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Article

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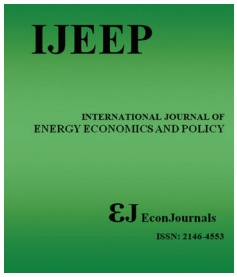

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Assessment of the Impact of Managing Large Energy-Using Users on National Energy Efficiency of Vietnam

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ABSTRACT

Viet Nam continues to experience high economic growth compared to regional and global economies. The average gross domestic product (GDP) growth rate reached approximately 6.8 % from 2016 to present. This economic growth, in combination with urbanization and rapid population growth, has boosted demand for energy in general and electricity in particular. The Government of Viet Nam is well aware that it needs to balance the need for increasing energy supply for socio-economic growth with ensuring energy security and environmental protection. This paper reviews the assessment of the impact of managing the large-energy-users on national energy efficiency and more coherent and consistent national-level regulatory framework contributing to low carbon policy for the Vietnam industry. From the scenario assessment, this paper indicated significant potential for improving the scope of managing the large-scale enterprises on improved compliance for energy efficiency to achieve the target of energy security and sustainable development for Vietnam.

Keywords: Energy Efficiency, Energy Policy, Large Energy User, Vietnam Industry
JEL Classifications: L5, P18, Q43, Q47, Q48

1. INTRODUCTION

Improving energy efficiency (EE) is generally considered to be one of the most cost-effective ways to concurrently improve the security of supply, reduce energy-related emissions, assure affordable energy prices, and improve economic competitiveness (Hirzel, 2016). Energy-saving is a key element to achieve decarbonization at a global level. Indeed, existing evidence suggests that strong energy efficiency policies are key to attaining the 1.5 ◦C objective and reducing energy and climate mitigation costs as increased energy efficiency can provide up to 50% of the emission reduction required to meet the objectives of the Paris Agreement (Allen et al., 2019). Within the framework of the Paris Agreement, different countries commit to reducing emissions in this area through the objectives and actions collected in their Nationally Determined Contributions (Labandeira et al., 2020). During the last three decades, many countries have introduced policies to reduce energy demand and improve energy efficiency (Bertoldi and Mosconi, 2020). However, achieve large savings can be very difficult as the actual implementation of energy efficiency actions has been consistently below the optimal level (Labandeira et al., 2020; Linares and Labandeira, 2010).

In recent decades, Vietnam has been one of the active and fastest growing economics in the region and the world. Economic growth is still a high priority by the government of Vietnam, however governmental strategies emphasize that fast development has to go side by side with sustainable development. The energy sector plays a significant role in promoting economy development. Economic growth requires secure and affordable supply of energy to all of the society participants and economic sectors. At the same time, in order to be sustainable, the energy sector must be able to attract the capital required to expand infrastructure, securing the needed supply of energy sources in the long term, and reducing negative environmental impacts as well as controlling green-house gas emissions (Danish Energy Agency, 2017).

Since 2006, the Viet Nam government has strengthened the policy framework on energy efficiency improvement of various end-users in the economy. A number of legal documents covering the planning and implementation of energy efficiency policy and the program has been approved and enforced by the government. In this regard, the Viet Nam government has also strengthened the institution for energy efficiency improvement by creating a special agency named Energy Efficiency and Conservation Office (EE and CO) under the Ministry of Industry and Trade (MOIT) This agency is tasked to formulate, develop and implement energy efficiency and conservation policies and programs (Asia-Pacific Economic Cooperation, 2010). As the part of energy efficiency improvement strategy, the government of Viet Nam developed and launched a comprehensive national energy efficiency and conservation program called the Viet Nam National Energy Efficiency Program (VNEEP). The VNEEP layouts energy efficiency 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). In addition, to coordinate and monitor the implementation of VNEEP programs, which involves various government agencies, a national steering committee chaired by the Minister of MOIT has been established. The Vietnam National Steering Committee comprises members are the Ministry of Construction, the Ministry of Transport, the Ministry of Science and technology, the Ministry of Education and Training, Ministry of Culture and Information, Ministry of Planning and Investment, Ministry of Finance, Ministry of Justice and the Union of Viet Nam Association of Science and Technology. In the circular No.09/2012/TT-BCT provided for the elaboration of plans, report on implementation of plans in economical and efficiency energy use and implementation of energy audit (Ministry of Industry and Trade, 2012). This circular indicated the elaboration of 5-year plans and making of reports on implementation of 5-year plans in economical and efficient energy use of the establishments for the key energy-using enterprises. Based on the list of selected enterprises, the purposes of the circular 09 are to conduct preliminary survey to detect and propose opportunities for energy saving without investment or only with small investment to perform, determine requirements and implement measure, survey in details means, devices, technology lines selected or entire establishments. The result of energy audit is a report on energy audit submitted to leaders of enterprises subjects to energy audit, including survey, measure, calculation, technology, energy use, and solution for energy saving proposal. With full analysis on expenses, benefits of proposals for enterprises are also shown.

To help policymakers identify the energy savings, manage the list of large energy-using users to support the energy solutions and ensure compliance with energy law and energy saving is very important. Decree No.21/2011/ND-CP indicated large energy-using users are establishments consuming energy at the following rates (The Government of Vietnam, 2011):

Industrial and agricultural production establishments and transport units which annually consume energy of a total of one thousand tons of oil equivalent (1000 TOE) or higher;

Construction works used as offices and houses; educational, medical, entertainment, physical training and sports establishments; hotels, supermarkets, restaurants and shops which annually consume energy of a total of five hundred tons of oil equivalent (500 TOE) or higher.

Therefore, through enterprise survey on energy consumption, this paper evaluated the economics-socio impact of managing the large energy-using enterprises at various levels of yearly energy consumption to enhance efficiency of total energy consumption for enterprise themselves and national energy efficiency.

2. LITERATURE REVIEW

The term “energy efficiency” is interpreted in national and international literature as well as in various scientific disciplines. In general definition, energy efficiency describes the ratio between the benefit gained and the energy used. 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 (Chen et al., 2020). Energy efficiency describes the ratio between the benefits gained and the energy used (Huan and Hong, 2021).

There are different levels and perspectives of energy efficiency, and (Irrek and Thomas, 2008) divided “energy efficiency” into four specified as following:

- The consideration of energy efficiency in the macro-economic aggregated perspective of the market-driven economy
- The perspective of the efficiency of energy conversion in the range of energy supply resp energy provision, which is predominantly characterized by engineering science
- The end-use energy efficiency perspective on the demand-side with an increase in energy end-use efficiency achieved by technical, organizational, institutional, structural or behavioral changes
- The energy end-use efficiency perspective of the caring economy that includes energy efforts of the human body during mainly unpaid household production.

In other way, energy efficiency is often defined as delivered energy service per unit of energy supplied into a system. The value of energy efficiency is grounded upon its ability to aid energy systems in meeting end-user needs without requiring an expansion of system capacity. Unlike approaches that simply expand energy supply, such as building new power plants, energy efficiency prioritizes actions that first reduce the need for energy (Asia Development Bank, 2013). To improve energy efficiency, regulatory approaches and information measures have been extensively applied, along with substantial public resources being invested in research and development for energy-efficient technologies. However, energy efficiency depends not only on the availability of cheap technologies or on policy interventions, but it is largely influenced by behavioural choices of users (Fondazione Eni Enrico Mattei, 2016).

Energy efficiency and saving are implied to be associated with environmental improvement through the reduction of greenhouse gas emissions as the main contributor to environmental pollution and climate change (Huan and Hong, 2021). 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 in specific sectors including household, services, industry, and transport (Bertoldi and Mosconi, 2020).

3. METHODOLOGY

The energy consumption database is conducted by survey through a questionnaire. The main information for yearly energy consumption collection include: Electricity, Coal, Diesel Oil, Fuel Oil, Gasoline, LPG, Biomass. The basis of this analysis is data on enterprises and the energy consumption on enterprise-level to evaluate the impacts of managing large energy-using users. The key data sources on energy consumption in industrial enterprises include:

- Large energy-using users on energy Consumption database in 2017 (Decree No.21/2011/ND-CP) (The Government of Vietnam, 2011)
- General Statistics Office (GSO) survey-based data on enterprises containing around 500,000 enterprises (Vietnam General Statistics Office, 2018).

The database of large energy users with energy consumption of 1000 TOE/year or more. Survey-based enterprise data from GSO on enterprises within the sectors industry, building, construction, transport and agriculture with energy consumption of 350 TOE/year or more – excluding enterprises already in the large energy-using users database in 2017 and 2018. As the Enterprise data has been cleaned to exclude enterprises already in the large energy-using users database, the two data sets supplement each other and together form a complete data set on enterprises within the sectors industry, building, construction, transport and agriculture with energy consumption of 350 TOE/year or more. The combined data set includes variables: ID number, Enterprise name, Region, Province, Sector, Subsector (based on the International Standard Industrial Classification, ISIC-2008), Energy consumption divided by energy type (United Nations Statistical Office, 2008).

The final data used for the impact assessment is the combined data from the consolidated large user data and the database of enterprises from GSO after it has been cleaned for errors. This data covers 8,685 enterprises and a total energy consumption of around 39 million TOE. This section presents some descriptive summaries of the full combined data set on sectors and consumption intervals (e.g. 800-900 TOE/year, 900-1,000 TOE/year, etc.). More than half of the enterprises are within the industrial sector (63%) which represents 90% of the energy consumption as seen in Table 1. The share of enterprises within building, construction and transportation are all around 10 % while the share of related energy consumption is around 3% within all three sectors. Few enterprises are within agriculture and the related energy consumption is only 0.5% of the total energy consumption.

For the analysis 11 consumption intervals have been defined following the categories in Table 2. Based on the energy consumption each enterprise has been categorized within one of these intervals.

From Table 2 above it is clear that the number of enterprises with an energy consumption above 1,000 TOE/year which is the current threshold level in LEEC, is much higher than the registered number of large users in 2017. In the existing large user data from 2017 as reported by the Department of Industry and Trade (DOIT) there were 2,497 large energy-using users. In the combined data set with both the large user and all enterprises in Vietnam (with energy consumption of 350 TOE/year or more) in 2017, there are 4,573 enterprises with energy consumption above the current threshold in LEEC of 1,000 TOE/year or more. This is illustrated in Table 3.

Figure 1 illustrates the accumulated number of enterprises included for each cut-off value. At the existing cut-off value of 1,000 TOE (marked by the vertical line) there are around 4,500 enterprises which should be included under LEEC. This is around 50 % of the enterprises (with a consumption above 350 TOE). If the cut-off value is decreased to e.g. 800 TOE, the number of enterprises to be included as Large energy-using users increase to around 5,200 enterprises.

Note that there are some (about 250) enterprises in the current large users that have energy consumption below 1,000 TOE. These are also included, as they have been approved as Large energy-using users by the authorities. If they are not included there are around 4,300 enterprises at the existing threshold and increases to around 5000 enterprises at a cut-off at 800 TOE.

Figure 2 illustrates the energy consumption covered for each cut-off value. At the existing threshold of 1,000 TOE (marked by the vertical line) around 37,000 thousand tons of oil equivalent (KTOE) is covered, which is around 94 % of the energy consumed by all the enterprises in the data set. If the cut-off value is decreased to e.g. 800 TOE, around 37,600 KTOE of energy is covered by

Table 1: Summary of enterprises and energy consumption by sector of combined data set

Sector	Energy consumption (1,000 TOE)	Number of enterprises	Energy consumption (%)	Number of enterprises (%)
Agriculture	184	193	0.5	2
Building	1,071	884	3	10
Construction	1,065	891	3	10
Industry	35,518	5,471	90	63
Transportation	1,608	1,246	4	14
Total	39,447	8,685	100	100

Source: The authors synthesis from Vietnam General Statistics Office, 2018

Table 2: Enterprises and energy consumption by consumption interval of combined data set

Consumption categories	Energy consumption (1,000 TOE)	No. of enterprises
<500 TOE/year	727	1,744
>500 TOE/year	461	846
>600 TOE/year	379	585
>700 TOE/year	364	486
>800 TOE/year	322	379
>900 TOE/year	315	333
>1000 TOE/year	3,084	2,245
>2000 TOE/year	4,377	1,443
>5000 TOE/year	2,227	344
>10,000 TOE/year	6,008	217
>100,000 TOE/year	21,181	63
Total	39,447	8,685

Source: The authors synthesis from Vietnam General Statistics Office, 2018

the LEEC, which is around 95 % of the energy consumed by the enterprises in the data set.

As noted above some of the current large users have energy consumption below 1,000 TOE. If these are not included around 36,900 KTOE of the energy consumption is covered at the existing threshold and increases to 37,500 KTOE at a threshold at 800 TOE.

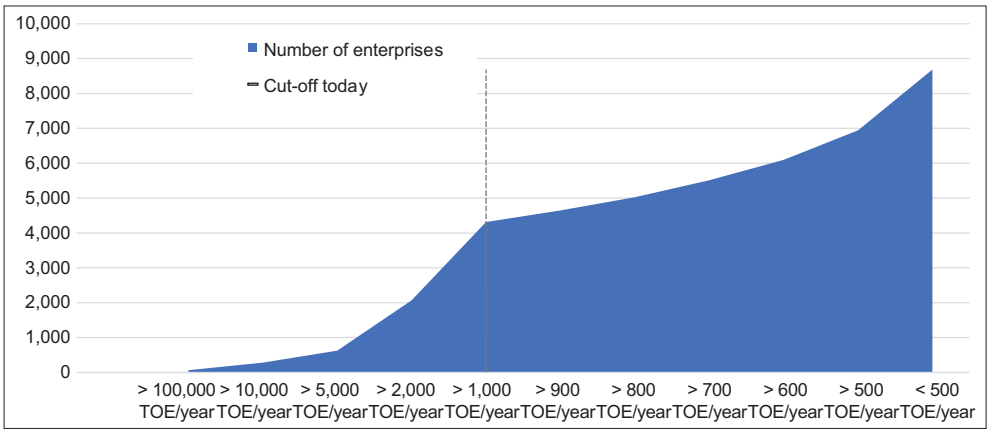
The amount of energy covered by LEEC increases steadily over the consumption categories until around the existing threshold of 1000 TOE. Decreasing the cut-off value any further than 1000 TOE only increases the energy consumption covered slightly, as already more than 90 % is covered with the existing cut-off – assuming that all enterprises with energy consumption above 1000 TOE are included.

Table 3: Enterprises with energy consumption of 1000 TOE/year or more in combined data set

Enterprises with energy consumption above 1,000 TOE/year	No. of enterprises above 1,000 TOE	Energy consumption (1,000 TOE)	Enterprises (%)	Energy consumption (%)
All enterprises (>1000 TOE/year)	4,573	37,060	100	100
Existing large user	2,497	31,540	55	85
Not previously defined as Large user	2,076	5,520	45	15

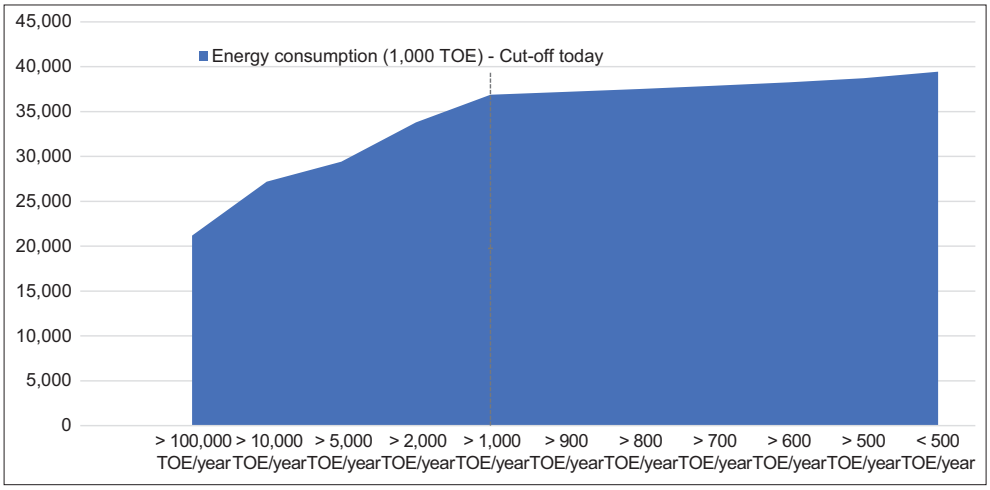
Source: The authors synthesis from Vietnam General Statistics Office, 2018

Figure 1: Accumulated number of enterprises at different cut-off values



Source: The authors synthesis

Figure 2: Accumulated energy consumption (1000 TOE) at different cut-off values



Source: The authors synthesis

4. ASSESSMENT OF IMPACTS OF MANAGING THE LARGE ENERGY USER

The current definition of large users in Decree No.21/2011/ND-CP, Article 6.1.2 is "Industrial and agricultural production establishments and transport units which annually consume energy of a total of one thousand tons of oil equivalent (1000 TOE) or higher". The cost-benefit analysis is structured as an assessment of:

- Impact on industrial enterprises
- Impact on MOIT
- Potential energy saving.

4.1. Impacts on Enterprises

The assessment of socioeconomic impacts on enterprises from a requirement to include more industrial enterprises in the group of Large energy-using users is based on a business case for an average enterprise being included in the group of Large energy-using users. In accordance with LEEC, Article 33 the responsibilities of large energy-using users are to:

- Conduct energy audits every 3 years
- Implement energy management system (EMS): Appoint energy manager, establish accountability systems and system for energy conservation target, apply energy management models set out by the competent State agency
- Develop and implement plans for energy efficiency and conservation (annual and 5-year plans)
- Annual reporting of the results of the implementation of the plans for energy efficiency and conservation to the MOIT.

These legal requirements together with the level of enforcement by the MOIT and any available incentives drive the level of large energy user compliance with LEEC. When complying with the LEEC the large energy users will have both costs (for energy audits, EMS, annual reporting and investments in energy efficiency measures) and benefits (due to realized energy savings after implementing the investments in energy efficiency measures). The key parameters are the energy costs before inclusion, energy costs after inclusion assuming implementation of energy savings measures with low investment requirements, the investment cost of implementing such measures, the cost to enterprises of energy audits, energy management organization and annual reporting as a large user to MOIT. The assessed cost and benefits of compliance for an enterprise becoming a large user are given in Table 4.

4.2. Impacts on MOIT

The assessment of impacts on MOIT from a requirement to include more industrial enterprises in the group of large energy users is based on an assessment of the necessary additional administrative and technical resources (Table 5).

The key parameters are the administrative resources needed for management and monitoring of compliance with LEEC of the addition large energy-using users as well as the cost of initial information and training of new large users.

4.3. Impacts on Potential Energy Saving

The broader socioeconomic consequences in terms of potential energy savings and potential CO_2 emission reductions resulting from a requirement to include more enterprises in the group of large energy-using users is further assessed. This is be based on an assessment of the potential energy savings from implementing energy saving measures. The potential energy-saving is used to establish the potential reduction in CO_2 emissions based on an implicit emission factor for Vietnam.

4.4. Cost-benefit Analysis

The separate impacts on enterprises, government and energy savings respectively, are combined in a cost benefit analysis of expanding the group of large energy-using users regulated under Decree No.21/2011/ND-CP. The cost-benefit analysis evaluates the socioeconomic impact of (1) increasing the compliance with the LEEC of the large energy-using users (2) including the enterprises with an energy consumption above the existing cut-off value of 1000 TOE which are not currently identified as large energy-using users, and (3) broadening the Large energy-using users criteria by expanding the requirements in Decree No.21/2011/ND-CP to include more enterprises in the group of large energy-using users. This means that the cost benefit-analysis operates with six scenarios which are described in Table 6.

The assessment of impacts on enterprises and MOIT, energy savings and the cost-benefit analysis are disseminated in a joint interactive spreadsheet model. In the model key policy parameters can be changed and the results easily reviewed. Documentation

Table 4: Input to assessment of impact on industrial enterprises and resulting energy saving

Component	Basis of estimation	Costs and benefits
Conduct Energy Audits every 3 years	Enterprise pays for Energy Audits. Costing is based on typical costs in the two partner provinces.	100 million VND for average large user every 3 years
Implement EMS	Enterprises need at least one full time energy manager. Sources of cost data are: https://www.vietnamonline.com/az/average-salary.html https://www.averagesalarysurvey.com/vietnam	400 million VND for average large user per year
Annual reporting	The energy manager is responsible for annual reporting.	Included above
Implement plans for energy efficiency and conservation	If enterprises implement investments with payback of 1.5 year or less, it is estimated that they may save 8 % of annual energy consumption from the year after implementation This requires an up-front investment in the year of implementation equal to (maximum 100%) of the cost of the annual energy consumption It is assumed that the enterprise will implement identified investments in the audit with enterprises implementing in first year after audit	

Source: The Authors conducted from LEEC

of the model is included in the model itself, briefly describing the input data, assumptions and output.

5. RESULTS

First the results on energy savings, reduction in CO2 emissions and NPV of total benefits and costs of different scenarios are presented. This includes a baseline (today), increasing the compliance of the existing large energy-using users, adding the enterprises with energy consumption of 1000 TOE/year or more both at the current compliance rate and increased compliance rate and expanding the requirements in LEEC. After follows a comparison of results at different thresholds (TOE/year).

Table 5: Input to assessment of impact on MOIT

Component	Basis of estimation	Costs
MOIT staff + consultants	Restrictions on government recruitment may make it easier to scale organization with consultants. Interviews with partner MOIT have indicated an approximate relation between number of large energy users and necessary staff (Danish Energy Agency, 2017).	1 person at MOIT per 14 large energy users
Training and information dissemination	New large energy users require training and information dissemination on the LEEC	Assumed included above

Source: The authors summarized from danish energy agency 2017

Table 6: Description of the scenarios analysed in the cost benefit analysis

Scenario	Description
Scenario 1	Baseline: An evaluation of the cost and benefits with the existing number of large energy-using users at the current compliance rate of around 15% as found under Output 1, activity 1–3
Scenario 2	Increasing compliance rate of existing large energy-using users to around 50%
Scenario 3	Including additional enterprises with energy consumption above 1,000 TOE at current compliance rate
Scenario 4	Including additional enterprises with energy consumption above 1,000 TOE and increased compliance rate
Scenario 5	Expanding LEEC by lowering the cut-off value (TOE) at current compliance rate
Scenario 6	Expanding LEEC by lowering the cut-off value (TOE) and increasing the compliance rate

Source: The authors proposed

5.1. Impact on Enterprises

Table 7 illustrates the costs and benefits for enterprises in the different scenarios. The enterprises have costs for energy audits, energy managers and investment in EE measures if they comply with the LEEC requirements of implementing all identified EE measures with payback time less than 1.5 years. If EE measures are implemented the enterprise have the benefit of yearly energy savings.

Table 8 compares the costs and benefits of enterprises at different thresholds.

The cost of investment in EE measures is paid once while the costs of energy audits and energy managers are yearly costs. The benefit from energy-saving is yearly once the enterprise has invested in EE measures. The overall benefit of increasing compliance is much higher than by expanding the large energy-using user definition. In Figures 4 and 5 the NPV of cost, benefits and total cost and benefits for enterprises are shown at different compliance rates. Figure 3 illustrates the NPVs for enterprises with a compliance rate of 15 % while Figure 5 illustrates the NPVs for enterprises with a compliance rate of 50%.

5.2. Impact on MOIT

Table 9 illustrates the administrative resources and related salary costs needed at the MOIT in the different scenarios.

The administrative costs are not dependent on the compliance rate among enterprises. As the reduction in CO_2 emissions are not monetized there are no monetary benefits of LEEC for the government. In Table 10 the impact on the government costs and the related energy saving and reduction in CO_2 emissions are compared at different threshold values. As can be seen a higher level of energy-savings and reduction in CO_2 emissions can be reached without additional cost to the government by increasing the compliance level.

Table 7: Costs and benefits for enterprises in each scenario

	Compliance rate	Enterprises	Cost of initial EE investment	Cost of energy audit	Cost of energy manager --	Total cost	Benefit of energy saving
	%	#			billion VND --		
Cut-off >1000 TOE/year							
Scenario 1	15	2.497	4.739	83	999	5.821	3.159
Scenario 2	50	2.497	15.797	83	999	16.87	10.53
Scenario 3	15	4.573	5.568	152	1.829	7.550	3.712
Scenario 4	50	4.573	18.562	152	1.829	20.54	12.37
Cut-off >800 TOE/year							
Scenario 5	15	5.213	5.654	174	2.085	7.913	3.770
Scenario 6	50	5.213	18.848	174	2.085	21.10	12.56
Cut-off >500 TOE/year							
Scenario 5	15	6.943	5.818	231	2.777	8.827	3.879
Scenario 6	50	6.943	19.394	231	2.777	22.40	12.92

Source: The authors calculated

Table 8: Cost and benefits for enterprises at different thresholds (TOE/year)

	Enterprises	Energy consumption	Cost of initial EE investment		Cost of energy audit	Cost of Energy manager	Benefit of energy saving	
	#	ktoe/year	-- billion VND ---					
Compliance rate			15%	50%			15%	50%
>500 TOE/year	6.943	38.721	5.818	19.394	231	2.777	3.879	12.929
>600 TOE/year	6.196	38.313	5.757	19.189	207	2.478	3.838	12.793
>700 TOE/year	5.654	37.962	5.704	19.014	188	2.262	3.803	12.676
>800 TOE/year	5.231	37.632	5.654	18.848	174	2.085	3.770	12.565
>900 TOE/year	4.870	37.340	5.611	18.702	162	1.948	3.740	12.468
>1000 TOE/year	4.573	37.060	5.568	18.562	152	1.829	3.712	12.374
>2000 TOE/year	3.351	35.389	5.317	17.725	112	1.340	3.545	11.816

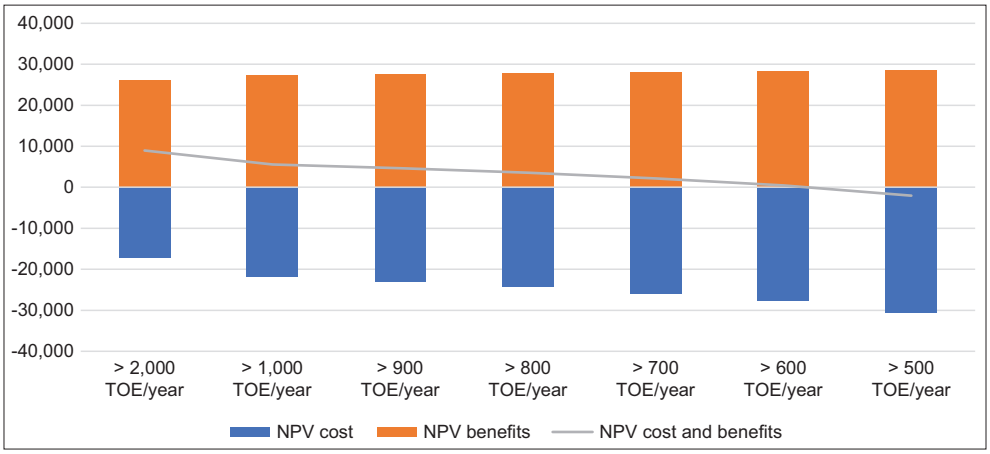
Source: The authors calculated

Table 9: Comparison of resources and costs for government in different scenarios

	Compliance rate	Enterprises	Resources needed*	Costs	NPV government
	%	#	#	-- billion VND --	
Cut-off >1000 TOE/year					
Scenario 1	15	2.497	178	71	–593
Scenario 2	50	2.497	178	71	–593
Scenario 3	15	4.573	327	131	–1.085
Scenario 4	50	4.573	327	131	–1.085
Cut-off >800 TOE/year					
Scenario 5	15	5.213	372	149	–1.237
Scenario 6	50	5.213	372	149	–1.237
Cut-off > 500 TOE/year					
Scenario 5	15	6.943	496	198	–1.648
Scenario 6	50	6.943	496	198	–1.648

Source: The authors calculated. *Assumed 14 Large energy-using users per administrative staff at MOIT

Figure 3: NPV of cost, benefits and total cost-benefit for enterprises with compliance rate 15 %



Source: The authors calculated

5.3. Comparison of Scenarios

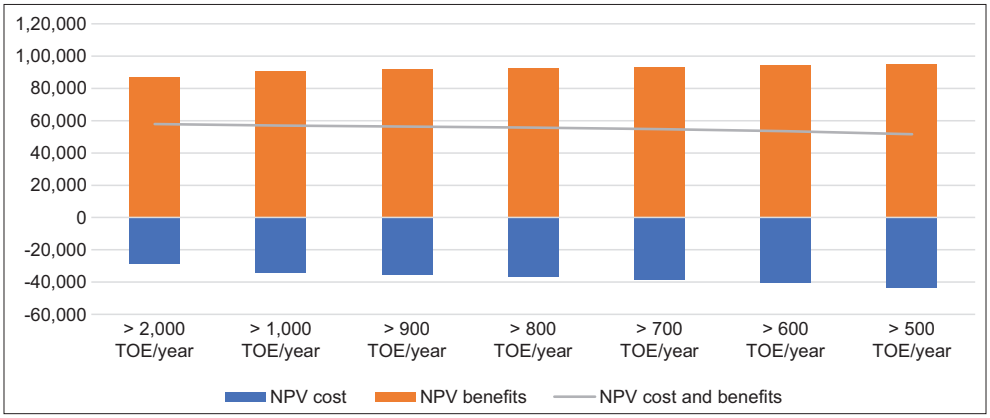
In Table 11 the impacts of the different scenarios are compared with an assumption of LEEC requires implementation of all identified EE measures with payback times less than 1.5 years, resulting in a saving potential of 8 %.

Scenario 1-4 focus on improving the compliance level of existing large energy-using users and including enterprises that should have been registered as Large energy-using users by the current definition (energy consumption of 1,000 TOE/year or more).

Scenario 5-6 focus on expanding the large energy-using users definition by lowering the requirements on energy consumption. In Table 11 the impacts of two different cut-off criteria are showed: 800 TOE/year or more and 500 TOE/year or more.

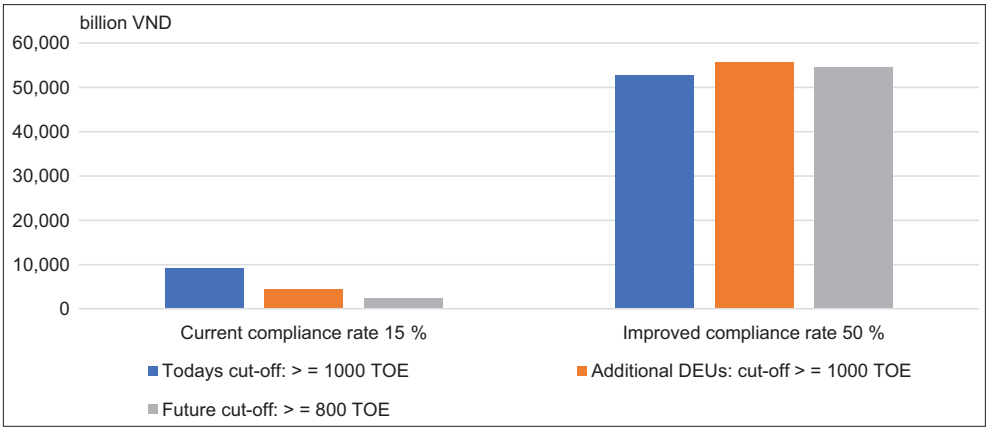
The NPV of the total costs and benefits of the six scenarios with a threshold value of 800 TOE and 500 TOE respectively are compared in Figures 5 and 6. From both figures it is clear that the overall benefit of increasing the Large energy-using users definition are close none if the compliance rate is not also increased. The benefit of increasing the definition even when

Figure 4: NPV of cost, benefits and total cost-benefit for enterprises with compliance rate 50 %



Source: The authors calculated

Figure 5: NPV of total benefits and costs at cut-off of 800 TOE/year or more (billion VND)



Source: The authors calculated

Table 10: Impact on MOIT of expanding the large energy-using user definition by reducing the threshold value

Thresholds	Enterprises included as large user	Resources needed	Cost of resources	NPV government cost and benefits	Energy saving		Reduction in CO2 emission	
	#	#	-- billion VND --		ktoe/year		kton/year	
Compliance rate					15%	50%	15%	50%
>500 TOE/year	6.943	496	198	–1.648	465	1.549	883	2.943
>600 TOE/year	6.196	443	177	–1.470	460	1.533	874	2.912
>700 TOE/year	5.654	404	162	–1.342	456	1.518	866	2.885
>800 TOE/year	5.231	374	149	–1.237	452	1.505	858	2.860
>900 TOE/year	4.870	348	139	–1.156	448	1.494	851	2.838
>1000 TOE/year	4.573	327	131	–1.085	445	1.482	845	2.817
>2000 TOE/year	3.351	239	96	–795	425	1.416	807	2.690

Source: The authors calculated

the compliance rate is also increase, is only slightly higher than the benefit of just increasing the compliance when looking at a threshold of 800 TOE/year.

5.4. Comparison of Different Thresholds

As illustrated the amount of energy covered by LEEC increases steadily as the threshold is decreased until around the existing cut-off of 1,000 TOE/year. Decreasing the cut-off value any further than 1,000 TOE increases the energy consumption covered slightly, as already more than 90 % is covered with the existing cut-off, and assuming that all enterprises with energy consumption above 1000 TOE are included.

Table 12 compares the impacts at different cut-off values. It is assumed that LEEC requires implementation of all identified EE measures with payback times less than 1.5 years, resulting in a saving potential of 8 %.

The results in Table 12 show that the effects of increasing compliance are by far the most effective way to achieve more energy savings, reduce CO_2 emissions and reach a point where the benefits are assessed to be higher than the costs. Figures 7 and 8 show the NPV for enterprises, government and total costs and benefits. Figure 6 compares the NPV with a compliance rate of 15 % and Figure 7 compares the NPV with a compliance rate of 50%.

Table 11: Comparison of variables across scenarios

	Compliance rate	Enterprises	Energy saving	CO2 reduction	NPV enterprises	NPV government	NPV total costs and benefits
	%	#	ktoe/year	kton	-- billion VND --		
Cut-off >1000 TOE/year							
Scenario 1	15%	2,497	378	719	9.733	–593	9.141
Scenario 2	50%	2,497	1.262	2.397	53.416	–593	52.823
Scenario 3	15%	4,573	445	845	5.537	–1.085	4.452
Scenario 4	50%	4,573	1.482	2.817	56.864	–1.085	55.779
Cut-off > 800 TOE/year							
Scenario 5	15%	5,213	452	858	3.573	–1.237	2.336
Scenario 6	50%	5,213	1.505	2.860	55.692	–1.237	54.455
Cut-off > 500 TOE/year							
Scenario 5	15%	6,196	465	883	–2.008	–1.648	–3.656
Scenario 6	50%	6,196	1.549	2.943	51.619	–1.648	49.972

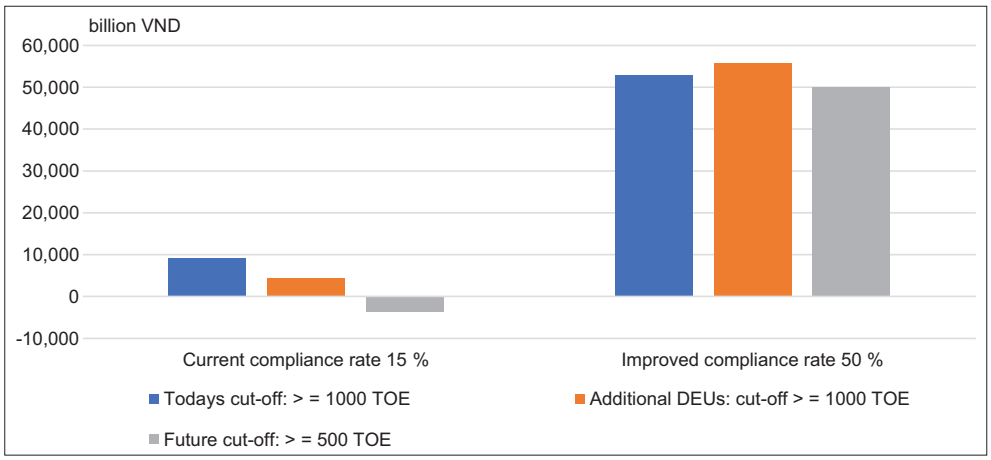
Source: The authors calculated

Table 12: Impact of expanding the large energy-using user definition by reducing the cut-off value of energy consumed/year

	Enterprises (#)	Energy consumption (ktoe/year)	Energy saving (ktoe/year)		Reduction in CO2 emission (kton/year)		NPV total cost and benefits (billion VND/year)	
Compliance rate			15%	50%	15%	50%	15%	50%
>500 TOE/year	6.943	38.721	465	1.549	883	2.943	-3.656	49.972
>600 TOE/year	6.196	38.313	460	1.533	874	2.912	-1.031	52.031
>700 TOE/year	5.654	37.962	456	1.518	866	2.885	840	53.416
>800 TOE/year	5.231	37.632	452	1.505	858	2.860	2.336	54.455
>900 TOE/year	4.870	37.340	448	1.494	851	2.838	3.479	55.194
>1000 TOE/year	4.573	37.060	445	1.482	845	2.817	4.452	55.779
>2000 TOE/year	3.351	35.389	425	1.416	807	2.690	8.148	57.161

Source: The authors calculated

Figure 6: NPV of total benefits and costs at cut-off of 500 TOE/year or more (billion VND)



Source: The authors calculated

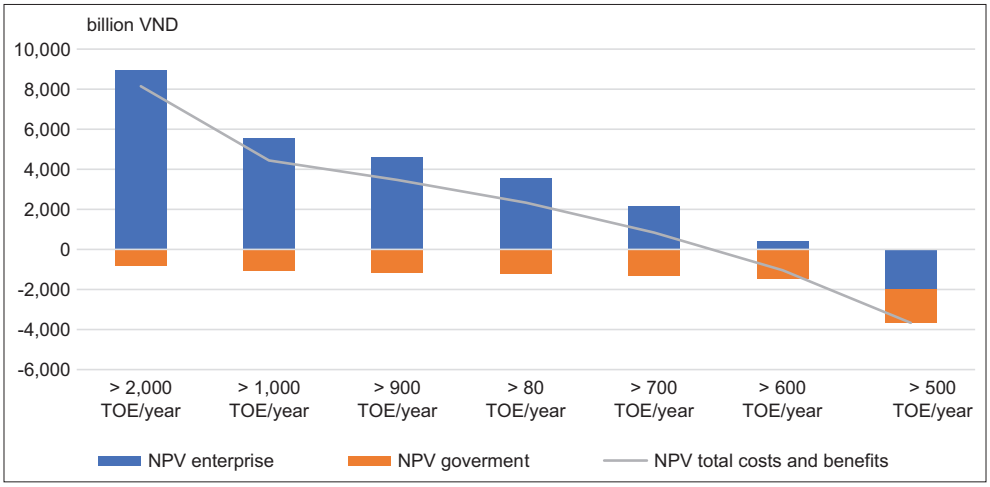
5.5. Including a Value for CO_2 Emissions

The calculations above were based purely on monetary benefits accrued to enterprises due to energy savings and monetary costs incurred by enterprises and MOIT due to costs of compliance with and administration of the LEEC.

In Figure 9 and 10, we present similar calculations taking into account the global environmental benefits of reduced CO_2 emissions resulting from the lower energy consumption at enterprise level. We have for this used a relatively conservative valuation of 8 EUR/ton CO_2. The current price of European CO_2 Emission Allowances is 23 EUR/ton CO_2 (20 December 2018), with a minimum of around 5 EUR/ton over the last 5 years.

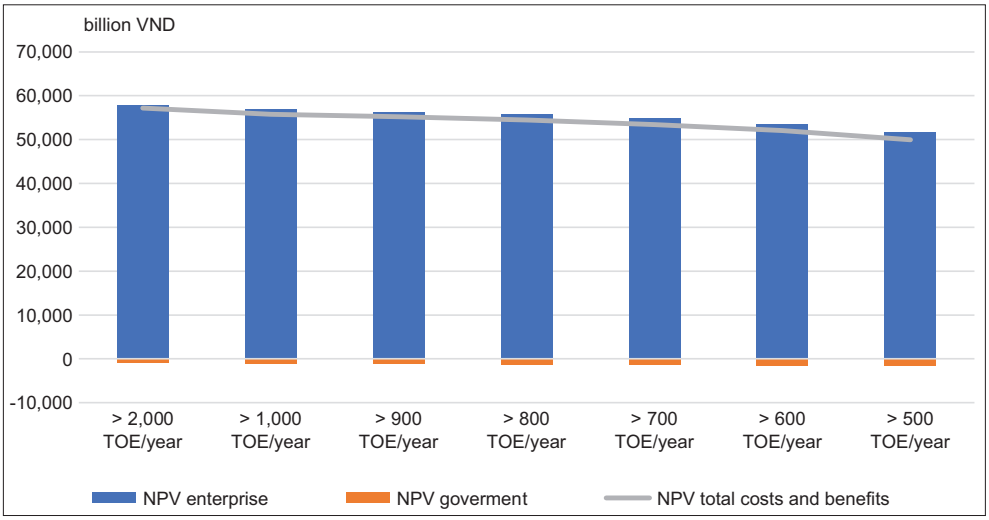
It is noted that the value of CO_2 emission reductions (at the used price of 8 EUR/ton) is low compared to the benefits accrued to enterprises due to energy savings. It is however also noted that even for a low compliance rate of 15% the value of CO_2 emissions is higher than the monetary costs incurred by MOIT due to costs of administration of the LEEC.

Figure 7: NPV for enterprises, government and total costs and benefits at compliance rate of 15%



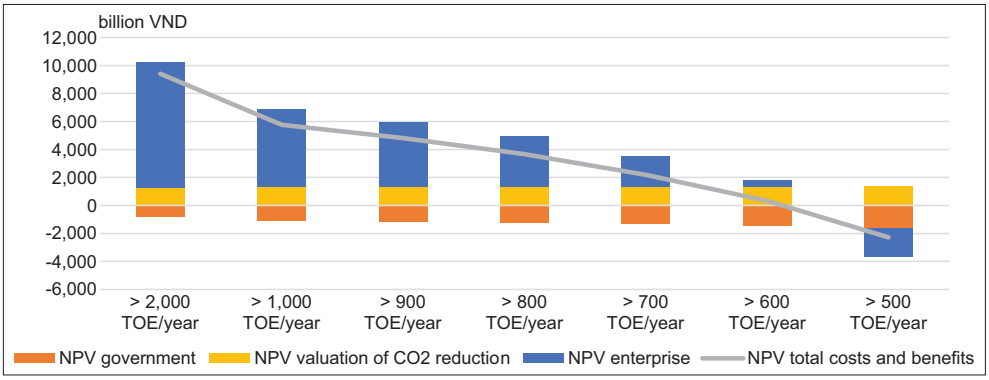
Source: The authors calculated

Figure 8: NPV for enterprises, government and total costs and benefits at compliance rate of 50%



Source: The authors calculated

Figure 9: NPV for enterprises, government, environment and total costs and benefits at compliance rate of 15%



Source: The authors calculated based on vietnam gso, 2018

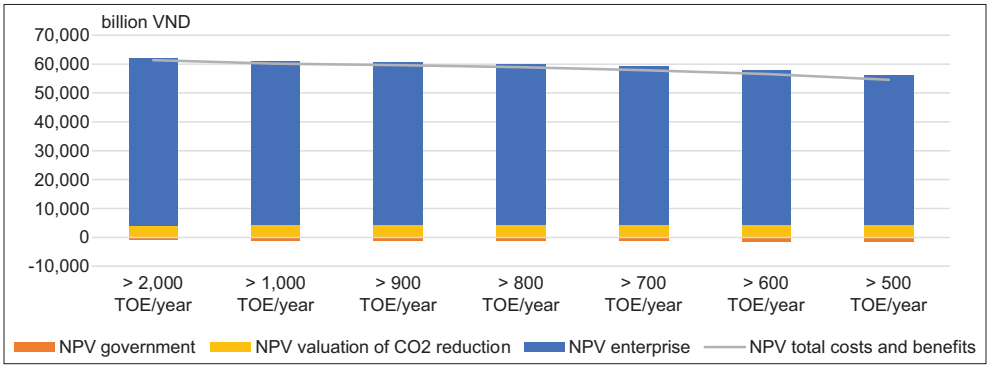
6. RECOMMENDATIONS

Based on the analysis of the data delivered, the work done in parallel assignments and the analysis in the current report the following recommendations have emerged.

It is recommended to:

1. Strengthen data collection and verification procedures to allow all enterprises with an energy consumption above 1,000 TOE to be included in future large energy-using users surveys (as the data analysis found that only 55 % of the enterprises with

Figure 10: NPV for enterprises, government, environment and total costs and benefits at compliance rate of 50%



Source: The authors calculated based on vietnam gso, 2018

an energy consumption of 1,000 TOE/year or more in GSO enterprise data were registered as large energy-using users). This could include establishing a cooperation with the General Statistical Office to help DOITs identify potential large energy-using users.

2. In the short-medium term focus on increasing the compliance level of large users within the existing large energy-using user definition (including the additional enterprises with energy consumption above 1,000 TOE) as the overall socioeconomic benefit of increasing compliance of the existing Large energy-using users is higher than expanding the definition of the group of Large energy-using users.
3. In light of the expected increase in the number of enterprises on the large users list and the current limitations on increasing administrative resources of DOIT could initially focus on improved compliance at the largest enterprises in their province.

7. CONCLUSION

This paper has conducted an assessment of the impact on national managing the EE policy for Vietnam. Based on the national database of energy consumption and the energy outlook report, this paper indicated the significant potential for improved compliance of EE to achieve the target of energy security and sustainable development for Vietnam. From the scenario assessment, the results on energy savings, reduction in CO2 emissions, and NPV of total benefits and costs of different scenarios are presented and indicated the suitable strategy for EE in Vietnam in the short-medium term to increasing the compliance level of large users. Therefore, further research should focus on how to encourage the EE action plan and its compliance to achieve the target of sustainable development for Vietnam.

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