

CLIMATE INVESTMENT FUNDS

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CLEAN TECHNOLOGY FUND INVESTMENT PLAN FOR THAILAND

Proposed Trust Fund Committee Decision

The Trust Fund Committee reviewed document CTF/TFC.IS.1/5, *CTF Investment Plan for Thailand*, endorses the plan and agrees to the further development of the activities foreseen in it. The Trust Fund Committee agrees to an envelope of up to USD 300 million in CTF funding to finance the plan.

Clean Technology Fund Investment Plan for Thailand

Executive Summary

Introduction

1. This Clean Technology Fund Investment Plan for Thailand proposes CTF co-financing of \$300 million to support Thailand's goal of increasing the share of alternative energy to 20 percent by 2022 and implementation of the Bangkok Metropolitan Authority's target of reducing the city's greenhouse gas (GHG) emissions below currently projected levels in 2012 by 15 percent. Specifically, the Investment Plan proposes CTF co-financing for catalyzing private sector investments in renewable energy and energy efficiency through the government's Specialized Financial Institutions and private commercial banks as financial intermediaries, as well as direct investments in renewable energy and energy efficiency by state-owned electric utilities as part of a clean energy advancement program. The Investment Plan will also support urban transformation through CTF co-financing bus rapid transit and building energy efficiency in Bangkok as a part of a comprehensive urban GHG reduction action plan. The CTF investments will mobilize financing of more than \$4 billion from the government, multilateral development banks, carbon finance and private sector.

Country and Sector Context

2. Thailand is one of the foremost development success stories in Asia, with decades of sustained growth and impressive poverty reduction. Energy consumption and electricity demand have closely followed economic growth over the past 25 years. The annual average growth rate for final energy consumption over the last 25 years was 6 percent, while electricity consumption grew even faster at 9 percent. Per capita electricity consumption grew by almost 25 percent in the past five years. Thailand's economic output per unit of energy has declined by over ten percent between 1996 and 2004. The driving forces for greater energy (and carbon) intensity are industrial development and increasing demand for transport fuels.

3. Major new investments in the power sector and introduction of new generation technologies will be needed to satisfy continued economic growth. Most of the new capacity will come from more than doubling the amount of coal-fired generation and increasing by two-thirds the amount of gas-fueled power plants, with a view to reducing reliance on imported natural gas and increasing the share of local coal and lignite.

4. Thailand's GHG emissions grew at an annual rate of about 2 percent per year between 1994 and 2003. In 2006, energy-related GHG emissions were 272 million tons of CO₂-equivalent, placing Thailand as the 24th largest emitter globally. GHG emissions from fossil fuel sources have been growing at three percent per year, mostly due to consumption of petroleum products. The largest contributors to Thailand's emissions are electricity generation (37 percent), transport sector (26 percent), and manufacturing (23 percent). Thailand's transport sector is dominated by road, both in terms of passenger and freight.

For example, car ownership in Bangkok rose at an 8 percent average annual rate between 1999 and 2007.

5. Bangkok is the center of economic activity and engine of growth in Thailand and is projected to account for almost 50 million tons of CO₂-equivalent by 2012. The metropolitan region accounts for 42 percent of the country's total fuel consumption. With per capita GHG emissions of 10.6 t Co₂-equivalent, Bangkok's residents generate more emissions than the global average for city dwellers. Per capita GHG emissions for Bangkok residents from ground transportation are relatively high when compared to many other global cities. This results largely from the fact that, on average, Bangkok is less dense than other East Asian cities, and its urban form is currently locked in by its urban transportation system.

Priority Sectors for GHG Abatement

6. Thailand's development policies and strategies have increasingly focused on GHG reductions and improved energy intensity. The Tenth National Economic and Social Development Plan (2007-2011) seeks to cap CO₂ emissions per capita at 3.5 tCO₂/person, below current levels of 3.8 t/CO₂/person. The Government has also recently announced the 15-year Alternative Energy Development Plan (AEDP) which lays out the country's long-term vision and strategic direction for reducing dependence on fossil fuels.

7. The AEDP identified four areas of alternative energy development to achieve the 20 percent alternative energy share target by the year 2022:

- Increasing the share of power generation from renewable sources by Small Power Producers and Very Small Power Producers (accounting for 2.4 percent)
- Increasing the share of thermal power from renewable sources (7.6 percent)
- Promoting the use of biofuels, including ethanol, biodiesel and hydrogen for transportation (4.1 percent)
- Promoting the use of natural gas for vehicles (6.2 percent)

8. Implementation of this program could yield total potential annual GHG reductions of 42 million tCO₂ by 2022. Substantial investment will be needed to add the 4000 MW of new renewable power generation capacity needed to reach AEDP's target of 5,608 MW. The private sector is expected to take on most of these investments; the public sector investments will mainly focus on small hydro and solar.

9. In the transport sector, implementing a comprehensive array of technology and policy interventions in the freight, inter-city passenger, and urban transport sub-sectors could result in annual GHG emissions savings of 13 million t CO₂-equivalent by 2025. Improving the integrated mass transit system in Bangkok would have the highest energy savings potential in the sector.

10. Bangkok is one of the few cities in the world which has developed a city-wide climate change strategy, as articulated in the Bangkok Metropolitan Authority's Action

Plan on Global Warming Mitigation 2007-2012. The Plan consists of five initiatives with the objective of reducing carbon emissions per person from current annual levels of 7.7 tons/person to 5.5 tons/person:

- Expand Mass Transit and Improve Traffic Systems
- Promote the Use of Renewable Energy
- Improve Electricity Consumption Efficiency
- Improve Solid Waste Management and Wastewater Treatment Efficiency
- Expand Park Areas

11. The transformative aspect of this urban initiative is that Bangkok will be the first city in a CTF-eligible country to launch a GHG mitigation program based on a credible and verifiable baseline, with a matching, Government-supported action plan. Re-developing the urban fabric through changes to land use planning supported by transportation infrastructure will be an essential element of BMA's Action Plan.

Rationale for Selected Sectors for CTF Co-Financing

12. The following priority activities are proposed for CTF co-financing:

- A. Clean energy advancement through complementary public and private sector initiatives that contribute to the ambitious national renewable energy targets set by the AEDP*
- (a) Catalyzing clean energy investments through the Specialized Financial Institutions (SFIs). CTF support is proposed for selected public SFIs to lend to renewable energy projects which are large in number, but small in size. The financial facility will focus on lending to small to medium scale biomass, solar, wind and other renewable energy projects, with an estimated new capacity of 374 MW.
- (b) Advancing public investments in clean energy through public utilities -- the Electricity Generating Authority of Thailand (EGAT) and the Provincial Electricity Authority (PEA). CTF funding is proposed for three public investment programs: (i) EGAT's renewable energy investments as identified in EGAT's Alternative Energy for Electricity Strategy (2008-2022), resulting in 220 MW of new renewable energy capacity; (ii) PEA's forest residues biomass investment program, resulting in 100 MW total capacity; and (iii) PEA's program for efficient lighting for national highways and public spaces, with annual electricity savings of 325 GWh, or about 25% of annual consumption of electricity for street lighting.
- (c) Clean energy advancement through private commercial banks. CTF support is proposed for renewable energy, energy efficiency and cleaner production across the industrial, commercial and residential sectors. Key components will include a risk sharing facility to provide partial credit guarantees to cover local banks' new portfolio of clean energy loans, a mezzanine finance facility to promote lending to developers of smaller renewable energy projects, and providing equity/finance to support developers of large-scale renewable energy projects.

B. Urban transformation through support to the comprehensive GHG reduction program of the Bangkok Metropolitan Authority

- (a) Bus Rapid Transit as part of an integrated urban transport system. CTF co-financing is proposed for construction of selected priority BRT routes as part of an interlinking network of 14 BRT routes throughout the city totaling more than 250 km. The investment program would feature pedestrian and bus connections with mass transit lines, as well as introduction of hybrid bus technologies. The BRT system would also seek to transform the bus sector in Bangkok, which has seen a steady decline in ridership in recent years, through new investments, modern operating practices and through “congestion cutting” priority afforded by BRT.
- (b) Improving City Energy Efficiency. CTF support is proposed to co-finance energy efficiency investments in BMA facilities and public spaces, covering 20,000 square meters with a target to reduce BMA’s electricity bill by 30 percent and serve as a model for commercial buildings in Bangkok and other municipal and provincial facilities throughout Thailand.

13. *Potential for GHG reduction:* The activities under the public and private sector clean energy program will result in estimated GHG emissions reductions of about 4 million tons CO₂-equivalent per year when the programs are fully implemented. The urban component would result in direct cumulative emissions savings of about 11.8 million tons of CO₂ equivalent over a ten-year project life.

14. *Demonstration potential:* The CTF public sector clean energy program is expected to directly finance around 700 MW of new renewable energy installed capacity, which would be equivalent to 18 percent of new capacity required to meet AEDP targets. The remainder of the 4,000 MW target represents the replication potential resulting from the wide-scale demonstration of successful business models and substantial expansion of lending to renewable energy (RE) in the local public and commercial banks’ lending portfolios. By demonstrating the technical and commercial viability of renewable energy projects – and lowering technological and financial risks for all market players – the proposed investment program is expected to firmly establish clean energy as a business line and thereby transform the financial sector.

15. By contributing to the BMA’s integrated plan in reducing GHG emission, the program would demonstrate the effectiveness of a comprehensive, programmatic approach to reducing GHG emissions on a mega-city scale. As such the program could serve as a potential role model for many mega-cities. Bangkok now ranks as the 32nd among the world’s largest cities in terms of population; 18th among Asian cities. Bangkok is already a world leader on the municipal climate change stage, and could have a significant demonstration effect by implementing high quality BRT services and good urban design and small scale investments to upgrade walk-in and cycling catchments, as well as connections to other modes of transport.

16. Thailand and Bangkok are also seen as regional leaders for introducing new ideas, technology and thus transformation induced by low carbon growth of Thai economy will also help promote these concepts in the region more broadly.

17. *Development impact:* The most important co-benefit is diversification of power production in Thailand away from reliance on coal and gas. Adding 4,000 MW of renewable power production will increase energy security and reduce the need for imported petroleum products for power production. Grid-connected renewable power will also help to reduce losses in the distribution system and improve the stability of PEA's rural distribution network. Small-scale RE development has strong local economic and social benefits given its strong linkage with poverty reduction, livelihoods improvement and productive use. A study conducted by PEA as part of project preparation estimated that communities could generate around US\$ 70,000 additional income per year by collecting the wood residues necessary to supply a district-scale biomass power project. Other co-benefits might include more affordable and reliable power supply and opportunities for local productive use of electricity.

18. A BRT network integrated into the existing public transport system including the mass transit rail system will drastically improve the mobility of low-income households through access to better and more affordable transport services. The effectiveness of BRT systems at creating accessible urban jobs for outlying low-income households has been proven in dozens of cities around the world. BRT is also expected to relieve severe congestion problems in Bangkok. Co-benefit of reduced air pollution in congested Bangkok is also expected to be significant (in the range of more than US\$ 100 million per year).

19. *Implementation Potential:* The SFIs have strategic policy direction to expand and diversify more into RE business lines from its traditional business lines but still lack implementation capacity in and familiarity with this new business area. EGAT and PEA have lengthy experiences in the power sector and strong technical and organizational capacity for implementation. For the urban component, BMA is the sole organization at the local authority level for the welfare of Bangkok and it has a strong vision for maintaining the competitiveness of Bangkok. BRT is simpler, less expensive and quicker to implement than other mass transit systems in Bangkok, although the BMA faces challenges in mobilizing financing and coordinating multiple national and local agencies involved.

20. *Additional costs and risk premiums:* While clean energy technologies are generally proven, project performance (including operation and feedstock management) in the long run still needs to be proven. At the same time, financial barriers need to be addressed to ensure developers' access to funds. Commercial banks are currently reluctant to lend because of both technological risk and perceived risks about projects. Without CTF co-financing to help overcome key barriers to scaling up investment in RE and EE projects, large scale clean energy investments will take a much longer time to materialize or will proceed on a smaller scale.

21. Under a business-as-usual scenario, BMA would find it risky to invest in a comprehensive network of several BRT lines when the BRT has not been successfully piloted in Thailand. BRT is however proven in many other cities around the world and an important lesson learned is that BRT will have the highest chance of success when implemented as a network rather than a single line. In addition, given budget and organizational constraints of BMA, it is unlikely that BMA could allocate sufficient budget determined on a yearly basis to finance the whole network in the short term. Concessional financing from CTF will support the scale of investment needed to prove the efficacy of a comprehensive BRT network that is integrated with other modes of transport and which introduces hybrid bus technology.

Table 1: Results Indicators for the Clean Energy Advancement – Public Sector Component

| Baseline | Results Indicator | Expected Program Results and year |
|--|---|--|
| 1,699 MW in 2008 (including hydro) | Installed renewable power production in Thailand (Biomass, Wind, Small Hydro and Solar) | 700 MW of new renewable power projects added by 2012 |
| Emissions in the power sector were 82 MtCO ₂ e per year in 2007 | Annual GHG reductions from power generation | 1.6 MtCO ₂ e per year by 2022 |

Table 2: Results Indicators for Clean Energy Advancement – Private Sector Component

| Project Components | Total Investment Mobilized | GHG Emissions Reduction (tons / Year) |
|-----------------------------|----------------------------|---------------------------------------|
| Risk Sharing Facility | \$270 Million | 700,000 |
| Mezzanine Finance | \$600 Million | 1,250,000 |
| Scaling Up Renewable Energy | \$450 Million | 833,000 |
| Capacity Building | N/A | N/A |
| Total | \$1,320 Million | 2,783,000 |

Table 3: Results Indicators for Urban Transformation Component

| Project Component | | Results | Investments Mobilized (\$ million) | CO ₂ reduction (million t) |
|-------------------|--|--------------------------------------|------------------------------------|---------------------------------------|
| Component 1 | Urban Transport: Integrated Public Urban Transport | Construction of priority BRT routes. | 1,218.0 | 1.16 |
| Component 2 | Energy efficiency: Reduce Building Electricity Consumption | 30% energy savings | 48.7 | 0.02 |
| Total | | | 1,266.7 | 1.18 |

Table 4: Indicative Financing Plan (\$ millions)

| Financing Source | Clean Energy Advancement – Public Sector | Clean Energy Advancement – Private Sector | Urban Transformation | Total |
|---------------------------|---|--|-----------------------------|--------------|
| | Annex 2 | Annex 3 | Annex 4 | |
| CTF | 160 | 70 | 70 | 300 |
| GoT/Counterpart | 956 | - | 1,127 | 2,083 |
| IBRD loans | 160 | - | 70 | 230 |
| IFC loans | | 270 | - | 270 |
| Private Sector | 400 | 980 | - | 1,380 |
| Total | 1,676 | 1,320 | 1,267 | 4,263 |
| Carbon Finance Potentials | 191 | 60 | 116 | 367 |

ABBREVIATIONS AND ACRONYMS

| | |
|---------------------|---|
| ADB | Asian Development Bank |
| AEDP | Alternative Energy Development Plan |
| ALGAS | Asia Least-Cost Greenhouse Gas Abatement Strategy |
| BMA | Bangkok Metropolitan Administration |
| BMR | Bangkok Metropolitan Region |
| BRT | Bus Rapid Transit |
| BTS | Elevated light rail transit, BTS Sky Train |
| CDM | Clean Development Mechanism |
| CNG | Compressed Natural Gas |
| CTF | Clean Technology Fund |
| DEDE | Department of Alternative Energy Development and Efficiency |
| EAF | Electric Arc Furnace |
| ECP | Energy Conservation Promotion |
| ECPF | Energy Conservation Promotion Fund |
| EE | Energy Efficiency |
| EGAT | Electricity Generating Authority of Thailand |
| EPPO | Energy Policy and Planning Office |
| ESCO | Energy Service Company |
| ERC | Energy Regulatory Commission |
| FIO | Forest Industry Organization |
| GHG | Greenhouse Gas |
| GoT | Government of Thailand |
| HID | High Energy Intensity Discharge |
| IBRD | International Bank for Reconstruction and Development |
| IFC | International Finance Corporation |
| IP | Investment Plan |
| KTOE | Kilotonne of Oil Equivalent |
| LDD | Land Development Department |
| LULUCF | Land Use, Land Use Change and Forestry |
| MOEN | Ministry of Energy |
| MRT | Mass Rapid Transit underground heavy rail system operated by MRTA |
| MRTA | Mass Rapid Transit Authority |
| MtCO ₂ e | Million tones of carbon dioxide equivalent |
| NESDB | National Economic and Social Development Board |
| NSCCM | National Strategy for Climate Change Management |
| ONEP | Office of Natural Resources and Environmental Policy |
| PEA | Provincial Electricity Authority |
| PIN | Project Identification Note |
| RE | Renewable Energy |
| SPPs | Small Power Producers (SPPs) |
| SFIs | Special Financial Institutions |
| TGO | Thailand Greenhouse Gas Management Organization |
| TNESDP | Tenth National Economic and Social Development Plan |
| VSPPs | Very Small Power Producers |

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I. INTRODUCTION

1. The Clean Technology Fund (CTF)¹ Investment Plan (IP) is a “business plan” owned by the Government of Thailand (GoT) in agreement with the International Bank for Reconstruction and Development (IBRD), the Asian Development Bank (ADB) and the International Finance Corporation (IFC). The objective of the Plan is to support the low-carbon objectives contained in the Tenth National Economic and Social Development Plan 2007-2011 (TNESDP), the National Strategy on Climate Change Management (2007-2012) (NSCCM), the Fifteen-Year Alternative Energy Development Plan (2008-2022) (AEDP), Transport for Thailand’s Sustainable Development, and Bangkok Metropolitan Administration Action Plan on Global Warming Mitigation 2007-2012. This multi-year business plan identifies the proposed programs to be co-financed by the CTF jointly with the IBRD, ADB and IFC. The IP is to be presented to the CTF Trust Fund Committee in December 2009.

2. The IP is considered a **dynamic document**, with the flexibility to consider changing circumstances and new opportunities. Such flexibility is particularly important during the current period of uncertainty associated with the current global economic conditions and financial markets. In addition, some of the programs proposed for financial support by the CTF have not yet been fully defined. Some programs presented in the annexes to the IP will be further refined over the coming year, and additional programs may be added and presented for CTF consideration in the form of an updated Investment Plan. Some internal reallocation of CTF funds may also be proposed based on further analysis and country’s evolving circumstances and/or needs.

II. COUNTRY AND SECTOR CONTEXTS

3. **Thailand is one of the foremost development success stories in Asia, with decades of sustained growth and impressive poverty reduction.** In the decade that ended in 1995, the Thai economy was one of the world’s fastest-growing at an average rate of 8-9 percent a year. After recovering from the Asian Crisis of 1997-1998, the Thai economy took off again, with growth averaging 5.7 percent in the period 2002-2006. As a result of this sustained growth, poverty fell from 42.0 percent in 1988 to 8.5 percent in 2007. Recently, however, Thailand’s economic growth has been slowed because of weak private consumption and investment demand, due to political uncertainty as well as the current global financial crisis. This deceleration in growth threatens some of the recent poverty

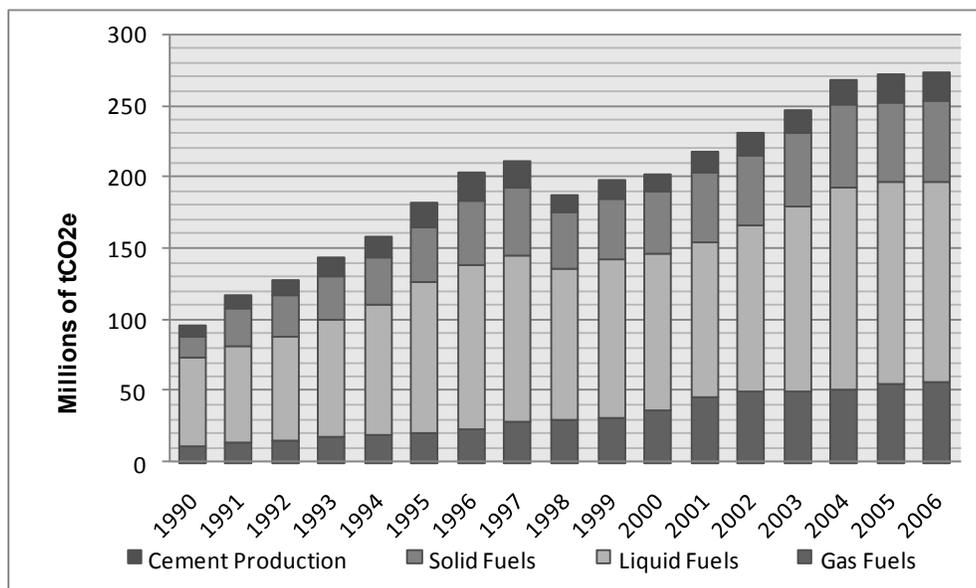
¹ The Clean Technology Fund (CTF) invests in projects and programs that contribute to the demonstration, deployment and transfer of low carbon technologies with a significant potential for long-term greenhouse gas emissions savings. The CTF Trust Fund Committee oversees the operations of the Fund. The World Bank (IBRD) is the Trustee of the Fund.

reduction gains. The country's key energy use indicators from 1996 to 2007 are presented in Annex 1.

4. **The benefits of this success have not been shared equally in Thailand, with some regions—particularly, the rural south and northeast—lagging behind the rest of the country.** Although these regional disparities are a natural part of the development process, the challenge for the authorities is to promote inclusive development through economic integration.² This will mean developing policies and programs to connect the fast growing urban areas with lagging regions and to target interventions toward the poorest areas of the country.

5. **Thailand's emissions have been steadily increasing, placing Thailand among the top 25 GHG emitting countries.** Between 1994 and 2003 Thailand's Greenhouse Gas (GHG) emissions grew from 286 MtCO₂e to 344 MtCO₂e - an annual rate of about 2 percent.³ More recently, with continued economic expansion, a growing population, and increased dependence on more carbon-intensive fossil fuels, GHG emissions continue to grow. Particularly, GHG emissions growth from fossil fuel source has been growing at three percent per annum, mostly in the form of petroleum products (See Figure 1). According to the latest data from the Energy Information Administration, US Department of Energy, energy-related GHG emissions of 272 MtCO₂e in 2006 placed Thailand as 24th among the World's largest GHG emitters.

Figure 1: Thailand's CO₂ emissions from fossil fuels



Source: Carbon Dioxide Information Analysis Center (<http://cdiac.ornl.gov/ftp/trends/emissions/tha.dat>)

² This is the theme of the 2009 World Development Report (WDR)—Reshaping Economic Geography—that: (i) highlights the unbalanced nature of economic growth which results in geographical disparities; and (ii) stresses the need for spatially targeted interventions to ensure more inclusive development.

³ Department of Alternative Energy Development and Efficiency (DEDE).

6. **The largest contributors to Thailand’s GHG emission are the electricity generation and transport sectors.** In 2006 more than a third (37 percent) of GHG emissions stemmed from the energy sector. The second largest GHG emission contributor was the transport sector (26 percent). The manufacturing sector accounted for almost another quarter (23 percent) of emissions, followed by the residential and commercial sectors (See Table 1).

Table 1: GHG Emissions by Sector

| Sector | 2002 | | 2006 | |
|----------------------------|--|--------|--|--------|
| | 1,000 tonnes of CO ₂ Equivalent | % | 1,000 tonnes of CO ₂ Equivalent | % |
| Transport | 48,110 | 29.29% | 48,388 | 26.32% |
| Electricity | 63,542 | 38.69% | 68,849 | 37.45% |
| Manufacturing | 37,198 | 22.65% | 42,207 | 22.96% |
| Residential and Commercial | 5,514 | 3.36% | 14,254 | 7.75% |
| Others | 9,872 | 6.01% | 10,162 | 5.53% |
| Total | 164,236 | 100% | 183,859 | 100% |

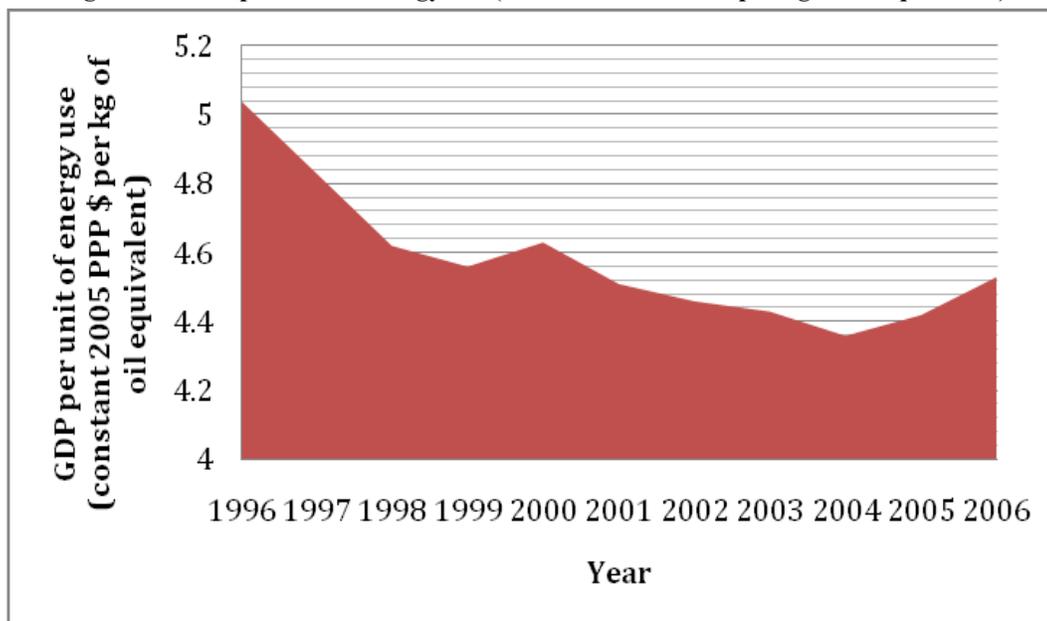
Source: Calculated based on Department of Alternative Energy Development and Efficiency data.

Note: GHG emissions shown here included CO₂ and CH₄. The conversion factors used are based on IPCC 1996 revised guideline. The emissions of other greenhouse gases excluded in this figure are negligible compared to the total.

7. **For Bangkok, energy and transportation sectors together produce 84 percent of the city’s GHG emissions.** Without major efforts to transform how energy is consumed in the country’s largest urban area like Bangkok, future GHG emissions for Bangkok alone are projected to grow to almost 50 million tCO₂e by 2012. Further, Bangkok leads Thailand and the region and unless low carbon technologies are successfully introduced here for these sectors, it will not be easy to convince the rest the region.

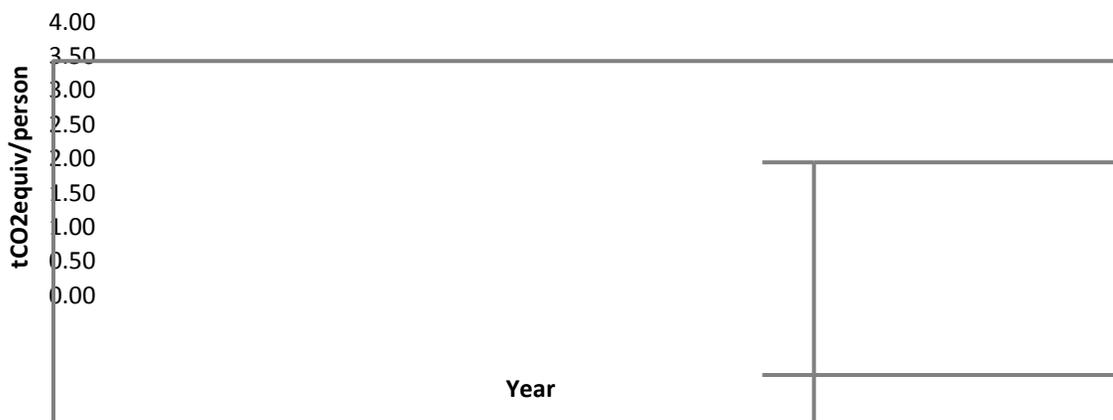
8. **Thailand’s economic output per unit of energy use has declined by over ten percent between 1996 and 2004, the period when the country was recovering from the 1997 economic crisis.** Although the trend since 2004 has shown slight improvement in efficiency of energy use mainly reflecting the response to higher global oil prices, it is not clear whether this trend will sustain in the long run (See Figure 2). The GDP per unit of energy use in 2006 was 4.5. GHG emission per capita has risen over the same period, from 2.5 tCO₂e to almost 3.8 tCO₂e (See Figure 3). Both trends suggest that the Thai economy has become more energy and carbon intensive. The driving forces for greater energy/carbon intensity are industrial development and increasing demands on transport fuel.

Figure 2: GDP per unit of energy use (constant 2005 PPP \$ per kg of oil equivalent)



Source: World Bank , The Little Green Data Book 09,

Figure 3: Per Capita CO₂ Emissions in Thailand



Source: Energy Information Administration, International Energy Annual 2006

9. **Thailand has voluntarily reduced its GHG emissions through the implementation of the Clean Development Mechanism.** As a non-Annex I country, Thailand is not mandated to limit or reduce its GHG emissions under the Kyoto Protocol. However, the country has voluntarily reduced its GHG emissions under the Clean Development Mechanism (CDM). Twenty four projects have been registered at the UNFCCC Executive Board with an estimated total emission reduction of 1.7 MtCO₂e per year.⁴

⁴ Data from <http://cdm.unfccc.int/Statistics/Registration/NumOfRegisteredProjByHostPartiesPieChart.html> on August 18, 2009

10. **Development policies and strategies have increasingly focused on GHG reductions and improved energy intensity.** The GoT has taken several steps to address development challenges while promoting a low carbon growth path. **The Tenth National Economic and Social Development Plan (“TNESDP”), 2007-2011**, approved by the Government in September 2006, is Thailand’s strategic framework for addressing its medium term development challenges. The TNESDP reflects changing attitudes towards development resulting from the globalization experience of the mid-2000s. The Plan maintains the priorities identified previously—i.e. human and social capital, competitiveness, poverty and inequality, and natural resources and the environment—while adding governance as a new priority. The Plan seeks to cap CO₂ emission per capita to 3.5 tCO₂/person, well below current level. Other initiatives, policies and strategies to tackle climate change and reduce energy intensity include:

- On June 20, 2007 the Office of the Prime Minister (OPM) took responsibility for **overall regulation of Climate Change Management in Thailand**. The OPM appointed the National Committee on Climate Change policy, which is chaired by the Prime Minister. The secretariat has been set up at the Office of Natural Resources and Environmental Policy (ONEP) within the Ministry of Natural Resources and Environment.
- **The Cabinet also adopted Thailand’s first National Strategy for Climate Change Management: NSCCM (2008-2012)** on 22nd January, 2008, together with policy frameworks for further development of action plans. In this strategy, the country commits itself to reducing GHG emissions on a voluntary basis.
- **The Ministry of Natural Resources and Environment** drawing from authority under the Promoting Enhancement and Conservation of Environmental Quality Act (1992) has announced the Policy and Prospective Plan for Enhancement and Conservation of National Environmental Quality (1997-2016). ONEP is the national focal point for UNFCCC. **The Thailand Greenhouse Gas Management Organization (TGO)** was established in 2007 and is the Designated National Authority for Thailand.
- **The Ministry of Energy (MOEN)** has been promoting energy conservation since 1992 based on the Energy Conservation Promotion Act (1992). In 2009, MOEN announced **the Fifteen-Year Alternative Energy Development Plan (AEDP)**, which sets a target to increase the share of alternative energy from 6.4 percent in 2008 to 20 percent in 2022. If the target is achieved, it will help Thailand avoid the addition of 42 MtCO₂e GHG emissions per year.
- **The Ministry of Transport** issued the white paper “**Transport for Thailand’s Sustainable Development**” in 2007, with the vision of developing the country’s transport systems to reach higher quality and efficiency in service deliveries resulting in a better quality of life, and sustainability for the country. The primary objective of this paper is to lay down a firm foundation for future development of Thailand’s multi-modal transportation system.

- In 2008, the **Bangkok Metropolitan Administration (BMA)** launched its **Action Plan on Global Warming Mitigation 2007-2012** with a target to reduce the city's emission by 15 percent or 6.4 MtCO₂e per year.

2.1 ENERGY SECTOR

11. **Thailand's energy consumption and electricity demand has closely followed GDP growth over the past twenty five years.** Both grew steadily from 1982 to 2007 other than some disruptions following the Asian financial crisis. The annual average growth rate for final energy consumption over the last 25 years was 6 percent, while electricity consumption grew at an even faster rate of 9 percent. In 2007, primary energy consumption reached 110,106 Kilotonne of Oil Equivalent (ktoe) while electricity demand topped 133,000 GWh. Electric peak demand has grown at 8 percent since 1986, reaching 22,586 MW in 2007. Per capita electricity consumption of 161 kWh in 2007 grew by almost 25 percent over just the last five years (See Figures 4 and 5).

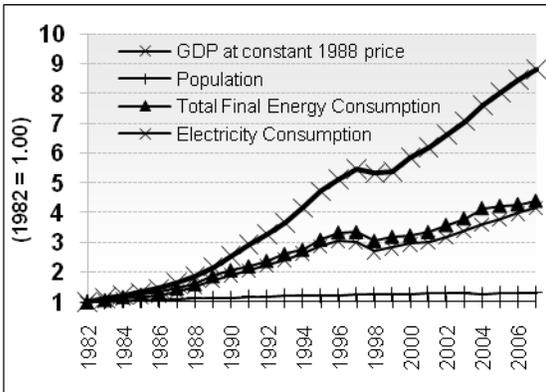
12. **Major new investment in the power sector and introduction of new generation technologies will be needed to satisfy continued rapid growth.** As of 2008, installed capacity of the national grid was 29,139.5 MW consisting of gas-fired (68.6 percent) and coal-fired (13.4 percent) power plants with the balance provided by hydropower and imports (See Figure 6).⁵ The latest Power Development Plan (2008 – 2021) forecasts an annual average growth rate of 5 percent over the next decade.⁶ Additional capacity of 30,154.8 MW by 2021 will need to be added to the grid to accommodate this growing demand.⁷ Most of the new capacity will come from more than doubling the amount of coal-fired generation (4,000 MW), and increasing by two-thirds the amount of gas-fueled (14,890 MW) power plants. By 2012, Thailand plans to better diversify its energy mix and avoid heavy reliance on the finite resource of local natural gas. The dominance on natural gas, which is imported from abroad will be reduced by 52 percent, while increasing the share of coal and lignite from local sources. There will be more diversification via fuel imports, other thermal sources, and potentially the first nuclear power plant in Thailand.

⁵ Source: Ministry of Energy.

⁶ Power Development Plan (2008-2021), 2nd revision.

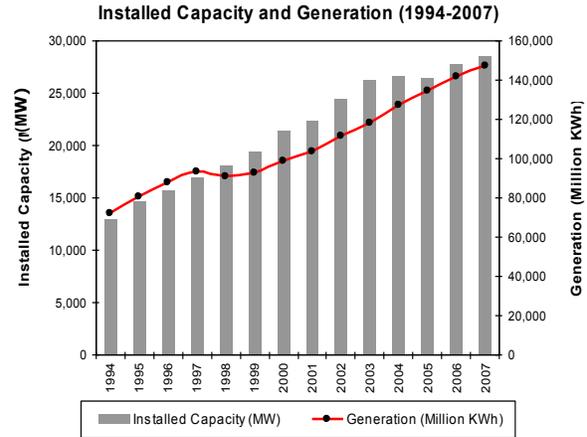
⁷ Installed capacity as of December 2008 was 29,140 MW. Net addition of 30,154.8 MW has taken into account total retired capacity of 7,502.3 MW (Power Development Plan (2008– 2021)).

Figure 4: Trends of Final Energy Consumption, Electricity Consumption, GDP and Population in Thailand, 1982-2007



Source: Calculated based on data from Bank of Thailand and Department of Alternative Energy Development and Efficiency.

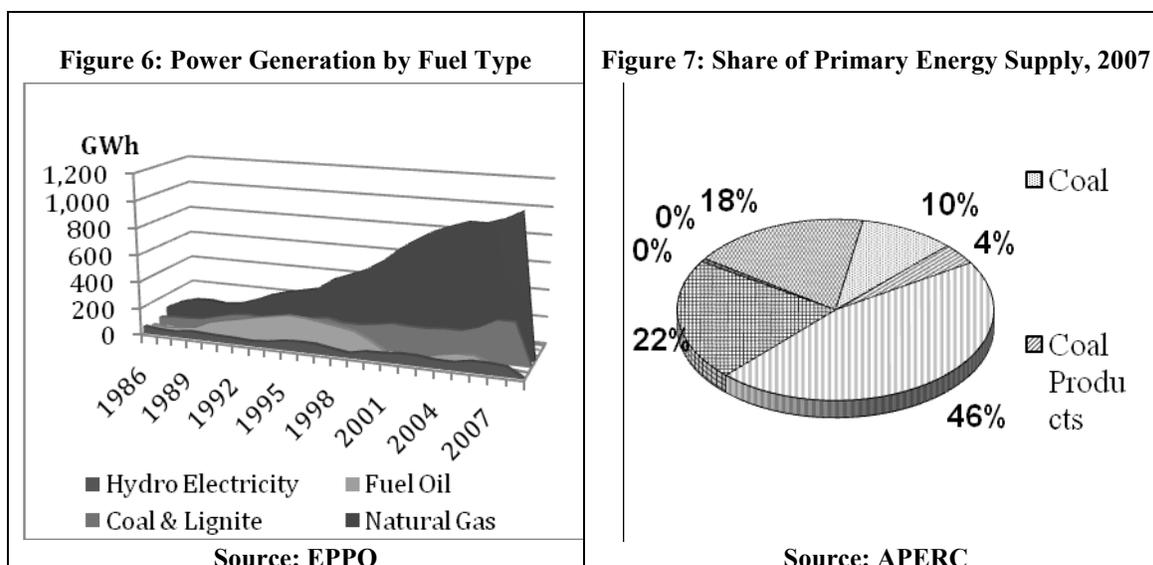
Figure 5: Installed Capacity and Power Generation in Thailand



Source: EPPO 2007

13. **With demand expected to continue growing to serve economic growth, Thailand faces supply constraints.** Thailand relies heavily on fossil fuels for all its energy and transport needs (See Figure 7). More than half of primary energy supply is imported, with crude oil accounting for over 70 percent of total imports, mostly for transport and industrial use. Electricity generation relies mainly on natural gas and coal, with the latter generating high GHG emissions. In 2008, 92 percent of total power generation came from fossil fuel sources, mostly natural gas (71 percent) with significant coal and lignite (21 percent). Electricity generated from Renewable Energy (RE) sources such as biomass, wind, and solar comprise a very small share of the generation mix, only 1.7 percent in 2006. Thailand's energy supply is also vulnerable to future supply constraints. Proven and possible reserves of natural gas are only sufficient to cover forecast gas demand for the next 26 years.⁸ Proven and possible reserves for coal will be available for much longer – an estimated 110 years. However, most coal reserves in Thailand are lignite with high sulfur content and low calorific value. Further development of coal-fired power generation faces numerous challenges, including local community resistance, local air pollution concerns, and of course, high GHG emissions.

⁸ According to the Department of Mineral Fuels.



14. **Energy demand and GDP growth need to be de-coupled through greatly improved efficiency of energy use in Thailand.** The reduction in GDP per unit of energy use and increase in GDP per capita over the past decade is an unfavorable trend from the viewpoint of sustainable development. The close link between GDP growth and energy demand growth means that total energy intensity, defined as total final energy consumption per unit of GDP, remains high, despite the availability of more energy efficient technologies. Several factors contribute to this trend including structure of economic activities, institutional barriers and pricing signals which might not adequately provide incentives for the market to shift to more energy-efficient technologies. Manufacturing/mining and transport are the two biggest consumers of energy, each consuming over 35 percent of the total in 2006. Industry is also the largest consumer of electricity with a 45 percent share, followed by commercial and residential at 32 percent and 21 percent, respectively.

2.2 TRANSPORT SECTOR

15. **The transport sector is a major consumer of imported fossil fuels and a big contributor to GHG emissions.** Petroleum products account for half of the total final energy consumption in Thailand. Over 70 percent of petroleum products were consumed by the transport sector, and most of these were derived from imported crude oil. Light liquid petroleum products (gasoline and diesel fuels) accounted for almost all of the energy consumed by the transport sector in 2006. The remaining portion (less than one percent) consisted of electricity for rail-based BTS Sky Train and underground Mass Rapid Transit (MRT) in Bangkok and natural gas for CNG vehicles, which have been actively promoted as an alternative energy use. Diesel fuel consumption in transport accounted for approximately half of the sector's total energy consumed in 2006.

16. **Thailand's transport sector is dominated by road, both in terms of passenger and freight.** The majority of transport fuel consumption takes place in and around Bangkok. Urban and rural motorization rates have also been growing. The overall trend of car ownership in Bangkok rose at an 8 percent average annual rate between 1999 and 2007. Rail plays a small and declining role in both freight and passenger transport, despite investment in the BTS and MRT. The high reliance on road modes, a limited role of rail and the growing motorization rate all suggest that transport will continue to be a main consumer of energy in the future.

2.3 URBAN SECTOR

17. **Bangkok is the center of economic activities and engine of growth in Thailand.** Bangkok has a population of over 6.5 million. The city and the five neighboring provinces form the Bangkok Metropolitan Region (BMR), with a population of over 10 million, which accounts for 16 percent of the national population. The BMR contributes around 42 percent of the national GDP.⁹ Rapid development and economic growth in Bangkok are driven largely by the private sectors on the basis of free market, which are open to both foreign and domestic investors, entrepreneurs and workforce. The city has a strong competitiveness with its strategic location, well-established commercial centers and blooming service economy. The productivity and livability of Bangkok will be important for the growth of the national economy and improvement of quality of life.

18. **The Bangkok Metropolitan Administration (BMA)** is organized in accordance with the Bangkok Metropolitan Administration Act 1985, to be responsible for the management of the city of Bangkok. It is **the sole organization at the local authority level responsible for the well-being of Bangkok residents** with financial support from the central government.

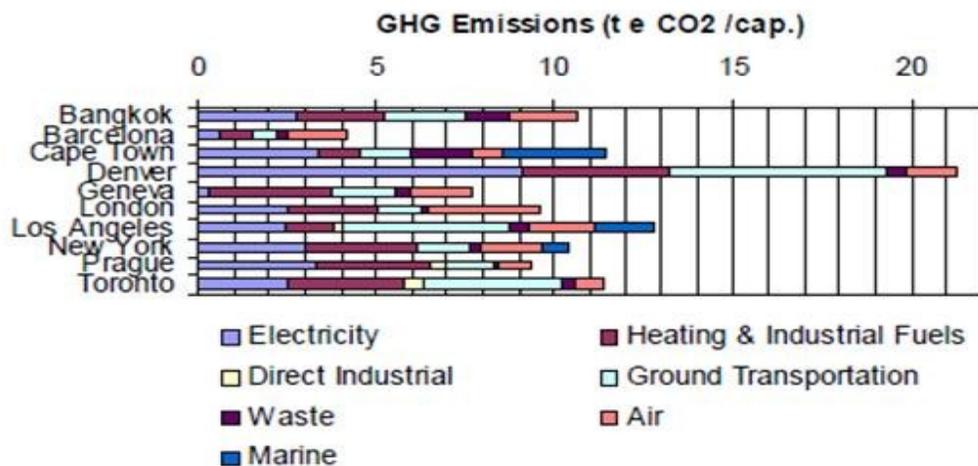
19. **As the city grows, it is facing several pressing challenges to its livability and productivity.** The city's physical development over the last few decades has been rapid but also posed major challenges in planning and coordination. The provision of basic urban services has been adequate but further improvement is needed to achieve the city's vision of a world class city. BMA's ability to manage land use, transport and environment is improving but many challenges remain to be addressed. Problems related to planning in the metropolitan region are exacerbated by the largely independent, uncoordinated actions by numerous national agencies and local governments in the BMR.

⁹ Gross Regional and Provincial Products 2007, the Office of National Economic and Social Development Board. <http://www.nesdb.go.th/Default.aspx?tabid=96>

20. **Energy consumption is concentrated in the BMR and directly contributes to the city’s GHG emissions.** Thirty-two percent of total fuels are consumed in Bangkok and 42 percent in the BMR. Forty-seven percent of gasoline and 44 percent of diesel, respectively, are consumed in the BMR. Severe congestion and heavy reliance on private vehicular modes is the key driver of the city’s energy needs. The transportation needs of Bangkok, mainly provided by CO₂-emitting vehicles, produce 21.18 million tons of CO₂ emissions annually. The BMR consumes 29,200 GWh of electricity annually, which is equivalent to 14.86 million tons of CO₂ emissions. Taken together energy and transportation sectors produce 84 percent of Bangkok’s GHG emissions. Without major efforts to transform how energy is consumed in the urban area, Bangkok’s future GHG emissions are projected to grow to almost 50 million tCO₂e by 2012. Improvements to the quality and competitiveness of public transport services, in particular bus transport, are critical to this transformation.

21. **With per capita GHG emissions of 10.6 tCO₂e, Bangkok’s residents generate more GHG emissions than the global average for city dwellers, within the highest tier for global cities.**¹⁰ Furthermore, per capita emissions would very likely be even higher for BMR given its overall lower density compared to the area of BMA.¹¹ As shown in Figure 8, when compared to nine other global cities, Bangkok has significantly higher GHG emissions than the best-performing cities in Europe. This level of per capita emissions is also significantly more than the global target average of 4 tCO₂e per capita, which would be needed to limit global warming to 2 degrees Celsius with high certainty.

Figure 8: Direct GHG emissions attributable to ten global cities



Source: Kennedy et al. (2009), *Greenhouse Gas Emissions from Global Cities*

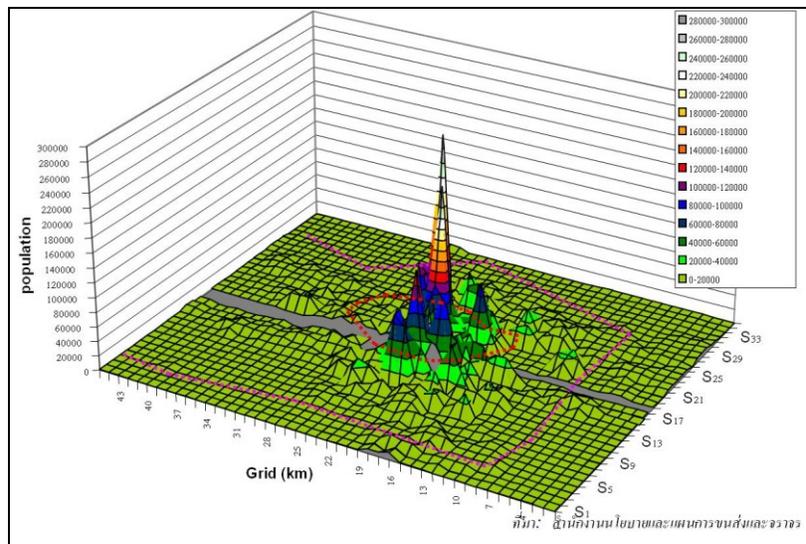
¹⁰ GHG emissions for BMA taken from Kennedy et al. (2009), *Greenhouse Gas Emissions from Global Cities*, *Enviro. Sci. Tech.*, Vol. 43, No. 19, pp 7297-7302.

¹¹ Several sources available, e.g. World Development Report, 2010, show that suburban residents – in this case, those in the outlying communities of BMA – generate 10-50% more GHG emissions per capita than more centrally-located residents in the same city.

22. **Bangkok’s urban form, and the challenges associated with it, highlights the link between Thailand’s overall GHG emissions and the urban setting.** Urban form has a strong bearing on urban metabolism; it is often the single greatest factor that a city can influence to bring down its GHG emissions. On average Bangkok is less dense than other East Asian cities, and its urban form is currently locked-in by its urban transportation system.

23. **One of the biggest challenges is the urban transport system.** Bangkok has seen significant improvement in urban transport and mobility since the late 1990s, but road traffic congestion remains a major daily challenge for most commuters, especially the less-well-to-do residents who rely on buses. The concentration of employment in the center of the city has created congestions from in-coming traffic around the city of Bangkok and its neighboring provinces (see Figure 9). Car ownership in Bangkok is three times higher than the national rate at about 380 cars per 1,000 persons.¹² The development of transport infrastructure and service delivery is lagging behind increasing demand. The share of person trips using public transport is already below 40 per cent and is declining, due to failure of regulator to permit bus operator to provide more market oriented services. While the national government and BMA recognize the importance of developing modern public transportation centered on mass transit, the focus is on rail which is very expensive and has a long lead time. Accordingly, the government and BMA see a vital role of BRT. Reforms to the bus system which carries the majority of transit riders are also long overdue despite several policy initiatives to tackle the issue. Walking is also an important mode of transport in urban area. Fourteen per cent of daily trips are made by walking. Also, a large number of walking trips are part of trips made by public transport. The poor quality of sidewalks not only reduces the quality of life for the residents, especially the disabled but also adversely affects the city’s image.

Figure 9: Employment concentration in the city of Bangkok

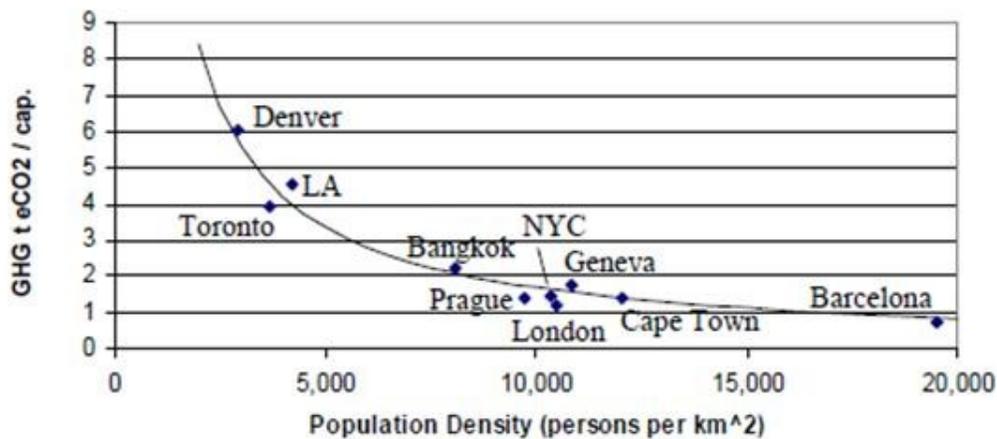


Source: OTP

¹² Based on data from the Department of Land Transport.

24. **Per capita GHG emissions for Bangkok residents from ground transportation at 2.2 tCO₂e are relatively high considering the city’s income level and the level of car ownership**, while per capita emissions in Bangkok from electricity use are 2.8 tCO₂e, and 2.5 tCO₂e for industrial fuel.¹³ Much of Bangkok’s ground transportation emissions can be attributed to the unprecedented seven-fold increase in automobile use between 1980 (600,000 vehicles) and 1999 (4,163,000 vehicles).¹⁴ Bangkok’s urban form and transportation network increasingly serve, and are impacted by, personal motor vehicles. These high transport emissions reflect the sprawling nature of Bangkok and considerable congestion. They also highlight a sector that could yield significant GHG mitigation opportunities. By comparison, Barcelona’s per capita ground transportation GHG emissions are just 0.75 tCO₂e, while Cape Town’s are 1.4 tCO₂e and London, 1.2 tCO₂e. Figure 10 below shows the inverted relation between population density and GHG emissions from ground transportation.

Figure 10: GHG emissions from ground transportation fuels vs population density



Source: Kennedy et al. (2009), Greenhouse Gas Emissions from Global Cities

25. **Climate change is of increasing concern and has been given a high priority on the city’s development agenda.** Climate change is causing various impacts, such as high temperature, floods, rising tidal movement, and worsening coastal erosion in coastal areas. Climate change and air pollution are identified by Bangkok citizens as two of the highest concerns today according to an opinion poll (Bangkok Post, 9 September 2008). The city’s coastal nature, vulnerable infrastructure, and large at-risk urban poor populations pose considerable challenges. These challenges are greatly exacerbated by Bangkok’s relatively low per capita GDP, compared to other global cities such as those in Europe, the US, and Japan. In terms of adaptation to climate change, therefore, Bangkok has many pressing concerns (see Bangkok Assessment Report on Climate Change, 2009).

¹³ Kennedy et al. (2009)

¹⁴ Bangkok Assessment Report on Climate Change, 2009.

26. **Environmental issues are also growing challenges which pose a threat to long-term sustainable urban development.** Air quality in Bangkok has been improving since 1997. However, some areas continue to experience higher levels of air pollution than the national standard. The water quality of the lower Chao Phraya River, the canals, and the sea along Bang Khuntien remains poor. Solid waste increases steadily, and the growing environmental cost of disposal has become a major burden to the BMA. The city generates about 8,500 tons of waste per day and continues to grow as the city becomes more affluent. The majority (88 percent) of wastes are disposed through land filling and the balance through composting. The city needs more active, environmentally sustainable, and socially responsible measures to deal with the large amount of waste generated daily.

III. PRIORITY SECTORS FOR GHG ABATEMENT

27. **Thailand's National Strategy for Climate Change Management (NSCCM), adopted in 2008, seeks to prepare Thailand to cope with the impacts of Climate Change and adapt to them.** The Strategy comprises six pillars, one of which is GHG Mitigation. The objective of GHG mitigation is to reduce GHG emissions and improve production technology through the adoption of clean technologies in energy and production industries. Plans for implementing the NSCCM are being formulated by the Climate Change Coordination Office of the Office of Natural Resources and Environmental Policy and Planning (ONEP) in conjunction with other Thai Ministries. NSCCM has identified seven priority areas for GHG emissions reductions through efficiency improvements and other means, including: (1) electricity production and use; (2) transportation; (3) alternative energy sources; (4) improved waste management and disposal practices; (5) industrial processes and efficiency; (6) agriculture; and (7) cleaner production technologies.

28. **Ministry of Energy has recently announced the 15-Year Alternative Energy Development Plan which is the country's first policy document that clearly lays down long-term vision and set out strategic direction for alternative energy development.** The DEDE within MOEN is responsible for implementing the AEDP. The AEDP has five main objectives:

- (i) To increase utilization of alternative energy as a major energy supply of the country for replacing oil import. The aim is to increase the share of alternative energy to be not less than 20.3 percent of the total final energy consumption in the year 2022.
- (ii) To increase energy security of the country and rely more on domestic energy sources.
- (iii) To promote integrated green energy utilization in communities by encouraging communities to utilize locally available resources to meet local demand in accordance with the principle of self-sufficiency economy and to transform the country towards low carbon society.

- (iv) To enhance the development of domestic alternative energy technology industry, increase local content in order to reduce costs of alternative energy production; and
- (v) To develop and encourage high efficiency alternative energy solutions, reduce reliance on imported technologies and promote innovative technological solutions to alternative energy.

29. **AEDP identified four areas of alternative energy development to achieve the 20 percent alternative energy share target (equivalent to 19,700 ktoe/ year) by the year 2022.** The four areas include: (i) Increasing the share of power generation from renewable sources by SPPs and VSPPs (2.4 percent); (ii) Increasing the share of thermal power from renewable sources (7.6 percent); (iii) Promoting the use of bio-fuels including ethanol, biodiesel, and hydrogen for transportation (4.1 percent); and (iv) Promoting the use of natural gas for vehicles (NGV) (6.2 percent). RE, excluding natural gas, represents 14.1 percent of the target. Implementation of this ambitious program could yield total potential annual GHG reduction of 42 million tCO₂e by 2022. Targets for various types of renewable and alternative energy under AEDP are shown in Table 2 below.

Table 2: MOEN's Targets for Alternative Energy Development

| Type of Energy | Potential | existing | 2008 - 2011 | | 2012 - 2016 | | 2017 - 2022 | |
|---------------------------------|-----------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|
| Electricity | MW | MW | MW | ktoe | MW | ktoe | MW | ktoe |
| Solar | 50,000 | 32 | 55 | 6 | 95 | 11 | 500 | 56 |
| Wind Energy | 1,600 | 1 | 115 | 13 | 375 | 42 | 800 | 89 |
| Hydro Power | 700 | 56 | 165 | 43 | 281 | 73 | 324 | 85 |
| Biomass | 4,400 | 1,610 | 2,800 | 1,463 | 3,220 | 1,682 | 3,700 | 1,933 |
| Biogas | 190 | 46 | 60 | 27 | 90 | 40 | 120 | 54 |
| Municipal Solid Waste | 400 | 5 | 78 | 35 | 130 | 58 | 160 | 72 |
| Hydrogen | | | 0 | 0 | 0 | 0 | 3.5 | 1 |
| Total | | 1,750 | 3,273 | 1,587 | 4,191 | 1,907 | 5,608 | 2,290 |
| Thermal | ktoe | ktoe | | ktoe | | ktoe | | ktoe |
| Solar Thermal | 154 | 1 | | 5 | | 17.5 | | 38 |
| Biomass | 7,400 | 2,781 | | 3,660 | | 5,000 | | 6,760 |
| Biogas | 600 | 224 | | 470 | | 540 | | 600 |
| Municipal Solid Waste | | 1 | | 15 | | 24 | | 35 |
| Total | | 3,007 | | 4,150 | | 5,582 | | 7,433 |
| Biofuel | m lt/d | m lt/d | m lt/d | ktoe | m lt/d | ktoe | m lt/d | ktoe |
| Ethanol | 3.00 | 1.24 | 3.00 | 805 | 6.20 | 1,686 | 9.00 | 2,447 |
| Biodiesel | 4.20 | 1.56 | 3.00 | 950 | 3.64 | 1,145 | 4.50 | 1,415 |
| Hydrogen | | | 0 | 0 | 0 | 0 | 01 mill kg | 124 |
| Total | | | 6.00 | 1,755 | 9.84 | 2,831 | 13.50 | 3,986 |
| Total Energy Consumption (ktoe) | | 66,248 | | 70,300 | | 81,500 | | 97,300 |
| Total Energy from R E (ktoe) | | 4,237 | | 7,492 | | 10,319 | | 13,709 |
| Renewable Energy Ratio | | 6.4% | | 10.6% | | 12.7% | | 14.1% |
| NGV (mmscfd - ktoe) | | 108.1 | 393.0 | 3,469 | 596 | 5,260 | 690 | 6,090 |
| Total Energy from RE + NGV | | | | 10,961 | | 15,579 | | 19,799 |
| Alternative Energy Ratio | | | | 15.6% | | 19.1% | | 20.3% |

Source: Department of Alternative Energy Development and Efficiency. Ministry of Energy. July 2009.

30. **Substantial investment will be needed to add the 4,000 MW of new renewable power generation capacity needed to reach the AEDP's 2022 target of 5,608 MW.**

MOEN's DEDE estimates the renewable component of the AEDP will require US\$ 10 billion of new investment, or an annual investment of around US\$ 760 million per year over the next 14 years. This amount of investment is expected to come from both the private sector and the public sector (government and state owned enterprises). The private sector is expected to take on most (over 80 percent) of the total investment. Public investments will mainly focus on small hydro and solar.

31. **The Energy Conservation Act 1992 provides the key policy framework for promoting energy conservation and energy efficiency in Thailand.** Energy efficiency (EE) target and other energy conservation measures are identified in the medium-term Energy Conservation Plan under the Act. The current plan covering the period from 2005 to 2011 is the second one. The Plan sets the target to reduce energy intensity ratio from 1.4:1 to 1:1. It also sets the target to reduce commercial energy consumption in the year 2011 from 91,877 ktoe to 81,523 ktoe or saving of 10,354 ktoe, representing 12 percent of commercial energy consumption in that year. The 10,354 ktoe of savings will come from EE improvement in three key areas: i) transport (6,269 ktoe or 21 percent reduction in the transport energy consumption); ii) industries, commercial, services and agriculture (3,411 ktoe or 9 percent reduction of the sectors' energy consumption); and iii) residential (673 ktoe or 4 percent of residential sector energy consumption).

32. **The potential for EE improvement in the transport sector is fully recognized and supported by analytical underpinnings.** The transport sector accounted for 48 million tCO₂e of GHG emissions in 2006, making transport the second largest GHG emissions source after electricity generation. The Plan identified several integrated measures needed to achieve the energy saving target in the transport sector. Three measures which have the highest saving potentials are: i) improving integrated mass transit system in Bangkok (2,577 ktoe); ii) increasing the role of intercity rail and water mode which aims to induce 10 percent modal shift from road to rail and water modes (1,570 ktoe); iii) improving logistics system (1,534 ktoe). The remaining savings will come from measures such as traffic management, pricing measures to increase the cost of motoring, tax incentives for eco-cars and EE labeling for personal vehicles. According to World Bank and NESDB (2008), the transport sector has high potential to reduce GHG emissions through various technology and policy interventions in the freight, inter-city passenger, and urban passenger transport sub-sectors. Implementing a comprehensive array of technology and policy options over the next 15 years could result in annual GHG reduction of 13 MtCO₂e by 2025. Transport in urban areas also contributes significantly to the local air pollution and thus co-benefits of activities in this sector are substantial.¹⁵

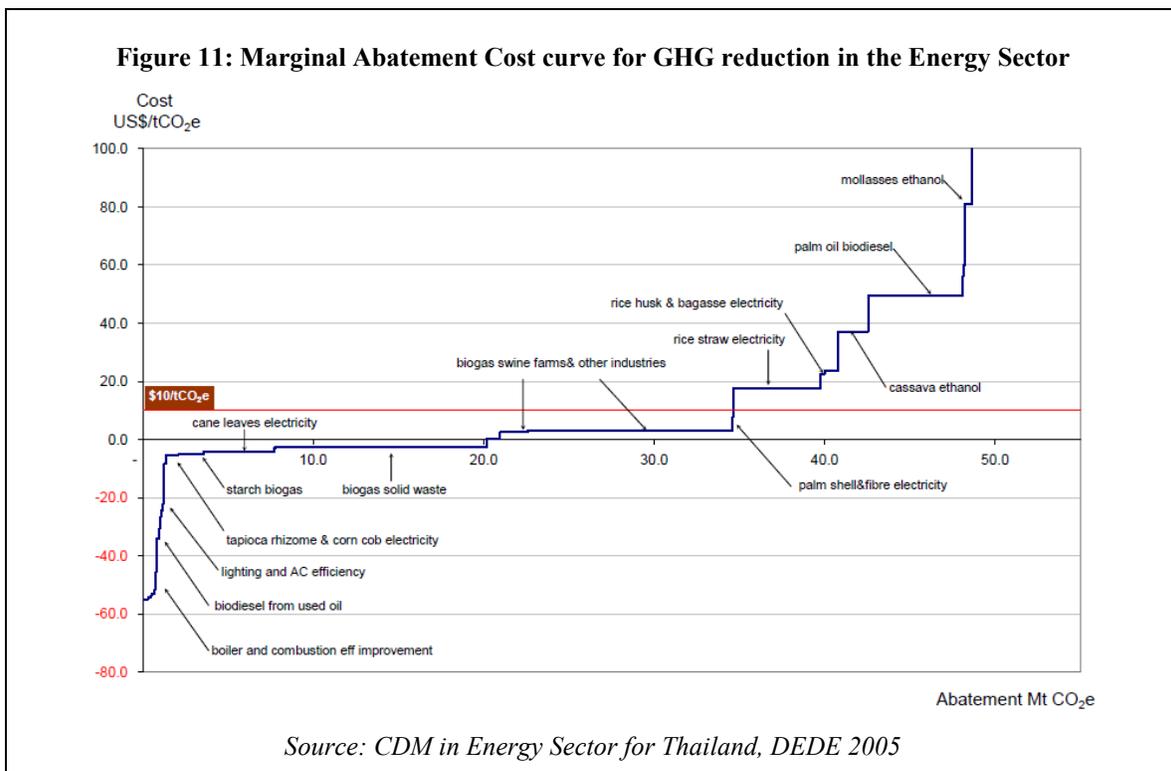
33. **In manufacturing and commercial sector, private investments in EE will play a crucial role.** The Plan identifies that substantial saving could be realized by encouraging factory owners to change to energy-efficient machineries (1,170 ktoe). Potentials of several financial measures required to provide incentives for the private sector to invest are: tax

¹⁵ NESDB and World Bank (2009), "Thailand: Making Transport More Energy Efficient"

incentives (570 ktoe), soft loan (300 ktoe) and the development of ESCOs (300 ktoe). Another key potential intervention to reduce energy consumption in the manufacturing is through industrial restructuring by promoting investment in energy-efficient/high value-added industries (1,400 ktoe).

34. **In the residential sector, saving potentials lie in promoting the use of energy-efficient electrical appliances.** According to the Plan, key measure to achieve this is by setting voluntary and compulsory performance standards (469 ktoe) focusing on i) key electrical appliances (air-condition, refrigerator, ballast, and lighting); ii) cook stoves; and iii) building materials and building code. Other potentials for savings are from increasing EE awareness and behavioral change of consumers.

35. **In addition, the findings from the study “CDM in Energy Sector for Thailand” by DEDE** showed that RE and EE sectors have high potential in GHG reduction. Figure 11 shows the GHG reduction potential in the energy sector based on availability of resources and GHG reduction cost effectiveness.



36. **Bangkok is one of a few cities in the world which has developed the first city-wide climate change strategy as articulated in the BMA Action Plan on Global Warming Mitigation 2007-2012, announced in 2007.** The Plan sets an ambitious goal to reduce Bangkok’s GHG emissions below currently projected 2012 emission level by 15 percent. Climate change issue is also included as one of the strategic issues under BMA’s

Administration Plan covering the period from 2009-2012 with specific goal to reduce carbon emissions per person to 5.5 tons/person/year from the current level of 7.7 tons/person/year by 2012. The Action Plan consists of five initiatives as follows:

- Initiative 1: Expand Mass Transit and Improve Traffic Systems
- Initiative 2: Promote the Use of RE
- Initiative 3: Improve Electricity Consumption Efficiency
- Initiative 4: Improve Solid Waste Management and Wastewater Treatment Efficiency
- Initiative 5: Expand Park Areas

37. **Placing Thailand's GHG emissions reduction efforts within the overall urban context is critical for achieving the objective of long-term target.** Thailand's urban sector needs to be fully engaged in order to bring down the country's GHG emissions. More than 75 percent of Thailand's electricity is consumed by urban customers, and the management and shape of urban areas has the greatest influence on electricity consumption and the ancillary – and usually directly correlated – GHG emissions. Meaningful reduction in GHG emissions, i.e. more than 10 percent reduction in per capita baselines, require coordinated efforts from Thailand's national government ministries and local governments, particularly the city of Bangkok. This urban management program would be best initiated in Bangkok where significant scale is possible, mitigation planning is already well advanced, and potential financing is forthcoming. However, the challenges associated with GHG emission mitigation in urban settings are daunting.

38. **Bangkok's mitigation program depends on successfully implementing a cross-sectoral approach and shifting public behavior.** A comprehensive and integrated approach is needed, which is predicated on inter-government cooperation and better identification and targeting of key incentives and urban infrastructure, with a major emphasis on long term land use planning and changes to societal behavior. Programs such as more efficient street lighting, improved buildings, and neighborhood efforts to reduce urban heat islands, when combined could reduce the regions GHG emissions by 10 percent.

39. **The transformative aspect of this urban component is that Bangkok will be the first CTF-eligible city in the world to launch a GHG mitigation program based on a credible and verifiable baseline, with a matching, Government-supported action plan (local and national level).** A prerequisite would be a third-party verifiable GHG emission baseline (preferably ISO standardized). Fortunately a peer-reviewed GHG baseline exists for BMA (the only other Part 2 city with a similar baseline is Cape Town). Bangkok therefore represents a unique opportunity to develop a new Carbon Finance methodology that has the potential to fundamentally expand carbon finance opportunities for cities. With the ancillary support of Carbon Finance, emissions trading, inter-municipal support, leadership within the C40, Carbon Finance Assist, broad and long-term public consultation, changes to local and regional legislation such as building codes, and re-developing the

urban fabric through changes to land use planning supported by transportation infrastructure, BMA has in place the tools needed to bring about their Mitigation Action Plan targets.

40. **A number of other studies and reports have provided analytical underpinning for the GoT in identifying priority actions and areas for reducing GHG emissions**, including: (i) “Thailand Country Study on Climate Change Finance” prepared for the US DOE’s Country Studies Program (Thailand Environment Institute, 1997); (ii) “Asia Least-Cost Greenhouse Gas Abatement Strategy (ALGAS): Thailand” prepared for the ADB (Thailand Environment Institute, 1997); (iii) “CDM Study for Thailand” financed by AusAID (IBRD, 2002); (iv) “CDM in Energy Sector for Thailand” (DEDE 2005); (v) “Thailand: Making Transport More Energy Efficient”, prepared by the World Bank in collaboration with the Office of National Economic and Social Development Board (NESDB), Office of Transport and Traffic Policy and Planning, and Energy Policy and Planning Office (World Bank, 2008); and (vi) “Strategic Urban Transport Policy Directions for Bangkok” prepared by the World Bank under the Urban Transport Development Partnership (2007). This partnership is a cooperation framework joined by the Asian Development Bank, the French Development Agency, the Japan Bank for International Cooperation and the World Bank Group

41. Based on these and other studies, other sectors besides energy and transport which have high potential for GHG emission reductions are:

- **Land use, land use change and forestry (LULUCF):** The Tenth National Economic and Social Development Plan (TNESDP) aims to reserve 33 percent of the country’s land as forest, with at least 18 percent as protected areas. The supporting action plans includes: (a) reduced deforestation and degradation (REDD); (b) commercial tree plantation; and (c) reforestation and restoration.
- **Waste management:** Thailand’s waste management sector has great potential (upto 28.3 million tCO₂e per year¹⁹) to reduce its carbon emissions through the following: (a) improving waste management and handling; (b) waste separation; (c) composting; and (d) recovering energy from waste.

IV. RATIONALE FOR SELECTED SECTORS

42. This section explains the rationale for the emission reduction opportunities being proposed for CTF support. Note that not all of the sectors where GHG emissions are high and could be mitigated are included in this Plan. These other sectors do not have equal priority for immediate funding, as explained in Section III. The measures put forward for immediate CTF support include following:

- a. **Clean Energy Advancement - Public Sector:** Catalyzing private investments in RE through the government’s Specialized Financial Institutions (SFIs) as financial intermediaries and direct investment in RE and EE by state-owned electric utilities. The Clean Energy Advancement – Public Sector will promote private investment by channeling funds through public banks complementing IFC’s proposed activities which will channel funds through private commercial banks.
- b. **Clean Energy Advancement - Private Sector:** Using a combination of credit guarantees, mezzanine finance facilities and capacity building programs to encourage and mobilize local financial institutions and private investors to invest in projects of EE, RE and cleaner production. IFC will focus on improving access to funds through private commercial banks.
- c. **Urban Transformation: Primary support to selected BRT routes (majority of CTF support will co-finance this component)** to promote urban transport integration and accelerate further BRT routes and mass transit. Building EE initiatives for Bangkok GHG emission reduction program will be covered to support their urban transformation as a part of the BMA’s Action Plan on Global Warming.

43. The proposed program is the result of several months of discussions amongst the GoT, World Bank, ADB, IFC, UN partners and bilateral agencies, and builds on years of development experience and policy dialogue between these institutions. The choice of programs reflects a combination of the government’s priorities, sector implementation readiness, the development banks’ capacity and focus, and priorities established by the CTF. The paragraphs below present the rationale for the proposed program.

44. None of the measures from the LULUCF sector are being proposed for CTF support at this stage, as CTF does not allow land-use change activities. The programs proposed for CTF support do not include new technologies per se. They include technologies that are readily available in Thailand today, **but face institutional, regulatory, commercial and financial barriers which must be surmounted to make large-scale deployment possible.** Co-financing from the CTF would help overcome these barriers.

4.1 CLEAN ENERGY ADVANCEMENT – PUBLIC SECTOR

45. **Energy is the target sector for CTF co-financing** given its large contribution to GHG emissions in Thailand and the priority government places on enhancing energy security of the country. **The primary focus of this intervention is RE development.** Support for EE is expected to be small and is included for comprehensive advancement of clean energy.

46. **CTF support is proposed to support RE for power generation under the AEDP.** This is consistent with the need to promote new and cleaner technologies for power generation in order to reduce the current reliance on coal and natural gas. The AEDP provides a clear strategic direction and target for the development of renewable resources for power generation. RE selected for CTF co-financing will focus on biomass, solar, wind and small hydro given their strong potential and importance relative to reaching the AEDP's targets.

47. **The key challenge in stimulating investments in RE and EE projects, for both public and private developers, is overcoming institutional, technical, market, risk perception and financial barriers.** Although there is ample liquidity in the domestic financial market, lending to RE projects remains limited. Access to affordable financing is a key barrier to investors, especially small- and medium-sized private companies. This suggests that there are structural rigidities in the renewable power generation development market. Key factors include: (i) lack of knowledge (e.g. limited familiarity and experiences with RE and EE projects among lenders and borrowers); (ii) lack of demonstrated successes (e.g. project designs, deal flows, and business models for RE and EE investment projects have not yet been widely demonstrated); and (iii) government regulations (e.g. resource mapping and zoning / planning for biomass-based power generation) need to be further improved. As a result, financial institutions, both public and commercial, perceive lending to RE and EE projects as risky. This perceived risk is reflected in higher costs of project development and debt financing. CTF intervention is expected to scale up investments in RE and EE projects by overcoming these barriers. This will be achieved through: **i) using CTF concessional funds to buy down the cost of overcoming these barriers; and ii) providing needed technical assistance to the selected SFIs to enter into the business and expand lending to both public and private developers.**

48. **Priority Activities.** CTF co-financing under the Clean Energy Advancement - Public Sector is proposed to overcome existing barriers, establish business models and transform business environment to scale-up and accelerate private and public investments for clean energy advancement through two interventions: i) Catalyzing Private Clean Energy Investment through SFIs as financial intermediaries; and ii) Advancing Public Investments in Clean Energy through Public Utilities. Both SFIs and commercial banks can play a significant and complimentary role in channeling funds to both public and private companies. The proposed Clean Energy Advancement – Public Sector will support the government SFIs and the Clean Energy Advancement – Private Sector operation will focus on commercial banks.

49. **i) Catalyzing Private Clean Energy Investments through SFIs.** The CTF support is proposed to create a financial facility in selected public SFIs to lend to RE projects which are large in number and small in size. The financial facility will focus on lending to small- to medium-scale biomass, solar, wind and other RE projects.

50. **CTF support through SFIs is proposed to co-finance small-scale biomass projects that utilize agricultural wastes as feedstock for distributed power generation.** These community biomass projects will be implemented in collaboration with the Ministry of Agriculture and Cooperatives (MOAC) which has strong expertise in agriculture sector. MOEN will be responsible for overall planning, regulation and oversight.

51. **CTF support to lending for renewable power generation will be complemented by technical assistance funded by trust funds and donor partners.** Key areas of technical assistance include: (i) advisory services to government agencies on resource (biomass, micro hydro) review and planning for renewable energy development; (ii) capacity building within the participating banks and borrowers for project identification, processing and preparation, mapping risk profile and developing mitigation measures; and (iii) capacity building for identification, preparation and processing CDM operations to enhance financial sustainability of RE projects.

52. **Contingent financing will also play an important role in unleashing commercial lending and private sector investment in renewable power generation.** CTF support is proposed to establish and fund a guarantee facility. A guarantee facility has already been identified in the scope of MOEN's ESCO Fund but revised guidelines including contingent financing criteria and procedures must be created and put into practice in the context of RE projects. A guarantee facility is an appropriate financial instrument in the Thai financial market, which is characterized by excess liquidity due to highly risk-averse banks. By addressing credit risks and short maturity related to RE and EE projects, a risk guarantee facility has the potential to leverage sizable bank lending, especially to facilitate local lending to the RE and EE projects during the replication period when the CTF is used up. Past policy dialogue with commercial banks, the private sector, and GOT indicate that there is strong demand for risk guarantee facility.

53. **Advancing Public Investments in Clean Energy through Public Utilities.** The second major activity under the Clean Energy Advancement – Public Sector focuses on public investments through public utilities such as the Electricity Generating Authority of Thailand (EGAT) and the Provincial Electricity Authority (PEA). As identified by the AEDP, public investments will be complementary to private investments in achieving the target. According to AEDP, public investments will focus on solar, small hydro and biomass. Both these state-owned enterprises (SOEs) have singular experience in the power sector and the technical, managerial and financial capacity to play a strategic role in scaling-up RE and EE investment. CTF funding is proposed to co-finance three public investment programs: (i) EGAT's RE investment as identified in EGAT's Alternative Energy for Electricity Strategy (2008-2022) or EGAT's AE Strategy; (ii) PEA's forest residues biomass investment program; and (iii) PEA's national efficient highways lighting investment program.

54. **CTF support is proposed to co-finance implementation of EGAT’s AE Strategy resulting in 224 MW of new RE capacity from wind, solar and small hydro.** As of 2007 renewable energy comprised only 1.6 percent (about 400 MW) of EGAT’s generation, with hydropower providing another 7 percent. However, as part of its power development planning, and to contribute to the national targets set by the AEDP, EGAT has prepared AE Strategy which sets out EGAT’s long-term investment program in RE power generation capacity over the period 2008-2022, in line with the AEDP period. CTF co-financing will primarily support the medium-term program to accelerate the long-term investment of EGAT’s AE Strategy.

55. **CTF co-financing is proposed for PEA scale-up small-scale forest residue biomass power generation to about 100 sites (1 MW per site with an approximate total capacity of 100 MW) in the next five years, and associated investment in transmission lines and substations.** PEA is collaborating with the Forest Industry Organization (FIO) to invest in pilot biomass power projects that produce electricity using the biomass residue from commercial forest plantations. As good plantation management, residue biomass from thinning/trimming and forest fire prevention will be used as feedstock. Electricity generated will be used locally and sold to PEA.

56. **CTF will co-finance PEA’s investment in energy efficient street, highways and public spaces lighting throughout the country.** Street and highways lighting is a significant energy user in Thailand. Annual consumption of electricity for street lighting is around 1,300 GWh. PEA provides electricity for municipal street lighting and provincial highway lighting, which makes it well positioned to undertake public investment in efficiency improvements. The proposed investment is expected to result in annual electricity savings of 325 GWh.

57. Table 3 summarizes the activities, investment costs and expected results of the Clean Energy Advancement –Public Sector component.

Table 3: Summary of the Clean Energy Advancement – Public Sector Component

| Potential Sub-Project | Description | Total Investment Cost | CO ₂ reduction (MtCO ₂ e per year) |
|--|---|-----------------------|---|
| Catalyzing investment through SFIs as financial intermediaries | Support 34 public and private investments in RE for biomass, wind and solar and in particular the development of small-scale/community-based biomass power plants. Estimated new capacity of 374 MW | \$800 million | 0.613 |
| EGAT Renewable Energy Investment Program | RE program 2008- 2022: (Indicative from draft Plan) including wind, solar and micro-hydro. Total: 224 MW | \$579 million | 0.44 |

| | | | |
|---|--|------------------------|--------------|
| PEA Renewable Energy and Energy Efficiency Investment Program | Support PEA's RE and EE plan. | | |
| | • Forestry residuals (wood chips): Construction of thermal biomass boilers and generators of 100 sites x 1 MW = 100MW | \$230 million | 0.42 |
| | • Streets lighting EE for national highways and public spaces | \$67 million | 0.16 |
| | Total 100 MW and expected annual electricity savings of 325 GWh | \$297 million | 0.580 |
| | Total | \$1,676 million | 1.636 |

58. **There is also large potential for EE improvement in electricity consumption** especially for industries, which is the key consumer of final energy and electricity (45 percent, 61,168 GWh per year); and buildings (consuming 32 percent of electricity or 42,866 GWh per year). Further discussions to elaborate the support and channeling funds to EE, possibly through the financial intermediary sub-project, will be carried out in the coming months.

59. **Transformational impact:** The clean energy advancement program proposed for CTF support will directly contribute to the implementation of the AEDP. The level of investment needed to achieve AEDP's target is only possible with enhanced private sector participation complemented by strategic public investments. As the AEDP was announced in 2009, the key issue is how to stimulate the investment needed to achieve the ambitious targets for renewable power generation, as shown in Table 2. CTF resources will support the GoT in facilitating private investment while scaling up public sector programs. CTF support to the AEDP program and successful implementation of AEDP itself will have a transformational impact on the development of RE in the country by:

- (i) Catalyzing actions to achieve the AEDP targets and demonstrating that RE could provide a reliable source of power and could play not only marginal but truly significant role in the country's energy mix;
- (ii) Transforming the country's energy mix with a much increased share of RE in the medium- and long-runs;
- (iii) Transforming the business environment through wide-scale demonstration of successful business models, and substantial expansion of lending to RE in the local banks' lending portfolios; and
- (iv) Transforming the power generation portfolios of public utilities (EGAT and PEA) with increased share of RE.

60. **The transformational impact of the proposed clean energy advancement program is expected to be achieved through market development approach.** The approach is suitable given the country's resource potentials (dispersed and available in smaller scale), business environment and the current policy regime. The market for clean

energy is expected to be developed and expanded by demonstrating technically feasible, commercially viable, socially and environmentally sound models for RE. This could be done by filling in both technical and financial gaps at the project level. While technologies are generally proven, project performance (including operation and feedstock management) in the long run still needs to be proven. At the same time, financial barrier needs to be addressed to ensure developers' access to fund. Commercial banks are currently reluctant to lend because of both technological and perceived risks about projects. The proposed priority activities will help address both risks. Technological risk will be mitigated by building technical capacity for developers as well as developing national expertise through public investments. High perceived risk among commercial banks will be addressed by working with SFIs to build technical capacity of SFIs in evaluating RE projects. By demonstrating technical and commercial viability of RE projects and lowering technological and financial risks for all market players, the clean energy advancement program is expected to transform the financial sector by establishing firmly a business line for clean energy within SFIs and other banks through replication. This will lead to development of local markets for green manufacturing and services industries which will be vital in preparing the country's transition to a low-carbon economy in the long run. Furthermore, clean energy programs undertaken by public utilities with CTF support will enhance the development of local RE industries, build local capacity in operation and maintenance and management of RE power plants and help establish best practices for distributed renewable power production. The public investment in EE is expected to have transformation impact by inducing other large-scale EE investment in public facilities and assets by demonstrating tangible savings of EE.

61. ***Cumulative emission savings.*** As summarized in Table 3 above, the activities under the RE program will result in estimated GHG reductions of 1.636 million tCO₂e per year when the program is fully implemented in 2022. This will result in cumulative emission savings of around 24.54 million tCO₂e assuming a 15-year project life.

62. ***Replication potential and scalability.*** The CTF is expected to directly finance around 700 MW of new RE installed capacity over the implementation period, equivalent to 18 percent of new capacity required to meet the AEDP target. The remainder of the 4,000 MW target to 2022 represents the replication potential given demonstrated viable business models, improved access to funds for developers with established lending instruments and business lines of both public and commercial banks, improved government regulations and stronger capacity and knowledge of market players. The great potential of replication is also demonstrated by large number of RE project proposals (especially solar and biomass) from the private sector developers in place, which are waiting for government review for licensing and by banks for lending. Additional regional replication potential also exists, as practical experience in Thailand and Thailand's role as a market leader in power generation would yield more opportunities for replication throughout South East Asia.

63. **Small-scale or community-level biomass distributed generation has particular and additional potential for replication and scalability.** Much of the remaining potential

for biomass in Thailand is available in relatively small quantities and scattered throughout the country. As a result, the most viable future business model to utilize these resources will be smaller scale biomass projects developed and operated with community participation. In addition, the projects may materialize benefits to local communities, support income generation and poverty alleviation. Achieving this will require building the implementation capacity of local entrepreneurs and communities as well as commercial banks. Biomass projects to be supported by CTF co-financing will demonstrate proper planning for use of resources, viable business models and participatory approach to sound project development and management.

64. ***Development impacts and co-benefits.*** The most important co-benefit is diversification of power production in Thailand away from reliance on coal and gas. Adding 4,000 MW of renewable power production will increase energy security and reduce the need for imported petroleum products for power production. Electricity generated from renewable power stations will replace electricity either generated from the grid using coal and natural gas or produced by diesel engines in off-grid areas. Grid-connected renewable power will also help to reduce losses in the distribution system and improve the stability of PEA's rural distribution network. Developing RE projects in remote areas might stimulate the extension of PEA's distribution network in order to off-take the power. Small-scale RE development has strong local economic and social benefits given its strong linkage with poverty reduction, livelihoods improvement and productive use. Small-scale biomass projects would provide additional sources of income for local communities, e.g. by hiring local labors for civil works of small hydropower projects, employing local community to collect biomass residue in the local area and creating jobs to operate distributed generation schemes. A study conducted by PEA as part of project preparation estimated that communities could generate around USD 70,000 additional income per year by collecting the wood residues necessary to supply a district-scale biomass power project. Other co-benefits might include more affordable and reliable power supply and opportunities for local productive use of electricity. As with any renewable power generation, there would be reduced air pollution as coal-fired power production is displaced or avoided.

65. **The development of local renewable power projects has economic co-benefits of stimulating private sector participation in the power sector and creating new jobs in manufacturing, construction, and operation of renewable power equipment.** If the CTF can leverage commercial lending, therefore unleashing excess liquidity in financial markets, this will help stimulate the economy in the short- and medium-term and help transition the economy toward low carbon growth path in the long term.

66. ***Implementation potential.*** SFIs have strategic policy direction to expand and diversify more into RE business lines from its traditional business lines but still lack implementation capacity in and familiarity with this new business area. EGAT and PEA have lengthy experiences in the power sector and strong technical and organizational capacity for implementation. EGAT is a key player and market leader in the power sector in Thailand. Currently, EGAT's installed capacity accounts for 48 percent of the country's

total installed capacity, mostly using fossil fuels. It acts as a single buyer of power. It is also a center of technical expertise in the power sector. PEA is a state-owned national power distribution company. It is responsible for electricity distribution all over the country outside the Bangkok Metropolitan area with the total distribution length of over 700,000 circuit kilometers and 14 million customers. PEA has accumulated experiences in renewable power through its role as purchaser of power under the government’s VSPP program for projects outside Bangkok Metropolitan area. CTF intervention will be critical to increase the RE/EE programs in their portfolios and further enhance their implementation capacity.

67. **Additional cost/risk premium.** Implementation of the AEDP is just underway; hence the intervention supported by CTF will come at a critical stage and work to catalyze and transform the market. AEDP will not be successful in reaching its ambitious targets without a concessional mechanism such as CTF to transform the business environment, stimulate investments, and overcome real and perceived project and performance risk. **Without CTF co-financing to help overcome key barriers to scaling up investment in RE and EE projects, large scale clean energy investments will take a much longer time to materialize.** The technologies for renewable power generation have been already proven in Thailand, but the sector must still overcome significant financial and institutional barriers before realizing its full potential. Capacity building to transfer knowledge and technological know-how will be instrumental to familiarize and open up the market and consequently encourage large-scale deployment of these technologies. Institution building and technical assistance along with concessional financing will be instrumental to reduce perceived risks of proposed activities, create momentum and mobilize the resources needed to implement the AEDP and the GoT’s long-term low carbon economy vision.

68. Results indicators for the Clean Energy Advancement – Public Sector component are summarized in Table 4.

Table 4: Results Indicators for the Clean Energy Advancement – Public Sector Component

| Baseline | Results Indicator | Expected Program Results and year |
|--|---|--|
| 1,699 MW in 2008 (including hydro) | Installed renewable power production in Thailand (Biomass, Wind, Small Hydro and Solar) | 700 MW of new renewable power projects added by 2012 |
| Emissions in the power sector were 82 MtCO ₂ e per year in 2007 | Annual GHG reductions from power generation | 1.6 MtCO ₂ e per year by 2022 |

4.2 CLEAN ENERGY ADVANCEMENT – PRIVATE SECTOR

69. To direct local and international capital towards investment in the private sector to undertake Renewable Energy, Energy Efficiency and Cleaner Production (RE/EE/CP) project, this component provides CTF support for IFC engagement in mobilizing the private sector in Thailand. IFC would leverage its skills, relationships and innovative financing instruments (e.g., partial risk guarantee and mezzanine finance facilities) to support clean energy projects across the industrial, commercial and residential sectors.

70. **Priority activities.** CTF support is proposed to co-finance three areas of private investments – Renewable Energy, Energy Efficiency and Cleaner Production.

71. **Renewable Energy.** RE activity would be IFC's provision of appropriate incentives for qualified developers to fast-track the implementation of RE projects. These initial projects, in addition to having an immediate GHG impact, would provide valuable information on the types and amounts of incentives required to catalyze RE development in the country.

72. **IFC would work with private sector RE developers and equipment manufacturers** who are interested in undertaking power projects in Thailand but need additional development incentives or risk mitigation. IFC is aware of several credible developers interested in Thailand's RE sector who require non-market based financing to make their projects feasible. The financing challenge facing private developers is made worse by the current financial crisis and the disappearance of traditional funding sources. It is expected that financing plans for RE projects under this program, especially those submitted within the first twelve months, would require leverage not only from multiple MDBs, but also from bilateral and other like-minded institutions.

73. **Energy Efficiency and Cleaner Production.** This activity would be IFC provision of a combined package of advisory services and financing instruments to local financial institutions for EE and cleaner production project development, using a programmatic approach. Such packages are aimed to help transform the behavior of local financial institutions, especially commercial banks, so that they will build their in-house capacity to assess the technical and market risks of EE and CP, and become willing financiers for the sector. The program would provide financial incentives or risk products to market leaders to encourage them to implement new low carbon technologies and establish new standards and benchmarks for such technologies in their respective industries.

74. **Transformational impact.** The combined effort by the programs is expected to result in a transformed financial sector that will view investment in EE and RE projects as a standard business practice. At the same time, it is expected that the industrial, commercial and residential sectors will view EE and RE projects as standard ways of operating an

efficient business and competing in the market. The CTF investment, combined with the advisory services, will build on the momentum of the Thai government to direct the business community to a low carbon growth path. Without CTF participation, it would be difficult to establish the enabling environment for scaled up investments in the RE and EE projects.

75. **Cumulative emission savings.** The Clean Energy Advancement – Private Sector has four distinct components: risk sharing, mezzanine finance, RE scale-up and capacity building. When all four components are up and running, the integrated IFC program will help mobilize more than \$1 billion of investment into the RE/EE/CP and achieve savings of close to 3 million tons of CO₂ per year.

76. **Replication potential and scalability.** The replication and scalability potential is inherently very high – once the private sector is mobilized to invest in RE/EE/CP and realize good returns, it will continue to do so without concessional support from MDBs. A meaningful long-term solution in sustainable development is only feasible with the active engagement of the willing private sector players.

77. **Development impacts and co-benefits.** The IFC private sector Program is designed to improve the private sector companies' ability to access local financing. The risk sharing component typically benefits SME developers of RE/EE/CP projects while the mezzanine finance facility mobilizes capital to support the developers of SPP and VSPP. At an annual GHG emissions saving of almost 3 million tons of CO₂, the program will greatly help to improve the environment, promote SME development, and create wealth in a low carbon way.

78. **Implementation potential.** IFC has been approached by several RE developers and local financial institutions that have expressed strong interest in partnering with IFC. With more than ten years implementing similar financing mobilization programs for RE/EE/CP, IFC is in a position to develop, design and implement these proposed interventions for Thailand. Once the CTF funding support is confirmed, IFC could readily arrange regional and global resources to support the implementation of the financing projects in Thailand. Accordingly, the likelihood of IFC being able to structure appropriate incentives using CTF funds and implement an initial program during the next six months is very high.

79. **Additional cost/risk premium.** In RE, the addition of CTF *financing* will provide appropriate financing and risk incentives for private developers to enter Thailand's RE sector, despite the barriers posed by the current financial crisis. The concessional support from the CTF will help transform interest in entering the market into firm commitments. Under a business-as-usual approach all but a few of these private sector developers and equipment manufacturers would stay on the sidelines or venture relatively small amounts of investment in the market.

80. **In EE, the addition of CTF funds will provide an additional incentive** to local financial institutions to undertake financing in newer, lower-carbon and sometimes more-costly EE technologies. Many companies and project developers have found themselves unable to borrow, even at high interest rates, for their projects in EE and CP. CTF support can provide the very practical incentive of access to necessary financing for those companies willing to implement EE and CP projects. By opening up access to preferential financing for lower-carbon projects, the CTF funds will catalyze the sector’s transition to a lower carbon base. This compares to a business-as-usual approach in which investment in general is stalled, including investment in EE and CP projects.

81. Results indicators for the Clean Energy Advancement – Private Sector component are summarized in Table 5.

Table 5: Results Indicators for Clean Energy Advancement – Private Sector Component

| Project Components | Description | Total Investment | GHG Emissions Reduction (tons / Year) |
|-----------------------------|---|-------------------------|--|
| Risk Sharing Facility | Provide partial credit guarantee to cover local banks’ new portfolio of loans for renewable energy, energy efficiency, cleaner production and waste treatment | \$270 Million | 700,000 |
| Mezzanine Finance | Provide mezzanine finance facility to local financial institutions for the promotion of lending to developers of smaller renewable energy projects, as well as injecting mezzanine finance to facilitate investment | \$600 Million | 1,250,000 |
| Scaling Up Renewable Energy | Provide equity / financing to support developers of large-scale renewable energy projects | \$450 Million | 833,000 |
| Capacity Building | Support local financial institutions in capacity building | N/A | N/A |
| Total | | \$1,320 Million | 2,783,000 |

4.3 URBAN TRANSFORMATION

82. **Priority activities.** CTF support is proposed to co-finance implementation of urban transport with limited support to building energy efficiency. These are the two selected initiatives under the BMA’s Action Plan on Global Warming. They are expected to

contribute to the comprehensive urban GHG reduction program in Bangkok as identified by the Plan.

83. **BMA's GHG mitigation strategy encompasses more components than what is proposed for CTF support.** These funds are however extremely catalytic and would be supported by several parallel and fully integrated components, namely; (i) investments in new solid waste management facilities; (ii) a pilot initiative with UNEP to establish a global standard on 'green buildings'; (iii) establishment of Bangkok as a regional learning center for GHG mitigation programming (with CF-Assist); (iv) twinning with Paris for climate change support (adaptation and mitigation); and (v) improved solid waste and waste water management at existing facilities.

84. **BMA's Mitigation Plan might also be financially supported by carbon finance under a post-Kyoto regime.** If the city is able to achieve the proposed 15 percent GHG emission reduction target, this could yield US\$60 million per year in carbon finance if the overall program could be incorporated into a CDM-approved methodology (assuming \$10 per ton ERs and 6 million tones CO₂e reduction). The World Bank's Carbon Finance Unit and Urban Anchor have jointly developed a "city-wide" approach to reduce GHG emissions. The approach covers key GHG sources in cities, encompassing technological interventions in management of waste and water, improving efficiency in energy demand and supply, and promoting efficient transport. It also includes urban agriculture and forestry as a possible GHG-sink. This approach encourages city authorities to holistically assess the GHG impact of the city as an integrated system, and thus assists cities to develop strategic, long-term programs to reduce their GHG emissions.

85. **Urban Transport Transformation through BRT.** CTF support is proposed to co-finance the integrated public transport and urban planning through construction of selected priority BRT routes as part of an interlinking network of 14 Bus Rapid Transit (BRT) routes throughout the city totaling more than 250km in length. Physical works for BMA's first pilot route covering total length of 15 kilometers are almost completed and operation is expected to start in December 2009. The second route has also started construction already. The current BRT routes are planned to have dedicated fleet and services operating as a closed BRT system, modeled on Bogota's Transmilenio BRT. BMA plans to develop BRT as part of an integrated urban transport. It has built pedestrian connections to the existing elevated BTS System and is planning bus and pedestrian connections with future mass transit lines. The original design proposed CNG buses. However, BMA is also considering more fuel efficient and lower carbon emission hybrid buses to meet future demand. The priority BRT routes to be supported by CTF are expected to start construction in 2010.

86. **Improving City EE.** CTF support is proposed to co-finance EE investment in BMA facilities and public spaces. EE investments will focus on electrical appliances and air-conditioning. The project will cover 20,000 square meters of BMA-owned offices and facilities and is expected to reduce BMA's electricity bill by 30 percent. The project will

serve as a model for commercial buildings in Bangkok and other municipal and provincial facilities throughout Thailand.

87. **Transformational impact.** With CTF support, BRT would have transformational impact on the development of integrated urban public transport, efficiency of urban transport energy use and sustainable urban development. The success of the current mass rapid transit lines in Bangkok¹⁶ has demonstrated that reliable and high quality public transport can transform travel patterns by inducing a shift from private cars to public modes, intensifying activities around mass transit stations, and improving urban livability. By delivering high quality and reliable transit services, a comprehensive BRT network could directly transform city travel in similar manner but more cost-effectively and with a lower energy requirement than the MRT. BRT would also require much less energy for construction than MRT. The life-cycle energy requirement on per passenger basis could therefore be much lower for BRT than MRT. In a metropolitan area like Bangkok there are many traffic corridors more suitable for BRT than for MRT. Constrained public budgets also make BRT essential to consider.

88. **The most significant transformational impact is potentially indirect.** However, successful implementation of BRT could assist in overcoming institutional impediments that favor maintenance of the status quo in particular the incumbent State-enterprise Bangkok Mass Transit Authority (BMTA), the urban bus monopoly, which is overstaffed and very slow to respond to the changing travel needs of Bangkok's commuters. BMTA's own 3,500 fleet and that of its 35 sub-contractors representing 4,000 buses average 17 years of age are uncomfortable, and not energy efficient. Consequently, BMTA's ridership has been declining at a rate of 5 percent per annum in recent years. Through overcoming impediments and moderate institutional reform, the bus sector could be transformed through new investment, modern operating practices and through the "congestion cutting" priority afforded by BRT.

89. **Success of BRT will also provide strategic contribution to the broader integrated urban transport strategy** by offering complementary services to existing and planned BTS and MRT lines. Realizing the full potential for significant modal shift from auto to bus would also depend on other complementary policies such as appropriate user charges (e.g. higher gasoline taxes), appropriate land use management, a comprehensive BRT network, high quality ordinary bus services, plus the government's planned BTS and MRT program.

90. **Cumulative emission savings.** The two activities under the urban transformation component is expected to result in an estimated emission reduction of 1.18 million tCO₂e

¹⁶ The IFC 2001 study of the external benefits of the elevated Bangkok Transit System showed that over 15% of patronage was attracted from driving cars.

per year when the program has been fully implemented, which will accumulate to 11.8 million tCO₂e for the project life over 10 years.

91. ***Replication potential and scalability.*** By contributing to the BMA's integrated plan in reducing GHG emission, the program would demonstrate the effectiveness of a comprehensive, programmatic approach to reducing GHG emissions on a mega-city scale. As such the program could serve as a potential role model for the many mega-cities. Bangkok now ranks as the 32nd among the world's largest cities in terms of population; 18th among Asian cities. Bangkok is already a world leader on the municipal climate change stage, being a member of the C40 and is hosting the Cool ASEAN Green Capitals Initiative. Outside of China and Indonesia, and excluding Japan, there are no successful examples of BRT in East Asia. China's strong institutions make its experience less easily transferred. TransJakarta, Indonesia's BRT, is improving in quality but other fully formed and successful BRT examples are required. Bangkok offers this opportunity with the first line virtually complete and built to high quality. The challenges, all of which are manageable, are to quickly implement high quality BRT services and through good urban design and small scale investments to upgrade the walk-in and cycling catchments, and connections to other bus and transport services.

92. **The Urban Transformation component would therefore create unique opportunities for replication, for both city-wide GHG emissions reductions effort and BRT, throughout Asia and the developing world.** In addition, congestion and lack of adequate public transport are also raising challenges for other secondary cities in Thailand such as Chiang Mai (0.5M) and Nakhon Ratchasima (0.4M). The success of BRT development in Bangkok could demonstrate viable low carbon transport solutions and models for replication in these secondary cities.

93. ***Development impacts and co-benefits.*** A BRT network integrated into the existing public transport system including the BTS and MRT will drastically improve the mobility of low-income households through access to better and more affordable transport services. The effectiveness of BRT systems at creating accessible urban jobs for outlying low-income households has been proven in dozens of cities around the world. BRT is also expected to relieve congestion problem. Improved congestion and better quality public transport should result in less travel time and improved quality of life for Bangkok residents. The co-benefit of reduced air pollution in congested Bangkok is also expected to be significant (in the range of more than US \$ 100 million per year). BRT could have large spill-over impacts on livability of the city; reshape neighborhood development and overall urban development.

94. **The adoption of urban GHG reduction program has a range of local and national air quality benefits.** The BRT component will provide improved services to commuters through provision of fast, secure, and convenient public transport that is integrated with other modes including rail BTS and MRT. The greater the benefits to public

transport users, the higher the switch from car to public transport will be with commensurate savings in travel time, vehicles, parking facilities, imported oil and road infrastructure. Reduced fuel imports will contribute to the country's energy security. Improved thermal performance of buildings reduces the fiscal drain of heating and cooling public buildings. Savings from reduced electricity bills for public buildings could be used for other purposes such as health and education services.

95. **Implementation potential.** The BRT Master Plan indicates an ambitious timeframe to complete the entire system by 2015. The construction of the BRT Line 1 is soon to be completed. The procurement of the low emission buses is underway. Furthermore, the Government has granted necessary authority to BMA to operate the BRT system instead of the Bangkok Mass Transit Authority (BMTA) which has long been operating in deficit. The Government's decision creates a conducive environment for the BRT to be effectively operated. Therefore, **the proposed CTF-co-financed program is timely and can provide tremendous value added to the successful deployment of the entire BRT system.** When comparing to other low carbon alternatives such as BTS and MRT systems, the BRT infrastructure is simpler, less expensive, and quicker to implement, and generates lower emissions during the construction. Additionally, BMA which has the oversight of more complex BTS system would be able to utilize its experience in the development and implementation of the BRT system. It is crucial, however, that the BRT system is integrated seamlessly with other modes of low emission transport to deliver the maximum benefits of GHG and other local air emission reductions, travel time and operating cost savings as well as safety benefits.

96. **Additional cost/risk premium.** Under a business-as-usual scenario, BMA would find it risky to invest in comprehensive network of several BRT lines and adopt low carbon emission buses when the BRT has not been successfully piloted in Thailand and due to higher cost of low emission buses. BRT is however proven in many other cities around the world and lessons learned is that BRT will have the highest chance of success when implemented as a network rather than a single line. In addition, given budget and organizational constraints of BMA, it is unlikely that BMA could allocate sufficient budget determined on a yearly basis to finance the whole project or network. Budget is only made available for each route with no long-term commitment or long-term investment plan and sequencing of future lines. Sometimes, budget is only made available for civil works construction and not sufficient for bus purchases and operation. This fragmented implementation of BRT seriously hampers the chance of success of the project. The concessional financing from CTF will support the scale of investment needed to prove the efficacy of a comprehensive BRT network.

97. Results indicators for the Urban Transformation component are summarized in Table 6.

Table 6: Results Indicators for Urban Transformation Component

| Project | | Descriptions | Investment (\$ million) | CO ₂ reduction (million t) |
|--------------|---|---|----------------------------|--|
| Component 1 | Urban Transport: Integrated public urban transport | Construction of priority BRT routes. | 1,218.0 | 1.16 |
| Component 2 | Energy efficiency: Improve Building Electricity Consumption | Improve public space energy and electricity consumption | 48.7 | 0.02 |
| Total | | | 1,266.7 | 1.18 |

V. ENABLING POLICY AND REGULATORY ENVIRONMENT

5.1 ENERGY

98. **The cornerstone of clean energy policy in Thailand is the 1992 Energy Conservation and Promotion Act (ECP Act), which in turn established the Energy Conservation Promotion Fund (ECPF) in 1993.** The objectives of the Energy Conservation Promotion (ECP) Act were to: (i) ensure efficiency of production and utilization of energy; (ii) provide the legal basis for compulsory energy efficiency activities by larger users; and (iii) establish a mechanism for financing energy conservation activities, e.g., the ECPF. The ECP Act provided for three types of government interventions in the energy sector: compulsory, voluntary, and complementary. The compulsory program, implemented by DEDE requires that designated factories and buildings conduct energy audits and submit energy conservation targets, plans, and reports every three years. The voluntary program, implemented primarily by the Energy Policy and Planning Office (EPPO), promotes and supports EE and RE programs across consuming sectors. The complementary programs include support for R&D projects and funding for public awareness building and capacity building of clean energy professionals.

99. **The ECPF is supported through a small levy on petroleum products.** The annual inflow to the ENCON Fund is about USD 40 million. Through the ENCON Fund, the government has been able to promote and support hundreds of EE, RE and CP programs and projects since 1995.

100. **A second cornerstone of clean energy in Thailand is EGAT's Demand Side Management Office (DSMO).** Established with the support of the GEF-financed Thailand Promotion of Electricity Energy Efficiency (TPEEE) project (1993-2000), the DSMO was instrumental in developing household appliance efficiency standards, labeling and testing regimes which continue today. The DSMO also helped establish foundation of private sector led energy efficiency industry through a series of ESCO pilot projects.

101. **An apex organization responsible for the entire energy sector, the Ministry of Energy, was established in 2002.** Most of the agencies charged with clean energy responsibilities are consolidated under MOEN, including EPPO and DEDE. MOEN also oversees most state-owned energy enterprises including EGAT, MEA, PEA, and the Energy Fund Administration Institute. Table 7 summarizes the roles of these agencies.

Table 7: Role of Energy Agencies in Thailand

| Organization | Scope of Work |
|---|---|
| Ministry of Energy (MOEN) | MOEN has overall responsibility for managing the energy sector and developing national strategic energy plans and targets. Its key duties are to supervise and promote the stability of the country's energy supply and to provide integrated services to the general public. |
| Energy Policy and Planning Office (EPPO) | EPPO's main responsibilities include recommending and setting energy policies, measures, and plans so as to effectively satisfy the energy needs of the country, and ensure sustainable energy security. EPPO implements voluntary energy conservation programs, such as public awareness campaigns and promotion of natural gas vehicles (NGVs) for the transportation sector. |
| Department of Alternative Energy Development and Efficiency (DEDE) | DEDE is the main implementing agency for compulsory and voluntary EE and renewable energy programs. DEDE is responsible for EE promotion, energy conservation regulation, development of alternative energy, and dissemination of energy technologies. |
| Electricity Generating Authority of Thailand (EGAT) | EGAT is a state enterprise responsible for generating and supplying electricity nationwide through two other state enterprises, the Metropolitan Electricity Authority (MEA) and Provincial Electricity Authority (PEA). EGAT also runs the Demand Side Management (DSM) Office, which promotes energy efficiency in appliances and equipment, primarily through a national standards and labeling program. |

Source: USAID Eco-Asia Country Report; Thailand (June 2007)

102. **In order to address Thailand's heavy dependence on imported oil, the government devised a National Energy Strategy in 2005.** The main strategies include establishing a regulatory framework for electricity and natural gas industries, enhancing energy supply for national energy security promoting energy saving and energy efficiency; promoting renewable and alternative energy, and diversifying fuel types and sources; Instituting market-based pricing structures to promote competition; establishing mandates on clean energy to lessen negative impacts on the environment; and promoting public and private participation in policy for sustainable development.

103. **In response to the National Energy Strategy, the Energy Industry Act was passed in December 2007, establishing the Energy Regulatory Commission (ERC).** The ERC was appointed in February 2008 and is still building capacity to undertake its responsibilities for regulating the power and natural gas sector. The Office of the Energy Regulatory Commission will be responsible for energy consumer protection plus approving tariffs, issuing licenses and regulating state-owned energy enterprises. Section 8 of the Act calls for the Government to establish policies to fully exploit renewable energy and other indigenous energy sources.

104. **An early initiative of the ERC was establishment of the Power Development Fund to finance subsidy programs for RE projects.** The Power Development Fund will act as a channel for implementing the subsidy arrangements for underprivileged power consumers, rehabilitating localities, compensating people affected by power plant

operations, and the promotion of renewable and environmentally friendly energy. Revenue for the fund is provided by a levy on power generators.

105. **The Thai government has encouraged private sector participation in renewable energy development for many years through programs such as the Small Power Producers (SPP) and Very Small Power Producer (VSPP).** These programs support renewable electricity production from biogas, biomass, municipal solid waste (MSW), wind, solar, and other renewable energy sources. The VSPP program promotes distributed renewable energy generation. It is restricted to power generated from renewable resources with capacity less than or equal to 10 MW. SPP promotes power generated from co-generation or renewable sources with capacity more than 10 MW but not exceeding 90 MW. The government subsidy for SPP and VSPP is an increment (“addor”) to the electricity purchase price, depending on the type of renewable energy. The minimum adder is 0.50 Baht/kWh (1.5 US cents/kWh). Adders by fuel type and size are shown in Table 8.

Table 8: Adder for RE Power Production Sorted by Type and Capacity

| Fuel Types / Size | Original Adder (Baht/kwh) | Extra Adder (Electricity from RE for diesel oil replacing) (Baht/kWh) | Extra Adder for Southern Provinces & Remote Areas Adder (Baht/kWh) | Period (Years) |
|-------------------------|---------------------------|---|--|----------------|
| 1. Biomass | | | | |
| Capacity ≤ 1 MW | 0.50 | 1.00 | 1.00 | 7 |
| Capacity > 1 MW | 0.30 | 1.00 | 1.00 | 7 |
| 2. Biogas | | | | |
| Capacity ≤ 1 MW | 0.50 | 1.00 | 1.00 | 7 |
| Capacity > 1 MW | 0.30 | 1.00 | 1.00 | 7 |
| 3. MSW | | | | |
| AD / Land Fill Gas | 2.50 | 1.00 | 1.00 | 7 |
| Thermal Process | 3.50 | 1.00 | 1.00 | 7 |
| 4. Wind Energy | | | | |
| Capacity ≤ 50 kW | 4.50 | 1.50 | 1.50 | 10 |
| Capacity > 50 kW | 3.50 | 1.50 | 1.50 | 10 |
| 5. Mini Hydro | | | | |
| Capacity 50 kW ≤ 200 kW | 0.80 | 1.00 | 1.00 | 7 |
| Capacity < 50 kW | 1.50 | 1.00 | 1.00 | 7 |
| 6. Solar PV | 8.00 | 1.50 | 1.50 | 10 |

Source: EPPO

106. **On the EE side, the Energy Conservation Promotion Fund (ECPF) established in 1992 continues to be an important source of technical and financial support to EE.** A Revolving Fund capitalized through the ECPF provides low interest loans for EE via financial institutes (Term: 7 years with 1 year grace, less than 4 percent APR, per-project cap of \$1.3 million). This Revolving Fund has supported over 250 EE/RE projects over the

period 2002-2008 and resulted in a total investment around \$500 million, including \$150 million co-financing from the Fund. Future plans include re-capitalization of up to \$60 million for the Fund plus new efforts to provide more technical assistance to developers and banking officers.

107. **A sister fund, the ESCO Fund, was established by MOEN in 2008. The ESCO Fund addresses the need for start-up capitalization of energy service companies by providing for the government to co-invest with private investors.** The Fund can provide equity investment, venture capital, facilitate equipment leasing, provide credit guarantees, and support project development. Two Fund Managers have already been selected (Energy Conservation of Thailand Foundation and Energy for Environment Foundation) and the goal for 2009/2010 is to leverage \$50 million in new project investment.

108. **The development of RE, EE and CP remains limited, but with good prospects for scaling-up in the near future.** This positive outlook stems from the strong frameworks in place for production subsidies and concessional financing, which have significantly improved commercial viability of RE/EE/CP projects and facilitated private investment. For example, there were over 1300 individual alternative (“Non-conventional”) SPP and VSPP projects totaling 10,500 MW either proposed, under consideration or operational as of June 2008. Although only 1,750 MW were operational and selling to the grid, another 580 projects totaling 4,200 MW had been approved but not yet constructed.¹⁷

109. **For RE development, especially biomass energy, the lack of proper zoning and management of biomass feedstock causes price volatility and shortages.** Although adders provide stable expectations for project developers and good financial incentives for investors, whether they are set at appropriate level considering cost of technologies and net benefits in developing each RE needs further review.

110. **There is a major need for Thailand to accumulate and develop technology and human capacity in a more integrated manner.** There is still lack of support on clean energy technology and operating requirements. This must be addressed in order to reduce perceived and real risks of RE projects and identify and develop critical domestic industries and specialties. Government support through R&D and early investment to close technological gaps and encourage technological development and innovations is needed.

111. **Financial barriers remain the most important barrier to investment in clean technologies.** Local banks still perceive a higher level of risk associated with RE power plants and EE/CP development due to limited experience in lending practices and proven business cases. Private investors continue to experience difficulty in securing debt

¹⁷ “The Role of Renewable Energy, Cogeneration and Distributed Generation in Sustainable Energy Development in Thailand”, Piyasvasti Amranand, World Renewable Energy Congress 2009 , 20 May 2009

financing or incurring high debt financing costs, which reduce returns on investment and commercial appetite for projects.

5.2 CLEAN URBAN ENVIRONMENTS

112. The BMA is taking various measures to maintain its competitiveness, better manage the urban environment, and particularly reduce greenhouse gas emissions.

The BMA Administration has a vision to develop Bangkok to be a “Sustainable Metropolis”, that is, “Developing Bangkok Metropolis to be the center of the region and one of the world’s leading metropolises, with high quality environment as well as good and sustainable quality of life”. BMA has developed a 12-year development framework plan, starting from 2009 to 2020. The 12-year plan will be divided into three stages of Performance Plans, each covering the period of 4 years according to the elected governor’s term. The first Performance Plan 2009-2012 laid out five main strategies (so-called “5 Big Moves”) for the 12-year plan. The 5 Big Moves identified are: 1) Strengthening Infrastructure for Regional Mega-City; 2) Developing Strong Economy and Knowledge-based Society; 3) Striving for Green Bangkok; 4) Providing Good Quality of Life in Cultural Mega-City; and 5) Mastering Best Service and Mega-city Management.

113. The BMA’s Action Plan on Global Warming Mitigation 2007-2012 is key in creating an enabling policy environment for the city to move ahead with its climate change and sustainable development vision. This document establishes the target of reducing the city’s emissions by 15 percent (6.4 mtCO₂e per year in 2012) from the levels projected under a business as usual scenario. The Action Plan sets out in some detail the specific activities, such as adopting the Building Energy Efficiency Code for all metropolitan buildings and investing in a Waste-to-Energy incineration/power plant facility.

114. Another enabling environment for clean urban development is decentralization policy in Thailand. Thailand has started the decentralization process in the 1970s where a local authority is given more responsibility and financial capacity to deliver infrastructure services and other public services. BMA’s desire to play an increasing role in service delivery is fully in line with the spirit of decentralization and bottom-up approach to climate change management.

115. Nevertheless, despite being driven by decentralization process of the central government and ambitious vision and strategies in place, BMA has experienced difficulty in implementing actions on the ground. The real challenge for the city from now on will be how this vision and strategies can be realized and implemented. Major constraints to successful implementation are mismatch between functional responsibilities which are: (i) financial resources as a result of decentralization process, which is still in progress; (ii) insufficient financial resources for capital investments; (iii) the lack of coordination between numerous national agencies and local government involved; and (iv) institutional weaknesses within BMA.

VI. IMPLEMENTATION POTENTIAL

116. This section addresses the capacity in place to implement the proposed investments, as well as the constraints that could impede implementation. A generic constraint for all investments that reduce GHG emissions through efficiency improvements is the volatility of oil prices. Higher primary energy prices, especially oil prices, make investing in a lower-carbon economy more financially attractive. A downward trend in oil prices might require additional incentives or price adjustments in order to keep investments financially attractive. Another overarching risk in the context of Thailand is the government’s policy on foreign borrowing which has been implicated due to ample liquidity in domestic financial market and political economy of foreign borrowing.

6.1 CLEAN ENERGY ADVANCEMENT COMPONENTS (PUBLIC AND PRIVATE)

117. Table 9 summarizes the main risks and risk mitigation measures. Overall risk is considered moderate.

Table 9: Clean Energy Advancement Project Risks and Mitigation Measures

| Risk | Mitigation Measure | Residual Risk |
|---|---|---------------|
| Policy and regulatory framework: Expected private sector investments may not materialize due to limited availability of debt financing | <ul style="list-style-type: none"> • Government Adder Policy issued to promote private sector investment. • Channel CTF and MDB’s lending through financial intermediary banks to targeted projects • Technical assistance to intermediary banks and borrowers in identifying and processing project, especially risk mitigation measures. • Technical assistance for the set up of guarantee facility to facilitate lending for private investments • Engage in policy dialogue with government and stakeholders. | L |
| Implementation Capacity: Limited implementation capacity of smaller-scale investors | <ul style="list-style-type: none"> • Technical assistance to transfer technological and know-how and build up implementation capacity of developers. | L/M |
| Technology: Limited know-how for wind and solar which have not been demonstrated at large-scale in Thailand. Limited planning on zoning and supply of feedstock for RE power generation project, especially for biomass | <ul style="list-style-type: none"> • Technology and know-how transfer for relatively new technologies such as solar and wind. • Enhanced overall planning and regulation for investment projects and management of feedstock risk by MOEN, with technical assistance if needed. • The capacity building component will provide technical support to implementing agency to identify optimal technologies for EE and learn from international experiences. | M/H |
| Finance: Commercial viability of small projects, especially | <ul style="list-style-type: none"> • Provide technical assistance to project developers in preparing projects including financial analysis and | M/H |

| | | |
|---|--|---|
| technology with high capital costs such as solar, will vary project by project. Commercial viability of small RE projects at community level/with community participation is a challenge. Commercial banks may still feel reluctant to lend without adequate risk management instrument in place. | <p>technological know-how.</p> <ul style="list-style-type: none"> • Additional support on carbon finance will be provided to support the development of programmatic CDM to pursue carbon credits that would enhance commercial viability of the projects. This also entails technical support during the implementation/verification phases. | |
| Environmental Management: Most of the RE projects will be small scale and have limited environmental impact. Thailand has strong policy and legal framework for and lengthy experiences with environmental management. | <ul style="list-style-type: none"> • Working closely with local communities to ensure sound environmental and social management practices. • Comply with national requirements for environmental management. • Ensure compliance with national requirements for environmental management. | L |
| Development Potential: Although small scale renewable has high development potential with close linkage to community participation, power plants have negative public images and may face community resistances. | <ul style="list-style-type: none"> • Working closely with local communities and use participatory approach to develop projects. | L |
| Carbon finance measurement and verification risk. Verification bottlenecks are currently delaying annual payments and affecting the financing structure of large scale transactions. | <ul style="list-style-type: none"> • Work closely with Carbon Finance Unit and counterparts to identify any steps in the methodology and verification process that could cause delays • Consider selling into secondary carbon markets | L |
| Procurement | <ul style="list-style-type: none"> • Competitive bidding would be used to acquire equipment where necessary. Support will be provided in the development of the bidding documents using technical specifications based on best international practice. | L |
| Overall | Moderate | |

6.2 URBAN TRANSFORMATION

118. **The Action Plan on Global Warming Mitigation 2007-2012 has laid out a very clear plan and specific activities to achieve its emission reduction target.** Other multilateral and bilateral agencies have extensively engaged with various departments within the BMA to advise and support the climate change activities contained in the Action Plan. For example, the World Bank Institute (WBI) through its CF-Assist program together

with Agence Française de Développement (AFD) is supporting a City Twinning program between Bangkok and Paris. This city-to-city program will involve structured knowledge exchange (capacity building) regarding wider use of carbon finance in sustainable urban development. Working with BMA as partner, WBI is assisting in designing a suitable program that meets the needs of city of Bangkok, focusing on specific tasks, and achievable with the available limited resources from the cities and the twinning program. The upshot of these exchange and capacity building efforts will be to build sufficient capacity within BMA to undertake the very ambitious content of the Action Plan as well as to implement the components of this Investment Plan related to urban transformation for Bangkok.

119. Table 10 below summarizes the main risks and risk mitigation measures for the urban transformation component. Overall risk is considered moderate.

Table 10: Urban Transformation Project Risks and Mitigation Measures

| Risk | Mitigation Measure | Residual Risk |
|--|--|----------------------|
| Policy and regulatory framework: There is a clear policy for urban GHG reduction. However, there is low level of implementation measures mandated under the new energy efficiency law. | <ul style="list-style-type: none"> The capacity building component will provide technical support to BMA in order to develop the additional regulatory and policy measures that are mandated under the new action plan. | M |
| Implementation capacity: Limited human resource capacity and inadequate technology transfer. Limited capacity for scaling up the carbon finance asset generation in a programmatic manner. | <ul style="list-style-type: none"> Technical, organizational and financial assistance to strengthen the relevant agencies will be provided. CTF resources will extend assistance throughout the implementing departments within BMA. Additional support on carbon finance will be provided to support the development of programmatic CDM to pursuer carbon credits that would support scaling up of the interventions. This also entails technical support during the implementation/verification phases. | M |
| Technology: New more efficient technologies present operational and maintenance problems | <ul style="list-style-type: none"> Only well proven technology would be used. Technical assistance will be provided if needed. | L |
| Finance: Lack of resources to scale up the implementation of the program | <ul style="list-style-type: none"> The financial crises and global and national economic recession will eventually force the government to revise the budget and adjust prioritization of projects across sectors. Loan resources will be complemented with carbon finance and private sector participation. | M |
| Environmental Management | <ul style="list-style-type: none"> Technical assistance will be provided to strengthen capacity. Programs will follow approved procedures and annual performance audits will be | L |

| | | |
|---|---|---|
| | carried out. | |
| Development Potential: Low penetration of new technologies. | <ul style="list-style-type: none"> Support in designing a phased approach will be provided together with the right incentives and supportive regulatory framework in order to ensure an adequate market uptake of the new technologies. | L |
| Carbon finance measurement and verification risk. Verification bottlenecks are currently delaying annual payments and affecting the financing structure of large scale transactions. | <ul style="list-style-type: none"> Work closely with Carbon Finance Unit and counterparts to identify any steps in the methodology and verification process that could cause delays Consider selling into secondary carbon markets | M |
| Procurement: | <ul style="list-style-type: none"> Competitive bidding would be used to acquire equipment where necessary. Support will be provided in the development of the bidding documents using technical specifications based on best international practice. | L |
| Overall | Moderate | |

VII. FINANCING PLAN AND INSTRUMENTS

120. This section explains how the GoT and its development partners will mobilize sufficient co-financing from various multilateral, public and private sources, including carbon finance, to achieve the Investment Plan’s ambitious objectives.

121. **Carbon Finance will potentially play a critical role in this Investment Plan, with the additional income assisting in project cash flow.** However, carbon finance is conditional on proved performance and therefore would only be available after sub-projects have been implemented and actual GHG emission reductions have been verified. These risks mean that project developers may, and often do, discount carbon revenues when making investment decisions. As a result, CTF funding if structured appropriately would still be required for projects that are expected to receive carbon revenues, in both situations when (i) carbon revenues are not sufficient to make the project feasible and (ii) when risks of receiving such revenues are perceived to be excessively high so as to prevent a project from taking place. An estimated \$367 million could eventually flow to these projects through the carbon finance mechanism.

122. Table 11 below summarizes the investment needs and proposed allocations across the various sources of financing (in US\$ million). It must be noted that these are notional amounts, revisable according to government plans.

123. **GoT will participate in the two public sector** components – Clean Energy Advancement – Public Sector and Urban Transformation. GoT will provide almost half of the total financing requirements (\$2,083 million of \$4,313 million in total).

124. **IBRD and CTF will participate in co-financing of \$460 million.** Total IBRD lending will be \$230 million with \$160 million for Clean Energy Advancement and \$ 70 million for Urban Transformation. Total CTF support will be \$230 million for these two components.

125. **IFC will provide \$270 million in financing for the Clean Energy Advancement - Private Sector component,** with CTF providing another \$70 million in support. IFC and GoT will work together to mobilize another \$980 million in private investment.

126. The private sector is expected to co-finance many individual projects within the Clean Energy Advancement Financial Intermediary sub-component.

Table 11: Indicative Financing Plan (\$ millions)

| Financing Source | Clean Energy Advancement – Public Sector | Clean Energy Advancement – Private Sector | Urban Transformation | Total |
|---------------------------|---|--|-----------------------------|--------------|
| | Annex 2 | Annex 3 | Annex 4 | |
| CTF | 160 | 70 | 70 | 300 |
| GoT/Counterpart | 956 | - | 1,127 | 2,083 |
| IBRD loans | 160 | - | 70 | 230 |
| IFC loans | | 270 | - | 270 |
| Private Sector | 400 | 980 | - | 1,380 |
| Total | 1,676 | 1,320 | 1,267 | 4,263 |
| Carbon Finance Potentials | 191 | 60 | 116 | 367 |

ANNEX 1: COUNTRY STATISTICS

| | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-------|
| GDP per unit of energy use (constant 2005 PPP \$ per kg of oil equivalent) | 5.04 | 4.83 | 4.62 | 4.56 | 4.63 | 4.51 | 4.46 | 4.43 | 4.36 | 4.42 | 4.53 | .. |
| Energy use (kg of oil equivalent per capita) | 1,226.70 | 1,248.66 | 1,157.14 | 1,209.59 | 1,236.70 | 1,285.68 | 1,359.34 | 1,454.26 | 1,562.12 | 1,597.51 | 1,629.67 | .. |
| Electric power consumption (GWh) | 80,520 | 86,678 | 84,332 | 84,623 | 91,160 | 95,611 | 103,636 | 110,614 | 118,762 | 125,259 | 131,971 | .. |
| Electricity production from coal sources (percent of total) | 20.04 | 20.43 | 18.48 | 18.22 | 18.33 | 19.14 | 17.25 | 15.78 | 15.97 | 15.42 | 17.97 | .. |
| Urban population (percent of total) | 30.46 | 30.62 | 30.78 | 30.94 | 31.10 | 31.34 | 31.58 | 31.82 | 32.06 | 32.30 | 32.64 | 32.98 |
| Urban population growth (annual percent) | 1.65 | 1.64 | 1.61 | 1.55 | 1.47 | 1.63 | 1.55 | 1.49 | 1.45 | 1.44 | 1.74 | 1.65 |
| Passenger cars (per 1,000 people) | 28.16 | .. | .. | .. | 43.00 | 46.00 | 52.00 | 54.00 | .. | .. | .. | .. |
| Final Energy Consumption (TOE/Million Constant 2000 USD GDP) | 399.9051 | 410.4598 | 419.8853 | 425.2132 | 417.355 | 423.4238 | 427.3983 | 422.0072 | 429.0871 | 421.1461 | .. | .. |

Source: World Bank (2009) *The Little Green Data Book 2009*.

ANNEX 2: CLEAN ENERGY ADVANCEMENT – PUBLIC SECTOR

The proposed Clean Energy Advancement Program – Public Sector comprises three subprojects. Each subproject has different implementing agency. The three subprojects are: (A) Catalyzing Private Clean Energy Investments through public SFIs as financial intermediaries; (B) Advancing Public Investments in Clean Energy through Public Utilities (EGAT); and (C) Advancing Public Investments in Clean Energy through Public Utilities (PEA). Details of each subproject are described below.

The proposed interventions adopt programmatic nature to collectively support the AEDP. In fact, achievement of AEDP targets need efforts of both public and private sectors, including making lending available from both public and commercial banks to public and private investors. The three proposed interventions focus The whole Clean Energy Advancement Program – Public Sector is expected to result in 700 MW of new renewable energy capacity, with the estimated total investment size of \$1.6 billion, contributing to 18 percent of additional capacity needed to achieve AEDP target by the year 2022.

A. Catalyzing Private Clean Energy Investments through SFIs

Problem Statement

1. Thailand is one of the most carbon intensive economies within the South East Asia region. So far, only 1,750 MW of renewable energy, mostly biomass, has been installed in Thailand. The total potential for the development of RE is 57,000 MW.
2. Financial barriers to clean energy investments are ranked as high by investors. This is due to high perceived risks of RE and EE businesses and lack of sufficient demonstrated business models in RE/EE. Given the incentive tariff regime in place and clear government policy to promote RE under AEDP, a large number of RE projects has been proposed by both public and private developers in the pipeline. This can be seen both from number of projects applying for licenses to operate and those seeking debt financing from banks. However, the RE/EE business lines are just being established in commercial banks and SFIs. And the sizes of lending as well as number of projects are still limited. There is a need to expand lending to RE projects in order to scale up RE investments to achieve the AEDP targets. There is also a need for knowledge and technology transfer for RE especially for small- and medium-sized entrepreneurs.

Proposed Transformation

3. The proposed activity will help transformation of the business environment for investment in RE and EE projects, through enhancing and opening up lending business in RE. This will improve access to and lower cost of fund by reducing perceived market

risks in RE technologies/businesses. The proposed program will also lead to transformation of the energy sector with increased renewable energy share in the country's energy mix by helping the country realize its national renewable energy target. This will also contribute and lay the foundation for the country's national long-term strategy to transition to low-carbon economy by incubating green manufacturing and services industries.

4. The proposed program is expected to result in around 370 MW of new capacity with the estimated total investment of \$800 million. The rest potentials are expected to be achieved by the IFC supported operation with local commercial banks to facilitate a lending of about \$1.3 billion to RE and EE projects, and replication of both IBRD and IFC supported RE and EE programs as a result of structural transformation of the market, with removal of the major barriers to scale up the investment in RE and EE.

5. There is a strong potential for private investments with large numbers of individual projects for RE (solar, biomass and wind). These individual projects are small in size but taken together could result in large scale investment. This proposed activity is proposed to channel financial resources through participating banks as the financial intermediaries to a large number of small and medium enterprises to invest in RE projects. The Specialized Financial Institutions (SFIs), which are policy banks under the Ministry of Finance, will act as financial intermediaries. The Bank of Agriculture and Agricultural Cooperatives (BAAC) and EXIM Bank will be the two participating SFIs. BAAC has a large and strong customer base in the agricultural sector with 5.68 million customers including 4.12 millions farmer households and 1.56 millions agricultural operatives. While individual farmers and agricultural operatives are BAAC's traditional customers, it also plans to expand its customer base to community enterprises and over 5,000 Local Administration Organizations (LAOs) and municipalities which are expected to invest more in local infrastructure services all over the country. EXIM's traditional business area focuses on export-import business and international trade in line with the country's export-driven economy. However, it has developed its vision to become a development bank by adopting a more ambitious role as a trade and investment financial institution in the GMS for economic development. To achieve this, it has started to develop new product and expertise to finance infrastructure and public utilities and aims to expand their lending to energy and renewable energy projects. Lending in RE are currently limited to biofuels in response to the government's policy.

6. The financial intermediary is proposed to support biomass, solar and wind projects which are in the participating banks' pipeline or to be identified in the future.

7. One potential project identified to be financed through SFIs is small scale community biomass development, which will be undertaken in collaboration with the Land Development Department (LDD), the Ministry of Agriculture and Cooperatives (MOAC), and PEA. The BAAC is interested to finance projects with strong linkages to agricultural, rural and community development that could build on BAAC accumulated expertise in these areas.

8. The objective of this project is to utilize agricultural wastes scattered around the country as fuel for power generation. This will also reduce agricultural waste disposal through burning, which is widespread and has adverse environmental consequences. The program is also expected to improve energy security of the grid in the rural areas, provide additional sources of income to farmers / rural communities and contribute to community development. Bio-charcoal, a byproduct from biomass power production, could also be used to improve soil condition and agricultural productivity.

9. The project involves investment in small-scale (less than 0.4 MW) community-level biomass gasification power plants using fuels such as agriculture crops, agriculture residues, wood and wood residues, and waste streams. Target private investors will be local agricultural/business cooperatives or the Local Administrative Organizations (LAOs). Power generated will be sold to PEA at the base tariff plus adders under the government's SPP/VSPPP program. The program is expected to enroll some 360 communities over a four year implementation period. The project will result in about 144 MW of new capacity, each of which is expected to result in 936 ton of annual CO₂ reductions. The total annual CO₂ reductions if the program is fully implemented will be 0.34 MtCO₂e.

10. The project has strong replication potential. LDD can work closely with other agencies in identifying potential sites all around the country. LDD would identify sites with fuel availabilities, PEA would provide expertise on potential sites that could be connected to the distribution network, MOEN would oversee national biomass development, BAAC would provide financing, and CTF would co-finance the investment program.

11. Solar is still in an early stage of development in Thailand. According to MOEN, only 0.064 percent of total potential (or 32 MW out of 50,000 MW) has been developed, mainly due to limited access to debt financing. The solar energy has the highest tariff incentive, with an “adder tariff” of 8 baht/kWh on top of the base tariff. There are great potentials to scale up solar in Thailand. The incentive tariff regime is favorable in attracting investments. There are several proposals for solar submitted to MOEN right now but they are facing barrier of access to financing. The CTF support could help overcome this barrier of access and scale up use of solar energy in parallel with other RE sources available in Thailand.

12. Wind also has strong potential with total estimated potential of 1,600 MW and 1 MW utilized in 2008. Several proposals to develop wind have been submitted to the MOEN. MOEN has set a target to develop 800 MW of wind capacity by 2022. The proposed CTF is critical to overcome technical and financing barriers to scale up wind energy use in Thailand. The Bank has experience in supporting the scale up of wind energy use in other countries, e.g. in China. Thailand could benefit from these experiences and lessons with the CTF and IBRD lending intervention.

13. The need to promote the financial sector in RE/EE lending is well recognized by MOEN with the establishment of the EE Revolving Fund and ESCO Fund. These funds

are relatively small in size and face limitations including: i) program design which limits project size at USD 1.2 million per project, considered too low for most renewable energy projects; and ii) risks are wholly allocated to commercial banks which allow them to approve mainly projects proposed by large customers/existing customers with good risk profiles. EE Revolving Fund and ESCO Fund which are administered by MOEN are also facing with limitations in terms of implementation capacity and legal/institutions constraints. These constraints limit MOEN in managing, scaling up or expanding the scope of the two Funds. The proposed financial intermediary project will complement and scale up MOEN’s ongoing effort in encouraging private RE investments.

14. Many RE and EE projects in Thailand have attempted to sell carbon credits via the CDM mechanism. However, development of small CDM projects face barriers including lack of projects development know-how, high upfront costs, and difficulty in aggregating small projects to qualify for CDM. The financial intermediary arrangement with SFIs will facilitate bundling small projects together using the CDM programmatic approach.

15. A risk guarantee facility is also proposed, in response to concerns expressed by commercial banks and resulting risk premiums passed on to investors in the form of higher cost of funds cost. A well established financing system, including lending and guarantee facilities, is critical to overcome the major barriers of access to financing for investment in RE in large scale, especially future investments to be replicated after the CTF resources are used up. A guarantee facility is an appropriate financial instrument in the Thai financial market, which is characterized by excess liquidity and highly risk-averse banks. Recognizing this barrier, a guarantee facility has already been identified in the scope of MOEN’s ESCO Fund, but revised guidelines including contingent financing criteria and procedures must be created and put into practice. By addressing credit risks and short maturity related to RE and EE projects, a risk guarantee facility has the potential to leverage sizable bank lending to ensure replication of RE after the CTF operation and achievement of the AEDP targets (by adding the rest RE capacity to achieve a total of 4,000 MW new RE capacity). Past policy dialogue with commercial banks, the private sector, and GoT indicate that there is strong demand for both risk guarantee facility.

16. In addition to providing concessional financing, the financial intermediary operation will provide a platform for the MDBs and international donors to help address barriers associated with scaling up RE investments in an integrated manner by working closely with key stakeholders such as the government agencies, local banks and private investors as follows:

| Agencies | Participation in the Program |
|-----------------|---|
| MOEN | <ul style="list-style-type: none"> - Creating enabling policy environment for RE/EE - Develop project pipelines - Regulatory advices - Scaling up the impact of the EE Revolving Fund and ESCO Fund |
| MOAC | <ul style="list-style-type: none"> - Collaboration to develop LDD Community Biomass Project - Planning and Identification of agriculturally-related/community |

| | |
|-------------------------------|--|
| | participation projects and provide related technical/regulatory advices |
| BAAC | - Financial intermediary providing lending to small-scale RE projects focusing on those with strong linkage to agriculture |
| EXIM Bank | - Financial intermediary providing lending to larger-scale RE/EE projects |
| Federation of Thai Industries | - Network of RE developers and factories which are looking for source of funds |

Rationale for CTF Financing

17. Although there are substantial Power Purchase Agreements (PPAs) signed under the SPP and VSPP program, only limited numbers of projects have materialized. Given high costs of investment and risks, RE projects in Thailand, particularly small- and medium-sized projects, still need financial incentives (production-based adders or carbon revenue streams) for commercial viability. **For solar and wind, adders and carbon revenue are still not sufficient and additional concessional financing is needed to buy down the risk and make projects feasible.** For biomass, though technology is proven and there are many large-scale biomass taking place, viable business models have not been demonstrated for smaller scale biomass projects and risks are still high.

18. **As liquidity is not a constraint in Thailand, the rationale for CTF financing is to overcome critical barriers to financing investment in RE projects and buy down the initial cost** of transforming business environment and building up successful business models of all key market players (regulators, banks and investors) for various types of RE and EE projects, including proper mechanism to assess and manage risks. Without CTF concessional financing and critical technical assistance programs, it would take much longer time for commercial banks to shift away from conventional practices where they normally feel reluctant to lend to new companies without established credit records or risk profile. Private developers would find it difficult to access fund and debt financing would be prohibitively high for new players.

19. Associated technical assistance and capacity building activities from other financing sources will fill in the knowledge gap and reduce high perceived risks of RE/EE.

Implementation Readiness

20. CTF through financial intermediaries will focus on biomass, solar and wind. Biomass is technologically proven in Thailand with several years of experience including projects supported by DEDE and other research institutes. Solar and wind technology are proven elsewhere but is deployed in a very limited manner in Thailand due to prohibitively high costs. However, with more local production of solar and wind equipment the cost has coming down and the technologies are expected to grow significantly. While there are great potentials of solar energy resources, the key risk for a wind project lies in its output performance as installed on a particular site.

21. The policy environment and enabling framework for RE is very favorable in Thailand. The latest adders as approved by the Cabinet on 24th March 2009 provide strong financial incentives. The recently announced AEDP demonstrates commitment from the government and provides a comprehensive policy framework and strategic direction for RE in Thailand. There are some gaps in regulations, e.g. planning and zoning for use of biomass. These gaps will be addressed by proposed CTF projects.

22. Small-scale community biomass projects are at advanced stage of technical preparation. LDD is taking the lead and working in close collaboration with other agencies in MOAC. The Agricultural Land Reform Office (ALRO) will be responsible for identifying potential sites. The Cooperatives Promotion Department (CPD) will be responsible for identifying potential cooperatives. SPPs and VSPPs have shown strong interest to access funding and international knowledge/expertise.

23. According to BAAC and EXIM Bank’s corporate strategy, both SFIs intend to expand into RE and EE business lines. However, they still lack the technical and financial capacity to expand this new business line at scale. Extensive technical assistance are needed for these SFIs to set up appropriate lending instruments, establish pipeline projects, access and manage risks and build up capacity along the entire values chain to manage lending to RE and EE projects. BAAC is also exploring this new business line by initiating the dialogue with the Bank to develop biogas CDM projects.

Financing

24. The program seeks to apply for CTF fund of US\$ 50 million in order to leverage approximately US\$ 800 million of total investment. The financial plan is shown in the table below.

| | Total Project Cost | CTF | IBRD | Counterpart | Private Investors | Carbon Finance |
|--------------|---------------------------|------------|-------------|--------------------|--------------------------|-----------------------|
| Total | 800 | 50 | 50 | 300 | 400 | 89 |

Project Preparation Timetable

| Activity ¹⁸ | Date |
|---|------------------------------------|
| Government Concept Approval/Bank Concept Review | January, 2010 |
| Project preparation | April, 2010 |
| Regional Operations Committee | September 2010 |
| Appraisal/Negotiations | December, 2010 – March 2011 |
| Board Approval | May, 2011 |
| Implementation | June 2011-December 2016 |
| Project Completion | December 2016 |

¹⁸ The Project preparation timetable is for illustrative purpose only. It is based on the assumption that the Thailand country investment plan is approved by the CTF committee in December 2009

B. Advancing Clean Energy Investments with Public Utilities (EGAT)

Problem Statement

1. Thailand is one of the most carbon intensive economies within the South East Asia region. So far, only 1,750 MW of renewable energy, mostly biomass, has been installed in Thailand. The total potential for the development of RE is 57,000 MW. According to AEDP, public investment is expected to contribute around 13 percent of the total investment required to achieve the overall AEDP target. As of 2007, Renewable Energies comprised only 1.6 percent (about 400 MW) of EGAT's generation, with large hydropower providing another 7 percent.

2. EGAT as the key public electricity utility needs to scale up its investment in RE to meet the government's policy. According to the Power Development Plan (PDP), EGAT will play a major role in supplying electricity to the country with around 42 percent of total generation capacity in 2021. EGAT's investment in RE will face with competing investment needs from coal, nuclear and natural gas. Mentioned thermal power generation is the priority for EGAT investments, rather than RE, because they provide reliable and more cost-effective electricity, despite having a high environmental impact.

Proposed Transformation

3. The proposed CTF will support EGAT long-term investments program in RE and provide technical assistance to enhance its Alternative Energy for Electricity Strategy. The objective is to demonstrate the viability of RE power plants in Thailand, support EGAT in complying with GoT's Renewable Portfolio Standards, decrease GHG emissions in the power sector, and contribute to RE industrial development in the country. EGAT is a key player and a market leader in the power sector in Thailand. Currently, EGAT's installed capacity accounts for 48 percent of the country's total installed capacity and it also acts as a single buyer of power. It is also a center of technical expertise in the power sector and has a central role in developing the national PDP formulating power sector-related policy, and guiding the development and strategic direction of the sector. EGAT also invested in several hydropowers in Laos and a key player in regional power trade in the Greater Mekong Sub Region engaging in import and export of power with neighboring countries including Lao PDR, Cambodia and Myanmar. In addition, given its well-developed technical expertise in the sector, EGAT is a leading public utility in the region and has been collaborating and sharing its successful experiences closely with other public utilities in the region. As a strategic player in the power sector, EGAT can play a leading role in RE technological development, help familiarize market players with renewable technologies and build up capacity and know-how in the operation and maintenance of renewable energy power plants.

4. EGAT's AE Strategy has been developed in line with and expected to make significant contribution toward the national target set out by the AEDP. The strong role

of EGAT at the beginning stage of the AEDP is critical to provide needed momentum to the AEDP when the rigidity in the financial market for RE/EE especially for new players and smaller projects may lead to slow take-up of private investments. The proposed investments by EGAT to be supported by CTF will contribute to 14 percent of the national AEDP target for small hydro, wind, and solar in 2022.

5. Thailand has significant potentials in hydro power with about 8 percent utilized. AEDP sets the target to develop 324 MW from the existing 56 MW by 2022 focusing on small hydro, village hydro and irrigation dam hydro. However, due to institutional and legal constraints, most of the hydro potentials will be developed by public agencies such as EGAT, PEA and DEDE for small or mini hydro. Village hydro will be developed by the Local Administrative Organizations (LAOs). EGAT’s experience in developing, operating and maintaining small hydro could be replicated for village hydro development where LAOs have less capacity in operating and maintaining the generators. This will have transformative impact not only for village hydro development but also enhancing the role and building capacity of local communities in renewable energy development. In addition, as EGAT is a well-known utility in the region, its accumulated experiences in renewable energy particularly small-hydro can be shared with neighboring countries such as Lao PDR and Cambodia, which also have strong potentials in small hydro, to scale up mini hydro in the region. The development of small hydro in these countries where rural electrification is still not fully covered could be very beneficial.

6. Solar and wind are another important RE in Thailand with strong potentials (50,000 MW and 1,600 MW, respectively) for scale up from currently 32 MW to 500 MW and 1 MW to 800 MW for wind during the AEDP period, given the availability of technological solution and commercially viable business model.

7. Indicative investment plan for small hydro, wind and solar under EGAT’s AE Strategy at the time of preparing this Investment Plan is shown in the table below. Note that EGAT’s AE also includes investment in municipal solid waste but it is not eligible for CTF support, since it can be routinely financed by CDM credits. The proposed investments in small hydro, wind and solar will result in estimated 443,369 ton of CO₂ annual reductions and reduce imported energy by 64.41 ktoe per year.

Table A: Short, medium and long-term Investment Plan for EGAT’s AE strategy

| | 2009-2012 | 2013-2017 | 2018-2022 | Total Project |
|--------------------------|-----------|-----------|-----------|---------------|
| Small Hydro | | | | |
| Installed Capacity (MW) | 78.7 | 65 | 50 | 193.7 |
| Annual Generation (GWh) | 388.2 | 340.4 | 199.8 | 928.4 |
| Investment (million THB) | 4,486.03 | 7,933.13 | 3,557.84 | 15,977 |
| Investment (million USD) | 128 | 227 | 102 | 456 |
| Wind | | | | |
| Installed Capacity (MW) | 20.5 | 19 | 89 | 128.5 |
| Annual Generation (GWh) | 42.4 | 38.8 | 184.0 | 265.1 |
| Investment (million THB) | 1,886.4 | 1,484.75 | 7,056 | 10,427.15 |

| | | | | |
|--------------------------|----------|----------|-----------|-----------|
| Investment (million USD) | 54 | 42 | 202 | 298 |
| Solar PV | | | | |
| Installed Capacity (MW) | 1 | 0.5 | 0.5 | 2 |
| Annual Generation (GWh) | 1.5 | 0.8 | 0.8 | 3.0 |
| Investment (million THB) | 194.92 | 126 | 101 | 421.92 |
| Investment (million USD) | 6 | 4 | 3 | 12 |
| Total RE | | | | |
| Installed Capacity (MW) | 100.20 | 84.50 | 139.50 | 324.20 |
| Annual Generation (GWh) | 432.0 | 380.0 | 384.5 | 1,196.5 |
| Investment (million THB) | 6,567.35 | 9,543.88 | 10,714.84 | 26,826.07 |
| Investment (million USD) | 187.64 | 272.68 | 306.14 | 766.46 |

| Type of AE | Target of EGAT | Target of Thailand | Percent |
|--------------|----------------|--------------------|--------------|
| Small Hydro | 193.7 | 324 | 59.78 |
| Wind | 108.5 | 800 | 16.06 |
| Solar | 2 | 500 | 0.4 |
| Total | 224.2 | 1,624 | 13.19 |

Rationale for CTF Financing

8. CTF will support small hydro, wind and solar under EGAT's medium- and long-term investment program. Wind and solar technologies are relatively new in the market and the operational and fuel risks associated with them have not been proven. Wind potential is still in an early stage of development in Thailand with only 0.063 percent utilized in 2008. In 2008, total installed capacity was 1.1 MW while the estimated potential is 1,600 MW. These capacities are not operating on a fully commercial basis. Although several proposals by private companies have been submitted to MOEN, none of them has come in to commercial operation yet. Fully commercial operation of wind still needs to be demonstrated to lead to large scale deployment of wind in Thailand.

9. EGAT has clear strategy to develop its long-term energy plan to support the national AEDP. EGAT's investments in renewable energy will play a pioneering role in catalyzing the renewable energy sector and build up national implementation capacity and knowledge in RE generation. CTF financing is needed to expedite EGAT's long-term investment programs by bringing up some investment programs planned in the later years. As EGAT's priority projects for its financial resources are traditional fuels (gas, coal and nuclear) which provide cost-effective and reliable power, CTF concessional financing is needed to support EGAT's RE investment which are more expensive and play a marginal role in providing reliable power needed to serve growing demand at the moment.

Implementation Readiness

10. EGAT has high implementation capacity. Preliminary technical preparations for most projects under the Plan have been carried out. Implementation readinesses of projects vary. Small hydro projects are relatively advanced in preparation and all the sites have been identified. EGAT has conducted extensive preparation for the proposed wind projects and it is ready for CTF and IBRD lending support. Most of the identified projects to be included in the Plan will utilize or add on EGAT's existing assets and expected to have limited environmental and social impacts and will require limited project preparation time.

Financing

11. The CTF fund will support the implementation of the medium- (2013-2017) and long-term (2018-2022) investment plan of EGAT's AE Strategy.

12. The program seeks to apply for CTF fund of US\$ 60 million in order to leverage approximately US\$ 580 million for total investment. The financial plan is shown in the table below.

| Total (US\$) | CTF (US\$) | IBRD (US\$) | EGAT (US\$) |
|---------------------|-------------------|--------------------|--------------------|
| 580 | 60 | 60 | 460 |

Project Preparation Timetable

| Activity¹⁹ | Date |
|---|------------------------------------|
| Government Concept Approval/Bank Concept Review | January, 2010 |
| Project preparation | April, 2010 |
| Regional Operations Committee | September 2010 |
| Appraisal/Negotiations | December, 2010 – March 2011 |
| Board Approval | May, 2011 |
| Implementation | June 2011-December 2016 |
| Project Completion | December 2016 |

C. Advancing Clean Energy Investments with Public Utilities (PEA)

Problem Statement

1. Biomass is the most mature RE in Thailand with 1,610 MW (36 percent) utilized from the total potential of 4,400 MW. The AEDP's target for biomass is to increase biomass capacity to 3,700 MW by 2022, reaching more than 80 percent of the total

¹⁹ The Project preparation timetable is for illustrative purpose only. It is based on the assumption that the Thailand country investment plan is approved by the CTF committee in November 2009.

potential. However, future development of biomass is facing two key barriers. First is feedstock management issue as past development of large scale biomass resulted in competition for raw materials driving the costs of biomass power generation and creating risk of insufficient resources to run the power plant at full capacity in the long run. The other barrier is the environmental impacts and community acceptance of biomass projects which have to be situated in the rural areas close to site of fuel supply. Lack of sound environmental management of biomass projects could create public resistance to biomass power plants in some cases. Lessons learned from hydro development as well as coal and natural gas power plants in the past showed that lack of community acceptance could obstruct or severely delay construction of power plants and constrain the country's options of energy sources in the long run.

2. Thailand has not seen large-scale investment in energy efficiency. Incentives for public agencies to reduce energy consumption are not in place. Experiences in other countries show that there are great potentials in energy saving through EE projects, including energy-efficient street lighting programs

Proposed Transformation

3. PEA is a provincial electricity distribution company which seeks to diversify into RE and EE areas. CTF Co-financing is proposed to assist with the transformation of PEA into an organization capable of delivering RE and EE investment by supporting two introductory clean energy programs.

4. **Forest Residues Biomass Development.** PEA is collaborating with the Forest Industry Organization (FIO) in a pilot biomass power generation projects to produce electricity from renewable biomass residue from commercial forest plantations. As good plantation management, residue biomass from thinning/trimming and forest fire prevention will be used as feedstock. Electricity generated will be used locally and sold to PEA. The CTF co-financing is proposed to support the scale-up to about 100 sites (with an approximate total capacity of 100 MW) in the next five years, and associated investment in transmission lines and substations. To implement these new business lines, PEA has established a subsidiary (wholly owned) named PEA ENCON International to invest in these projects. The technology employed will be gasification. The biomass will be collected by local communities hired by FIO, hence, increase local income for the communities around the plantations and help to alleviate poverty and improve livelihood. The project activity provides incentive for people to collect biomass residue from the forest which is one of the contributing factors to undesired and unexpected forest fires.

5. Total electricity generated is expected to be 7 million unit per year and annual GHG emissions reductions are around 4,200 tonnes of CO₂ per site or annual reduction of 0.42 million tonnes of CO₂ in total. This is estimated to reduce crude oil imports by 246 liter/hour.

6. The forest residues biomass project has potential to be replicated to up to 500 sites to further utilize fuel availability of FIO. The experiences and demonstration of successful business models from the CTF-funded projects will be shared with other communities around the country and a knowledge center will be set up to disseminate the experiences. This is a transformational change not only for the country but also expected to spread to neighboring countries in the region

7. **Energy Efficiency for Streets Lighting (500,000 lamps, US\$ 67 million).** PEA also has a plan to improve energy efficiency of street lighting on national highways and other public spaces throughout the country by deploying energy saving technologies and improved management practice. Technology that will be used is proven to reduce energy consumption by at least 25 percent from the base line case. The investment involves installation of energy saving devices (i.e. dimmer) for High Mast and High Energy Intensity Discharge (HID) Project by for 500,000 lamps. Total investment cost is US\$ 67 million. The project duration is three years. Current annual consumption of national streets lighting is 1,300 GWh. The proposed investment is expected to result in annual electricity savings of 325 GWh. More detailed information / design will be prepared during project preparation stage.

Rationale for CTF Financing

8. Large-scale biomass gasification technology is proven, however the business model including feedstock and performance risk management aspect still needs to be demonstrated. Low cost of financing from CTF helps improve commercial viability of the projects and also helps PEA leverage further financial resources by developing the project as CDM project.

9. The proposed investment is the first large-scale public energy efficiency program in Thailand. Currently, the public sector has not been active in investing in large scale investment to reduce power consumption. There is lack of incentives for public sector to invest in as EE investment does not lead to additional revenue. The proposed investment can help demonstrate that investment in EE can lead to substantial savings in electricity bills and expenses of public organization and the savings could be used for other productive activities.

10. The streets lighting energy efficiency project involves a scale investment and focus of energy efficiency investment that is unknown in Thailand. CTF support will help overcome the perceived financial risk associated with such a large-scale first-of-its-kind project.

Implementation Readiness

11. PEA has strong implementation capacity, technically and organizationally, and has lengthy experiences in electric sector focusing on rural power distribution. FIO has expertise and lengthy experiences in area of forest waste management and commercial forest plantation and could help handle feedstock risks which are the major concern for most biomass projects in Thailand.

12. Streets lighting will be implemented through proven technologies. During the project preparation, the MDBs could work with PEA to further explore other technologies proven in other countries, such as LED, that could achieve higher energy savings in a cost-effective way.

Financing

13. The program seeks to apply for CTF fund of US\$ 50 million in order to leverage approximately US\$ 297 million for total investment.

14. The financial plan is shown in the table below.

| Total (US\$) | CTF (US\$) | IBRD (US\$) | PEA (US\$) |
|---------------------|-------------------|--------------------|--------------------|
| 297 million | 50 million | 50 million | 197 million |

Project Preparation Timetable

| Activity²⁰ | Date |
|---|------------------------------------|
| Government Concept Approval/Bank Concept Review | January, 2010 |
| Project preparation | April, 2010 |
| Regional Operations Committee | September 2010 |
| Appraisal/Negotiations | December, 2010 – March 2011 |
| Board Approval | May, 2011 |
| Implementation | June 2011-December 2016 |
| Project Completion | December 2016 |

²⁰ The Project preparation timetable is for illustrative purpose only. It is based on the assumption that the Thailand country investment plan is approved by the CTF committee in November 2009

ANNEX 3: CLEAN ENERGY ADVANCEMENT – PRIVATE SECTOR

Problem Statement

1. The Thailand IP has identified several areas where the use of CTF funded interventions can have a transformational impact on the carbon footprint of the country. Annexes 2 through 4 discuss the initiatives to be undertaken by the IBRD to address GHG emissions growth in power generation and energy demand. This annex outlines where IFC would leverage its skills, relationships and innovative financing instruments such as partial risk guarantee and mezzanine finance facilities to mobilize local financing to support the development of Renewable Energy projects, Energy Efficiency improvement in the industrial, commercial and residential sectors and cleaner production.

Proposed Transformation

2. *Renewable Energy.* IFC would provide appropriate incentives for qualified developers to fast-track the implementation of Renewable Energy projects. These initial projects, in addition to having an immediate GHG impact, would provide valuable information on the types and amounts of incentives required to catalyze Renewable Energy development in the country.

3. IFC would work with private sector Renewable Energy developers, and when necessary equipment manufacturers, interested in entering the Thailand power sector, but who need additional incentives or risk mitigation to make their projects feasible/palatable. IFC has already been approached by several credible developers that want to enter Thailand's Renewable Energy sector but who require non-market based financing to make their projects feasible. The financing challenge is made worse by the current financial crisis and the disappearance of traditional funding sources. It is expected that financing plans for Renewable Energy projects under this program, especially those submitted within the first twelve months, would require leverage not only from multiple MDBs, but also from bilateral and other like-minded institutions. Each CTF project proposal would discuss the barriers to be addressed with CTF funds, the role of the carbon market in helping to move the sector and direct GHG impact from the project. The program would address the question of additionality (supporting the lowest cost, qualified, producer) by either supporting successful bidders of an RFP or by supporting all developers that meet specified, transparent, credit criteria established by IFC.

4. *Energy Efficiency and Cleaner Production.* IFC would provide a combined package of capacity building and financing instruments to local financial institutions for the latter to finance projects of Energy Efficiency improvement and cleaner production under a programmatic approach. Such packages are aimed to help transform the behavior of local financial institutions, especially commercial banks, so that they will build up their in-house capacity to assess the perceived technical and market risks of EE and CP, and become ready financiers for the sector. The program would provide financial incentives or risk products to market leaders to encourage them to implement new low

carbon technologies and establish new standards and benchmarks for such technologies in their respective industries. By working with companies that have significant market share or market influence, the program would have the largest impact, both by capturing a large share of the industry's emissions reduction potential through one sponsor, and by catalyzing competition and a need for other market players to follow suit. Smaller players would be incentivized indirectly through programs with financial institutions. To ensure a comprehensive approach to market development IFC would, when necessary, also support equipment manufacturers and vendors of low carbon technology.

Implementation Readiness

5. *There are currently* a number of private sector RE projects that have been developed and could be implemented during 2010 with the appropriate financial / risk incentives. Several of these companies have already approached IFC for help in obtaining financing on terms that would make the project feasible. IFC believes it could support two Renewable Energy projects in the short term if the requested CTF resources were available.

6. Several local financial institutions have also expressed strong interests in partnering with IFC under either a partial risk guarantee program or a mezzanine finance facility to provide financing to developers of small RE projects, companies implementing EE improvement and cleaner production, and firms involved in waste treatment and other emission reduction projects. The implementation potential of these programs is enhanced by IFC's established relationships with market players and its technical expertise in the topic (IFC has a core team focused on sustainable energy and more than ten years of history of financing such projects directly and through financial intermediaries). Accordingly, the likelihood of IFC being able to structure appropriate incentives and implement an initial program during the next six months is very high.

Rationale for CTF Financing

7. In Renewable Energy CTF financing will be needed to provide appropriate financing (including to cover the gap that has resulted from the financial crisis) and risk incentives for private developers to enter Thailand's Renewable Energy sector. While there is interest in entering the market, private developers will be unwilling and unable to do so without some concessional support.

8. In Energy Efficiency, CTF funds are needed to incentivize local financial institutions to undertake financing in lower carbon emitting technologies. Many companies involved in the development of Renewable Energy, Energy Efficiency, cleaner production and waste treatment projects have recently found themselves unable to borrow, even at high interest rates, for any type of investment. CTF funding, and its flexible application, can provide incentive to these local financial institutions the necessary financing for these companies to implement projects. With effective financial structuring, CTF funds can address the specific barriers and catalyze the sector's transition to a lower carbon base.

Financing Plan

9. Financing plans will be developed at the proposal stage. The following is a conceptual financing plan for indicative purposes.

| Source (US\$ million) | RE | EE/CP | Total |
|---|------------|------------|--------------|
| Sponsors / Other lenders / Carbon Finance | 480 | 500 | 980 |
| IFC | 100 | 170 | 270 |
| CTF | 30 | 40 | 70 |
| Total | 610 | 710 | 1,320 |

10. The project is expected to be prepared along the following timeframe.

| Activity ²¹ | Date |
|---|-------------------------|
| Government concept approval/Bank concept review | January 2010 |
| Project preparation | March 2010 |
| Appraisal/Negotiations | June - July 2010 |
| Approval | August 2010 |
| Project Implementation Start | September 2010 |

²¹ The Project preparation timetable is for illustrative purpose only. It is based on the assumption that the Thailand country investment plan is approved by the CTF committee in November 2009.

ANNEX 4: URBAN TRANSFORMATION

Problem Statement

1. The Bangkok Metropolitan area consumes approximately 29,200 GWh of electricity annually, which is equivalent to 14.86 million tons of CO₂ emissions, or about 4.7 tCO₂e/capita. (see detail in Table A). Bangkok's transportation sector is the second largest GHG emitter, equivalent to about 2.2 tCO₂e/capita annually (see detail in Table B). Since it is the second largest source of emissions and the most visible sector for the public, BMA intends to focus first on urban transportation improvements as it implements the 2007 – 2012 Mitigation Action Plan. Progress in the transportation sector is thought to be the best way forward for progress in all five areas of the Mitigation Action Plan.

Table A: Total GHG emissions, including direct, life cycle and within city measures.

| | Emissions within city t eCO₂ /cap. | Direct emissions t eCO₂ /cap. | Life-cycle emissions t eCO₂ /cap. |
|---------------|--|---|---|
| Bangkok | 4.7 | 10.6 | not determined |
| Barcelona | 2.4 | 4.2 | 4.6 |
| Cape Town | not determined | 11.5 | not determined |
| Denver | not determined | 21.3 | 24.3 |
| Geneva | 7.3 | 7.7 | 8.6 |
| London | not determined | 9.6 | 10.5 |
| Los Angeles | not determined | 12.8 | 15.4 |
| New York City | not determined | 10.4 | 12.2 |
| Prague | 4.3 | 9.3 | 10.1 |
| Toronto | 8.1 | 11.4 | 14.2 |

Source: Kennedy et al. (2009), *Greenhouse Gas Emissions from Global Cities*, *Enviro. Sci. Tech.*, Vol. 43, No. 19, pp 7297-7302.

Table B: Ground Transportation Fuels, consumption and GHG emissions.

| | Gasoline consumption ML | Diesel consumption ML | GHG emissions t eCO ₂ /cap. |
|---------------|-------------------------------|-----------------------------|---|
| Bangkok | 2,741 | 2,094 | 2.20 |
| Barcelona | 209 | 266 | 0.75 |
| Cape Town | 1,249 | 724 | 1.39 |
| Denver | 1,234 | 197 | 6.07 |
| Geneva | 260 | 51 | 1.78 |
| London | 1,797 | 1,238 | 1.18 |
| Los Angeles | 14,751 | 3,212 | 4.74 |
| New York City | 4,179 | 657 | 1.47 |
| Prague | 357 | 281 | 1.39 |
| Toronto | 6,691 | 2,011 | 3.91 |

Source: GHG emissions for BMA taken from Kennedy et al. (2009), *Greenhouse Gas Emissions from Global Cities*, *Enviro. Sci. Tech.*, Vol. 43, No. 19, pp 7297-7302.

2. The transport sector is responsible for 20 percent (12.5 million tCO₂e/year) of the total GHG emissions from Bangkok. This amount is expected to grow as population, income, and car ownership continue to grow. Currently private passenger vehicles account for 46 percent of the total daily travel trips each day; the resulting congestion is a serious economic drain to the region and is the main contributor to local air pollution. A serious modal shift from private vehicle to public transport is necessary to reduce Bangkok's overall GHG emissions.

3. Realizing the significant adverse impacts of unchecked growth in motorized trips, especially from private cars, BMA's first Initiative under the Global Warming Mitigation Action Plan (GWMAP), 2007 – 2012, primarily focuses on expanding mass transit. With the expansion of the successful elevated light rail system (BTS) and underground rail system (MRT) is under way, the integrating link is a modern public bus rapid transit system (BRT) that connects with the BTS and MRT, and replaces the existing inefficient and unsafe public bus system. BMA is embarking on developing the Bus Rapid Transit (BRT) System Master Plan. BRT has proven very successful in many countries but has yet to make inroads into Thailand.

Proposed Transformation

4. In 2008, BMA announced its Global Warming Action Plan 2007-2012 to reduce the city's greenhouse gases by 15 percent (approximately 6.4 million ton of CO₂e). The plan includes 5 initiatives: 1) Expand Mass Transit systems and improve traffic system, 2) Promote the Use of Renewable Energies, 3) Improve Building Electricity Consumption Efficiency, 4) Improve solid waste management and wastewater treatment efficiency, and 5) Expand park area. This is one of the world's most ambitious and well-

founded GHG mitigation strategies for a city within non Annex 1 Kyoto Protocol signatory.

5. BMA has expressed its interest in working with the World Bank with the support of CTF co-financing to assist and accelerate the implementation of the Global Warming Action Plan (2007-2012).

6. The proposed CTF program would support BMA in implementing the Action Plan on Global Warming Mitigation 2007-2012. Among a set of potential greenhouse mitigation potential activities, BMA has prioritized the BRT and building EE for CTF funds. These two components would proceed in parallel to other 3 Mitigation components, all of which would support each other component in an integrated manner.

7. The BRT component will maximize the modal shift toward cleaner public transport systems through the 14-Line BRT system (of which 2 are under construction) which is proposed to be implemented in three phases during 2007 – 2025. This significant shift in infrastructure prioritization, choice of cleaner technology, and changes to public behavior will provide long lasting transformational impacts throughout the project life which is expected to be more than 20 years. These changes will reinforce efforts in buildings energy efficiency, improved solid waste and wastewater management, increased use of renewable, and expansion of parks.

8. In particular, the proposed CTF co-financed investments will include:

9. **Urban transport Transformation through BRT.** There are three sub-components proposed for CTF co-financing for BRT.

- a. **Modal Shift to BRT System:** The program will provide financial support to accelerate the implementation of selected priority lines of the BRT Master Plan. The successful execution of the proposed Program will lead to the early adoption and implementation of the rest 8 BRT lines to complete the BRT network for Bangkok. The BRT system will be developed as part of an integrated urban transport system complementing the sustainable urban development objectives such as better air quality goals, reduced travel time and improved productivity and competitiveness, safety of transport operations, as well as reduced GHG emissions. The program will also finance BRT infrastructure, integration measures with other low carbon and non-motorized transport options, and marketing activities that promote sustained modal shift. Lessons learned from the well-tested World Bank experiences in Mexico City, Bogota, and Lima will be shared with the government to ensure successful implementation in Bangkok. It is expected that when completed, the entire BRT system would be able to service more than half a million passengers per day. Based on experience on the modal shift for the BTS system, which showed that around 15 percent of passengers shifted away from private cars, total GHG emission reductions from the complete

BRT system are expected to be 1.89 million tCO₂e per annum whereas the first six BRT lines would lead to 1.18 million tCO₂e per annum;

- b. **Promotion of Low Emission Bus Technologies:** Low emission bus technologies are becoming more mature and deliver significant reductions in emissions of air pollution as well as reducing fuel consumption. Among these low emission bus technologies, diesel hybrid electric buses and Compressed Natural Gas (CNG) hybrid buses have been demonstrated to deliver significant reductions in emission of carbon dioxide (>25%) fine particulate matter (>30%), carbon monoxide (>70%), as well as fuel consumption (>25%) when compared to more typical Euro II-III diesel buses. The proposed program will finance part of incremental costs of shifting toward lower emission bus technologies. With the adoption of the low emission buses, additional GHG emission reductions will be generated; and
- c. **Implementation Support:** Although, BMA has comprehensive experience in the development and implementation of the well-run BTS system, BMA and its wholly owned private enterprise, Krungthep Tanakhom, have little experience in managing and operating a BRT system. Therefore, capacity building support to ensure efficient operations and maximum level of ridership is critical to the success of the proposed Urban Transformation program. The Implementation Support will focus on all aspects of BRT operation and management including marketing, operations and maintenance of the infrastructure and low emission buses, administrative, procurement and financial management, environment and social safeguard, regulation, institutional arrangements, and integration with other modes of transportation.

10. The lessons learned from the implementation of the BRT system in the city of Bangkok can be shared and replicated to the entire Bangkok Metropolitan Region (BMR) with a total population of around 10 million, in the three neighboring provinces (Nonthaburi, Samutprakarn, and Patumthani) as well as other fast growing cities such as Chiang Mai, Khon Kaen, Nakorn Rachasima, Udon Thani, Surat Thani, and Had Yai which will help stabilize the GHG emissions from transportation sector for the entire Kingdom.

11. **Improving City EE.** CTF co-financing is also proposed to support BMA's EE program of retrofitting 588 buildings managed by BMA including BMA offices, hospitals, apartment blocks, school, and wastewater treatment facilities;

Implementation Readiness

12. The BRT Master Plan indicates an ambitious timeframe to complete the entire system by 2015. The construction of the BRT Line 1 is expected to be completed soon. The procurement of the low emission buses is underway. Furthermore, the Government has granted necessary authority to BMA to operate the BRT system instead of the Bangkok Mass Transit Authority (BMTA) which has long been operating in deficit. The

Government's decision creates a conducive environment for the BRT to be effectively operated. Therefore, **the proposed CTF-co-financed program is timely and can provide tremendous value added to the successful deployment of the entire BRT system.** When comparing to other low carbon alternatives such as BTS and MRT systems, the BRT infrastructure is simpler, less expensive, and quicker to implement, and generates lower emissions during the construction. Additionally, BMA which has the oversight of more complex BTS system would be able to utilize its experience in the development and implementation of the BRT system. It is crucial, however, that the BRT system is integrated seamlessly with other modes of low emission transport to deliver the maximum benefits of GHG and other local air emission reductions, travel time and operating cost savings as well as safety benefits. The co-benefit of reduced air pollution in congested Bangkok is also expected to be significant (in the range of more than US \$ 100 million per year).

Rationale for CTF Financing

13. The low emission BRT System has been implemented successfully in many countries around the world. However, the implementations of the BRT system in Southeast Asia, especially Thailand, has experienced a number of significant barriers:

- a. **High Upfront Capital Expenditures:** While BRT is relatively less expensive than BTS, MRT, or even new highways, the upfront capital expenditure (CAPEX) is still substantial and requires significant public sector investments that are not readily available at the local government (BMA) level, especially as Thailand is still recovering from the global financial crisis;
- b. **High Costs of Low Emission Buses:** Currently, the incremental additional cost of a typical diesel hybrid bus is in the range of 20 - 30 percent more than a typical Euro IV buses. The expected operating cost savings from lower fuel consumption, less maintenance expenditure and reduced downtime, are only gradually realized throughout the service life of the bus, while higher CAPEX is needed upfront;
- c. **Difficult to Change Travel Behavior:** Most commuters are used to the convenient point-to-point transport using mostly private vehicles. Modal shift from this high carbon intensive way of travelling to low carbon public transport alternatives requires political will, fiscal incentives, marketing and promotion measures, as well as possible unpopular measures to make travelling by private vehicle more expensive and less attractive than public transport; and
- d. **Integration with other Modes of Transport:** Public transport in Thailand is fragmented as many different agencies and operators are involved. For example, the single ticket system has been well studied but yet has not been adopted as no agreement exists between different operators, namely, BTS, which is run by the private concessionaires under the oversight of BMA, while the MRT is operated by Mass Rapid Transit Authority (MRTA), and buses are run by Bangkok

Metropolitan Transit Authority (BMTA) and private concessionaires both under the Ministry of Transport. Without a strong program with a common goal of reducing emissions and improving traffic congestion, efficient integration among various modes of transport is unlikely to be realized in the near future.

14. The availability of the concessional financing will help reduce high upfront financial barriers and provide a strong incentive to adopt the low emission BRT system at the desired scale for the city of Bangkok with significant replication potential to the entire BMR with population of more than 10 million. Blending CTF funding with IBRD and other possible resources such as carbon finance will provide sufficient CAPEX for the BRT infrastructure as well as recurrent operation and maintenance expenditure for BMA. This will improve sustainability of the system and require less fiscal subsidy. Furthermore, the concessional finance is necessary to provide a strong incentive to adopt advanced low emission buses such as hybrid technology.

Financing Plan

15. The financing (US\$ mil) of the program is shown in the table below:

| | Total Project Cost | CTF | IBRD | Counterpart | Private Investors | Carbon Finance | Donors | TA |
|--------------|--------------------|-----|------|-------------|-------------------|----------------|--------|----|
| Total | 1267 | 70 | 70 | 1127 | - | 116 | - | - |

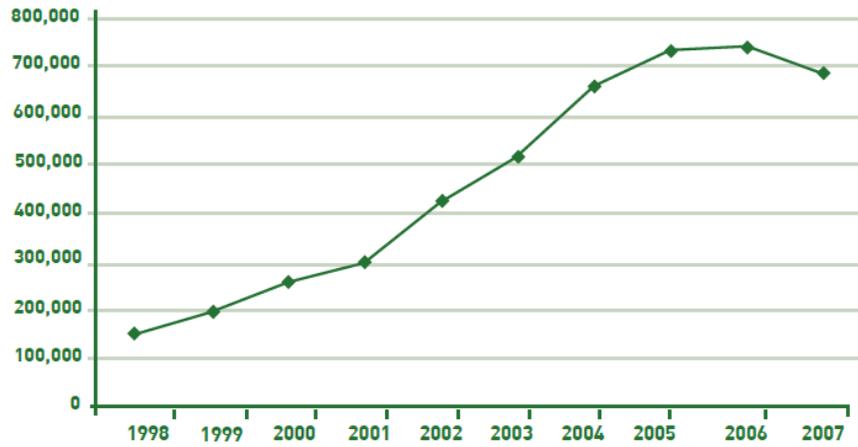
Program Preparation Timetable

16. The project is expected to be prepared and delivered according to the following tentative schedule:

| Activity ²² | Date |
|---|------------------------------------|
| Government Concept Approval/Bank Concept Review | January, 2010 |
| Project preparation | April, 2010 |
| Regional Operations Committee | September 2010 |
| Appraisal/Negotiations | December, 2010 – March 2011 |
| Board Approval | May, 2011 |
| Implementation | June 2011-December 2016 |
| Project Completion | December 2016 |

²² The Project preparation timetable is for illustrative purpose only. It is based on the assumption that the Thailand country investment plan is approved by the CTF committee in November 2009

Figure A: Number of Newly registered Vehicles in Bangkok, 1998 – 2007



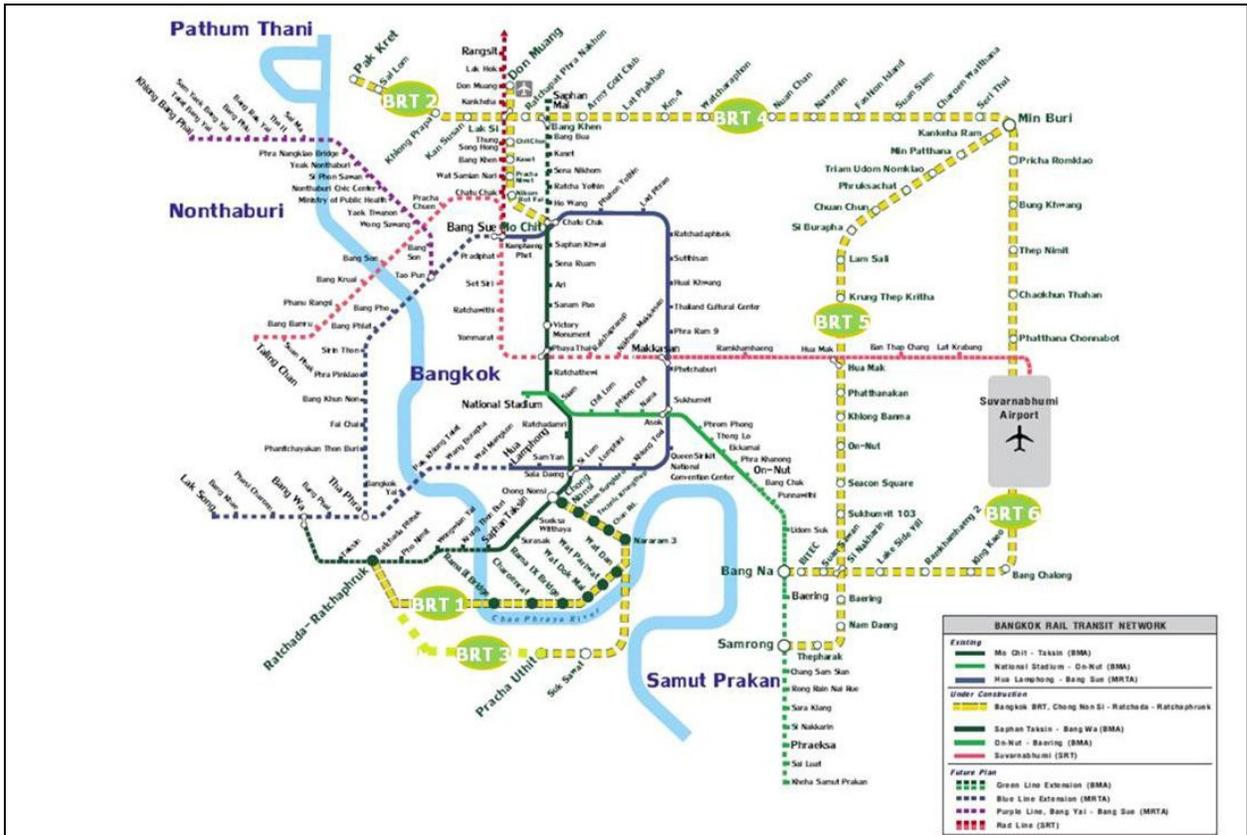
Source: Department of Land Transport, Ministry of Transport 2007

Figure B: BRT Master Plan with 14 Corridors, 2007 – 2015



Source: PCI (2007) – unpublished

Figure C: The First 6 Bus Rapid Transit Lines in Bangkok



Source: BMA 2009