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Article

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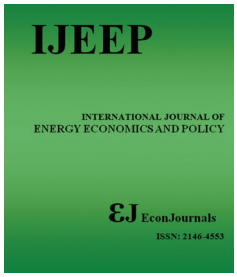

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Development of Energy Efficiency Action Plan at Provincial Level of Vietnam

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ABSTRACT

Energy efficiency (EE), which is one of the pillars of national strategy to improve economic competitiveness and sustainability of the economy. This is an area that complements and cross-cuts such national strategic goals as easing the burden of energy costs on the economy, ensuring energy supply security, alleviating risks arising from external dependency, the transition to low-carbon economy and protection of the environment. The energy consumption by Vietnam increases faster than in developed countries on account of population growth, rising prosperity, strengthening service sector and industrialization. The Vietnam National Energy Efficiency Program (VNEEP) was approved in 13th March 2019 in Decision No. 280/2019/QD-TTg by the Prime Minister to set up the energy efficiency goals as well as activities, and outcomes for period 2019 – 2025 and 2026 – 2030 (Prime Minister of Vietnam, 2019). In accordance with the VNEEP program, all city/provincial governments have been developing their own action plans of EE to achieve the goals of 5%-7% of energy consumption. Through case study, the main purpose of this study is to develop the action plan of EE implementation (EEAP) at provincial level of Vietnam.

Keywords: Energy Efficiency, Energy Policy, EE Action Plan
JEL Classifications: L5, P18, Q43, Q47, Q48

1. INTRODUCTION

Energy efficiency (EE) and saving is a key element to achieve decarbonization at a global level to attaining the 1.5°C objective and reducing energy and climate mitigation costs (Labandeira et al., 2020). EE provides an important contribution to security of energy supply and in increasing business competitiveness and citizen welfare (Bertoldi and Mosconi, 2020). EE is the core dimensions of the Energy Union, next to energy security, solidarity and trust; the internal energy market; decarbonization of the economy; and research, innovation and competitiveness. Co-benefits of energy efficiency like the reduction of emissions, enhanced competitiveness, health and economic benefits can be significantly higher than the cost of energy measures (Zhang et al., 2016).

Besides, EE is not only keep an important issue to the economic issues (Chen et al., 2020) but challenges the very structure of our global society and covers issues like economics, politics, business management and each individual's lifestyle choices (Solnørdal and Foss, 2018). At the national perspective, using EE brings significant environmental, economic and social benefits by reducing greenhouse gas emissions and other pollutants, limiting climate change, limiting risks due to uncertainties can occur due to fluctuations in fuel prices and exhaustion those enable sustainable development of a nation (Huan and Hong, 2021). Indeed, existing evidence suggests that strong EE policies can provide up to 50% of the emission reduction required to meet the objectives of the Paris Agreement (Agency, 2018), thus many countries have introduced policies to reduce energy demand and improve EE to achieve sustainable development (Bertoldi and Mosconi, 2020).

While most of the advanced countries are establishing frame work to boost the use of renewable green energy which protect the environment (Tariq et al., 2018), energy use in developing

countries has risen more than fourfold over the past three decades and is expected to continue increasing rapidly in the future (U.S. Congress, 1991). Recent years, although a large amount of energy is being disbursed for economic development in developing countries (Tariq et al., 2018) many countries are trying to impose different strategies and policies and to overcome the problems of environment due to energy consumption (Toman and Jemelkova, 2003).

Vietnam government has strengthened the policy framework on EE improvement of various end-users in the economy. A number of legal documents covering the planning and implementation of EE policy and the program has been approved and enforced by the government. In this regard, the Vietnam government has also strengthened the institution for EE improvement by creating a special agency named Energy Efficiency and Conservation Office (EE & CO) under the Ministry of Industry and Trade (MOIT). This agency is tasked to formulate, develop and implement EE & C policies and programs (Asia-Pacific Economic Cooperation, 2010). As the part of EE improvement strategy, the government of Vietnam developed and launched a comprehensive national EE & C program called the Vietnam National Energy Efficiency Program (VNEEP). The VNEEP layouts EE programs for the period 2006–2015, which was approved and enforced on 14 April 2006 by the Prime Minister - Decision No.79/2006/QD-TTG (The Government of Vietnam, 2006).

Currently, Vietnam has been one of the active and fastest growing economics in the region. Economic growth is still a high priority for development, however governmental strategies emphasize that fast development has to go side by side with sustainable development (Danish Energy Agency, 2017). The energy sector has become a dynamic economic sector, contributing to promoting socio-economic development, assuring national defense and security in many localities and for the country (Central committee of the communist party of Vietnam, 2020). Economic growth requires secure and affordable supply of energy to all of the society participants and economic sectors. Thus, the overall objective is to ensure national energy security, provide sufficient, stable and high-quality energy at an affordable price for rapid and sustainable socio-economic development, ensure national defense and security, improve people's lives and contribute to the protection of the ecological environment. Accordingly, the specific objective for EE is to reduce greenhouse gases emission from energy activities against the business -as-usual (BAU) scenario by 15% by 2030 and 20% by 2045 (Central committee of the communist party of Vietnam, 2020).

However, to achieve this National Program effectively, the commitment of the provincial/city level is of particular importance, as they are responsible for providing inputs on the determination of the targets set out under the national program. Further, they are also responsible for the implementation of the program in each province, which will be the key to achieving the set targets. From this perspective, the purpose of this study is to develop the guideline of action plans of the National Program on Energy Efficiency and Conservation (EE & C) of Vietnam in the period of 2020 – 2030.

2. ENERGY EFFICIENCY MEASUREMENT

"Energy efficiency" is a conceptual term that is commonly used across a wide range of areas such as engineering, architectural design, production activities, management, organization, economics, and numerous important policy design and development initiatives (Shove, 2018). The concept of EE is diverse depending on perspectives, approaches, contexts and characteristics of research subjects (Huan and Hong, 2021), the meaning may vary depending on the domain, target, or purpose of use (Chen et al., 2020). When considering EE, the International Energy Agency (IEA) defines something to be more EE when it is able to provide more services with the same energy input or provide the same services with less energy input (International Energy Agency, 2014).

At the national level, Patterson (1996) defined a set of indicators used to measure EE from a physical and economic perspective, focusing on the energy consumption caused by each segment of the national economy, concluding that more attention needs to be given by policy analysts to manage this concept (Patterson, 1996).

To improve EE, regulatory approaches and information measures have been extensively applied, along with substantial resources being invested in research and development for energy-efficient technologies. However, EE depends not only on the availability of cheap technologies or on policy interventions, but it is largely influenced by the behavioral choices of users (Fondazione Eni Enrico Mattei, 2016). According to the macro-economic aggregated perspective of the conventional market-driven economy, EE is either denoted as energy intensity of (reciprocal) as energy productivity. An increase in EE can be realized by technical, organizational, institutional, and structural changing actions seeking to save energy (Irrek and Thomas, 2008). From the perspective of energy policy, the EE can be achieved through the establishment of the national energy compliance system to measure effectiveness reduce energy consumption (Bertoldi and Mosconi, 2020).

The EEAP, as part of the implementation of the macro-economic on EE & C can promote the deployment of practical energy-saving solutions, and identify suitable energy-saving targets for provinces/cities based on the local context and potentials. The analysis and EEAP development will present in the following sections. The EE/EEAP target setting, there are two main types of targets mentioned in the national EE action plan (NEEAP): interim targets and final targets. The interim target is set for each NEEAP period and can be sectoral or national (aggregated sum of the sectorial interim targets). The final target corresponds to the desired value of savings the country wants to achieve. Table 1 show the example of EE target setting (Barghouth, 2014).

In this paper, we introduce an explicit measure of energy policy, based on the EE saving target in the period 2019-2025, vision 2030 at the level of provincial of Vietnam through case of Hanoi capital. The procedure for EEAP contain (1) Set the target, (2) Estimate baseline, (3) Develop action plan to meet the target. Action plans must be in line with NEEAP, be feasible, practical, and suitable to the general development context of each specific city.

3. METHOD AND MATERIAL

3.1. Assumption

Assumption 1: The growth rate of energy demand (excluding electricity) of the province/city is equal to the growth rate of energy demand (excluding electricity) of the country according to the Viet Nam energy outlook report 2017 (Danish Energy Agency, 2017).

Assumption 2: The growth rate of industrial production value is equal to the growth rate of energy consumption.

Vietnam's industrial growth rate is based on the separate industrial planning of each province or city. However, for industrial sub-sectors, the growth rates used for the EEAP development process were based on Decision 880/QD-TTg of the Prime Minister on approving the master plan for the development of Viet Nam's industry up to 2020, vision to 2030" (Prime Minister of Vietnam, 2014).

3.2. Research Method

3.2.1. Cases selection

Hanoi capital was selected to conduct this study to develop EEAP as a model project of Vietnam EEAP. Hanoi is the capital city of Vietnam situated in the north of Vietnam. Hanoi economy has been the important position in the whole economy and is the economic central of Northern of Vietnam.

Besides, Hanoi is a representative economic central from Key-Economics-Regions of Vietnam had implemented several EE programs and achieved some positive results on EE & C, received financial and technical resources and support from international agencies and organizations, and have a potential for energy savings in large industries and sub-sectors, especially industrial sub-sectors.

Currently, People's Committee of Hanoi has deployed some program for EE & C to achieve the EE targets by 2025.

- Decision No. 3700/QĐ-UBND on "*Promulgating the implementation plan of the National program on energy efficiency and conservation in the area of Ha Noi City for the period 2021 – 2025*"
- Number of action programs: 8 groups of action programs with 26 specific action programs
- Set the EE objective: By 2025, to achieve energy savings of 5.0% to 7.0% of total energy consumption and reduce power loss to lower than 4.0% in the whole city
- Expected fund VND 130 billion (one hundred and thirty billion Vietnamese dong) from the city budget.

3.2.2. Research procedure

The methodology for EEAP development of consists of 6 steps, which are specifically illustrated in the following diagram, and discussed in detail as shown in Table 2.

- Step 1. Authors conducted to develop EEAP was taking a preliminary assessment on the status of provincial energy data through kick-off meetings with local authorities. To collect sufficient data with high reliability, in the kick-off meetings with the six provinces and cities, the authors discussed the data collection and compilation methods, expected data types, data period and as well as data sources, and collection feasibility. The data collection methods, detailed time frames for each province and data collection form are agreed in consutation with stakeholders
- Step 2. Data were collected from three main data sources: Department of Industry and Trade (DOIT), General Statistics Office (GSO), and Provincial Power Company (PC); Specifically
  - DOIT supply: List of designated energy users (DEUs), including details of energy consumption of each user; energy audit reports of DEUs in each province and city; Reports on the implementation of the energy-saving programs in previous VNEEP stages; Documents on

Table 1: Example of EE target setting

	Baseline consumption GWh/ Average consumption in the last years	The national indicative energy efficiency target			
		Target		Current (after implementing the national plan for EE)	
		%	GWh/ TOE	%	GWh/ TOE
Total					
Section 1					
Section 2					
Section 3					

Source: The authors systhesis from Barghouth, 2014

Table 2: Framework of research methodology

Step 1	**Establish the implementation plan**
	Pre-assessment of current status of provincial baseline data
	Define data collection method
	Define a detailed time-frame
	Design the data collection template
Step 2	**Collect data**
	Collect data from stakeholders
	Standardize data
Step 3	**Baseline calculation and estimate the energy saving potential**
	Calculate the energy baseline
	Estimate based energy consumption on year targets
	Divide total energy consumption by sector
	Estimate potential energy saving by sector
Step 4	**Set the energy saving target**
	Calculate energy saving according to energy and subsector
	Estimate cost increases compared to the base scenarios
	Select appropriate energy saving target
Step 5	**Establish the action plan**
	Integrate activities under Decision 280/2019/QD-TTg into the plan
	Estimate the amount of saving achieved
	Propose next actions
	Define measurement plans, identify the amount of saving
Step 6	**Monitoring systems and updating**
	Define monitoring criteria
	Define the progress monitoring methodology and update target

Source: The authors developed

orientations and plans for socio-economic development of the province or city to 2030; Other documents
    - GSO supply: Statistical data on energy consumption in enterprises and organizations in provinces/cities in 2016 (interviews and survey data); Statistics on population, GRDP of the province up to 2019
    - PC supply: Electricity output by economic sectors, power loss in the period 2010-2019; Power development planning of provinces/cities for the period 2016-2025, with a vision to 2035.
- Step 3. Identify energy structure by sector and by energy types; determine the electricity baseline for each load category in 2025 and 2030; determine the demand for other base fuel (exclude electricity) by each load object in 2025 and 2030
- Step 4. According to the Prime Minister's Decision No. 280/QD-TTg; Circulars regulating energy consumption norms of industries and sectors; and energy audit reports to identifying energy-saving targets for each specific sector or sub-sector
- Step 5. Establish the action program
    - After setting targets and estimating baselines for cities/provinces, the next step was to develop action plans to meet the required targets. Action plans must be in line with Vietnam NEEAP, be feasible, practical, and suitable to the general development context of each specific province and city
    - Funding for implementation: After identifying all potential action plans, it was necessary to identify funding sources for implementation from the following: State budget funds (central budget, local budget), support funding from domestic and foreign organizations, reciprocal funding from enterprises, and lawful funding sources as allowed under regulations
    - Implementation agencies: Relevant organizations responsible for implementing the EEAP covering all socio-economic sectors of the province/city were identified.
- Step 6. Provide relevant departments and agencies in the provinces and cities with an appropriate excel form to monitor and evaluate the achieved results annually and by stages. Relevant departments and branches will self-monitor the targets set out under the approved plan, and annually send the results to DOIT for synthesizing and reporting to the Provincial People's Committee.

3.2.3. Data collection and analysis

The data collection were gathered from January' 2020 to May' 2021 including energy audit reports, action plans of the energy-saving programs in previous stages, documents on orientations and plans for socio-economic development to 2030, list of DEUs, electricity consumption output by economic sectors in the period 2010-2019, and power development planning for the period 2016-2025, vision to 2035.

- Data by base year 2016: Data provided by the GSO, including energy consumption of energy users in the whole province/city in 2016 (Agriculture, forestry, fisheries; Industry and Construction Commercial, hotel, restaurant; Transportation and Public services); It was noted the residential sector consumes a considerable amount of energy. At the current time, there are no statistics to determine the total amounts of energy consumed by this sector
- Energy audit reports: 132 energy audit reports from 2016 to 2020 including industry, public, and trade building collected from DOITs
- Previous energy-saving programs: These reports showed the details of implemented programs including energy savings, timeline and investment costs. These were the bases for the development of the implementation plans of the National target program on EE and conservation in the period 2020-2030
- Orientations and plans for socio-economic development: The total electricity consumption of each industry sub-sectors was based on the city own planning; The total electricity consumption of all industry sub-sectors was based on the national plan; The document on the socio-economic development plan of the city to 2030 was used as the basis for forecasting energy consumption of other types of energy (exclude electricity) in the industry in the period 2020-2030
- List of DEUs: Based on the DEUs inspection report in 2019 submitted to MOIT by DOIT to collect information on energy types of DEUs, therefore, it is a highly reliable and accurate data source. This is the basis of forecasting the energy consumption need of industrial sub-sectors in the period 2019-2030
- Power development planning: Power development planning of Hanoi for the period 2016-2025, vision to 2030, provide detailed forecast of electricity consumption growth by economic sectors up to 2035. This is the basis for determining the electricity consumption of all economic sectors in the 2016-2025 period, with a vision to 2030.

4. IMPLEMENTATION OF EEAP IN HANOI

4.1. General Target

After implemented the procedure of evaluation and assessment of opportunities and challenges of EEAP program in provinces/cities, the following section will present the detailed plan for EEAP on the development of the model project to implement the National Program on EEAP in the period 2020-2030. It provided an opportunity to view in detail the situation related to EEAP of three cities in particular, and the whole country in general; issues such as lack of reliable energy data, the current status of energy-consuming equipment, trends in energy demand were highlighted. In general, the target for EEAP implementation in 2019-2025 and vision 2026-2030 as:

- Implement Decision No. 280/QD-TTG dated 13th March 2019 of the Prime Minister of Viettnam approving the National Energy Efficiency and Conservation Programme for the 2019-2030 period; Program of the Party Committee to implement Resolution No. 55-NQ/TW of Politburo dated 11th February 2020 on the orientation of Viet Nam›s National Energy Development Strategy to 2030, with a vision to 2045
- Promote the state management role on EE & C activities; continue to implement effectively the Law on Energy Efficiency and Conservation, Decree No. 21/2011/ND-CP

dated 29th March 2011, prescribes in detail and implementation measures of the Law on EE & C

- Promote using energy efficiency and conservation through synchronous implementation of tasks, state management solutions, support of technical solutions, innovation of equipment, technology transfer, implementing energy-saving solutions, converting high-efficiency energy equipment, training and developing human resources; take advantage of experience and active support from domestic and foreign organizations and units to implement technical assistance projects, investment support projects related to using EE & C and promote the implementation of economical solutions
- Implement synchronously the Program's activities, creating a breakthrough in improving EE focusing on the fields such as industrial production; construction works using a lot of energy; public building; street lighting; transportation; trade and service activities, households; disseminate high-performance, energy-saving equipment
- Promote EE & C activities; Form good behavior on EE & C in all activities of society; reduce energy intensity in the economic fields and sectors; help energy-saving activities become the regular activities of DEUs and key economic sectors having large energy consumption; From there, contributing to ensuring energy security, environment protection, towards the objective of green growth and sustainable development, environmental protection to respond to climate change of the city
- Strengthen the controlling, management work in investment projects that overuse energy, limiting to use of natural resources causing environmental pollution.

4.2. EE Action Plan in Hanoi

In recent years, Hanoi's economy has a gradual growth rate (average 7.95%/year in the period 2016-2019). Additionally, the economic structure has shifted towards increasing the proportion of service and industry-construction sectors, reducing the proportion of the agricultural, forestry and fishery sector. Along with that, the energy demand of the city has increased; The average growth rate of power sale in the period 2016-2019 was 5.76%/year, in which: Industry - Construction increased 5.31%/year; Agriculture - Forestry - Fishery increased 37.68%/year; Trade and Services increased by 5.26%/year; Residentials consumption management increased by 8.08%/year; Public services increased by 11.27%/year. To achieve the national target of 5-7% of energy-saving by 2025, Hanoi implemented 8 groups of action programs with 26 specific action programs under the Decision promulgating the implementation plan of the National program on energy efficiency and conservation in the area of Hanoi for the period 2021 – 2025 (People's Committee of Hanoi, 2020).

In addition, in the Decision No. 1264/QD-TTg (NPDMP VIII) dated October, 1st 2019 by the Primer Minister of Vietnam on approval for the "national power development master plan for 2021-2030 period with vision towards 2045" presented the growth rate of power sale as a fundamental for provincial EEAP implementation. The forecast of energy consumption (electricity is the main element) growth rate to 2025 was based on the NPDMP VIII as shown in Table 3.

Table 3: Forecast on electricity consumption growth rate

Growth rate target	Period		
	2016-2020	2021-2025	2026-2030
Peak power (MW)	4,600	6,800	9,400
Power sale (million kWh)	22,535	34,691	52,178
Growth rate of power sale (%/year)	9.80%	9.00%	8.50%
Agriculture, forestry and fisheries (%/year)	1.80%	1.40%	1.00%
Public sector (%/year)	9.90%	9.20%	8.30%
Residential (%/year)	9.60%	8.40%	7.30%
Trade and Service (%/year)	10.80%	10.30%	8.00%
Industry (%/year)	9.90%	8.90%	7.60%
Loss rate	4.00%	4.00%	3.90%

Source: NPDMP VIII

Table 4 present the forecast of energy consumption in the period of 2021-2025. Based on the calculation from the database, the potential for energy savings in large industries and sub-sectors, especially industrial sub-sectors up to 14.9% in the period of 2021 – 2025.

In detail, the energy consumption forcasting from sub-sectors are indicated in Table 5:

After forecasted yearly energy consumption and its growth rate by sector and sub-sectors, we conducted the work of target setting for energy-saving year by year for Hanoi from 2021 to 2025 as Tables 6 and 7.

For the specific target in the period of 2021-2025:

- Energy-saving level of 5.0% - 7.0% of total energy consumption; and reduce power loss to less than 4.0% throughout the City
- 100% of key transport enterprises have programs about vehicle control skills/technical measures in exploitation and energy-saving means of transportation
- 100% of enterprises in industrial zones and clusters and 80% of agricultural units and handicraft villages have the ability to access, apply measures of energy efficiency and conservation
- 100% of DEUs apply energy management systems as required by regulations
- Ensure the compliance of implementation of requirements of the National Technical Regulation on energy efficiency buildings which are under the applicable scope of the Regulation
- 330 units, buildings across the city are recognized as "Green energy user" with the use of energy efficiency and conservation. Besides, there are at least 2-3 buildings recognized as green units using energy efficiency and conservation every year
- Organize training for 5000 technical staff, energy managers in industrial units, buildings; educating and issuing certifications for 250-300 energy managers

Table 4: Total energy consumption forecast for 2021-2025 (Unit: TOE)

Sector	2021	2022	2023	2024	2025
Total	**14,696,666**	**15,995,639**	**17,413,499**	**18,961,410**	**20,651,608**
Electricity loss on the distribution grid	143,626	156,052	169,568	184,270	200,262
Transportation	3,196,824	3,404,618	3,625,918	3,861,603	4,112,607
Agriculture	50,943	51,653	52,372	53,101	53,841
Public sector	242,797	264,899	289,029	315,373	344,135
Residential	1,949,571	2,113,335	2,290,855	2,483,286	2,691,882
Trade and Services	674,899	723,863	776,801	834,067	896,049
Industry, Total	8,438,006	9,281,221	10,208,957	11,229,710	12,352,832

Source: Calculated by the authors

Table 5: Forecast of sub-sector energy consumption for 2021-2025

Industry in total	2021	2022	2023	2024	2025
	8,438,006	**9,281,221**	**10,208,957**	**11,229,710**	**12,352,832**
Steel	26,216	30,148	34,670	39,871	45,851
Chemical	64,521	69,192	74,202	79,574	85,335
Plastic	33,250	35,910	38,782	41,885	45,236
Cement	63,300	68,997	75,207	81,975	89,353
Textile	7,612	7,974	8,353	8,749	9,165
Beer and beverage	16,383	18,206	20,232	22,484	24,987
Paper	21,382	23,093	24,940	26,936	29,090
Electronics	110,967	124,483	139,645	156,654	175,734
Metal products	36,146	39,977	44,215	48,902	54,085
Electric cable	5,299	5,861	6,482	7,169	7,929
Motor vehicle parts	63,132	69,824	77,225	85,411	94,465
Ceramic products	21,604	23,170	24,850	26,652	28,584
Electronic components	5,968	6,601	7,301	8,075	8,930
Medical equipment	16,905	18,697	20,678	22,870	25,294
Cattle & aquatic feed	6,227	6,920	7,690	8,546	9,497
Building materials	19,605	21,026	22,551	24,185	25,939
Water treatment	6,597	7,270	8,012	8,829	9,729
Construction	1,033,833	1,139,284	1,255,491	1,383,551	1,524,673
Others	6,879,061	7,564,589	8,318,432	9,147,394	10,058,955
Trade & service in total	674,899	723,863	776,801	834,067	896,049
Hotels, restaurants	38,476	42,351	46,619	51,323	56,506
Supermarkets, center	52,041	56,954	62,349	68,275	74,786
Working Offices	47,231	52,092	57,454	63,368	69,891
Others	537,151	572,466	610,379	651,101	694,867
Public service in total	242,797	264,899	289,029	315,373	344,135
Working Offices	45,875	50,092	54,697	59,726	65,218
Hospitals	27,778	30,289	33,031	36,023	39,290
Schools	2,331	2,546	2,780	3,036	3,315
Others	166,812	181,971	198,520	216,587	236,312

Source: Calculated by the authors

Table 6: Targets for energy saving of Hanoi in the period 2021-2025

	Energy-saving target					
	2021	**2022**	**2023**	**2024**	**2025**	**2021-2025**
Percentage						
Totals	3.2%	5.1%	6.5%	8.1%	9.7%	6.8%
Agriculture	2.1%	3.3%	3.9%	5.0%	6.0%	4.1%
Public Service	4.5%	7.3%	9.5%	11.8%	14.0%	9.8%
Households	2.1%	3.3%	3.9%	5.0%	6.0%	4.2%
Trade & Service	5.2%	8.4%	11.0%	13.6%	16.2%	11.3%
Industrial	3.7%	6.0%	7.6%	9.5%	11.3%	8.0%
TOE value						
Totals	467,521	818,420	1,126,275	1,542,865	2,006,163	5,961,243
Transportation	67,133	112,352	141,411	193,080	246,756	760,733
Agriculture	1,070	1,705	2,043	2,655	3,230	10,702
Public Service	10,945	19,372	27,510	37,283	48,267	143,375
Households	40,941	69,740	89,343	124,164	161,513	485,702
Trade & Service	34,761	60,691	85,588	113,794	144,879	439,713
Industrial	312,671	554,561	780,380	1,071,889	1,401,517	4,121,018

Source: Calculated by the authors

Table 7: Detailed of energy-saving target for sub-sectors by percentage in period 2021-2025

	Energy-saving target (%)					
	2021	2022	2023	2024	2025	2021-2025
Totals	3.7	6.0	7.6	9.5	11.3	8.0
Steel	3.4	5.5	7.0	8.8	10.4	7.5
Chemical	3.4	5.4	6.9	8.6	10.3	7.1
Plastic	4.3	7.0	9.1	11.3	13.5	9.4
Cement	6.6	10.8	14.4	17.7	21.0	14.7
Textile	3.9	6.2	8.0	10.0	11.8	8.2
Beer & Beverage	4.1	6.7	8.6	10.7	12.7	9.0
Paper	3.6	5.8	7.4	9.2	10.9	7.6
Electronics	3.7	6.0	7.7	9.6	11.5	8.1
Metal	4.1	6.6	8.5	10.6	12.6	8.9
Electric cable	4.6	7.5	9.8	12.2	14.4	10.2
Motor vehicle parts	4.4	7.1	9.2	11.4	13.6	9.6
Ceramic	5.7	9.3	12.2	15.1	17.9	12.5
Electronic components	4.0	6.5	8.3	10.4	12.3	8.7
Medical equipment	4.3	7.0	9.0	11.2	13.4	9.4
Cattle & aquatic feed	3.5	5.6	7.1	8.9	10.6	7.5
Building materials	4.0	6.4	8.2	10.3	12.2	8.5
Water treatment	3.9	6.4	8.2	10.2	12.1	8.5
Construction	3.1	4.9	6.2	7.8	9.2	6.5
Others	3.8	6.1	7.8	9.7	11.5	8.1

Source: Calculated by the authors

- Contribute to reducing the average energy consumption for all sectors/sub-sectors compared to the period 2016 – 2020.

5. DISCUSSION, CONCLUSION, AND RECOMMENDATIONS

Using energy economically and efficiently is essential, and should be maintained over time in line with the socio-economic development of the country. To sustain EE & C, Viet Nam requires a well-defined long-term plan and strategy, with continue implementation and adjustments in order to remove barriers and control risks from increasing national energy demands. EE & C can also address the five core issues:

- Pressure to invest in new power sources
- Depleting national energy resources
- Increasing national energy intensity
- Degradation of the environment and increasing greenhouse gas emissions
- Maintain economic, social benefits and establish a safe, civilized and modern living environment for people, enterprises and communities.

The national program on EE & C in the period of 2019 - 2030 (here in after referred to as the VNEEP Program) is needed to continue energy development strategy, and represents an important element in the national sustainable development strategy, aimed at turning Vietnam to become a country using EE & C.

To support for the municipal EEAP planning, this study aims:

- Deployed a detailed evaluation of available data and data sources at the provincial level
- Development of appropriate conservation targets specific to energy savings potentials of each province or city
- Identification of EE measures suitable for general development and energy situation of the province or city.

Besides, the support for developing provincial/city EEAP is essential to the promotion and deployment of practical energy-saving solutions; and setting of suitable energy-saving targets for provinces and cities based on local contexts and potentials. Results and methodology developed from this study can form the basis to help other countries like Vietnam in their development and implementation of the National Program on EE & C.

Based on the analysis of the data delivered and proposed action plan of EE and C for Vietnam's capital, the analysis in this study the following recommendations have emerged: (1) Improvements to the local energy database system to determine specific factors affecting energy demand of the province/city, (2) Implement training programs to improve the capacity of specialized managers to implement the National target program on energy efficiency and conservation in the period of 2020 – 2030, (3) Scaling up the project to provide support for development and implementation of the National target program on energy efficiency and conservation in the period 2020-2030 for provinces and cities.

Although this study provides interesting results and insights, it has some limitations:

- Assessment and analysis of energy consumption trends were based on relative impact factors, which have not fully reflected specific characteristics of the province or city due to the fact that the statistical data for the province or city were incomplete and inconsistent
- The energy-saving potentials by sub-sectors and sectors are not yet comprehensive due to the limited number of energy audit reports and the quality of energy audit reports;

In general, these limitations provide chances for future researches continue to contribute to the literature of EE & C for developing countries.

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