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Country Case Study Vietnam

Removing barriers for climate change mitigation

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This report is part of the project “Linking public finance and market mechanisms to leverage private funds in the post-2012 climate regime”, conducted by the Department of Political Science, University of Zurich for the Swiss State Secretariat for Economic Affairs (SECO) & Climate Strategies.

Climate Strategies is an international organisation that convenes networks of leading academic experts around specific climate change policy challenges. From this it offers rigorous, independent research to governments and the full range of stakeholders, in Europe and beyond.

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The picture on page 1 shows a biogas plant in Binh Duong province, Vietnam.
Source: http://sure.com.ph/wordpress/wp-content/uploads/2010/02/22.Biogas-tank.jpg

Executive summary

Vietnam is one of the most vulnerable countries to climate change. Its contribution to climate change is also expected to increase significantly in the coming years due to it being one of the fastest growing economies in the Asia Pacific. **Emissions are expected to growth at over 3% per annum from 2005-2030, reaching 387 Mt in 2030, excluding emissions from LULUCF**. On a per capita basis, emissions remain low compared to other developed economies. Agriculture represented the largest share of emissions in the last 15 years, but by 2030 emissions from energy supply is expected to account for 49% of total emissions, as coal is used to fuel the economy's blistering growth.

The government of Vietnam has made significant progress in adopting legislation to provide a suitable footing for adaptation and mitigation programs. Its National Target Program to respond to climate change is building capacity to tackle the problems of mitigation and adaptation. The country has also passed renewable energy and energy efficiency regulations that will begin to curb its emissions. As Vietnam's greenhouse gas emissions have increased, it has become a preferred target of emission reduction projects and **programs financed by multilateral and bilateral agencies and the carbon market**s. Multi-lateral agencies are collaborating with the government to tackle emissions across major emitting sectors.

Despite these efforts, significant abatement potential in Vietnam remains**. Based on available data, existing and planned projects are only likely to harvest 12% of available abatement potential in the medium term (2015-2030).** This suggests that a scale up of emission reduction programs in the country is possible.

Low electricity and coal prices in Vietnam are a major obstacle to undertaking energy efficiency improvements and investing in renewable energy. **Technical, financial and legal capacity among all stakeholders in mitigation projects further limits the adoption of low carbon technologies.** Detailed information on abatement potential is also lacking, which makes it difficult for investors and funders to target certain sectors.

Existing and planned mitigation projects will help to address some of these barriers, but several further projects have been identified through this study. At the national policy level an ambitious mitigation programme in conjunction to the existing National Target Program would bring significant benefits in coordinating and targeting the implementation of emission reduction efforts. **A single policy approach would help reducing overlap and confusion amongst competing initiatives in each sector and funding could be funneled through one source**. A panel assessing the overlap of projects would help allocate funding more efficiently and identify where gaps exist.

At the sector level **several potential programmes have been identified that SECO could potentially fund**. These programs would target areas where little or inadequate efforts have been undertaken to date and would work well with existing initiatives.

Structured by the three goals of SECO's Vietnam Country strategy 2009-2012, the following programs are proposed for funding;

Strengthening of macroeconomic framework conditions and financial sector infrastructure

- **Wind policy assessment** examining experiences with feed-in tariffs and capacity caps
- **Review of electricity tariff** and cost benefit analysis of different methods for encouraging clean technology market development

Promotion and internationalisation of SMEs

- Technical **capacity building for emerging REDD+ private sector companies** that reduce pressure on government and stimulate market development
- **ESCO capacity building in iron & steel and cement sectors**
- **An efficient cook stove program**, including testing of stove types, training of producers and vendors, quality labels and a public awareness initiative
- Funding a local R&D program and supporting **joint ventures with foreign companies on energy abatement technologies**
- **Technical Needs Assessment in industrial energy efficiency** in conjunction with existing CTF and GEF programs
- **Capacity building program on water management in rice cultivation** in conjunction with the Ministry of Agriculture and Rural Development

Sustainable trade policy / trade promotion

- **CDM Programmes of Activities (PoAs) linked to agricultural wastes, industrial waste water treatment or composting/landfill gas** projects in small provincial cities across the country
- **Expand the labelling to more appliances** in the residential and commercial sectors.
- Strengthening intellectual property protection and **lowering barriers to market entry for low-carbon technology providers in the transport sector.**

The Vietnamese government has made climate change a clear priority. However, unless further investment, capacity building and regulations are implemented, Vietnam's contribution to climate change will increase to its own detriment.

Table of Contents

List of Table

List of Figures

Acronyms and abbreviations

A/R	Afforestation/Reforestation
ADB	Asian Development Bank
CDM	Clean Development Mechanism
CER	Certified Emission Reduction
CO2e	CO2 equivalent
EB	Executive Board
EDGAR	Emission Database for Global Atmospheric Research
EE	Energy efficiency
EVN	Electricity Viet Nam (publicly owned company)
GDP	Gross domestic product
GEF	Global Environment Facility
GHG	Greenhouse Gas
GTZ	German Society for Technical Cooperation (*Deutsche Gesellschaft für Technische Zusammenarbeit*)
HCMC	Ho Chi Minh City
IDA	International Development Association
IFC	International Financial Corporation
LULUCF	Land use, land use change and forestry
MACC	Marginal abatement cost curve
MARD	Ministry of Agriculture and Rural Development
MDB	Multilateral Development Bank
MOF	Ministry of Finance
MOIT	Ministry of Industry and Trade
MONRE	Ministry of Natural Resources and Environment
NAMA	Nationally appropriate mitigation action
NGO	Non-governmental organization
ODA	Official Development Assistance
OECD	Organization of Economic Cooperatioan and Development
PDD	Project Development Document
PoA	Program of Activities
RE	Renewable energy
REDD	Reducing emissions from deforestation and degradation
SECO	State Secretariat for Economic Affairs (Staatssekretariat für Wirtschaft)
UNFCCC	United Nations Framework Convention on Climate Change
UNIDO	United Nations Industrial Development Organization
VCS	Voluntary carbon standard
WB	World Bank

1. Introduction

1.1. Reason for this Country Case Study

This Country Case Study is part of the larger project "Linking public finance and market mechanisms to leverage private funds in the post-2012 climate regime" funded by SECO and Climate Strategies. While the larger project looks at ways of leveraging and accounting of private funds, which are catalyzed by public finance and market mechanisms in the climate regime, the two country case studies in Vietnam and Peru take a deeper look into the climate change mitigation potential and related barriers in those countries. Vietnam is an interesting country for climate change mitigation as it is a focus country for SECO, it has rapidly growing emissions and high vulnerability to climate change.

Vietnam is one of the most vulnerable countries to climate change, with many of the impacts of climate change particularly pronounced in the country. The frequency of droughts and severe rainfalls has increased overtime. Higher evapotranspiration has also reduced the availability of water for irrigation. Vietnam's long coastal region and monsoons make it particularly sensitive to changes in sea level. Rising sea levels have already caused severe saltwater intrusion in agricultural areas, which has reduced agricultural productivity (Jung et al., 2010). Furthermore, an estimated 10% of the population of the country would be displaced by a 1 metre rise in sea level (Dasgupta, 2010). These effects are driving mitigation and adaptation strategies to climate change in the country, and make it open-minded to international efforts for mitigating climate change

Vietnam is also facing a significant energy security challenge. In 1986, the government of Vietnam began a reform programme, Doi Moi, which resulted in the gradual liberalisation of the economy. As a result, Vietnam is one of the fastest growing economies in the Asia Pacific region. Real GDP has grown at an average rate of 7.6% from 2000 to 2007, driven by the expansion of the industrial, commercial and service sectors (WB, 2010). Energy use has expanded at an even faster pace with Vietnam's energy-use to GDP growth elasticity averaging 1.7 from 1998-2007 (Taylor et al., 2007). From 1990-2007 per capita electricity consumption grew even faster than energy consumption rising 12.8% per annum (Toan et al., 2010). Therefore, the country has an important mitigation potential to offer.

With limited supplies of domestic fossil fuels, the rapid pace of Vietnam's economic transformation has raised concerns over energy security. Vietnam is increasingly contributing to global climate change, as greenhouse gas emissions, associated with growing energy use, have more than doubled from 1990-2005. Economic growth is also placing pressure on Vietnam's forests and other natural resources.

Several efforts to reduce Vietnam's GHG emissions are already underway, yet significant abatement opportunities remain in the country.

1.2. Outline for this Country Case Study

This study will begin by explaining the socio-economic background of Vietnam and move on to the current and projected emissions as well as the mitigation potential. Then, existing national polices and mitigation programs, including internationally supported projects are explored, as well as planned multilateral programs and carbon market activities. This serves to examine the remaining national mitigation potential per sector. The various barriers for climate change mitigation are explained by sector and ways of removing such barriers are suggested. The study concludes with some recommendations on potential actions Switzerland or SECO could undertake in Vietnam.

2. Emissions and reduction potential

2.1. Past and current emissions: from agriculture to energy

The expansion of industries, motorized transport and electricity consumption has led to a rapid rise in the country's GHG emissions over the past 15 year. According to EDGAR, emissions more than doubled from 1990 to 2005, rising from 91 megatonnes of carbon dioxide equivalent (Mt) to 209 Mt, respectively (see As a result of the expansion of industrial activity in Vietnam, emissions from the sector, which only accounted for 8% of total emissions in 1990, represented around 21% of total emissions in 2005. Around 63% of the emissions in the sector stem from manufacturing industries and construction, whereas 36% are generated in the production of metals (EDGAR, 2010). Industrial energy use grew from 3.6 million tons of oil equivalent (toe) in 1998 to 13.9 million toe in 2007, an almost four fold increase. Energy intensity of industrial production also rose over the period from 129 kgoe per US$1,000 in 1998 to 264 kgoe per US$1,000 in 2007 in constant prices (Taylor et al, 2010).

Emissions from the residential sector have also risen sharply, more than doubling from 1990 to 2005. Increased substitution of coal and liquefied petroleum gas for biomass has led to a tripling of commercial energy use from 1999-2007.

Figure 1).

Not only is Vietnam one of the most vulnerable countries to climate change, but its emissions per capita are small relative to developed economies. Per capita emissions rose from around 1.4 t in 1990 to 2.5 t in 2005 (EDGAR, 2010). In 2005, its per capita emissions were around one fifth the size of Germany's and one tenth of the US and Vietnam's greenhouse gas emissions per capita ranked 122nd out of 186 countries. This implies that the country is likely to be a large recipient of climate mitigation and adaptation finance (WRI, 2011).

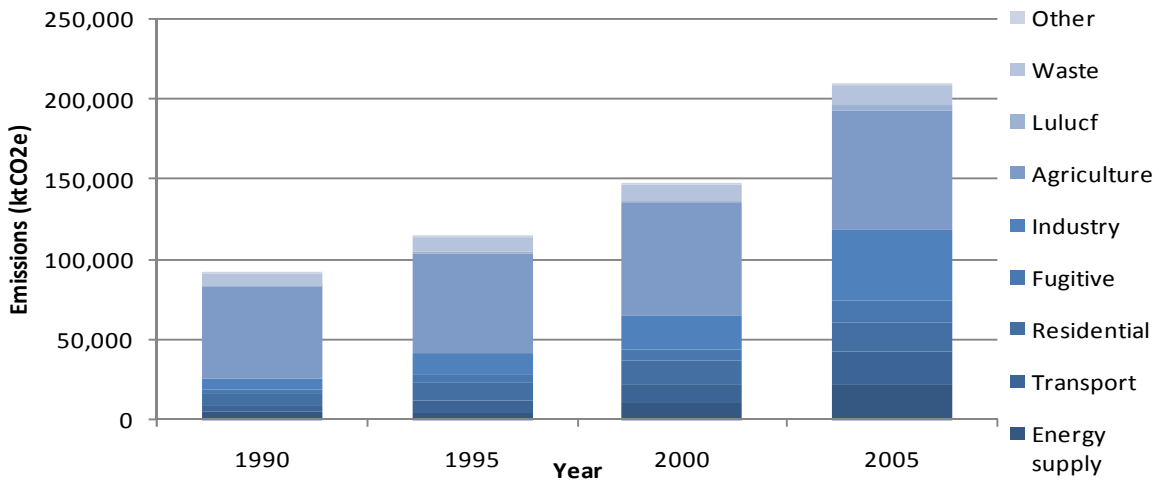
Emissions from the agriculture sector represent the largest source of emissions. Agriculture emissions in Vietnam largely stem from methane released during rice cultivation, but also due to methane emissions from livestock, nitrous oxide emissions from fertilisers and emissions from agricultural residues (WBCFA, 2010b). The share of agriculture emissions dropped from 63% of total emissions in 1990 to 36% in 2005. This fall can be attributed to a rise in emissions from other sources especially energy supply, transport, fugitive and industry, which more than doubled between 2000 and 2005. Emissions from energy supply only accounted for 11% of total emissions in 2005, but were almost 5 times their 1990 levels (EDGAR, 2010).

Significant deforestation has occurred in Vietnam in the past. Between 1943-1993 forest coverage dropped from 43% to 20%. Considerable efforts since then have helped to increase forest area to 13.26 million hectares (ha) in 2009, which represents 39% of total land area. Plantations, natural regeneration and the inclusion of previously omitted limestone forests are largely responsible for this significant increase. Yet, areas of the country still experience extensive deforestation and degradation and certain ecosystems such as the lowland forests and mangrove forests have been largely destroyed (FCPF, 2010). Deforestation in the country is largely driven by Vietnam's forestry sector harvesting tropical hardwood for export, impoverished communities use forest products for fuel and construction, conversion to cash crops and rapid economic and infrastructure development (WBCFA, 2010b). Emissions from land use and land use change rose from around 1 Mt in 2000 to 4.2 Mt in 2005 (EDGAR, 2010).

As a result of the expansion of industrial activity in Vietnam, emissions from the sector, which only accounted for 8% of total emissions in 1990, represented around 21% of total emissions in 2005. Around 63% of the emissions in the sector stem from manufacturing industries and construction, whereas 36% are generated in the production of metals (EDGAR, 2010). Industrial energy use grew from 3.6 million tons of oil equivalent (toe) in 1998 to 13.9 million toe in 2007, an almost four fold increase. Energy intensity of industrial production also rose over the period from 129 kgoe per US$1,000 in 1998 to 264 kgoe per US$1,000 in 2007 in constant prices (Taylor et al, 2010).

Emissions from the residential sector have also risen sharply, more than doubling from 1990 to 2005. Increased substitution of coal and liquefied petroleum gas for biomass has led to a tripling of commercial energy use from 1999-2007.

Figure 1: Emissions in Vietnam by sector (1990-2005)

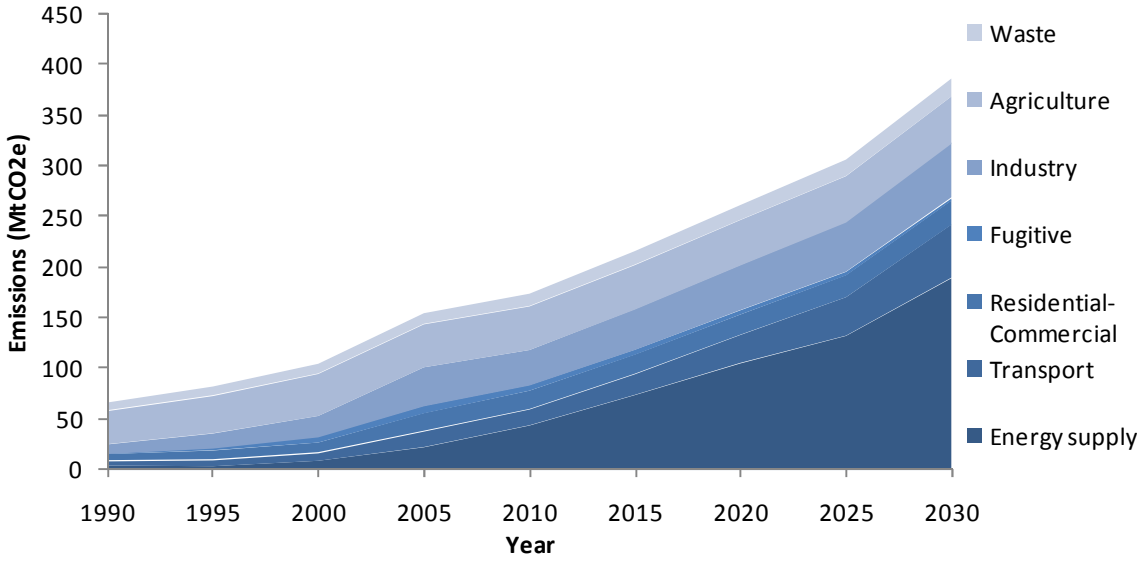


Source: EDGAR, 2010

2.2. Emission projections

Emissions in Vietnam are expected to almost double by 2030, growing by 3.1% per annum from 2005-2030. According to data from the IEA scenario of the GAINS model, GHG emissions are expected to reach 387 Mt in 2030, excluding emissions from LULUCF (see Figure 2). Estimates of emissions in 2005 by the GAINS model and EDGAR differ slightly; this is largely a result of EDGAR's higher figures for fugitive, transportation and agriculture emissions. This suggests that emissions in 2030 could be even higher in the country than given in Figure 2.

Figure 2: Emission projections in Vietnam by sector (1990-2030), excluding forests/LULUCF



Source: GAINS, 2010

An analysis of projected emissions by sector suggests a substantial increase in emissions from energy supply. Whereas the agriculture sector represented the largest share of emissions in the last 15 years, by 2030 emissions from energy supply are expected to account for 49% of total emissions, continuing recent growth trends. According to GAINS data, emissions from the energy sector are expected to reach 189 Mt, increasing by almost 9% per annum. This projected growth is expected to be driven by the addition of new coal fired capacity to meet Vietnam's accelerating economic

development and power demand (GAINS, 2010). Growth in energy generation has largely been achieved through the use of local energy resources, especially hydro power, but domestic resources that can be easily developed are insufficient to sustain this magnitude of growth in energy demand. This will increase the country's reliance on imports (both fossil fuels and electricity) (Taylor et al., 2010).

Emissions from the transportation sector are also expected to grow rapidly, reaching 52 Mt in 2030, or 3.4 times 2005 levels. Fugitive emissions are projected to fall, whereas residential, industry and waste emissions are only expected to rise by around 2% per year.

2.3. Emission reduction potential

Marginal abatement cost curve (MACC) in general

Marginal abatement cost curves (MACC) is a tool for showing the GHG abatement potential and related costs, which has recently become popular after the publishing of the global greenhouse gas abatement cost curve by Enkvist et al. (2007). Its popularity may stem from the easy-to-communicate message by each MACC that each country has a significant abatement potential with negative social costs. While economists doubt that negative costs exist, one can respond to them that MACCs only consider investment but not transaction costs. Therefore, "negative cost options" simply point to the fact that in many cases the imposition of a carbon price will hardly be sufficient to trigger this potential. Instead, removal of transaction costs such as information or regulatory hurdles may be needed. In the barrier removal chapter, we will exactly with such transaction costs and show ways of dealing with them.

This introduction to MACCs is to warn the policy maker that he should not see the "negative costs" as easy win. Specific tools for each technology are needed to remove barriers. An abatement cost curve serves just as heuristic tool for policy makers to see where the carbon price may make a difference and where other policy measures are needed.

MACC for Vietnam

Several analyses of mitigation potential and cost exist for Vietnam. Abatement cost studies use varying assumptions in their models **t**hat often lead to significant differences in cost and potential estimates.

Six studies, presented below were compared to produce a representative marginal abatement cost curve (MACC). In addition McKinsey & Company (2009) was consulted for mitigation costs where none were available, and in cases where this source could not provide costs zero has been assumed.

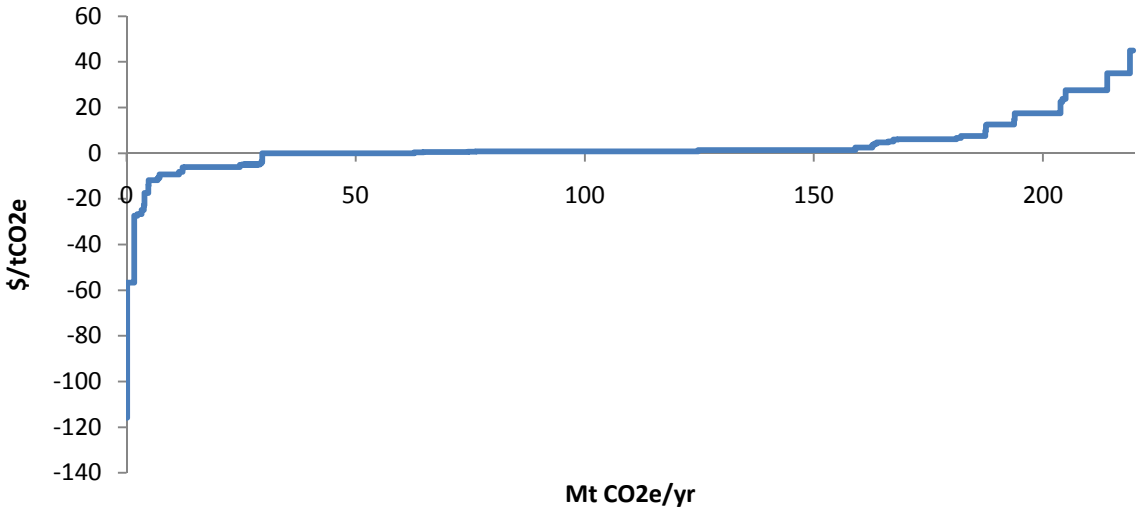
Table 1: Abatement cost studies for Vietnam

Study	Abatement Year/Period	Sectors	Total MT/yr	Comments
Jung et al., 2009	2020	Energy use in: Energy Supply, Fugitive, Industry, Transport, Residential-commercial	213.29	Cost represented as a range
MONRE, 2003	1994-2020	Industry, Transport, Energy Supply, Residential-commercial, Agriculture and Forestry	140.22	Potentials were for 26 year period, therefore one year average is represented below
ARRPEEC, 2002	2003-2017	Energy Supply (Wind, Geothermal and Hydro)	16.6	Costs are investment rather than mitigation costs and are therefore not comparable to other studies
ADB, 1998	2005-2015	Energy Supply (only Wind), Residential-commercial, Forestry and Agriculture	155.3	Some of the potentials are in carbon rather than carbon dioxide

Study	Abatement Year/Period	Sectors	Total MT/yr	Comments
WBCFA, 2009a,b,c 2010a,b	2010-2015	Industry, Transport, Energy Supply, Residential-commercial, Agriculture and Forestry	104.44	No costs are provided
MONRE, 2010	2000-2030	Industry, Transport, Energy Supply, Residential-commercial, Agriculture and Forestry	104.55	Unclear for some of the potentials what time period is used, 30 years was assumed in such cases.

Source: Jung et al., 2009; MONRE, 2003; ARRPEEC, 2002; ADB, 1998; WBCFA, 2009a, 2009b, 2009c, 2010a, 2010b; MONRE, 2010.

Figure 3: Marginal abatement cost curve for Vietnam for the year 2015-2030



Each study examines different mitigation options within each sector, using different assumptions. This results in large discrepancies across the studies. In aggregate, Jung et al. estimates that around 157 Mt/yr could be reduced in 2020 at a cost below US$ 10/t and a further 56 Mt/yr at a cost US$ 10-50/t through various measures addressing emissions from energy consumption. In comparison, the MONRE (2003) analysis calculates that only 11 Mt/yr could be reduced in energy sectors from 1994 to 2020 at a cost below US$ 7/t. A further 129 Mt/yr may be abated over the same period at a cost below US$ 14/t in the Agriculture and forestry sectors. Similarly, although MONRE (2010) and WBCFA (2009a, 2009b, 2009c, 2010a, 2010b) obtain similar figures in aggregate, at the technology level large discrepancies exist.

Table 2: Abatement by sector

Sector	Mt/yr
Forestry	96.26
Energy Supply	73.41
Transport	13.74
Agriculture	10.82
Waste	10.17
Industry	6.56
Fugitive	5.05
Residential and commercial	3.49
Total	**219.49**

Source: Jung et al., 2009; MONRE, 2003; ARRPEEC, 2002; ADB, 1998; WBCFA, 2009a, 2009b, 2009c; WBCFA, 2010a, 2010b; MONRE, 2010.

Using the various studies in Table 1 above, an indicative marginal abatement cost curve was constructed. A more detailed analysis of each sector below will explain the data used for each sector and discuss the discrepancies in more detail.

Energy Supply

An estimated 73 Mt can be reduced through various measures in the energy supply sector. Jung et al. estimates that around 20.9 Mt/yr could be reduced through the installation of CCS technologies in 2020 and 4.0 Mt/yr through the construction of nuclear power plants. Both of these measures would be at a cost above US$10/t. A further 13.6 Mt/yr could be reduced through fuel switching measures at costs ranging from US$ 0-50/t. This includes an estimated 0.5 Mt/yr by switching from coal-fired plants to LNG thermal power, which MONRE (2010) estimates would cost around US$15.1/t.

Table 3: Abatement potential per year and cost in the power sector

Option	Sector	Mt/yr	$/t	Year	Source
Subcritical coal in old plants	Coal EE	1.80	NA	2010-2015	WBCFA, 2009a
Supercritical coal in new plants	Coal EE	8.20	NA	2010-2015	WBCFA, 2009a
Subcritical coal in new plants	Coal EE	6.60	NA	2010-2015	WBCFA, 2009a
Fuel switching among fossil fuels	Fuel switch	3.19	2.5	2020	Jung et al., 2009
Geothermal power	Geothermal	1.12	5.2	1994-2020	MONRE, 2003
Solar power	Solar	1.00	6.0	1994-2020	MONRE, 2003
Hydro	Hydro	12.80	6.1	2010-2015	WBCFA, 2009a /McKinsey & Company, 2009
Rice husk and bagasse power replacing coal thermal power	Bioenergy	0.91	6.6	2000-2030	MONRE, 2010/ WBCFA, 2009a
Fuel switching among fossil fuels	Fuel switch	4.64	7.5	2020	Jung et al., 2009
CCS	CCS	3.70	12.5	2020	Jung et al., 2009
Fuel switching among fossil fuels	Fuel switch	0.09	12.5	2020	Jung et al., 2009
Nuclear	Nuclear	2.10	12.5	2020	Jung et al., 2009
CCS	CCS	8.51	17.5	2020	Jung et al., 2009
Nuclear	Nuclear	1.22	17.5	2020	Jung et al., 2009
Nuclear	Nuclear	0.39	22.5	2020	Jung et al., 2009
Wind power	Wind	2.50	4.6	2010-2015	MONRE, 1994/ WBCFA, 2009a
CCS	CCS	8.25	27.5	2020	Jung et al., 2009
Fuel switching among fossil fuels	Fuel switch	0.76	27.5	2020	Jung et al., 2009
CCS	CCS	0.47	35	2020	Jung et al., 2009
Fuel switching among fossil fuels	Fuel switch	4.24	35	2020	Jung et al., 2009
Nuclear	Nuclear	0.26	35	2020	Jung et al., 2009
Fuel switching among fossil fuels	Fuel switch	0.67	45	2020	Jung et al., 2009
Total		**73.41**			

Source: Jung et al., 2009; MONRE, 2003; ARRPEEC, 2002; ADB, 1998; WBCFA, 2009a; MONRE, 2010

Jung et al. estimates that through a series of energy saving options in the power sector around 47 Mt/yr could be reduced at a negative cost and a further 23 Mt/yr costs from US$ 0-50/t. However, few details are available on the technologies to be deployed to capture this potential and therefore these estimates are not included in the MAC curve in this study. Some of these energy savings are likely to stem from increasing the efficiency of transmission infrastructure with losses averaging around 11 percent for the system as a whole at the moment. Although these levels are not unreasonable for a developing country, rural power systems lose substantially more reaching 30% in some areas (Taylor et al., 2010).

According to ARRPEEC, 5 Mt/yr could be reduced through total investment of US$ 12.2/t, by switching to pressurized fluidized bed combustion in coal plants. The World Bank also estimates significant potential largely through energy efficiency improvements in coal-fired plants. By applying subcritical technologies in 3 old coal plants 1.8 Mt/yr could be reduced. The adoption of supercritical and subcritical boilers in 50% of new coal-fired power plants constructed between 2010 and 2012 could see a further 14.8 Mt/yr abated.

Estimates of abatement potential by expanding hydro and geothermal capacity range substantially across the studies. Jung et al. estimates that around 1.7 Mt/yr could be reduced by deploying both technologies at a cost of US$ 0-5/t and a further 1.6 Mt/yr at a cost of US$ 30-50/t. In comparison, ARRPEEC calculates that 10.3 Mt/yr could be reduced by expanding hydro capacity. The World Bank also has a high estimate of 12.8 Mt/yr over two thirds of which is reduced through small scale hydro power plants between 15-30 MW. McKinsey & Company (2009) estimate that reducing emissions through hydro projects could cost around US$6/t.

MONRE (1994) estimates around 1.1 Mt/yr could be reduced through geothermal power. This is similar to ARRPEEC's estimate of 1.3 Mt/yr. However the two studies' cost estimates of US$92.5/t for ARRPEEC and US$5.2/t for MONRE (1994) are not readily comparable as the ARRPEEC figure is an estimate of investment costs, or the total capital expenditure required, rather than mitigation costs.

Mitigation options also exist through the deployment of wind and solar power technologies. Jung et al. (2009) suggests that solar technologies do not present a viable abatement option in 2020, whereas MONRE (1994) estimates that around 1 Mt/yr could be reduced at a cost of US$ 6/t. Figures for the abatement potential of wind power range from 0.01 to 2.5 Mt/yr. Both the ADB and Jung et al. study suggest that this could be realised at a negative cost. However, this is unlikely to take into account the current tariffs that make wind power prohibitively expensive. Vietnam has a large wind resource and, therefore, the Jung et al. estimate of 0.01 Mt/yr may be low.

Forestry and Agriculture

According to MONRE (2010), an estimated 96.26 Mt/yr could be reduced through initiatives in the forestry sector. Around 51 Mt/yr could be abated through forest protection compared to 45 Mt/yr through afforestation and reforestation efforts. In comparison, the ADB suggests that 139 Mt/yr could be reduced from 2005-2015 through reforestation and forest protection relative to the World Bank figure of 21.1 Mt/yr from 2010-2015.

In the agriculture sector around 10.8 Mt/yr could be mitigated through a variety of options. Improved water management techniques, such as midseason drainage or alternate wetting and drying, have the potential to reduce around 6.4 Mt/yr. In the agriculture sector only 26% of agricultural residues are utilised for alternative purposes, leaving significant opportunities for power generation. Rice husks are mainly used as a cooking fuel, but in the Mekong Delta a large amount is thrown into rivers after the harvest. Bagasse is used by sugar mills, but mainly in inefficient low pressure boilers. Other biomass is used for fuel, house roofing and other uses. The more effective application of nitrogen fertilisers could also help reduce emissions from agriculture (WBCFA, 2010b).

Table 4: Abatement potential per year and cost in the forestry and agriculture sectors

Option	Sector	Mt/yr	$/t	Source	Year
Molasses Urea Block Cattle feeds	Agriculture	0.26	-10.9	MONRE, 2010	2000-2030
Reducing methane emissions from rice fields	Agriculture	6.40	-6.0	WBCFA, 2010b/ McKinsey & Company, 2009	2010-2015
Reducing nitrous oxide emissions from fertiliser application	Agriculture	3.40	-6.0	WBCFA, 2010b/ McKinsey & Company, 2009	2010-2015
Reforestation of large timber forests in conjunction with natural regeneration	Afforestation/ Reforestation	2.00	0.4	MONRE, 2010	2000-2030
Growing long-rotation non-timber product forest	Afforestation/ Reforestation	2.93	0.5	MONRE, 2010	2000-2030
Planting long-rotation large timber trees	Afforestation/ Reforestation	6.78	0.6	MONRE, 2010	2000-2030
Planting melaleuca forest on alkaline wetlands	Afforestation/ Reforestation	1.67	0.6	MONRE, 2010	2000-2030
Conservation of existing protection forests	Forest protection	28.83	0.8	MONRE, 2010	2000-2030
Planting fast-growing trees for lumber	Afforestation/ Reforestation	19.73	0.8	MONRE, 2010	2000-2030
Protection and sustainable management of existing production forest areas	Forest protection	22.60	1.4	MONRE, 2010	2000-2030
Planting short-rotation pulpwood forest	Afforestation/ Reforestation	11.73	1.4	MONRE, 2010	2000-2030
Biogas replacing cooking coal in lowlands	Agriculture	0.58	4.1	MONRE, 2010	2000-2030
Biogas replacing cooking coal in mountain areas	Agriculture	0.17	9.7	MONRE, 2010	2000-2030
Total		**107.08**			

Source: MONRE, 2010; WBCFA, 2010b; McKinsey & Company, 2009

Industry and fugitive emissions

WBCFA (2010a) estimates that a 4.37 Mt/yr could be reduced through mitigation options in the cement sector. Waste heat recovery, increased blending of cement and fuel switching could reduce emissions by 3.76 Mt/yr at a negative cost, whereas other energy efficiency measures would abate a further 0.6 Mt/yr. Waste heat recovery and energy efficiency measures in the iron and steel sector could mitigate 0.3 Mt/yr, compared to 0.38 Mt/yr through co-generation and CHP in the paper and pulp sector and 0.17 Mt/yr through the replacement of traditional kilns in brick making. A further 1.04 Mt/yr could be reduced through generic energy efficiency efforts in various industries, by installing high efficiency electric motors and boilers.

Jung et al. (2009) estimates that over 5 Mt/yr could be abated by reducing fugitive emissions in other energy conversion sectors, mainly the oil and gas sector. Around 3.5 Mt/yr could be reduced at a negative cost. The study's figures likely includes around 2 Mt/yr that the World Bank calculates could be reduced through the recovery and use of gas from oil fields and 1.8 Mt/yr from coal fields.

Table 5: Abatement potential per year and cost in Industry

Option	Sector	Mt/yr	$/t	Source	Year
Waste heat recovery	Iron & steel	0.11	-115.9	WBCFA, 2010a /McKinsey & Company, 2009	2010-2015
Waste heat recovery	Cement	0.64	-27.4	WBCFA, 2010a / McKinsey & Company, 2009	2010-2015
Increased blending of cement	Cement	0.92	-26.7	WBCFA, 2010a / McKinsey & Company, 2009	2010-2015
High efficiency electric motors	Generic industry	0.52	-24.9	MONRE, 2010	2000-2030
Fuel switching	Cement	2.20	-6.1	WBCFA, 2010a / McKinsey & Company, 2009	2010-2015
Innovative brick kilns	Brick	0.47	-5.1	MONRE, 2010	2000-2030
Co-generation and Combined heat and power	Paper & pulp	0.38	-5	WBCFA, 2010a /Jung et al., 2009	2010-2015
Other energy conversion sectors	Fugitive	3.56	-5	Jung et al., 2009	2020
Replacing low efficiency oil boilers with higher ones in industry	Generic industry	0.13	-3.7	MONRE, 1994	1994-2020
Energy efficiency	Cement	0.61	NA	WBCFA, 2010a	2010-2015
Other energy conversion sectors	Fugitive	0.5	2.5	Jung et al., 2009	2020
Replacing low efficiency coal-fired boilers with higher ones in industry	Generic industry	0.39	3.7	MONRE, 1994	1994-2020
Other energy conversion sectors	Fugitive	0.67	7.5	Jung et al., 2009	2020
Improving energy efficiency	Iron & steel	0.18	14.6	WBCFA, 2010a / McKinsey & Company, 2009	2010-2015
Other energy conversion sectors	Fugitive	0.21	17.5	Jung et al., 2009	2020
Other energy conversion sectors	Fugitive	0.03	22.5	Jung et al., 2009	2020
Other energy conversion sectors	Fugitive	0.07	27.5	Jung et al., 2009	2020
Total		**11.61**			

Source: Jung et al., 2009; MONRE, 2003; WBCFA, 2010a; McKinsey & Company, 2009

An estimated 11.6 Mt/yr could be reduced through programs in industry and fugitive sectors. Jung et al. (2009) estimates that around 74 Mt/yr could be reduced through efforts in other industries, 55 Mt/yr of which could be achieved at a negative cost, yet no specifics on technologies are provided. According to Jung et al., significant negative cost abatement opportunities exist through energy efficiency measures in industry. In addition, the study suggests that no abatement potential exists in 2020 in the cement, chemical or aluminium industries; therefore it is unclear which subsectors 'other industries' reference.

Transport, Residential, Commercial and Waste

MONRE (2010) suggests that 3.49 Mt/yr could be reduced through mitigation options in the residential and commercial sectors. The installation of efficient coal stoves, HVAC systems, solar

water heating and lighting could abate around 2.5 Mt/yr at a negative cost. High efficiency refrigerators and replacing LPG in cooking could mitigate a further 1 Mt/yr at US$12.3/t and US$23.8/t, respectively. In comparison, Jung et al. (2009) estimates around 17.5 Mt/yr could be reduced in these sectors, including 11 Mt/yr at a negative cost. However, limited details on the technologies are provided.

An estimated 13.92 Mt/yr could be reduced through several abatement options in the transport sector. In comparison, Jung et al. (2009) calculate that the increased use of bio-ethanol and efficiency improvements of internal combustion engine vehicles could reduce emissions by 5.14 Mt/yr in 2020. The World Bank calculates that the introduction of low emitting vehicles, including electric motorcycles, could reduce emissions by 8.4 Mt/yr. MONRE (2010) estimates that switching from diesel oil and using LPG fuelled cabs could abate 0.07 Mt/yr and 0.11 Mt/yr, respectively.

Table 6: Abatement potential per year and cost in transport, residential and commercial sectors

Option	Sector	Mt/yr	$/t	Source	Year
Biofuels	Transport	1.60	-56.7	WBCFA, 2009b/ McKinsey & Company, 2009	2010-2015
High press sodium lamps in public lighting	Residential-commercial	0.10	-22.8	MONRE, 2010	2000-2030
Innovative coal stoves	Residential-commercial	0.84	-17.4	MONRE, 2010	2000-2030
Switching from diesel oil to CNG in transportation	Transport	0.07	-14.1	MONRE, 2010	2000-2030
Urban solid waste: landfills to energy	Waste	2.00	-11.9	WBCFA, 2009c/McKinsey & Company, 2009	2010-2015
LPG fuelled cabs	Transport	0.11	-11	MONRE, 2010	2000-2030
Urban solid waste: composting	Waste	4.30	-9.3	WBCFA, 2009c /Mckinsey & Company, 2009	2010-2015
Energy-saving compact fluorescent light bulbs	Residential-commercial	0.78	-8.2	MONRE, 2010	2000-2030
Solar water-heating appliances	Residential-commercial	0.46	-6.2	MONRE, 2010	2000-2030
High efficiency air conditioner	Residential-commercial	0.33	-4.4	MONRE, 2010	2000-2030
Introduction of low emitting vehicles (of which electric motorcycles)	Transport	8.40 (3.90)	NA	WBCFA, 2009b	2010-2015
Shift road freight to waterways	Transport	1.57	NA	WBCFA, 2009b	2010-2015
Shift road freight to railways	Transport	1.84	NA	WBCFA, 2009b	2010-2015
BRT systems for Hanoi and HCMC	Transport	0.33	NA	WBCFA, 2009b	2010-2015
Urban wastewater treatment	Waste	1.12	NA	WBCFA, 2009c	2010-2015
Rural wastewater treatment	Waste	1.65	NA	WBCFA, 2009c	2010-2015
Industrial wastewater methane	Waste	1.10	NA	WBCFA, 2009c	2010-2015
High efficiency refrigerators	Residential-commercial	0.24	12.3	MONRE, 2010	2000-2030
Replacing coal with LPG in household cooking	Residential-commercial	0.73	23.8	MONRE, 2010	2000-2030
Total		**27.40**			

Source: Jung et al., 2009; MONRE, 2003; ADB, 1998; WBCFA, 2009b, 2009c; McKinsey & Company, 2009

The World Bank suggests that 10.17 Mt/yr could be mitigated in the waste sector. Managing urban solid wastes could reduce emissions by around 6.3 Mt/yr, which according to McKinsey could be achieved at negative costs. A further 3.87 Mt/yr could be abated through the treatment of urban, rural and industrial waste water.

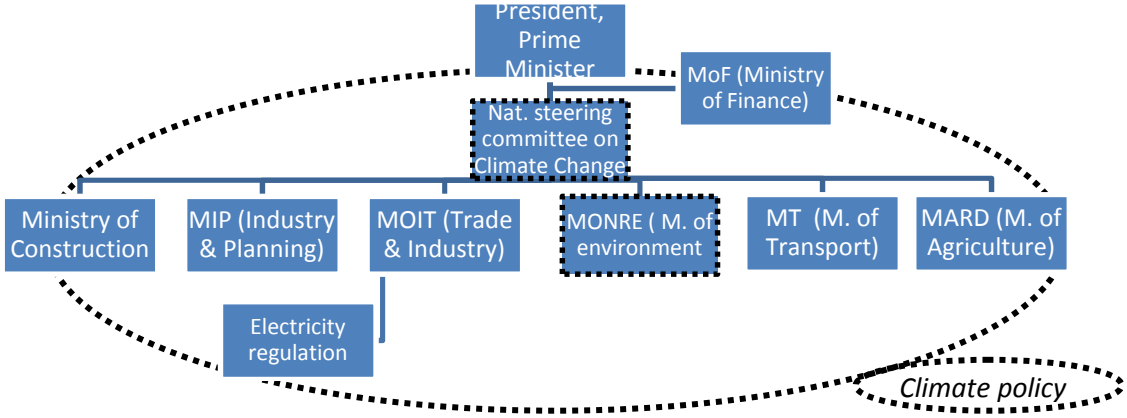
3. Current emission reduction actions

3.1. National actions and policies

Vietnam has a number of different legislative measures to help address the challenge of climate change mitigation and adaptation. Vietnam ratified the UNFCCC and the Kyoto Protocol (KP) in 1994 and 2002, respectively. The Ministry of Natural Resources and Environment acts as the national focal point for the UNFCCC and the KP.

The national climate change governance received a new structure in 2010 when the National steering committee on climate change was established, which's Chairman is the Vice Minister for Natural Resources and the Environment (MONRE, 2010). Besides MONRE, the important ministries for climate change include Ministeries of Contstruction, Agriculture, Transport, Industry and Planning, and especially the Ministery of Trade and Industry, responsible for Energy (see figure 4).

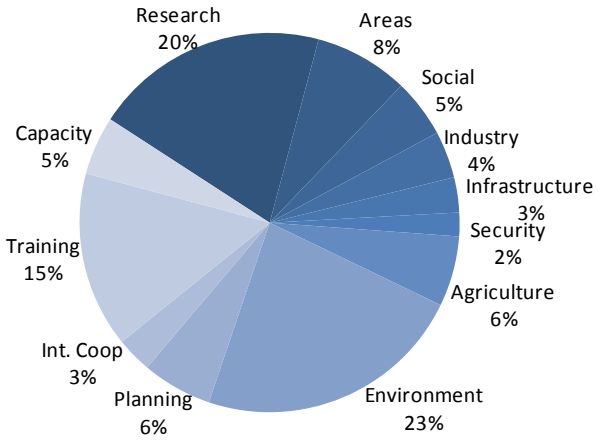
Figure 4: Organizational structure of the Vietnamese government and its climate policy.



Source: Own graph

The country's overall response to climate change is guided by the National Target Program (NTP) to respond to climate change approved in 2008. The program is mainly concerned with addressing Vietnam's adaptation to climate change and building capacity for this response. The NTP also seeks to mainstream climate change issues in the development plans for other sectors (GOV, 2008). It remains unclear to what degree the NTP's commitment to fighting climate change extends beyond the immediate drive of MONRE and into broader political circles. As highlighted by Table 7 the majority of funding goes towards environmental research and governance as well as training and education activities, largely controlled by MONRE (Fortier, 2010). This may have important ramifications for the effectiveness of the Programme.

Table 7: Distribution of National Target Programme (NTP) for Climate Change funding



Source: Fortier, 2010

In 2004, the Government passed a law for the implementation of Agenda 21. The law provides a strategic framework which serves as a legal basis for ministries, organisations, provinces and sectors to coordinate action for sustainable development in Vietnam. The programme highlights issues to be solved and outlines policies to promote the efficient use of natural resources and sustainable development, particularly in rural areas. As a result of the law, ministries, sectors and provinces formulated Agenda 21 programs to guide development (MONRE, 2010).

Table 8: Key climate change and environment laws

Law	Date
Strategic Orientation for Sustainable Development in Vietnam (Agenda 21)	153/2004/QD-TTg
National Strategy on Environmental Protection to 2010 orientation to 2020	256/2003/QD-TTg
Global Environmental Facility Strategy 2001-2010	18/2007/QD-TTg
National Target Program to Respond to Climate Change	2008
Law on Environmental Protection	2005

Agriculture

Vietnam does not have a national strategy for agriculture and rural development in place. Several policies though have contributed to better land management practices, which have in turn helped to reduce emissions. The Law on Water Resources, which came into force in 1999, targeted improvements in irrigation and water conservation. A national strategy to 2020 has also been developed. The improvement of rational irrigation and drainage management have increased crop yields and reduced methane emissions. The Strategic Plan on Husbandry Development and Decision No. 10/2008QD-TTg aim to promote the transformation of husbandry practices from traditional farms to industrialised models (WBCFA, 2010b).

Energy supply

As a result of Vietnam's rapid economic growth energy security is high on the policy agenda. Policy makers in Vietnam are seeking to open energy markets and introduce new and renewable forms of energy to help alleviate grid and energy security constraints. In 2008, Viet Nam passed the National

Energy Development Strategy (Decision No. 1855/QD-TTg), which outlines the general trajectory of the country's energy policy. One of its aims is to reform and liberalise the electricity market in order to attract investment from foreign and local companies, a process first initiated through the Electricity Law of 2004. By 2014 the government hopes to form a competitive generation power market and gradually move towards a competitive wholesale market before 2022 (APERC, 2010a). The Law on Environmental Protection also calls for the state to encourage the development of renewable energy (Phuong, 2008).

Table 9: Key energy supply laws

Law	Date
Law of Electricity	2004
Strategy for Application of Nuclear Energy for Peaceful Purposes to 2020	01/2006/QD-TTg
National Energy Development Strategy	1855/2007/QD-TTg
Viet Nam Power Sector Development Strategy	176/2004/QD-TTg
Sixth Power Development Master Plan	110/2007/QD-TTg
Renewable Energy Action Plan	2001
Investment Law	2005

The government in 2002 established the Viet Nam Environment Protection Fund to provide financial support and incentives to projects reducing environmental degradation. The fund provides loans with favourable interest rates, lending interest support and financing and co-financing. It has operating capital of US$ 26 million, which is topped up by the central bank (GOV, 2002).

The Viet Nam Power Sector Development Strategy (176/2004/QD-TTg) encourages the promotion of renewable energy R&D and an increase in renewable energy capacity by limiting government investment to power plants with a capacity that exceeds 100 MW. This is intended to stimulate investment in smaller scale renewable energy infrastructure. The government is especially focusing on hydropower plants, with the ambition of developing 13,000 MW to 15,000 MW of hydropower by 2020 (APERC, 2010a).

The National Energy Development Strategy (2007) has also set a series of renewable energy objectives. The government has set targets to increase the renewable energy's share of total commercial primary energy by 3% in 2010, 5% in 2020 and 11% in 2050. The plan also aspires to connect the Vietnamese grid to regional transmission lines in 2010-2015 (APERC, 2010a). The Sixth Power Development Master Plan calls for the installation of 4051 MW of renewable energy capacity by 2025. This is broken down into 2451 MW from 2006-2015 and 1600 MW from 2016-2025 (Cuong, 2008). Vietnam also hopes to build its first nuclear plant in 2020 and to have nuclear contribute 10-15% of total power by 2050 (APERC, 2010a). The plant may be financed by Japan's bilateral emission reduction mechanism.

Electricity tariffs are in the process of substantial reform. In the past, the government employed a fixed tariff, but this inefficiently reflected electricity supply and failed to separate the cost components for generation, transmission, distribution and retail. As a result of these issues, an annual market-based tariff adjustment mechanism will begin to apply from 2010 onwards. The government also plans to gradually phase out the cross subsidies between industrial and residential tariffs. In order to stimulate investment in energy infrastructure, favourable tariffs and other financial incentives for BOT projects are negotiable with ERAV on a case by case basis, and foreign invested generators are offered long-term PPAs. In addition, the government has stated that it will grant all renewable energy projects PPAs (Tuan, 2010).

In 2008 the government also introduced an avoided cost tariff policy and standardized power purchase agreements for small renewable energy power plants. The avoided cost tariffs are

determined based on the cost of generating the most expensive kWh of power in the national grid. Only renewable energy power plants less than 30 MW or (60 MW if multiple micro-hydro plants on the same river) are eligible for the avoided cost tariff. Nguyen & Ha-Duong (2009) estimate that the tariffs could support the addition of 4400 MW of commercial renewable energy capacity.

One of the main drivers of these tariffs has been the expansion of rural electrification. The Renewable Energy Action Plan promulgated in 2001 encouraged rural electrification through the installation of renewable energy technologies. It is a two phase programme ending in 2010, with targets of 25-50 MW in Phase I and 3% installed capacity in Phase 2 (around 475 MW) (GTZ, 2009).

GOV provides tax incentives for new power installations during the first 15 years of operation (Norton Rose, 2010). In addition, there are incentives to encourage investment in new energy, including tax, fees and credit provisions, part of which are outlined in the Investment Law of 2005 (Phuong, 2008).

Energy efficiency – residential, commercial and industry

The government has introduced a number of initiatives to increase energy conservation in several different sectors. In 2003, the Vietnamese government released the Decree on Energy Efficiency and Conservation which aimed to promote energy conservation and efficiency in order to meet increasing energy demand. The decree applies to all sectors and regulates energy consumers that consume over 3 million kWh/year of electricity or 1000 tonnes of oil equivalent of energy (APERC, 2010b).

Table 10: Key energy efficiency laws

Law	Date
Decree on Energy Conservation and Energy Efficiency	102/2003/ND-CP
Law of Electricity	3rd December 2004
Law on Energy Efficiency and Conservation	17th June, 2010
National Strategic Program on Energy Saving and Effective Use 2006-2015 (VNEEP)	79/2006/QD-TTg
Vietnam Energy Efficiency Building Codes	No. 40/2005/QD-BXD

The National Strategic Program on Energy Savings and Effective Use (VNEEP), released by the MOIT in 2005 is a comprehensive energy efficiency and conservation program. It covers the period 2006-2015 and sets a goal of achieving energy savings of 5-8% relative to BAU of total energy consumption in the period 2011-2015. The first phase, which ended in 2010, set a target of saving 3-5% of total energy consumption relative to business as usual during phase 1 (APERC, 2010b). The program includes 6 components and 11 projects outline in Table 11 below.

Through the VNEEP, the government has allocated state funds to support specific energy efficiency projects. In 2007, around US$2 million of state funds were allocated to 28 energy efficiency projects registered under the VNEEP, of which a third was used to support two energy efficient lighting manufacturers. In 2008, a further US$2.25 million was allocated for 48 projects, including establishing an energy efficiency laboratory (Taylor et al., 2010).

Table 11: Key components of the National Strategic Program on Energy Savings and Effective Use (VNEEP)

Component	
1. State management and EE&C	• *Project 1* aims to complete the legislative framework on EE&C in industrial production, construction site management, domestic activities, and energy-consumed equipment.
2. Education and Information Dissemination	• *Project 2* focuses on raising public awareness about EE&C concerns and opportunities, • *Project 3* serves to integrate EE&C into the national education system, and • *Project 4* aims to develop pilot models for the "EE&C in households" movement.
3. High Energy Efficiency Equipment	• *Project 5* focuses on developing standards and energy use labels for selected products, and • *Project 6* provides technical assistance to domestic producers on how tocomply with energy-efficiency regulations.
4. EE&C in industrial enterprises	• *Project 7* develops EE&C management models in enterprises. • *Project 8* supports industrial enterprises in improving, upgrading, and optimizing technology aiming at energy savings and efficiency.
5. EE&C in buildings	• *Project 9* aims to improve the capacity for understanding EE&C issues and developing potential projects involving EE&C in building design and management. • *Project 10* focuses on developing pilot models for uptake of EE&C management activities in building operation.
6. EE&C in transport	• *Project 11* aims to foster optimal use of transportation facilities and equipment, minimize fuel consumption, and reduce discharge of air pollutants from transport systems.

Source: Taylor et al., 2010

In 2006, the Energy Efficiency and Conservation Office was also established as part of the Ministry of Industry and Trade (MOIT). It is responsible for developing organizations and systems to increase energy efficiency in government (APERC, 2010a). The Viet Nam Energy Efficiency Building Codes introduced minimum requirements for extensions and new buildings. Regulations are applied to the building envelope, outdoor and indoor lighting, air conditioning and ventilation and other power consuming equipment. The requirements vary depending on the size of the building (APERC, 2010b). However, Hieu (2010) suggests that standards and codes for buildings, which fall under the mandate of the Ministry of Construction, are old and could be renewed.

The National Assembly pass the Law of Energy Conservation and Effective Use in July 2010. Few details of this law are available at this stage as circulars under the law are still being drafted and are expected to be completed in June 2011 (MOIT, 2011). The Law would make it mandatory for 1200 industrial establishments to periodically report energy consumption, implement energy audits and invest in reducing their energy consumption (CTF, 2009). The Law is also expected to include mandatory performance standards and labelling for appliances which are to be gradually introduced (APERC, 2010b).

Forestry

Forests are a key component of the government's economic development policies. Deforestation in Vietnam has primarily been driven by the four following factors:

1. Demand for forest products, mainly furniture, from Europe, Japan and North America and other countries
2. Poor people in Vietnam's uplands use forests for fuel, construction products and agriculture
3. Increasing pressure on forest land for conversion to cash crops
4. Growth of hydro power and other infrastructure in forested areas

Inadequate forest management regulations and poor land tenure rights further exacerbate the impacts of these drivers, leading to substantial deforestation in the country (WBCFA, 2010b).

Table 12: Key forestry laws

Law	Date
Law on forest protection and development	2004
Strategy of Forestry Development of Vietnam for the Period 2006-2020	18/2007/QD-TTg
Policy on Payment for Environmental Services	99/2010/ND-CP

The Vietnam Forestry Development Strategy, approved in 2007, includes a number of objectives to increase the size of forested areas in Vietnam from 2006-2020:

- One million hectares of new plantation established by 2010 and a further 1 million over the next period
- Increase plantation forest area from 1.38 million hectares in 2005 to 2.65 million hectares in 2010 and 4.15 million hectares by 2020
- Afforestation of 1 million hectares of new land by 2010 and 1.5 million hectares in the next phase
- Scattered tree planting of 200 million trees per year
- Increase forest cover to around 43% by 2010 and 47% by 2020.
- Increase revenue from environmental value of forests to US$ 2 billion by 2020 (WBCFA, 2010b)

The government is also beginning to establish the policy framework required for reducing emissions from deforestation and degradation (REDD+) projects. In September, 2010, GOV issued a Decree on the Policy on Payment for Forest Environmental Services, which stipulates that carbon sequestration and conservation are considered forest services. This set an important legal foundation for the implementation of REDD+ projects in the country (FCPF, 2011).

Transport

GOV has largely focused on the development of mass transit systems to reduce emissions in this sector. The Law on Land Road Traffic provides that GOV adopts policies to prioritise the development of mass transit and limit the use of personal vehicles in big cities. To help reduce pollution from cars, in July 2008, Vietnam applied the EURO 2 Standard to all cars and motor vehicles, which provides acceptable exhaust limits for new cars. In addition, the Law on Environmental Protection states that all motor vehicles and motorbikes must comply with vehicle emission standards and be inspected and certified by the registry office before use. The Ministry of Transport and MONRE are mainly responsible for implementing this system (Phuong, 2008).

Table 13: Key transport laws

Law	Date
Strategy of Transport Development in Vietnam for the Period 2006-2020	206/2004/QD-TTg
Law on Land Road Traffic	2001

The government has initiated substantial investment in mass transit systems and has set the objective of increasing public transport from 10-15% to 50% of total passenger kilometres by 2020. Transport Master Plans also exist for Hanoi and Ho Chi Minh City (HCMC), which established targets of increasing the share of mass transit to 40-50% of total kilometre by 2020. The plans include 6 urban rail lines for HCMC and 5 for Hanoi (CTF, 2009).

Liquefied Petroleum Gas and Compressed Natural Gas are being piloted, but expansion of these programs will depend on the availability of supply. Petrovietnam is also leading a biofuels initiative with the objective of having 10% biodiesel and 10% ethanol blending by 2020 (CTF, 2009).

3.2. Carbon Markets

Clean Development Mechanism

The CDM is expected to play a large role in reducing emissions in Vietnam. At the beginning of April 2011, a total of 153 projects remain active and have the potential to reduce 9.8 Mt/yr. According to the UNEP Risoe CDM pipeline, 4 projects, which are expected to avoid 729 kt/yr, have issued a total of 4.5 Mt. A further 51 projects or 12.4 Mt have been registered, but have yet to issue CERs. The majority of projects (99) is at the validation stage and is expected to generate around 7.2 Mt/yr.

Table 14: registered CDM projects by sector

Type	# of projects	kt/year	Issued kt until 2010
Energy Supply	**43**	**1499**	**24**
Biomass energy	*1*	*40*	
Hydro – Existing dam	*1*	*4*	*1*
Hydro – New dam	*18*	*687*	*11*
Hydro – Run of river	*22*	*710*	*12*
Wind	*1*	*58*	
Forestry	**1**	**3**	
Reforestation	*1*	*3*	
Fugitive	**1**	**677**	**4,487**
Oil field flaring	*1*	*677*	
Waste	**10**	**944**	
Landfill power	*3*	*654*	
Waste water treatm.	*7*	*290*	
Total	**55**	**3,122**	**4,511**

Source: UNEP Risoe Centre, 2011

The 56 projects that have been registered are expected to reduce emissions by around 3.1 MtCO2/yr, which is less than 2% of emissions in 2005. CDM projects have largely targeted three sectors: waste, energy supply and fugitive emissions (see Table 14). A large fugitive emissions project is reducing emissions by around 0.7 Mt/yr from flaring at an oil field. There are 43 registered energy supply projects that are expected to reduce emissions by 1.5 Mt/yr. Forty of these projects are hydro power with only one biomass energy project and one wind power project. Projects in the waste sector could generate 0.9 Mt/yr, through landfill gas and waste water projects.

Voluntary markets

There are few voluntary emission reduction projects in Vietnam. No projects exist in the registries of the major voluntary offset standards: Planvivo, Climate Community Biodiversity Alliance, Gold Standard, Voluntary Carbon Standard, VER+. Awareness of the voluntary carbon markets is extremely limited in the country (Practical Action Consulting, 2009). There may be potential in certain sectors like forestry.

3.3. Multilateral funds

World Bank/Global Environment Facility

There are a total of 6 Global Environmental Facility projects in Vietnam that are either under implementation or have been completed. The GEF is providing US$ 33.5 million to the six projects, which are expected to reduce emissions by around 950 kt/yr. The grants are leveraging further financing of around US$ 661.8 million from the UNDP, the World Bank, the Vietnamese government, private sector and other international development agencies. One of the projects is targeting reductions of 242.9 ktCO2/yr through the development of an efficient public transportation system for Hanoi. Four energy efficiency projects are projected to abate emissions by 690.2 kt/yr in the residential and energy supply sectors. One of the projects is expanding the transmission grid to provide access to more efficient sources of power to rural areas. Two of the projects are being implemented by the UNDP and four by the World Bank.

Table 15: GEF and World Bank projects

	# of projects	kt CO2e/yr	GEF grant (Mn $)	WB loan (Mn $)	Other (Mn $)	Total (Mn $)
Energy Supply	**5**	**705.9**	**18.3**	**435.3**	**76.1**	**525.2**
Renewable energy	*2*	*591*	4.5	210.1	1.4	211.5
EE energy supply	*1*	*351*	5.5	5.2	8.5	19.2
EE lighting	*1*	*287*	3.0		12.4	15.4
EE transmission	*1*	*51*	5.3	220.0	53.8	279.1
Residential and commercial	**1**	**1**	**5.5**		**23.4**	**28.9**
EE commercial	*1*	*1*	5.5		23.4	28.9
Transport	**1**	**243**	**9.8**	**175.9**	**153.0**	**338.7**
Hanoi Urban Transport	*1*	*243*	9.8	175.9	153.0	338.7
Total	**7**	**1,524**	**33.5**	**611.2**	**252.5**	**892.8**

Source: GEF, 2010.

The GEF has also funded a number of projects focused on biodiversity conservation and sustainable management of protected areas that have also helped avoid GHG emissions, but no accurate figures are available. The GEF has allocated a total of US$ 20.5 million to completed and undergoing biodiversity projects, which has generated a further US$94 million in cofinancing. Livestock Waste Management has also been targeted by the GEF through its international waters focal area. A regional project received a grant US$ 7.7 million from the GEF and seeks to demonstrate and introduce waste management technologies to reduce environmental damage from livestock activities.

The GEF's small grants programme is also active in the country. In 2003 the GEF and World Bank initiated a US$1.1 million programme commercial energy efficiency programme for small businesses. The project is expected to leverage around US$ 7.5 million in private investment.

The World Bank is financing a separate project for a Renewable Energy Development Project, which is expected to reduce emissions by an estimated 574 kt/yr. The Bank is providing a loan of US$ 202 million and the project will address a number of barriers to the deployment of renewable energy technologies. The program is increasing access to credit to commercial banks, providing technical assistance to banks for RE investments and supporting regulatory and project pipeline development (CTF, 2009).

ADB

The ADB provides only limited information on the emission reductions that are expected to be generated by its projects. The organization also does not classify the projects based on their climate change qualities, making it difficult to determine which loans or grants are climate change related. Based on an analysis of the project database, an estimated US$ 1,118 million has been provided in loans and grants to projects that are likely to have directly or indirectly reduced emissions. A major focus of ADB projects has been on improving the transmission grid of the country's electricity network, with over US$ 630 million in loans and technical assistance allocated for this purpose. One project is expected to reduce emissions through the construction of hydro power plants and improvement of transmission network in remote areas of the country. Two forestry projects are also improving forestry management practices to reduce LULUCF emissions.

Table 16: ADB projects by type

Sector	# of projects	US$ million
Energy Supply	**6**	**981.3**
EE Transmission	*4*	*632.0*
Hydro	*1*	*196.8*
Renewable energy	*1*	*152.6*
LULUCF	**2**	**132.5**
Adaptation	**4**	**112.0**
Capacity Building EE	**2**	**4.2**
Total	**14**	**1,230.0**

Other Multilateral Activities

The European Investment Bank provided a framework loan to Vietnam signed in 2009 to support investments in energy efficiency and renewable energy. The loan, which totals €100 million, will be managed by the Ministry of Finance and allocated to four Vietnamese Banks to provide loans to renewable energy and energy efficiency projects (Europa, 2009).

A number of programs focused on reducing emissions from deforestation and degradation are also being undertaken in the country. Vietnam is a member of the UN REDD programme, from which it has received US$ 4.4 million in funding. The objectives of the project mainly focused on technical and institutional capacity building to manage REDD projects (UN REDD, 2009).

3.4. Bilateral aid

In the analysis of bilateral aid two key sources were used: a study by Michaelowa (2010) using data available from Aid Data and a database of climate change activities in Vietnam published by the World Bank among others.

According to an analysis of Aid Data (2010) by Michaelowa (2010), from 2002-2008, around US$ 26 million has been spent on climate change mitigation and adaptation projects. Germany has contributed 28% of total money disbursed to Vietnam. The majority of projects have been adaptation focused, which accounts for 67% of total spending.

Table 17: Climate change related bilateral aid 2002-2008 by donor and purpose

Type	Germany	Norway	Netherlands	Spain	Denmark	Others	Total
Adaptation	5.9	2.5	3.9	0.9	1.2	2.8	17.3
Mitigation	1.4	4.2	-	1.0	0.4	1.5	8.5
Adaptation & mitigation	-	-	-	-	0.1	-	0.1
Total	**7.2**	**6.7**	**3.9**	**2.0**	**1.6**	**4.3**	**25.7**

Source: Aid Data, 2010; Michaelowa, 2010;

Disbursements for mitigation projects largely targeted the waste sector, which received almost US$ 6 million. The majority of these projects were in the waste water and sanitation sector. Sixteen projects in the energy supply sector received around US$ 740,000 with around 40% of the money directed towards hydro power projects.

Table 18: Bilateral aid by sector

Sector	# of projects	Disbursement
Renewable energy	16	738,994
Industry	3	324,123
Waste	14	5,907,062
Transport	2	74,369
Total	**35**	**7,044,549**
Environment Protection	*2*	*345,546*
Capacity Building	*15*	*1,067,939*

Source: AidData, 2010; Michaelowa, 2010

A number of bilateral development agencies have been implementing projects in Vietnam in the last three years, but these programs have largely focused on technical assistance. The Agence Francaise de Development has provided ongoing support to the energy sector in Vietnam, including hydropower investments, electricity load management and DSM and energy access. The Danish International Development Agency recently approved a multiyear technical assistance program of around US$15 million to support MOIT's energy efficiency program that will support energy audit initiatives. The Japanese International Cooperation Agency provided technical assistance to develop a Study on National Energy Master Plan in Vietnam. The Swedish International Development Agency has provided a grant administered by the International Development Association to support energy efficiency efforts in Vietnam, largely focused on technical assistance (Taylor et al., 2010).

Germany through GTZ has initiated a project to develop a legal framework and build capacity for wind power development in the country. It has been allocated around US$ 1.4 million. Netherlands has also provided development assistance to create a market-oriented biogas industry (VUFO-NGO, 2010). A report supported by German bilateral assistance followed, which examined the viability of applying a Programme of Activities approach to biogas through the CDM (GFA Envest, 2009).

The Swiss State Secretariat for Economic Affairs (SECO) has been collaborating with UNIDO to establish a national focal point to promote and expand energy efficient industrial production through the Vietnam Cleaner Production Center (VNCPC). Phase I largely focused on capacity building, whereas phase 2 has aimed to make the VNCPC program financially sustainable. SECO has also established a trust fund, known as the Green Credit Trust Fund, under the VNCPC to provide partial credit guarantees and incentive grants for green projects undertaken by SMEs (Taylor et al., 2010).

The Swiss Agency for Development Cooperation (SDC) has promoted energy efficiency brick making through the Nam Dinh Urban Development Project and use of cleaner fuels in the Clean Air program[1]. SECO has also provided funding to the World Bank Renewable Energy Development Program.

A number of national development agencies have also provided aid targeting emissions from deforestation and degradation. Finland, Norway, Japan and the Netherlands have been particularly active in this space (VUFO-NGO, 2010). Finland and JICA are providing support for the development of forest reference levels a key factor for measuring emission reductions through REDD projects (FCPF, 2010). The Darwin Initiative of the UK Ministry of Environment is funding a pro poor REDD project run by SNV in Cat Tien district. It began in January 2010 and is expected to run for 3 years. The project will support local institutions to establish a monitoring facility that will compensate villagers for emission reductions (REDD Vietnam, 2011).

3.5. Overview

Table 19: Current abatement by sector and mechanism (kt CO2/yr)

Type	Carbon Markets	Multilateral	Bilateral[1]	
Energy Supply	**1499**	**1,280**	**74**	**2,853**
Biomass energy	*40*	*591*	*74*	*1,195*
Hydro – Existing dam	*4*			
Hydro – New dam	*687*			
Hydro – Run of river	*710*			
Wind	*58*			
Solar				
EE energy supply		*351*		*351*
EE lighting		*287*		*287*
EE transmission		*51*		*51*
Forestry	**3**			**3**
Reforestation	*3*			*3*
Fugitive	**677**			**677**
Oil field flaring	*677*			*677*
Industry			**32**	**32**
Residential and Commercial		**1**		**1**
EE commercial		*1*		*1*
Transport		**243**	**7**	**250**
Hanoi urban transport		*243*		*243*
Waste	**944**		**590**	**1634**
Landfill power	*654*			*654*
Waste water treatment	*290*			*290*
Total	**3,122**	**1,524**	**703**	**5.349**

[1]Bilateral emission reductions provides an indicative figure calculated by dividing amount invested by a carbon price of 10$/t.

[1] In sum, the Swiss development cooperation agencies have contributed up to 10 Mn USD for Vietnamese mitigation activities in the past. Therefore, Switzerland may be one of the main contributors to CC mitigation activities. However, neither the Vietnamese authorities (see expert interviews) nor the analysis by Michaelowa (2010) has acknowledged that.

Current emission reduction projects and programmes have largely targeted the energy supply, fugitive and waste sectors. Limited funding has been directed to address industrial, residential, commercial and agricultural emissions. Similarly forestry from an emission reduction standpoint has received little attention. Multilateral funding has been more effective at targeting the transport sector, whereas the CDM has been successful in the fugitive and waste sectors. This is largely due to factors that relate to undertaking CDM projects as a large number of credits can be generated through fugitive and waste projects.

Table 20: Current climate change finance (USD million) by source and sector

	Grants and subsidies				Loans		
	Carbon markets[1]	GEF	Bilateral	Total Grants	World Bank	ADB[2]	Total Loans
Agriculture							
Energy supply	15.0	18.3	0.7	**34.0**	435.3	981.3	**1,412.6**
Forestry	0.03			**0.03**		132.5	**132.5**
Fugitive	6.8			**6.8**			
Industrial			0.3	**0.3**			
Residential-commercial		5.5		**5.5**			
Transport		9.8	0.07	**9.9**	175.9		**175.9**
Waste	9.4		5.9	**17.3**			
Total	31.2	33.6	7.0	**71.6**	611.2	1,113.8	**1,725.0**

[1] Climate change finance for the carbon markets was calculated by using a carbon price of 10$/t;
[2]ADB figures include some grants.

4. Planned emission reduction actions

4.1. National actions and policies

The Vietnamese government associated itself with the Copenhagen Accord through the submission of its response on 31 March, 2010. In its letter it did not highlight any new Nationally Appropriate Mitigation Actions, but referenced its existing National Target Programme. It reaffirmed that the UNFCCC and Kyoto Protocol are the main legal frameworks and that future agreements must be guided by the principles of common, but differentiated responsibility. Furthermore it also reiterated that developed countries must lead emission reduction efforts, but that developing countries must also contribute towards mitigation through Nationally Appropriate Mitigation Actions.

Energy

Climate change policies in Vietnam are largely tied with initiatives being proposed by the International Financial Institutions (IFIs). The ADB has provided a grant of US$ 2.5 million for Viet Nam to develop renewable energy legislation and for capacity building (Norton Rose, 2010). MOIT is in the process of studying government options for a national renewable energy strategy. This may include creating a Renewable Energy Office. The government is also considering establishing new Energy Efficiency and Renewable Energy Funds (one of the ambitions of its CTF investment plan), which would form a part of wider Energy Efficiency and Renewable Energy Legislation. The funds would be capitalised through taxes on the consumption of fossil fuels (CTF, 2009).

New renewable energy legislation was further confirmed through Discussions with Nguyen Tuan, the Chief of the Power System development department of the Institute of Energy. He suggests that Viet Nam is in the process of drafting new renewable energy legislation. The Institute of Energy is finalising a report that it will submit to the government specifying two main policy options: a feed in tariff using a competitive bidding process or a portfolio standard. The scale and ambitions of these policies will depend on the objectives of the Vietnamese government. For instance, it remains unclear whether a potential feed-in tariff would only be extended to wind power and what level the feed-in tariff would reach (Tuan, 2010).

Forestry

Vietnam is also preparing a National REDD+ Programme. There has been wide consultation with stakeholders throughout the development of the Programme and seeks to consider all existing and future funding sources for current REDD+ projects. It has led to the identification of certain strategic options for addressing deforestation and degradation, which will provide the basics for a national REDD+ strategy (FCPFC, 2011). The FAO and the Finland Cooperation Programme, which is a member of the UN REDD programme, has also proposed a separately funded project on National Assessment and Long-term Monitoring of Forests and Tree Resources in Vietnam. It is awaiting approval by the government, but would last for around 3 years (REDD Vietnam, 2011).

Waste

Viet Nam is also in the process of developing a national waste management strategy. As part of the plan, the solid waste collection rate will be increased from 70% in 2003 to 80% by 2015 and recycling and reuse increased to 30% of total waste collected. By 2020 these targets will be increased to 95% and 40% respectively (IGES, 2009).

4.2. CDM

The majority of Vietnam's CDM projects have yet to be registered. A total of 102 projects are at this stage and are expected to generate 7. Mt/yr. With over 80 projects, energy supply accounts for two third of the total annual volume of CERs prior to registration. Hydro projects represent 97% of the CERs expected to be generated from future energy supply projects. Seventeen waste projects have yet to be registered and are expected to generate 2.2 Mt/yr, mainly through landfill gas and waste water projects. One coke oven gas project is projected to reduce emissions by 62 kt/yr.

Table 21: CDM projects in pipeline by sector (kt/yr)

	PDD developed, not yet registered		PDD development		Total	
Sector	**# of projects**	**Kt CO2/yr**	**# of projects**	**Kt CO2/yr**	**# of projects**	**Kt CO2/yr**
Energy Supply						
Biomass energy	*5*	*131*	*0*	*0*	*3*	*81*
Hydro	*78*	*5,067*	*2*	*357*	*78*	*5,424*
Wind	*0*	*0*	*1*	*11*	*1*	*11*
CO2 capture	*0*	*0*	*1*	*4,622*	*1*	*4,622*
Industry						
EE own generation	*1*	*62*	*0*	*0*	*1*	*62*
Transport						
Transport	*0*	*0*	*1*	*4*	*1*	*4*
Waste						
Landfill gas	*1*	*153*	*2*	*320*	*3*	*473*
Manure	*2*	*1019*	*1*	*16*	*2*	*1035*
Waste water treatment	*14*	*1014*	*1*	*34*	*12*	*1048*
Total	**94**	**7,452**	**9**	**5,364**	103	12,816

Source: UNEP Risoe Centre, 2011; Point Carbon, 2010

A further 9 projects are in the PDD development stage. Similar to projects prior to registration the majority of emission reductions are expected to come from the energy supply sector. One project is projected to reduce emissions by 4.6 MtCO2/yr through the capture and sequestration of emissions from gas fired plants.

4.3. Multilateral funds

World Bank/Global Environment Facility

Three GEF projects have been proposed in Vietnam, which are projected to reduce emissions by around 4.8 Mt/yr. One project could reduce emissions by around 1.8 Mt/yr through the introduction of efficient lighting technologies and the phase-out of incandescent lamps in the country. A further project is expected to abate 3 MtCO2/yr through energy efficient measures in the industrial, commercial and residential sectors including increasing the use of energy efficient appliances.

Table 22: Planned GEF projects by sector

	kt CO2e	# of projects	GEF grant	WB loan	Other co-financing
Energy Supply					
EE lighting	*1,811*	*1*	*2.4*	*50*	*51.5*
Industry					
EE Industry	*3,024*	*2*	*3.9*	*0*	*14.8*
Total	**4,835**	**3**	**6.3**	**50**	**66.3**

Source: GEF, 2010

Vietnam has also submitted a Readiness Preparation Proposal to the Forest Carbon Partnership Facility managed by the World Bank. The country is requesting a total of US$ 3.6 million from 2011 to 2013 largely to help develop an effective MRV system (FCPF, 2011).

Clean Technology Fund (CTF)

Viet Nam's Climate Technology Fund Investment Plan, a program under the World Bank's Climate Investment Funds, was endorsed at the end of December 2009 (CIF, 2009). A subsequent revision was submitted on May 2010, which reduced the number of programs from 5 to 4.[2] It is seeking US$ 250 million from the CTF to fund five programs outlined below. The CTF monies are set to mobilise a further US$ 1,145 from other development institutions and the government of Viet Nam, US$ 1000 million from the Private Sector and US$ 540 million from other co-financing. The initiatives are expected to result in the reduction of up to 10 Mt/yr (see Table 23).

Table 23: Funding for CTF programs

Program	Lead	Mt/yr	Financing (US$ million)					
			CTF	MDBs	GOV	Carbon Finance	Other Co-Financing	Private Sector
Industrial Energy Efficiency	ADB	1.8	50	40	25	10	40	100
Smart Grid Technology	IBRD	0.5*	30	180	100	0	0	0
Urban Transport	ADB	1.3	100	500	100	0	500	0
Clean Energy Financing Facility	IFC	4.8	70	200	0	0	0	900
Total		**8.4**	**250**	**920**	**225**	**10**	**540**	**1000**

*further 4.8 Mt/yr from small hydro enabled by the new grid technologies

A total of 4 programs are planned for Vietnam. An Industrial energy efficiency program will make high-cost EE investments more attractive through risk sharing facilities with commercial banks and loan guarantees. The program will mainly target waste heat recovery at 10 cement plants, but it will also address other sectors including co-generation in iron and steel and energy recovery from organic wastes. The investment plan estimates that 1.8 Mt/yr could be reduced per year through this measure. The replication of these energy efficiency technologies could result in further emission reductions of 7.8 Mt/yr. The CTF would also help catalyse and Energy Conservation Fund to support

[2] The cancelled program proposed to upgrade existing transmission lines with advanced composite core products and software to enhance system operations. However it was determined that more analytical work was needed to confirm the advantages of the technology and consistency with the CTF.

energy efficiency initiatives undertaken by ESCOs and provide low-interest working capital to ESCO-led projects.

The CTF is also addressing inefficiencies in Vietnam's transmission systems. It is providing funding to support the demonstration and deployment of smarter grid technologies at substations and the necessary network management infrastructure.

The CTF will fund the expansion of urban transport systems in Hanoi and Ho Chi Minh City. It will initiate a risk sharing facility and provide private sector support for around 500 MW of new renewable energy capacity. The capitalization of a renewable energy fund will help provide financing for the construction of a further 1,500 MW.

Bilateral

Vietnam became the 20th country to join USA's Environmental Protection Agency's methane to markets program. A project has been proposed that would implement a series of demonstration projects to introduce methane reducing technologies and practices for livestock waste management in pig producing centres. The EPA has provided US$ 75,000 and a further US$ 300,000 has been raised from other sources. A landfill gas project has also been proposed that would trap methane from the Phuoc Hiep Landfill in Ho Chi Minh City. A feasibility study has been prepared for the project (EPA, 2010).

4.4. Overview of planned abatement and financing

Table 24: Planned abatement by sector and mechanism (in Million tonnes of CO2 per year)

Sector	CDM	Multilateral	Total
Energy Supply			
Biomass energy	*81*	*4,800*	
Hydro	*5,424*		
Wind	*11*		
Solar			
CO2 capture	*4,622*		4,622
EE lighting		*1,811*	1,811
EE transmission		*1,000*	1,000
Industry			
EE own generation	*62*		62
EE industry		*4,824*	4,824
Transport			
Transport	*4*	*1,300*	1,304
Waste			
Landfill gas	*473*		473
Manure	*1035*		1,035
Waste water treatment	*1048*		1,048
Total	**12,816**	**10,235**	**23,051**

A significant scale up of emission reductions is targeted through efforts in the energy supply, industry and waste sectors. Based on the sources used in this study, limited effort is being undertaken in the agriculture, residential/commercial and forestry sectors.

Table 25: Planned climate change finance (USD million) by source and sector

	Grants and subsidies			Loans				
	Carbon markets	GEF	Total Grants	World Bank	ADB[1]	IFC	CTF	Total Loans
Agriculture								
Energy supply	101.4	2.4	**103.8**	180		200	100	**480**
Forestry								
Fugitive								
Industrial	0.6	3.9	**4.5**	50	40		50	**140**
Residential-commercial								
Transport	0.04		**0.04**		500		100	**600**
Waste	25.6		**25.6**					
Total	**128**	**6.3**	**134.3**	**230**	**540**	**200**	**250**	**1,220**

4.5. Remaining emission reduction potential

As examined in the previous two sections, several multilateral, CDM and government projects are targeting emission reductions across a diverse set of sectors. Yet even after considering current and planned emission reductions through these efforts, significant abatement potential still remains in Vietnam. Table 26 presents an overview of current and planned actions compared to abatement potential and suggests that only 12% of abatement potential has been harvested. Bilateral aid is excluded, as future climate-specific aid has not yet been allocated. Furthermore, policies without emission reduction estimates are not listed.

Table 14 illustrates that efforts in Vietnam have inadequately targeted abatement potential in the forestry, waste water treatment, residential and transportation sectors, but have been more effective in undertaking projects focused on renewable energy, industrial energy efficiency and energy efficient lighting.

Agriculture

Current and future emissions from the agriculture sector have not been effectively targeted by the CDM and multilateral organisations. Certain agriculture residues and wastes have been used for projects. For instance, one biomass CDM project is using rice husks for energy generation, and further biomass energy projects are at validation. Similarly, a project at validation will use manure to generate energy. However, other options for reducing emissions are still available. Improved water management techniques, such as midseason drainage or alternate wetting and drying, have the potential to reduce around 6.4 Mt/yr. The more effective application of nitrogen fertilisers could also help reduce emissions from agriculture by 3.4 Mt/yr (WBCFA, 2010b).

Further abatement potential exists through the use of biogas to replace cooking coal. The Netherlands has funded a program to create a market-oriented biogas industry, but an estimated abatement potential of 0.75 Mt CO_2/yr remains.

Energy Supply

The effectiveness of efforts in the energy supply sector have varied depending on the technology. Both the CDM and multilateral efforts have focused particularly on the deployment of hydro power throughout the country. Almost 6 Mt/yr is expected to be reduced through CDM projects in validation, it is unclear how many of these projects will actually be constructed. The World Bank Renewable Energy Development Program is largely targeting small hydro due to additional barriers faced by wind, bioenergy and solar. The expansion of small hydro has been slow due to persistent

barriers that the program hopes to address. Abatement opportunities in wind, bioenergy and solar show tremendous potential, but additional barriers to those faced by hydro make it even more difficult for these projects to get off the ground. The CTF's planned renewable energy fund will also play an important role.

Multilateral organisations are successfully targeting emission reductions through increasing the energy efficiency of the electricity transmission network and demand side management. No abatement potential figures are available for savings due to improvements in the grid and general EE supply side through demand side management. The GEF's lighting programs, though, are expected to result in emission reductions that exceed estimates of abatement potential in the sector.

The potential of carbon capture and storage is being explored by one CDM project. If completed it could reduce emissions by around 4.6 Mt/yr through the capture and storage of CO2. Jung et al. (2009) estimates that in total 20.92 Mt/yr could be reduced through these technologies, but such projects are very capital intensive and require significant investment in order to reach economies of scale. Nuclear power, which the government is considering as an alternative fuel, is similarly expensive and Jung et al. (2009) estimates that around 3.97 Mt/yr could be reduced by 2020.

Efficient coal technologies present tremendous potential in reducing emissions in Vietnam. The WBCFA (2009a) suggest that 16.6 Mt/yr could be reduced through these technologies. Multilateral agencies have not directly targeted the installation of these technologies, though they have financed coal plants that use more efficient processes in the country. The WBCFA (2009a) estimates that the adoption of supercritical boilers in 50% of new coal-fired power plants constructed between 2010 and 2012 and the adoption of subcritical technologies in the other half could reduce emissions by 8.2 Mt/yr and 6.6 Mt/yr respectively.

Forestry

The majority of abatement potential in the LULUCF is being captured through reforestation programs being undertaken by the government, as described in the National actions and policies section above. Estimates of these emission reductions are not available. Further mitigation potential may remain in the reforestation of mangrove forests, which the World Bank estimates could reduce emissions by 5.3 Mt/yr. The greatest potential exists through forest protection. The pilot REDD program initiated by UN-REDD will need to be expanded beyond capacity building, with the implementation of actual projects avoiding emissions from deforestation.

Industry (including fugitive emissions)

Planned programs by the GEF and CTF are likely to capture a large portion of abatement potential. The CTF will mainly target waste heat recovery at cement plants, but it will also address other sectors including co-generation in iron and steel and energy recovery from organic wastes to reduce emissions by around 1.8 Mt/yr. The World Bank estimates that 4.37 Mt/yr could be reduced in the cement sector alone. The GEF projects will target broader sectors and introduce energy efficient technologies in new and existing facilities. Abatement potential presented in the table below amounts to around 6.6 Mt/yr through initiatives in four sectors: Iron and steel, cement, paper & pulp and brick making. However, it does not include a further 70-80 MtCO2/yr[3] that Jung et al. (2009) estimate could be reduced through initiatives in other sectors. The GEF projects will help to harvest some of this, but significant potential in these other sectors remains.

[3] The number of 70-80 MtCO2 by Jung et al. (2009) is probably too high. While Jung et al. (2009) estimate an abatement potential of 211 MtCO2 in the energy sector alone, the abatement potential for the energy sector, given in Table 26, is only 119 MtCO2, and the projections by the GAINS model, 2010 (see Figure 2) are only 200 MtCO2 per 2020 for the energy sector.

Only one CDM project has targeted emissions in this sector through the recovery and use of gas in an oil field. Emissions from this sector could be reduced further through the recovery and use of gas in coal fields as well as undertaking further projects in oil fields.

Table 26: Overview of current and planned abatement (in kt CO2/yr)

	Current		Planned		Current & Planned	Harvested potential	Abatement potential
Sector	**CDM**	**Multi-lateral**	**CDM**	**Multi-lateral**	**Total**	**%**	**Total**
Energy Supply	**1499**	1,280	10,138	7,611	**20,528**	28%	74,291
Biomass energy	*40*		*81*				
Hydro	*1401*	*591*	*5,424*	*4,800*		*78%*	*15,840*
Wind	*58*		*11*				
Solar					**12,406**		
CO2 capture			*4,622*		**4,622**	23%	20,920
EE energy supply		*351*			**351**	NA	NA
EE lighting		*287*		*1,811*	**2,098**	>100%	880
EE transmission		*51*		*1,000*	**1,051**	NA	NA
Forestry					**3**	<0.01%	96,258
Reforestation	3				**3**	0.01%	44,833
Industry (with fugitive)	677		62	4,824	**5,563**	48%	11,609
EE industry			62	*4,824*	**4,886**	74%	6,559
Oil field flaring	677				**677**	13%	5,050
Residential and Commercial					**1**	<0.01%	2,610
EE commercial		1			**1**	<0.01%	2,610
Transport						11%	13,920
Transport		*243*	*4*	*1,300*	1,547	11%	13,920
Waste					**2,208**	22%	10,170
Landfill gas	*654*		*473*		1,127	56%	2,000
Manure			*1035*		1,035	NA	NA
Waste water treatment	*290*		*1048*		1,338	35%	3,870
Total	**3,122**	**1,524**	**12,816**	**10,235**	**25,803**	12%	219,675

Residential and commercial

Efforts in the residential and commercial sector have largely only targeted indirect emissions. Lighting projects initiated by the GEF will help reduce emissions by over 2 Mt/yr, but these emissions are emitted at the power source. A large number of Vietnamese households still use fuel wood, coal and other fuels for cooking. The introduction of biogas based fuels through the expansion of biogas programs, innovative coal stoves or LPG stoves could help reduce these emissions. As part of the Vietnam Clean Production and Energy Efficiency Project, the GEF in collaboration with GOV will help promote energy efficient appliances. However this project is largely focusing on industrial energy efficiency, therefore opportunities remain. The introduction of high efficiency air conditioners and refrigerators and solar water heating appliances could help further reduce indirect emissions from this sector.

Transport

Transport emissions in Vietnam are largely being reduced through the introduction of mass transport schemes in Hanoi and Ho Chi Minh City. Both the GEF and CTF have funded such programs. LPG and CNG are being piloted and biofuels are being introduced by Petrovietnam. These programs, which according to the abatement cost curve have the potential to reduce emissions by 1.78 Mt/yr, are likely to be expanded if piloting is successful and sufficient cost-effective supply is available. However, significant abatement potential still exists. The introduction of electric motor cycles in major cities across Vietnam could help reduce emissions by around 3.9 Mt/yr (Note this is based on one study and the impact from a GHG perspective could be substantially lower given the high emissions factor of Vietnam's grid. Furthermore electric motorcycles lack the power to carry more than one person which is common practice). Other low emitting vehicles could reduce emissions by a further 4.5 Mt/yr. Hybrid buses could be particularly interesting, which is being explored by the CTF programmes. A shift from road freight to waterways and railways could provide further emission reductions of 3.41 Mt/yr.

Waste

The CDM has successfully targeted emissions from landfill gas, although under half of the potential remains. Landfills in small cities and provinces have yet to be targeted by these programs (Hieu, 2010). Substantial opportunities still exist in reducing emissions from urban, rural and industrial waste waters, only under a quarter have been harvested. For instance, 75% of emissions from waste waters in the bioethanol, meat, pulp and paper, liquor and beer, tapioca starch and fishing processing industries could be reduced. Further abatement opportunities are possible through the composting of urban solid waste in large cities in Vietnam.

5. Barriers to implementation

For this part of the study, several persons were interviewed per phone, email or in personal, including;

- Mr. Nguyen Khac Hieu, Vice Chairman National Steering Committee for UNFCCC / Head of DNA Vietnam
- Mr. Ky Hong Tran, World Bank, Energy Specialist at the Vietnam Sustainable Development Unit
- Nguyen Tuan, Chief Power System Development Department, Institute of Energy MOIT
- Anh Nguyet Pham, World Bank, Sr. Energy Specialist Vietnam Renewable Energy Development Programme
- Dang Hanh, Vietnam Energy and Environment Consultancy Joint Stock Company
- Patrick Van Laake, Senior Technical Advisor UN-REDD Vietnam at UNDP

Furthermore, the literature has been reviewed. An extensive literature examining general barriers to the deployment of clean energy technologies in developing countries exists, but few studies examining these barriers in specific countries or specific sectors are available. As part of the Promotion of Renewable Energy, Energy Efficiency and Greenhouse Gas Abatement programme of the World Bank, institutional and policy barriers to clean energy technologies were analysed (PREGA, 2005). Lidula (2007) assesses barriers to renewable energy development across ASEAN countries. Nguyen et al. (2010) has examined in greater detail barriers to hydro, geothermal and efficient coal technologies in Vietnam using a series of interviews with experts.

Barriers are grouped into three main categories: financial, knowledge and regulatory barriers. Financial barriers mainly comprise of costs associated with the mitigation option and access to finance. Regulatory barriers relate to insufficient policy incentives to promote abatement actions or the presence of policies that hinder their uptake. Knowledge barriers mainly refer to inadequate capacity of various stakeholders implementing the mitigation activities.

5.1. General Barriers

Financial barriers (technology cost and risk)

A number of financial barriers are impeding the growth of abatement projects in Vietnam. Abatement technology sectors in Vietnam largely remain immature. There are few large domestic enterprises or technology providers engaged in many of the sectors where abatement is possible, which limits the natural growth of these sectors (Lidula, 2007 & PREGA, 2005). Commercial banks are also reluctant to provide financing to projects in immature markets due to the unproven nature of many of these technologies. Furthermore, commercial banks lack the qualifications to assess these projects and investors lack the financial and managerial capabilities required to drive projects to completion (Pham, 2011).

Key financial barriers
1. Immaturity of abatement technology market
2. Weak financial capabilities of commercial banks and investors
3. Inadequate infrastructure and remoteness of resources
4. Inadequate economic pricing system or incentives
5. Small size of resources and projects
6. Lack of funding

Inadequate infrastructure in Vietnam is also making it difficult for project developers to undertake projects in remote areas. This barrier is particularly important for hydro and geothermal (Nguyen et al., 2010). It is also itself a mitigation opportunity, as better transmission infrastructure can help reduce losses and more efficiently transmit electricity. Improved road infrastructure and mass transit systems will help to alleviate congestion in cities and lead to modal shifts.

The opportunity cost of abatement technologies also presents a significant financial barrier. Deficient government policies and incentives limit the ability of abatement technologies to compete with more cost-effective options or common practices. The small size of potential projects in Vietnam caused by for instance the size of a farm or industrial plant limits their financial attractiveness. This is particularly important in bioenergy, agriculture, certain industries and residential and commercial sectors (Hanh, 2011).

In many sectors, the lack of adequate funding is inhibiting the expansion of mitigation programs. For instance, REDD programs in Vietnam are underfunded, which makes it difficult for them to meet their objectives. Lack of funding is particularly important in new abatement sectors like REDD, wind and solar, where the regulatory framework and capacity are almost nonexistent.

Knowledge barriers (capability)

The availability of information is crucial in order to enable stakeholders to make appropriate decisions. Stakeholders in a number of sectors lack basic general information. This is particularly an issue for implementing energy efficiency mitigation options. For instance, a lack of comparable and reliable information on actual energy-use patterns of certain appliances makes it difficult for consumers to make informed choices (Taylor et al., 2010).

Key information barriers
1. Lack of general information on abatement technologies to make informed choices
2. Imprecise information systems on abatement potential
3. Lack of technical know-how and experience in management

Although several studies on abatement potential are available on Vietnam, greater granularity is required on certain technologies (Tran, 2011). For instance, data on other industries presented by Jung et al. does not facilitate informed decision making. Similarly, detailed studies on geothermal and wind potential have yet to be published (Nguyen et al., 2010 & Pham, 2011). A lack of information is also a major barrier for REDD projects (van Laake, 2011). This makes it difficult for stakeholders to determine where potential opportunities exist.

In certain sectors lack of technical know-how and experience in management is limiting the implementation of certain abatement options. This barrier is particularly pronounced in rural areas, where a lack of education, development and knowledge has limited mitigation in agriculture and forestry. This barrier is linked with the immaturity of many of these markets (Lidula, 2007 & Hanh, 2011).

Regulatory barriers

In a number of abatement sectors there is significant institutional overlap, with no clear division of authority. This makes it difficult for stakeholders seeking guidance or approval for a mitigation project (Nguyen et al., 2010). Even where adequate policies exist, corruption and poor implementation may reduce their effectiveness. Furthermore, many of the responsibilities in the energy, agriculture and forestry sectors have been devolved to the provincial level. Although this enables more local monitoring of projects, provincial governments lack adequate capacity and often fail to effectively implement regulations approved by the central government (van Laake, 2011).

Linked to this are inadequate policies in many abatement sectors. Vietnam has not set up clear regulatory frameworks to support clean energy development and it is still in the initial stages of drafting comprehensive renewable energy legislation. Policies and incentives are required to support these new industries. Electricity Vietnam (EVN), the government-owned utility in Viet Nam, is also financially constrained which limits its ability to purchase electricity at higher prices even though this is needed to incentivise renewable energy development (Nguyen et al., 2010).

Key regulatory barriers
1. Poor division of authority and coordination among government bodies
2. Insufficient policy incentives to promote abatement actions

In some cases where appropriate regulations are in place their effective implementation is inhibited by corrupt practices. For instance, in the forestry sector, deforestation still continues despite regulations limiting these practices (van Laake, 2011).

5.2. Barriers by sector

Agriculture

The barriers to increasing abatement potential in the agriculture sector depend on the specific mitigation option. The use of biomass energy is particularly limited by the availability of inputs. Food production is seasonal and therefore inputs are not available directly from farms year round. Storage is required in order for power to be produced constantly and this presents a significant barrier. Each input faces additional constraints: for instance rice husks are particularly expensive, whereas bagasse requires the addition of other feedstocks. Biomass energy is also limited by the low electricity tariffs in Vietnam, which will be explored in greater depth below. Part of the problem with feedstocks is the difficulty of collecting inputs from farms. In northern Vietnam, farms are particularly small making it logistically challenging to collect feedstocks from a large number of farms (Pham, 2011).

The large number of small farms presents a significant barrier for other types of abatement options in agriculture. Reducing emissions through water management and the more effective application of fertilisers have tremendous potential, but they require capacity building, training and education. Undertaking this task across the large number of farms in Vietnam is a serious challenge (Pham, 2011). This barrier is also pertinent for biogas programs.

Energy supply

The growth of renewable energy and efficient technologies in the energy supply sector has been limited by a combination of all three barriers. Vietnam's electricity tariffs and coal prices are very low relative to other markets. The electricity tariff level in Vietnam has fallen in real terms over the past several years, and was around VND 950/kWh (4.5 US cents/kWh) in 2009. This factor combined with low coal prices relative to other countries disincentivises investment in energy saving technologies (Taylor et al., 2010). The government has also kept uniform electricity prices across the country, which poses a significant barrier to local energy generation or efficiency projects in remote areas where electricity prices would likely be higher (Nguyen et al., 2010). The combination of these factors has made investment in clean energy unattractive to date.

Investors in clean energy often use cheaper technologies, which result in operation difficulties. Technical problems often arise after only a few years in operation. Furthermore, the clean energy industry remains very small. This means that there are few domestic suppliers of clean energy equipment making repair and replacement difficult and expensive.

Regulation in certain sectors has also impeded the uptake of certain technologies. Vietnam for instance has a large wind potential, but current electricity prices are not high enough to incentivise investment. Wind technologies are costly and thus an added feed-in tariff is required to make these investments attractive. New energy sectors like wind and solar therefore face a significant regulatory barrier.

Developers, operators, investors and financiers of clean energy lack the capacity to effectively implement projects in Vietnam. Many commercial banks lack the qualifications to assess clean energy projects. According to Nguyen et al. (2010), in some cases ineligible projects received loans from banks, whereas other qualified projects did not. Access to capital is a critical barrier to small hydro. Joint-stock companies, which are partly owned by the government, often expect interventions by the government rather than seeking their own financing. This makes it difficult for clean energy projects to get access to capital. Specific abatement potential information is also required in many new energy sectors. This is a particularly important barrier for the development of Vietnam's geothermal and hydro resources.

In the clean coal subsector justifying the use of more expensive energy efficient technologies is difficult, when the major driver of expansion is due to electricity shortages. It therefore makes sense to build more megawatts than more efficient megawatts. Clean coal technologies are also perceived as costly, unproven and unsuitable for Vietnam. Furthermore, there is limited experience with the implementation and operation of efficient coal technologies, discouraging their deployment (Nguyen et al., 2010).

Forestry

Reducing emissions from deforestation and degradation faces significant barriers largely to do with missing knowledge and funding. Forestry information systems in Vietnam are underdeveloped. It is even difficult in many areas to obtain recent maps of surrounding forests. This makes it difficult for stakeholders in the REDD sector to monitor Vietnam's forests and determine which forests are particularly under threat.

Technical capacity in government and the private sector is also a limiting factor. REDD projects require technical skills for instance to develop emission baselines and monitor project sites that are largely new to Vietnam. The private sector could provide support to the government and alleviate some of the pressure on these institutions.

Although Vietnam has improved its forestry regulations it still requires further development, which the National REDD Programme should help address. However, even with appropriate regulations, corrupt practices could limit the effectiveness of these policies. Key to this will be engaging the timber sector which has played a role in deforestation in the past. The UN REDD programme has begun to do this, yet more work is needed to help them understand the impacts that REDD will have on their access to timber.

REDD programs in Vietnam are underfunded, which makes it difficult for them to meet their objectives.

Industry

Energy efficiency improvements in industry face a number of interrelated barriers. Low electricity and coal prices limit the attractiveness of energy efficiency improvements. Higher energy prices would reduce the pay-back period making these investments more enticing. In a number of industries in Vietnam reducing operating costs is not always a main priority of managers even if it is profitable. Many will focus more of their efforts on expanding production and the introduction of new products.

Limited detailed information on abatement potential in industry has also constrained the expansion of mitigation projects. Abatement potential in this sector is very variable therefore having precise abatement information is a prerequisite to undertaking projects. Through the efforts of the GEF projects, Vietnam has developed a small but sustainable ESCO market. Some of them are beginning to provide financing and are looking to tackle bigger potential targets. However, the ESCO market remains small and technical expertise and awareness is still limited. ESCOs have mainly targeted food processing, textiles and some ceramics, whereas significant opportunities remain in cement and iron and steel (Tran, 2011). A lack of capacity at banks is also critical and is needed to help to deploy more capital in these sectors (Taylor et al., 2010).

Residential and commercial

Mitigation options in the residential and commercial sector have largely been limited due to financial and information barriers. Low electricity prices, as described in the energy supply section, do not incentivise the installation of energy efficient appliances in commercial and residential buildings. Although energy efficiency investments are still attractive, higher electricity prices would sharply improve returns (Taylor et al., 2010).

Residents and companies do not have the information required for them to make informed choices. Companies often do not recognise the potential energy savings in their businesses and the corresponding money they could save through better management and investment in efficient equipment. There is still a lack of comparable information on the energy use of appliances. VNEEP is helping to address this barrier, but in future years consumers will require more information on financing options for the implementation of such retrofits. Expanding the technical capacity of energy service companies for residential and commercial clients to enable them to undertake energy use audits, identify projects and sources of financing will also help harvest significant abatement potential (Taylor et al., 2010).

Transport

Abatement options in the transport sector are costly relative to other potential sectors. Mass transit systems are usually paid for by the government and large multilaterals. For instance, the expansion of bus and urban rail services in Hanoi and HCMC faces institutional and political economy barriers that require financial and regulatory incentives. Furthermore, the replacement of existing equipment is expensive and can involve large transaction costs. Low carbon technologies such as hybrid vehicles are much more capital intensive that existing options, even if they may reduce maintenance. Capacity building in government is also needed in order to create sustainable transportation plans and monitor ongoing projects (CTF, 2009).

Electric motorcycles in Vietnam have faced similar barriers that have limited their deployment to date. Residents show a distinct preference towards gasoline vehicles. The technology is limited by its speed, range and recharging time even though improvements have been made and these motorcycles have lower operating costs. Public education programs are needed to inform residents of the potential benefits of using these technologies. The upfront cost of the technology is also limiting its uptake, which could be addressed through appropriate policies (ADB, 2009).

Waste

A lack of incentives to appropriately manage wastes in Vietnam is a key barrier to adopting abatement technologies in the waste sector. Technical capacity amongst farmers is usually low, meaning it is difficult for them to seize on the opportunities in this sector. Regulations for municipalities and provinces, which could require the capture of methane at landfills or composting, are also missing.

6. Barrier removal and potential projects

In order for to limit the growth of Vietnam's emissions, the barriers impeding the expansion of abatement projects must be addressed. There are four main tools for the removal of barriers: the provision of finance, policies, technology transfer and capacity building.

Table 27: Tools to remove barriers

Type of Barrier	Tool to remove barriers
Financial barriers	Carbon credits, international public finance, or shift of domestic credit lines, investment risk reduction tools
Regulatory barriers	Change of national or sub-national policies
Knowledge barriers	Capacity building (targeted to specific audience groups)

6.1. Removing national barriers

The National Target Programme is primarily focused on building capacity and addressing adaptation to climate change in Vietnam. An ambitious mitigation programme in conjunction to this would bring significant benefits in coordinating and targeting the implementation of emission reduction efforts. This could take the form of submitting NAMAs to the UNFCCC. **A single approach would help reduce overlap and confusion amongst competing initiatives in each sector and funding could be funneled through one source**. A panel assessing the overlap of projects would help allocate funding more efficiently and identify where gaps exist. Detailed information systems on abatement potential of existing and planned plants at the national level and managed by the government could also help.

The existing National Target Programme is underfinanced and requires additional funding. An ambitious mitigation programme would need further sources of money. Encouraging private sector development across all sectors will help to share the burden, as long as appropriate policy support is present.

6.2. Removing sectoral barriers

Agriculture

Existing agriculture programs can be used to disseminate water management and fertilizer application techniques. **Working with the Ministry of Agriculture (MARD) could also help establish education and training programs**. Funding will be needed to teach farmers these practices, but savings due to lower fertilizer use may encourage the replicability of these programs. A PoA for biogas projects could also potentially be used for agricultural residues, yet technical and monitoring capacity will be needed to register such a project through the CDM. Expanding SNV's biogas programme could help manage agriculture wastes in smaller farms and a PoA for such a programme could be suitable. Common collection points for larger farms could be used to provide feedstocks for biomass power plants. Initial subsidies could encourage these projects, leading to lower input costs over time as farmers realize the economic benefits from these wastes. This in conjunction with a higher electricity tariff could encourage these types of facilities.

Energy supply

The key mechanism for overcoming barriers in the energy supply sector will be the continuation of the current reform of electricity tariffs. The introduction of the avoided cost tariff was a step in the right direction, yet prices still remain too low to provide sufficient incentives for energy producers to build clean energy plants and users to reduce their energy consumption. A potential **feed-in tariff for**

wind and other renewable energy technologies would be very effective in encouraging the growth of these sectors. Multilateral finance could be used to help subsidize such a program.

Efforts by the CTF and the Renewable Energy Development plan will help alleviate technical and financial capacity constraints amongst project developers, government, investors and financiers. Funding gaps though remain. **Promoting local R&D and establishing joint ventures with foreign companies in conjunction with capacity building programs** would be an effective way of increasing technical know-how and build a local clean energy market**.** This could potentially be achieved through the establishment of a joint R&D centre that collaborates with foreign and local companies and universities.

Targeting subsidized loans from multilaterals for clean coal plants would help catalyse the construction of more efficient power facilities.

Forestry

Vietnam is still in the early stages of preparing for REDD implementation. Therefore the focus at this stage should be on capacity building. **REDD initiatives require additional funding in order to build the technical capacity of the government and national, provincial and local levels.** Better information systems at the national and local level are required to help target projects and monitor forests. The **development of a national REDD programme** that effectively coordinates the multitude of REDD initiatives will be important to ensure that funding is used efficiently.

Developing the capacity of the private sector could also help reduce the requirements on MARD and MONRE. A project in Da Lat, for instance, used university students to raise awareness about REDD. Opportunities in the REDD sector will incentivise the formation of new companies, but capacity building in the private sector at this stage could be effective in more rapidly catalysing this outcome.

Industry

Higher energy prices, like in the energy supply sector, would be a very effective means of encouraging the adoption of energy efficient technologies and the use of waste energy. This combined with the implementation of the new Law on Energy Conservation and Efficient Use will help provide the legislative foundation for increasing energy efficiency in industry. It is important to align the design of regulations and their rollout with the government's own capacity to assist in their implementation. **Building the capacities within industry to institute energy management programs in certain enterprises and the banning of wasteful equipment will be particularly effective** (Taylor et al., 2010).

A more detailed study of abatement potential and projected growth of various industries would help understand in which sectors opportunities remain. Considering energy security concerns in medium and long term industrial development planning will help reduce energy consumption of new plants. **Expanding Vietnam's small ESCO market to new industries and increasing their capacity to provide finance would encourage the adoption of energy efficient technologies across multiple sectors.** Training and education programs in each sector on abatement options would help encourage industry stakeholders to undertake energy savings. Providing innovative financing mechanisms for many of these technologies would be effective.

Many of the barriers in industry are beginning to be addressed by new programs from the CTF and GEF. As these efforts proceed, assessments of their effectiveness will help identify in which sectors potential opportunities remain.

Residential and commercial

The Law on Energy Conservation and Efficient use will help to establish regulation for the introduction of energy efficiency standards for equipment used in the residential and commercial sector. The main initiatives undertaken so far are on the dissemination of CFLs, initial market labeling, testing protocols and a local testing facility. **The extension of labeling to more appliances and the establishment of promotional programs through retail stores will help sustain recent gains.** Aggressive marketing and education programs can help inform consumers of the cost-effectiveness of energy efficient appliances.

Studies on consumer purchasing behavior can help inform market transformation programs undertaken by the government, which will require upfront investment. The expansion of the local testing facility will help provide more reliable labeling information to consumers across a wider array of appliances. Bulk procurement can help bring costs down or consumer subsidies could help expand markets for energy efficient appliances. These subsidies will be particularly effective in the introduction of appliances such as solar water heaters.

Training of small businesses producing and selling energy efficient cook stoves would be very effective. Such training followed by a public awareness campaign would help introduce these technologies that have been successful elsewhere.

Transport

The CTF will provide adequate funding to help expand mass transit systems in the two major cities in Vietnam. **Capacity building to enforce fuel standards that were recently introduced will help improve the efficiency of motor vehicles.** Vehicle inspection and maintenance programs could also be used to promote the early retirement of inefficient vehicles (Taylor et al., 2010).

Information programs demonstrating the advantages of using electric motorcycles could help in the deployment of this technology. Initial tax incentives or financing schemes may increase the attractiveness of these technologies to consumers. Raising sales taxes and registration fees at the point of purchase for gasoline scooters would be one effective mechanism. **Reducing gasoline subsidies** throughout Vietnam would further increase the cost-effectiveness of electric scooters, yet may be politically resisted. The government could also adopt e-scooters, which would help stimulate initial market penetration (ADB, 2009).

Local technology development and innovation would also help bring down costs of e-scooters and increase speed, range and acceleration. **Strengthening intellectual property protection and lowering barriers to market entry would provide incentives to technology developers.** The establishment of an industry association that helps to regulate the quality of scooters would help to overcome negative perceptions of this means of transportation (ADB, 2009).

Waste

The carbon markets have driven the majority of emission reductions in this sector to date. **Developing a programme of activities would be an effective way of undertaking projects in managing wastes in the agriculture and industrial sector**. Capacity building programmes for farmers would also help them realise the economic potential of using wastes to produce composts that can be reapplied to their fields. Regulations mandating the disposal of municipal solid waste either through landfill energy or composting would help reduce emissions from landfills in provincial cities (Hieu, 2010).

7. Conclusions & recommendations for SECO

The **government of Vietnam has made significant progress in adopting legislation to provide a suitable footing for adaptation and mitigation programs**. Its National Target Program to respond to climate change is building capacity to tackle the problems of mitigation and adaptation. The country has also passed renewable energy and energy efficiency regulations that will begin to curb its emissions. As Vietnam's greenhouse gas emissions have increased, it **has become a preferred target of emission reduction projects and programs financed by multilateral and bilateral agencies and the carbon markets**. Multi-lateral agencies are collaborating with the government to tackle emissions across major emitting sectors.

Despite these efforts, significant abatement potential in Vietnam remains. **Based on available data, existing and planned projects are only likely to harvest 12% of available abatement potential in the medium term (2015-2030).** This suggests that a scale up of emission reduction programs in the country is possible.

Several further projects have been identified through this study. At the national policy level an **ambitious mitigation programme in conjunction to the existing National Target Program would bring significant benefits in coordinating and targeting the implementation of emission reduction efforts**. A single approach would help reduce overlap and confusion amongst competing initiatives in each sector and funding could be funneled through one source. A panel assessing the overlap of projects would help allocate funding more efficiently and identify where gaps exist.

At the sector level, **several potential programmes** would target areas where little or inadequate efforts have been undertaken to date and would work well with existing initiatives.

1. Technical **capacity building for emerging REDD+ private sector companies** that reduce pressure on government and stimulate market development
2. Capacity building program on **water management in rice cultivation** in conjunction with the Ministry of Agriculture and Rural Development (MARD)
3. Wind policy assessment examining experiences with feed-in tariffs and capacity caps
4. **An efficient cook stove program**, including testing of stove types, training of producers and vendors, quality labels and a public awareness initiative
5. **Expand the labelling to more appliances** in the residential and commercial sectors.
6. **CDM Programmes of Activities (PoAs) linked to agricultural wastes, industrial waste water treatment or composting/landfill gas** projects in small provincial cities across the country
7. Technical Needs Assessment in industrial energy efficiency in conjunction with existing CTF and GEF programs
8. **ESCO capacity building in iron & steel and cement sectors**
9. Funding a local R&D program and **supporting joint ventures with foreign companies on abatement technologies**
10. **Review of electricity tariff** and cost-benefit analysis of different methods for encouraging clean technology market development
11. Strengthening intellectual property protection and **lowering barriers to market entry for low-carbon technology providers in the transport sector.**

The Vietnamese government has made climate change a clear priority. However, unless further investment, capacity building and regulation are implemented, Vietnam's contribution to climate change will increase to its own detriment.

A number of limitations exist in this study. The availability of data for bilateral aid projects and some multilateral agencies is limited. Furthermore, forestry and agriculture projects are poorly covered as

most projects in this space are not undertaken to reduce emissions but are instead pursued for other socio-economic benefits. In addition, **much of the funding that the Vietnamese government has directed towards climate change projects receives limited treatment in this study due to the availability of data.**

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