NFP Final Report on JCM Network Project in Indonesia

FY 2015

Executive Summary

A workshop was held on 17th December 2015 in PSLH-ITB as a continuation of workshop on Joint Crediting Mechanism (JCM) in early 2015. It has two main objectives that are (1) updating the JCM projects during 2015; and (2) promoting JCM to industries in Indonesia as an option for reducing carbon emissions. This report covers not only the summary of the workshop, but also domestic network building activities, possible JCM projects, and MRV role in Indonesia.

Chapter 1 explains about the objectives of this workshop. Overview of JCM scheme and finished JCM feasibility studies in Indonesia is described. Brief summary of the workshop is also explained.

Chapter 2 gives the overview of network building activities. Firstly, NFP scheme in Indonesia is described, which NFP communicates with each organizations in energy, environment, and resources communities. Secondly, detailed summary of the workshop is presented. This workshop contained 8 sessions, such as introduction to 3E Nexus, introduction to JCM in Indonesia, potential JCM projects in industrial sectors, potential JCM projects in palm oil industries, low-carbon society in energy sector, research mapping for mitigation, development of JCM proposal, and Q&A sessions. Thirdly, important stakeholders and role of academic community for JCM in Indonesia is also described.

Chapter 3 covers the possible JCM projects. It contains the details JCM projects presented in the workshop. It also includes MRV and JCM challenges in Indonesia. Lastly, some possible co-benefits and co-benefits indicators development is discussed.

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I. Introduction

I.1 Purpose and goal of this project

A workshop regarding JCM was held on December 2015 with purposes and goals as follow:

- To facilitate the diffusion of advanced low carbon technologies, products, systems, services and infrastructures in line with the Joint Crediting Mechanism (JCM), which advances mitigation measures and contributes to sustainable development in Indonesia
- To educate and promote the potential of JCM projects for sustainable development of low carbon societies in Indonesia through invited leading academicians, scientists, researchers, and scholars
- To improve the consulting and know-how for JCM project proposal writing and for participants to consult with knowledgeable experts on potential JCM projects
- For participants to exchange their experiences and ideas towards creating actual JCM projects in Indonesia
- To update JCM projects during 2015

I.2 Overview of JCM in Indonesia

Joint crediting mechanism (JCM) was initiated in informal meetings between Indonesian and Japanese government on 2010. This meeting was continued to formal meetings of JCM between Indonesia and Japan, including National Climate Change Council and related ministries. The operation and management of JCM is handled by joint committee from both countries. The joint committee is also responsible for MRV methodologies development, projects evaluation, etc. GHG emission reduction resulted from JCM projects are calculated to carbon credits and divided between Japan and its host country. Credits could not be traded to other country, but it could be traded inside each countries (Japan and host countries). Figure I-1 gives more complete picture of JCM scheme in Indonesia. It shows that third party entities are also necessary for projects validation and GHG emission reduction verification. JCM secretariat in both countries plays important role for the success of JCM projects.

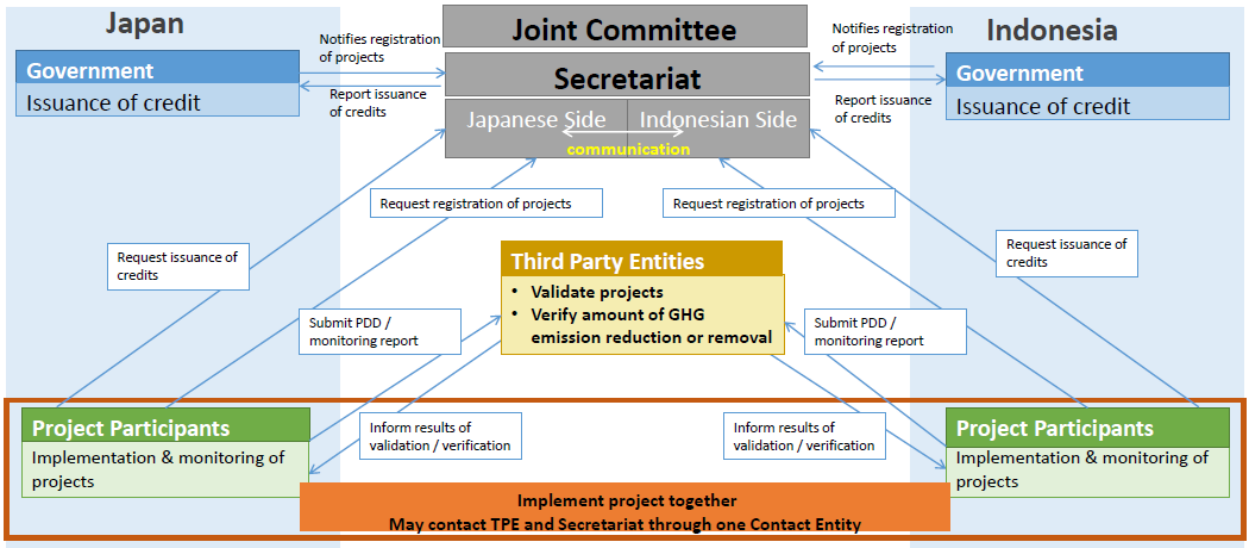

Figure I-1 JCM scheme in Indonesia

From 2010 to 2015, 103 feasibility studies have been conducted in various sector, viz. carbon capture sequestration (CCS), Reducing Emissions from Deforestation and Forest Degradation (REDD+), energy industries, energy demand, low-carbon city, transportation, etc. (Figure I-2). Regarding implementation of JCM projects in Indonesia, 20 projects has been implemented, with 3 projects are registered as JCM projects and 17 projects are in the final steps. These projects are predicted will reduce GHG emission around 320,000 ton CO_2/year. JCM also has mobilized grant from the Japanese government around US$ 41 million for low-carbon development in Indonesia and leveraged more than US$ 107 million investment in the low-carbon development.

I.3 Summary of Workshop on JCM Projects Development

On 17th December 2015, a workshop entitled "*Workshop on 3E Nexus and Development of Joint Crediting Mechanism (JCM) Projects toward a Sustainable Low-Carbon Society in Indonesia"* was held in Center for Environmental Studies, Institute of Technology Bandung (PSLH – ITB), Indonesia. It was co-organized by PSLH – ITB with Integrated Research System for Sustainable Science (IR3S), University of Tokyo. It was attended by 28 participants from Indonesian industries, universities, government, some Japanese industries, and JCM secretariat in Indonesia.

Figure I-2 Summary of JCM feasibility studies in Indonesia

There were seven experts who gave the presentation regarding JCM and low-carbon society. First, Dr. Geetha Mohan from IR3S gave introduction about 3E Nexus, a program from IR3S for sustainable development. 3E Nexus focus on promoting awareness of host countries government and companies on JCM and it has network in 20 countries, including Japan and Indonesia. Second, Mr. Dicky Edwin Hindarto from Indonesia JCM secretariat gave introduction of JCM scheme and its development. Moreover, he also explained about the structure of the committee and steps to participate in JCM. Third, Mrs. Shinta D. Sirait from Ministry of Industry explained about regulations for industry to develop green industry and potential emission reduction activities in industrial sector. Fourth, Prof. Udin Hasanudin from UNILA introduced GHG emission sources and potential reduction projects in Palm Oil Industries. Fifth, Dr. Retno Gumilang Dewi from ITB presented about low-carbon society and options to achieve low-carbon society in energy sector. Sixth, Dr. Arie Dipareza Syafei from ITS presented research mapping for adaptation and mitigation of air pollution and GHG emission by ITS, that provide various data of air quality in East Java. Finally, Prof. Kensuke Fukushi from IR3S gave explanation of general JCM scheme from Japanese government for evaluating JCM projects.

The last session was sharing session from industries and universities about their opinions, perspectives, and projects regarding green industries and carbon reduction updates. Several industries and low-carbon projects involved in this workshop, include agroindustries, EPC, fertilizer, and carbon capture and sequestration (CCS) project in natural gas field. Closing remarks from Mr. Dicky, Prof. Fukushi, and Prof. Tjandra Setiadi were summarized this workshop for stimulating low-carbon projects in industries, the role of JCM, and the future works of carbon emission reduction in Indonesia.

II. Overview of Domestic Network Building Activities

II.1 One-Stop Service

In preparation of the one stop service the following actions have been conducted:

1. Discussed internally about who will be the stakeholders in the 3E (Energy, Environment and Ecosystem) community.
2. The focus will be on Energy, Environment and Resources.
3. The first targets will be the Eco-Industrial Parks/Zones, because they have big challenges and wide opportunities.

Figure II-1 shows the National Focal Point (NFP) scheme in Indonesia. The Centre for Environmental Studies (PSLH) ITB will be the NFP with the guidance of IR3S, University of Tokyo. There are three sections (community), namely Energy Community, Environment Community and Resources Community. The NFP will coordinate each community in Indonesia accordingly. Each of them has different stake-holders. In the Energy Community, we have to work together with the Ministry of Energy and Mineral Resources, because they have long experiences in energy sector. In the Environment Community, we may collaborate with other Centre for Environmental Studies in other Universities around Indonesia and Ministry of Environment and Forestry. We also have the Association of Centre for Environmental Studies. In the Resource Community, ITB have Centre for Resource Efficient and Cleaner Production Indonesia (CRECPI). We also could collaborate with Centre for Assessment of Green Industry and Environment (CAGIE) under Ministry of Industry of Indonesia and Centre for Cleaner Production Indonesia under Ministry of Environment and Forestry and Business Chamber of Indonesia.

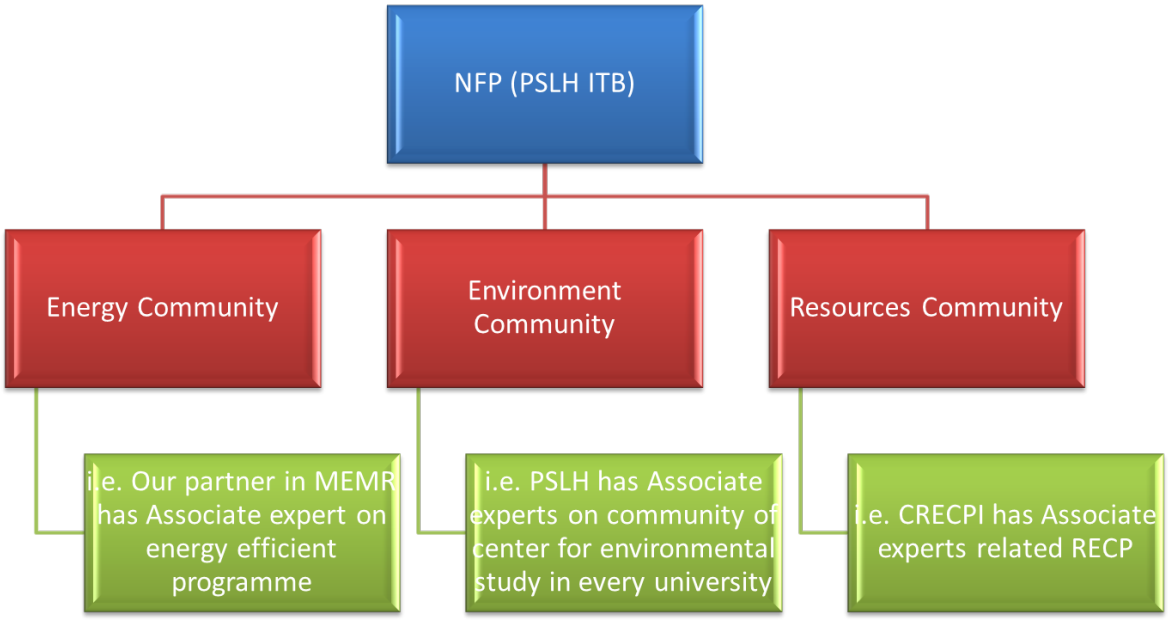

Figure II-1 Scheme of NFP in Indonesia

II.2 Detailed summary of the workshop

As explained in the first part, the workshop was divided into eight sessions. Each session is summarized below.

II.2.1 Introduction to 3E Nexus by Dr. Geetha Mohan

The first session was from Dr. Geetha Mohan (from IR3S) about explanation of 3E Nexus. He explained that Japan is committed to promote low carbon societies. Japan promotes their knowledge, experience and technology within and outside the country by utilizing Joint Crediting Mechanism (JCM) with a greater emphasis on the Asia-Pacific region for both developed and developing countries. 3E nexus is an initiative of Integrated Research System for Sustainability Science (IR3S) from University of Tokyo for developing a sustainable society through integration of energy, environment and ecosystems (3E). The initiative has produced the idea of a “regional low-emission and nature-harmonious sphere”. 3E Nexus framework is shown in Figure II-2.

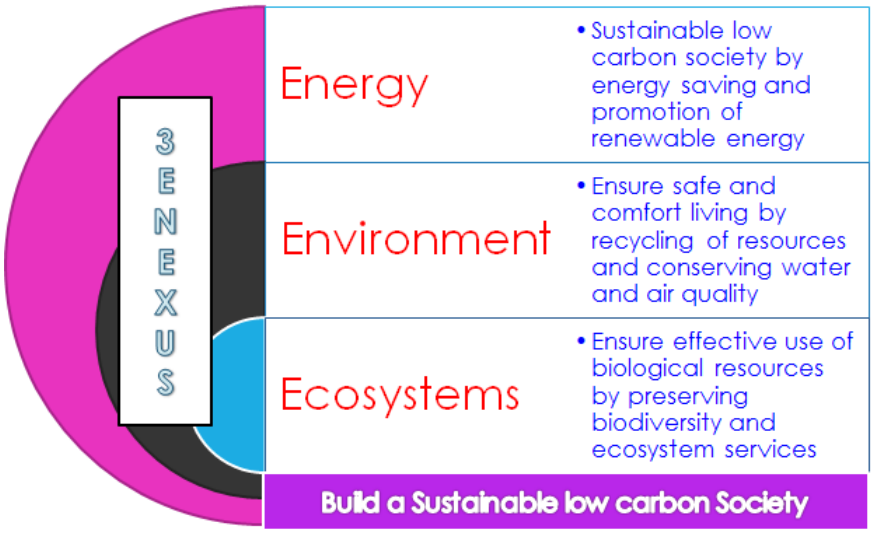

Figure II-2 3E Nexus framework

In achieving this goals, 3E nexus has networks with 16 countries, i.e. Bangladesh, Cambodia, China, Fiji, India, Indonesia, Japan, Laos PDR, Malaysia, Mongolia, Nepal, Pakistan, Philippines, Singapore, Thailand, and Vietnam. Each country has at least one NFP whose duties are:

- To develop a domestic network, which includes academicians, researchers, policy makers, business partners and other stakeholders.
- To provide a platform to discuss on the advanced technologies of low carbon development (for e.g. Japanese Joint Crediting Mechanism Projects) for sustainable societies in Asia.

On the other hand, 3E Nexus secretariat has its own role, as follows:

- Promote 3E nexus initiative activities in Asia-Pacific countries through kick-off and general meetings.
- Develop capacity building with research partners and exchange methodologies, technology, knowledge sharing for sustainable low carbon development.
- Be an engagement platform to regional partners, national and domestic level research institutions, academicians and scientists.

II.2.2 Introduction of JCM scheme in Indonesia by Mr. Dicky Edwin Hindarto

Mr. Dicky Edwin Hindarto is from Indonesia JCM secretariat. He explained not only the JCM scheme but also the updated condition of JCM in Indonesia up to 2015.

Indonesia has implemented JCM for 5 years, the longest time for a country that implements JCM scheme. The basic concept of JCM could be seen in Figure II-3. JCM facilitates diffusion of leading low carbon technologies, products, systems, services, and/or infrastructures as well as implementation of mitigation actions from Japan to host countries. These actions contribute to sustainable development of developing countries (host countries). JCM will give fund to the projects after evaluating contributions to GHG emission reductions or removals from Japan in a quantitative manner, by applying measurement, reporting and verification (MRV) methodologies, and use them to achieve Japan's emission reduction target. JCM also contributes to the ultimate objective of the United Nations Framework Convention on Climate Change (UNFCCC) by facilitating global actions for GHG emission reduction or removals and also complementing clean development mechanism (CDM). The operation and management of JCM is handled by joint committee from both countries. Each country also has its own JCM secretariat for JCM projects management.

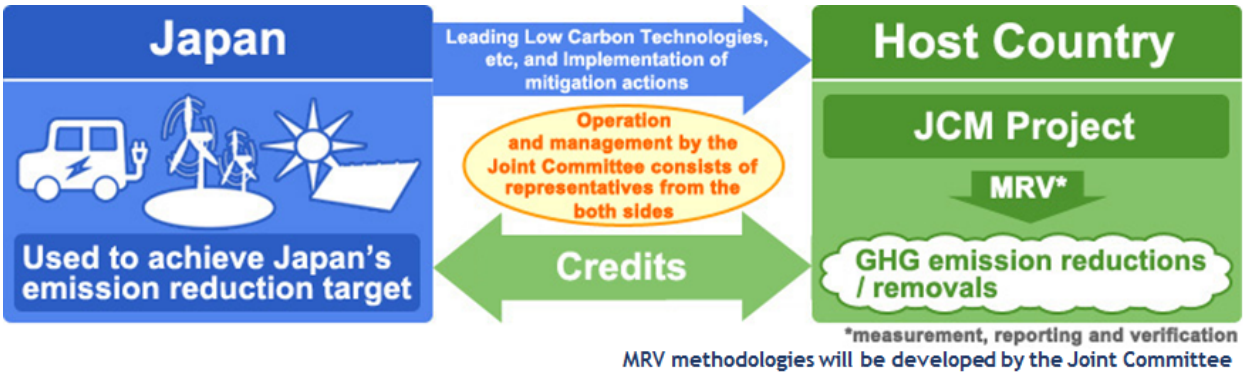

Figure II-3 Basic concept of JCM

Development of JCM project from Indonesia side is a little bit different with Japan side because the procedure from each country JCM secretariat is a little bit different. The procedure of JCM proposal development and its responsible organization until issuance of credits from Indonesia side is shown in Figure II-4.

Figure II-4 Procedure of JCM project proposal development and involving parties

II.2.3 Potential JCM projects in industrial sector by Mrs. Shinta D. Sirait

Mrs. Shinta D. Sirait is from Centre for Assessment of Green Industry and Environment (CAGIE), Indonesian Ministry of Industry. She explains about some regulations regarding green industry and some potential JCM projects in industries (shown in the next chapter).

Green industry policy in Indonesia is a relatively new concept (the act was published on 2014). In this act, green industry is defined as Industry which places priority on efficiency and effectivity in the sustainable use of resources, to harmonize industrial development and environmental protection. Green industry is one of Indonesia goal, as stated in the act"… to achieve self-sustaining, competitive and advanced industry, as well as green industry" (Green Industry Policy in Act No. 3/2014 on Industry). Green industry policy (Act No. 3/2014 on Industry) also relates with other policy, such as:

- Presidential Regulation No. 61/2011 on National Action Plan: Emission Reduction 26% and 41% in 2020
- INDCs (Intended Nationally Determined Contributions) in 2030 is 29%
- Ministerial Regulation No. 12/2012 on Road Map for Cement Industry in Emission Reduction Mandatory 3% per year since 2016

Besides of these acts, green industry also relates with Government Regulation No. 79/2014 on National Energy Policy. This regulation declares Indonesia national energy

mix target in 2025 and 2050 (Figure II-5). It also gives target of energy conservation in several sector, including industry (Table II-1). These targets push companies to reduce their energy sources and consumptions.

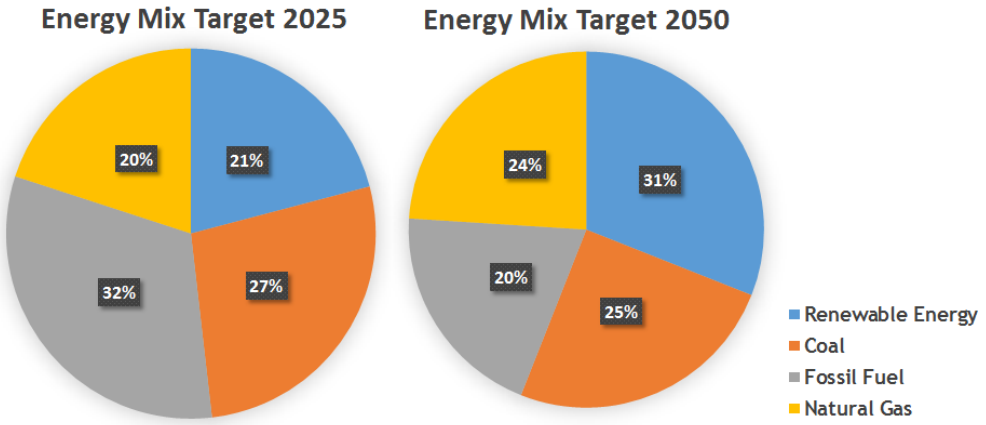

Figure II-5 Indonesia's national energy mix target 2025 and 2050

Table II-1 Indonesia's national energy conservation target per sector

Sector	Energy Consumption Per Sector Year 2012 (Million BOE)	Potential of EC	Sectoral Target of EC (2025)
Industry	305 (39,7%)	10 - 30%	17%
Transportation	311 (40,4%)	15 - 35%	20%
Household	92 (12%)	15 - 30%	15%
Commercial	34 (4,4%)	10 - 30%	15%
Others (Agriculture, Construction, and Mining)	26 (3,4%)	25%	-

Note:
- Based on *Handbook of Energy & Economic Statistics of Indonesia* 2013
- Exclude biomass and non-energy used

GHG emission in industrial sector is from power plant, waste management, and industrial processes and product use (IPPU) as shown in Figure II-6. Example of IPPU activity that emit GHG are production process, non-energy product from fuels and solvent use, ozone depleting substances, and other product use.

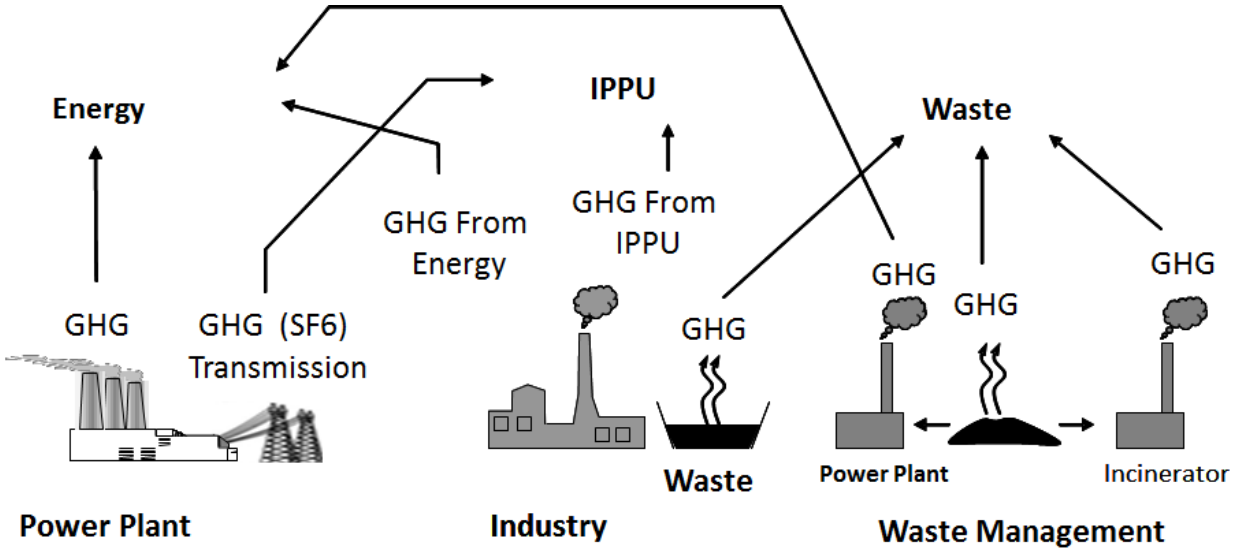

Figure II-6 GHG emission in industrial sector

II.2.4 Potential JCM projects in palm oil mill industries by Prof. Udin Hasanudin

Prof. Udin Hasanudin is a professor in agricultural waste management at University of Lampung. He explained the GHG and renewable potency from palm oil mill industrial waste. The summary of this presentation is written in the next chapter (possible JCM projects.)

II.2.5 Low-carbon society and potential JCM project in energy sector by Dr. Retno Gumilang Dewi

Dr. Retno Gumilang Dewi is an expert in energy policies from Institute of Technology Bandung. She explained about the concept of low-carbon society and potential JCM projects to reach low-carbon society in energy sector in Indonesia. The potential projects in energy sector are shown in the next chapter.

Low-carbon society could be defined as activities of a society which result in low carbon emission by reducing anthropogenic emission intensity, for example by changing people lifestyle, city design, country's development pathway, and economic structure. It is a concept that was developed to avoid the increase of global world average temp of 2°C in the mid of the century. This goal could be achieved if GHG emission is reduced. One of the parameter is carbon budget, the amount of carbon dioxide emissions the world can emit while still having a likely chance of limiting global temperature rise to

2 °Celsius above pre-industrial levels. Carbon budget until 2050 is 825 Giga Ton. The scientists predict that world trajectory will follow this trend: GHG emission increase until 2030/2040 then drastically decrease to 11 – 15 Giga Ton per year in 2050. Assuming world population of 9.5 billion in 2050, emission per capita in 2050 has to decrease become less than 1.6 ton di 2050. Currently, world average of per capita emission is 5.6 ton (developed countries emission is more than this average), while Indonesia energy sector emission in 2010 is 1.8 ton/capita. Figure II-7 shows this trajectory. The dashed line represents GHG emission if the energy sources pattern in the world is same as today.

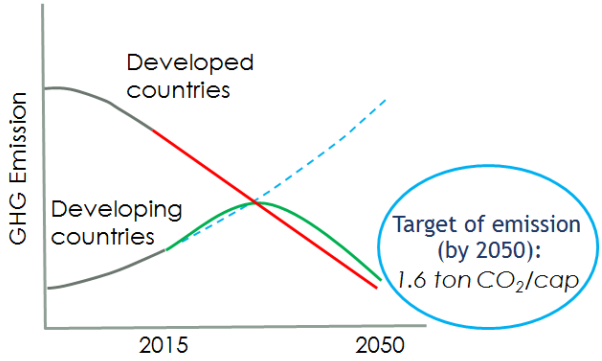

Figure II-7 Trajectory of Low-Carbon Society

In Indonesia case, GHG emission is mainly produced by land use, land-use change and forestry (LULUCF) and energy sector (Figure II-8), with total annual growth of CO_2 emission is 3.2 % from 2000 to 2012 (Table II-2).

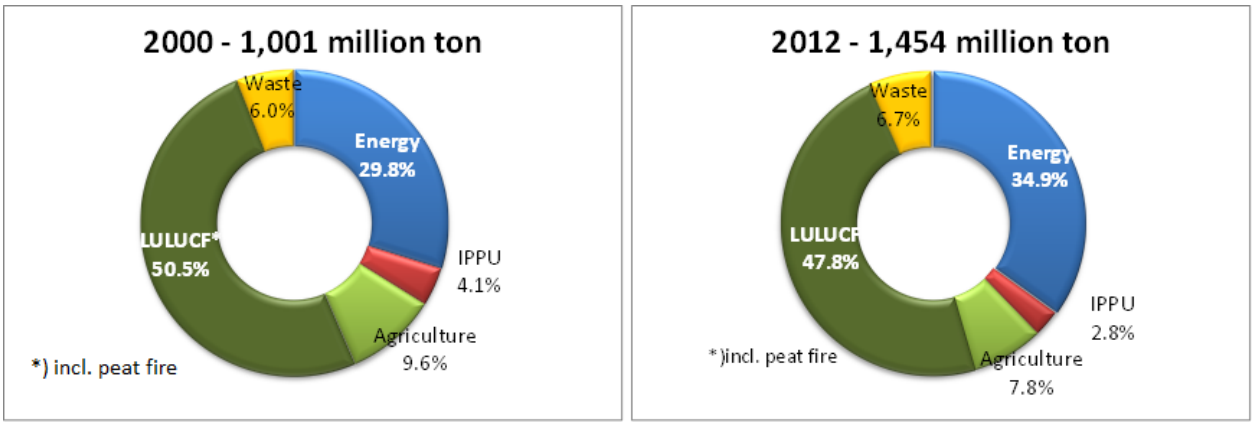

Figure II-8 Trend of Indonesia GHG Emission

Table II-2 Average annual growth of Indonesia GHG emission by sectors

Sectors	Million ton CO2e		Percentage		Average annual growth
	2000	2012	2000	2012	
Energy	298	508	30	35	4.5%
IPPU	41	41	4	3	0.1%
Agriculture	96	113	10	8	1.3%
LULUCF *	505	695	51	48	2.7%
Waste	61	97	6	7	4.0%
Total	1,001	1,454			3.2%

Table II-2 shows that energy sector have the biggest GHG emission. Major sources of this emission are from coal and oil used in power generation plant, while industry and transportation also plays important role in GHG emission (Figure II-9). Emissions from power generation are accounted by building (60%) and industry (40%) sectors.

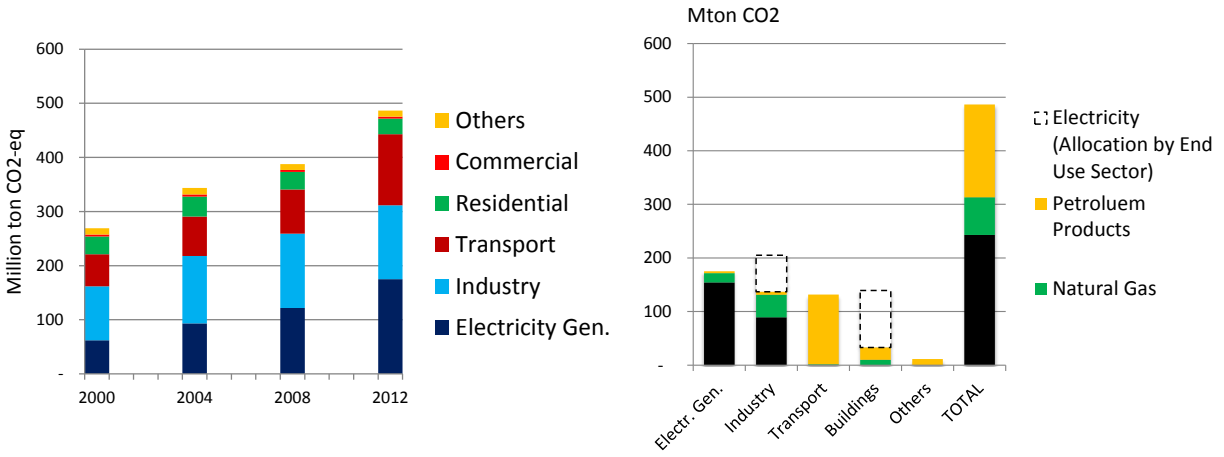

Figure II-9 GHG emission based on end-use sector (left) and energy sources (right)

As stated before, INDC target is 29%. Based on data, it is an ambitious target and difficult to achieve because the increase of contribution from 2012 – 2014 was only 1%. To achieve INDC 29%, 835 million ton of CO_2 emission should be decreased. It needs delineation into specific projects and programs by the government. If government could not do it soon, the INDC target will not be achieved (Figure II-10). To fasten this progress, JCM could be used as one option for achieving INDC target towards low-carbon society in Indonesia.

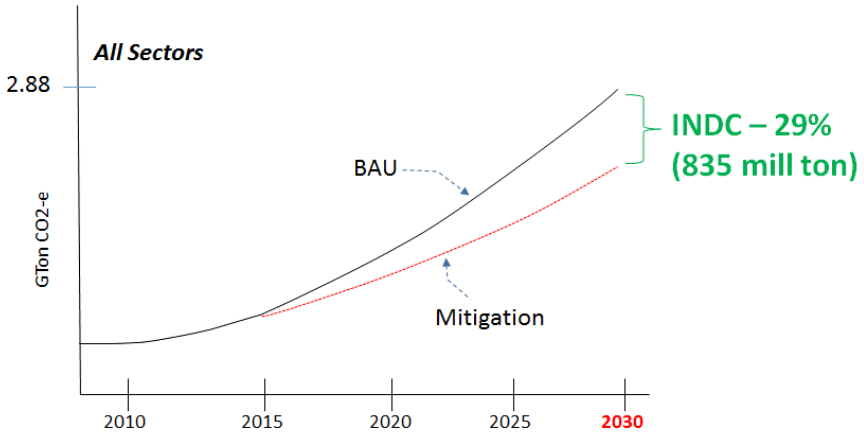

Figure II-10 Indonesia INDC on 2030

II.2.6 Research mapping for adaptation and mitigation by Dr. Arie Dipareza Syafei

Dr. Arie Dipareza Syafei is a professor in air pollution control and climate change from Institute of Technology Sepuluh Nopember (ITS). He explained about research mapping about climate change in East Java for adaptation and mitigation.

JCM is one mechanism to reduce GHG emission, which calculated using carbon credits. Besides of GHG emission reduction, JCM also provides another benefits for Indonesia, e.g. increasing capital inflow, implementing clean technology, and technology transfer from Japan to Indonesia. However, the data about GHG emission in Indonesia is limited. Moreover, Indonesia government awareness regarding GHG emission is still low. For this reason, emission reduction and carbon credits data was conducted. This research mapping had been conducted for five years in East Java by Institute of Technology – Sepuluh Nopember (ITS). The data includes adaptation, mitigation, measurement, and analysis of GHG emission from several sectors:

- Residential CO_2 emission
- Emission from energy usage
- Solid waste burning
- Human behavior
- Green space
- Effects of climate change to water resources
- Using satellites to adapt and mitigate

- Forestation
- Low emission energy

The availability of these data could promote emission reduction and help to prioritize the most urgent sectors to be handled. These data also could be used for mapping the highest GHG emission sources and help to find potential JCM projects that could be applied in the society to reduce GHG emission. For example, residential CO_2 emission reduction is very important, even though individually, the emission is small.

II.2.7 Development of JCM projects proposal by Prof. Kensuke Fukushi

Prof. Kensuke Fukushi is a professor from IR3S, University of Tokyo. He explained about JCM proposal development.

JCM project proposal development steps in every host countries are almost same. Some differences could occur due to various bureaucracies in each host countries. However, the projects proposal is very important. JCM will be not implemented without proposal. Therefore, JCM project proposal should be developed carefully. In general, there are six key points for developing JCM projects proposal:

a. Follow the format of proposal strictly, especially for Japanese counterparts.
b. Apply proposed methodology to calculate carbon emission reduction or other parameters
c. Appropriate **reduction efficiency** (Yen/t-CO_2) is required, no rule for minimum amount of CO_2 reduced. The reduction efficiency should be less than 500 USD/t-CO_2.
d. Co-benefit should be clearly stated (quantitative evaluation is preferred)
e. Project size should not be very small
f. Application to other facility, city, or country is preferred (good model). If the projects could be applied to other countries or cases, the acceptance probability is better. For example, a groceries (franchise) store implement JCM only by changing its fluorescent lamps to LED, but this project could trigger other groceries stores to follow this action and give a bigger impact in GHG emission reduction.

JCM projects are carried out through cooperation between Indonesia institutions (corporations, foundations, local government, etc.) and Japanese institutions using proven technology from Japan. This cooperation includes capacity building of technology from Japan institutions to Indonesia sides. However, Indonesia institution also could initiate JCM projects, following these steps:

a. Identifying the potential JCM project

   A short but clear proposal development that explains about the project should be developed by team projects in the host country. During this process, the participants could consult with local JCM secretariat, which will help proposal development during this process.

b. Identify host institution in Japan

   Because the initiative actions come from host country, the Indonesian institution has not yet had Japanese partner. Indonesia JCM secretariat could inform proposed initiative to Japan government to disseminate to Japanese institutions whom may be interested. Moreover, 3E Nexus from Japanese JCM secretariat could help by finding the potential partner.

c. Proposal development

   In general, proposal should be developed by Japanese institutions. However, it depends on the projects. If the initiative comes from Indonesia institutions, proposal could be developed together by Japanese and Indonesian institutions. In any case, proposals from both sides should be submitted to both Japanese JCM secretariat (by Japanese institutions) and Indonesia JCM secretariat (by Indonesian institutions). In proposal development, MoU or other documents showing discussion history may help to furnish proposal. Proposal also should include co-benefit identification to both countries. Again, project idea development should be discussed with JCM secretariat before submission of the proposal. In Japan, 3E Nexus secretariat will support the communication during the proposal development.

II.2.8 Summary of Q&A and discussions

- 3E Nexus mainly conducts capacity building in each countries and development technology. 3E Nexus helping participant by contacting with Japanese company, but not directly involving of the program in each country. 3E Nexus is not under or team of JCM, but it promotes JCMs
- Capacity building in Indonesia JCM is needed to unite the focus from different backgrounds experts.
- Carbon credit share in JCM depends on the projects. In other mechanisms, Indonesian Government had never got the credit, but in JCM there are credit for government. In REED+ projects, Indonesia government get 51% credit, in another project, Indonesia government get min. 10% carbon credit.
- In JCM, air quality control is calculated and the technology is from Japan.
- University can join by applying as project participants, joining as consultants, making some review in methodologies and projects.
- In JCM, there are no minimum emission reductions, but it will not pass the FS if the emission reductions are small and investment cost is high.
- Not all eligible feasibility studies could become JCM projects, if it is 'too eligible' to get another grant, then it is possible to get another grant.
- In measuring potential emission reduction, industries have been trained to measure emission reduction and the software calculated for them by inputting the data to see the emission increasing or decreasing.
- The main difficulty to join low-carbon society is national policy that use coal as the cheapest solution as energy sources. Gas is expensive and have problems in transportation. If the coal is replaced, the textile industry in Indonesia will be not competitive anymore. Cheaper technology is examined, i.e. membrane technology.
- There are some policies for agroindustries:
    - Mixed energy for GHG emission reduction. The price of CPO depends on sustainability index. Contribution from agroindustries is high from POME, fiber, solid waste, etc. to reduce GHG emission and increase renewable energy percentage.

- JCM is one of the tools from Japan side to fulfill the GHG emission reduction and need the help to other people. It is not effort, but it is business. From FS it is not technically and economically feasible.
- First regulation, INDC (intended nationally determined contribution), year 2025 should be measured and verified. If it could not be measured and verified, it is useless. Second, bioenergy is promoted. Third, Big company has to report. But we have contradicted policy which is increase 7% of coal for power plant.

- JCM depends the regulation and politics. This is policy-driven and should be used policies-approaches. The target is not only technical things but also the policy. JCM is tiny tools, but it can be used to learn and make awareness from ministries.

II.3 Important stakeholders, list of individuals/organizations in Indonesia network

In Indonesia, the JCM joint committee is co-chaired by Assistant Deputy Minister for Multilateral Economic Cooperation and Financing of Coordinating Ministry for Economic Affair (CMEA) and consists of ten director-level members from seven ministries and JCM secretariat (see Figure II-11).

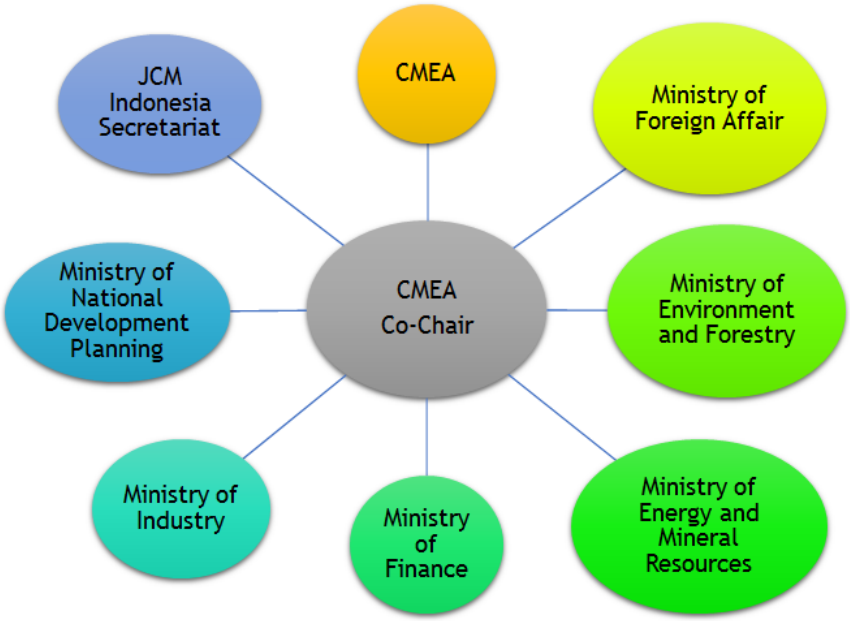

Figure II-11 Structure of Indonesia JCM joint committee

II.4 Role of the academic community/researchers in creating future JCM projects

The roles of academicians/scientists are very important in JCM. They are the persons who know how to transfer the technology/knowledge, to give the advices regarding the policy to the government, and to create sustainable society locally and globally. Besides, they have capacity to find the suitable green technology for local community. Finally, they also have power to transfer the awareness of GHG emissions reduction to younger generation, which will be important policy-makers in the future.

Currently, academic communities/researchers have two main roles in the Indonesian JCM secretariat. First, they develop suitable methodologies in JCM projects for measuring the amount of reduced carbon. It is important for measuring, verification, and reporting (MRV). JCM secretariat has 10 methodologies of energy efficiencies and renewable energy. Most of them were developed together with academicians. Second, they also could joint as a consultant in feasibility studies. In this role, they will validate, verify, and evaluate the proposed feasibility studies.

III. Creation of JCM Projects and Co-benefits

III.1 Possible JCM projects

Four potential JCM projects were presented in the workshop. These potential projects were the idea of universities, ministry of Industry, and JCM secretariat for reducing GHG emissions.

III.1.1 Palm oil mill industries

Palm oil mill uses fresh palm bunches to produces crude palm oil and palm kernel. Only 22% mass of fresh palm bunches that is converted to crude palm oil. The rest of them is palm kernel and waste (Figure III-1). Regarding fossil fuel consumption, palm oil industries do not consume much fossil fuel because they use biomass from empty bunches as energy sources. However, it does not mean that GHG emission from palm oil industries is low. The main GHG emission from palm oil industries is from methane that is generated from its waste.

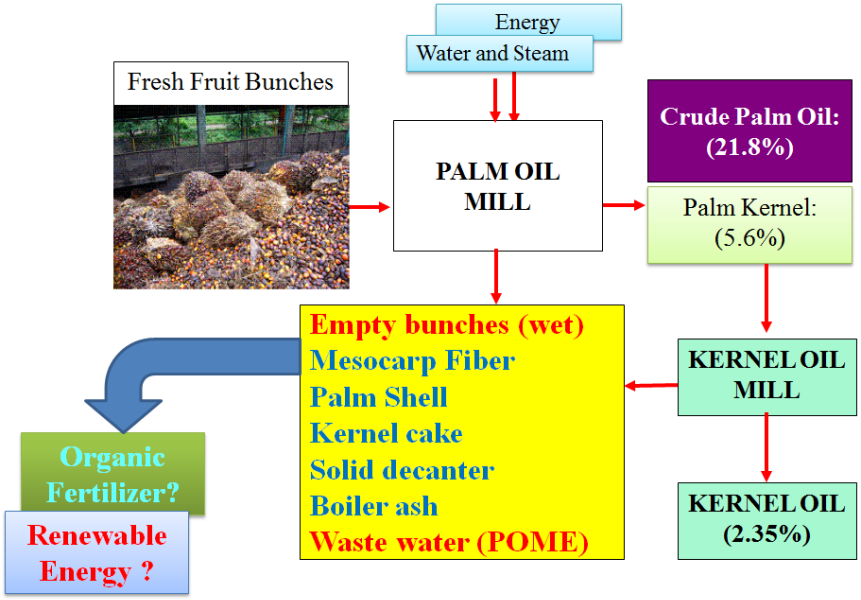

Figure III-1 Palm oil mill process

Palm oil waste could be classified as solid waste and wastewater (palm oil mill effluent, POME). The solid waste contains empty fruit bunches (EFB), mesocarp fiber, palm shell, kernel cake, solid decanter, and boiler ash. The wet EFB and POME has the biggest

potential to emit methane. POME could be treated and utilized as fertilizer for producing fresh fruit bunches in oil palm cultivation. About POME application as fertilizer, treated POME gave 13% higher productivity of the plant than untreated POME. However, POME also produce high amount of methane, 5 – 8.5 kg methane per ton fresh fruit bunch (FFB). This methane could be captured to reduce carbon footprint and increase revenue. Advantages of methane capture from POME are renewable energy production for in-house used, fossil fuel replacement for generating steam and electricity, GHG emission reduction, and electricity production for grid connection. Based on methane production potential, the energy production from POME is estimated about 25.3 – 40.6 kWh/ton FFB. Using this value, palm oil mill with 45 ton FFB/hour or 900 ton FFB/day capacity will has potential to generate electricity about 0.95 to 1.52 MW. It is a huge amount, considering that energy consumption in palm oil mill typically is 17 kWh/ton FFB. The rest of energy as electricity could be used for people around palm oil mill. If this energy could be captured, it could give a profitable revenue for the companies.

But, the GHG emission in palm oil mill is also generated from empty fruit bunch (EFB) and it also should be reduced. One of the promising technology for reducing GHG emission from EFB is dry anaerobic digestion/composting. The experiment showed that from 16 kg EFB, 12,000 L of biogas could be produced (Figure III-2). Besides of biogas production, EFB composting also produced fertilizer for plantation.

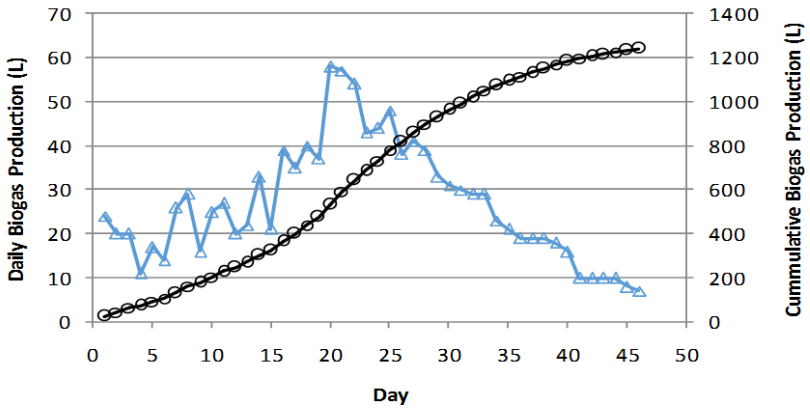

Figure III-2 Daily and cumulative biogas productions from dry anaerobic digestion of EFB

Furthermore, co-composting of EFB and POME could be an option. Co-composting was practiced by pouring some of POME for moisturizing EFB composting. This practices

have three main advantages, viz. reduction of wastewater release (by 80%), GHG emission reduction (30 – 80% of methane captured, depends on method), and additional electricity for the plant from EFB. Coupling POME anaerobic digestion and dry anaerobic co-composting at palm oil mill with 45 ton FFB/hour capacity capable to add another emission reduction 150 kg CO_2e /ton FFB and about 0.93 MW electricity. Using this system, the palm oil industry also can produce compost and liquid fertilizer which is important to ensure the sustainability of FFB production. This fertilizer is important not only because it reduces chemical fertilizer usage, but also carbon and nutrient contents in EFB and POME are returned to the plantation. Coupling utilization of POME and EFB for renewable energy and compost production not only is beneficial to increase the added value of POME and EFB, but also is able to lower environmental burden and to ensure the sustainability of FFB supply in palm oil industries. This scheme is an option for sustainable palm oil mill industries. Figure III-3 represents the different options for co-composting EFB and POME application in palm oil mill industries. It could be used open system where biogas is used for producing electricity using combined heat and power (CHP). Otherwise, biogas could be applied for transporting FFB using biogas compressor to fuel transporting trucks. However, the latter option could be practiced if compressed biogas (CBG) is compatible with the truck specification.

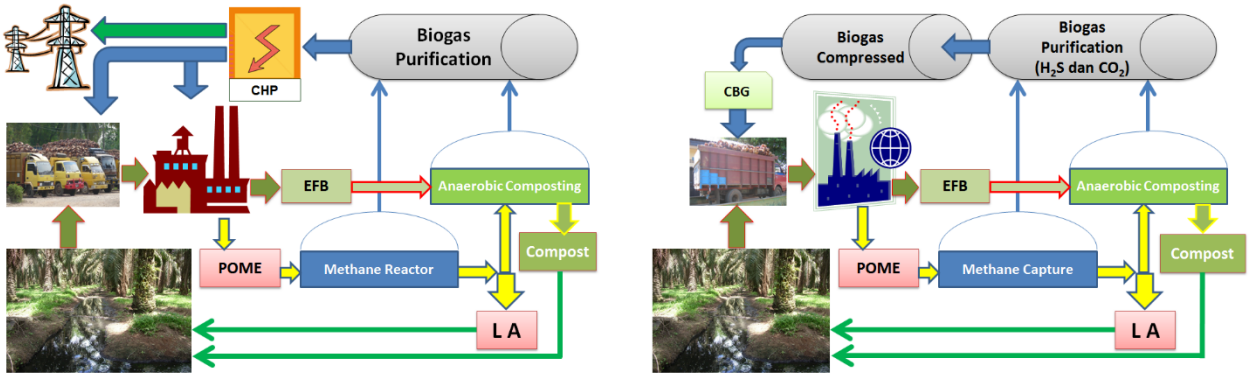

Figure III-3 Diagram of open system (left) and closed system (right) co-composting EFB and POME

III.1.2 Potential JCM projects in energy sectors

Figure II-8 and Table II-2 shows that energy sector contributed the highest amount of GHG emission. Decomposition of energy-related CO_2 emission (Figure III-4) shows that

energy sector in Indonesia depended on fossil fuel. Figure III-4 is a data from 1995 to 2010. In this period, economic activity was increasing (5 – 6% growth per year). This is the main driving force of increasing energy consumption. In the other hand, energy per GDP was decreased. It indicates that decoupling between energy and economy has begun. However, intensity of carbon in energy is still increasing, which means the energy mix is moving toward more fossil fuels utilization. Based on energy sources, the growth of fossil fuel utilization, especially coal was high, both as primary energy supply and power generation mix (Figure III-5).

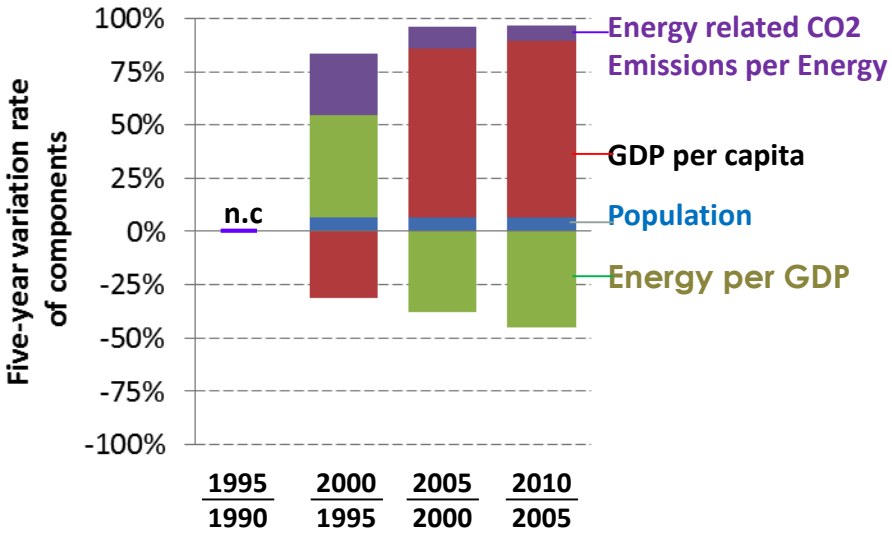

Figure III-4 Decomposition of energy-related CO_2 emission

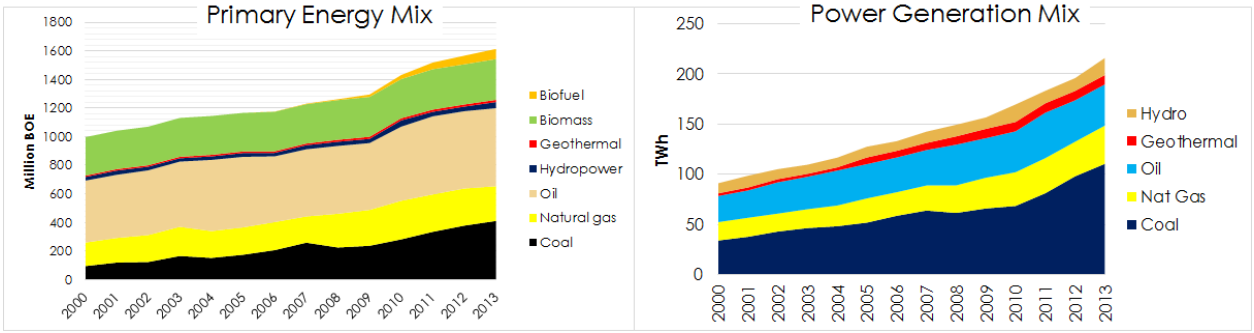

Figure III-5 Energy sources trend for primary energy mix (left) and power generation mix (right)

These trends should be intervened to reduce GHG emission and achieve carbon budget target. Therefore, decarbonization pathway of energy should be undertaken. To achieve decarbonization, Indonesia has to drastically change primary energy (total energy

demand) supply mix and final energy demand (end-user energy demand). By projection, primary energy of Indonesia will increase around 211 %, while final energy demand will increase around 250% (Figure III-6). Decarbonization of primary energy could be performed by reduce share of coal, reduce oil consumption, increase the share of natural gas, significantly increase renewables, and begin to deploy nuclear power plant. In the other hand, decarbonization of final energy could be conducted by significantly increase share of electricity in of final energy (electrification of end-use), substitute oil fuels by biofuels, increase the share of natural gas, and significantly reduce coal in industry.

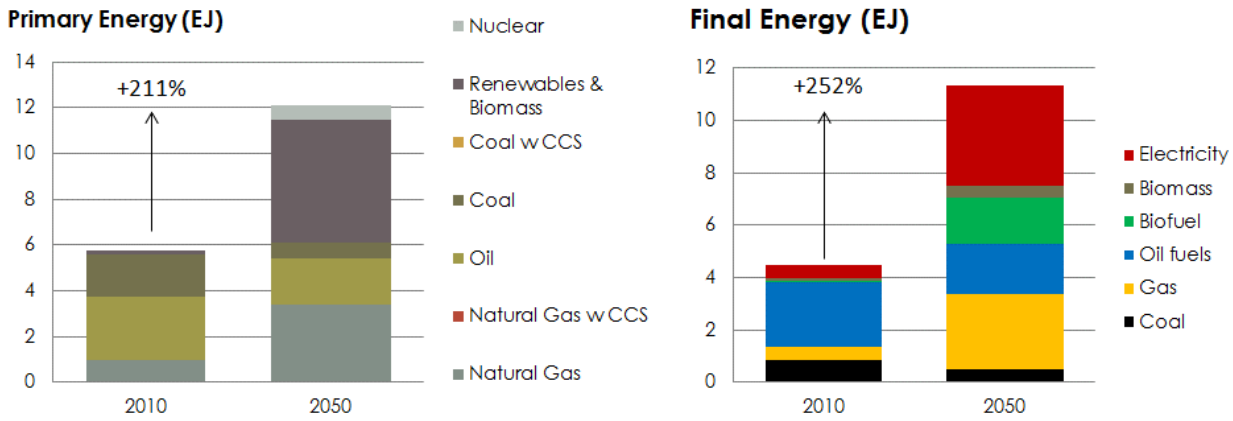

Figure III-6 Projection of primary energy (left) and final energy (right) of Indonesia in 2050

Decarbonization has three main pillars. First, **energy efficiency** measures would drastically decrease energy intensity of GDP (Energy per GDP). Second, **decarbonization of electricity** by using low carbon emitting fuels. It would significantly decrease electricity emission intensity (mass of CO_2/kWh). Third, **electrification of end uses** will reduce fossil fuel combustions and reduce emission (as long as the power generation is deeply decarbonized). If these pillars could be applied, some effect could be resulted (Figure III-7):

- Emission will first increase (economic development) and then decrease (results of decarbonization measures).
- Industry and transport are the main emitter in 2050.

- Significant decarbonization in power generation, from 144 $MtCO_2$ (2010) to 56 $MtCO_2$ (2050).
- Emission from industry will remain to increase 152 $MtCO_2$ in 2010 to 211 $MtCO_2$ in 2050.
- Emission per capita will decrease from 1.84 ton CO_2 to 1.31 ton CO_2

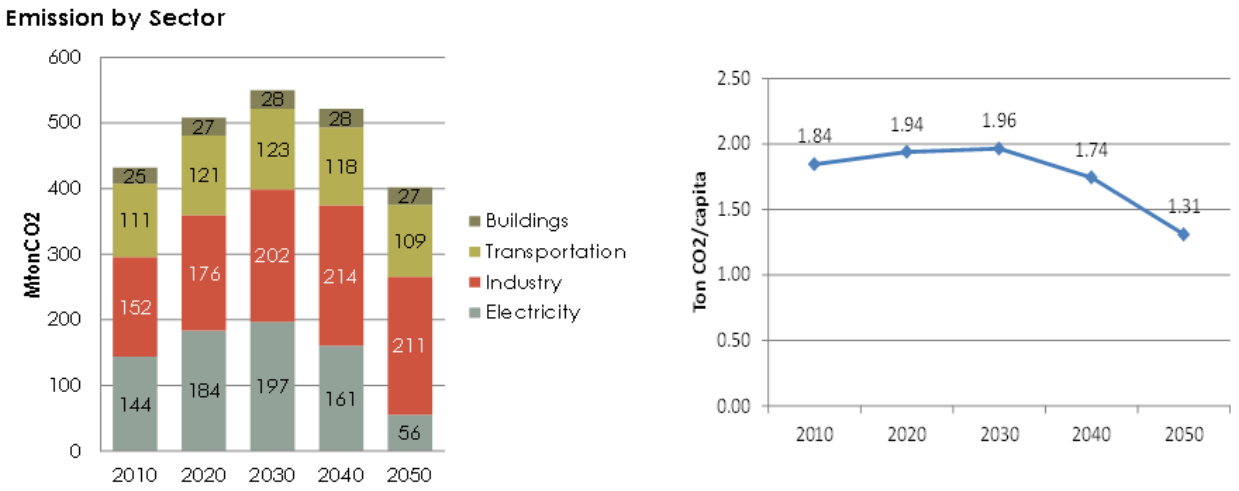

Figure III-7 Result of decarbonization in emission by sector (left) and CO_2 emission per capita (right)

Furthermore, mitigation opportunity exists in power generation, industry, transportation, and building (commercial and residential) sectors. In power generation sector, demand of electricity will continue to increase due to improved wealth and electrification of end-use in building, industry, and transport. Some decarbonization strategy for power generation sector are:

- Fuel switching to lower carbon-emitting fuels (coal to gas, oil to gas),
- Maximize renewable (solar, geothermal, hydropower, biofuels)
- Use of nuclear power
- Efficiency improvements di power plants.

Decarbonization in power generation sector could decrease carbon intensity from 871 gigatons CO_2/kWh to 51 gigatons CO_2/kWh in 2050. In industry sector, components of decarbonization are fuel switching to gas and bioenergy (solid biomass and biofuel), electrification of industrial end users, and reduction of coal. These actions could

decrease of carbon intensity in energy from 88 gigatons CO_2/MJ to 33 gigatons CO_2/MJ. In transportation sector, the decarbonization strategy are modal shift to mass transport, electrification, fuel switching to gas and biofuels, more energy-efficient vehicles, shift of freight transport from road to railway. These actions will reduce personal vehicles from 60% in 2010 to 40% in 2050 and share electric cars up to 30% in 2050. The reduction of carbon intensity in transportation is from 73 gigatons CO_2/MJ to 49 gigatons CO_2/MJ. In residential and commercial building sectors, increase of per capita income will increase energy demand. However, the increase is counterweighted by use of more efficient equipment. Decarbonization strategies are fuel switching to gas/LPG, increase electrification in end use, and super-efficient energy devices utilization. Carbon intensity of commerce and residential sectors could be reduced from 151 gigatons CO_2/MJ to 26 gigatons CO_2/MJ. These mitigation opportunities could be developed using JCM projects. JCM is one of tools that could be used for achieving GHG emission reduction in energy sector.

III.1.3 Some potential JCM projects regarding green industry

Green industry policy in Indonesia consists of several components, i.e. efficient input material usage, use of alternate raw material, low energy intensity, low water intensity, competent human resources, waste minimization, and low carbon technology. In relation to JCM, JCM projects could focus on low carbon technology, which give two simultaneous advantages for companies, viz. receiving funds for GHG emission reduction and helping companies to convert to green industry. JCM is a tool for industries to convert their production process to low-carbon technology process. Main energy-intensive industries that become main target from ministry of industry (MoI) to reduce GHG emission are cement, metal and steel, textile, pulp and paper, petrochemical, fertilizer, food and beverages, glass, and ceramics. MoI also had conducted audit with Indonesia Climate Change Trust Fund (ICCTF) that recommend medium and high cost option to reduce GHG emission, especially in iron and steel company and pulp and paper industries (Table III-1). These projects, alongside with other potential projects could take advantage of JCM for GHG emission reduction. Here, it proves that JCM is only one of the small tools that can be used for national purposes.

Table III-1 Audit recommendation to reduce GHG emission for Iron & Steel and Pulp & Paper Industries by ICCTF and MoI

Audit Recommendations for Iron and Steel Companies	Audit Recommendations for Pulp and Paper Industries
Installation of Inverter Dust Collector	Blowdown heat recovery
Installation of Capacitor Bank	Addition of microturbine tools
Installation of High Efficiency Recuperator	Capasitor Bank Installation
Replacement of Fan Blade Cooling Tower	Superbatch system application
Installation of Variable-Speed Drive (VSD)	Installation of Variable-Speed Drive (VSD)
Installation of Preheating Scrap	Recovery steam blow down
Installation of High Efficiency Recuperator	Improve Total Solids Black Liquor to increase Steam production in Recovery Boiler
Improving of vacuum system by installation of bigger vacuum pump.	Improving of vacuum system by installation of bigger vacuum pump.
Installation of High Frequency Furnace equipped with Automatic Frequency Control	Using super consentrator and evaporator tipe plate (lamella) to increase total solids in black liquor evaporator system
Improvement of Furnace Wall isolation	NCG gas utilization produce methanol gas to replace fuel oil
Installation Variable Voltage Regulator on Hoist & Crane	-

III.1.4 JCM feasibility study in carbon capture and storage (CCS) project

A JCM feasibility study in CCS project had been conducted at Gundih gas field in Indonesia. The partner from Indonesian side is Pertamina at Gundih gas field and the implementing agency is The General Environmental Technos. The study aims at the development of a CCS project under the JCM scheme by examining the viability of the ongoing Gundih CCS research project in Indonesia (the first of its kind in Southeast Asia) as a JCM project.

The feasibility study showed that the associated CO_2 gas (ca. 300,000t/year) was released to the atmosphere from the Gundih natural gas production facility before the implementation. The proposed project plans to monitor the amount of CO_2 injected, the amount of electricity and fossil fuel consumed. The reference emission for this project was 10,950 t-CO_2/year and the target for this project was 10,803t-CO_2/year. Three actions was planned in this projects, i.e. separation and capture (using absorption and

membrane), transport and injection (using CO_2 pump and microbubbles), and monitoring (using microseismic, seismic tomography, well logging, time domain electromagnetic, and interferometric synthetic aperture radar technology).

III.2 Measurement, Reporting, Verification (MRV) in Indonesia

UN Framework Convention on Climate Change (UNFCCC) requires MRV for each country to calculate the reduced emissions from mitigation actions. MRV helps define the reduced emissions that are measureable, reportable, and verifiable. MRV system is not only applied to emissions reductions, but also measure and monitor all enabling condition components (technology, finance, and capacity building) relevant to emission reduction measures. Some potential components, data, and responsible actors in MRV is shown on Table III-2.

Table III-2 Potential indicators to be included in MRV

Measured component	Type of Data	Actor(s)
Emission reduction	Activity Data Emission Factor (EF)	Ministries and local governments
Development indicators	Calculated data	BPS
Finance	Amount Flow How it is used	Coordinating Ministry on Economic Affairs Bappenas
Technology	Type of technology Nature (loan/grant)	Ministry of Research and Technology
Capacity Building	Human resource development Institutional setting and capacity strengthening	Sectors, Ministries Central and local government

Since 2015, Indonesia has a system for MRV called The Indonesian National Carbon Accounting System (INCAS). The methods that covered in INCAS are methods on measuring initial conditions, forest growth and turnover, forest management events and regimes, spatial allocation of regimes, peatland GHG emissions, and method on modelling and reporting. INCAS is developed under Ministry of Environment and Forestry. Some data was provided also by Ministry of Agriculture and several research institutes. This system is still focus on the land sector as prerequisite from REDD+. Currently, Indonesia JCM secretariat has had 25 feasibility studies in REDD+ sectors. It is the second biggest amount than other sectors and INCAS could help to verify the

emissions reduction from this sector. However, MRV for other sectors are still limited and JCM secretariat in Indonesia has to develop their own scheme in measuring the emission reduction.

Main difference of JCM calculation of emission reduction with measurement, reporting, and verification (MRV) is described here. In the JCM, emission reductions to be credited are defined as the difference between reference emissions and project emissions (Figure III-8). Reference emissions are calculated below business-as-usual (BaU) emissions which represent plausible emissions in providing the same outputs or service level of the proposed JCM project in the host country. JCM approach will ensure a net decrease and/or avoidance of GHG emissions. The value of Reference Emissions in JCM depends on the methodology. Therefore, the value can be equal or different with Baseline Emission. This method is usually developed in collaboration with government and especially experts from universities.

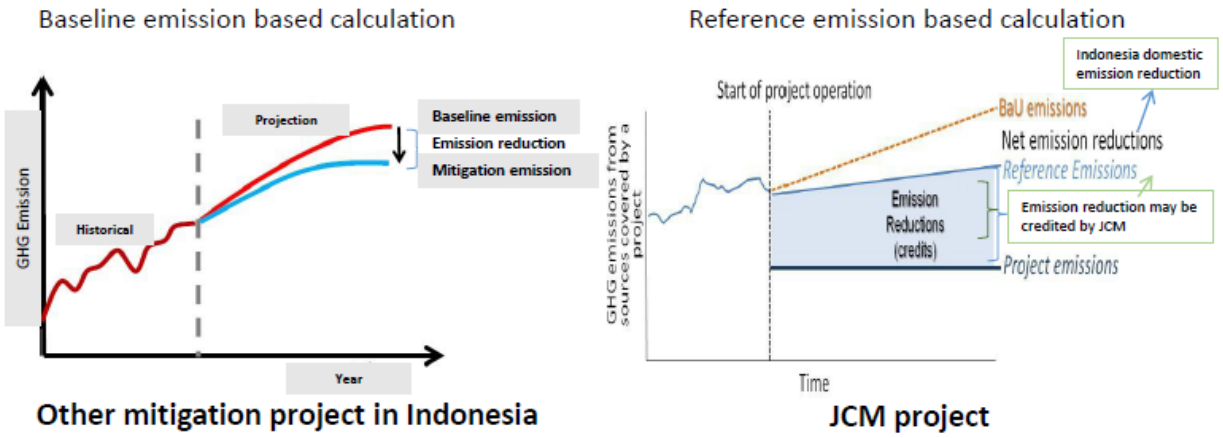

Figure III-8 Emission reduction calculation in other mitigation project (left) and JCM project (right)

III.3 Challenges of JCM projects in Indonesia

JCM secretariat indicated that there are two main challenges of JCM projects in Indonesia. The biggest challenge is communication between stakeholders. The stakeholders consist of industries, government, and universities. The communication to link them is not easy because each of them feel that they are the expert. To solve this problem, JCM secretariat develops a communication protocol as well as communication material to be used by the JCM stakeholders. Moreover, some business forum and

dissemination were held to increase the communication between stakeholders. The second biggest challenge is the JCM infrastructure development. It is not easy to develop new market based initiative infrastructures that must be transparent, based on scientific approaches, and using international standards, but still simple, robust, and easy to be implemented.

III.4 Possible co-benefits and the development of co-benefit indicators

III.4.1 Possible co-benefits

Co-benefits are added benefit other than climate change and air pollution-related projects. During the workshop, there are four possible JCM projects, i.e. palm oil mill industries, energy sectors, industrial sectors, and CCS. Among them, three projects have potential co-benefits.

1. Palm oil mill industries

   In 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 are also received in this project. Two of them are:

   a. Energy from waste utilization. Methane capture and fermentation of solid waste from palm oil result sufficient energy to fulfill the palm oil mill plant energy requirement. It will reduce the operational cost of the plant.
   b. Reduce waste loading to the environment. By utilizing wastewater and solid waste of palm oil, the generated wastewater is reduced. It also reduces the waste loading to the environment and operational cost of the plant.

2. Industrial sectors

   Most of the GHG emission in industrial sector could be reduced by increasing present production process efficiency. The potential JCM projects in industrial sector related in increasing the efficiency of the industry. It reduce the GHG emission and also increase the productivity of the industry.

3. Carbon capture and storage project

   Carbon capture and storage concept (CCS) is to put carbon dioxide from oil and gas activities back to the underground. This carbon dioxide could be used in enhance oil

recovery (EOR) to increase the pressure of the well. This practice not only reduces GHG emission, but also increases the productivity of the well.

III.4.2 Co-benefit indicators development

For assessing the co-benefit, some indicators should be developed. There is a working group that develop sustainability indicators for biomass utilization in East and Southeast Asia (Kudoh et al, 2015[1]). This working group suggested three sustainability pillar that consist of main and secondary indicators. These indicators were developed in several city in Asia. In Indonesia, the pilot study was taken place in Lampung.

1. Environmental pillar

   The suggested main indicator for environmental pillar is life cycle GHG emissions. In JCM projects, it is the main objective. The secondary indicators (co-benefit indicators) are water consumption and soil quality. The concept is water utilization for biomass utilization should be lower than water consumption for biomass cultivation. Meanwhile, the soil quality is important indicator that relates to soil characteristics, environmental conditions, and land use. The technology for biomass utilization should not deteriorate the soil quality.
2. Economic pillar

   The main indicator in economic pillar is total value added by the biomass utilization. The secondary indicators include net profit, productivity, and net energy balance. The biomass utilization should increase the profit of the project and increase the productivity efficiency of plant.
3. Social pillar

   The main indicators are employment generation and access to modern energy. The secondary indicator is human development index. Biomass utilization should consider the employment because by diverting the waste to energy, some industry could be affected. Biomass utilization could help to disseminate the modern form energy, which is cleaner.

[1] Kudoh, Y.; Sagisaka, M.; Chen, S.S.; Elauria, J.C.; Gheewala, S.H.; Hasanudin, U.; Romero, J.; Sharma V.K.; and Shi, X. "Region-Specific Indicators for Assessing the Sustainability of Biomass Utilisation in East Asia". Sustainability 7, **2015**, pp. 16237-16259.