LOW CARBON SOCIETY SCENARIOS

VIETNAM 2030

"Consider low carbon economy and green growth as principles in achieving sustainable development; Greenhouse Gases (GHG) emission reduction to become a mandatory index in social and economic development" is one of the main objectives of the "National Climate Change Strategy" which was approved by the Government of Vietnam in December 2011. In addition, a concrete target to reduce GHG emission by 30% in the Energy sector in 2030 compared to business as usual were set in the "Vietnam Green Growth Strategy "- Decision No. 1393/QD-TTg (9/25/2012) . In order to contribute implementing these policies and envision a sustainable low carbon society with a long-term perspective as well as introduce the measures to realize it, we developed "Low Carbon Society (LCS) scenarios Vietnam 2030". This research has being conducted in a collaboration between the Institute of Strategy and Policy on Natural Resources and Environment (ISPONRE) from Vietnam, and Kyoto University (KU), National Institute for Environmental Studies (NIES), Institute for Global Environmental Strategies (IGES), E-Konzal, and Mizuho Information and Research Institute (MHIR) from Japan.

Table Projection of GHG emissions and their reduction in 2030

		2005	**2030BaU**	**2030CM**	**Reduction ratio* (this study)**	**National target in 2030 (The Vietnam Green Growth Strategy-Decision 1393/QD-TTg)**
Population	1000 pers.	82,392	109,250	109,250		
GDP	Bill.US$	53	256	256		
GHG emission	$MtCO_2eq$	**173.8**	**686.5**	**429.7**	37%	Reduce GHG emission intensity by 1-2%/year
Energy		81.0	521.9	342.4	30%	30%
AFOLU		69.8	78.8	37.1	53%	-
Waste		23.0	85.8	50.2	42%	-

(*) Reduction ratio = (2030BaU-2030CM)/2030BaU

The above table shows projected GHG emissions by emission sectors: energy demand sectors, Agriculture, Forestry and Other Land Use (AFOLU) and waste sector. In 2030BaU (Business as Usual) scenario, total GHG emission increased up to 686.5 $MtCO_2eq$, about 4 times increase from 2005. In 2030CM (CounterMeasure) scenario, emission is reduced by 37% from 2030BaU, reached a number of 429.7 $MtCO_2eq$. The official target of 30% reduction of GHG intensity in the energy sector in 2030 is achieved in 2030CM scenario. The results of the modelling also show the GHG emission reduction in AFOLU and waste sectors are 53% and 42%, respectively.

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Methodology

In order to identify the necessary actions, an "integrated modeling" based on "back-casting" approach is used.
The back-casting approach sets a vision of the future society as a goal, and then seeks a pathway towards achieving that goal. We used ExSS (Extended Snapshot tool) for socio-economic indicators, energy and waste sectors, AFOLUA (AFOLU Activity model), and AFOLUB (AFOLU bottom-up model) for AFOLU sectors. Combining both of the results from ExSS and AFOLU models, emissions and reduction amounts are analyzed.
Information collection is the first step in the modeling work. Socio-economic information as well as environmental information for the base year (2005) was collected and analyzed in order to estimate current carbon emissions.
Besides this, feasible low carbon measures for Vietnam LCS 2030 were also collected. For the future projection, information is based on planned developments, as the model estimates socio-economic activity levels including population, number of households, land area, transport demand and other variables. Based on the collected information, GHG emissions are calculated with or without counter measures. Finally, they are aggregated to Actions.

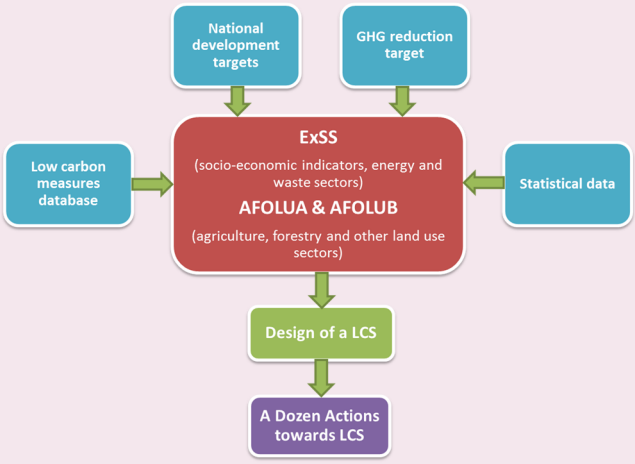

Figure 8. Methodology of the study

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ACRONYMS & ABBREVIATIONS

ACC	Allowable Additional Costs
AIM	Asia-Pacific Integrated Model
AFOLU	Agriculture, Forestry and other Land use
BaU	Business as Usual
CM	Countermeasure
GHG	Greenhouse Gases
EE	Energy Efficiency
ExSS	Extended Snapshot Tool
FAO	Food and Agriculture Organization
GDP	Gross Domestic Product
IGES	Institute for Global Environmental Strategies, Japan
ISPONRE	Institute of Strategy and Policy on Natural Resources and Environment, Vietnam
KU	Kyoto University
LCS	Low Carbon Society
MARD	Ministry of Agriculture and Rural Development
MHIR	MIZUHO Information and Research Institute, Japan
NIES	National Institute for Environmental Studies, Japan
SYB	Statistical Yearbook
UNFCCC	United Nations Framework Convention on Climate Change

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Waste Scenario

Projection of GHG emissions and reductions

In 2030BaU scenario, GHG emissions increase more than 2.1 times in 2020, 4.1 times in 2030 and 8.8 times in 2050 compared to 2005. GHG emission from the industrial sector continues to increase due to rapid industrial expansion and contributes the largest emission which accounting for 67% in 2030, and 75% in 2050 of total emission. On the other hand, the emission from the municipal sector increases gradually due to slight increase in population in Vietnam in the future.

In 2030CM scenario, total GHG emission is reduced by 26% (2020), 42% (2030) and 57% (2050) from BaU scenario (Figure 6).

Recycling shows the largest contribution, followed by CH_4 recovery. Vietnamese government expects almost all of the waste generation in future will be recovered, and reused before dumping to landfill or going to other processes (Figure 7).

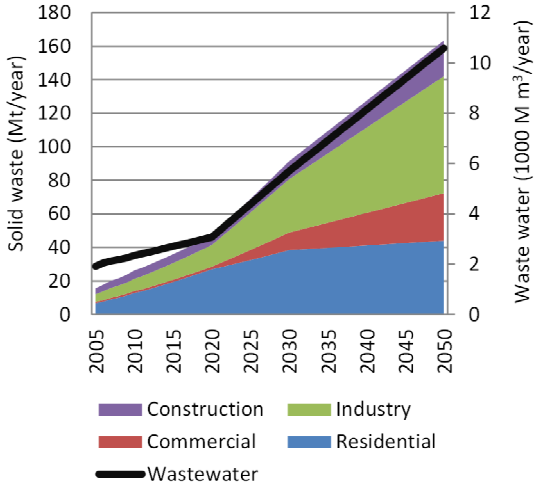

Figure 5. Waste generation by sector in Vietnam

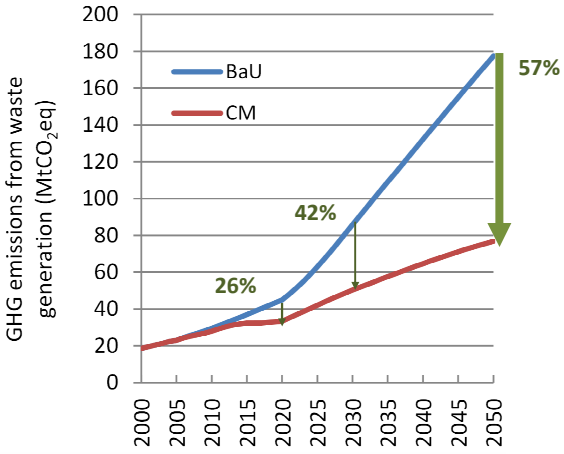

Figure 6. GHG emissions from waste generation in Vietnam

Assumptions of solid waste management

Assumptions of solid waste management are based on the targets in "National Strategy for Integrated Management of Solid Waste up to 2025 and vision towards 2050" approved by Decision 2149/QD-TTg (12/17/2009). For instance, by 2025, 100% of the total solid waste generated from households in urban area will be collected and treated with environmentally friendly manners, of which 90% will be recycled, used for energy recovery, or utilized for production of organic fertilizer.

90% of the construction solid waste will be collected, of which 60% will be reused or recycled. 100% of the total generated non-hazardous and hazardous industrial waste will be collected and treated with environmentally friendly manners.

As for wastewater, 30% of municipal wastewater is discharged and remaining 70% is treated. As for industrial wastewater, 5% is discharged and 95% is treated.

At present, there is no targets in collecting CH_4 from landfill and waste water. In 2030CM scenario, 25% is assumed in the year of 2030 to be collected from landfill and from wastewater.

Waste generation

Solid waste generation in 2005 was 15.6Mt from rural, village craft, hazardous and sludge. Solid waste generation is expected to increase more than 2.8 times in 2020, 5.5 times in 2030 and 9.9 times in 2050 compared to 2005. In 2030BAU scenario, about 90% of total solid is dumped to disposal sites, where no regulations or standards have been established to control CH_4 in the landfill gas released by the decay of solid waste in these disposal sites. In 2030CM scenario, with introduction of countermeasures through activities of composting, recycling and incineration, the amount of solid waste which goes to disposal site is expected to reduce significantly.

Wastewater from both domestic and industrial sector is expected to increase dramatically from about 1.9 trillion ton in 2005 to 3.1, 5.7 and 10.6 trillion ton in 2020, 2030 and 2050 respectively. The industry intensive cities and provinces in the Southern of Vietnam and Red River Delta regions generate the major part of the country's industrial wastewater. (Figure 5)

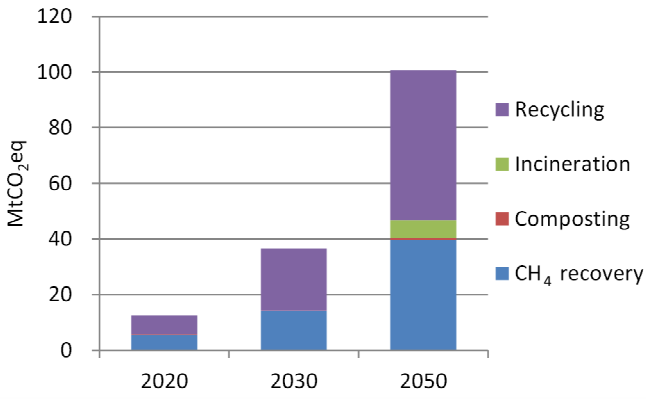

Figure 7. Contribution of low carbon measures in Waste sector

Executive Summary

This study aims to investigate future socio-economic scenarios and GHG mitigation potentials by low carbon measures based on integrated modeling and back-casting approach. The target year is 2030. Two scenarios were set: 2030BaU (Business as Usual) and 2030CM (CounterMeasures). The 2030BaU scenario, where additional countermeasures for GHG emission reduction are not introduced, reflects the situation, in which the levels of commitments to climate-friendly-energy production and technological breakthroughs are relatively low. Specifically, countermeasures are assumed the same level as in 2005.
On the other hand, the 2030CM scenario, in which additional low carbon countermeasures are introduced in order to assess the reduction effects of GHG emission.
The socio-economic assumptions about population, industrial structure and economic growth are common to both scenarios.

Socio-economic assumptions in 2030

With an annual growth rate of 0.9%, population in 2030 increased 1.3 times compared to 2005, whereas increasing of household number is slightly larger because of reduction of household size. With an annual growth rate of 6.5%, GDP increases almost 5 times in 2030 compared to 2005. In which, secondary and tertiary sectors contribution to GDP increase much higher than the one contributed by primary sector. Passenger and freight transport increase 2.4 and 6.1 times in 2030 compared to 2005, respectively. Freight transport will increase faster than passenger transport because of rapid development of industry sector.

A dozen Actions towards low carbon 2030 in Vietnam

Based on the quantitative results with the models, a dozen actions has been identified. As for the contribution to emission reductions, energy efficient technology (Action E4) is the most important in long term while forest and land use management (Action A5) is another indispensable option. Renewable energy in Smart power plant (Action E6) and Smart 3R (Reuse, Reduce, Recycle) (Action W) also have a significant contribution.

Action A1. Livestock Manure Management. Low carbon countermeasures in this action are such as “dairy spread of manure” and “dome digester, for cooking fuel and electricity generation”.

Action A2. Livestock Enteric Fermentation. Comprising of two main countermeasures; namely, “high genetic merit” and “replacement of roughage with concentrates”.

Action A3. Rice Cultivation Management. CH_4 emitted from rice fields is reduced through modified water management technologies, such as “midseason drainage” and “alternate wetting and drying”.

Action A4. Soil Management. This action comprises of two main countermeasures; namely, “high efficiency fertilizer application” and “slow-release fertilizer”.

Action A5. Forest and Land Use Management. This action has the biggest contribution, accounting for 50% of GHG emission reduction in AFOLU sector.

Action E1. Green Building. Buildings with intelligent structures for utilization of natural energy resources such as “photovoltaic energy”. Number of households which utilize solar and wind energy in daily life is enlarged.

Action E2. Convenient Transport. Using public transportation and bicycle will increase the level of convenience in travel, and it leads to decline in usage of automobiles and results in a safe and comfortable transportation environment. Instead of freight transportation by trucks, convenient and comfortable systematic transportation by train and by ship is increasingly used. Promoting the use of biofuel in automobile also brings a benefit in cutting down CO_2 emission.

Action E3. Energy Saving Behavior. Energy saving activities focus on energy services such as cooling, heating, hot water, cooking in commercial and residential sectors, direct heating, steam and motor in the industrial sector.

Action E4. Energy Efficiency Improvement. This action includes not only enhancing Energy Efficiency (EE) of devices in all sectors, but also to strengthen state management of EE by establishing a management systems for energy saving and rizing public awareness to promote EE.

Action E5. Fuel Shift in Industry. The action aims to switch from coal to natural gas and other renewable energies. Some amount of financial commitments would be required not only in technology but also in associated infrastructure.

Action E6. Smart Power Plants. A Smart Power Plant is not only environmental friendly, but also important for sufficient and continuous supply of energy required for the social and economic development of the whole country. Leverages to achieve it are the benefit of energy efficiency, utilizing nuclear energy and renewable energy.

Action W. Smart 3R. Recycling shows the largest contribution, followed by CH_4 recovery. Vietnamese government expects almost all of the waste generation in future will be recovered and will be reused before dumping to landfill or going to other processes.

Table 1. A dozen actions towards low carbon 2030 in Vi-

Dozen Actions towards LCS in Vietnam in 2030		GHG mitigations ($MtCO_2eq$)
AFOLU sectors		**41.7**
Action A1	Livestock Manure Management	2.8
Action A2	Livestock Enteric Fermentation	3.3
Action A3	Rice Cultivation Management	11.9
Action A4	Soil Management	2.9
Action A5	Forest and Land Use Management	20.9
Energy sectors		**179.5**
Action E1	Green Building	14.4
Action E2	Convenient Transport	15.0
Action E3	Energy Saving Behavior	16.9
Action E4	Energy Efficiency Improvement	78.8
Action E5	Fuel Shift in Industry	15.7
Action E6	Smart Power Plants	38.7
Waste sector		**35.6**
Action W	Smart 3R	35.6
Total		**256.9**

Energy Scenario

CO_2 emissions and reductions

GHG emission in the energy sector increase 6.4 times and 4.2 times in 2030BaU and 2030CM scenario respectively from that in 2005 level, as a result of increasing use of fossil fuels. The total emission in 2005 is about 81.0 $MtCO_2eq$. This figure is expected to increase to 521.9 and 342.5 $MtCO_2eq$ by 2030 in BaU and CM scenarios, respectively. The major contributors to GHG emission include industrial sector (49% of total GHG emissions in 2030BaU scenario), followed by transport and residential sectors which account for 21% and 22% of total GHG emissions in the 2030BaU scenario, respectively. (Table 2).

In energy sectors, among the countermeasures, energy efficiency improvement and fuel shift in the power sectors account for the largest proportion of the reduction (38.7 $MtCO_2$), followed by efficient vehicles in the freight transport sector (23.9 $MtCO_2$), and energy efficiency improvement in industry (23.5 $MtCO_2$).

Final energy demand

The total final energy requirement of residential, commercial, industrial and transport sectors is expected to increase annually at 5.1% (2030BaU) and 4.0% (2030CM) over the outlook period, from 44.5 million tonnes equivalent (Mtoe) in 2005 to 153.8 Mtoe in 2030BaU scenario and 117.9 Mtoe in 2030CM scenario. The projected final energy demand growth in 2030BaU scenario is higher than the past decade of 4.4% per year between 1995 and 2005.

Regarding the target of being an industrialized country, energy demand in the industrial sector is expected to increase dramatically and to be the largest consumer of final energy – almost 41% and 45% in 2030BaU and 2030CM scenarios, respectively.

The share of energy demand by residential sector is projected to be reduced substantially from 59% in 2005 to 30% in 2030BaU scenario and to 32% in 2030CM scenario, as a result of a reduction of the traditional biomass fuels for cooking. It is followed by transport sector, accounting for 23% and 16% in 2030BaU and 2030CM scenarios, respectively.

The finding shows that the energy shares of industrial and transport sectors are expected to increase in future, while the share of residential sector decreases. This is because of continued trends of industrialization and increasing travel demand by private cars. It can be said that the energy consumption of industrial and transport sectors should be highlighted in Vietnam's energy sector in future.

Compared to the other sectors, the share of final energy consumption of commercial sector will keep small number which accounts for only 6% in 2030BaU scenario and 7% in 2030CM scenario.

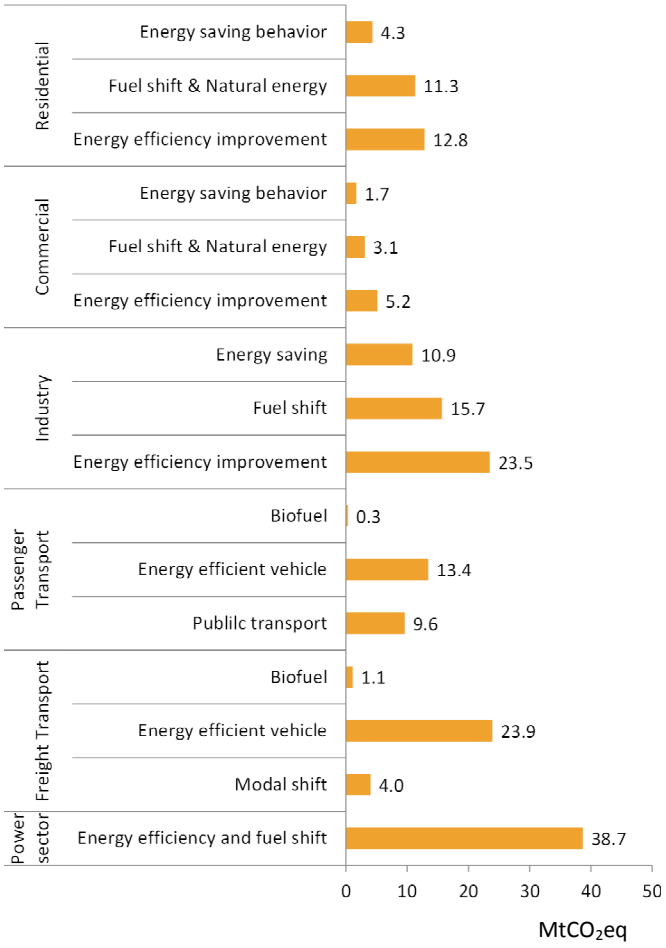

Figure 2. Contribution of low carbon measures in energy sector

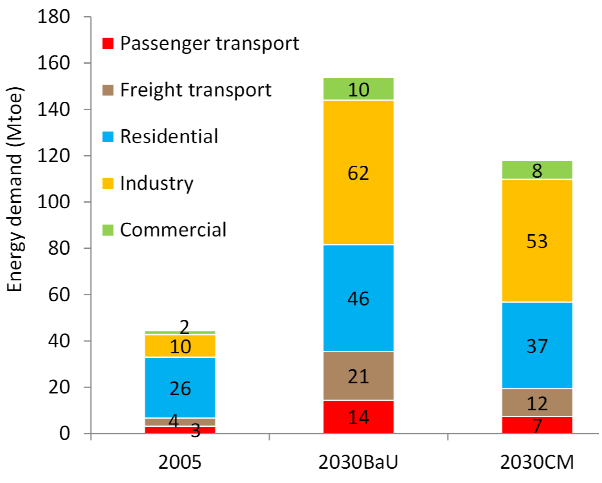

Figure 1. Final energy demand

Table 2. GHG emission in energy sector

$MtCO_2eq$

Sector	2005	2030BaU	2030CM	2030BaU /2005	2030CM /2005	2030CM/ 2030BaU
Residential	14.8	110.2	68.2	7.4	4.6	0.6
Commercial	6.2	41.3	27.9	6.7	4.5	0.7
Industry	38.8	256.5	185.4	6.6	4.8	0.7
Passenger transport	10.0	46.5	23.1	4.7	2.3	0.5
Freight transport	11.3	67.3	37.8	6.0	3.4	0.6
Total	81.0	521.9	342.4	6.4	4.2	0.7

Agriculture, Forestry and Other Land Use (AFOLU) Scenario

We used AFOLUA to describe the AFOLU activity scenarios. "Activity" here means a level of production of agriculture commodities, area of land use and land use change. To consider the country specific situation, some part of the necessary information was derived from the international information sources, such as FAO (2012), and supplemented with the reports from domestic institutions, such as General Statistic Office (SYB) Vietnam, the Second Vietnam National Communication to UNFCCC, the draft report of Vietnam Inventory in 2005, and other reports from Ministry of Agriculture and Rural Development (MARD). Future trends in activity levels were assumed based on governmental plans prospective. If they are not available, future scenarios are estimated based on the extrapolation of the historical trend. Assumptions in 2030BaU Scenarios are shown in Table 3.

2030BaU Emissions

Total GHG emissions in AFOLU sectors in 2030 are expected to reach 78.8 $MtCO_2eq$ (Figure 3).

In the agricultural sector, CH_4 is the largest GHG emission, followed by N_2O. The major sources are rice cultivation (CH_4), livestock (CH_4 and N_2O) and managed soil (N_2O). GHG emissions in the agricultural sector in 2000 were 62.4 $MtCO_2eq$, and gradually increased to 64.8 and 71.7 $MtCO_2eq$ in 2005 and 2010, respectively. After that, the emission is keeping to increase gradually to 84.5 $MtCO_2eq$ in 2030.

For LULUCF sector, the main source/sink of GHG is from forest and grassland conversion, which is followed by emission and removal from/to soils. Total GHG emissions from forestry and land use change were estimated to have declined gradually from 5.0 $MtCO_2eq$ in 2005 to 2.9 $MtCO_2eq$ in 2010, respectively. After 2015, LULUCF is expected to be a net sequestration of CO_2, with amounts of –2.7 and –5.7 $MtCO_2eq$, respectively in 2020 and 2030.

Table 3. AFOLU sector assumptions in 2030

	Assumption in 2030	Source of assumption
Population density	Population is increasing gradually, density is assumed to increase about 1.1 times in 2030 compared to 2005 2005: 40859 person per ha 2030: 45000 person per ha	GSO (2011)
Per capita food demand	Demand on rice consumption of Vietnamese in 2030 is same as current time. Rice and wheat: the same as 2005 Other commodities: increase by 0.5% per year	Food security's objectives in Vietnam. HP: <http://cholu-athembong.uniad.com.vn/tin-nong-nghiep/37-tin-nong-nghiep/112-kich-ban-nao-cho-an-ninh-luong-thuc-quoc-gia.html>
Food import rate	Same with 2005	This study
Yield	Projected values by MARD	MARD (2011) attached with Decision 124/QD-TTg/2012
Land use conversion matrix	Same conversion pattern as the matrix from 2001 to 2005	Vietnam Inventory report in 2005 (draft version)

Mitigation in AFOLU sectors

In the AFOLU sectors, we projected GHG reduction amount by countermeasures under a wide range of Allowable Additional Costs (AAC) for GHG emission mitigation. The result shows the reduction in 2030 is 10.8 $MtCO_2eq$ under AAC of 0 US$/$tCO_2eq$. It will increase to 42.7 $MtCO_2eq$ under AAC of 10 US$/$tCO_2eq$ and 44.5 and 48.4 $MtCO_2eq$ under 100 and for any cost of AAC. Based on our findings, a package of mitigation countermeasures at 10 USD/tCO_2eq is expected to have some economic efficiencies and high mitigations for GHG emission in the AFOLU sector in Vietnam. In which, emission reduction related to rice cultivation is the significant contribution (11.9 $MtCO_2eq$/year) while those in forest and land use management are the greatest contribution (Figure 4).

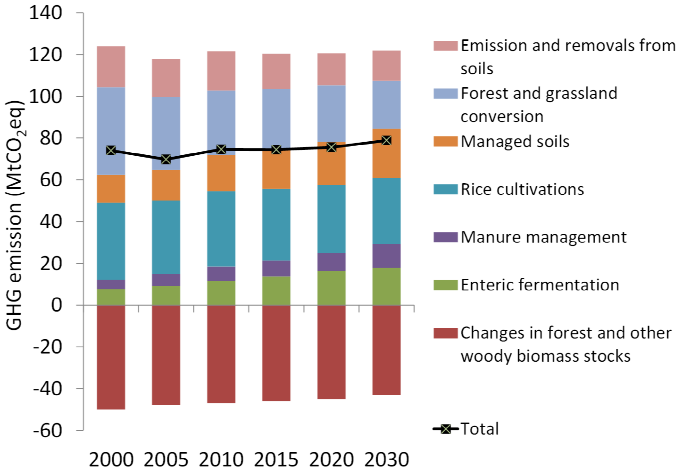

Figure 3. GHG emissions in AFOLU sector in 2030

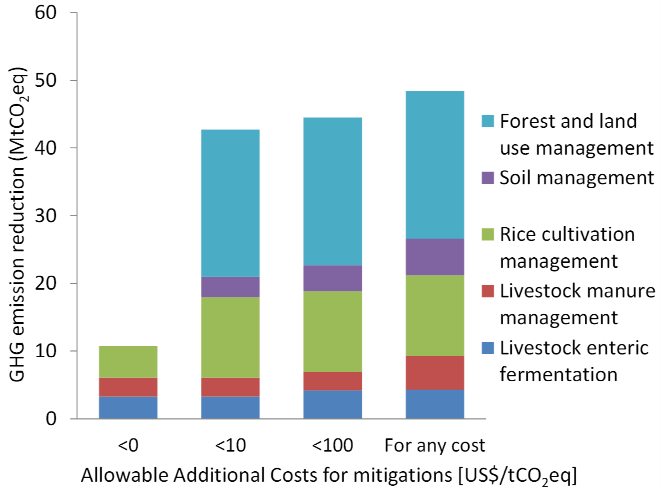

Figure 4. GHG mitigation potential in AFOLU sector in 2030