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# Sustainable Energy Cooperation between CLMV Countries and Korea*

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While Korea's commitment for ODA in CLMV countries (Cambodia, Laos, Myanmar, and Vietnam) has mainly focused on economic infrastructure and services, its aids in the energy sector have been low with only 3.2%. To maximize Korea's ODA for CLMV countries, this study aims to build a concrete cooperation programs in energy sector for each of these countries. After analyzing energy conditions in four countries, the study suggests that (1) constant communication between partner countries, (2) consideration of energy's synergistic effect with other sectors, (3) community involvement, and (4) institutional strengthening and capacity building are essential for successful cooperative programs.

JEL Classification: Q42, Q53, Q54
Keywords: energy, ODA, cooperation program, CLMV, Korea

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## 1. ENERGY IN DEVELOPING COUNTRIES

About 1.3 billion people, accounting for 20% of the world's population, are living without electricity, and about 2.7 billion people still use wood, charcoal, and excrement for cooking and heating (IEA, 2011). Even in the areas where modern energy, such as electricity, is provided, energy is not sufficiently provided due to a lack of supply and reliability.

Energy, which is not included directly into the targets of the Millennium Development Goals (MDGs), has been recognized as an essential sector in the development of developing countries. Consequently, it has emerged in the discussion of the international development community in recent years. It was the 9th United Nations Conference on Sustainable Development (UNCSD) in 2001 where energy was treated as a separate agenda of the UN for the first time, which became the foundation of cooperation promotion plan to improve the energy access that has been discussed at the World Summit on Sustainable Development (WSSD) in Johannesburg in 2002 (Gualberti *et al*., 2014). The United Nations (UN) declared 2012 to be the "International Year of Sustainable Energy for All" and selected energy as one of the priority areas in the Rio+20 conference. In recent years, 2014-2024 have been announced the "Decade of Sustainable Energy for All".

As the impact that energy has on the development of developing countries had been seen, the international community was under active discussion of energy issues in the goal-setting process to succeed the MDGs. It was agreed during the development of the Sustainable Development Goals (following SDGs) as the goals of a post-2015 development framework at the Rio+20 conference, and then, the SDGs was adopted by the UN in 2015. The SDGs has presented the global goals and the specific targets including energy-related goals.

Under the global goal (Goal 7), "Ensure access to affordable, reliable, sustainable and modern energy for all", the specific targets of (1) ensure universal access to affordable, reliable and modern energy services, (2) increase substantially the share of renewable energy in the global energy mix,

and (3) double the global rate of improvement in energy efficiency, by 2030, were set up. In addition, two supplementary targets, “enhance international cooperation to facilitate access to clean energy research and technology” and “expand infrastructure and upgrade technology for supplying modern and sustainable energy services for all in developing countries” by 2030, were added.

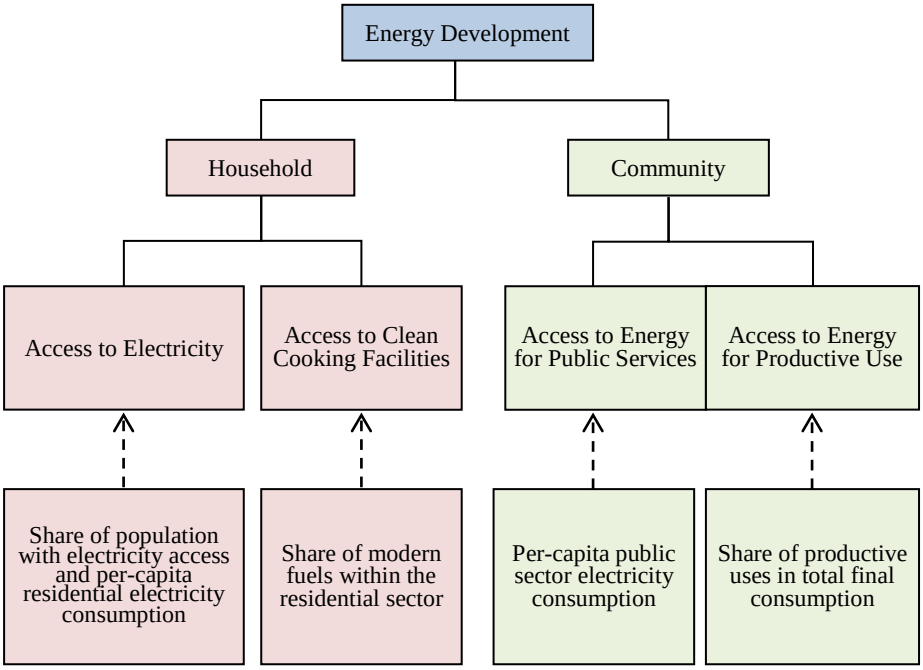
Dissemination of modern energy helps achieve sustainable development and expands the opportunities for income generation activity of the poor in developing countries. A certain research shows that the energy access rate has a positive correlation with economic growth (represented by GNI per capita) or basic human development (represented by the Human Development Index, HDI) (Bhattacharyya, 2012).

The international community has increased the effort to measure the degree of the energy poverty or the energy development objectively through researches showing the relationship between energy and development. Information on the energy development can be utilized to formulate policy, institutional and financial strategies. Since not a single indicator is present that can describe the energy development, many experts and relevant agencies have attempted to develop the multi-attribute indices, which can improve the explanatory power by taking the complex attributes of energy poverty and development into consideration.

An Energy Development Index (EDI), which was developed by the International Energy Agency (IEA) and has been published since 2004, is a representative index related to the development of energy. The EDI is designed to better understand the role of energy for human development and help to monitor the improvement of energy access of each country.

The IEA has developed a new EDI by adding more descriptive indicators to explain the energy development more effectively while publishing the 2012 World Energy Outlook. As a result, the concept of the energy development could be expanded to include the energy situation of a community, which had been previously limited to domestic electricity and modern cooking fuel. According to the new energy development framework

**Figure 1 Composition of the New Energy Development Index Created by the IEA**

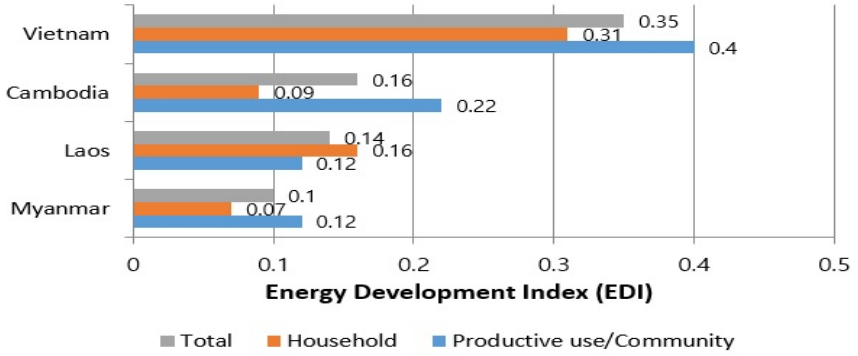



Source: IEA (2012).

presented by the IEA in 2012, the development of energy can be measured by household and community categories (see Figure 1).

The energy development of the household unit is subdivided into the accessibility to electricity and clean cooking facilities; while the community unit is subdivided into the accessibility to energy for public services and productive use. The geometric mean of the share of population with electricity access and per-capita residential electricity consumption is taken to measure partially the access to household electricity. The share of productive energy uses utilized industry, agriculture, services, transport and other non-specified energy use for identifying the access to a part of community energy. All these variables are normalized before calculating the EDI. When the indicators are aggregated to reach the EDI, they are averaged assuming that they have the same weight of the importance.

**Figure 2 Comparison of the Energy Development in CLMV Countries**




Source: IEA (2012).

The EDI is shown as a normalized number between 0 and 1 for each developing country. The closer to 1 the EDI gets, the higher the level of the energy development is. According to the 2012 World Energy Outlook, Libya shows the highest EDI value of 0.92 among the 80 target developing countries, followed by Venezuela, Argentina, Malaysia, and Jordan, being ranked first consecutively since 2011. The good state of energy development in Libya has been caused especially by the advancement of the community energy. On the other hand, the country with the lowest value of the EDI is Ethiopia recording 0.04. Sub-Saharan African countries, among others, Liberia, Rwanda, Guinea, and Uganda are the typical countries with poor energy development condition in terms of the EDI.

The energy development situation of CLMV countries (Cambodia, Laos, Myanmar, Vietnam), which are the subject of this study, was investigated based on the EDI of these countries. Vietnam is ranked the 36th among 80 developing countries (EDI 0.35), Cambodia the 56th (EDI 0.16), Laos the 59th (EDI 0.14), and Myanmar the 71st (EDI 0.10) (see Figure 2). The three countries except Vietnam belong to the poor group in terms of the energy development; therefore, they are in urgent need of the development in the energy sector. Vietnam, Cambodia, and Myanmar have better energy condition in the community than in households.

Besides EDI, several works to develop indices for measuring the

relationship between energy and the development have been conducted. Nussbaumer *et al*. (2011) focused on the lack of access to modern energy services through developing the Multidimensional Energy Poverty Index (MEPI). The MEPI is a multidimensional approach consisting of the variables relevant to cooking, lighting, household appliances, education, and communication to explain both the frequency and the intensity of energy poverty. Nussbaumer *et al*. (2011) compares the energy poverty of the individual African country by applying the MEPI to the case of African countries (Nussbaumer *et al*., 2011).

## 2. INTERNATIONAL DEVELOPMENT COOPERATION IN ENERGY SECTOR

The international community has continued in various forms to support the improvement in the energy access from the initial phase of the official development assistance. The energy infrastructure or facility is one of the essential prerequisites for pursuing economic development, for which the need of developing countries is high. In recent years, energy is considered as a measure for enhancing universal rights and addressing economic inequality. Also, as environmental sustainability is regarded to be an important global agenda, a support for energy access has become a key area of international aid.

Since the 1970s, development assistance for energy provision by developed countries has grown steadily, despite its repeated ups and downs depending on the situation of the world economy. Early 1970s, bilateral aid of the energy sector started with about 1.4 billion USD of assistance and has rapidly increased both in terms of absolute and relative values until the mid-1980s, reaching 6.3 billion USD. This marked expansion is partially because of the tremendous assistance for energy against the difficulties of developing countries in importing oil, due to the influence of the 1979 second oil shock (Michaelowa and Michaelowa, 2010). The aid of the energy sector started to

**Figure 3 Trends in Aid to Energy of the OECD Countries in 1971-2012**

(unit: 5-year moving average)

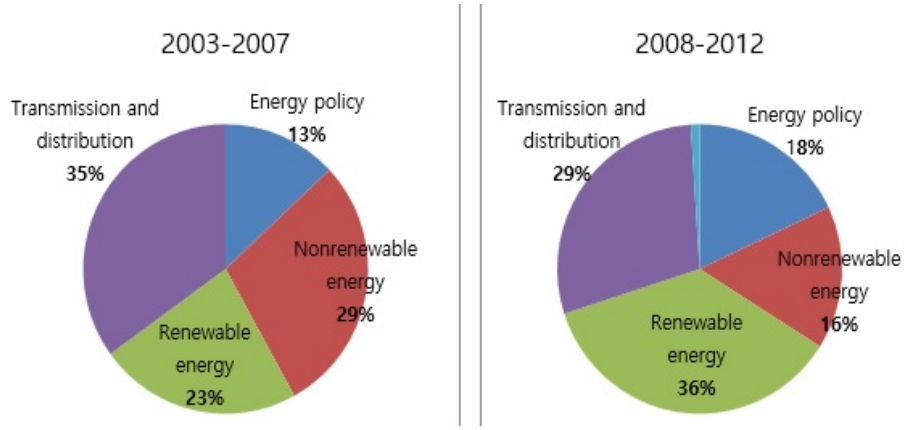

Source: OECD Creditor Reporting System (CRS).

decline in the 1990s in accordance with the Helsinki package of 1992 which discourages the tied-aid modality, and then has risen again in the 2000s presumably influenced by the entry into force of the Kyoto Protocol (Piebalgs, 2012).

The analysis of the energy sector official development assistance (ODA) by subsector indicates that the bilateral cooperation to enhance the use of renewable energy and the energy efficiency has been strengthened since the 2000s. The proportion of non-renewable energy ODA of Organization for Economic Co-operation and Development (OECD)'s Development Assistance Committee (DAC) member countries has decreased from 29% in 2003-2007 years to 16% in 2008-2012 years; while renewable energy ODA and energy policy and administrative management ODA have increased from 23% to 36% and from 13% to 18%, respectively, during the same period (see Figure 4).

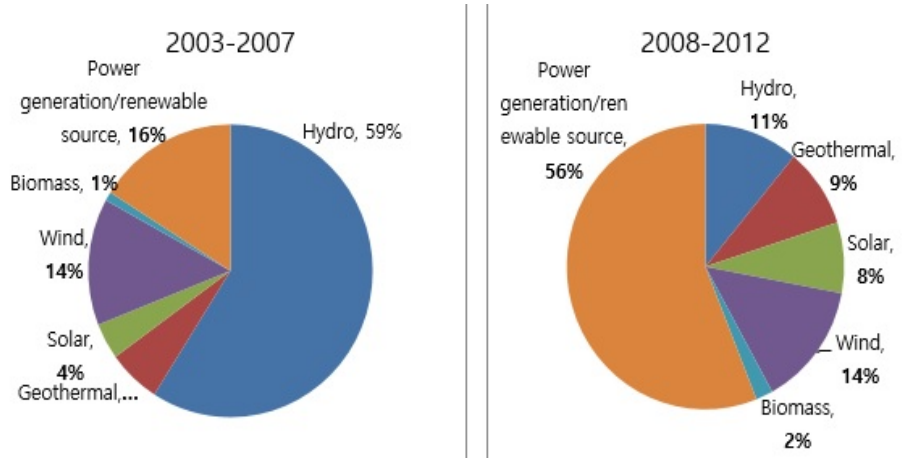
Asian countries are the most benefited of the energy sector ODA and sub-Saharan Africa has remarkably increased its own proportion in the global energy sector ODA from 7% in 2003-2007 years to 18% in 2008-2012 years. Top ODA recipient countries in the energy sector during 2008-2012 years are

**Figure 4 Comparison of the Commitments of Aid to Energy by Area between 2003 and 2007**




Source: OECD Creditor Reporting System (CRS).

**Figure 5 Comparison of the Commitments of Aid to Renewable Energy by Type between 2003 and 2007**




Source: OECD Creditor Reporting System (CRS).

India, Iraq, Afghanistan, Vietnam, and Kenya in order of the amount of energy ODA (see Table 1). Post-war reconstruction countries (i.e., Iraq, Afghanistan) and the major reserves of natural resources or the exporters of

**Table 1 Top 10 Recipient Countries of the Energy Sector ODA between 2008 and 2012**

| Ranking | Country | The Commitments of Energy ODA (million USD) | The Energy ODA / Total ODA |
|---|---|---|---|
| 1 | India | 3,526 | 11% |
| 2 | Iraq | 2,420 | 7% |
| 3 | Afghanistan | 1,817 | 6% |
| 4 | Vietnam | 1,659 | 5% |
| 5 | Kenya | 1,288 | 4% |
| 6 | Pakistan | 1,237 | 4% |
| 7 | Egypt | 1,150 | 4% |
| 8 | Indonesia | 1,031 | 3% |
| 9 | Bangladesh | 908 | 3% |
| 10 | Morocco | 817 | 3% |

Source: OECD Creditor Reporting System (CRS).

energy (i.e., Kenya, Indonesia, etc.) have received intensive assistance of energy, which reveals one of the important motive of the energy sector to be political action and resource security purposes.

In 2011-2012, the major donor countries of the energy sector were Japan, Germany, France, and the United States in terms of the annual average commitment. Meanwhile, in terms of the percentage of the energy sector out of the total ODA amount, Germany and Japan (12%), France (9%), and Korea and Norway (8%) were the major donors.

Japan has been positioned as the largest energy ODA donor country in the world by focusing on the energy sector since the 1990s (Yamaguchi, 2005). The annual average energy ODA of Japan between 2011 and 2012 is about 1.9 billion USD, which accounts for about one third of total amount of energy ODA of DAC member countries. However, Japan still has high share of power generation from fossil fuel, which differentiates Japan's energy ODA from Germany's energy. In addition, Japan's ODA has very high variation in the share of renewable energy, due to the support of some energy projects with the large scale.

The Germany's annual average of the energy aid between 2011 and 2012 is about 1.5 billion USD, second to Japan. In particular, the energy aid of Germany is concentrated on the use of renewable energy and the improvement in energy accessibility. Germany has supported and maintained the highest level of the share of renewable energy among the DAC members to over 60%.

The proportion of the energy sector out of the total ODA of Korea is about 8% in terms of the commitment in the 2011-2012 years. The support in the energy sector of South Korea had been maintained centered on small-scale projects in the 1990s, and then has been earnest since the 2000s. In the 1990s, the support of energy by Korea largely consisted of the grant for technical assistance including pre-feasibility study and implementation design for the construction of hydropower plant and the concessional loan for power transmission and distribution.

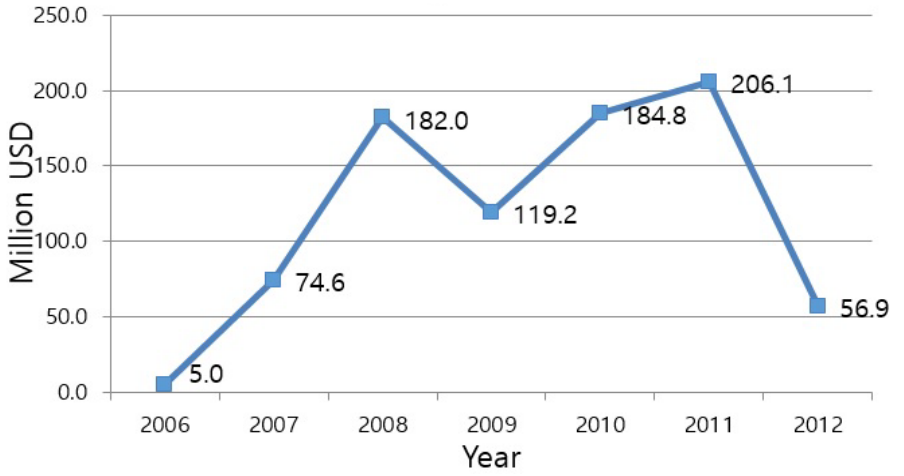
Korea's energy sector ODA which was limited to the hydroelectric power for power transmission and distribution has been diversified into solar, waste energy and biomass since the 2000s. Particularly, to reflect the trend in the international community that intensively discussed the importance of addressing climate change, and the domestic situation that emphasized green growth throughout national affairs, Korea's support of sustainable energy for developing countries has been substantially increased since 2000s. The fund, East Asia Climate Partnership, which was proposed by Korea in order to help developing countries in Asia, addressing climate change also influenced the diversification of energy sector ODA of Korea.

According to the trend of Korea's energy sector ODA obtained from OECD DAC statistical system since 2006, when Korea's energy sector ODA started to be recorded, it is somewhat difficult to make significant conclusions on the trend due to the variations. The reason the annual trend in the energy sector support is quite fluctuated is that the scale of several stand-alone infrastructure projects, such as the construction of hydropower plant and the power transmission and distribution, was tremendous (see Figure 6).

Another feature of the Korea's ODA in the energy sector is that the

**Figure 6 The Trend of Korea's Bilateral Commitments for Energy Sector ODA**

(unit: million USD)



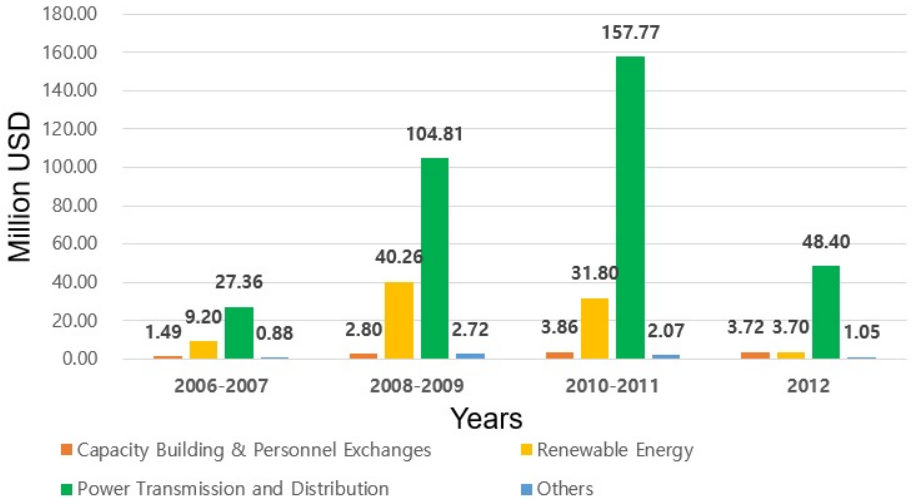

Source: OECD Creditor Reporting System (CRS).

proportion of the programs related to capacity building and personnel exchanges, such as training and the dispatch of experts, is remarkably small. The amount of support to personnel exchange and institutional building between 2007 and 2012 accounted for 0.7% to 6% out of total energy sector ODA. As such, the result is partially due to the support of large-scale energy infrastructure projects compared to Korea's total ODA scale. Subjects of Korea's capacity building projects are very diverse. They dealt mainly with nuclear safety and management policy, petroleum development and management, petroleum market and products, expanding to themes that reflect the diverse needs of the international community including electricity market, the development of clean energy, power transmission and distribution technology, regional energy cooperation, energy and climate change, and natural resource based economic development.

According to the result of comparing the performance of the main target sectoral support in the energy sector of Korea, the scale of the support for the power transmission and distribution has kept overwhelmingly large and the level of the support for renewable energy has significantly increased since

**Figure 7 Comparison between the Sectoral Commitments of Korea's Energy ODA**

(unit: million USD)




Source: OECD Creditor Reporting System (CRS).

2008. In contrast, the percentage of capacity building among the total energy sector ODA of Korea has been very insignificant. Large-scale hydropower projects had been supported until 2008, but have not been implemented at all except for small hydropower projects and capacity building projects. It is partially because of social and environmental impacts large hydropower projects may bring about.

## 3. COOPERATION PROGRAMS FOR ENERGY BETWEEN CLMV COUNTIRES AND KOREA

According to the OECD DAC statistical data, Korea's aid to the CLMV countries has focused on economic infrastructure and services including the transport and communications sector in particular. The aid for economic infrastructure and services has occupied 62% of the total amount extended to the CLMV countries. The main sectors are transport and communications

**Table 2 Comparison of the Sectoral Proportions of Korea's Aid by Region (2008-2012)**

(units: Commitments, %)

| Sector | Total | Asia | CLMV Countries |
|---|---|---|---|
| Economic Infrastructure/Services | 38.5 | 46.0 | 62.4 |
| - Transportation and Communications | 29.1 | 38.9 | 59.0 |
| - Energy | 9.3 | 6.9 | 3.2 |
| - Others | 0.1 | 0.2 | 0.2 |
| Social Infrastructure/Services | 43.0 | 40.1 | 30.9 |
| - Water Supply and Sanitation | 12.2 | 14.3 | 11.2 |
| - Education | 11.2 | 10.2 | 5.0 |
| - Others | 19.6 | 15.6 | 14.7 |
| Production | 8.5 | 8.3 | 2.8 |
| Multi- | 4.5 | 4.6 | 3.6 |
| Others | 5.5 | 1.0 | 0.3 |
| Total | 100 | 100 | 100 |

Source: OECD Creditor Reporting System (CRS).

(59%), water support and sanitation (11.2%), education (5%), and energy (3.2%), among others (see Table 2).

The Country Partnership Strategies (CPS) for 26 focal countries of Korea's were established based on the development needs of partner countries and comparative advantage of Korea. Cambodia, Laos, and Vietnam belong to the list of 26 focal countries of which CPSs were created, while not for Myanmar until 2015. However, Myanmar became remarkably important from a geopolitical perspective recently no less than other focal countries. The CPSs for Cambodia, Laos, and Vietnam, and the mid-term assistance plan for Myanmar highlighted the programs related to the provision of sustainable energy even with the diverse economic conditions and developmental stages among CLMV countries, because CLMV countries are in urgent need of energy and electricity and Korea has experienced the success in complete access to electricity. Nevertheless, Korea's aid to energy for CLMV countries has not been sufficient, accounting for only 3.2% of total Korea's ODA. Therefore, it is necessary for concrete strategies or plans

to further enhance the assistance of the projects providing renewable energy or access to electricity for CLMV countries.

Among the CLMV countries, Vietnam is in the relatively improved stage in terms of economic growth compared with the rest of the three countries that are included in the 2014 UN list of the poorest countries. It makes differences in the aspect of energy development among Vietnam and the other three countries. As for the primary energy source, the proportion of biomass in Cambodia, Laos, and Myanmar is approximately 70%, while that of fossil fuels including oil, coal, and natural gas in Vietnam reaches about 70%. Leaving biomass out, the other important sources of primary energy are oil in Cambodia, hydropower and fossil fuels in Laos, and natural gas in Myanmar. Meanwhile, Vietnam exhibits a high electrification rate to reach 96% whereas Cambodia (34%), Laos (78%), and Myanmar (49%) indicate the still low electrification rates (IEA, 2013).

### 3.1. Program of Decentralized Solar Energy for Remote Areas in Cambodia

Cambodia has a high level of solar radiation, especially in the southwestern region (UNDP, 2010). Power generation through bio-gasification is in the stage of commercialization, while the degree of the use of small hydropower is not very high in Cambodia. Cambodia set up the target of rural electrification as 100% by 2020 and the target of grid-connected electrification as 70% by 2030 in accordance with Cambodia's Rural Electrification Master Plan. It is especially necessary to update the energy-related policies and institutions and to make economic incentives for inducing participation of private sectors in Cambodia.

Cambodia shows a considerably low level of rural electrification rate even among the countries having the similar conditions of economics and energy development with Cambodia. People tend to rely on traditional biomass in spite of the abundant potential of solar energy in Cambodia leading a particularly poor condition of household energy development. Thus, rural

electrification using indigenous resources is an urgently needed promising area in Cambodia.

Consequently, this study suggests the "Program of decentralized solar energy for remote areas" as a cooperation program of Korea for Cambodia based on the policy consistency, the energy condition of Cambodia, and the comparative advantage and experiences of Korea.[1] We should consider ways

**Table 3 Decentralized Solar Energy Program for Remote Areas in Cambodia**

| |
|---|
| **Program Outcome** |
| - Increase in the access to modern energy using sustainable energy |
| **Project/Program Outputs** |
| - Increase in the electrification rate |
| - Expansion of the supply of renewable energy |
| - Increase in the installed capacity of renewable energy |
| - Enhancement of the access to electricity of vulnerable social group including women and children |
| - Capacity building of the residents to operate energy facilities |
| **Activities** |
| - Establishment of the off-grid solar charging system |
| - Establishment of the solar mini-grid system |
| - Support of community-based PV pumping system for drinking water |
| - Provision of electrical appliances to schools and hospitals |
| - Dispatch of experts and local/invitation training for technicians for operation, management, and maintenance |
| - Training for standardization and certification system |

Source: Adapted from Lim *et al*. (2014).

[1] The National Strategic Development Plan 2014-2018 of Cambodia set up the goal of complete supply of electricity to all villages by 2020, and of increase in the portion of renewable energy for rural electrification up to 15% by 2015. The Master Plan for Rural Electrification of Cambodia recommends biomass and solar energy as the important sources for achieving 100% rural electrification in Cambodia other than the expansion of national grid. Korea's Country Partnership Strategy for Cambodia selected Transportation and Green Energy as one of 4 focal areas and highlighted rural electrification using renewable energy.

to improve the sustainability of the program. In order to achieve and maintain the outcome of the program, the systematic operation beyond the provision of a stand-alone project should be planned and provided. For instance, the implementation of this program should be accompanied by the education of product standard, certification and awareness raising activities for creating and maintaining related markets.

### 3.2. Program for Enhancing Hydropower Efficiency through the Improvement in Electrical Transmission/Distribution Lines in Laos

Both proportion and absolute potential of hydropower in Laos are markedly high, providing almost 100% of power generation source of Laos (ADB, 2013). In spite of the abundant amount of hydropower enough to be the second export item of Laos, the Lao people lack electricity; which is complemented by electricity imported from neighboring countries, such as China, Thailand, and Vietnam. This contradictory energy market is partially due to the limitations of the current electrical grid in Laos, such as low voltage and deteriorated quality of grid.

The 7th National Socio-Economic Development Plan of Laos selected the development of hydropower and the expansion of transmission line as the important development areas. As for the development of hydropower, Laos has a plan to establish 8 power plants accounting for 2,862MW of installed capacity during 2011-2015. It is expected to generate 15,321GWh of electricity per year. On the other hand, in line with the expansion of transmission lines, Laos proposed to increase in 22kV of intermediate pressure lines and decentralized electricity systems to reach 80% of household electrification rate by 2015. The Power Development Plan 2007-2016 has set the target of 90% of electrification by 2020 and the goal to expand up to 30% the share of renewable energy in the total energy by 2025.

This study suggests the “Program for enhancing hydropower efficiency through the improvement in electrical transmission/distribution lines” as a cooperation program between Laos and Korea, which may help ensure the

**Table 4 Program for the Enhancement of Hydropower Efficiency through Improving in Electrical Transmission/ Distribution in Laos**

| |
|---|
| **Program Outcome** |
| - Ensuring energy security through the enhancement of the efficiency in electrical transmission/distribution |
| **Project/Program Outputs** |
| - Reduction of the quantity of the unit energy use |
| - Improvement in electrical transmission/distribution efficiency |
| - Enhancement of the confidence and stability of electrical transmission/distribution |
| - Reduction of the frequency and duration of power outage |
| **Activities** |
| - Establishment of the master plan for improving electrical transmission/distribution |
| - Construction of transmission lines and substations |
| - Strengthening and modernization of substations and facilities |
| - Enhancement of the quality and confidence of electricity |
| - Establishment of distribution automation system and conduct of pilot projects |
| - Provision of automatic or remote meter-reading system |
| - Dispatch of experts and local/invitation training for technicians for operation, management, and maintenance |

Source: Adapted from Lim *et al*. (2014).

energy security of Laos. From a perspective of the capability of the supply side, Korea has comparative advantage in this area with abundant experiences of providing the consultation for Bangladesh, Pakistan, Ghana and Myanmar regarding the improvement in electrical transmission and distribution. Moreover, Korea's Country Partnership Strategy (2013-2015) for Laos includes the Establishment of infrastructure for hydropower and electricity' as one of the three focal cooperation programs. These factors show that the suggested cooperation program for Laos in this study is consistent with the condition of Korea.

Through this program, the replication and extension of the Korea's existing electrical transmission/distribution projects which have dominated Korea's energy sector ODA are expected. Moreover, this program will produce the result of the improvement in energy efficiency and reliability; thus, in energy security.

### 3.3. Program for Strengthening Enabling Environment for the Introduction of Smart-grid to Myanmar

The proportion of biomass and natural gas accounts for nearly 90% out of the total primary energy supply in Myanmar (Sovacool, 2013). Myanmar has a plan to increase the share of renewable energy up to 15% to 18% of the total power installed capacity by 2020 (Republic of the Union of Myanmar, 2012). However, any concrete action plan for the development of renewable energy does not yet exist. Myanmar still holds the Electricity Act, which was enacted in 1984 and is currently being revised. Myanmar has recently shown interest in cooperation with Korea in the areas of the development of infrastructure and the know-how of rural development. In particular, it has to be considered that Myanmar is very weak from institutional aspects when the plan of the assistance of energy sector is designed for Myanmar.

This study proposes the "Program for strengthening enabling environment for the introduction of smart-grid" as a cooperation program between Korea and Myanmar in accordance with Korea's comparative advantage along with the Myanmar's conditions. Myanmar is characterized by a high power loss rate, 7.11% and 18.2% in terms of transmission and distribution, respectively, in 2012 (ADB, 2012). It is because of the deteriorated facility of transmission/distribution and the inefficient operation and management of power supply in Myanmar. Consequently, Myanmar government plans to construct 92 transmission lines and 116 substations and to adjust the highest transmission voltage upward to 500kV from traditional 230kV during the period of 2015-2016 to enhance Myanmar's poor power conditions (Korea EXIM Bank, 2014). This requires the introduction of a sustainable next

**Table 5 Program for Strengthening Enabling Environment for the Introduction of Smart-grid in Myanmar**

| |
|---|
| **Program Outcome** |
| - Securing the base for sustainable energy use and reducing GHG emissions |
| **Project/Program Outputs** |
| - Improvement in energy efficiency |
| - Reduction of the energy dependence and cut down of the construction costs of new power plants |
| - Enhancement of consumers' access to the information of electricity use |
| - Expansion of the base for the use of renewable energy |
| - Technology transfer and job creation |
| **Activities** |
| - Consultation for the design of laws, system, and policies including electricity control policies based on the quantity of electricity use |
| - Establishment of the master plan for the development and operation of smart-grid system |
| - Training for standardization, evaluation, and certification system |
| - Provision of related equipment such as digital meters |
| - Supporting pilot projects testing micro-grid connected smart-grid system |
| - Capacity building for officials and technicians through invitation training and workshops and so on |

Source: Adapted from Lim *et al*. (2014).

generation power facility to Myanmar's newly constructed energy infrastructure.

The proposed program focuses on the creation of enabling environment in which smart grid system can be effectively applied rather than the construction of systems in itself. It includes electricity usage-based power management, laws and institutions necessary for creating enabling environment, consultations for technical standards, and development of related master plans. Furthermore, it should consider to provide opportunities of capacity building for related officials, experts, and technicians, and thus, to raise awareness and consensus on the necessity of smart grid.

### 3.4. Capacity Building Program for Designing and Operating the Demand-Driven Systems for Energy Conservation in Vietnam

Vietnam has shown the trend of increasing consumption of fossil fuels, mainly oil and coal, since 2000s. Currently, the electricity demand in the industrial sector is the highest with the expectation of the increase in the transportation and commercial/service sectors (Tuan, 2014). The Vietnamese government plans to supply electricity to all households by 2020, and to increase in the percentage of renewable energy among electricity generation up to 3.5% by 2015, 4.5% by 2020, and finally 6% by 2030 (MOIT, 2011). For this reason, the Vietnamese Prime Minister Decree stipulates the application of the electricity bill in good condition for the grid-connected small hydropower and wind power. Meanwhile, some forecasts say that the energy demand will rapidly increase exceeding the supply from 2015, which requires the improvement in energy efficiency for sustainable energy development in Vietnam (MOIT, 2011).

Vietnamese government which recognized the urgency for the improvement in energy efficiency has focused on promoting programs/ projects and on establishing legal systems regarding energy efficiency since the mid-2000s. The representative outcomes are “Vietnam National Energy Efficiency Program (2006)” which is the first comprehensive national program for energy efficiency in Vietnam and “Vietnam Law on Energy Saving and Efficiency (2010)” (AFD Hanoi, 2012). External assistance by the multilateral development banks (i.e., ADB, World Bank, etc.), the international organizations or funds (i.e., UNDP, UNIDO, GEF, etc.), and the bilateral institutions (i.e., AFD, DANIDA, JICA, SDC, SIDA, etc.) has also been facilitated to help Vietnam improve energy efficiency.

Meanwhile, Korea has operated various programs to improve energy efficiency, which can be classified into the sectors of industry, building, transportation, and equipment. Korea’s technology regarding energy efficiency, particularly at the product level, has been acknowledged to attain a world standard in full compliance with strong domestic regulations for

**Table 6 Capacity Building Program for Designing and Operating the Demand-Driven Systems for Energy Conservation in Vietnam**

| |
|---|
| **Program Outcome** |
| - Ensuring energy security and reducing GHG emissions |
| **Project/Program Outputs** |
| - Reduction of the unit energy use in all sectors |
| - Cut down of the costs due to decreased imports of energy |
| - Behavioral shift of consumers' use of energy |
| - Technology transfer and job creation |
| **Activities** |
| - Support of the development of energy policies based on ICT |
| - Support of the design and operation of the systems for energy efficiency management |
| - Provision of high efficiency lighting products |
| - Education of enhancing capacity for energy diagnosis |
| - Promotion for public awareness raising regarding energy efficiency and conservation |
| - Joint research for the economic reviews for related policies |

Source: Adapted from Lim *et al*. (2014).

energy efficiency since 1990s. Nevertheless, Korea's support for developing countries related to energy efficiency has not received enough attention to be sufficiently delivered, except for small-sized programs of training or dispatch of experts.

To be consistent with Vietnam's needs and Korea's capability, this study suggests the "Capacity building program for designing and operating the demand-driven systems for energy conservation" as a cooperation program between two countries. The program will support the establishment of ICT-based policies for energy demand management which are tailored to the conditions of Vietnam. The program must be implemented subsequent to the systematic investigation of the conditions of Vietnam in order to avoid mere duplicate Korea's experience. Furthermore, the program will also provide

education and public relations to raise the general public awareness and improve energy efficiency in terms of demand-side management.

## 4. IMPLICATIONS

This study investigates and analyzes the energy conditions of CLMV countries to help understand the cooperation program of Korea with each country. As a result, it derives the energy cooperation programs appropriate for CLMV countries. CLMV countries are promising partner countries of Korea in view of economic cooperation as well as development cooperation. In addition, they are very poor in energy supply based on the indicators which measure the status of energy development of developing countries, such as the EDI developed by the IEA. Furthermore, this study tries to search for the rationale behind the cooperation programs in the energy sector between CLMV countries and Korea, which may possibly result in effective developments in the region.

Korea's energy sector ODA was focused on infrastructure mainly including transmission and distribution projects, compared with the support of OECD DAC member countries. Support for policy formulation and capacity building was delivered by Korea by a relatively low proportion. Myanmar and Cambodia with poor energy policy and institutional infrastructure need preemptive support for strengthening capacity ahead of infrastructure support. In order to maximize the effectiveness of ODA projects, this study proposed cooperative program for each country in energy sector at the national level in view of the need for country-specific approaches. We propose the common requirements for successful implementation of such national energy programs as follows:

Firstly, the programs must be planned and implemented based on continuous dialogues and consultations with partner countries. Since these programs require the sincere willingness to cooperate along with the active participation at the level of government of partner countries to enhance the

sustainability of the program. These are directly influenced by country ownership; thus, possibly be affected by the consistency of the policies with the partner countries.

Secondly, the programs must be linked with social sectors — such as health, education, gender — as well as economic sectors, because energy is related to a variety of issues arising from diverse sectors particularly including social ones. For example, providing electricity for the areas where people cannot access to modern energy will result in job creation, strengthening of the role of women, the expansion of educational opportunities, and the reduction of respiratory diseases. Therefore, the cooperation programs regarding energy development should be designed and implemented in consideration of the synergistic effect with other sectors.

Thirdly, the proposed programs are capable of benefiting greatly from the involvement of people and organizations at the community level. Although donors have provided energy to developing countries through its own study, they have experienced difficulties in obtaining accurate information and coordinating projects within community. Any kind of representative committee or association of local community will play a crucial role in assessing the level of demand, educating the residents in advance, and promoting the wider use of electricity (Barnes and Foley, 2004).

Lastly, the institutional strengthening and capacity building beyond merely supporting the infrastructure are needed as a fundamental measure to accomplish energy development. Korea’s energy sector support has been carried out mainly for the construction of infrastructure centered on the projects regarding transmission/distribution lines. It is time for Korea to shift a way of supporting developing countries with energy projects for enhancing development effectiveness.

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