International Journal of Latest Engineering and Management Research (IJLEMR)
ISSN: 2455-4847
www.ijlemr.com || Volume 04 - Issue 09 || September 2019 || PP. 72-85

Assessment of Managing Major Energy-Using Users for Energy Sustainable in Vietnam

Nguyen Dat Minh[*1]
Duong Trung Kien[2]
[1, 2]*Faculty of Industrial and Energy Management, Electric Power University, Hanoi, Vietnam*
[*]Corresponding author

Abstract: This paper reviews the assessment of the cost beneficial opportunities for low carbon development in industry and more coherent and consistent national level regulatory framework contributing to low carbon policy for Vietnam industry. The research objects of this paper are middle-size and large-size enterprises with yearly energy consumption more than 500 tons of oil equivalent. This paper indicated a significant potential for improving the scope of managing the large-scale enterprises on improved compliance for energy saving to achieve the target of energy security and sustainable development for Vietnam.
Keywords: Energy consumption, Enterprise, Vietnam industry, Major Energy-using User

1. Introduction

Recent decades, Vietnam has been one of the active and fastest growing economics in the region and in the world. Economic growth is still 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 the 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 [1].

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 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&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 [2].

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 [3]. 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 National Steering Committee comprises members are the Ministry of Construction (MOC), the Ministry of Transport (MOT), the Ministry of Science and technology (MOST), 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 of (MOIT) provided for elaboration of plans, report on implementation of plans in economical and efficiency energy use and implementation of energy audit [4]. 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 major energy-using users to support the energy solutions and ensure the compliance for energy law and energy saving is very important. Decree No.21/2011/ND-CP indicated major energy-using users are establishments consuming energy at the following rates [5]:

- Industrial and agricultural production establishments and transport units which annually consume energy of a total of one thousand tons of oil equivalent (1,000 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 all of the major energy-using enterprises for energy audit report to enhance efficient of energy consumption for enterprise themselves.

2. Energy Efficiency Economics

The term "energy efficiency" is interpreted in national and international literature as well as in variousscientific disciplines. In general definition, energy efficiency describes the ratio between the benefit gained and the energy used. There are different levels and perspectives of energy efficiency, the Wuppertal Institute (2008) defined and divided "energy efficiency" into four specified as following [6]:

- 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 predominantlycharacterized 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 (EE) 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 [7].

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 [8].

3. Methodology and Database

The energy consumption database is conducted by survey through 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 the managing major energy-using users.

The key data sources on energy consumption in industrial enterprises include:

- Major energy-using users on energy Consumption database in 2017 (Decree No.21/2011/ND-CP)
- General Statistics Office (GSO) survey-based data on enterprises containing around 500,000 enterprises [9].

The data database of Major energy-using users with energy consumption of 1,000 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 major energy-using users database in 2017. As the Enterprise data has been cleaned to exclude enterprises already in the major 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 on: ID number, Enterprise name, Region, Province, Sector, Subsector (based on the International Standard Industrial Classification, ISIC-2008), Energy consumption divided by energy type [10].

The final data used for the impact assessment is the combined data from the consolidated major users data and the GSO enterprise data 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 the 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.

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 %

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

Table 3. Enterprises and energy consumption by consumption interval of combined data set

Consumption Categories	Energy consumption (1,000 TOE)	Number 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
> 1,000 TOE/year	3,084	2,245
> 2,000 TOE/year	4,377	1,443
> 5,000 TOE/year	2,227	344
> 10,000 TOE/year	6,008	217
> 100,000 TOE/year	21,181	63
Total	39,447	8,685

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 major users in 2017. In the existing major users data from 2017 as reported by the Department of Industry and Trade (DOITs) there were 2,497 Major energy-using users. In the combined data set with both the Major energy-using users 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.

Table 3. Enterprises with energy consumption of 1,000 TOE/year or more in combined data set

Enterprises with energy consumption above 1,000 TOE/year	Enterprises above 1,000 TOE (#)	Energy consumption (1,000 TOE)	Enterprises (%)	Energy consumption (%)
All enterprises (> 1,000 TOE/year)	4,573	37,060	100 %	100 %
Existing Major users	2,497	31,540	55 %	85 %
Not previously defined as Major users	2,076	5,520	45 %	15 %

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 Major energy-using users increase to around 5,200 enterprises.

Note that there are some (about 250) enterprises in the current major users that have energy consumption below 1,000 TOE. These are also included, as they have been approved as Major 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 5,000 enterprises at a cut-off at 800 TOE.

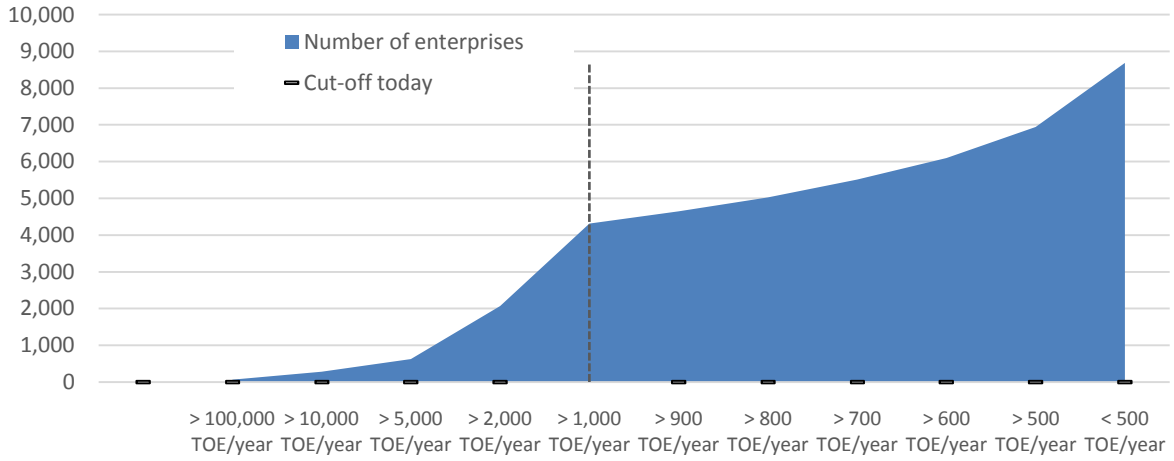

Figure 1. Accumulated number of enterprises at different cut-off values

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

As noted above some of the current Major 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.

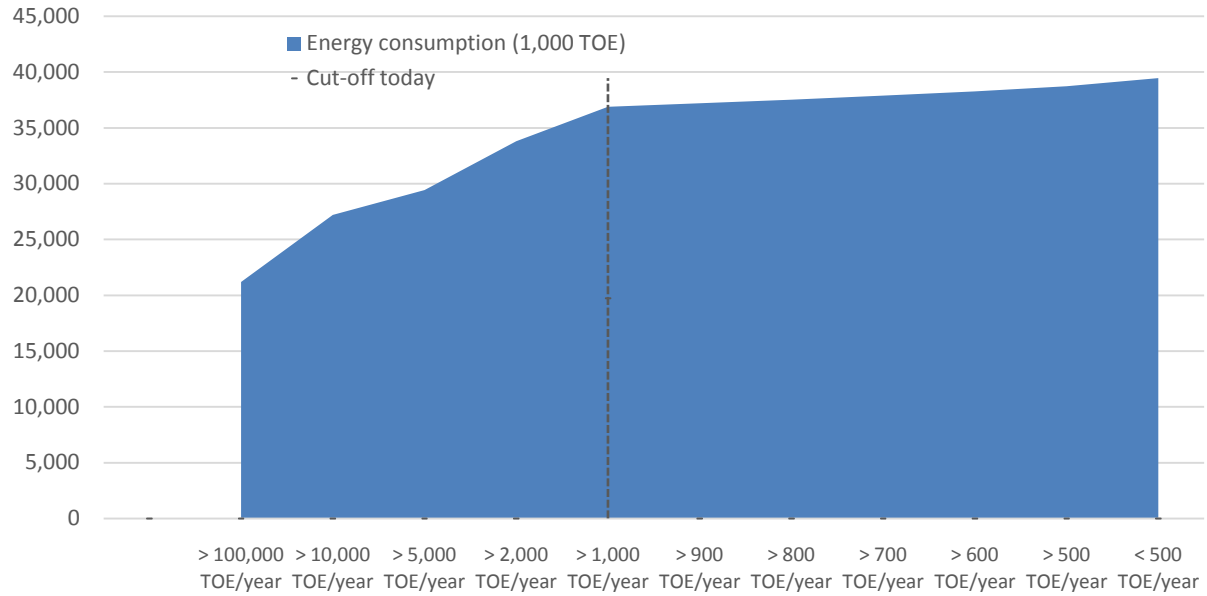

Figure 2. Accumulated Energy Consumption (1,000 TOE) at different cut-off values

The amount of energy covered by LEEC increases steadily over the consumption categories until around the existing threshold of 1,000 TOE. Decreasing the cut-off value any further than 1,000 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 1,000 TOE are included.

4. Assessment of Impacts of Managing the Major Energy-Using Users

The current definition of Major users in Decree 21, 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 (1,000 TOE) or higher".

The cost benefit analysis is structured as an assessment of:

- Impact on industrial enterprises
- Impact on MOIT and DOITs
- 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 Major energy-using users is based on a business case for an average enterprise being included in the group of Major energy-using users. In accordance with LEEC, Article 33 the responsibilities of Major 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 implementation of the plans for energy efficiency and conservation to the provincial DOIT

These legal requirements together with the level of enforcement by the DOITs and any available incentives drives the level of Major energy-using users compliance with LEEC.

When complying with the LEEC the Major energy-using users will have both costs (for energy audits, EMS, annual reporting and investments in energy efficiency measures) and benefits (due to realised 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 an Major energy-using users to a DOIT.

The assessed cost and benefits of compliance for an enterprise becoming a Major energy-using users are given in table 4.

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 Major users 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 Major users per year
Annual reporting	The energy manager is responsible for annual reporting.	Included above
Implement plans for energyefficiency andconservation	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 withenterprises implementing in first year after audit	

4.2. Impacts on MOIT

The assessment of impacts on MOIT and DOITs from a requirement to include more industrial enterprises in the group of Major energy-using users is based on an assessment of the necessary additional administrative and technical resources at DOIT level.

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

Table 5. Input to assessment of impact on DOIT/MOIT

Component	Basis of estimation	Costs
DOIT + ECC staff + consultants	Restrictions on government recruitment may make it easier to scale organization with consultants or through the ECC. Interviews with partner DOITs have indicated an approximate relation between number of Major energy-using users and necessary DOIT/ECC staff.	1 person at DOIT or ECC per 14 Major energy-using users.
Training and information dissemination	New Major energy-using users require training and information dissemination on the LEEC	Assumed included above

4.3. Impacts on potential energy saving

The broader socioeconomic consequences in terms of potential energy savings and potential CO2 emission reductions resulting from a requirement to include more enterprises in the group of Major 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 CO2 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 Major energy-using users regulated under Decree No.21.

The cost benefit analysis evaluates the socioeconomic impact of 1) increasing the compliance with the LEEC of the Major energy-using users 2) including the enterprises with an energy consumption above the existing cut-off value of 1,000 TOE which are not currently identified as Major energy-using users and 3) broadening the Major energy-using users criteria by expanding the requirements in Decree 21 to include more enterprises in the group of Major energy-using users. This means that the cost benefit analysis operates with six scenarios which are described in table 6.

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 Major 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 Major 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

The assessment of impacts on enterprises, MOIT/DOITs, 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 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 Major energy-using users, adding the enterprises with energy consumption of 1,000 TOE/year or more both at current compliance rate and increased compliance rate and expanding the requirements in LEEC. After follows a comparison of results at different thresholds (TOE/year).

5.1. Impact on enterprises

Table 7 below 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 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 > 1,000 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

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

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
> 1,000 TOE/year	4.573	37.060	5.568	18.562	152	1.829	3.712	12.374
> 2,000 TOE/year	3.351	35.389	5.317	17.725	112	1.340	3.545	11.816

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 Major energy-using users definition. In figure 4 and 5 below 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 %.

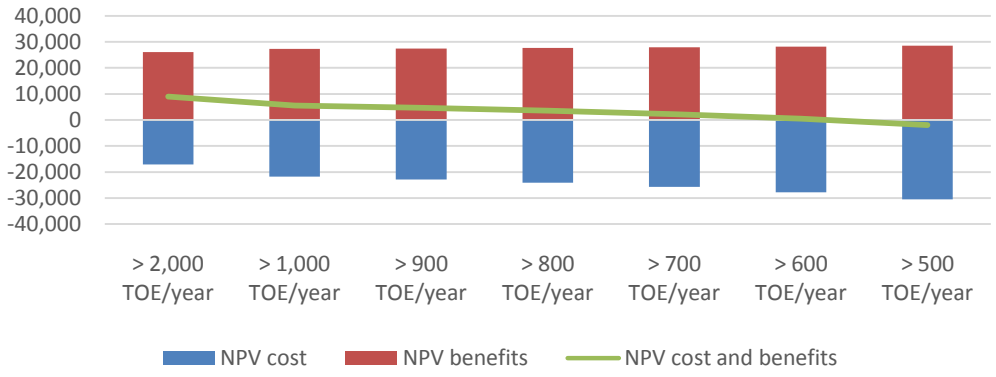

Figure 3. NPV of cost, benefits and total costs and benefits for enterprises with compliance rate 15 %

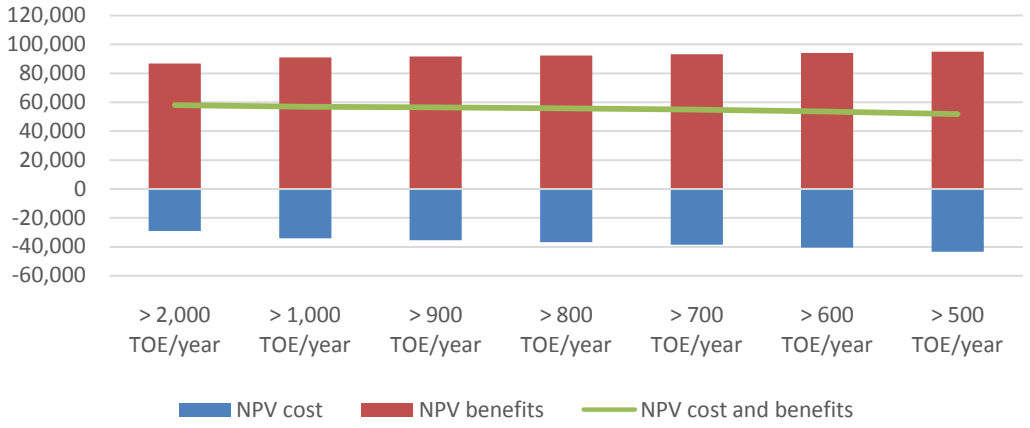

Figure 4. NPV of cost, benefits and total costs and benefits for enterprises with compliance rate 50 %

5.2. Impact on DOITs

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

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

	Compliance rate	Enterprises	Resources needed*	Costs	NPV government
	%	#	#	-- billion VND --	
Cut-off > 1,000 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

* Assumed 14 Major energy-using users per administrative staff at DOIT

The administrative costs are not dependent on the compliance rate among enterprises. As the reduction in CO2 emissions are not monetized there are no monetary benefits of LEEC for the government. In table 10 below the impact on the government costs and the related energy saving and reduction in CO2 emissions are compared at different threshold values. As can be seen a higher level of energy savings and reduction in CO2 emissions can be reached without additional cost to the government by increasing the compliance level.

Table 10. Impact on DOITs of expanding the Major energy-using users definition by reducing the threshold value

Thresholds	Enterprises included as Major users	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	5.654	404	162	-1.342	456	1.518	866	2.885

TOE/year >800								
TOE/year >900	5.231	374	149	-1.237	452	1.505	858	2.860
TOE/year >1,000	4.870	348	139	-1.156	448	1.494	851	2.838
TOE/year >2,000	4.573	327	131	-1.085	445	1.482	845	2.817
TOE/year	3.351	239	96	-795	425	1.416	807	2.690

5.3. Comparison of scenarios

In table 11 below 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 Major energy-using users and including enterprises that should have been registered as Major energy-using users by the current definition (energy consumption of 1,000 TOE/year or more).

Scenario 5-6 focus on expanding the Major energy-using users definition by lowering the requirements on energy consumption. In table 13 the impacts of two different cut-off criteria are showed: 800 TOE/year or more and 500 TOE/year or more.

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 > 1,000 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

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 figure 5 and 6. From both figures it is clear that the overall benefit of increasing the Major energy-using users definition are close none if the compliance rate is not also increased. The benefit of increasing the definition even when 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.

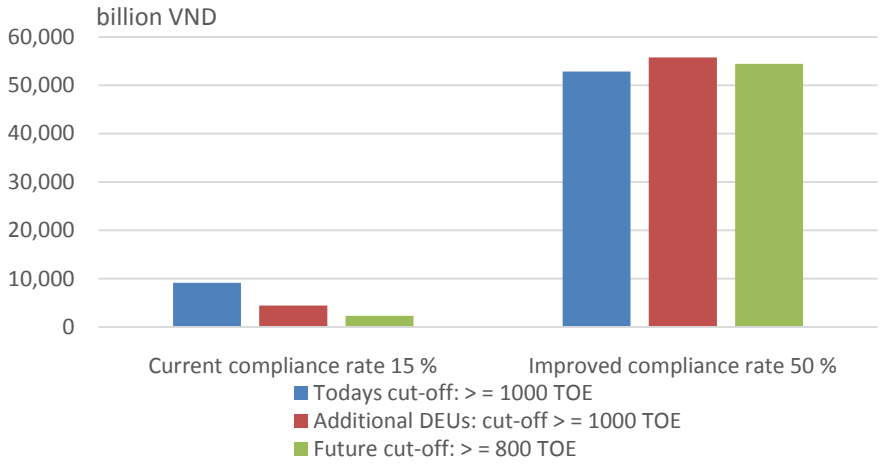

Figure 5. NPV of total benefits and costs at cut-off of 800 TOE/year or more (billion VND)

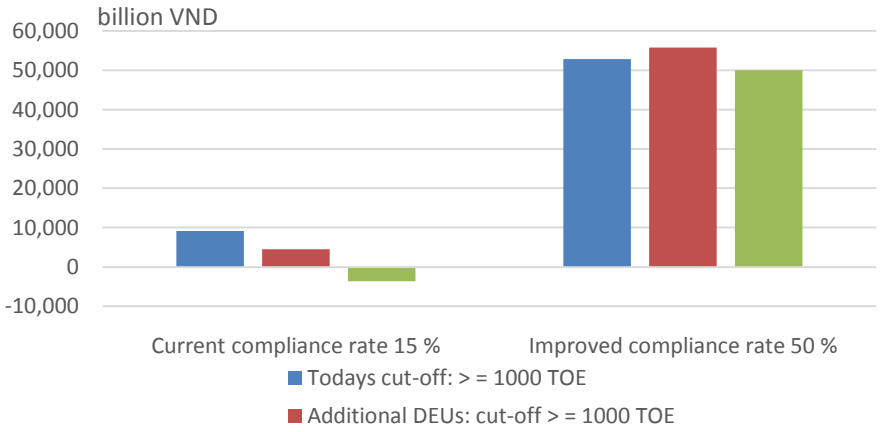

Figure 6. NPV of total benefits and costs at cut-off of 500 TOE/year or more (billion VND)

5.4. Comparison of differentthesholds

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 1,000 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 %.

Table 12. Impact of expanding the Major energy-using users 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
> 1,000 TOE/year	4.573	37.060	445	1.482	845	2.817	4.452	55.779

> 2,000 TOE/year		3.351	35.389	425	1.416	807	2.690	8.148	57.161

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 CO2 emissions and reach a point where the benefits are assessed to be higher than the costs. Figure 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 %.

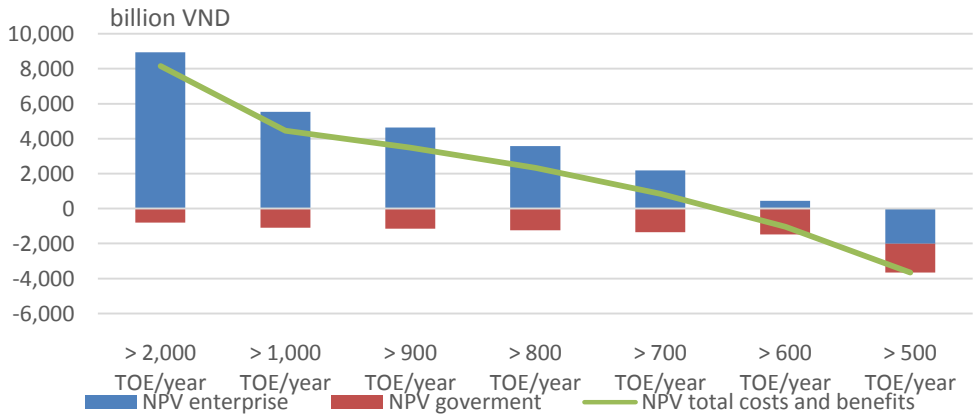

Figure 7. NPV for enterprises, government and total costs and benefits at compliance rate of 15 %

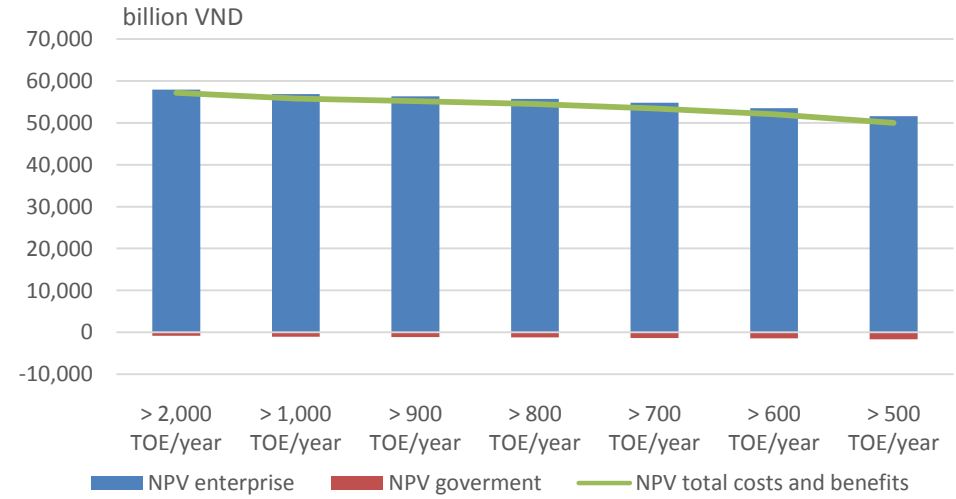

Figure 8. NPV for enterprises, government and total costs and benefits at compliance rate of 50 %

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 DOITs due to costs of compliance with and administration of the LEEC.

Below we present similar calculations taking into account the global environmental benefits of reduced CO2 emissions resulting from the lower energy consumption at enterprise level. We have for this used a relatively conservative valuation of 8 EUR/ton CO2. The current price of European CO2 Emission Allowances is 23 EUR/ton CO2 (20 December 2018), with a minimum of around 5 EUR/ton over the last 5 years.

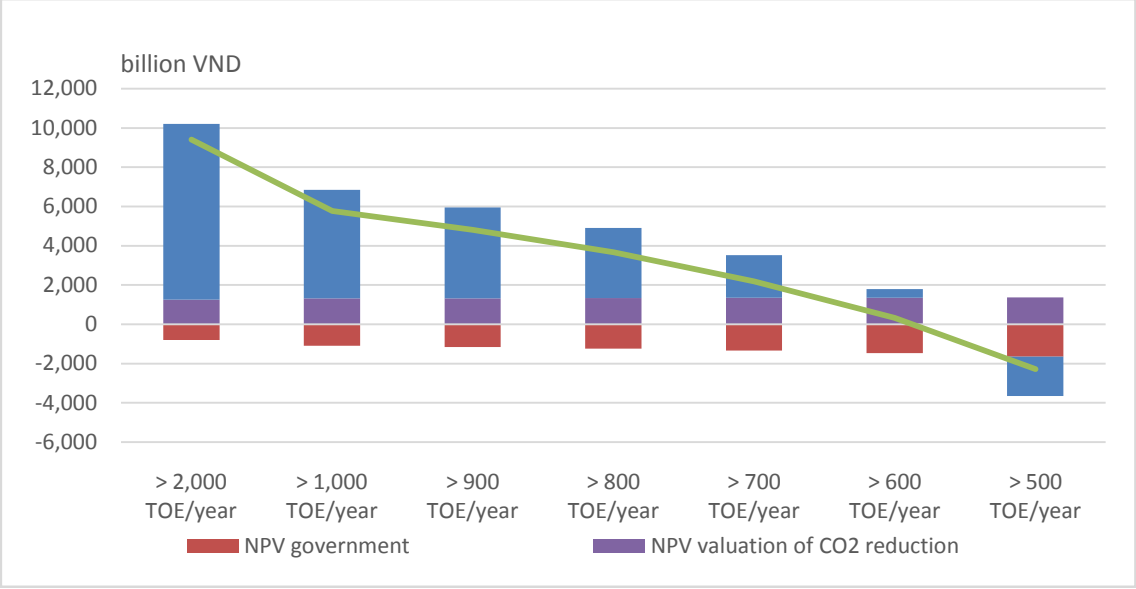

Figure 9. NPV for enterprises, government, environment and total costs and benefits at compliance rate of 15 %

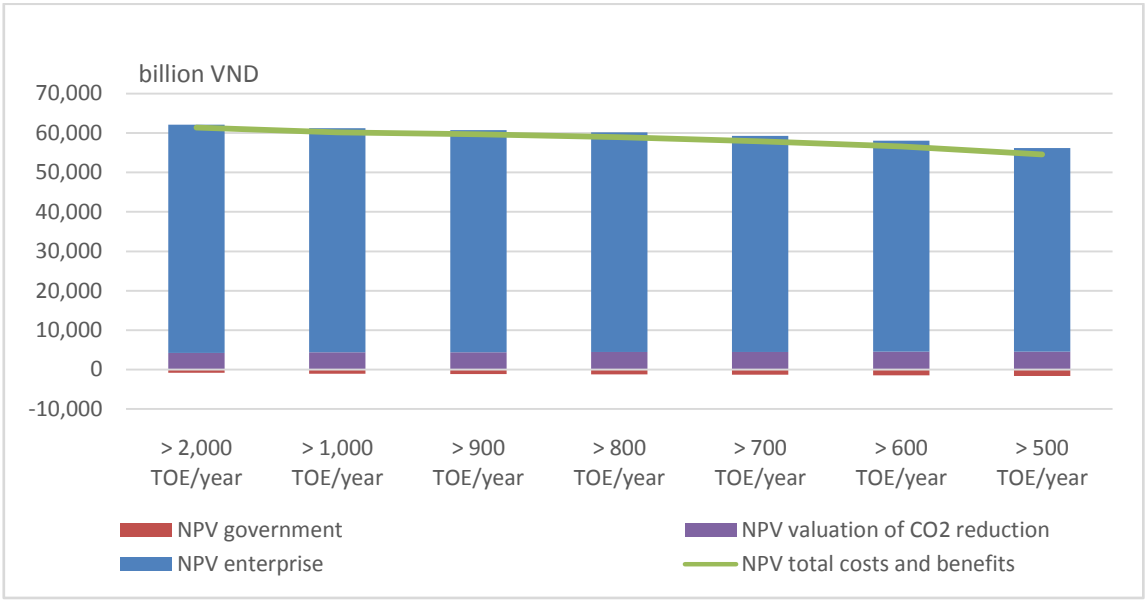

Figure 10. NPV for enterprises, government, environment and total costs and benefits at compliance rate of 50 %

It is noted that the value of CO2 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 CO2 emissions is higher than the monetary costs incurred by DOITs due to costs of administration of the LEEC.

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 Major energy-using users surveys (as the data analysis found that only 55 % of the enterprises with an energy consumption of 1,000 TOE/year or more in GSO enterprise data were registered as Major energy-using users). This could include establishing a cooperation with the General Statistical Office to help DOITs identify potential Major energy-using users.

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

Reference

[1]. Danish Energy Agency (2017), *Vietnam Energy Outlook Report.*
[2]. Asia-Pacific Economic Cooperation (2010), *Report "Peer Review on Energy Efficiency in Vietnam",* APEC Energy Working Group
[3]. The Government of Vietnam (2006), *Decision 79/2006/QD-TT "The VN National Energy Efficiency Program".*
[4]. Ministry of Industry and Trade (2012), *Circular No.09/2012/TT-BCT "Providing for elaboration of plans, report on implementation of plans on economical and efficient energy use, implementation of energy audit"*, released April, 20th, 2012.
[5]. The Government of Vietnam (2011), *Decree No.21/2011/ND-CP "Detailing the law on economical and efficient use of energy and measures for its implementation",* released on March, 29th, 2011.
[6]. Wuppertal Institut (2008), *Difining Energy Efficiency*, Energie GmbH.
[7]. Asia Development Bank (2013), *Same energy, More Power: Accelerating Energy Efficiency in Asia*, Mandaluyong City, Philippines
[8]. Fondazione Eni Enrico Mattei (2016), *Report on assessment of energy-efficient policies and interventions*, European Union's Horizon 2020 research and innovation programme
[9]. General Statistics Office (2018*), General survey of Enterprises and energy consumption*.
[10]. United Nations Statistical Office (2008), *International Standard Industrial Classification of All Economic Activities*, New York.