

No. 0905/21162



Ministry of Finance
Rama VI Road
Bangkok 10400, Thailand

2 December B.E. 2554 (2011)

Dear CTF Trust Fund Committee,

Subject: Clean Technology Fund (CTF): Update of CTF Investment Plan for Thailand

Reference is made to our letter dated June 24, 2011 proposing the reallocation of an envelope of US\$ 230 Million from Public Sector Clean Energy Investment and Urban Transformation to Private Sector Clean Energy Investment. The Royal Thai Government is pleased to submit herewith an Update of Investment Plan for Clean Technology Fund (CTF).

In this connection, we would like to inform you that the Cabinet approved on November 22, 2011 the draft Update of the CTF Country Investment Plan (CIP) of Thailand. The CIP Update proposes to utilize US\$ 170 million in CTF cofinancing resources for near-term opportunities in 2012-2013. During this operational period, the Government of Thailand may request additional support pending implementation performance and availability of additional funds from the CTF. The Government of Thailand will temporarily relinquish its claim on US\$ 130 million of the US\$ 300 Million which was endorsed by the CTF Trust Fund Committee in December 2009.

/We look...

CTF Trust Fund Committee
1818 H Street NW
Washington, D.C. 20433, USA

CC: Mr. Craig M. Steffensen
Country Director
Thailand Residence Mission
Asian Development Bank
23rd Floor, The Offices at Central World
999/9 Rama 1 Road, Wangmai, Pathumwan
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We look forward to your endorsement of this Update of the CTF Investment Plan for Thailand and our continuing collaboration for the implementation of the Investment Plan.

Your kind cooperation is always appreciated.

Yours sincerely,

A handwritten signature in black ink, appearing to read 'T. Phuvanatanarubala', written in a cursive style.

Thirachai Phuvanatanarubala
Minister of Finance

**CLEAN TECHNOLOGY FUND
UPDATE
OF
INVESTMENT PLAN FOR THAILAND
(DRAFT)**

13 September 2011

ABBREVIATIONS AND ACRONYMS

ADB	Asian Development Bank
AEDP	Alternative Energy Development Plan
BMA	Bangkok Metropolitan Administration
CIP	CTF Country Investment Plan
CTF	Clean Technology Fund
DEDE	Department of Alternative Energy Development and Efficiency
EE	Energy Efficiency
EGAT	Electricity Generating Authority of Thailand
GHG	Greenhouse Gas
IBRD	International Bank for Reconstruction and Development
IFC	International Finance Corporation
MtCO ₂ e	Million tons of carbon dioxide equivalent
PEA	Provincial Electricity Authority
RE	Renewable Energy
SPPs	Small Power Producers (SPPs)
TGO	Thailand Greenhouse Gas Management Organization
VSPPs	Very Small Power Producers

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EXECUTIVE SUMMARY

The Government of Thailand (GoT) proposes to reallocate resources in the Clean Technology Fund (CTF) Country Investment Plan (CIP) which was endorsed by the Trust Fund Committee (TFC) in December 2009. Table ES1 summarizes the indicative financing plan as endorsed in December 2009. Table ES2 presents the indicative financing plan after the proposed reallocations.

Table ES1: Thailand CTF Indicative Financing Plan Endorsed in December 2009 (\$million)

Financing Source	Clean Energy (IBRD)	Clean Energy (IFC)	Urban Transformation (IBRD)	Total
CTF	160	70	70	300
Government of Thailand	956	0	1,127	2,083
IBRD Loans	160	0	70	230
IFC Loans	0	270	0	270
Private sector	400	980	0	1,380
Total	1,676	1,320	1,267	4,263
Carbon Finance Potential	191	60	116	367

Source: CTF Investment Plan for Thailand 2009

ADB=Asian Development Bank, CTF=Clean Technology Fund, EE=energy efficiency, FI=financial intermediary, IBRD=International Bank for Reconstruction and Development, IFC=International Finance Corporation, MDB=multi-lateral development bank

Table ES2: Indicative Financing Plan After Reallocation (\$million)

Financing Source	Clean Energy (ADB)	Clean Energy (IFC)	Total
CTF	100	70	170
ADB Loans	360	--	360
IFC Loans	--	270	270
Private sector	960	980	1,940
Total	1,420	1,320	2,740
Carbon Finance Potential	100	60	160

ADB=Asian Development Bank, CTF=Clean Technology Fund, EE=energy efficiency, FI=financial intermediary, IFC=International Finance Corporation

The overall context and objectives of the CIP remain unchanged. No changes have been proposed to the CTF allocation for the International Finance Corporation (IFC) and the IFC-led investment programs. This document covers the proposed changes and program to be implemented by the Asian Development Bank (ADB). The proposed change will reallocate funds from public to private sector investments in renewable energy (RE), consistent with the long-term objectives of the original CIP. The updated CIP is focused on achievable success in the next two years (2012-2013). During this operational period, GoT may request additional support pending implementation performance and availability of additional funds from the CTF.

I. INTRODUCTION

1. The Clean Technology Fund (CTF) Country Investment Plan (CIP) was endorsed by the Trust Fund Committee (TFC) on 2 December 2009, with an envelope of \$300 million in CTF cofinancing. The original Investment Plan comprised clean energy investments in both the public and private sector, and public sector investments for urban transformation.

2. The proposed change will reallocate funds from public to private sector investments in renewable energy (RE), consistent with the long-term objectives of the original CIP. The updated CIP is focused on utility-scale RE projects which can be financed during the next two years (2012-2013). During this operational period, GoT may request additional support pending implementation performance and availability of additional funds from the CTF.

3. The overall context and objectives of the CIP are the same as the original CIP. The updated CIP is a business plan owned by GoT. The updated CIP is a dynamic document with the flexibility to consider changing circumstances and new opportunities.

4. No changes have been proposed to the CTF allocation for the International Finance Corporation (IFC) and the IFC-led investment programs. Therefore, this document covers the proposed changes and program to be implemented by the Asian Development Bank (ADB), and is organized as follows:

- Section II -- Review of the status of the implementation of the original investment plan;
- Section III -- Explanation of the circumstances and rationale for revising the investment plan and making changes to the projects or programs included;
- Section IV -- Description of the proposed changes, i.e., proposed reallocation of funds as requested by the Government of Thailand (GoT) through the Ministry of Finance's letter dated 24 June 2011 to the CTF Trust Fund Committee; and
- Section V -- Assessment of the potential impact of the proposed changes on achieving the objectives and targets of the original investment plan.

II. STATUS OF ORIGINAL INVESTMENT PLAN IMPLEMENTATION

5. As of June 2011, two project proposals have proceeded: \$40 million was approved in June 2010 for the IFC Renewable Energy (RE) Accelerator Program, and \$30 million was approved in October 2010 for the IFC Sustainable Energy Financial (SEF) intermediation program. The projected approval dates by IFC's Board are December 2011 for the RE Accelerator program, and June 2011 for the SEF program. The status of project approvals is presented in Table 1.¹

¹The IBRD projects included in the original CIP have been dropped for further consideration.

Table 1: Processing Status of IFC Investment Programs

Project	TFC Approval Date	Projected IFC Board Approval Date	CTF Amount (\$ million)	Leveraged Funding (\$ million)
Renewable Energy Accelerator Program (TSEFF)	June 2010	December 2011	40	260
Sustainable Energy Financing Program (T-SEF)	October 2010	July 2011	30	990

Source: Clean Technology Fund Administrative Unit, June 2011

IFC Renewable Energy Accelerator Program (T-SEFF)

6. **Description:** IFC would provide appropriate incentives for qualified solar and wind developers to fast-track the implementation of Renewable Energy projects. These projects would provide immediate GHG reduction impact and provide valuable information on the types and amounts of incentives required to catalyze Renewable Energy development in the country.

7. **Rationale:** IFC will continue to develop projects with CTF support in close coordination with the GoT and the policies that govern private sector growth. The rationale is the same as envisioned in the original CIP.

8. **Progress:** IFC continues to work with project developers and refining financial structures in the development of projects. Overall progress is shown above in Table 1. As of August 2011, \$4 million for 2 utility scale solar projects has been approved by IFC's Board. IFC has a pipeline of projects that are at various stages of development that would fully utilize IFC's CTF allocation.

IFC Sustainable Energy Financing Program (T-SEF)

9. **Description:** The Program comprises both an Investment and Advisory Services component to support the scale up of EE/RE/ESCO projects in Thailand's large corporate, SME, commercial, residential and municipal sectors. It aims to contribute to increasing private sector involvement, support EE market transformation and enhance energy savings.

10. **Rationale:** The CTF funds will continue to be needed to incentivize local financial institutions to undertake financing in lower carbon emitting technologies. The rationale is the same as envisioned in the original CIP.

11. **Progress:** IFC continues to work with various stakeholders in developing Investment and Advisory Services under the Sustainable Energy Financing Program. Overall progress is shown above in Table 1. Several projects are under development including one that is being scheduled for Board review.

III. CIRCUMSTANCES AND RATIONALE FOR INVESTMENT PLAN UPDATE

12. Circumstances guiding low-carbon development financing approaches have changed sufficiently to warrant a revision to the Investment Plan. Two major issues underpin the proposed revision:

- (i) Public financing is now available at low rates,² obviating the need for concessional funds for public sector projects in the near term; and
- (ii) Due to the existing Constitution of the Kingdom of Thailand, the GoT has to follow Article 190 of the Constitution which requires two approvals by Parliament for committing any loan agreement for sovereign borrowing, including from CTF. The constitutionally-mandated review and approval procedures for sovereign borrowing are expected to take 1 to 2 years, and full government approvals are not guaranteed, especially considering point (i).

13. ***The public sector projects included in the original CIP therefore face a major implementation risk that was not explicitly identified in 2009 and that cannot be mitigated.*** While public sector projects may be fundamentally sound investments, going through the process required under Article 190 of the Constitution of the Kingdom of Thailand will take time and can delay the implementation of the projects. Such an outcome would present a substantial opportunity cost by tying up CTF funds which might otherwise be directed toward candidate investments which are seeking concessional financing now.

14. Bangkok's urban transformation, envisioned in the original CIP, requires an evolution in the policy framework to continue rebuilding the urban area around people rather than cars. The public transport and energy efficiency (EE) investments envisioned in the BMA urban transformation program can be serviced by public financing, public-private partnerships, or by commercial investment via private sector implementation. For example, green building retrofits could be facilitated with an interest rate buy-down or guarantee, possibly with "bottom-up" CTF private sector support through energy service companies and their partner banks or other financial institutions.³

15. Given the low cost of financing noted above, public sector funds can support the major power utilities (EGAT and PEA), the Specialized Financial Institutions, and the Bangkok Metropolitan Authority. GoT has determined that in the near term CTF resources would be more appropriately and effectively utilized by targeting private sector utility-scale renewable energy (RE) projects which face financing barriers.

16. ***The Government of Thailand (GoT) remains fully committed to its development policy framework for energy security, climate change, environmental management, and public health.*** The general approach and overall objectives for low-carbon development presented in the CTF Investment Plan remain the same. GoT is committed to reducing energy intensity and greenhouse gas (GHG) reductions through a comprehensive policy framework (as described in the original CIP). Key aspects of the energy policy and technical challenges are depicted in Figure 1.

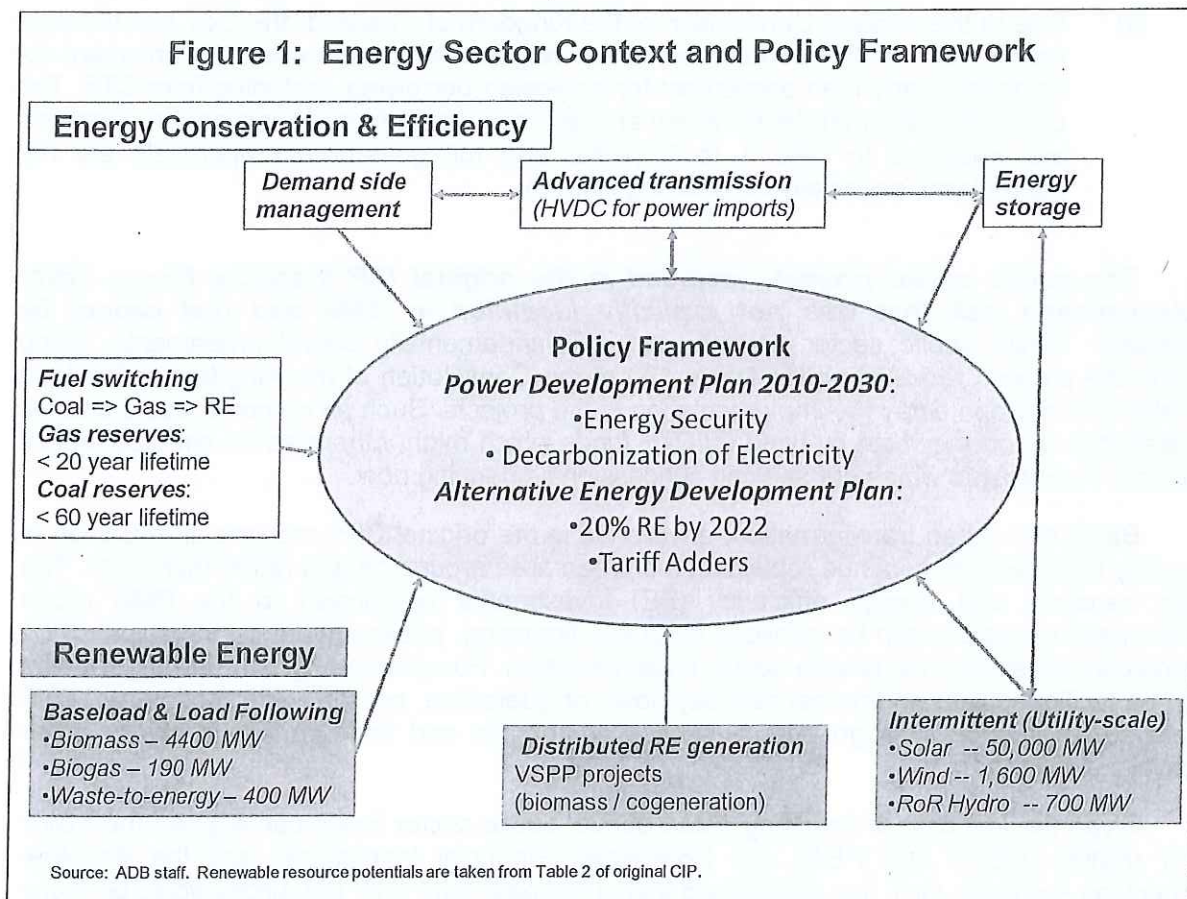
17. As illustrated in Figure 2, total emissions, per capita emissions, and per capita energy use grew from 1990 through 2007; the CO₂ intensity of the economy declined slightly from the mid-2000s. GHG emissions are projected to continue increasing for the foreseeable future. Energy use and industrial processes are still the largest sources of GHG emissions, with electricity generation accounting for about 40% to 42% of total emissions.⁴ Energy demand is

² Recently, GoT issued 50-year bonds at 4.8% and 10-year bonds at 3.7%.

³ These types of investments are a logical target of the IFC Sustainable Energy Finance program.

⁴ Thailand Energy Statistics (Preliminary) 2010, Table 20; Department of Alternative Energy Development and Efficiency.

projected to increase from 146,182 gigawatt-hours (GWh) in 2009 to 347,947 GWh in 2030, an average of about 4.2% per year.⁵



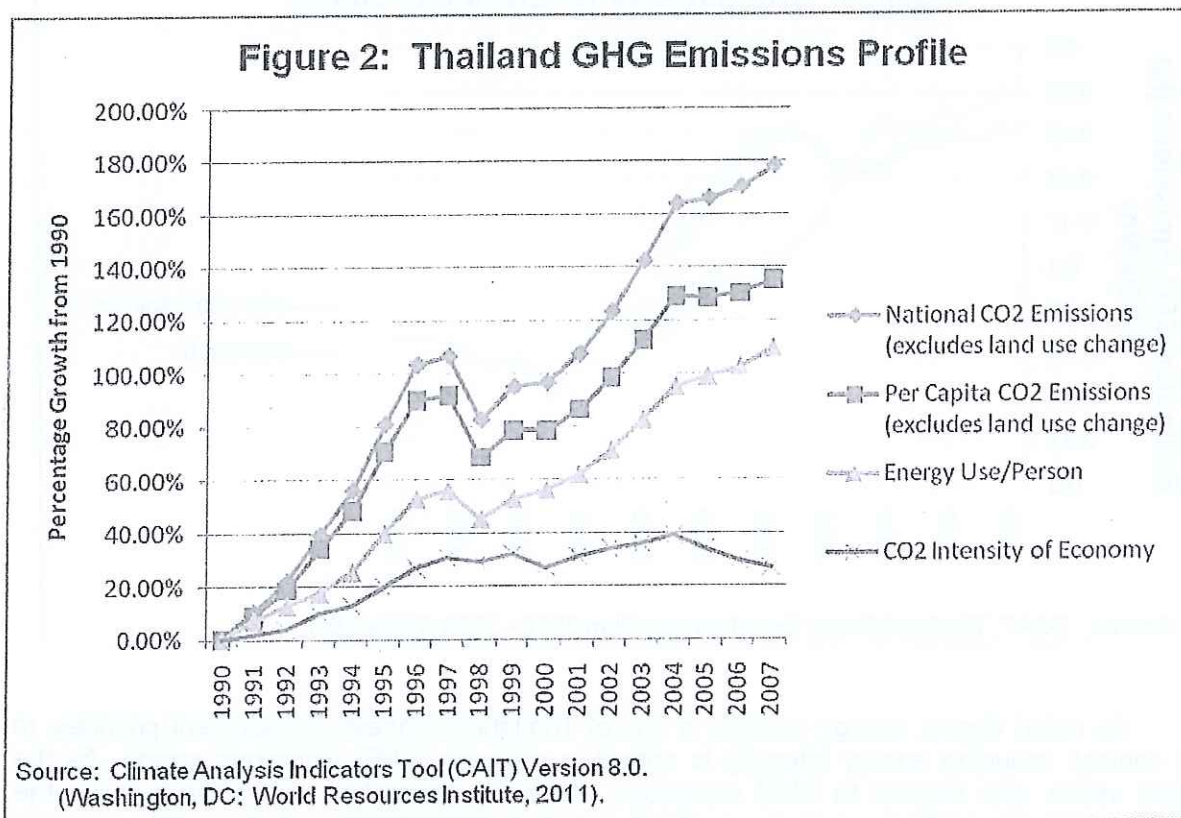
18. Energy security is a high priority, as Thailand relies heavily on natural gas from the Gulf of Thailand⁶ and imported gas from Myanmar for power generation. In order to enhance energy security, control pollution from fossil fuels, and mitigate long-term GHG impacts, domestic resources will be further utilized to expand supply of renewable electricity and transport fuels.⁷ Expanding the use of non-tradable domestic resources such as solar and wind power will improve energy security by offsetting demand for imported natural gas and imported

⁵ EGAT. 2010. *Summary of Thailand Power Development Plan 2010 – 2030*. EGAT System Planning Division, Report No. 912000-5305, April 2010.

⁶ Thailand's natural gas reserves (23 trillion cubic feet) are estimated to last 18 years at current production rate of 3,747 million cubic feet per day (MMcfd) if no new reserves are found. Source: Natural Gas for Asia Website: <http://naturalgasforasia.com/> Accessed on 3 August 2011. Coal reserves have about 60 year lifetime at 2006 production rates. Source: US Department of Energy, Energy Information Administration, *International Energy Annual 2005*, posted online 21 June 2007 [to be updated]

⁷ The transport sector will remain reliant on petroleum-based fuels for the foreseeable future; however, renewable fuel production capacity is the highest of any country in Southeast Asia. Gasoline blended with 20% ethanol (E20) and 85% ethanol (E85) has been introduced and vehicle manufacturers have begun to deliver flex-fuel vehicles to the market.

hydropower. As of 2010, total alternative energy consumption was estimated at 7148 kilotons oil equivalent, of which 62% was in the form of heat, and only 4.3% in the form of electricity.⁸

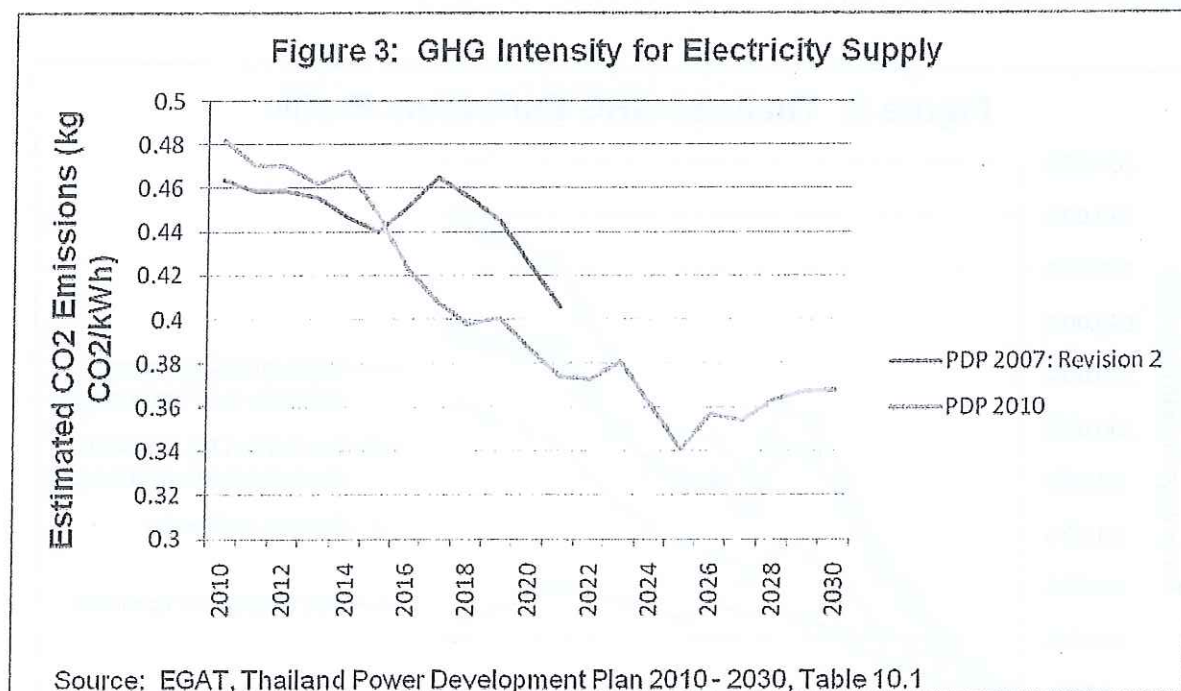


19. *The government is still focused on its policy of having alternative energy as a national agenda through encouraging production and use of indigenous renewable energy resources.* The EGAT Power Development Plan (2010-2030) released in 2010 is fully consistent with the earlier Renewable Energy Development Plan of 2008-2022. The EGAT Power Development Plan 2010 – 2030 calls for electricity supplies to be progressively decarbonized as shown in Figure 3, which will require continued addition of clean energy to the generation mix, complemented by conservation and efficiency gains. This decarbonization objective is consistent with energy security objectives, and will require effective neutralization of GHG emissions from approximately 12,000 MW of existing and future coal-fired generating plants by the year 2030. To this end, the Ministry of Energy through the Department of Alternative Energy Development and Efficiency (DEDE) is planning to prepare a revised Renewable Energy (RE) Plan of doubling the electricity generated by solar energy, from 500MW to 1000 MW due to increased interest from the private sector.^{9,10}

⁸ Thailand Energy Statistics (Preliminary) 2010, page 10; Department of Alternative Energy Development and Efficiency.

⁹ DEDE Website. Accessed on 3 August 2011 from http://www.dede.go.th/dede/index.php?option=com_content&view=article&id=7173%3A2010-09-30-16-33-06&catid=137%3Ainternational-news&Itemid=1&lang=en

¹⁰ The new government is considering raising this target to 2000 MW.



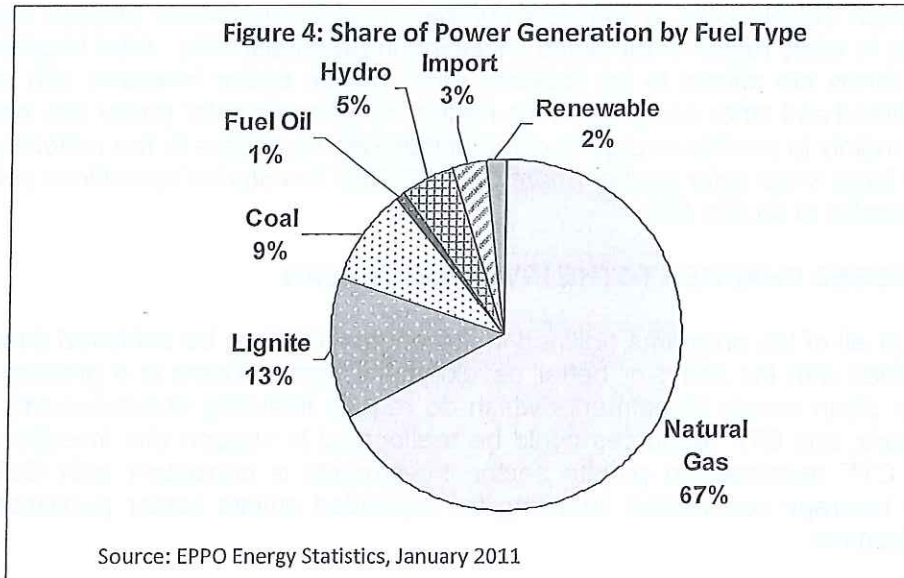
20. As noted above, energy security is one of Thailand's highest development priorities; in this context, reducing energy intensity is critical to reducing GHG emissions growth. As the largest sector with respect to GHG emissions, electricity generation will continue to be the highest priority for achieving large-scale GHG reductions. The fuel mix in the power sector is illustrated in Figure 4. As noted above and in the original CIP, Thailand is heavily reliant on natural gas for power generation and petroleum-based fuels in the transport sector. Domestic natural gas reserves are projected to last less than 20 years at current production rates, and imported gas from Myanmar faces potential political risks. Global natural gas reserves have increased during the last several years, but import of additional gas supplies for the long-term would require investment in new pipelines and/or liquefied natural gas (LNG) facilities. An aggressive domestic exploration program would be subject to limitations in the petroleum services sector: the extended global petroleum supply chain has been severely stressed in recent years, and will remain problematic in the near term.¹¹

21. The prospect of displacing gas with coal is problematic. Under the EGAT *PDP 2010-2030*, 6400 MW of clean coal power plants¹² will be added to the generation mix. A more aggressive strategy to displace gas based on imported coal would be subject to similar supply risks as exist in the petroleum sector (e.g., limitations of port and transshipment capacity), as well as external price volatility. In the absence of advanced sustainable coal systems, domestic

¹¹ A recent US Department of Defense study notes that "the central problem for the coming decade will not be a lack of petroleum reserves, but rather a shortage of drilling platforms, engineers and refining capacity. Even were a concerted effort begun today to repair that shortage, it would be 10 years before production could catch up with expected demand." United States Joint Forces Command (USJFCOM), *The Joint Operating Environment* (Virginia, USJFCOM, 2010). Accessed on 16 April 2010 from www.jfcom.mil/newslink/storyarchive/2010/JOE_2010_o.pdf.

¹² The plants would utilize supercritical and/or ultra-supercritical technology, but are not expected to include carbon capture and storage.

coal reserves are insufficient with respect to quality and volume to displace gas in an environmentally and socially acceptable manner.



22. RE technologies such as solar and wind have yet to achieve economies of scale to effectively break into markets that have long been dominated by conventional energy. The prices of solar PV modules, wind turbines and light emitting diodes have declined over the past decade through technological innovations and mass production. These technologies, however, have yet to compete with fossil fuel-based energy generation at gigawatt (GW) scale. In the absence of disruptive technologies, more RE capacity is needed to be built to achieve grid parity. New business models and financial instruments are also needed to scale up RE capacity and complementary investments in new grid technologies, energy storage, and other low-carbon systems.

23. According to the International Energy Agency (IEA) *World Energy Outlook 2009*, wind power is projected to soon become the most significant source of renewable-based electricity after hydropower, ahead of biomass. Wind power has been growing rapidly in the OECD and, increasingly, in non-OECD countries, notably in China and India. Electricity generation from wind power is projected to reach 4.5% of total electricity generation in 2030 worldwide, compared with less than 1% in 2007. In the OECD, this share reaches 8% by 2030. In this context, it appears that the potential for wind power in Thailand remains significantly unexploited as only 5 MW of wind capacity was installed by 2009 of the total 1,600 MW estimated potential.

24. Over the past two decades, solar power has become increasingly attractive economically as noted above. Grid-connected solar photovoltaic (PV) generation systems are the fastest growing in the world: cumulative installed capacity grew by 50% yearly in 2006 and 2007 to 7.8 GW by the end of 2007. According to the *Annual Energy Outlook 2009*, the capacity costs in 2030 of new solar PV plants will be 37% lower than in 2009. At the same time, it will cost more to generate electricity from conventional sources, meaning electricity prices will increase in places that rely significantly on gas-fired power plants (e.g., Thailand). Assuming

that the solar power sector continues to be supported over the short to medium term, the cost of solar energy and conventional power generation are expected to approach grid parity by 2020–2022; as a result, global installed solar capacity in 2020 could be 20–40 times what it is today. In order to reach this outcome, a sufficient number of large solar power projects need to reach financial close in every region of the world, including in Southeast Asia. After large-scale private sector solar farms are shown to be feasible, other private sector investors can replicate the model in Thailand and other countries in the region. Small-scale solar power has been used for many years, mainly to provide energy to communities with no access to the national power grid. *However, no large scale solar project (more than 20 MW) has started operations yet despite an estimated potential of 50,000 MW.*

IV. PROPOSED CHANGES TO THE INVESTMENT PLAN

25. Most or all of the programs outlined in the original CIP can be achieved through private sector modalities with the same or better development impact. There is a growing pipeline of private sector clean energy investments which do require financing enhancements to achieve financial closure, and CTF resources could be reallocated to support this investment pipeline. Reallocating CTF resources to private sector investments is consistent with GoT and CTF objectives to leverage commercial financing for expanded private sector participation in low-carbon development.

26. The original CIP identified several prospective interventions in energy efficiency (EE) and RE, focusing primarily on demand-side EE and small-scale distributed generation using RE resources. The indicative financing plan endorsed in December 2009 is summarized in Table 2.¹³

Table 2: Thailand CTF Indicative Financing Plan Endorsed in December 2009 (\$million)

Financing Source	Clean Energy (IBRD)	Clean Energy (IFC)	Urban Transformation (IBRD)	Total
CTF	160	70	70	300
Government of Thailand	956	0	1,127	2,083
IBRD Loans	160	0	70	230
IFC Loans	0	270	0	270
Private sector	400	980	0	1,380
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Carbon Finance Potential	191	60	116	367

Source: CTF Investment Plan for Thailand 2009

ADB=Asian Development Bank, CTF=Clean Technology Fund, EE=energy efficiency, FI=financial intermediary, IBRD=International Bank for Reconstruction and Development, IFC=International Finance Corporation, MDB=multi-lateral development bank

27. *The rationale for CTF intervention in the energy sector remains unchanged.* Thailand's energy generation is highly dependent on imported fuels, which makes the country vulnerable to energy supply disruptions and global price fluctuations. Thailand is endowed with abundant renewable energy resources—biomass/biogas, small-scale hydropower, solar, and waste-to-energy (WTE)—with estimated total potential of 57,000 MW. Less than 3% of this potential has been developed. Tapping the RE potential will increase Thailand's energy security,

¹³ Paragraph 1 of the Investment Plan notes that Asian Development Bank (ADB) is included in the country operational context, but no specific funding allocation was made for ADB projects in 2009.

save foreign exchange, and protect against global price fluctuations by using non-tradable domestic energy sources.

28. *The major change proposed is to reallocate CTF funds from public sector to private sector investments, including candidate projects being considered by the ADB Private Sector Operations Department (ADB-PSOD).* There are immediate opportunities for large-scale RE projects which face additional cost and risks that could be supported by CTF. Utility-scale WTE using municipal solid waste (MSW) and wind power are at the “pioneer” stage and face additional costs and risks which are not being covered by commercial financing. Utility-scale solar projects are also at an early commercial scale, with only a few large projects under construction.¹⁴ While some biomass potential is being successfully developed, there are still substantial resources which remain untapped, including MSW. CTF can play a catalytic role in reducing the first mover risk and accelerating replication and scale-up in the near term. The replication potential for biomass, solar, WTE, and wind is more than 10 to 1.

29. ADB-PSOD is currently engaged with sponsors who are developing several waste-to-energy (WTE) projects with total capacity of about 50 MW, and several wind power projects with total capacity of about 350 MW and solar power projects with total capacity of 120 MW. As of August 2011, ADB has closed financing for two utility-scale solar projects which are now under construction, and additional investments in similar projects are under consideration. These “pioneer” projects face (i) additional costs associated with state-of-the-art RE technologies and systems, and (ii) first-mover risk associated with deployment of these RE systems in Thailand which will not be mitigated by conventional financing. The replication and scale-up potential is at least 10 to 1. A concept paper for the candidate investments is presented in Appendix 1.

30. These prospective investments are appropriate for CTF support given the transformational nature of the projects and the replication and scale-up potential. Opening a second window for private sector access to CTF with ADB-PSOD expertise and resources will add substantial value to the CIP. ADB-PSOD will be able to provide its array of financial products and instruments including long-term Thai Baht denominated loans, contingency finance, partial credit guarantees, and risk-sharing, to mobilize additional investment and bring a second private sector window for deploying CTF resources in Thailand. The proposed changes will allocate \$100 million to ADB for private sector clean energy investments, as shown in Table 3. Anticipated funding leverage is consistent with the global CTF average. No changes are proposed for the IFC allocation and investment programs.

Table 3: Indicative Financing Plan After Reallocation (\$million)

Financing Source	Clean Energy (ADB)	Clean Energy (IFC)	Total
CTF	100	70	170
ADB Loans	360	--	360
IFC Loans	--	270	270
Private sector	960	980	1,940
Total	1,420	1,320	2,740
Carbon Finance Potential	100	60	160

ADB=Asian Development Bank, CTF=Clean Technology Fund, EE=energy efficiency, FI=financial intermediary, IFC=International Finance Corporation
Source: August 2011 Joint Mission findings

¹⁴ These include the Bangchak 34.5 MW and 10 MW plants, and the NED 73 MW plant supported by ADB-PSOD.

V. POTENTIAL IMPACTS OF PROPOSED CHANGES ON INVESTMENT PLAN OBJECTIVES

31. The proposed changes will enhance the clean energy financing program by using CTF resources to accelerate and expand private sector investment, which is a long-term objective of the GoT as elucidated in the original CIP. The proposed changes will not have a negative effect on the community-scale biomass power program and urban transformation, as the proposed investments can be supported with public financing, and possibly via new public-private partnerships (e.g., commercial financing for green building retrofits). The assessment of potential impact of the proposed changes on achieving the objectives and targets of the original investment plan are summarized in Table 4 and discussed below.

Table 4: Assessment of Proposed Changes

CTF Investment Criteria	Original Investment Plan (IBRD Programs)	Updated Investment Plan (ADB RE Program)
Potential for GHG Emissions Savings	IBRD investments primarily targeted biomass power which is the most advanced RE sub-sector with respect to the Alternative Energy Development Plan objectives.	ADB program will target utility-scale waste-to-energy, wind, and solar projects which are the least advanced with respect to the Alternative Energy Development Plan objectives, but which have the highest potential after biomass and hydropower.
Cost-effectiveness	[see Table 5]	[see Table 5]
Demonstration Potential at Scale	The transformation potential was not defined as per paragraphs 15 - 17 of the <i>CTF Investment Criteria for Public Sector Operations</i> dated 9 February 2009	Transformation potential is estimated to be > 8.4 [see Table 5]
Development Impact	The IBRD RE program primarily targeted small-scale RE projects (less than 15 MW per project). The public sector investments in RE and urban transformation will be supported by government financing.	ADB program will finance large-scale projects which will accelerate growth of the RE industry in Thailand by supporting developers, equipment suppliers, and domestic financing partners. These larger projects have attracted private sector interest but face additional cost and risk barriers (noted below). Impacts with respect to energy security, access to energy, and environmental benefits should be higher than the original CIP; impacts on employment may be lower than the original CIP.
Implementation Potential	None of the proposed IBRD projects had proceeded to the appraisal stage as of June 2011. The proposed projects can still be implemented by EGAT, PEA, and BMA with government funding support.	ADB Board has approved financing for 2 large-scale RE transactions since mid-2009, using small grant funds. Judicious placement and pricing of CTF funds will facilitate successful implementation. See Table 6 for discussion of implementation risks and mitigation.
Additional Costs and Risk Premium	As AEDP was introduced in 2009, the overall program faced first-mover risks and additional costs of RE systems	Experience since 2009 suggests that the tariff adders are sufficient to cover additional costs of RE systems, but not the front- and back-end risks of large-scale RE projects. ADB's program will focus on using CTF for risk coverage.

32. **Transformational impact will be enhanced.** ADB-PSOD can bring additional value to the Investment Plan by mobilizing additional resources focusing primarily on utility-scale RE opportunities. ADB-PSOD is working with private sector sponsors on a variety of pioneering utility-scale RE projects. CTF cofinancing will further accelerate and deepen market penetration of commercial and newly commercialized RE technologies, including wind and thin-film solar photovoltaic (PV). ADB-PSOD is working with developers and financial institutions to structure an investment program that will support pioneer projects facing first mover risk, and then target rapid scale-up and replication. ADB-PSOD will be able to provide its array of financial products and instruments including long-term Thai Baht denominated loans, contingency finance, partial credit guarantees, and risk-sharing, to mobilize additional investment and bring a second private sector window for deploying CTF resources in Thailand. A key objective of GoT energy and climate change policies is to promote private sector participation: the proposed changes to the Investment Plan will accelerate private investment in utility-scale clean energy projects and crowd in additional commercial financing. Given the GoT ability to raise funds at competitive prices, it is possible to leap-frog the earlier-proposed public sector investments proposed for IBRD support.

33. **Emissions reductions from clean energy investments will be higher than in the original investment plan.** The pipeline of ADB-PSOD projects will result in avoided fossil power emissions of about 1.1 million tCO_{2e}/y, but with comparable cost-effectiveness and higher replication and scale-up potential than the original CIP (see Table 5 and Appendix 1). The WTE projects will bring environmental and public health co-benefits equal to or greater than that which would be realized under the original Investment Plan.

Table 5: Results Indicators

Baseline	Results Indicator	Expected Program Results For Public Sector Programs in Original CIP	Expected Program Results For ADB-PSOD RE Program
1,699 MW in 2008 (including hydro)	Installed renewable power capacity and electricity production in Thailand (Biomass, Wind, and Solar)	700 MW of new renewable power projects added by 2012 ^a	520 MW of new renewable power projects added by 2014, with generation output of 1.6 terawatt-hours per year
Emissions in the power sector were 82 MtCO _{2e} per year in 2009	Annual GHG reductions from power generation	1.6 MtCO _{2e} per year by 2022 ^a <u>Cost effectiveness</u> ^b : CTF\$160 million / 1.6 MtCO _{2e} per year = CTF\$10 / ton	1.1 MtCO _{2e} per year reductions directly supported by CTF > 10 MtCO _{2e} per year with replication and scale up by 2022 <u>Cost effectiveness</u> : CTF\$100 million / 10 MtCO _{2e} per year = CTF\$9 / ton ^c
[Urban transformation baselines and results indicators were not defined in original CIP]		1.16 MtCO _{2e} per year reductions from integrated urban public transport 0.02 MtCO _{2e} per year reductions from EE investments in BMA buildings <u>Cost effectiveness</u> ^b : CTF\$70 million / 1.18 MtCO _{2e} per year = CTF\$ 59 / ton	n/a

Notes: ^a Indicators are from Table 4 of the original CIP.

^b Cost effectiveness was not included in the original CIP but is calculated here as shown.

^c Estimated GHG reductions and cost-effectiveness calculations are shown in Appendix 1

Source: August 2011 Joint Mission

34. **Replication and scale up potential will be higher than originally planned.** Utility-scale solar projects have the best potential for replication and scale-up, with more than 50,000 MW estimated resources in Thailand. Commercial demonstration of WTE and wind will expand the RE program beyond the original CIP. The replication potential for wind and WTE is more than 10 to 1 and is much higher for solar resources. Using CTF to cofinance commercial investment on pioneer projects will eliminate first-mover risk and will help unlock additional near-term investment and crowd in commercial financing for utility-scale RE projects. As noted above (in paragraph 18), as of 2010, the total 4.3% of alternative energy consumption was in the form of electricity: in order to increase this share, **the ADB program will focus on grid-connected RE projects which are necessary to meet the decarbonization objectives shown in Figure 3.**
35. **Development impacts and co-benefits will be maintained or enhanced.** Expanded investment in EE and RE will improve energy security, reduce GHG emissions, and reduce conventional pollutant emissions with substantial public health benefits. Using CTF to cofinance commercial investment will help unlock liquidity in financial markets which will stimulate economic growth and facilitate the long-term transition to low-carbon development.
36. **Implementation potential for an expanded private sector RE program is high.** ADB-PSOD is actively engaged with developers on a program of 350 MW of wind power, 50 MW of waste-to-energy projects, and 120 MW of utility-scale solar power projects. These projects are at various stages of feasibility analysis and initial due diligence stage, and some are expected to be presented to ADB-PSOD's Board of Directors in late 2011 and early 2012. The balance of these candidate projects can be prepared and brought to financial closure by year-end 2012 (assuming that no fatal flaws emerge during due diligence). Risks and mitigation measures of the RE program are summarized in Table 6.
37. **Additional costs and risk premiums justify use of CTF.** The WTE and utility-scale projects are first-of-a-kind in Thailand. These pioneer projects have high capital costs compared to conventional fossil fuel plants, and face first-mover risk. Wind and solar power have additional costs and project risk due to the intermittent nature of the resources. Wind power projects require at least one year of site-specific monitoring to confirm the resource and proceed with design and financing, which has hindered development. Private sector developers have generally been unable to obtain project financing due to the perceived risk of wind and solar systems, especially for utility scale projects with first-mover risk.
38. The tariff adder policy for RE projects is designed to offset some of the additional capital costs and risks, but clearly does not offset all development, financial, and technical risks. The adders are essentially a "one size fits all" instrument, and the value of adders can not readily be monetized to cover up-front development risk or back-end risk after the adder period has ended and capital cost have to be amortized with the wholesale rate. Innovative financing approaches are needed for end-to-end risk coverage, e.g., concessional funds to reduce the cost of developers' up-front equity and long term funding beyond the adder period.
39. Carbon finance is increasingly at risk due to post-2012 market uncertainties. Carbon finance opportunities¹⁵ will be pursued but any revenue is expected to be "on delivery" and will not be sufficient to catalyze up-front investment. Also, any CDM funds are uncertain until registration with the UN, which typically occurs after the project's financial close.

¹⁵In November 2010, the Cabinet approved a decree that exempts companies from the payment of corporate tax on income derived from the sale of CERs and VERs.

Table 6: ADB RE Program 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 to be maintained in order to promote private sector investment Application of innovative financing to front- and back-end risks and to reduce costs of developers' equity and contingency funds 	L
Implementation Capacity: Limited implementation capacity of smaller-scale investors	<ul style="list-style-type: none"> Technical assistance to transfer know-how on project planning, financing, risk management, especially for pioneering projects 	L/M
Technology: Limited know-how for wind and solar which have not been demonstrated at large scale in Thailand.	<ul style="list-style-type: none"> Technology and know-how transfer for newly-introduced systems such as utility-scale solar and wind. Enhanced overall planning and management of intermittent resource risks, with technical assistance if needed. 	M/H
Finance: Commercial viability of SPP projects up to 90 MW, especially technology with high capital costs such as solar, will vary project by project. Commercial banks may still feel reluctant to lend without adequate risk management instrument in place.	<ul style="list-style-type: none"> Provide technical assistance to project developers in preparing projects including financial and risk analysis. Carbon finance will be mobilized to the maximum extent possible, including prospective post-2012 carbon revenue. 	M/H
Environmental Management: Utility-scale solar, wind and WTE projects are expected to have limited environmental impact, but may face local community concerns.	<ul style="list-style-type: none"> Working closely with local communities to ensure sound environmental and social management practices. Rigorous application of GoT regulatory framework and ADB safeguards for environmental and social impact 	L
Development Impact: Large-scale renewable has good development potential with close linkage to community participation, but large power plants may face community resistance.	<ul style="list-style-type: none"> Work closely with local communities including early consultation at project conception and planning stages. Enhance public awareness of utility-scale RE projects. 	L
Carbon finance delivery risk: Verification bottlenecks are currently delaying annual payments and affecting the financing structure of large scale transactions. Adders may preclude demonstration of CDM additionality.	<ul style="list-style-type: none"> Coordinate with ADB Future Carbon Fund to identify opportunities to maximize potential carbon revenues, and reduce or eliminate delays in methodology and verification processes Consider voluntary transaction in secondary carbon markets 	
Procurement : Limited number of global suppliers for some RE technologies may limit competition in some instances	<ul style="list-style-type: none"> Initial set of large-scale RE projects are being developed by sponsors with Competitive bidding will be utilized in accordance with MDB and Thai requirements. 	L
Overall risk after mitigation	Moderate	

Appendix 1: Private Sector Renewable Energy Program (ADB)

Problem Statement

1. Thailand is one of the largest electricity consumers in Asia. As of December 2009, installed power generation capacity in Thailand was 29,211 MW, 71% of which is sourced from natural gas and 19% from coal and lignite. Recent government energy policy has underscored the importance of fuel diversification and security for power generation. The electric power sector is reliant on imported natural gas and hydropower. Energy security considerations point toward increasing use of domestic coal resources to offset dependence on natural gas imports.
2. Thailand's growth rates in energy consumption are much higher than the GDP growth rate. The economy has become more energy and GHG intensive during the past decade [see CTF Investment Plan Figures 2, 6, and 7]. Energy consumption accounts for approximately 60% of the country's greenhouse gas (GHG) emissions.¹⁶ In its most recent Power Development Plan (PDP-2010) published in April 2010, the Electricity Generating Authority of Thailand (EGAT) projected an average growth rate of 4.22% in energy demand and a 4.19% annual average increase in peak demand during 2008-2030.¹⁷
3. Thailand's renewable energy (RE) sources—biomass, biogas, mini-hydro, solar, wind, and waste-to-energy (WTE) —can be utilized to increase Thailand's energy security, save foreign exchange, and protect against global price fluctuations. As part of Thailand's energy strategy to diversify its energy mix and promote renewable energy, the Government has developed an Alternative Energy Development Plan (AEDP) and set a target for 20.3% of primary commercial energy to come from alternative energy sources by 2022. This implies a RE target of 5,608 MW by 2022, which is a significant increase from the current level of 1,750 MW.¹⁸ As of 2010, total alternative energy consumption was estimated at 7148 kilotons oil equivalent, of which 62% was in the form of heat, 22% for natural gas vehicles, 6.6% for bio-diesel, 4.6% for bio-ethanol, and only 4.3% in the form of electricity.¹⁹ Meeting the AEDP targets and EGAT decarbonization targets will require a significant shift in investment trajectories to support utility-scale, grid-connected RE projects, which is not expected to happen without additional private sector participation and commercial financing.
4. ADB-PSOD is currently engaged with sponsors who are developing several waste-to-energy (WTE) projects, using municipal solid waste (MSW) with total capacity of about 50 MW, several wind power projects with total capacity of about 350 MW, and solar power projects of about 120 MW. As of June 2011, ADB has closed financing for two utility-scale solar projects which are now under construction, and additional investments in similar projects are under consideration. These "pioneer" projects face (i) additional costs associated with state-of-the-art RE technologies and systems; and (ii) first-mover risk associated with deployment of these RE systems in Thailand.

Proposed Transformation

5. CTF cofinancing will be utilized for creative financial structuring for utility scale RE projects, building on recent ADB-PSOD experience. CTF will be used to cover part of the

¹⁶ ADB. 2009. *Building a sustainable energy future: The Greater Mekong Subregion*. Manila.

¹⁷ Electricity Generating Authority of Thailand. 2010. *Thailand Power Development Plan 2010-2030*. Bangkok

¹⁸ This target comprises biomass 3,700 MW; biogas 120 MW; waste to energy 160 MW; wind 800 MW; small hydro 328 MW; and solar 500 MW.

¹⁹ Thailand Energy Statistics (Preliminary) 2010, page 10; Department of Alternative Energy Development and Efficiency.

additional capital costs and to take out first-mover risks so that commercial financing can be effectively mobilized for large-scale RE projects. In addition, CTF funds will be used - alongside ADB's loan - to amortize renewable technologies' high up-front capital costs over a longer period than otherwise possible. Commercial banks typically restrict the tenor of their loans to the adder period (7-10 years after commercial operations date), which is not sufficient to amortize high capital costs.

6. CTF will facilitate mainstreaming of RE investments by crowding-in private sector financing. The RE program will demonstrate the commercial viability of several large-scale WTE, wind, and solar projects. These projects will provide business models that can be replicated in Thailand and elsewhere in the region.

7. Successful demonstration of a variety of utility-scale RE projects will facilitate development of local green industries which are required to enable long-term low-carbon development.

8. The effective disposal of MSW has always been a serious environmental challenge for developing countries such as Thailand where improper MSW management potentially causes serious local, regional, and global environmental problems such as air pollution, soil and groundwater contamination, and emissions of greenhouse gases, particularly methane (CH₄). The WTE projects will provide a quantum improvement in solid waste management systems with substantial environmental and public health co-benefits.

Implementation Readiness

9. ADB is actively engaged with the developers of the wind, solar and WTE power projects which are at various stages of feasibility analysis and initial due diligence stage. Some are expected to be presented to ADB's Board of Directors in late 2011 and early 2012. Projects will be developed and implemented under a 5-year automatically renewable PPA with EGAT and with PEA under the SPP and VSPP programs respectively. The balance of these candidate projects can be prepared and brought to financial closure by year-end 2012 (assuming that no fatal flaws emerge during due diligence). An indicative financing plan is presented below.

Rationale for CTF Financing

10. Utility-scale RE development is constrained by several factors:

- Commercial development of WTE, wind, and solar energy resources will increase Thailand's energy security, save foreign exchange, and protect against global price fluctuations by using non-tradable domestic energy sources.
- Utility-scale WTE, wind, and solar projects are at the pioneer stage and face additional costs and risks which are not being covered by conventional project financing. Creative financing approaches, including the use of concessional funds, are needed to engender confidence in the financial markets and mainstream large-scale RE project financing.
- Carbon finance can provide some financial support, but is not sufficient to overcome the cost and risk barriers noted above.
- CTF can provide a catalytic role in reducing or eliminating first mover risk for utility-scale RE projects, and foster accelerated replication and scale-up in the near term.
- The replication potential for WTE, wind, and solar projects is more than 10 to 1.
- GHG reductions and cost-effectiveness are comparable to or better than the original CIP, as summarized in the table below.

Estimated GHG Reductions and Cost-effectiveness^a			
<i>Total GHG reductions directly supported by CTF</i>		<i>Total GHG Reductions with replication and scale up</i>	
350 MW wind at 30% output	643,860 tons / year CO ₂ e	1250 MW ^b wind at 30% output	2,299,500 tons / year CO ₂ e
50 MW waste-to-energy at 80% output	245,280 tons / year CO ₂ e	350 MW ^c waste-to-energy at 80% output	1,716,960 tons / year CO ₂ e
120 MW solar at 25% output	183,960 tons / year CO ₂ e	5000 MW ^d solar at 25% output	7,665,000 tons / year CO ₂ e
Total	1,073,100 tons / year CO ₂ e	Total	11,681,460 tons / year CO ₂ e
Cost effectiveness	CTF \$93 ton / year CO ₂ e	Cost effectiveness	CTF \$8.56 ton / year CO ₂ e

Notes:

^a GHG reductions assume that RE displaces fossil power in the grid at 0.7 tons CO₂e/MW-h

^b Assumes replication and scale-up potential is limited to total of 1600 MW potential identified in the AEDP (see Table 8 of original CIP)

^c Assumes replication and scale-up potential is limited to total of 400 MW potential identified in the AEDP (see Table 8 of original CIP)

^d Assumes replication and scale-up potential is 10% of total of 50,000 MW potential identified in the AEDP (see Table 8 of original CIP)

Financing Plan

11. The indicative financing plan for the ADB RE program of projects is shown in the table below.

Source	Amount (US \$ million)
Project Sponsors / other lenders	960
ADB	360
CTF	100
Total^a	1,420
Carbon Finance ^b	100

^a Total cost assumes 50 MW waste-to-energy and 350 MW wind at \$2.5 million per MW installed, and 120MW of solar at \$3.75 million per MW installed.

^b No provision has been made for the carbon finance risks associated with possible lack of agreement on a post-2012 successor to the Kyoto Protocol. The carbon finance estimate is preliminary and subject to further revision.

Project Preparation Timetable

12. The indicative processing schedule for the initial set of RE projects is shown in the table below.

Milestone	Date
ADB Project Identification	July - September 2011
Appraisal / Negotiations	September – October 2011
ADB Board Consideration (Approval)	December 2011 – March 2012
Project Completion	March 2014– December 2014