodia than just a single project implementation. The LED lighting was equipped with wireless dimming controls, which made use of the IoT. This system helps to optimise electricity distribution and usage while avoiding blackouts (MinebeaMitsumi 2017). MinebeaMitsumi Inc. was a project participant from Japan, and by showcasing successful cases under the JCM as well as maintaining cooperation with local governments, the company planned to expand its production capacity in Cambodia thereby aiming to create further job opportunities in the country (Khmer Times 2017).

In example 3), the project was initially based on cooperation between Yokohama City in Japan and Da Nang City in Viet Nam, in line with an MoU for sustainable urban development which was signed in 2013 (City of Yokohama 2018). Accordingly, a comprehensive city development plan called “Da Nang Urban Development Action Plan” was established at the municipal level including actions in the fields of energy, ports, solid waste management, environmental sanitation, wastewater treatment, and transportation as well as the JCM (City of Yokohama 2018). The success of the JCM project, which installed a high-efficiency pump at a water treatment plant in Da Nang led to the implementation of another JCM project in Ho Chi Minh City to install efficient water pumps with an inverter control system (MOEJ 2019).

In the case of 4), several renewable energy projects were implemented in Butuan City in the Philippines based on a strong partnership between companies in Japan and the Philippines for regional economic development (Chodai 2019). The projects introduced small hydropower generation, biomass power generation, and micro-hydro, which supplied clean energy to a local water treatment plant and contributed to strengthening basic infrastructure development in the city (MOEJ 2019).

In example 5), the project installed 1,000 units of energy-efficient inverter air conditioners together with energy management systems at hospitals and contributed to the optimisation of energy use at project sites, aiming to realise the concept of “green hospitals” (GoJ 2017). The project was enabled through close consultations with local stakeholders, including hospitals and relevant ministries and agencies in the government of Viet Nam. Energy efficiency labeling was also established for the air conditioning system together with the Cooling Seasonal Performance Factor (GoJ 2017). This system improved methods of evaluating the efficiency of the inverter air conditioners and thus helped to create more incentives for installing this type of high-efficiency equipment in Viet Nam by visualising how this equipment can save energy.

3-3. Benefits and contribution in terms of impacts on sustainable development

The JCM introduced specific guidelines for planning and evaluating sustainable development impacts of project implementation, including the concept of SDGs. These guidelines are already being adopted for JCM projects in Indonesia and Mongolia (JCM website 2019).

There is a strong linkage between climate change and sustainable development. For example, the IPCC's special report "Global Warming of 1.5℃" stipulates, with high confidence, that:

"Climate change impacts and responses are closely linked to sustainable development, which balances social well-being, economic prosperity, and environmental protection. The United Nations Sustainable Development Goals (SDGs), adopted in 2015, provide an established framework for assessing the links between global warming of 1.5°C or 2°C and development goals that include poverty eradication, reducing inequalities, and climate action." (IPCC 2018)

The report also mentions that there are both positive synergies and negative trade-offs between mitigation and adaptation measures, and SDGs (IPCC 2018). It is also understood that, among others, careful planning and implementation of mitigation measures are needed if such trade-offs are to be minimised.

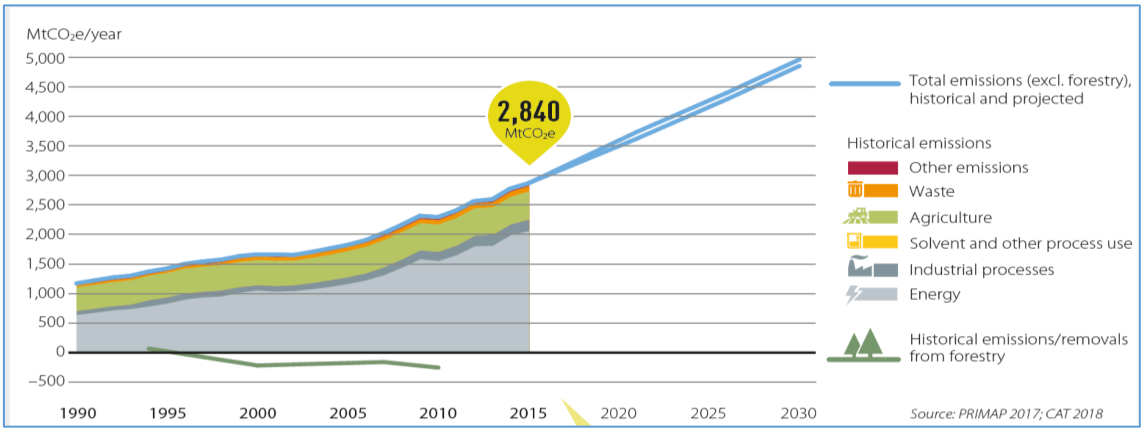
The JCM sustainable development guidelines require project participants to plan how to avoid the negative impact of their project against pre-determined criteria related to sustainable development. These criteria are categorised in items related to policy alignment, Environmental Impact Assessment, pollution control, safety and health, natural environment and biodiversity, economy, social environment, and community participation and technology, at the time of PDD development. The plan of sustainable development impacts of project implementation will be evaluated by members of the Joint Committee consisting of government officials from a partner country and Japan. The guidelines also require project participants to submit a report on the impact of sustainable development at the time of requesting the issuance of the credits. This report will be re-evaluated by the Joint Committee members. Also, the guidelines adopted in Mongolia require project participants to fill in potential contributions of their project towards each goal of the SDGs, as applicable.

The guidelines give a practical framework not only so that project participants can appropriately plan and report the possible and actual impacts on sustainable development by implementing the JCM projects but also so that government officials have the means for clear assessment and evaluation at the project level. Moreover, as the Joint Committee consists of government officials from both the partner country and Japan, there are potential merits for the partner country to appropriately include policy objectives for its sustainable development into the operation of the JCM projects, taking into account each country's specific circumstances.

4. Mitigation potential in India

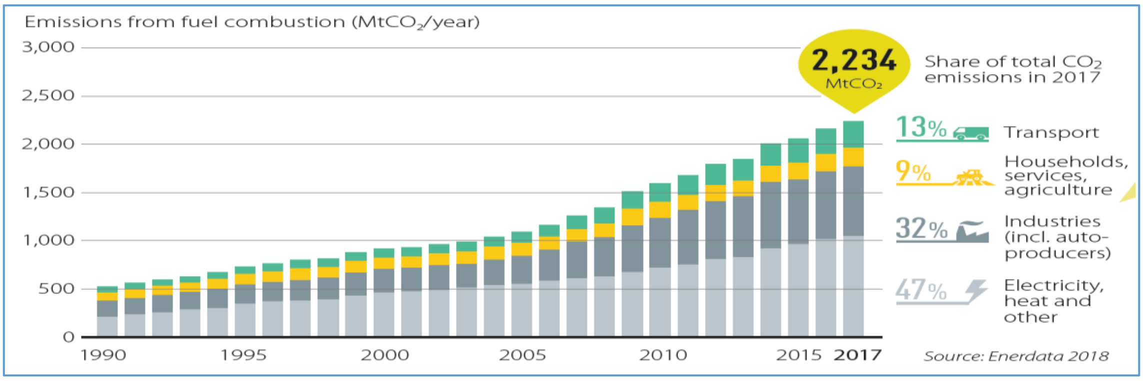
India's GHG emissions more than doubled between 1990 and 2015, and that trend is expected to continue (**Figure 4**). CO_2 dominates total GHG emissions, and energy-related CO_2 emissions from electricity production, manufacturing industries, the transport sector, as well as fugitive emissions account for more than 75% of the total CO_2 emissions in the country. These emissions have more than quadrupled since 1990, mainly driven by power generation and industries (Figure 5).

Figure 4 Total GHG Emissions across Sectors



Source: <https://www.climate-transparency.org/wp-content/uploads/2018/11/BROWN-TO-GREEN_2018_India.pdf>

Figure 5 Energy-related CO2 Emissions



Source: <https://www.climate-transparency.org/wp-content/uploads/2018/11/BROWN-TO-GREEN_2018_India.pdf>

4-1. Mitigation potential in the industrial sector

In its NDC, India committed itself to reduce the emission intensity of its GDP by between 33% and 35% below 2005 levels by 2030. Enhancing energy efficiency in India has been envisaged as one of the prime instruments to meet these commitments. For instance, to reduce specific energy consumption in most of the energy-intensive sectors of the economy, India launched the Perform

Achieve and Trade (PAT) scheme as a multi-cycle regulatory instrument[13]. The first cycle of PAT started in April 2012 targeting Designated Consumers (DCs) in eight energy-intensive sectors namely: Aluminum, Cement, Chlor- Alkali, Fertilizer, Iron & Steel, Paper & Pulp, Textiles, and Thermal Power Plants. The second cycle of PAT added DCs in three sectors, namely Railways, Electricity DISCOMs, and Refineries. It aimed to achieve an overall energy consumption reduction of 8.869 Mtoe. In its third cycle, a total of 737 numbers of DCs from the eleven sectors previously targeted have been assigned to reduce the mandatory energy consumption reduction targets of about 9.929 Mtoe by FY 2020 (Table 3).

Table 3 Sector-wise Number of Designated Consumers (DCs) and Saving Targets under PAT Scheme

Sector	Annual energy consumption (Mtoe)	PAT Cycle1 (2012-2015)		PAT Cycle2 (2016-2019)		PAT Cycle3 (2017-2020)	
		No. of DCs	Targeted energy savings (Mtoe e)	No. of DCs	Targeted energy savings (Mtoe)	No. of DCs	Targeted energy savings (Mtoe)
Thermal power plants	104.56	144	3.211	154	3.13	191	3.50
Iron and steel	25.32	67	1.486	71	2.14	100	2.59
Cement	15.01	85	0.816	111	1.1	125	1.18
Fertilizer	8.2	29	0.478	37	0.446	37	0.446
Aluminium	7.71	10	0.456	12	0.57	13	0.60
Pulp and paper	2.09	31	0.119	29	0.15	30	0.16
Textiles	1.2	90	0.066	99	0.087	133	0.11
Chlor alkali	0.88	22	0.054	24	0.101	24	0.101
Petroleum refinery		-	-	18	1.1	18	1.10
Electricity DISCOMs		-	-	44	0.046	44	0.46
Railways		-	-	22	0.033	22	0.03
Targeted total		478	6.686	621	8.87	737	9.93
Reported total		448	8.67	-	-	-	-

Source: Authors, based on "Booklet on Pathways for Accelerated Transformation in Industry Sector, BEE 2017 (available at <https://beeindia.gov.in/sites/default/files/Final%20Booklet%2029-9-2017.pdf> last accessed 23 May 2019)

The sectors covered under the PAT scheme represent significant potential to enhance energy efficiency and mitigate GHG emission in India. Equally important are small and medium-sized enterprises (SMEs). SMEs are a major contributor to the Indian economy. They account for about 45% of manufacturing output, 40% of exports and are the largest employer after agriculture. Energy audit studies in SMEs have shown that it is possible to achieve energy savings of between 15% and 30% by introducing new energy-efficient technologies and best operating practices (BOP) (Pal 2018). SMEs in

[13] PAT is a scheme under the National Mission for Enhanced Energy Efficiency mission <https://beeindia.gov.in/content/nmeee-1>

traditional manufacturing sectors like castings, forgings, glass and ceramics, food processing, textile processing and so on, use of obsolete, inefficient technologies to burn commercial fuels like coal, oil, and gas, leads to wastage of fuel as well as release of high volumes of greenhouse gases (GHGs) and particulate emissions that are harmful to health and damage the atmosphere. Coal (and coke) account for 86% of total energy usage among energy-intensive SMEs while the contributions of oil and natural gas, biomass and electricity were 7%, 4%, and 3% respectively (Pal 2018).

Waste-to-energy is also another potential area to consider towards mitigating GHG emissions in India. According to the Ministry of New and Renewable Energy (MNRE), there is the potential to recover 2,000 MW of power from industrial waste. Major industries where the potential exists include distilleries, pulp, and paper mills, and food processing and starch industries. Market research reports that the waste-to-energy market in India is worth USD14 billion and is growing at a rate of 7% (Pal 2018).

According to the Central Pollution Control Board (CPCB), municipal areas in India generate 133,760 tonnes/day of waste, of which only 25,884 tonnes/day (19%) is treated. The balance of 107,876 tonnes/day is disposed on landfill. Hence, looking at estimates, the combined potential for generating power from waste-to-energy projects in India is around 500 MW. The states contributing maximum potential include Andhra Pradesh (43 MW), Delhi NCT (28 MW), Gujarat (31 MW), Karnataka (35), Maharashtra (62 MW), Tamil Nadu (53 MW) and West Bengal (32 MW). Several municipal solid waste-to-energy projects are operational or planned (Table 4), but many more such projects are required to tap the existing potential.

Table 4 Major Municipal Solid Waste-to-Energy Projects in India

S.No.	**Project**	**Size (waste input)**	**Power output**	**Technology**	**Technology supplier**
Operational					
1	Okhla, Delhi	1,500 tpd	9 MW	Incineration based	China
2	Ghazipur, Delhi	1,200 tpd	12 MW	Boiler based	Italy and Germany
3	Narela–Bawana, Delhi	2,000 tpd	24 MW		Ramky Group, India
4	Jabalpur, MP	600 tpd	11.5 MW	Incineration based	Japan
Planned					
5	Bhalswa, Delhi	1,500 tpd	15 MW	Planned	Essel Group, India

Source: Pal 2018, Report on potential infrastructure technologies in India

All in all, promoting the implementation of best-operating practices and low-carbon technologies in the industries targeted under the PAT scheme and in the SMEs sector, along with promoting waste to energy projects will substantially contribute to enhancing energy efficiency and mitigating GHG emissions in India, thereby contributing in achieving the country's commitment under its NDC.

4-2. Possible technologies which can be transferred/installed for emission reductions

To achieve the targeted energy savings under PAT, various technologies, and best operating practices (BOP) have been implemented[14]. Promoting the implementation/replication of these technologies, especially those on a relatively larger scale, will be easier than considering new market technologies given that they have been already proved.

On the other hand, for technologies to be applied to SMEs, looking at the pattern of energy usage and the major energy-consuming equipment/sections in different industry clusters, the majority of energy use is in the thermal form (for instance, in furnaces and boilers). As a result, it is envisaged that major energy-saving technologies are likely to involve the introduction of energy-efficient furnaces and boilers and corresponding capacity building on BOP at the plant level to accommodate these changes.

Considering the above and reviewing the technologies which have been implemented so far under the JCM in other countries, it seems clear that if an agreement on the JCM were to be signed with the Indian government, it should be devoted to large-scale technologies/projects. An expert from TERI has listed several of those which could be considered (Table 5).

Table 5. Technologies to be Targeted under the JCM Scheme in India (if agreed).

Sector	Technology
1. Energy Efficiency	Boiler
	Waste Heat Recovery System
	Regenerative Burners
	Loom
	Electrolyzer in Chlorine Production
	Multi-effect Distillation System
2. Effective Use of Energy	Power Generation by Waste Heat Recovery
	Gas Co-generation
3.Waste Handling and Disposal	Waste-to-Energy Plant
	Power Generation by Methane Recovery

Source: Prosanto Pal, Senior Fellow, TERI

[14] Booklet on Achievements under PAT: May 2017", BEE, 2017. Available at: https://beeindia.gov.in/sites/default/files/Booklet_Achievements%20under%20PAT_May%202017.pdf last accessed 23 May 2019.

4-3. Approach to tap the mitigation potential in India

The number of Japanese companies in India has steadily increased over the last ten years, increasing from 550 companies in 2008 to 1441 in 2018 (Embassy of Japan in India 2018). Nevertheless, there is a significant market potential that remains untapped because actors in both countries face barriers in accessing and applying the information, knowledge, and expertise that are required for the smooth transfer, adaptation, and adoption of low-carbon technologies in India. From projects conducted by the Institute for Global Environmental Strategies (IGES) and its counterpart in India, The Energy and Resources Institute (TERI) over nearly a decade in India, there are three key barriers hindering faster adoption of low-carbon technologies among Indian SMEs: 1) information and knowledge gaps; 2) networking and communication challenges; and 3) higher cost of low-carbon technologies. While the first two barriers can be addressed through existing schemes, including the IGES-TERI initiative, and JITMAP (Japan-India Technology Matchmaking Platform)[15], the third one requires large-scale financial support which can be secured through the JCM.

At a consultancy workshop on the JCM organised by IGES and TERI in July 2018 in Delhi, participants from various industrial sectors shared their views that the JCM would help Indian industries to obtain essential technologies. For example, in the case of the steel industry, it was mentioned that low-carbon technologies such as Waste Heat Recovery (WHR), Energy Efficient Air compressors, regenerative burners, and rooftop solar power could all benefit the sector due to their energy efficiency and uptake of cleaner energy. In the case of the manufacturing sector, it was mentioned that technologies such as space air conditioning from recovering waste heat, municipal waste-to-energy, the capture of CO_2 in flue gas for conversion to methanol, and biomass (paddy stub) collection and utilisation had been identified as possible technologies. The industry participants mentioned they would consider advanced technologies if they were available on the Indian market.

Studies indicate that consumer behaviour tends to lean towards price over value (Arsha Consulting 2017). The intense market competition places Japanese products at a disadvantage (Kondo 2012). Supporting schemes to promote “green” technologies are abundant in India, and these can also be used to promote low-carbon technologies. However, most end-users prefer to use those schemes to implement alternative technologies that are available in the market at a lower cost. The JCM is one option that could make advanced technologies financially affordable in India and ultimately ensure that Indian end-users benefit from the most advanced technologies that are not yet affordable.

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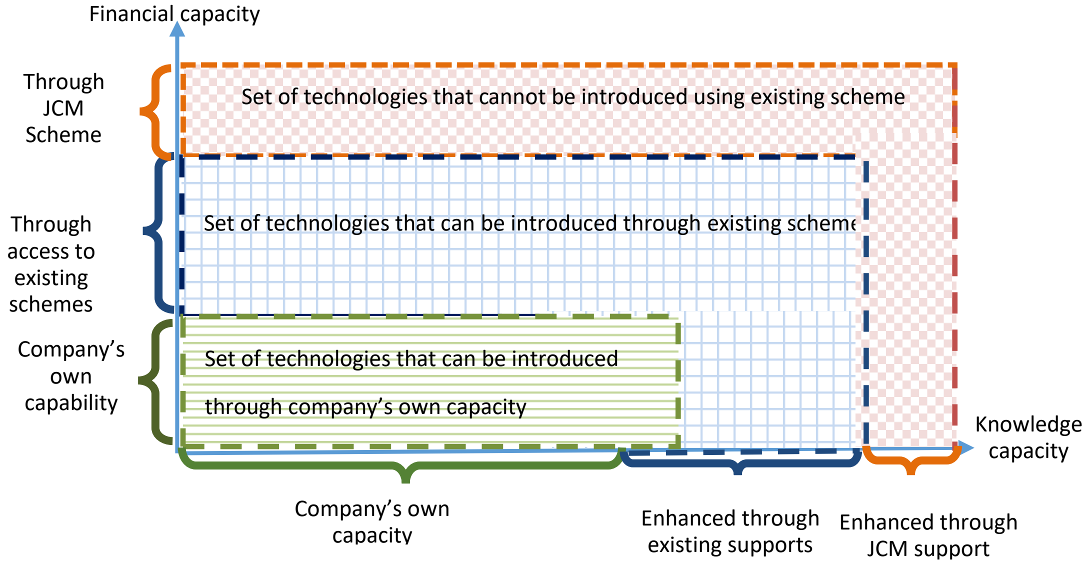
15 For further information visit <http://www.jitmap.org/>

The JCM has to be considered as a complementary measure to enhance the financial and technical capacity of Indian end-users in terms of low-carbon technologies, especially those that are not possible to be implemented using company capacity or using existing schemes (

Figure **6**).

Figure 6 JCM as a Complementary Measure to Promote Low-carbon Technologies in India



The JCM can effectively work in synergy with other existing schemes. For instance, JITMAP could be used as a support to catalyse business-to-business (B2B) matching. This takes various form, including awareness enhancement, networking (arrangement of business meetings and onsite feasibility studies), access to financial schemes, as well as arrangement of policy and regulatory discussions. These activities are needed for the identification of projects to be implemented through JCM as well as for their subsequent replication.

5. A possible way forward towards the establishment of the JCM between Japan and India

While operationalising the JCM requires a bilateral document to establish the mechanism signed by Japan and India, it is also essential to establish a Joint Committee which consists of government officials from both countries. In the case of the current 17 JCM partner countries, Joint Committee members are not only those from environment ministries but also include those from other line ministries as necessary. Usually, the environment ministry works as a communication channel between Japan and the partner country, and also serves as the secretariat in the country. Therefore, considering this would also apply in the case of India when operationalising the JCM, the first step would be to identify which line ministries would be involved in the process and have their representatives participate as members of the Joint Committee while making sure to maintain good communications among them.

The necessary guidelines to operationalise the JCM have already been adopted in the current 17 partner countries, and these can be used as a reference to enhance understanding of how the mechanism works. For that purpose, it would be beneficial to organise technical workshops/consultations for government officials from the ministries as identified above to familiarise them with the procedures.

It is considered that the most important aspect of operationalising the JCM would be to incentivize private sectors and to implement mitigation projects under the mechanism contributing to real emission reductions. As analysed above, there is a great deal of potential and feasibility in India to implement mitigation projects which inherently contribute to the achievement of its NDCs. The Government of Japan implements several financing programmes to facilitate the implementation of JCM projects, and it would be beneficial to familiarise potential project participants in India including private sector entities about available support for project implementation and to organise seminars to ensure that they are aware of the possible merits of utilising such support. It would also be beneficial to steadily develop projects by giving these participants opportunities for matchmaking with regards to project implementation whereby they can communicate with each other to exchange information on potential technology providers and technology needs. This has already been done in Indonesia and Thailand, where project development has had the most success under the mechanism with dozens of JCM projects ongoing in each country.

The possible establishment of the JCM between Japan and India has been touched upon several times in joint statements of summit meetings between two countries. For example, the Japan-India Vision Statement, which was adopted after the summit meeting in 2018, stipulates as follows:

"21. The two Prime Ministers underlined the importance of their growing collaboration for achieving the Sustainable Development Goals (SDGs). They committed themselves to strengthen environmental partnership in areas such as pollution control, sustainable biodiversity management, chemical and waste management, climate change, and wastewater management, utilizing the cooperation framework between their relevant authorities. Underscoring the need for concerted global action to combat climate change, in line with the Paris Agreement adopted under UN Framework Convention on Climate Change (UNFCCC), they shared the view to play a leading role in this field, and reiterated their commitment to finalising the work programme for implementation of the Paris Agreement and accelerate further consultations for establishing the Joint Crediting Mechanism." (MOFA 2018)

Expectation are therefore high to further accelerate the consultation processes in the near future. To expedite the processes for the establishment of the JCM, aside from technical consideration of the bilateral documents among two countries, it would be beneficial to take a two-track approach, and organise consultations/seminars for government officials on one hand, while also organising workshops for potential project participants to familiarise them with the mechanism and ensure they are ready for early project development and implementation, which is the most important aspect of the JCM. This two-track approach would enhance understanding of the JCM as a whole package among public and private sectors in the country and gain merit for establishing the mechanism and contributing towards real emission reductions.

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Explanatory note on the identification and calculation of reference emissions

[JCM approved methodology on introducing high-efficiency centrifugal chillers]

The methodology is approved in four countries[16]. The basic concept for calculating reference emissions is the same among all the countries, using the following equation:

$$\mathbf{RE_p} = \sum_{\mathbf{i}} \{\mathbf{EC_{PJ,i,p}} \times (\mathbf{COP_{PJ,tc,i}} \div \mathbf{COP_{RE,i}}) \times \mathbf{EF_{elec}}\}$$

Where

RE_p	Reference emissions during the period *p* [tCO_2/p]
$EC_{PJ,i,p}$	Power consumption of project chiller *i* during the period *p* [MWh/p]
$COP_{PJ,tc,i}$	COP of project chiller *i* calculated under the standardising temperature conditions [-]
$COP_{RE,i}$	COP of reference chiller *i* under the standardising temperature conditions [-]
EF_{elec}	CO_2 emission factor for consumed electricity [tCO_2/MWh]

The key parameter is the value of $COP_{RE,i}$ which is identified per each country, according to the expected cooling capacities applicable to potential projects to be implemented in the countries as well as catalogue data available from the research conducted for the methodology development. In general, it is observed that the larger the cooling capacity is, the higher the COP values are, therefore, $COP_{RE,i}$ is identified in a manner by selecting the most efficient COP values available from the catalogue data within certain range of cooling capacity. The following figure is an example of data analysed for developing the methodology for Thailand and Viet Nam and the table shows the established $COP_{RE,i}$ as a result of the analysis.

[16] Bangladesh, Viet Nam, Indonesia and Thailand

Figure: COP values of inverter type centrifugal chiller marketed in Thailand and Viet Nam

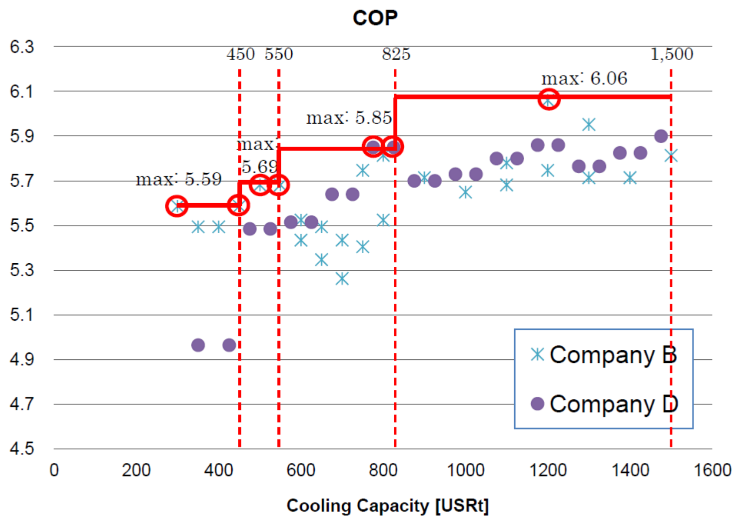

Table: Established $COP_{RE,i}$ for the methodology

Cooling capacity per unit (USRt)	300≤x<450	450≤x<550	550≤x<825	825≤x≤1,500
$COP_{RE,i}$	5.59	5.69	5.85	6.06

Excerpt from the JCM methodology (VN_AM011) "Energy Saving by Introduction of High-Efficiency Inverter Type Centrifugal Chiller."

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[JCM approved methodology on introducing solar PV system]

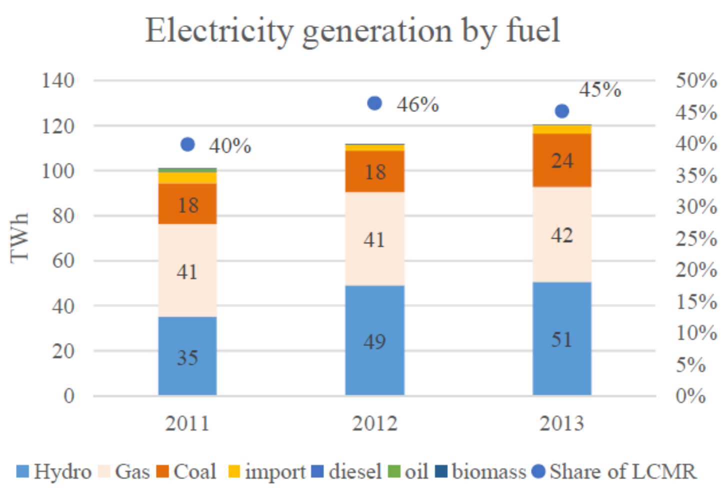
The methodology is approved in 13 partner countries[17]. Under this methodology, the type of project may vary, i.e., whether it is generating electricity for captive consumption or selling it to the grid or both, but in general, reference emissions are derived using the following equation:

$$RE_p = \sum_i \left(EG_{i,p} \times EF_{RE,i}\right)$$

Where

RE_p	Reference emissions during the period *p* [tCO_2/p]
$EG_{i,p}$	The quantity of the electricity generated by the project solar PV system *i* during the period *p* [MWh/p]
$EF_{RE,i}$	The reference CO_2 emission factor for the project solar PV system *i* [tCO_2/MWh]

The key parameter is the value of $EF_{RE,i}$ which is identified per each country considering its energy mix for generating electricity supplied to the grid. In the case of Viet Nam, for example, the electricity generation by fuel type was analysed as follows:



In the methodology, natural gas is identified as a primary thermal energy source as it consists of 67% of all the fossil fuel-based electricity generation in the country at the time of analysis (2011-

[17] Mongolia, Bangladesh, Kenya, Cambodia, Costa Rica, Chile, Palau, Maldives, Mexico, Lao PDR, Viet Nam, Indonesia and Thailand

2013). Accordingly, the best heat efficiency of a gas-fired power plant in the country, which is 58.7% (Lower Heating Value: LHV), is used to estimate conservatively $\mathrm{EF}_{\mathrm{RE,i}}$. The following equation is applied for the calculation:

$$\mathrm{EF}_{\mathrm{RE,i}} = \mathrm{EF}_{natural\ gas} \times 3.6 \times 10^{-6} \ / \ (\mathrm{LHV}[\%]/100)$$

Where

$\mathrm{EF}_{\mathrm{RE,i}}$	The reference CO_2 emission factor for the project solar PV system *i* [tCO_2/MWh]
$\mathrm{EF}_{natural\ gas}$	54,300 $kgCO_2$/TJ derived from "IPCC guideline 2006, Chapter 2, stationary combustion"
$\mathrm{LHV}[\%]$	58.7% derived from the best heat efficiency of a gas-fired power plant in Viet Nam

As a result, $\mathrm{EF}_{\mathrm{RE,i}}$ is set to be 0.333 t-CO_2/MWh for calculating reference emissions for the solar PV projects which supply generated electricity to the grid, which is much lower than the current grid emission factor of 0.5657 tCO_2/MWh published by the country at that time.

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(CR_AM001) "Installation of Solar PV System"
(CL_AM001) "Installation of Solar PV System"
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