Republic of Indonesia

Indonesia Climate Change Sectoral Roadmap
ICCSR

Industry Sector

March 2010

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Indonesia Climate Change Sectoral Roadmap – ICCSR

Industry Sector Report

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ACKNOWLEDGMENTS

The Indonesia Climate Change Sectoral Roadmap (ICCSR) is meant to provide inputs for the next five year Medium-term Development Plan (RPJM) 2010-2014, and also for the subsequent RPJMN until 2030, laying particular emphasis on the challenges emerging in the forestry, energy, industry, agriculture, transportation, coastal area, water, waste and health sectors. It is Bappenas' policy to address these challenges and opportunities through effective development planning and coordination of the work of all line ministries, departments and agencies of the Government of Indonesia (GoI). It is a dynamic document and it will be improved based on the needs and challenges to cope with climate change in the future. Changes and adjustments to this document would be carried out through participative consultation among stakeholders.

High appreciation goes to Mrs. Armida S. Alisyahbana as Minister of National Development Planning /Head of the National Development Planning Agency (Bappenas) for the support and encouragement. Besides, Mr. Paskah Suzetta as the Previous Minister of National Development Planning/ Head of Bappenas who initiated and supported the development of the ICCSR, and Deputy Minister for Natural Resources and Environment, Ministry of National Development Planning /Bappenas, who initiates and coordinates the development of the ICCSR.

To the following steering committee, working groups, and stakeholders, who provide valuable comments and inputs in the development of the ICCSR Industry Sector document, their contributions are highly appreciated and acknowledged:

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Grateful thanks to all staff of the Deputy Minister for Natural Resources and Environment, Ministry of National Development Planning/ Bappenas, who were always ready to assist the technical facilitation as well as in administrative matters for the finalization process of this document.

The development of the ICCSR document was supported by the Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) through its Study and Expert Fund for Advisory Services in Climate Protection and its support is gratefully acknowledged.

Remarks from Minister of National Development Planning/Head of Bappenas

We have seen that with its far reaching impact on the world's ecosystems as well as human security and development, climate change has emerged as one of the most intensely critical issues that deserve the attention of the world's policy makers. The main theme is to avoid an increase in global average temperature that exceeds 2°C, i.e. to reduce annual worldwide emissions more than half from the present level in 2050. We believe that this effort of course requires concerted international response – collective actions to address potential conflicting national and international policy initiatives. As the world economy is now facing a recovery and developing countries are struggling to fulfill basic needs for their population, climate change exposes the world population to exacerbated life. It is necessary, therefore, to incorporate measures to address climate change as a core concern and mainstream in sustainable development policy agenda.

We are aware that climate change has been researched and discussed the world over. Solutions have been proffered, programs funded and partnerships embraced. Despite this, carbon emissions continue to increase in both developed and developing countries. Due to its geographical location, Indonesia's vulnerability to climate change cannot be underplayed. We stand to experience significant losses. We will face – indeed we are seeing the impact of some these issues right now- prolonged droughts, flooding and increased frequency of extreme weather events. Our rich biodiversity is at risk as well.

Those who would seek to silence debate on this issue or delay in engagement to solve it are now marginalized to the edges of what science would tell us. Decades of research, analysis and emerging environmental evidence tell us that far from being merely just an environmental issue, climate change will touch every aspect of our life as a nation and as individuals.

Regrettably, we cannot prevent or escape some negative impacts of climate change. We and in particular the developed world, have been warming the world for too long. We have to prepare therefore to adapt to the changes we will face and also ready, with our full energy, to mitigate against further change. We have ratified the Kyoto Protocol early and guided and contributed to world debate, through hosting the 13th Convention of the Parties to the United Nations Framework Convention on Climate Change (UNFCCC), which generated the Bali Action Plan in 2007. Most recently, we have turned our attention *to our biggest challenge yet, that of delivering on our President's promise to reduce carbon emissions by 26% by 2020. Real action is urgent. But before action, we need to come up with careful analysis, strategic planning and priority setting.*

I am delighted therefore to deliver Indonesia Climate Change Sectoral Roadmap, or I call it ICCSR, with the aim at mainstreaming climate change into our national medium-term development plan.

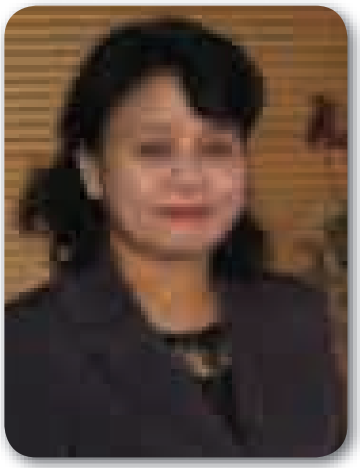
The ICCSR outlines our strategic vision that places particular emphasis on the challenges emerging in the forestry, energy, industry, transport, agriculture, coastal areas, water, waste and health sectors. The content of the roadmap has been formulated through a rigorius analysis. We have undertaken vulnerability assessments, prioritized actions including capacity-building and response strategies, completed by associated financial assessments and sought to develop a coherent plan that could be supported by line Ministries and relevant strategic partners and donors.

I launched ICCSR to you and I invite for your commitment support and partnership in joining us in realising priorities for climate-resilient sustainable development while protecting our population from further vulnerability.

Minister for National Development Planning/
Head of National Development Planning Agency

Prof. Armida S. Alisjahbana

Remarks from Deputy Minister for Natural Resources and Environment, Bappenas



To be a part of the solution to global climate change, the government of Indonesia has endorsed a commitment to reduce the country's GHG emission by 26%, within ten years and with national resources, benchmarked to the emission level from a business as usual and, up to 41% emission reductions can be achieved with international support to our mitigation efforts. The top two sectors that contribute to the country's emissions are forestry and energy sector, mainly emissions from deforestation and by power plants, which is in part due to the fuel used, i.e., oil and coal, and part of our high energy intensity.

With a unique set of geographical location, among countries on the Earth we are at most vulnerable to the negative impacts of climate change. Measures are needed to protect our people from the adverse effect of sea level rise, flood, greater variability of rainfall, and other predicted impacts. Unless adaptive measures are taken, prediction tells us that a large fraction of Indonesia could experience freshwater scarcity, declining crop yields, and vanishing habitats for coastal communities and ecosystem.

National actions are needed both to mitigate the global climate change and to identify climate change adaptation measures. This is the ultimate objective of the Indonesia Climate Change Sectoral Roadmap, ICCSR. A set of highest priorities of the actions are to be integrated into our system of national development planning. We have therefore been working to build national concensus and understanding of climate change response options. The Indonesia Climate Change Sectoral Roadmap (ICCSR) represents our long-term commitment to emission reduction and adaptation measures and it shows our ongoing, inovative climate mitigation and adaptation programs for the decades to come.

Deputy Minister for Natural Resources and Environment
National Development Planning Agency

U. Hayati Triastuti

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AFD	*Agence Française de Développement*
ASI	*Indonesian Cement Association*
AUD	*Australian dollars*
BAU	*Business as Usual*
BAPPENAS	*Badan Perencanaan Pembangunan Nasional/ National Development Planning Agency*
BOE	*barrels of oil equivalent – unit of energy*
BPPT	*Agency for the Assessment and Application of Technology*
BPS	*Central Statistics Agency*
BUMN	*Badan Usaha Milik Negara/ State owned enterprises*
CCGT	*Combined Cycle Gas Turbine*
CCS	*Carbon Captures and Storage (of CO2)*
CDM	*Clean Development Mechanism*
CER	*Certified Emission Reductions*
CHP	*Combined Heat and Power (or cogeneration)*
CO_2	*carbon dioxide*
CO_2e	*carbon dioxide equivalent*
COP	*Conference of the Parties (to the UNFCCC)*
CSI	*Cement Sustainability Initiative (a program of the WBCSD)*
DCC	*Directorate of Downstream Chemicals*
DGEEU	*Directorate General Electricity and Energy Utilisation*
DNPI	*Dewan Nasional Perubahan Iklim/ National Council on Climate Change*
DRI	*Direct Reduced Iron*
DSM	*Demand-side Management*
ESCO	*Energy services company*
ESDM	*Ministry of Energy and Mineral Resources*

GBP	*British pound*
GDP	*Gross Domestic Product*
GHGe	*Greenhouse Gas Emission(s)*
GHG Intensity	*Greenhouse emission intensity (t CO_2e/unit of GDP or MWh of energy)*
GRI	*Global Reporting Initiative*
GSM	*grams per square metre*
GTZ	*Deutsche Gesellschaft für Technische Zusammenarbeit (German Technical Cooperation)*
ICCTF	*Indonesian Climate Change Trust Fund*
IDO	*Industrial Diesel Oil*
IEA	*International Energy Agency*
IPCC	*Intergovernmental Panel on Climate Change*
JFE	*NEDO*
kl	*kiloliters – metric unit of volume*
KWh	*kilowatt hour (1000 watts per hour) – measure of energy*
LUCF	*Land Use Change and Forestry*
MC	*Masonry Cement*
MMSCF	*million metric standard cubic feet per day – metric unit of volume*
MRV	*Measurement, Reporting, Verification*
MSW	*Municipal Solid Waste*
Mt	*megatonne (1 million tonnes) – measure of mass*
MW	*Megawatt (1 million watts) – measure of power*
MWh	*Megawatt hour (millions of watts per hour) - measure of energy*
NAMA	*Nationally Appropriate Mitigation Action*
OC	*Open Cycle (gas turbine)*
OPC	*Ordinary Portland Cement*
OWC	*Oil Well Cement*

PAKLIM	*Program Advis Kebijakan untuk Lingkungan Kidup dan Perubahan Iklim/ Policy Advice for Environment and Climate Change*
p.a.	*per annum*
PCC	*Portland Composite Cement*
PCB	*Polychlorinated Biphenyls*
PDD	*Project Design Document*
PLN	*Perusahaan Listrik Negara/ National Electricity Company*
PPC	*Portland Pozzolan Cement*
PT. PGN	*Perusahaan Gas Negara/ National Gas Company*
RAN-PI	*Rencana Aksi Nasional dalam menghadapi Perubahan Iklim/ Indonesian National Action Plan on Climate Change*
RPJM	*Rencana Pembangunan Jangka Menengah/ Medium Term Development Plan*
SBC	*Special Blended Cement*
SFM	*Sustainable Forest Management*
SMC	*Super Masonry Cement*
SME	*Small and Medium Enterprise*
SNC	*Second National Communication of Indonesia to UNFCCC*
t	*tonnes - metric unit of mass*
TCF	*Trillion Cubic Feet*
TNA	*Technology Needs Assessment*
UNEP	*United Nations Environment Programme*
UNFCCC	*United Nations Framework Convention on Climate Change*
UNIDO	*United Nations Industrial Development Organization*
U.S.	*United States (of America)*
USD	*United States (of America) dollars or US$*
WBCSD	*World Business Council for Sustainable Development*
worldsteel	*World Steel Association*

1

INTRODUCTION

1.1 Background

Indonesia ratified the United Nations Framework of Climate Change Convention (UNFCCC) through Act No.6, in 1994 and the Kyoto Protocol through Act No, 17, in 2004. On November 26, 2007 the State Ministry of the Environment through the Indonesian National Action Plan (RAN-PI) on Climate Change stated "Now, this commitment needs a thorough effort and real action, covering all sectors that contribute to greenhouse gas emission and carbon sequestration" [RAN-PI, 2007].

Already the Government of Indonesia is "looking into the distinct possibility to commit a billion tonnes of CO_2 reduction by 2050 from business as usual", with medium-term targets of 26% of CO_2 reduction by 2020 from business as usual (including Land Use, Land Use Change and Forestry). With the right mixture of domestic policies and international support, the Government of Indonesia is confident that greenhouse gas emissions can be reduced by as much as 41% [SBY, 2009]. A presidential decree, stipulating this commitment, had been prepared in January 2010.

In September 2009, Indonesia's Climate Change Trust Fund [ICCTF, 2009] was launched by the National Development Planning Agency (BAPPENAS) and is the financing mechanism for national policies and programs. It is designed to bridge the international architecture for climate change and the national level in an efficient, transparent and accountable manner.

1.2 Purpose and Objectives

Indonesia's Climate Change Sectoral Roadmap (managed by BAPPENAS) aims to identify impacts and interactions of climate change in main sectors of the Indonesian economy, to establish and integrate a vision, priorities and action plans into national development planning and estimate arising needs for external assistance out to 2030.

BAPPENAS initiated work on the climate change challenge in December 2007 by issuing the policy document National Development Planning: Response to Climate Change. The Climate Change Sectoral Roadmap is meant to bridge the National Action Plan on Climate Change (2007) into the five year mid-term Development Plan (RPJM) 2010 – 2014, which provides the basis for annual planning and budgeting at both national as well as regional levels. The Climate Change Sectoral Roadmap also offers inputs for the subsequent plan until 2030. It covers greenhouse gas mitigation and climate change adaptation across nine key sectors: Forestry Sector, Energy Sector, Industry Sector, Transportation Sector, Agriculture Sector, Coastal Area Sector, Water Sector, Waste Sector and Health Sector.

This chapter of the Climate Change Sectoral Roadmap, the Industry Sector Roadmap for Indonesia's industry sector, attempts to be a facts-based assessment of emission reduction potential, medium (2020) and long term (2030) with cost estimates for each of the reduction opportunities.

Given the longer-term direction of the Climate Change Sectoral Roadmap against a backdrop of *emerging international climate policy and rapid growth forecasted in Indonesia's emerging economy, the Climate Change Sectoral Roadmap is a "point in time" for an on-going and dynamic process. The purpose of this Industry Sector Roadmap is to provide as much policy certainty as possible for industry stakeholders around greenhouse gas mitigation. The aim is twofold: (1) to articulate the Government of Indonesia's expectations of the industry sector in assisting the national and the broader international community in its "common but differentiated responsibilities and respective capabilities" [UNFCCC, Art. 4] for greenhouse gas mitigation; and (2) to outline the policies and key responsibilities for helping meet these mitigation expectations.*

The Government of Indonesia is committed to reducing GHGe across its entire industry sector and has committed a particular focus to cement industry as an industry:

- *Ranking as the 10th largest cement producer in the world in 2005 [Mahasenan/ Natesan, 2003].*
- *Having the largest industry sub-sector emissions and being the 10th largest emission source in Indonesia's GHGe inventory (excluding LUCF) [SNC, 2009];*
- *Consisting of a small number of private and public entities, some with headquarters in Annex 1 countries; and*
- *Being an industry offering already a sophisticated level of energy management and hence the opportunity to modernise the cement industry in the near-term in order to meet the projected strong domestic demand for cement.*

In late September 2009, the Ministry of Industry therefore decreed that GHGe reductions from the cement industry are a priority for Indonesia's industrial development for the next 20 years.

The detailed objectives of this Industry Sector Roadmap are:

- *To estimate Indonesia's potential greenhouse gas emissions (GHGe) resulting from industrial activity to year 2030 with a particular emphasis on cement industry;*
- *To estimate the size of abatement potential from the industry sector as a contribution to Indonesia's national commitments to reduce GHGe, with a particular emphasis on the cement industry;*
- *To incorporate the industry sector's emission reduction efforts into the national economic development plans;*
- *To position the cement industry as a priority for action in the short and medium-terms; and*
- *To identify technologies, programs, and funding required to support activities that can reduce GHGe from the industry sector.*

1.3 Scope

The Industry Sector Roadmap covers direct emissions from the industry sector from the period 2005 – 2030. This complements existing planning frameworks and longer-term planning to 2030 to provide vision and direction for the industry sector and potential investors.

The Indusry Sector Roadmap focuses on cement industry. Other industries covered in brief in this Industry Sector Roadmap are: iron & steel, pulp & paper, textiles and fertilizer. Besides the cement industry these industries are main contributors to Indonesia's industry sector GHGe inventory. In depth roadmapping for these industries will take place either in future reviews or in the scope of a future development of Nationally Appropriate Mitigation Actions (NAMA).

An analysis is given on:

- *GHGe resulting from energy use (stationary fossil fuel combustion for heat production and self-generated electricity) of industry sector including cement & other non-metallic minerals, iron & steel, pulp & paper, textiles, fertilizer and other industries*
- *GHGe resulting from energy use (grid-supplied electricity) of industry sector cement*
- *GHGe resulting from industrial processes during cement production*

There will be no analysis of GHGe from transport or industrial waste/-water. GHGe from the use of grid-supplied electricity and industrial processes are discussed for cement industry only.

Since emissions from mining and transportation can comprise up to 10% of total cement production emissions, future Industry Sector Roadmaps may also consider including emissions from:

- *Transportation*
- *Machinery used at the quarries to blast the cement;*
- *Emissions from the production of explosives;*
- *Equipment used to reduce dust during quarrying;*
- *Equipment to trap and separate exhaust gases; and*
- *Rehabilitation of landscape after quarrying is complete.*

GHGe from Carbon-dioxide (CO_2) is the main greenhouse gas resultant from the production of cement and is the only gas considered in detail in the inventory analysis of GHGe.

1.4 Methodology

This report provides an analysis of the opportunities and barriers for comprehensive GHGe mitigation in the Indonesian industry sector. The report focuses on identifying preferable technology and policy portfolio options for GHGe mitigation for the cement industry.

The main data sources for the study are:

- *National Energy Planning applying the MARKAL model by the Agency for the Assessment and Application of Technology (BPPT);*
- *Central Statistics Agency (BPS);*
- *National Industry Development Policy formulated in Presidential Decree 28/ 2008;*
- *Indonesian Cement Association (ASI) - an industry membership association connecting all Indonesian cement companies. Members report regularly to the ASI which in turn publishes aggregated industry-level data on key metrics such as sales, production, etc; and*
- *World Business Council for Sustainable Development - Cement Sustainability Initiative[1] – a worldwide industry led-association providing research, analysis and policy framing for sustainability in the cement industry.*

In the case of ASI, the statistics, published at least yearly, are comprised of commercial data only. Therefore environmental indicators could be gathered only for the largest stakeholders – PT. Indocement, PT. Holcim Indonesia and PT. Semen Gresik, who have their own internal reporting system according to the World Business Council for Sustainable Development – Cement Sustainability Initiative standards.

For the reference year (2008), data published in company annual and sustainability reports correlates to data published by ASI and was integrated into this report. Commercially sensitive data, such as the internal projection of the future cement demand growth and plans of capacity enlargement have been received from only a few stakeholders and were integrated into this report in an aggregated form.

For estimating current and future GHGe from the cement industry, data and methodology has been aligned with the working group of the Indonesian GHGe inventory; the Second National Communication to the UNFCCC, which was published in November 2009.

Activities to determine the range of GHGe mitigation activities included workshops with:

- *PT. Indocement in their Citeureup factory;*
- *PT. Holcim Indonesia in their Narogong factory; and*
- *PT. Semen Gresik in their main office in Gresik.*

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[1] *Please see "Appendix 5 - World Business Council for Sustainable Development – Cement Sustainability Initiative".*

Telephone interviews and other meetings included non-cement industry stakeholders such as but not limited to the Indonesian Green Building Council and the Institute for Economic and Social Research at the Faculty of Economics (LPEM) at the University of Indonesia.

In order to maximise the breadth of issues covered, interviews were facilitated and joined by Ibu Endang Supraptini, the Director of the Center for Resources, Environment and Energy Research and Development of the Ministry of Industry, Nicolette Boele of Banarra Sustainability Assurance and Advice, Anandita Laksmi Susanto and Anja Rosenberg as representatives of the GTZ program on Policy Advice for Environment and Climate Change (PAKLIM).

The draft was delivered by Pak Agus Wahyudi, former Director Ministry of Industry Center for Resources, Environment and Energy Research and Development and later consultant to the Industry Sector Roadmap project through BAPPENAS and PAKLIM. The draft was workshopped with stakeholder in early July 2009 and comments from participant included in the final report as appropriate. The draft initially reviewed by climate change expert Irving Mintzer and then further reviewed by an international expert in industry and climate change, Nicolette Boele of Banarra Sustainability Assurance and Advice. Final elaboration was undertaken by Anja Rosenberg.

2

INTRODUCTION

2.1 Current Policies influencing the Industry Sector

There are a number of existing and planned national policies whose aims are not directly to reduce GHGe but whose implementation nonetheless will impact materially on reducing greenhouse emissions. They are listed here:

1. *Presidential Regulation No.5/2006 – energy diversification and conservation*

   Indonesia's national energy mix policy, formulated in Presidential Regulation No. 5/2006, targets the reduction of current oil consumption from 51.6% to less than 20% in 2025 by substitution from other energy sources. If implemented as intended, carbon emissions are predicted to be 17% lower than the Business as Usual (BAU) in 2025 on a 2005 baseline. The national energy mix policy reflects consideration of the importance of alternative energy utilization, energy conservation, and energy security aims to enable secure energy supply.

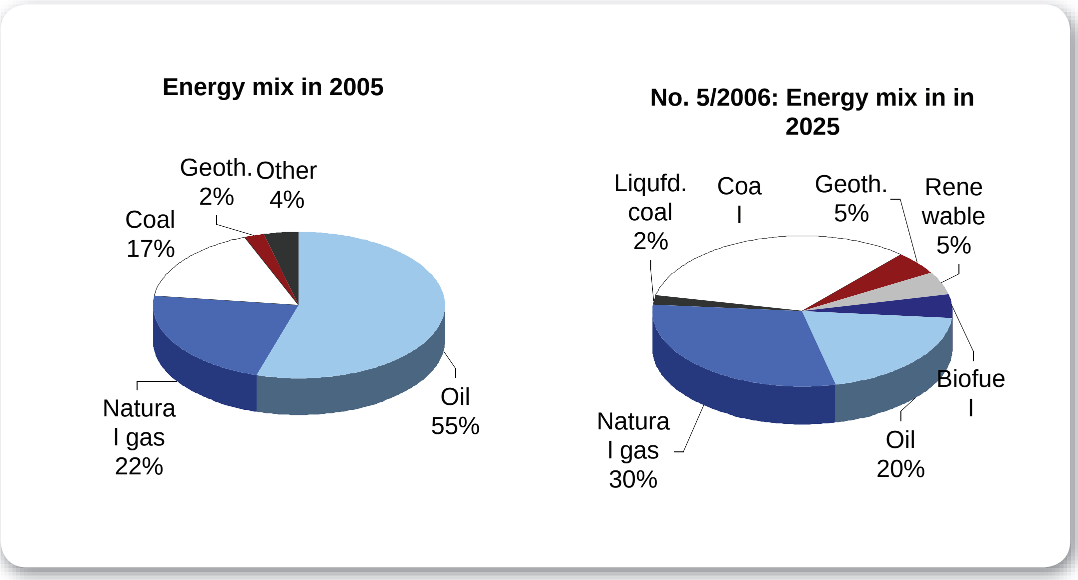

Figure 2-1: Primary energy mix 2005 - 2030 according to Presidential Regulation 05/2006

The objective to be achieved is the reduction of energy elasticity to < 1. Energy elasticity is the prime indicator for low carbon growth being defined as the percentage change in energy consumption to achieve one per cent change in national GDP. To reach that, the optimum energy mix has been established as follow:

Oil	
Gas	
Coal	
Geothermal	*> 5%*
Other renewable sources (biomass, nuclear, hydro, solar and wind)	*> 5%*
Liquid coal	*> 2%*

Furthermore, it is expected that the share of new and renewable energy in the primary energy mix of Indonesia will reach 30% in 2050 [RAN-PI, 2007].

2. *Presidential Regulation No. 28/2008 about National Industrial Policy - is aimed to strengthen competitiveness of the manufacturing industry as a driver of economic growth – supported by "macro economic stability, qualified public institutions, an improved industry structure with increasing role for Small-to-Medium Enterprises (SME) and improved productivity". The objective is to achieve balanced roles between SME and large industries, so Indonesia will become recognized worldwide by 2030 as an industrialized country. Furthermore, the Presidential Regulation anticipates the problems about energy in the industry sector (meeting future demand, fossil fuel resource depletion and gradual withdrawal of energy pricing subsidies).*

3. *Act No.30/2007 concerning energy development in Indonesia - The law incorporates several provisions, whose implementation will affect GHGe mitigation, i.e. provisions, which support energy conservation and the development of new and renewable energy through incentive mechanisms. The implementation of the provisions concerning energy conservation and renewable energy development has to be regulated by a Government Regulation. The operational provision of this Government Regulation is under preparation (status June 2009).*

4. *Presidential Instruction No. 10/2005 concerning Energy Saving.*

5. *Strategic Plan on National Energy Conservation Program Development 2005 – 2025 – covers energy conservation programs, campaigns, information, education and training. Focus is on demand side management, energy savings labelling, partnership programs.*

6. *Green Energy Policy – Ministerial Decree No. 0002/2004 – implements the maximum use of renewable energy; efficient use of energy and increasing public awareness on energy efficiency.*

7. *Ministry of Energy and Mineral Resources Ministerial Regulation No. 31/2005 about guidance for the implementation of Energy Saving. Demand-side policy objectives are to reduce economy-wide energy intensity by 1% p.a. In the medium-term PLN has set up to 14.3TWh the cumulated electricity*

savings target for the period 2005 – 2010.

8. *Partnership Program on Energy Conservation – provides free of charge energy audits for buildings and industries. 2003 – 2007 energy audit service already done for more than 250 industries and buildings; paid for by Government.*

9. *Energy Manager Competency Program – prepares energy manager accreditation mechanisms, and competency standard for energy manager in building and industry, paid for by Government.*

10. *Monitoring of Air Pollution emission from industry sector - conducted by State Ministry of Environment through Company Performance Evaluation Program (PROPER).*

11. *Implementation of Cleaner Production Program (CP EE/Cleaner Production) and Energy Efficiency for energy intensive industry – industries include cement, iron & steel, fertilizer, pulp & paper, textile, power plant etc.*

12. *Ministry of Environment Decree No.206/05 - Establishment of National Commission on Clean Development Mechanism as Designated National Authority (DNA)[2]. Gives national approval to the proposal of CDM projects that have satisfied sustainable development criteria. The National Commission on Clean Development Mechanism consists of nine departments, and chaired by Deputy III, State Ministry of Environment.*

13. *Jakarta Commitments – signed jointly by GOI and our development partners regarding strengthening country ownership on development as well as on the creation of a new aid instrument.*

14. *Act N0. 17/2006 concerning the change on Act No.10/1055 regarding custom regulations - gives free or reduced import tax on clean technology equipment.*

15. *State Ministry of Environment Minister Regulation No.7/2007 regards static source emission standard for boiler.*

16. *Act No 18/2008 regarding Solid Waste Management – gives explanation on the composition of solid waste and its different sources, such as domestic waste, specific waste. It states also that waste is seen as a resource with economic value that can be utilised for energy, compost or material for industry.*

17. *Government Regulation No. 18/1999 regarding Hazardous Waste Management – covers regulation concerning hazardous waste e.g. for the handling, storage, process, utilisation, transportation.*

18. *Ministry of Environment Regulation No. 02/2008 regarding Hazardous Waste Utilisation – covers regulation on how to include hazardous waste as part of reuse, recycle and recovery actions. Includes activities to use hazardous waste to substitute material, fuel and other purposes, such as research and*

[2] *In the two years since it was established (until August 2007), the National Commission on Clean Development Mechanism has approved 24 CDM project proposals, and nine of them have been registered internationally at UNFCCC executive board. From these 24 projects, the total emission of CO2 could be reduce in the amount of 33,079,993 tonnes CO2eq*

other environment analysis.

19. *Ministry of Environment Decree regarding Permit on Utilisation of Hazardous Waste as Alternative Fuel and Raw Material – made specific for each industry that uses or plans to use hazardous waste as alternative fuel and raw material.*

2.1.1 Cement industry specific laws, regulations and policies

Each factory must have an Environmental Impact Assessment study on development (Analisis Mengenai Dampak Lingkungan (AMDAL). From this two further approvals for ongoing operations are required:

1. *Environmental operational permits - approved Environmental Management Plans (Rencana Pengelolaan Lingkungan, RKL); and*
2. *Environmental Monitoring Plans (Rencana Pemantauan Lingkungan, RPL).*

2.2 Future Challenges

In the coming years, other industries will emerge as players in reducing Indonesia's industrial GHGe. Even though the current priority is the cement industry, fertilizer, iron & steel, textiles and pulp & paper will emerge as the major industrial contributors to GHGe without actions to modernise and roll out eco-efficiency measures. Steps must be taken now to ensure that these industries are ready for the challenge of rapidly reducing their respective greenhouse gas impact as they grow and modernise their equipment over the next few years.

Please see also "Appendix 1 – Current Policy Framework: Cross-Sectoral Issues".

3

Indonesia's Primary Key Industries

3.1 Overview

Excluding emissions from land use change and forestry, the cement production process/ calcination (2.6%) was the equal 10th largest GHGe contributor in 2000 after fuel combustion from petroleum and gas refining (26.2%), industrial wastewater and discharge (20.8%), transportation (9.4%), electricity and heat production (6.2%), rice cultivation (5.9%), residential fuel combustion (4.7%), fugitive emissions from oil and natural gas (4.0%), agricultural soil (3.9%) and fuel combustion from other manufacturing industries and construction (3.0%) [SNC, 2009].

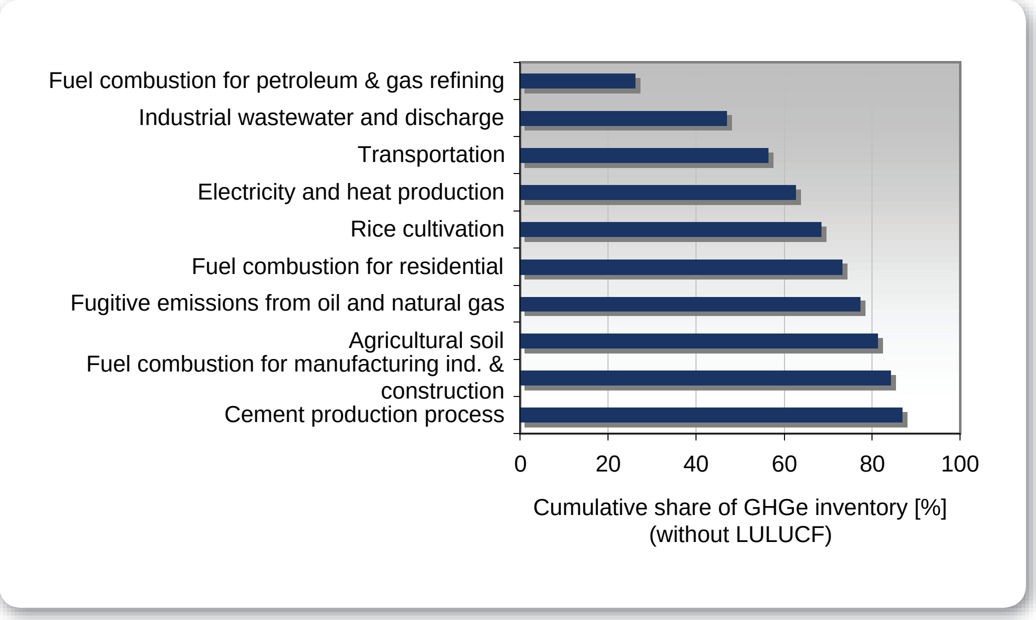

Figure 3-1: *The Cumulative Contribution of Cement Industry to Indonesia's Greenhouse Gas Inventory in 2000 Source: [SNC, 2009]*

Furthermore, cement industry is an energy-intense industry, which - besides GHGe from industrial processes - also contributes a high share of GHGe from fuel combustion activities (energy use) as can be seen in Figure 3-2.

Of GHGe from the industry sector in 2000, cement manufacturing made up 41%, compared to 26% from energy use of other manufacturing industries and 33% from industrial processes of other manufacturing industries such as non-metallic minerals industry, textiles, food & beverages, transport equipment, chemicals, pulp & paper, basic metals including iron & steel, machinery, wood & wood products and other product manufacturing.

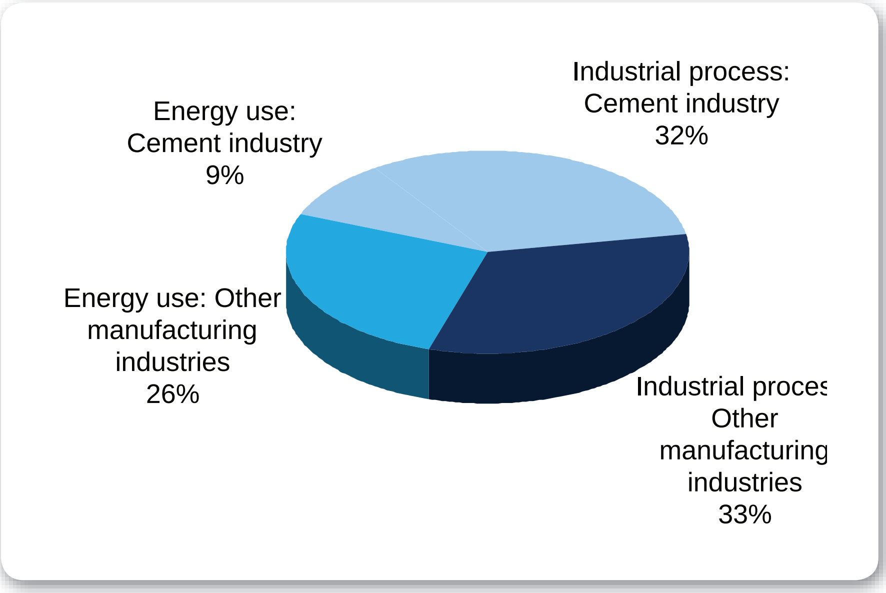

Figure 3-2: *Contribution of GHGe from Industry Sector by Category in 2000 Source: [SNC, 2009]*

5.1.1 Cement

Cement is the dry powder substance used to bind aggregate materials of concrete. Upon the addition of water and/or additives the cement mixture is referred to as concrete. Manufacture of cement is by chemical process with the assistance of very high temperatures. The most popular cement is Ordinary Portland Cement (OPC) which is also the most commonly produced and consumed in Indonesia. It has a high clinker content, indicating a high strength and quality cement.

Stages of the Ordinary Portland Cement (OPC) production process [Cemex, 2009]:

- *Mining the raw material – explosives blast limestone and clay;*
- *Transporting the raw material – rocks transported by truck or conveyor belt;*
- *Crushing – stone delivered through chutes to crushers, pounded to chunks approx 3 cm in size;*
- *Prehomogenisation – proportional mix of the different types of clay, limestone and other required materials;*
- *Raw Material Storage – each raw material is transported separately and stored;*
- *Raw material mill – vertical steel mill which grinds the material through pressure exerted by 3 colonic rollers; later pulverized by steel bars;*

- *Raw meal homogenization – takes place in silos;*
- *Calcination – huge rotary kilns at 1450 degrees Centigrade heat calcium carbonate producing lime and carbon dioxide, or clinker– small, dark gray nodules 3 – 4 cm in diameter;*
- *Cement milling – clinker is ground by different size steel balls, with gypsum being added to extend cement setting times; and*
- *Cement packaging and shipping – housed in silos and hydraulically or mechanically extracted and transported.*

The cement industry in Indonesia is highly integrated – vertically and horizontally. While some companies own and operate their own quarries, the scope of this Industry Sector Roadmap covers GHGe resulting directly from the plant-based process of manufacturing cement, which includes both GHGe from energy use and industrial processes [IPCC, 2006].

The installed annual production capacity of the cement plants in 2008 is 47.22 megatonnes of cement and 40.73 megatonnes of clinker. In 2008 cement plants produced 38.95 megatonnes of cement and 37.30 megatonnes of clinker. Domestic cement consumption reached 38.34 megatonnes with the market share of 43.44% by Semen Gresik Group, 32.14% by PT. Indocement Tunggal Prakarsa Tbk., 14.01% by PT. Holcim Indonesia Tbk. and 10.41% by other companies [ASI, 2008].

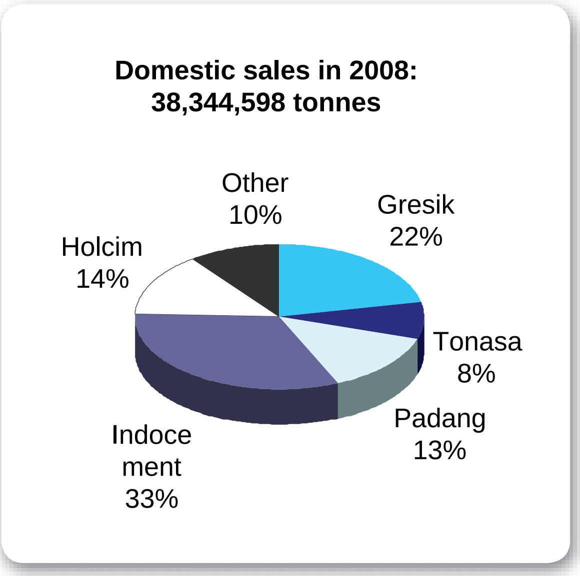

Figure 3-3: *Domestic cement production and consumption in 2008 Source: [ASI, 2008]*

There are currently nine cement companies in Indonesia (number of plants/ kilns in brackets).

1. *PT. Semen Andalas Indonesia (part of the Lafarge Group) - Aceh (1) destroyed in the 2004 tsunami but is scheduled to re-open its cement mill at the end of 2009 and the rest of the plant by end 2010;*
2. *PT. Semen Padang (part of the Semen Gresik Group), first Indonesian cement factory 1904 - Indarung West Sumatera*
3. *PT. Semen Baturaja (state owned company) - Baturaja South Sumatera (1), Palembang, Lampung dan Baturaja (3 grinding plants);*
4. *PT. Indocement Tunggal Prakarsa Tbk (part of the Heidelberg Group) – Citeureup/ Bogor (9), Cirebon (2), Tarjun South Kalimantan (1);*
5. *PT. Holcim Indonesia Tbk (previously known as PT. Semen Cibinong) – Narogong/ Bogor (2), Cilacap (1);*
6. *PT. Semen Gresik in East Java (part of the Semen Gresik Group, state-owned company) Tuban (3);*
7. *PT. Semen Bosowa Maros (a private national company) - Maros, South Sulawesi (1); the youngest cement company in Indonesia.*
8. *PT. Semen Tonasa (Semen Gresik Group) - Sulawesi Selatan (3); and*
9. *PT. Semen Kupang (state owned company) - Kupang East Nusa Tenggara (1).*

Please see also "Appendix 2 – Indonesia's Primary Key Industries: Company profiles" and "Appendix 3 – Indonesia's Primary Key Industries: Figures on production, sales and export".

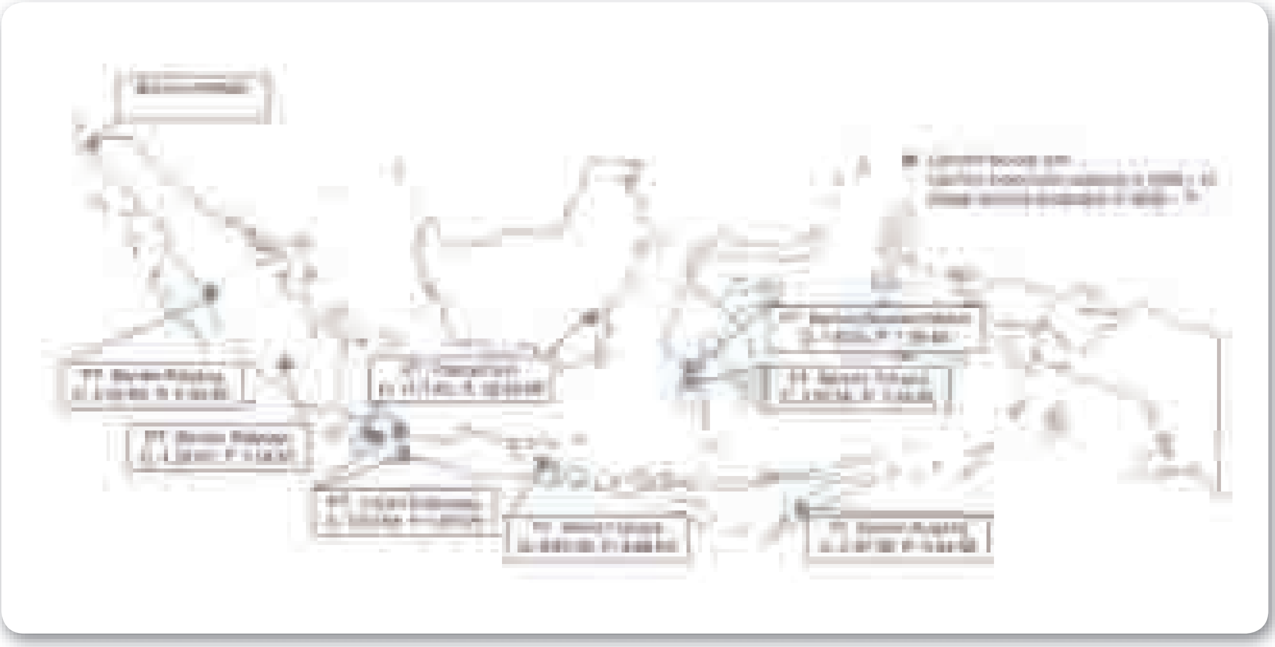

Figure 3-4: *Location and Production Capacity of Indonesia's Cement Companies*
Sources: [ASI, 2008, PT. Semen Gesik – Annual report, 2008, PT. Indocement – Annual report, 2008, PT. Holcim – Annual report, 2008]

Indonesia's cement output is forecasted to grow almost 285% between 2010 and 2030, while global average demand is forecasted to grow just 200% in the same period [WBCSD, 2007] - with the average being dependent largely on demand growth in China being responsible for around 50% of global production.

3.2 Opportunities for Greenhouse Gas Emissions Mitigation

According to non-Annex 1 countries contributing to the UNFCCC TNA [SBSTA, 2009], there are over 60 individual technologies currently available to reduce GHGe from the cement industry. The technical opportunity for mitigation emissions from the cement manufacturing process can be divided into four categories [WBCSD, 2007]:

- **Energy efficiency** *(10% of emissions) –reducing energy consumption from non-kiln activities such as lighting, motor efficiencies, air-conditioning and fuel in machinery including trucks. Only small opportunities remain compared to other categories; new plants in most parts of the world are already highly energy efficiency;*
- **Alternative fuels** *(40% of emissions) – biomass as agricultural waste, fuel crops, municipal and industrial waste, including hazardous wastes. Opportunities exist where large scale agricultural waste sources are within proximity to cement factory with guaranteed supply and close to large cities supply municipal sold waste;*

- **Blending materials** *(50% of emissions) – using substitutes for clinker (including recycled concrete, fly-ash); and*
- **Carbon capture and storage** *(CCS) – unproven technology.*

CCS has not been included in this Industry Sector Roadmap. If ever proven to be technically viable for large scale CO2 sequestration, according to the International Energy Agency, CCS for industry and transformation (as opposed to power generation) is likely to be economically viable after 2030 for Indonesia[3,4].

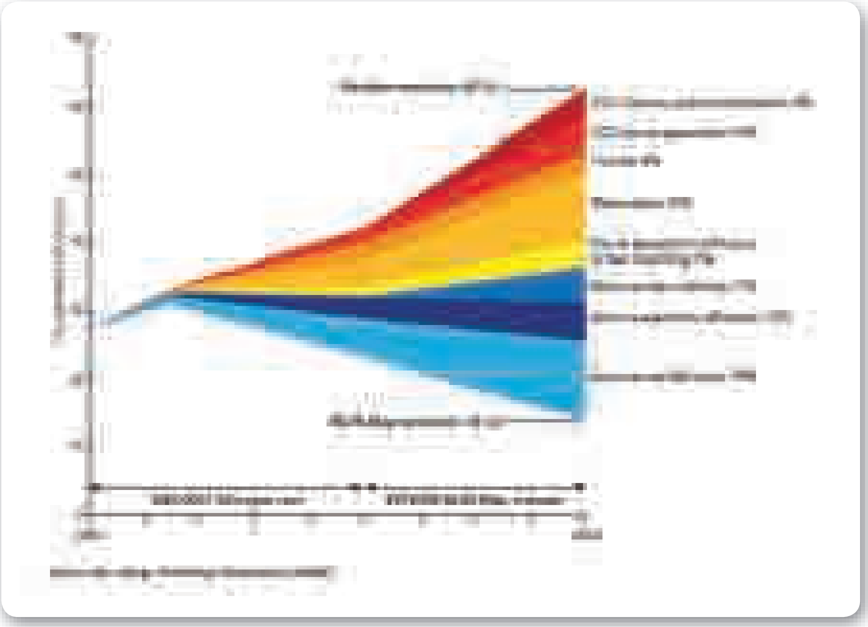

Figure 3-5*: Contribution of abatement technologies to global GHGe reduction to produce 450ppm of GHGe by 2050 Source : [IEA, 2009]*

In addition, there are some physical risk issues associated with applying CCS technology in the Indonesian landscape, namely risk of CO_2 leakage from damaged reservoirs due to earthquakes, which need to be resolved [Kammen, 2009]. CCS is discussed in more detail in the Energy Sector Roadmap.

[3] According to [IEA, 2009] CCS for industry and transformation will be available for deployment after 2030.

[4] According to Professor Daniel Kammen of Berkeley if technologically feasible and appropriate, CCS integrated as part of new coal power stations would cost 37USD compared with 34USD for solar and 25USD for low penetration wind [Kammen, 2009].

3.1.1 Energy Efficiency

Energy efficiency is a component of Demand-side Management (DSM) and forms a key recommendation of the Econoler International Report for The World Bank [Econoler, 2006]. The report recommends DSM activities in industrial and building energy audits among other things.

Industrial systems which may include lighting, compressed air, steam systems, process heating systems, pumps, fans, industrial motors and combined heat and power (CHP) support industrial processes so they are engineered for reliability rather than energy efficiency. Industrial systems that are over-sized in an effort to create greater reliability, can result in energy lost to excessive equipment cycling, less efficient part load operation and system throttling to manage excessive flow. Waste heat and premature equipment failure from excessive cycling and vibration are side effects of this approach that contribute to diminished, not enhanced reliability.

Modern control systems create reliability through flexibility of response – and redundancy in the case of equipment failure – rather than by brute force. The energy savings can be substantial, with savings of 20% of more common for motor systems and 10% or more for steam and process heating systems.[5].

Lack of knowledge about system controls and competing objectives of the plant maintenance staff (i.e. reliability rather than efficiency) are the key barriers to the uptake of more efficient industrial systems. Even if the plant operators have discovered ways of saving energy or improving efficiency, the "if it isn't broken, don't fix it" attitude tends to prevail in industrial plants.

As a general trend globally, energy efficiency is now being taught to the new generation of engineers and designers at university – previously it was learned through experience. Systems are designed to maintain reliability at the lowest first cost investment, despite the fact that operating costs are often 80% or more of the life cycle costs of the equipment. Facility plant engineers are typically evaluated on their ability to avoid disruptions and constraints in production processes, not energy-efficient operations. Similarly when plant equipment fails, to avoid disruption to production, plant engineers swiftly replace the broken component with a working version of the same; missing the opportunity for a applying a more efficient component or system. Energy efficiency research and skills acquisition must be done in a systematic way to enable plant engineers to make informed decisions through both their routine plant maintenance and their crisis-based repairs [Econoler, 2006].

UNIDO is currently championing an Industrial Standards Framework linking ISO9000 with ISO14000 quality and environmental systems and industrial energy efficiency. The purpose of the proposed Framework is to introduce standardised and transparent methodology into industrial energy efficiency projects and practices (system optimisation, process improvements, waste heat recovery and the installation of on-site power generation).

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[5] *United States Department of Energy (USDOE) 2004 in [IEA, 2007]*

According to the National Energy Conservation Master Plan (RIKEN) there are still many opportunities to save energy in various sectors. In case of the Indonesian industry sector this opportunity is estimated between 15% - 30% [RAN-PI, 2007].

Summarizing – the main barriers to the implementation of energy efficiency measures are:

- **Lack of Knowledge** – *about system controls and competing objectives of the plant maintenance staff; and*
- **Competing investment strategies** – *investment is undertaken rather for reliability and/ or new capacity than energy efficiency.*

3.1.2 Alternative Fuels

Cement production is an energy-intense production process. According to the World Business Council for Sustainable Development - Cement Sustainability Initiative (WBCSD CSI), a cement plant consumes 3GJ to 6GJ of fuel per tonne of clinker produced, depending on the raw materials and the process used. Most cement kilns today use coal and petroleum coke as primary fuels, and to a lesser extent natural gas and fuel oil. GHGe from stationary fuel combustion in the kiln could be reduced by substituting coal and petroleum coke by alternative fuels such as agricultural biomass, municipal solid waste, hazardous and other waste.

Agricultural Biomass

One alternative fuel opportunity already being explored by cement companies operating in Indonesia is agricultural waste as biomass – particularly palm oil kernels shells (PKS) and rice husks and to a smaller extent corn, wood and tobacco waste.

As way of illustration, Indonesian agriculture produces 12 megatonnes of rice husks p.a. [Kamaruddin, 2002]. One tonne of rice husks contains the same calorific value as 415 litres of petrol or 378 litres of kerosene. Environmental benefit can be gained by burning rice husks instead of coal or oil, since GHGe from the combustion of rice husks[6] is nearly 0 when offset against emissions from coal or oil combustion [Chungsangunsit, 2004].

[6] *Oxides of sulphur (SOx) and nitrous oxides (NOx) emissions from combusting rice husks are higher than natural gas (but less than oil), raising some questions about local air quality particularly for people suffering respiratory illness including asthma. Since only a few Indonesian cement producers use natural gas for heat production, while the majority uses coal and oil, air quality is expected to improve around most of the cement factories, if the use of rice husk as alternative fuel is increased.*

Another alternative fuel offering the same environmental benefit is agricultural waste from palm mills. In Indonesia 1.2 megatonnes of palm kernel shell and 3.6 megatonnes of fibres remain from palm oil milling per year [Kamaruddin, 2002]. The use of palm oil products and palm mill waste e.g. palm kernel shell as alternative fuel can result in a net carbon gain, if future palm oil plantations will be located on open areas or degraded areas [CIFOR, 2009][7].

According to interviews with cement industry stakeholders, some of the barriers to further developing agricultural biomass for fossil fuel substitution include:

- **Supply reliability –** *agricultural waste is seasonal;*
- **Economic viability** - *the ever increasing demand for biomass being driven primarily by the CDM is leading to biomass being exported and is pushing up domestic prices. Stakeholders reported that, in some seasons, delivering biomass to the kiln can be more expensive than using coal; and*
- **Legal limitations –** *the lower calorific value of a tonne of biomass compared to coal, for example, means that production output of cement is lower for the same operating time. This is a problem for the state-owned operators that are legally required to meet a production output before income can be retained by the company for reinvestment. This licence requirement is currently a barrier to innovation and abatement activities.*

Agricultural biomass is also only an option for co-firing where cement factories are located close to a reliable supply of biomass, namely Sumatra. Cement manufacturers operating in central Sulawesi and Kalimantan may be in a technical position to substitute conventional fuel supply with natural gas. Cement factories operating on Java have limited agricultural biomass availability and may look to other waste resources for co-firing in the kiln.

(Please see the following figures, which shows: (1) electricity generation-transmission capacity; (2) plans for the replacement of diesel oil on large OC- and CCGT power plants with LNG including the planned installation of LNG receiving terminals; and (3) the potential of biomass for electricity generation in Indonesia.)

[7] The impact of the use of palm oil products and palm mill waste is currently discussed, because such biomass can still cause net carbon emissions in the short to medium term due to carbon loss in the original land use conversion. Estimates of the time required for oil palm to make a positive carbon contribution vary between 71 and 93 years for oil palm planted following forest conversion and more than 600 years on peat swamp. In contrast, planting oil palm on degraded sites might lead to positive gains in only 10 years or in some cases, immediately. One recent study estimated that about one-quarter of existing Indonesian oil palm concessions are located on peat .The Indonesian government temporarily stopped allocating peatlands to oil palm plantations in 2007 in response to growing concern about climate change and GHGe arising from peat degradation, however, it revoked this decision in February 2009.

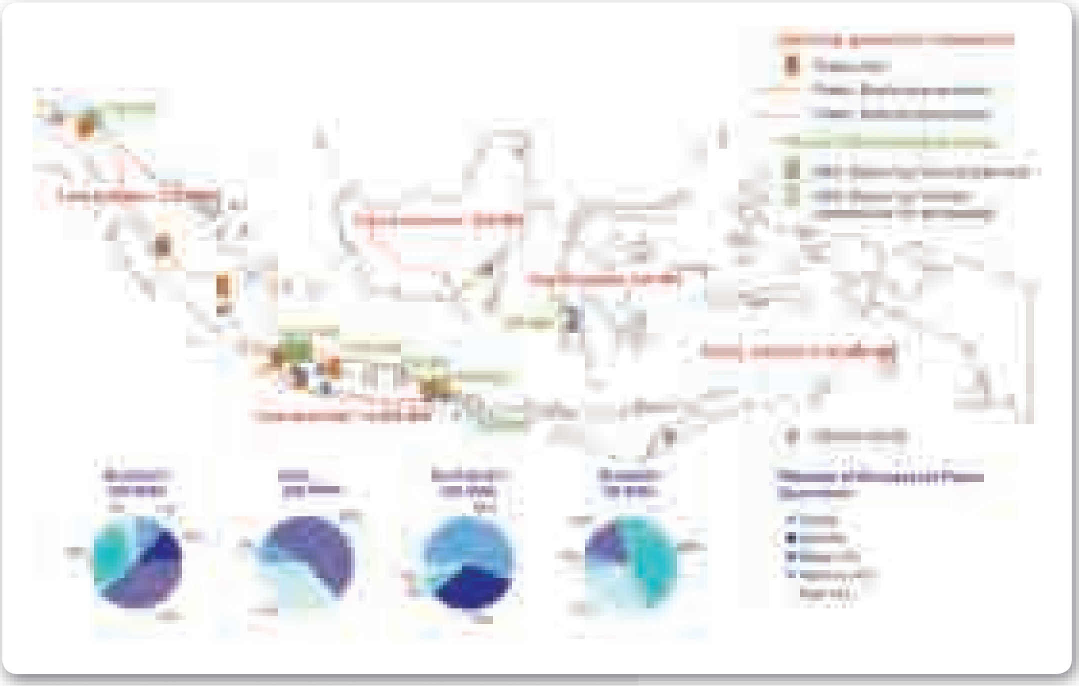

Figure 3-6*: Current Electricity Generation-Transmission Capacity & Potential of LNG/ Biomass for Electricity Generation Sources: (1) Indonesian Electricity Generation-Transmission Capacity in 2005 [PEN, 2006] (2) BKPM Investment Plans for LNG for Domestic Market in 2008 (3) Potential of Biomass for Power Generation in 2000 [ZREU, 2000]*

Municipal Solid Waste

MSW could theoretically contribute up to 50% of energy used in the kiln with considerable and currently uneconomic equipment upgrades in the Indonesian context. According to interviews with stakeholders, MSW can be used to substitute up to 10% of coal in the kiln without major equipment investment.

Nearly 220 million people generate domestic solid waste in Indonesia in quantities approaching 48.8 megatonnes p.a. The level of per capita waste production is approximately 0.61kg/capita/day. Most of the waste is collected for final disposal; the rest is disposed of illegally[8], composted and recycled, burned or processed in other ways [RKP, 2003, please see the roadmap chapter on the Indonesian Waste Sector for precise figures]. MSW is estimated to increase more than 200% in the 10 years between 2010 and 2020. With the country's growing and increasingly affluent population, dealing with waste, particularly in and around major cities, will become an issue worthy of closer public policy scrutiny.

[8] *Illegal waste is waste that is buried individually, usually by villagers in their private home or in other unregulated locations.*

Dandenong answers industrial waste problem for Victoria
May 7, 2009

State Government changed its policy on landfill levies for industrial waste and banned particular wastes going to landfill. The policy was designed to encourage businesses to invest in more sustainable technologies.

In a joint partnership between the Commonwealth Government of Australia (1.8 million AUD under the Asia-Pacific Partnership on Clean Development and Climate (APP)), Victorian EPA (600,000AUD) and Geocycle – a largely manual local waste transformation business, innovative systems for managing waste was formulated. Cement Australia contributed 1.8 million AUD into the project

With the assistance of one of Cement Australia's major shareholders, Holcim, a unique 'megablender' system was designed, combining technologies from processing industries around the world.

The 20,000 tonne p.a. system has been designed so that it is fully automated, safe, easy to use and able to blend a broad range of bulk and packaged materials into a usable kiln fuel. The system also separates and cleans all steel from the drums and containers so that it can be recycled.

Figure 3-7: *Case study of Alternative Fuel Use in Cement Kiln Source: [Cemaust, 2009]*

Aside from the technical limitations surrounding maximum limits of substitution by MSW, other barriers include:

- **Inadequate waste policy** – *the true cost (economic, environment, social) of disposing of domestic solid and liquid wastes is not reflected in waste collection and landfill prices. This provides no economic incentive to find alternative resources streams for the waste, such as reuse as fuel in a cement kiln to avoid the cost of dumping in landfill;*
- **Inadequate enforcement of waste policy** – *policies that are not enforced are rarely implemented. Enforcement creates a "level playing field" and removes risk for private investment in new technologies, such as kiln upgrade to process up to 50% MSW;*

- **Heterogeneous qualities of MSW** – *MSW needs to be sorted before it can be used optimally in a cement kiln; this is a human intensive exercise; and*

- **Public perception of burning waste** – *there are some public concerns about the processing of MSW and hazardous wastes in the cement kiln. Facts need to be compiled and cement companies need to work closely with concerned community members to ensure a workable balance.*

Hazardous waste

In Norway, national policy makes cement kilns the preferred method for hazardous material management, including destruction of polychlorinated biphenyls (PCBs), an approach that has been used for 15 years. In recent years, animal bone meal has been successfully destroyed in a number of kilns following its implication of "mad cow" disease [WBCSD, 2005].

With a number of small changes to hazardous waste management policy in Indonesia, the cement (and steel) industries can be used to manage the ever increasing volume of hazardous waste produced. According to the Indonesian cement producers PT. Holcim and PT. Indocement, who cooperated with the Indonesian Ministry of Environment for setting up a "Guideline on Hazardous Waste Utilization for Co-Processing in Cement Industry" [KLH/ GTZ, 2009], high temperatures in the kiln will break down organic toxic materials and also inorganic toxic materials, as long as the temperature in the kiln is stable and above 1200°C. The kiln's high temperature (1450°C) makes processing of most hazardous wastes a simple solution, excluding transportation.

Barriers for the use of hazardous waste are similar to those of municipal solid waste, especially:

- **Public perception of burning waste** – *there are some public concerns about the processing of hazardous wastes in the cement kiln. Facts need to be compiled and cement companies need to work closely with concerned community members to ensure a workable balance.*

Other waste

Other wastes include used tyres, sawdust, plastics, paper, textiles, waste oil, industrial liquid, solid waste, etc. Stakeholder discussions revealed used tyres as a desired possible source of alternative fuel. There are currently some barriers for the use of tyres in Indonesian cement kilns being:

- **Supply reliability** – *can not be ensured;*

- **Economic viability** - *Import tariffs placed on the import of used tyres from other countries increasing their price; and*

- **Competition of Use** - *Growing competition for waste tyres being used in road beds and playgrounds, particularly internationally.*

3.2.3 Blended Materials

According to IPCC Guidelines on National Greenhouse Gas Inventories on average approximately 950kg of clinker is used to make one tonne of OPC [IPCC, 2006]. More than 50% of CO_2 emissions from cement production result from the clinker making process. By reducing clinker content in cement via blending, CO_2 emissions from cement production can be decreased significantly (e.g Each 10kg of clinker content reduction per tonne of cement will result in 8.5kg CO_2 emission reduction from cement production).

Selected waste and bi-products containing useful minerals such as calcium, silica, alumina, and iron can be used as raw materials in the kiln, replacing raw materials such as clay, shale, and limestone. Because some materials have both useful mineral content and recoverable calorific value, the distinction between alternative fuels and raw materials is not always clear. For example, sewage sludge has a low but significant calorific value, and burns to give ash containing minerals useful in the clinker matrix[9].

The investment needed if wastes are used for alternative fuel or raw material is for transportation, storage and handling. Some investment is also needed for waste pre-processing dependent on waste sources.

Fly ash

Fly ash is a waste product of burning coal of electricity generation is a popular material used internationally for blending with cement.

There has been some concern in recent years about the radioactive nature of some fly ash when used in cement for residential construction and the impact that this may have on human health. Research in Sweden on this issue is on-going.

Fly ash is considered a hazardous waste in Indonesia, even though it is not classified as hazardous waste in Europe.

Slag

Slag is a partially vitreous by-product of smelting ore to separating the metal fraction from the worthless fraction. It can be considered a mixture of metal oxides however slags can contain metal sulfides as well. While slags are generally used as a waste removal mechanism in metal smelting they can also serve other purposes such as assisting in smelt temperature control and minimising re-oxidation of the final liquid metal product before casting[10].

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[9] *tp:/en.wikipedia.org/wiki/Cement#cite_note-18*

[10] *en.Wikipedia.org/wiki/slag*

Slag is considered hazardous waste in Indonesia and a permit is required to obtain and process it in the cement kiln. Currently slag is processed by specific hazardous waste services organisations.

Recycled concrete

Recycled concrete is a large part of blended material in some countries (Netherlands 70%) and is growing in prominence as governments world-wide attempt to modernise policies dealing with waste from construction and demolition with a view to material efficiency and landfill avoidance. The recovery of concrete falls between standard definitions of reuse and recycling: concrete is broken down into aggregates (granular material), generally to be used in road works, but also as aggregates in new concrete. Recovering concrete has two main advantages: it reduces the use of new virgin aggregate and the associated environmental costs of exploitation and transportation, and it reduces landfill of valuable materials.

While in some countries near full recovery of concrete is achieved, in most parts of the world the potential to recover concrete is overlooked and it ends up as unnecessary waste in landfill. This is generally the result of low public concern, as the waste poses relatively low hazard risks compared to other materials.

The CSI recommends that governments and key stakeholders: publicise data on construction and demolition waste and develop reliable and consistent statistics; that they develop economic incentives and legislation to allow infrastructure that promotes concrete recycling (particularly green building schemes); and that they set targets for the use of recycled concrete in both road construction and building industries.

Some of the barriers to further developing alternative fuel for fossil fuel substitution and using blended cement include:

- **Investment into facilities and equipment** - *Based on the co-processing guideline of the Indonesian Ministry of Environment [KLH/GTZ, 2009], cement plants would have to invest the construction of pre-processing equipments and related facilities to implement alternative fuel and blended material technologies. The plants would also need special/designated manpower to handle pre-processing operation. Investment through financial assistance would help acceleration of using alternative fuel and blended material;*
- **Legal limitations** - *Globally current use of alternative fuel and use of blending materials from alternative material is limited by waste management policies and emission policies. This is also what has happened in Indonesia. The policies on waste management and emission are still hindering the application of alternative fuel and material in the cement industry, which needs additional investment. As long as the adaptation of these policies is not enforced, the industry does not want to invest; and*
- **Public perception of cement quality –** *there are public concerns about the quality of blended cement, which have to be overcome.*

3.3 Mitigation Effort to Date

Indonesia's three largest cement manufacturers are employing a double-pronged strategy of emissions abatement: (1) increasing production of blended cement to reduce clinker to cement ratio; and (2) using alternative fuels to displace a proportion of fossil fuels used in the kiln.

PT. Holcim Indonesia has a large-scale CDM project aimed at reducing GHGe from the burning of oil and coal through biomass substitution in its two factories and will reduce GHGe by 4.54 megatonnes within the 10 years of project activity [PDD AF PT. Holcim, 2006].

PT. Holcim Indonesia's Alternative Fuel Initiative

Following approval from the Executive Board of the UNFCCC in December 2008, PT. Holcim Indonesia is now running the largest single alternative fuel CDM project in Indonesia in terms of the volume of GHGe saved; when fully operational – an estimated 500,000 tonnes of CO2e saved each year for 10 years.

PT. Holcim Indonesia's 2 factories in Cilacap/ Central Java and Narogong/ West Java produced 5.81 megatonnes of cement in 2008 and current have an average gross emissions intensity of 715kg CO2 t of cementitious materials.

To co-fire the kiln furnace, rice husks are used in the place of some coal. The biomass needs to be checked for moisture content before being stored and used in the kiln. PT. Holcim Indonesia uses the same trucks responsible for transporting bags of cement out of the factory for bringing agricultural waste to the factory for co-firing, thereby contributing negligibly to additional GHGe from the transport of agricultural wastes.

The biomass in-take system was regulated to provide both certainty of supply for PT. Holcim Indonesia and certainty of employment and income for micro-transport enterprises and their employees and contractors. A contract-system was devised for three specified monthly volumes (1,000-tonne a month minimum; a 500-tonne a month, and a contract for small irregular deliveries). The system of payment for the incoming biomass was also refined from an end-of-month system to a cash-on-delivery system – a move that is more sympathetic to the biomass collectors who have limited cash flows.

Figure 3-8: *Case Study – PT. Holcim Indonesia's Alternative Fuel Initiative*
Source: [PDD AF PT. Holcim, 2006]

PT. Indocement's first CDM project involves the use of alternative fuels in the place of coal. Various alternative fuels are envisaged such as biomass (main source of alternative fuel in factory in Cirebon), palm oil waste (primarily used as alternative fuel in factory in Tarjun) waste tyres, waste oils, plastics, papers, textiles, etc. The use of different types of alternative fuels is subject to further studies and relevant Government permits. The project will reduce GHGe by 1.01 megatonnes within the 7 years crediting period [PDD AF PT. Indocement, 2006]. The second CDM project aims the blending of cement by producing Portland Composite Cement (PCC). The additives, which will be introduced into finish grinding for PCC production, will mainly be limestone and fly ash from the Tarjun Power Station. GHGe will be reduced by 4.70 megatonnes within the 10 years of project activity [PDD BC PT. Indocement, 2006].

PT. Semen Gresik is in the latter stages of seeking approval for a biomass project under the CDM.

The barriers, which have been experienced during and after the implementation of these projects, have already been described in former chapters on energy efficiency, alternative fuel and blended cement and have also influenced the policy options suggested for GHGe mitigation in Indonesian cement industry.

3.4 Proposed Policies

3.4.1 Methodology for Policy Selection in Industry Sector Roadmap

Based on the strategies outlined earlier, the roadmapping process identifies key GHGe abatement activities applicable for the Indonesian industry sector. The process involved:

1. *Scoping policies relevant to reducing carbon emissions from the industry sector, from various international sources including the IPCC 4th Assessment Report, the World Business Council for Sustainable Development - Cement Sustainability Initiative[11], published sustainability reports from cement producers world-wide, project design document (PDD) for Indonesian, Indian and Chinese CDM for the cement industry, among other sources.*
2. *Building on the stated greenhouse gas reduction priorities of the Government of Indonesia as well as studies and reports such as the draft Technology Needs Assessment report for the industry sector.*
3. *Developing a list of policy options, combining the two sources above.*
4. *Prioritising the policy options involved assessing them against a set of agreed criteria including:*
   - *Total mitigation potential (total tonnes of GHGe reduced from given activity);*
   - *Cost effectiveness of mitigation (USD/ t CO_2e reduced);*
   - *Ease of implementation (institutional capacity, cultural, social, building on existing government/ industry policies and technical knowledge and skills);*

[11] Please see "Appendix 5 - World Business Council for Sustainable Development – Cement Sustainability Initiative".

- *Political and commercial acceptability (attractiveness of each policy in the current Indonesian context);*
- *Technological opportunity (transferability; potential for market transformation);*
- *Cross sectoral implications;*
- *Access to finance;*
- *Ease of measurement, reporting and verification (MRV);*
- *Technical risks (including vulnerability to climate change impacts and tectonic activity);*
- *Future export potential and opportunities;*
- *Impact on balance of payments and other economic considerations; and*
- *Compatibility with development goals (energy security, economic growth, environmental protection).*

5. *Developing a short-list of policies that differentiates between short-term and mid/long-term considerations.*
6. *Discussing each short-listed policy with industry stakeholders to check their applicability in the field, both in the short and longer-term.*

3.4.2 Proposed Policies and Key Performance Indicators

This section explores the range of policy options including their key performance indicators (KPI) that could bring about the GHGe abatement potential for the cement industry in Indonesia over the next 20 years, described in Section "Potential for Greenhouse Gas Emissions Mitigation". This abatement potential is based on the scenarios described in Section "Opportunities for Greenhouse Gas Emissions " and is achievable without any major technological advancement, such as CCS. The proposed policies are meant to change the current condition in that way, that an implementation of the three discussed scenarios energy efficiency, alternative fuel and blended cement will be possible. The abatement targets are ambitious but achievable and based on the literature review above, worldwide case studies described and discussions with PT. Holcim, PT. Indocement and PT. Semen Gresik.

The first step to be taken to achieve these abatement targets is the involvement and agreement of all stakeholders in the process.

A. *Negotiate and Agree Climate Change Cooperative Agreements (2010 – 2014)*

Given the Government's priority to reducing emissions from the cement industry, the vehicle of a Climate Change Cooperative Agreement (CCCA or Cooperative Agreement) would help provide clear expectations for both parties (government and industry) going forward. The Cooperative Agreement would set out the roles, responsibilities and expectations of each party over the period of the agreement including an agreed emission reduction goal. This helps build certainty for the parties and assists with measurement, reporting and verification (MRV) of abatement activities from the cement industry.

Various existing and proposed initiatives could be incorporated into the Cooperative Agreements. The United Kingdom's Climate Change Agreement (CCA)[12] is an appropriate model. The Long-Term Agreements (LTA) in the Netherlands is an equally suitable model for adoption in Indonesia.

[12] Signatories to the CCA are exempt from paying a climate change levy (put across all economy sectors, including trade-exposed) thereby creating an incentive to implement energy efficiency savings. During the first target period (2001-2002) total realized reductions were three times higher than the target for that period (Pender, 2004 in McKane et al.). Sectors did better than expected because industry underestimated what they could achieve via energy efficiency. Industry also realized total reductions that were more than double the target set by the government during the second target period (Future Energy Solutions, 2005 in McKane et al.)

Target setting agreements in the United Kingdom

The United Kingdom Climate Change Programme was established in 2000 to meet both the country's Kyoto Protocol commitment of a 12.5% reduction in GHGe by 2008-2012 relative to 1990, and the domestic goal of a 20% CO2 emissions reduction relative to 1990 by 2010 (DEFRA, 2000). A key programme element is the Climate Change Levy , which is an energy tax applied to industry, commerce, agriculture and the public sector. Certain companies can also participate in Climate Change Agreements (CCAs). There are 44 sector agreements representing about 5,000 companies and 10,000 facilities. The goal of the CCAs is to reduce carbon dioxide emissions by 2.5 megatonnes C (9.2 megatonnes CO2) by 2010, which is ten times the estimated savings from the Levy without the agreements. During the first target period (2001-2002) total realised reductions were three times higher than the target for that period (Pender, 2004). Sectors did better than expected because industry underestimated what they could achieve via energy efficiency. Industry also realised total reductions that were more than double the target set by the government during the second target period (Future Energy Solutions, 2005)
Source: [UNIDO, 2008]

Figure 3-9: *Target setting agreements in the United Kindom*

The agreements must contain target-setting process, benchmarking, energy audits, energy savings action plans, the appointment of energy managers at each facility, information and training workshops, measuring and monitoring progress towards targets, annual reporting, program evaluation and incentives and supporting policies, such as a CO_2 tax rebate as a reward for meeting emission reduction targets (all these issues will be described subsequently).

When implementing a policy that could increase the marketplace price of cement, care must be taken to manage the possibility of carbon leakage[13]; that is using border carbon adjustments (BCA) or import/export tariffs.

KPI: *All cement companies have a signed cooperative agreement with the Ministry of Industry by December 31, 2011.*

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[13] *Carbon Leakage is the term used to describe the undesired impact of costing carbon into locally produced goods and services which leads to comparable goods and services produced in countries where there is no carbon price signal (and hence production is cheaper) gaining extra market share. The net results is "carbon leakage" or no net reduction in global GHGe.*

Outcome: Increase energy efficiency - 3.6% p.a. reduction in energy use in non-kiln operations by 2030

B. Require the implementation of no-regrets activities from Energy Savings Plans (2015 – 2020)

There are two existing measures for promoting energy efficiency in Indonesian industry:

(1) Partnership Program on Energy Conservation – providing free of charge energy audits for buildings and industries. Energy audit services during 2003 – 2007 have already been completed for more than 250 industries and buildings; administered through the ESDM.

(2) Energy Manager Competency Program – preparing energy manager accreditation mechanisms, and competency standards for energy manager in building and industry. This is administered through the Ministry of Energy and Mineral Resources (ESDM).

Progress reports from these programs reveal that they are yet to involve energy intensive industries such as the cement industry. This is due to the fact, that the energy audit program has been implemented at a very slow speed since its inception in 2003. Therefore, a strong marketing program is recommended to increase the number of energy audits done in the industry and commercial sectors. The suggested target group for this marketing in the industry sector includes specialized sector end users: i.e. steel industry, pulp & paper industry, aluminium industry, chemical industry, etc.

The recommended medium-term strategies to be developed in the future in Indonesia are identified in the Econoler International Report [Econoler, 2006]:

1. *Conducting energy audit in energy intensive industries;*
2. *Reviewing and update policy and regulation on energy efficiency and energy conservation (EE & EC);*
3. *EE & EC programs being an integral part of energy law should include a regulation for obligatory audits and labelling; and*
4. *Developing the energy efficiency reporting system (on-line system) for buildings and industries and exploring the potential to convert the results into a comprehensive benchmarking system.*

   Furthermore, the World Bank [Econoler, 2006] notes that providing free of charge energy savings plans (energy audits) is prejudicial to the program as it reduces customer obligation towards the implementation stage and decreases interest toward the proposed energy efficient measures.

An energy savings program is recommended where cement manufacturers pay only between 5% and 30% [Econoler, 2006, pp. 55] of the plan costs providing that they are required to implement all measures *in the report that are economically viable, within a reasonable period (e.g. a minimum IRR of 12% p.a. over the life of the technology implemented within three years of the audit report). Failure to do so, results in them reimbursing the price of the energy savings plan. The Directorate General Electricity and Energy Utilisation (DGEEU) would be the responsible agency for rolling out this initiative.*

In order to 'kick start' investment, the GOI, via the Ministry of Finance could consider providing complying manufacturers with either accelerated depreciation for new plant equipment (100% in year of purchase) or through the DGEEU contributing to the cost of installing new plant and equipment to enable savings greater than a five-year payback, once all no-regret options (12% IRR or better) have been fully implemented. This recommendation is consistent with those in the Econoler International Report to the World Bank in 2006. Total funds for this initiative would be capped and funds would only be made available to companies providing the required plant level data on GHGe. Stakeholders would be required to develop a schedule of complying energy saving technologies and systems.

KPI: *100% of audits completed have Energy Savings Plans agreed by senior management. All activities shown to achieve an IRR 12% or greater are implemented.*

C. Capacity-build Energy Services Companies (ESCO)s for supporting the cement industry, other heavy manufacturing industries and the government with policy development, program delivery for eco-efficiency, energy audits and -services (2010 – 2014)

Knowledge of energy efficiency technologies and their practical application in the Indonesian cement industry is very limited, creating a barrier for cement industry technical staff working cooperatively with "energy audit experts".

On top of this most energy efficiency technology, equipment and services are imported so the local "promotional" activity for these technologies into the marketplace is currently limited.

Government support for an Energy Savings Plan Program (as above) would benefit from the resourcing of a number of "pilot projects" in the cement industry as well as energy efficiency training for staff already working within the cement factories. Accreditation of energy service providers would assist with creating status, confidence, trust and quality control in the marketplace [Econoler, 2006].

At the same time the Government and industry sector need "third sector" assistance for sharing information, designing industry-wide policies and programs and implementing actions to meet Government policies of reducing GHGe. This is particularly true for Indonesia where public disclosure *of greenhouse gas inventories and finance is not yet commonplace. Industry associations provide the role of aggregating data and publishing it in a way that is helpful to policy makers but sensitive to the commercial interests of individual industry members. Similarly non-government organisations can play a key role in:*

1. *Data and international best practice tracking and benchmarking;*
2. *Policy development and advocacy;*
3. *Information and training delivery to industry about new systems of data collection, emissions reduction technology opportunities; and*
4. *New government policy interpretation and guidance for implementation at a company level.*

Once such entities were established, they could provide research, technical assistance, advice and training to the industry optimising the use of blended cements and overseeing guidelines about waste management in construction and demolition (to maximise the recovery of concrete for use in the production of cement) among other things.

With membership from key industry players (based on influence, size of output etc.) and funding from government, these "third sector" bodies are unlikely to thrive in Indonesia.

At the same time as accrediting ESCOs, the resourcing of a central research and development unit could take place. This unit could perhaps be linked to a university or technical college and would enable both the sharing of information and experience with technology deployment and also the capacity building of new professionals and cement industry staff in the planning for, commissioning and operation of new low-emissions plant equipment and systems.

KPI*: DGEEU funds energy savings plan pilots in the cement industry and promotes these case-studies through the ASI and international conferences.*

KPI*: Plant maintenance and factory/energy managers have undertaken fully resourced training on energy efficient technologies and implementing energy savings plans.*

KPI*: An accreditation process for practitioners providing Energy Savings Plans to the Indonesian industry sector is established and co-promoted by the Ministry of Energy and Ministry of Industry.*

KPI: *Government has committed on-going funding to two or three key non-government organizations and/or industry associations to coordinate and deliver policies for improving the delivery of blended cements to the Indonesian marketplace.*

KPI: *A scoping study to identify the strengths, opportunities and gaps in research and training for* *energy services, low emissions technologies, etc. be undertaken and led by the MOI with the Ministry of National Education.*

Outcome: Use alternative fuel - Displace 30% of the fossil fuel (coal) used in the kiln processes with waste materials reducing emissions by 8.2% p.a. by 2030

D. Review waste policy – increase landfill levies over time and make it viable to create new resource streams for municipal, agricultural and industrial waste (2015 – 2020)

Providing a sliding scale of fees overtime, providing an economic incentive to find alternative uses for waste, as well as managing Indonesia's present and future waste management challenges. This would also provide a financial incentive to resource waste concrete for use as clinker substitute and tyres, plastics and other fossil fuel based wastes as alternative fuels in the kiln. The Ministry of Environment has carriage of this initiative.

KPI: *Issue a supporting regulation for waste management to open opportunities for 3R (reuse, reduce, recycle) and to subsequently open the resource stream for municipal and agricultural waste. This supporting regulation stipulates a standard for waste management and technical assistance for local governments.*

KPI: *Sliding scale of landfill levy is implemented by regional governments across Indonesia. Resource recovery services sector in Indonesia is expanded.*

E. Review hazardous waste register and permit requirements for the cement industry (2010 – 2014)

Amend hazardous waste policy to align with European Union, removing slag, tyres and other high value waste resources from the hazardous waste register. Provide an exemption for hazardous waste permits for the cement (and steel) industry for hazardous waste used in co-firing the kiln. Ensure the highest air quality standards are maintained by the cement manufacturers with a view to protecting the health of local stakeholders.

KPI: *Hazardous waste register is updated and aligned with international best practice. Permit exemption is provided to cement (and steel) industries using high temperature kiln facilities.*

F. Provide a supportive export and import tariff for waste products *to be used as alternative fuel in industry sector (2015 – 2020)*

Regional demand for agricultural biomass waste is increasing its sale price. A tonne of waste such as rice husks and PKS is now almost as high as the equivalent calorific value in coal pushing local companies to choose traditional fossil fuel supply over alternative lower-greenhouse emitting waste resources. Similarly an import levy on tyres is a disincentive for cement companies using waste from other countries to co-fire their kilns and creating a limited supply of alternative fuels. A boarder levy for the export of waste resource and/or an exemption for the import levy waste resources would provide the local market with a more affordable, fair and reliable source of lower GHGe fuels for use in the kiln. These policies are in the responsibility of the Ministry of Finance and the Ministry of Trade.

KPI: *Either a decrease of the import tariff for imported wastes for cement industry or a new tariff applied to the export of wastes, which would support the availability of waste to be used as alternative fuel by the Indonesian industry sector.*

Besides the mentioned policies, care must be taken by all stakeholders when sourcing and using alternative fuel for co-firing to:

1. *Consider GHGe resulting from additional transportation of agricultural waste to the cement factory;*
2. *Ensure that hazardous waste burned in the kiln is done so with due diligence for total environmental and human health considerations to both the immediate community and future generations; and*
3. *Ensure that biomass used in the kiln processes is genuinely "waste" and not biomass produced specifically for co-firing where that growing that biomass has lead to a perverse environmental outcomes, such as clearing native forest for "sustainable plantation forest' impacting biodiversity and habitat for other species.*

<u>Outcome: Use blended cement - 15% p.a. reduction in the clinker usage by 2030</u>

It is noted that Indonesia has one of the highest average clinker/cement content in the world (95%) and this is due largely due to the failed attempt in the mid-1990s to introduce a range of blended cements to the market, without proper quality controls, marketing and training. Hence the first step to take to implement the blended cement scenario is the resource of a national communications campaign to increase the awareness and encourage the use of blended cements. The government and industry-funded campaign will target users requiring less strength from their cement, retailer builders, low-rise buildings such as residential homes, local councils for local road construction etc. It will involve a mass marketing campaign, point of sale and trade person education. To maximize the success of rolling out new concrete standards, a communications campaign would need to be supported by government, industry and civil *society groups urging Indonesians to choose the right cement. Subsequently the following steps have to be taken.*

G. *Review and set new cement performance standards - to avoid over specification of cement strength for use, and therefore reduce overall demand for clinker content (2015 – 2020)*

Given that the majority of emission abatement opportunity is from reducing the amount of clinker used in cement through blending, not over specifying concrete quality/characteristics for the respective job could be a demand-led way of reducing cement industry emissions. This would need to be supported through an awareness raising initiative with the construction industry. It is noted that standard SNI 1-15-7064-2004 (Indonesian National Standard) was most recently updated in 2004. This standard should be updated, or new standard developed, and be based on performance, not on composition.

KPI: *New cement performance standard(s) adopted*

H. *Review national building codes – require a minimum recycled concrete content for new cement (2015-2020)*

In line with many European nations, set a minimum recycled content standard for all new buildings. Concrete can be processed and blended with cement achieving a reduction in raw clinker requirements as well as reducing waste to landfill. Some further work would have to be done by the government in concert with local authorities to review the ownership and responsibility of managing construction waste as well as adding a minimum recycled concrete component for new buildings. Care needs to be taken that this initiative does not unintentionally increase emissions due to the additional emissions resultant from the transportation of waste from demolition site to cement plant.

This could be the role of the Department of Public Works in close consultation with key stakeholders such as the Green Building Council of Indonesia and the Civil Engineering Association. It is important to ensure that any changes to commercial building standards are supported by the insurance industry.

During the review of national building codes, the government can "lead by example". It procures blended cement as appropriate to reduce overall demand for high clinker content cement (green procurement) and urges the 3 big state-owned construction companies in Indonesia PT. Pembangunan Perumahan, PT. Wijaya Karya (Persero) Tbk. and PT Adhi Karya Tbk. (Badan Usaha Milik Negara - BUMN) to use blended cement accordingly. Government procurement specifications for blended cement would both raise the awareness of blending and provide the industry with some certainty for the buyer. Cements products/services could arranged as: prefabricated concrete structures, high performance concrete, high early strength concrete, concrete additions, concrete admixtures and economical concrete production.

KPI: *National Building Code updated to require a minimum recycled concrete content for all new commercial and industrial constructions.*

KPI: *Government sets and requires an increase in PPC and other cement blends as appropriate.*

Outcome: Building in climate change mitigation policy certainty for investor confidence

I. *Create a robust system of data measurement, reporting and verification – to improve investment certainty (2010 – 2014)*

A robust methodology to collect, analyse and compare data on industry emissions at plant level is essential in developing responsive and appropriate greenhouse gas mitigation policies for the industry. Apart from improving the accuracy of national planning, publicly disclosed and verified data builds international confidence in Indonesia's mitigation plans – assisting with UN negotiations, NAMA development and attracting international finance such as through CDM.

Already companies representing a majority of production are reporting plant level emissions in compliance with the WBCSD CSI[14] [ECOFYS, 2009]. This factor alone holds great hope for the swift access of essential data for informing policy formation and securing investor confidence in Indonesia's cement industry. The GOI, through the Ministry of Industry's Directorate of Downstream Chemicals (DDC) needs to work with cement industry to develop efficient and effective system for MRV. The way data is published needs to be mindful of the commercial sensitivity of information while at the same time ensuring that the level and scope of data is useful for policy makers. In this respect it is recommended that the GOI works with the Indonesian cement industry to develop its own method of categorising plants on the basis of (a) style of production; (b) kiln technology employed; (c) average cement to clinker ratios etc.. Emissions data for each category could be published, instead of emissions data from each plant in order to respect commercially sensitive information. The ASI would play a key role in this coordination.

Publishing for data by DDC is currently five-yearly. To be helpful for driving industry improvements data from the cement industry would need to be delivered at least annually. The DCC should require the cement industry to provide the first year of complete data in its first reporting year 2010.

Failure to report to government requirements means failure of operating license and penalty or cooperative agreement. In the case of the BUMN cement companies, reporting performance could be linked directly to the performance appraisal of the CEO. The legislation needs to be updated to take these new standards into account.

As a first action industry and government have to agree on the data requirements for the industry to measure, report and verify emission reductions against a business as usual baseline and decide the method

[14] *Please see "Appendix 5 - World Business Council for Sustainable Development – Cement Sustainability Initiative".*

of data presentation as well as the period and location of data publication. The agreed data requirements and methods of MRV should be included in the Cement Industry Cooperative Agreements.

The operating licence conditions for cement factories can be amended in such way, that the publicly reporting of plant level GHGe data is required.

KPI: *ASI publishes annual factory-level greenhouse gas and emissions intensity data for the Indonesian cement industry.*

J. *Inform about Best Available Technology (BAT) and assist BAT installation for new cement plants (2015 – 2020)*

If the Government of Indonesia is requiring new cement plants to be built using the best available technology, then this needs to be clearly defined in a government and industry endorsed policy that is continuously updated to reflect the improvements in performance of the cement industry worldwide. This measure could also be incorporated in the Climate Change Cooperative Agreements (CCCA). This function would sit well with either the ASI or the Ministry of Industry.

KPI: *Emissions intensity figures for cement factories are published annually. A list of new technologies and systems are published with case studies showing "best available" practice internationally.*

K. *Introduce an Award System for specific savings in GHGe across the (target) industries (2010 – 2014)*

Currently Indonesia has five eco label products. A range of blended cements could carry the label or receive an award demonstrating that it comprises a portion of recycled content and/or lower greenhouse gas intensity. This step can only take place after the cement performance standards have been revised. It will be based on the new Indonesian National Standard.

Such eco labels or ecognition awards are key to supporting individuals or champions within businesses. It provides both a reward for hard-work and achievement through recognition and provides a platform to exchange ideas and stories about best practice performance and local innovation.

KPI: *New cement performance standard(s) adopted and subsequently a new Award provided for most improved/most innovative greenhouse gas emissions savings from the industry sector.*

Outcome: Building capacity for financing key industry greenhouse gas abatement initiatives

L. General Finance Instruments for upfront capital

The Asian Development Bank (ADB) launched the Energy Efficiency Initiative (EEI) in July 2005, the core objective of which is to expand ADB's investments in energy efficiency projects (including renewable energy), with an indicative annual lending target of 1 billion USD between 2008 and 2010. The World Bank has announced the establishment of the Clean Energy Fund Vehicle with a capitalisation of 10 billion USD and an annual disbursement of 2 billion USD to accelerate the transition to a low carbon economy [IPCC, 2007, Chapter 13].

KPI: *Study has identified opportunities for the Government of Indonesia to secure funding for key greenhouse gas mitigating activities (particularly energy efficiency) in the industry sector.*

M. Indonesian Climate Change Trust Fund (ICCTF)

Innovation Fund [ICCTF, 2009] provides grants for the purposes of capacity building within both Indonesian Government and civil sector organisations. Phase 1 started in 2009 and focuses on Sectoral Ministries. Phase 2 of the Innovation Fund is scheduled to commence in 2011 and is focused at regional and local government, private firms (through PPPs), NGOs and learning institutions such as universities.

Phase 3 is called the Transformation Fund and is scheduled to commence in 2012. It aims to harmonise public sector involvement and maximise the deployment of financing mechanisms for climate change mitigation and adaptation finance. This includes loans, capital markets, carbon trading etc. The ICCTF would take in policy options in Soft-loans and Contestable grants following.

M. i. Soft-loans/interest free

Soft or interest free loans are the stakeholder-preferred financial instrument for managing additional up-front capital outlays.

Soft loans (or those where the government is part-financier through the provision of paying interest) are *useful in a time when private lending is difficult to obtain for various market reasons. Government involvement in a project tends to reduce credit risk (on the assumption that the government agency would have undertaken a project risk assessment as well). Soft loans however can be costly to the government and do not necessarily result in long-term changes in market behaviour.*

In the case of financing energy efficiency technologies and services, performance based contracting via, ESCOs is a superior policy measure[15]. This builds capacity in the private energy services sector and creates a new form of specific risk-managed financing for energy saving measures.

Soft loans are a useful tool for government to use when very large and above risk capital expenditure is expected of the private sector to meet compliance with ambitious reduction targets in a short time period.

M. ii. Contestable grants

Contestable grants are provided to cement manufacturers by a fund manager, which in the case of Indonesia would most likely be the ICCTF. The process involves individual companies or a collection of companies, usually via its peak industry association, to bid to the Fund administrator who provides funding to projects demonstrating the lowest cost of CO_2 abatement. Funding is provided to companies that have already demonstrated significant initiative on greenhouse gas abatement already.

Because of the challenges with free-riders, prohibitively high transaction costs and complex, long procedures to process applications, these grants should be provided only to a selected list of equipment with long payback time but high efficiency gains, or to investment of a certain size or level of cost-effectiveness.

N. Accelerated depreciation/ Reduced tax on energy-conserving technology

As part of the Climate Change Cooperative Agreement, cement manufacturers have access to the tailored initiative that enables them to fully (100%) tax deduct the capital cost of a clean technology – irrespective of the technology life – in the tax year of purchase.

Benefits flowing to the companies would depend on the current tax being paid. A schedule of eligible technologies would need to be agreed before proceeding.

[15] Performance-based energy services are where a third-party undertakes an energy audit, develops and energy savings plan and then finances the purchase, installation and often management of the energy saving equipment. The loan is financed via the cost savings accruing from the energy savings resultant from the installation and operation of the energy savings measures. This process transfers nearly all the risk to the ESCO and makes wide-scale roll out of energy saving technologies and systems commonplace in the industrial market. In order to build a robust ESCO industry, initial government assistance is required (procurement of services, underwriting loans etc.)

O. Flexible Mechanisms (PoA)

Flexible Mechanisms are primarily the Clean Development Mechanism (CDM) and PoA and the CERs that these projects create for entities operating in emissions trading schemes in Annex-1 countries.

As a funding mechanism, CDM in Indonesia is not without its challenges. Particularly there is a long period between registration and project realisation, meaning that involvement in Indonesian CDM tends to be strategic rather than tactical for meeting compliance in Annex 1 countries. CDM will continue to play a role in financing large projects in Indonesia, but will have limited application for industries such as textiles where there the industry is highly disaggregated.

3.4.4 Conclusion

The policies are broadly grouped into the following types:

- *Planning - to ensure long-term strategies on industry, energy and waste are in line with low-carbon industry objectives;*
- *Regulations – to create a "level playing-field" to provide certainty for industry players and the consuming public to change their behaviours; this is particularly useful for improving industry-wide MRV and lifting the performance standards of the lowest performers;*
- *Economic instruments (e.g. taxes, subsidies, tradeable permits) - to create financial incentives for industry players to change behaviours;*
- *Information and marketing – to complement the delivery of other policy options and assist with the delivery of new products and services; and*
- *Technologies – including alternative fuels, new kiln systems, high efficiency motors, new products and services (such as blended cement).*

Generally speaking a blend of policy approaches is required to achieve both short and longer-term emission reductions. Some policies when implemented may not directly create behaviours that reduce emissions, but they will improve the likely success of other policies in reducing emissions. Other policies again will be slow to achieve emission reductions but will be necessary to achieve a genuine shift to a domestically responsive and internationally competitive low-carbon industry sector into the future.

This Industry Sector Roadmap contains a mixture of these policies as appropriate for use in the Indonesian industry sector (below).

Table 3-1: *Overview of policies proposed for greenhouse gas emissions mitigation in Indonesian cement industry*

	Policy	Type of Instrument	Scenario	Level: Difficulty	Level: Urgency	Level: Benefit	Responsibility	Primary Co-benefits of mitigation actions	Barriers
A	*Climate Change Cooperative Agreements, which aim GHG emissions mitigation (2010 – 2014)*	*P*	*EE, AF, BC*	*2*	*5*	*5*	*Gov/Ind*	*Reduced energy demand from the industry. Better overall MRV of cement GHGe abatement activities*	*Requires the participation of all players to be successful; will it be binding? Requires Gov resources to administrate adequately and fairly*
B	*Require the no-regrets implementation of energy audits/savings plans (2015 – 2020)*	*P/E/I/T*	*EE*	*4*	*3*	*3*	*Gov/Ind*	*Improved efficiency of industry, international competitiveness, assists with demand-side management of energy*	*Requires a new government policy instrument*
C	*Capacity build ESCOs (2010 – 2014)*	*P/I*	*EE, AF, BC*	*2*	*3*	*2*	*Gov/ Ind*	*Increased competitiveness of cement industry through more efficient production; improved skills in construction industry; institutional capacity building*	*Limited local stock currently. May need to attract overseas ESCOs to Indonesia*
D	*Increase landfill levies over time (2015 – 2020)*	*E*	*AF, BC*	*5*	*2*	*5*	*Gov*	*Less waste to landfill; improved air quality*	*Adds expense to the cost of doing business*
E	*Review hazardous waste register (2010 – 2014)*	*P*	*AF, BC*	*2*	*4*	*5*	*Gov*	*Better disposal of hazardous waste; improved local health conditions*	*Need to overcome local prejudice/ perception, that hazardous waste combustion in cement kiln is negative.*
F	*Provide supportive export/import tariffs for waste (2015 – 2020)*	*E*	*AF, BC*	*5*	*3*	*4*	*Gov*	*Alternative fuel supply improves reliability*	*Would need to overcome perception that importing waste is a negative activity*
G	*Review and set new cement standards (2015 – 2020)*	*P/R/ I*	*BC*	*3*	*5*	*5*	*Gov*	*Reduced energy demand from cement production. Reduced construction waste to landfill.*	*Cement standards updated in 2004; industry "fatigue" in updating again so soon; long lead-time to test/ try cements and agree to set standards for labelling; enforcement of accurate labelling requires gov resources even after implementation*

	Policy	Type of Instrument	Scenario	Level: Difficulty	Level: Urgency	Level: Benefit	Responsibility	Primary Co-benefits of mitigation actions	Barriers
H	New minimum recycled materials content standard/ Green gov procurement (2015 – 2020)	R/E	BC	4	5	4	Gov	Reduced energy demand from cement production. Reduced construction waste to landfill.	Public acceptance, policy design to protect the poor
I	Require robust MRV of GHGe data at plant level (2010 – 2014)	I	EE, AF, BC	1	3	3	G/In	Improved data for better financial modelling and subsequent (foreign) investment	Adds administrative burden to liable reporting entities
J	Assist the installation of BAT for new cement plants (2015 – 2020)	T/R	EE, AF	5	1	5	Gov	National productivity improved	Requires on-going monitoring of BAT and updating of law
K	Introduce Award System to acknowledge GHGe successes (2010 – 2014)	I	EE, AF, BC	2	2	2	Gov	Improved information and knowledge of GHGe abatement activities	Requires cross departmental cooperation
L	General Finance Instruments for upfront capital	F	EE, AF, BC	4	4	4	Gov		Requires on-going monitoring
M	Indonesian Climate Change Trust Fund (ICCTF) i. Soft-loans ii. Contestable grants	F	EE, AF, BC	2	5	4	Gov		Does not necessarily result in long-term changes in market behaviour, risk of free-riders, prohibitively high transaction costs, complex procedures to process applications
N	Accelerated depreciation/ Reduced tax for energy-conserving technologies	F	EE, AF, BC	2	4	4	Gov		Requires on-going scheduling of eligible technologies
O	Flexible Mechanisms such as PoA/ CDM	F	EE, AF, BC	5	4	3	Gov		Long period between registration and project realisation, limited application for highly disaggregated industries

Code:

P = Planning - to ensure long-term strategies on industry, energy and waste are in line with low-carbon industry objectives

R = Regulations – to create a "level playing-field" to provide certainty for industry players and the consuming public to change their behaviours;

E = Economic instruments (e.g. taxes, subsidies, tradeable permits) - to create financial incentives for industry players to change behaviours

I = Information and marketing – to complement the delivery of other policy options and assist with the delivery of new products and services

T = Technologies – including alternative fuels, new kiln systems, high efficiency motors, new products and services (such as blended cement)

F = Financial assistance

EE = Energy Efficiency scenario

AF = Alternative Fuel scenario

BC = Blended Cement scenario

Gov = Government

Ind = Industry

Level of difficulty/ urgency/ benefit: (1) slight ... (5) most

3.5 Potential for Greenhouse Gas Emissions Mitigation

Emissions in 2020 are projected to be 64.29 megatonnes and in 2030 105.42 megatonnes CO_2e up from 2008 emissions of 35.37 megatonnes CO_2e (as explained later in this chapter). We assume the following maximum potential percentage savings from the three key emissions abatement activity areas: energy efficiency, use of alternative fuels and blending of cement.

Table 3-2: *Total Estimated Abatement Potential from the Indonesian Cement Industry p.a. To 2030 without Major Technological Advancement*

Emission Abatement Activity	Share of total emissions from cement manufacture	Abatement potential from each activity based on lit.	Total % abatement opportunity from each activity	Total abatement opportunity from this activity	Total abatement potential still to be realised**
	[%]	[%]	[%]	[Mt CO_2e]	[Mt CO_2e]
Energy Efficiency	10	36[1]	4	3.8	3.8
Alternative Fuels*	40	20	8	8.6	6.0
Blending	50	30	15	15.7	12.7
Total	100		27		22.5

*Depends on the fuel characteristics; e.g. rice husks give 100% CO_2e savings on burning coal

** Less existing and committed GHGe abatement activities in the cement industry

Accordingly four scenarios have been developed to illustrate the impact of these three activities:

	Description	*Assumptions*
Scenario 1: Business-As-Usual	*No change in cement production process takes place but demand rises at 4.5% to 6.0% p.a.*	*Average clinker-to-cement-ratio: 0.90t clinker/ t cement (2008)*
Scenario 2: Energy-Efficiency	*Reduce energy use by approximately 4% p.a. in 2030*	*Emission from fossil fuel combustion for heat production, grid- and self-generated electricity decrease by 0.4% p.a.*
Scenario 3: Alternative-Fuel	*Use of alternative fuels is increased up to 30% of the total average fuel mix in 2030*	*Emission factor from fossil fuel combustion for heat production during clinker making decreases from 0.298t CO_2/ t clinker in 2008 to 0.216t CO_2/ t clinker in 2030*
Scenario 4: Blended-Cement	*Clinker content in cement is reduced*	*Reduction of the average clinker-to-cement-ratio (in t clinker/ t cement): from 0.90 (2008) to 0.87 (2014), 0.85 (2020), 0.80 (2025), 0.75 (2030)*

3.5.1 Methodology

In its revised 2006 "Guideline for National Greenhouse Gas Inventories", the IPCC categorises GHGe from manufacturing industries into GHGe from energy use, GHGe from industrial processes and GHGe from industrial waste [IPCC, 2006]. This chapter covers GHGe from energy use and industrial processes during cement production applying IPCC methodology. Therefore the following formulas are applied.

Emissions $_{GHG, fuel}$ = Fuel Consumption $_{fuel}$ * Emission Factor $_{GHG, fuel}$	
Where:	
Emissions $_{GHG, fuel}$	*Emissions of a given GHG by type of fuel [kg GHG]*
Fuel Consumption $_{fuel}$	*Amount of fuel combusted [TJ]*
Emission Factor $_{GHG, fuel}$	*Default emission factor of a given GHG by type of fuel [kg GHG/TJ]*

Figure 3-10*: Industrial processes: Emission based on cement production*
Source: [IPCC, 2006]

$Emissions_{CO2} = (M_{cement\ type} * Cl_{cement\ type} - I_{clinker} + E_{clinker}) * EF_{clinker,\ cement\ type}$	
Where:	
$Emissions_{CO2}$	*Emissions of CO_2 from cement production [t CO_2]*
$M_{cement\ type}$	*Weight (mass) of cement produced of particular type [t]*
$Cl_{cement\ type}$	*Clinker fraction of cement of particular type [fraction]*
$I_{clinker}$	*Imports of clinker [t]*
$E_{clinker}$	*Exports of clinker [t]*
$EF_{clinker,\ cement\ type}$	*Emission factor for clinker in the particular cement [t CO_2/ t clinker]*

Figure 3-11*: Energy use: GHGe from stationary combustion,*
Source: [IPCC, 2006]

3.5.2 Data Sources and Limitations

The application of IPCC methodology and the development of realistic greenhouse gas mitigation scenarios require the following data on cement factory level:

✓	*Parent company*
✓	*Factory name and/ or ID, factory location*
✓	*Type of factory (integrated or only grinding mill)*
✓ / X	*Current/ Future status: Production capacity by product type (i.e. clinker, cement) p.a. [t]*
✓ / X	*Current/ Future status: Production and hence average annual capacity utilization factor by product type (i.e. clinker, cement) p.a. [t]*
✓ / X	*Types of cement produced (e.g., Portland cement, white cement, and masonry cement) and their relative shares p.a. [t]*
✓ / X	*Amount of conventional and alternative fuels consumed for calcination, heat and electricity production – by fuel type (coal, diesel oil, natural gas, etc.), volume p.a. [t, kl, etc.] and emission factor [tCO_2/TJ]*
✓ / X	*Electricity obtained from grid p.a. [MWh] and emission factor [tCO_2/MWh]*

X	*Quantities of raw materials used by type of raw material p.a. [t] and emission factor [tCO_2/TJ]*
X	*Amount of cement kiln dust (CKD) generated p.a. [t]*
X	*Amount of CKD recycled and discarded p.a. [t]*
X	*Plans for plant expansion or new plants to meet increasing demand for cement (location, expansion/ new plant, size, etc.)*

The ideal set of data inputs would also contain data on cement plant level (operating unit):

✓ /X	*Number of plants in the factory*
✓ /X	*Plant name and/ or ID*
X	*Type of plant/ production unit (kiln or grinding mill)*
X	*Type of technology (i.e., dry kiln, wet kiln, dry kiln with preheater, dry kiln with calciner, etc.)*
X	*Type of grinding technology used*
X	*Last year of modernization*
X	*Plant operating status*
X	*Current/ Future status: Production capacity by product type (i.e. clinker, cement production, mill grinding capacity) p.a. [t]*
X	*Current/ Future status: Production and hence average annual capacity utilization factor by product type (i.e. clinker, cement) p.a. [t]*
X	*Amount of conventional and alternative fuels consumed for calcination, heat and electricity production – by fuel type (coal, diesel oil, natural gas, etc.), volume p.a. [t, kl, etc.] and emission factor [tCO_2/TJ]*
X	*Electricity obtained from grid p.a. [MWh] and emission factor [tCO_2/MWh]*
X	*Quantities of raw materials used by type of raw material p.a. [t] and emission factor [tCO_2/TJ]*
X	*Amount of cement kiln dust (CKD) generated p.a. [t]*
X	*Amount of CKD recycled and discarded p.a. [t]*

Data and information for the cement industry in Indonesia are available from a wide variety of sources including cement companies, industry groups and public agencies. Data collection activities for this project were focused on gathering factory-specific information from both public and private sources. All Indonesian cement manufacturers are members of the ASI, to whom the manufacturers report regularly. Details about the locations and capacity of the cement plants, annual cement production and clinker *export could be obtained from statistics provided by the ASI. The latest figures about cement production in 2008 result from the annual reports of the major cement manufacturers, PT. Indocement, PT. Holcim Indonesia and PT. Semen Gresik (the three largest manufacturers), and the ASI. The same sources reported a future projection of cement industry growth until 2014 or 2025.*

Only the three largest Indonesian cement manufacturers report details on energy use and associated emission factors/ -intensity. The emission factors used for the following Baseline/ GHGe mitigation scenarios are based on the Project Design Documents (PDD) of PT. Indocement, which describe the company's CDM projects development for using alternative fuel and cement blending [PDD AF PT. Indocement, 2006, PDD BC PT. Indocement, 2006] and the CDM PDD of the alternative fuel project implemented by PT. Holcim Indonesia [PDD AF PT. Holcim, 2006]. Due to a lack of data, it is assumed that all Indonesian cement manufacturers produce with similar technology and fuel mix.

Information on currently used technology and plans for modernisation or capacity increase could not be gathered.

The described data gaps required to develop average factory level estimates, based on historic regional and known factory-level information. A variety of assumptions about specific factories, their fuel use, and emissions were made by the analysts developing the emission estimates and the abatement cost analysis.

For future roadmapping the following steps are recommended. Indonesian cement manufacturers collect and report commercial data (sales, production, etc.) annually. Environmental indicators and the progress of implementing GHGe mitigation measures are published by the largest cement companies only. Two Indonesian cement manufacturers are members of the WBCSD CSI[16] and use the CSI methodology for greenhouse gas accounting. Therefore methodologies and data analysis differs as does the degree of completion of the published data between the companies and hence complicate a comparison between the companies in terms of GHGe. In order to improve future reporting of GHGe it is recommended that the WBCSD CSI methodology be used by all Indonesian cement companies. Since the companies are connected to each other via the ASI, the introduction of an appropriate MRV system might be initiated and facilitated by the association.

In order to reduce uncertainty of GHGe estimation, country specific emission factors have to be discussed. An attempt for this was made in the scope of the Second National Communication to the UNFCCC (SNC) [SNC, 2009]. Since reporting on energy use per industry was not in the scope of the SNC, country specific emission factors describing fossil fuel combustion and electricity use have not been covered by that report.

[16] *Please see "Appendix 5 - World Business Council for Sustainable Development – Cement Sustainability Initiative".*

3.5.3 Performance Metrics

Each industry has its own metrics for measuring performance and these metrics are discussed in the respective industry's report section. The IEA suggests [IEA, 2007]:

- *Emission intensity - CO_2 emissions from process and energy consumption (including electricity) emissions per tonne of unit produced It must be noted that the specific CO_2 emissions per tonne of cement are heavily influenced by different factors. The most important of these factors are the clinker content in cement, the specific energy consumption (SEC) and the fuel mix used to provide the required energy; and*
- *Energy intensity - CO_2 emissions from energy consumption (including electricity) per tonne of unit produced.*

Metric 1 looks at the overall picture of abatement activities for production while metric 2 seeks to measure the impact of e.g. energy efficiency or alternative fuels, rather than changes in the process e.g. blending in the case of cement industry. These have been chosen to reflect the heterogeneous nature of production in Indonesia, with some clinker sold for export before being made into cement, for example.

Metric 1 is the one used to measure the relative merits of policy options for achieving cost-effective GHGe reductions from the cement industry.

Globally the Indonesian cement industry has a relatively high emission intensity. Figure 3-12 shows the potential for the Indonesian cement industry to improve its cement emissions intensity.

Figure 3-12*: Examples of Emission Intensity in Cement Production*
Source: [IPCC, 2007, ECOFYS, 2009, SNC, 2009]

3.5.4 Key assumptions and Business-As-Usual Scenario

From 1990 to 1997 Indonesia experienced industrial growth at an average annual rate of around 6.3%, but economic growth slowed after 1997 due to the Asian financial crisis. However, based on the National Analysis of Industrial Development Policies incorporated into Presidential Decree no. 28/2008 the national policy target for economic growth in the industry sector is set to 7.5% in 2025.

The Indonesian government predicts GDP to grow 7% p.a. for the following years with the cement industry rising in proportion to that figure. The largest Indonesian cement manufacturers and ASI plan therefore internally with a cement industry growth rate of 5% - 8% p.a. until 2025 and 2014 respectively. To reflect the whole cement industry's potential, a growth rate between 4.5% - 6.0% p.a. is assumed for projected cement production (5.4% p.a. in average) in this report. Clinker export is considered to be constant in terms of production volume.

Projected growth of cement demand	ASI/ Cement companies	Assumptions for Industry Sector Roadmap
2009 – 2014	6.0% to 8.0%	6.0%
2015 – 2020	5.3%	5.0%
2021 – 2025	5.0%	4.5%
2026 – 2030	N/A	6.0%

Accordingly cement production is projected to increase from 38.95 megatonnes in 2008 to 123.47 megatonnes in 2030.

Table 3-3: *Cement Industry – Actual and projected Cement/ Clinker Production 2005 – 2030(tonnes)*

Year	Cement production	Clinker export	Total clinker production
2005	33,916,980	3,407,239	33,932,521
2008	38,946,883	3,329,688	38,381,883
2014	55,246,898	3,000,000	52,722,208
2020	74,036,127	3,000,000	69,632,514
2025	92,262,484	3,000,000	86,036,236
2030	123,468,016	3,000,000	114,121,215

Assuming that cement production capacity will be adapted to increasing demand every 3 years and new installations always comply with best available technology (BAT) according to future policies, the following development can be projected.

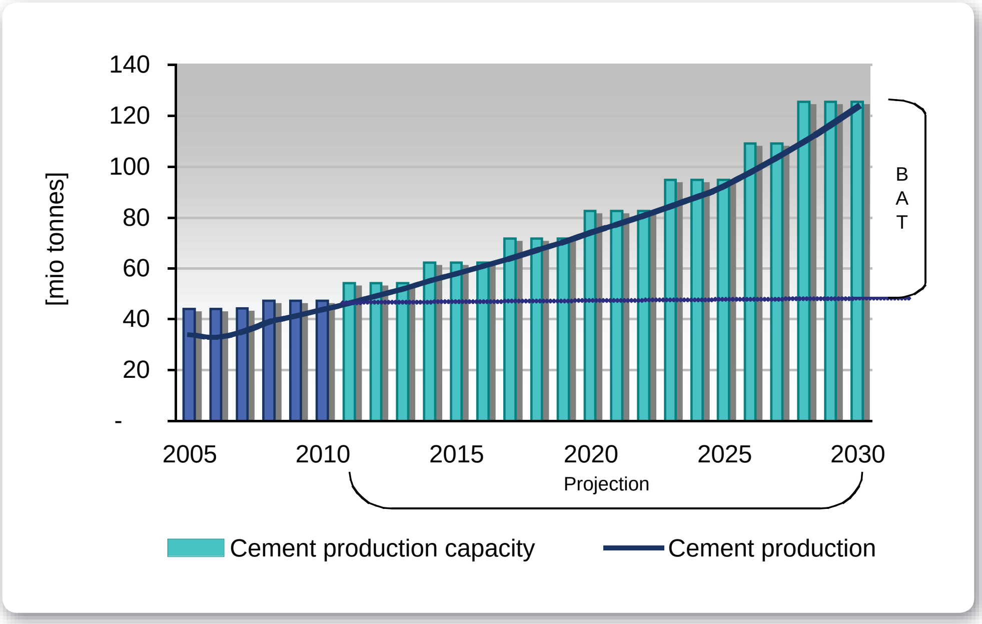

Figure 3-13*: Cement Industry – Actual and projected Cement Production Capacity 2005 - 2030*

The GHGe baseline (2008) was calculated using the following emission factors, which are based on the Project Design Documents of PT. Indocement and default values recommended by IPCC [IPCC, 2006]:

Source of emissions	*Emission intensity*
Clinker production	
Emissions due to calcinations	*0.525t CO_2/t clinker*
Emissions from fossil fuel combustion in kiln	*0.298t CO_2/t clinker*
Emissions from grid supplied electricity	*0.017t CO_2/t clinker*
Emissions from self-generated electricity	*0.046t CO_2/t clinker*
Total: Clinker production	*0.886t CO_2/t clinker*
Total: Clinker production (excluding grid supplied electricity	**0.869t CO_2/t clinker**
Material preparation/ Blended cement grinding	
Emissions from grid supplied electricity	*0.011t CO_2/t cement*
Emissions from self-generated electricity	*0.024t CO_2/t cement*
Total: Cement grinding/ material preparation	**0.035t CO_2/t cement**
Emission intensity of cement production (Baseline/ Business-As-Usual)	**0.833t CO_2/t cement**

The default clinker-to-cement-ratio recommended by IPCC is 0.95t clinker/ t cement produced [IPCC, 2006]. In its annual and sustainable development reports of 2008, PT. Indocement, PT. Holcim Indonesia and PT. Semen Gresik report clinker-to-cement-ratios, which are below this default value:

Clinker-to-cement-ratio

PT. Holcim Indonesia	*0.809t clinker/ t cement*
PT. Indocement	*0.825t clinker/ t cement*
PT. Semen Gresik	*0.830t clinker/ t cement*

Therefore, in order to provide a data mid-point, the greenhouse gas emission baseline will be estimated based on an average clinker-to-cement-ratio of 0.9. Emission intensity describes the amount of CO_2 emissions per tonne of produced cement. Under the given assumptions emission intensity for baseline and Business-As-Usual scenario would be 0.833t CO_2/t cement.

In 2005 Indonesian cement industry emitted approximately 31.25 megatonnes CO_2 and in 2008 already 35.37 megatonnes CO_2; 57% was contributed by the calcination process alone. Heat production led to 32% and electricity production to 11% of total GHGe. Emission intensity counted 0.833t CO_2/t cement.

Table 3-4*: Cement Industry – GHGe under BAU scenario 2005 – 2030(t CO2)*

Year	Emissions: Calcination	Emissions: Fossil fuel combust.	Emissions: Use of grid-supplied electricity	Emissions: Total	Emissions intensity per t cement
2005	17,814,574	12,486,795	946,546	31,247,915	0.832
2008	20,150,488	14,138,093	1,077,070	35,365,651	0.832
2014	27,679,159	19,462,365	1,498,721	48,640,246	0.832
2020	36,557,070	25,730,452	1,991,187	64,278,709	0.832
2025	45,169,024	31,810,765	2,468,900	79,448,688	0.832
2030	59,913,638	42,220,930	3,286,797	105,421,365	0.832

3.5.5 Calculating Energy-Efficiency Scenario

Discussions with PT. Indocement, PT. Holcim, PT. Semen Gresik and analysis of literature (particularly the WBCSD CSI[17]) reveal that efficiency improvement in Indonesian cement manufacture is achievable in increments but within a total maximum cap without major technological innovation in kiln technology or cement chemistry. A study team from the Battelle Memorial Institute estimates that the cement industry worldwide can increase its energy efficiency by 0.5% to 2% p.a. Regions or advanced companies that are

[17] *Please see "Appendix 5 - World Business Council for Sustainable Development – Cement Sustainability Initiative".*

already highly efficient (e.g. Japan) may improve more slowly than countries like the United States, which are less efficient [Battelle, 2000]. For the Energy-Efficiency scenario, a reduction of the emissions from fossil fuel combustion and electricity use is assumed, due to the implementation of energy efficiency measures. A reduction of the respective emission factors by 0.4% p.a. will lead to a decrease of CO_2 emissions of 2.0% p.a. (1.3 megatonnes CO_2 p.a.) in 2020 and up to 3.6% p.a. (3.8 megatonnes CO_2 p.a.) in 2030 compared to Business-As-Usual. Emission intensity can be reduced from 0.832t CO_2/ t cement in 2008 to 0.815t CO_2/ t cement in 2020 and 0.802t CO_2/ t cement in 2030.

Table 3-5: *Cement Industry – GHGe under Energy-Efficiency scenario 2008 – 2030 (t CO2)*

Year	Emissions: Calcination	Emissions: Fossil fuel combust.	Emissions: Use of grid-supplied electricity	Emissions: Total	Emissions intensity per t cement
2008	20,150,488	14,138,093	1,077,070	35,365,651	0.832
2014	27,679,159	18,999,915	1,463,110	48,142,183	0.824
2020	36,557,070	24,522,203	1,897,685	62,976,957	0.815
2025	45,169,024	29,715,488	2,306,281	77,190,792	0.809
2030	59,913,638	38,657,454	3,009,389	101,580,480	0.802

3.5.6 Calculating Alternative-Fuel Scenario

Currently heat for clinker production is generated by combusting coal and diesel oil by the majority of Indonesian cement producers. This scenario discusses the potential of substituting coal and diesel oil by alternative fuels (e.g. rice husk, wood residues, saw dust, palm kernel shell, municipal waste etc.). The heat demand, which is currently fulfilled by using 98% coal and 2% diesel oil, equals 0.00312TJ/t clinker [PDD AF PT. Holcim, 2006].

Table 3-6 shows the fuel mix suggested for the Alternative-Fuel scenario. For the calculation of the average emission factor of the fuel mix and the amount of emissions from heat consumption during clinker production, IPCC default emission factors have been used [IPCC, 2006].

Table 3-6: *Cement Industry – Fuel mix under Alternative-Fuel scenario 2008 - 2030*

Share of fuel mix	Palm kernel shell	Rice husk	Wood residues/ Saw dust	Municipal waste (non-biomass)	Waste oil	Coal	Diesel oil	Emission factor of fuel mix	Emissions from fossil fuel comb.
	[%]	[%]	[%]	[%]	[%]	[%]	[%]	[t CO_2/ TJ]	[t CO_2/ t clinker]
2008	-	-	-	-	-	98	2	95.66	0.298
2014	1	6	2	1	1	87	2	85.82	0.270
2020	1	10	3	2	1	81	2	80.06	0.255
2025	2	15	4	3	1	73	2	72.37	0.234
2030	2	21	4	3	1	67	2	66.60	0.216

By substituting 30% of fossil fuels with alternative fuels, which are for heat production during clinker making, emissions can be reduced from 0.298t CO_2/t clinker in 2008 to 0.255t CO_2/t clinker in 2020 and 0.216t CO_2/t clinker in 2030. An unintended consequence of this activity is the increase in electricity use and GHGe emissions for raw material preparation, including drying biomass and non-biomass material before using it in the kiln as alternative fuels. Still the net emission intensity can be decreased from 0.832t CO_2/t cement in 2008 to 0.796t CO_2/t cement in 2020 and 0.765t CO_2/t cement in 2030, which will result in 4.4% CO_2 reduction p.a. (2.8 megatonnes CO_2 p.a.) in 2020 and almost 8.2% CO_2 reduction (8.6 megatonnes CO_2 p.a.) in 2030 compared to Business-as-Usual.

Table 3-7: *Cement Industry – GHGe under Alternative-Fuel scenario 2008 – 2030*

Year	Emissions: Calcination	Emissions: Fossil fuel combust.	Emissions: Use of grid-supplied electricity	Emissions: Total	Emissions intensity per t cement
2008	20,150,488	14,138,093	1,077,070	35,365,651	0.832
2014	27,679,159	18,052,425	1,498,721	47,230,306	0.808
2020	36,557,070	22,891,547	1,991,187	61,439,804	0.796
2025	45,169,024	26,674,415	2,468,900	74,312,338	0.779
2030	59,913,638	33,609,327	3,286,797	96,809,761	0.765

A substitution of coal and diesel oil according to the described scenario would require a biomass supply of 0.4 megatonnes palm kernel shell, 6.0 megatonnes rice husk, 1.5 megatonnes wood residues/saw dust and a supply of municipal waste of 1.1 megatonnes in 2030. For the calculation of the biomass/ non-biomass alternative fuel demand, lower heating values have been assumed according to the Project

Design Documents of PT. Holcim Indonesia and PT. Indocement: palm kernel shell 0.02TJ/ t, rice husk 0.0124TJ/ t, wood residue/saw dust 0.098TJ/t, municipal waste (non-biomass fraction) 0.01TJ/t, waste oil 0.02TJ/t, coal 0.22TJ/t, diesel oil 0.045TJ/t.

The table shows clearly, that this scenario is only feasible, if biomass supply to the industry can be ensured. Since a significant amount of biomass is currently exported, the cement industry's demand for biomass according to the Alternative-Fuel scenario will be greater than the supply in 2030, if cement production grows as predicted.

The collection of biomass might also lead to higher transportation costs and higher CO_2 emissions from transportation. Hence new cement factories are likely to remain close to sites of raw material extraction due to the transportation costs. To estimate the difference between transporting fossil fuels and transporting biomass/non-biomass alternative fuels regarding costs and GHGe for existing cement factories, factory locations have to be studied in further detail.

Table 3-8: *Cement Industry – Fuel demand under Alternative-Fuel scenario 2008 - 2030*

Demand of biomass/ non-biomass	Palm Kernel Shell	Rice Husk	Wood residues/ saw dust	Municipal waste (non-biomass)
	[t]	[t]	[t]	[t]
2008	-	-	-	-
2014	82,120	794,711	335,184	164,240
2020	108,460	1,749,348	664,038	433,838
2025	268,020	3,242,178	1,093,959	804,060
2030	355,510	6,020,740	1,451,063	1,066,531
Estimated biomass potential in Java, Sumatra, Kalimantan, Sulawesi, Maluku, Irian Jaya Source: [ZREU, 2000]	1,200,000	12,000,000	7,300,000	

3.5.7 Calculating Blended-Cement Scenario

This scenario reflects the reduction of the average clinker-to-cement-ratio from 0.9t clinker/ t cement in 2008 to 0.87t clinker/ t cement in 2014, 0.85t clinker/ t cement in 2020, 0.80t clinker/ t cement in 2025 and finally 0.75t clinker/ t cement in 2030. According to ASI, the access to and quality of raw materials (which will be used as additives for blending) depend on the location of each cement plant. For some plants this will lead to a higher effort for raw material preparation (e.g. drying of raw material). It is expected therefore, that the use of self-generated electricity and related expenses will increase.

Reducing the clinker content in the produced cement will result in a total emission reduction of 4.9% p.a. (3.1 megatonnes CO_2 p.a.) in 2020 and almost 15% p.a. (15.67 megatonnes CO_2 p.a.) in 2030. Emission intensity will decrease to 0.790t CO_2/ t cement in 2020 and 0.705t CO_2/ t cement.

Table 3-9: *Cement Industry – GHGe under Blended-Cement scenario 2008 – 2030*

(t CO2)

Year	Emissions: Calcination	Emissions: Fossil fuel combust.	Emissions: Use of grid-supplied electricity	Emissions: Total	Emissions intensity per t cement
2008	20,150,488	14,138,093	1,077,070	35,365,651	0.832
2014	26,809,021	18,947,464	1,470,711	47,227,196	0.807
2020	34,613,622	24,605,103	1,928,626	61,147,351	0.790
2025	40,325,243	29,005,985	2,312,976	71,644,205	0.748
2030	50,190,531	36,590,789	2,973,805	89,755,125	0.705

3.5.8 Conclusion

It can be assumed that new production capacity to meet the growing demand for cement will be met by the Best Available Technology (BAT) for carbon emissions reduction, if an according policy had been implemented as suggested later in this document. This means that even though total cement industry emissions will rise between 2010 and 2030, the emissions intensity of cement production in Indonesia will fall. The following table shows the emission intensity that can be achieved, if all three discusses scenarios are combined.

Table 3-10: *Cement Industry – GHGe under combined scenarios 2008 – 2030*

(t CO2)

Year	Emissions: Calcination	Emissions: Fossil fuel combust.	Emissions: Use of grid-supplied electricity	Emissions: Total	Emissions intensity per t cement
2008	20,150,488	14,138,093	1,077,070	35,365,651	0.832
2014	26,809,021	17,075,073	1,435,099	45,319,194	0.774
2020	34,613,622	20,557,949	1,835,124	57,006,695	0.737
2025	40,325,243	21,774,358	2,150,357	64,249,959	0.670
2030	50,190,531	24,415,709	2,696,397	77,302,638	0.607

The targeted reduction of emission intensity via the implementation of energy efficiency measures, the use of alternative fuel and increase of cement blending will have been achieved by 20% to 35% of the Indonesian cement companies in 2014, by 35% to 60% of the Indonesian cement companies in 2020 and by all Indonesian cement companies in 2030.

Table 3-11: *Cement Industry – Percentage of Indonesian cement companies achieving targets of different scenarios 2014 - 2030*

	Energy Efficiency	Alternative Fuel	Blended Cement
2014	35%	35%	20%
2020	60%	50%	35%
2025	80%	80%	65%
2030	100%	100%	100%

Figure 3-14 shows an ambitious but achievable abatement goal in the order of 11% p.a. (7.3 megatonnes CO_2e p.a.) by 2020 and 27% p.a. (28.1 megatonnes CO_2e p.a.) by 2030 using the three scenarios described above and without any major technological advancement (i.e. new kiln technology for lower temperature treatments, carbon capture and storage, emerging cement technology that sequesters CO_2 as part of the bonding process in cement). It is assumed that the price of fossil-fuel energy rises quicker than that of biomass and that the price of CERs and other tradable carbon commodities increase over this period, further driving efficiency demands, alternative fuels and blending practices in the cement industry.

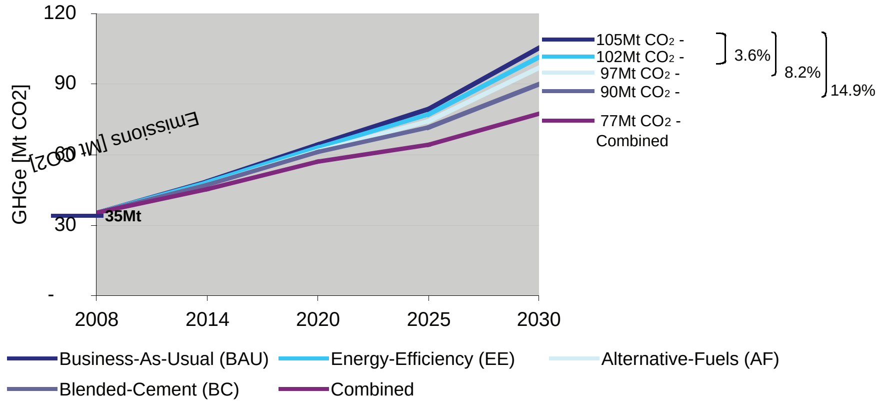

Figure 3-14*: Cement Industry - Total Estimated Abatement Potential 2008 - 2030*

Other analyses show that the Industry Sector Roadmap goal is possible for Indonesia[18]. According to HeidelbergCement Group, the market share of blended cements is 50% in Germany, 47% in India[19] and 13% in Indonesia [PDD BC PT. Indocement, 2006].

The same report shows that dried sewage sludge and shredded plastic have proven excellent alternative fuels in Europe with the Netherlands (72%), Germany (30%) and Belgium (30%) demonstrating that it is technologically feasible to co-fire the furnace with waste materials. In Germany alone, the use of alternative fuels in the cement industry has grown from 4.1% in 1987 to around 35% in 2002. The majority alternative fuel used is animal meal/bone meal/animal fat at 760 megatonnes p.a., despite its low calorific value (24Mj/ kg) compared with 500 megatonnes of tyres (26Mj/ kg) and 380 megatonnes of waste oil/oiled water (33Mj/kg). 530 megatonnes of hazardous waste is also used with approximately 22Mj/ kg [CEMBUREAU, 2009].

In order to more precisely understand the future potential for emissions abatement from the cement industry, these figures will need to be tested against a range of other data and trends including but not limited to:

- *Discussions with national and international cement efficiency managers;*
- *Agricultural waste suppliers for Indonesia and the future competing uses of biomass in Indonesia;*
- *Water availability for industry and agriculture;*
- *Future energy prices, particularly for coal and gas;*
- *Future landfill pricing and policies;*
- *Future policies for the management of hazardous waste; and*
- *Government procurement policies including PPC rather than OPC where appropriate and recycled concrete.*

[18] According to HeidelbergCement Group, reduction in the German Cement Industry between 1990 and 2012 was estimated at 36%, comprising blended cements (5%), alternative fuels (24%) and process optimization (5%).

[19] It took about five years in India to increase the blended cement share to 47% (1999-2003).

3.6 Technology costs

For each of the discussed GHGe mitigation scenarios the abatement costs in terms of cost per tonne of GHGe reduced will be estimated in the following. Each mitigation option is characterized by its capital, operation and maintenance costs and cost savings. These parameters are used to calculate the abatement costs, which represent the price of one tonne of CO_2 at which Indonesian cement companies would be financially indifferent as to whether or not to implement an option. At negative abatement costs, companies will implement mitigation options cost-effectively while simultaneously reducing emissions. At positive abatement costs, companies might only consider an option worthwhile if some external value were "attached" to the emission reductions. This value might be in the form of tax relief, rebates, or other government-offered incentives, or it might be associated with emission reductions through the application of regulations limiting GHGe. Abatement costs are determined using a discounted cash-flow analysis where cost savings are equal to the costs. Based on the assumptions and projection of GHGe mitigation potential described in the former chapters a technology abatement cost assessment was drafted.

Energy costs were assumed to be 50USD/tonne coal, 75USD/barrel oil, 25USD/tonne biomass and 0.08USD/kWh electricity of PLN[20].

Capital costs supposed for the Energy-Efficiency scenario are based on studies of GHGe mitigation options in Mexican and Brazilian cement industry. One-time costs associated with installations are assumed to be 4.00USD/tonne cement capacity for high efficiency grinding technologies, 0.20USD/tonne cement capacity for high efficiency motors, 1.00USD/tonne cement capacity for adjustable speed drives and 2.00USD/tonne cement capacity for high efficiency classifiers. Ideally all of these technologies will be implemented [ICF, 2009].

Capital costs assumed for the Alternative-Fuel and Blended-Cement scenario are based on current CDM projects of Indonesian cement companies[21]. PT. Holcim reported a total investment of 29.55million USD for implementing its alternative fuel project in 2 factories [PDD AF PT. Holcim, 2006]. This also includes installations counted among energy efficiency measures in the Industry Sector roadmap. PT. Indocement invested 15.75million USD into the use of alternative fuel in the companies' 3 factories [PDD AF PT. Indocement, 2006]. Abatement costs in this Industry Sector roadmap are therefore based on an average investment of 8.00million USD per factory for installing alternative fuel use technology.

Blending cement required an investment of 35.60million USD for PT. Indocement's 3 factories [PDD BC PT. Indocement, 2006], approximately 11.87million USD per factory.

For all scenarios annual costs are constrained to operation and maintenance costs, which equal to 5% of the one-time cost associated with the specific technologies.

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[20] *Conversion into USD using an exchange rate of 9,500IDR/USD*

[21] *Conversion into USD using an exchange rate of 1.45USD/EUR*

According to the calculation the Blended-Cement scenario offers the least cost intense option to reduce GHGe mitigation in cement industry, followed by the Alternative-Fuel scenario and finally by the implementation of energy efficiency measures. Without taking cost savings such as e.g. reduced fuel consumption into consideration, cumulated costs for GHGe mitigation as suggested for the Indonesian cement industry will equal 276.70million USD until 2020 and 494.54million USD until 2030. Since significant cost savings from reduced fossil fuel consumption are expected for all scenarios during the course of the project, abatement costs will be reasonable for Energy-Efficiency scenario and even negative for Alternative-Fuel and Blended-Cement scenario. Still these cost savings cannot be achieved yet at the beginning of an GHGe mitigation project and cement companies will still face the project barrier of raising upfront capital. Therefore a decision for such investments is only likely, if financial assistance is provided for upfront capital and the policy framework ensures reliable alternative raw material/ -fuel supplies at stable prices over the short and long term (please take therefore the proposed policies into particular consideration).

Cumulative GHGe according to Business-As-Usual scenario are 562.96megatonnes of CO2 between 2010 – 2020, respective 1,400.67megatonnes CO2 between 2010 – 2030. The following table summarizes for each scenario its costs, GHGe mitigation potential, proposed policies and barriers.

Table 3-12: *Matrix of greenhouse gas emissions mitigations actions feasible for Indonesian cement industry*

Scenario	*Period*	*Cumulative Emission Reduction (Mt CO2)*	*Total Mitigation Cost (million USD)*	*Abatement Cost (USD/t CO2)*	*Emission Reduction compared to*	*Required policies*
Energy-Efficiency scenario (EE)	*2010 – 2020* *2010 – 2030* *2010 – 2020* *2010 – 2030* *(w/o fuel savings)*	*7.16* *32.19*	*115.65* *134.24* *216.56* *361.45*	*16.16* *4.17*	*1.27* *2.30*	*(A) Climate Change Cooperative Agreements, (B) No-regrets implementation of energy audits/ savings plans, (C) Capacity build ESCOs, (I) MRV of GHGe data at plant level, (J) BAT for new cement plants, (K) Award System for GHGe successes, (L) General Finance Instruments for upfront capital, (M) ICCTF, (N) Accelerated depreciation/ Reduced tax for green technologies, (O) Flexible Mechanisms (PoA/ CDM)*
Alternative-Fuel scenario (AF)	*2010 – 2020* *2010 – 2030* *2010 – 2020* *2010 – 2030* *(w/o fuel savings)*	*17.45* *73.75*	*10.74* *24.83* *24.22* *52.47*	*0.62* *0.34*	*3.10* *5.27*	*(A) Climate Change Cooperative Agreements, (C) Capacity build ESCOs, (D) Increase landfill levies over time, (E) Review hazardous waste register, (F) Supportive export/import tariffs for waste, (I) MRV of GHGe data at plant level, (J) BAT for new cement plants, (K) Award System for GHGe successes, (L) Gen. Finance Instruments for upfront capital, (M) ICCTF, (N) Accelerated depreciation/ Reduced tax for green technologies, (O) Flexible Mechanisms (PoA/ CDM)*

Scenario	Period	Cumulative Emission Reduction (Mt CO2)	Total Mitigation Cost (million USD)	Abatement Cost (USD/t CO2)	Emission Reduction compared to	Required policies
Blended-Cement scenario (BC)	*2010 – 2020* *2010 – 2030* *2010 – 2020* *2010 – 2030* *(w/o fuel savings)*	*18.50* *108.62*	*(20.48)* *(107.74)* *35.92* *80.62*	*(1.11)* *(0.99)*	*3.29* *7.76*	*(A) Climate Change Cooperative Agreements, (C) Capacity build ESCOs, (D) Increase landfill levies over time, (E) Review hazardous waste register, (F) Supportive export/import tariffs for waste, (G) Set new cement standards, (H) Recycled materials content standard/ Green gov procurement, (I) MRV of GHGe data at plant level, (K) Award System for GHGe successes, (L) Gen. Finance Instruments for upfront capital, (M) ICCTF, (N) Accelerated depreciation/ Reduced tax green technologies, (O) Flexible Mechanisms (PoA/ CDM)*

4

Indonesia's Secondary Key Industries

4.1 Overview

4.1.1 Iron & Steel

In 2007, the global production of steel was 1,351million metric tonnes. The biggest steel producers were China (37%), EU-25 (15%) and Japan (9%). The World Steel Association (worldsteel) ranked Indonesia as the 37th among the world's major steel producing countries in that year. Since the country imported almost as much as it produced according to the same statistic, Indonesia was furthermore counted as the 12th largest net importer of steel worldwide in 2007 [Worldsteel, 2009].

Indonesia's National Industry Development Policy, which has been established in Presidential Decree No. 28/2008, is aimed to strengthen competitiveness of the manufacturing industries and to enhance their production capacity. The long term plan to achieve that goal focuses (among other objective) on the establishment and development of Indonesian iron & steel industry with a capacity of 20 megatonnes p.a. by implementing technologies such as blast furnace technology (or other proven technologies), iron-making process technology with a capacity of 10 megatonnes p.a. (based on coal and local iron ore), steel melting technology with integrated slab, hot rolling coil (HRC) and cold rolling coil (CRC) with a capacity of up to 0.6 megatonnes p.a. (based on iron ore and chrome available on the islands of South Kalimantan and South Sulawesi).

Global steel industry's GHGe are estimated to be up to 1600 megatonnes CO_2e, including emissions from coke manufacture and indirect emissions due to power consumption. Emissions produced per tonne of steel (emissions intensity) vary widely between countries:

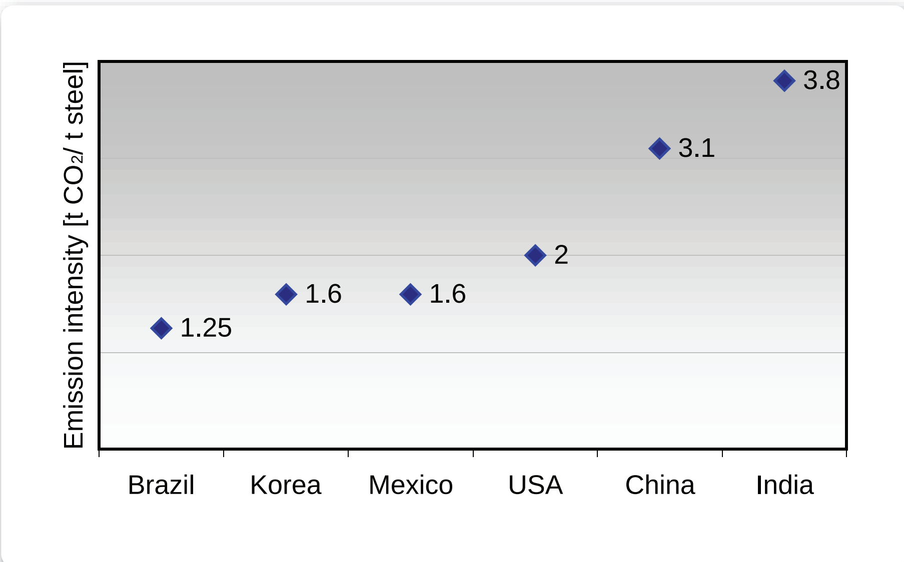

Figure 4-1: *Examples of Emission Intensity in Steel Production*
Source: [IPCC, 2007]

The differences in emissions intensity are based on the production routes used, product mix, production energy efficiency, fuel mix, emissions intensity of the fuel mix, and emissions intensity of electricity [IPCC, 2007].

Iron and steel production is one of the most energy-intensive industries, using fossil fuels for energy utilisation and as reductors in the production process. Three routes are used to make steel. In the primary route (about 60%), iron ore is reduced to iron in blast furnaces using mostly coke or coal then processed into steel. In the second route (about 35%) scrap steel is melted in electric-arc furnaces to produce crude steel that is further processed; this process uses only 30% to 40% of the energy of the primary route, with GHGe reduction being a function of the source of electricity. The remaining steel production (about 5%) uses natural gas to produce direct reduced iron (DRI). DRI cannot be used in primary steel plants and is mainly used as an alternative iron input in electric arc furnaces which can result in a reduction of up to 50% in GHGe compared with primary steel making [IPCC, 2007].

According to the Ministry of Industry, Indonesia ranges among the countries with highest emission intensity in steel production. Emission intensity is even assumed to increase under the BAU scenario — without the implementation of energy conservation measures [TNA, 2009].

In 2007, 71 steel producers were operating in Indonesia with a total production capacity of 15.4 megatonnes of steel p.a. The largest company is PT. Krakatau Steel contributing almost 25% of the country's total steel production capacity[22]. The Ministry of Industry projects steel production to rise up to 77 megatonnes p.a. in 2025 [TNA, 2009]

The IPCC's Working Group III to the 4th Assessment Report (AR4) mentions energy conservation potential in steel production as (1) energy audits/energy management systems to increase energy efficiency, (2) fuel switching and (3) recycling.

Energy audits/energy management systems

According to AR4 energy audits and management systems need to be used in steel plants to identify opportunities for reducing energy use, which in turn reduces GHGe. Approximately 10% of total energy consumption in steel making could be saved through improved energy and materials management. The potential for energy efficiency improvement varies between steel plants based on the production route used, product mix, energy and emissions intensities of fuel and electricity, and the boundaries chosen for the evaluation [IPCC, 2007].

[22] The production process of the company relies mostly on electricity as an energy source (55 %), followed by natural gas (42%), and refinery products (4%).Electricity is used during steel making (74%), rolling (21%), and iron making (5%). While natural gas is used during iron making (84%), followed by rolling (11%), and steel making (5%) [TNA, 2009].

Fuel switching

Fuel switching, including the use of waste materials, is mentioned as an energy conservation measure for the steel industry. Technology to use wastes such as plastics as alternative fuel and feedstock for steel production has already been developed. Pre-treated plastic wastes can be recycled in coke ovens and blast furnaces, reducing GHGe by reducing both emissions from incineration and the demand for fossil fuels [IPCC, 2007].

Recycling

Recycling is the best-documented material efficiency option for the industry sector and is used in steel production already. Recycling of steel in electric arc furnaces accounts about a third of world production and typically uses 60–70% less energy [IPCC, 2007].

In the frame of its Energy Conservation Program the Ministry of Industry plans to focus on energy efficiency measures. For the increase of energy efficiency in the steel industry the Ministry planned to invest USD236.6m on the (1) utilization of coal gasification, (2) change of electric furnace technology and (3) reheating fuel furnaces [TNA, 2009].

According to a case study[23] undertaken by the Japan International Cooperation Agency (JICA) at an Indonesian steel plant the energy conservation potential of these technologies was estimated 25% (electric arc furnace) and 40% (reheating fuel furnaces) respectively [JICA, 2009]. For the study the production process and technology used in the audited plant in Indonesia was compared with plants operating in Japan. Japan's steel production is already efficient and is ranked as 3rd largest producer of crude steel worldwide [Worldsteel, 2009].

The same study suggests providing three separate approaches to reduce energy consumption up to 30% until 2025 [JICA, 2009].

- *1st Approach (2005 – 2015) - Energy management and operation improvement (production yield) require almost no investment and will reduce the energy consumption by 12%;*
- *2nd Approach (2015 – 2020) – Modification of equipment requires relatively small investment and will reduce the energy consumption by 5%; and*
- *3rd Approach (2020 – 2025) – Replacement of technology and change of processes requires high investment, but will reduce the energy consumption by 13%.*

[23] Results of PT. Krakatau Steel's energy conservation program could also serve as a case study. The company is the largest Indonesian steel producer. Its energy conservation program involves three phases. During the first phase energy efficiency measures in the steelmaking process have been implemented as well as fuel substitution in hot rolling mills took place. During a second phase fuel will be substituted in cold rolling mills too, besides the implementation of an energy control centre, coal gasification in calcinations plants, etc. The third phase is still in the planning process [TNA, 2009].

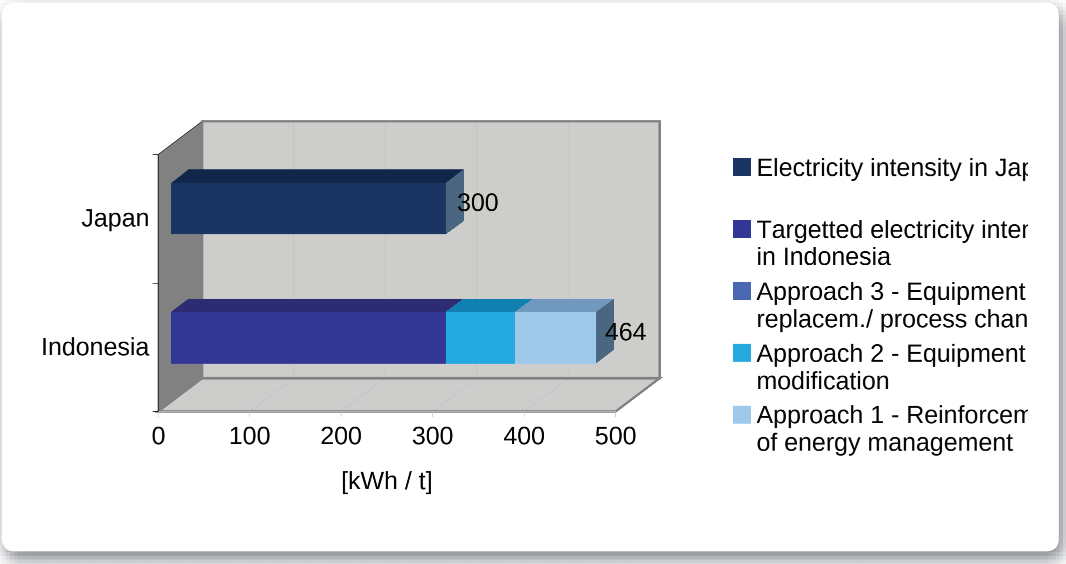

Figure 4-2: *Energy conservation potential in a steel plant - Electric Arc Furnaces Source: [JICA, 2009]*

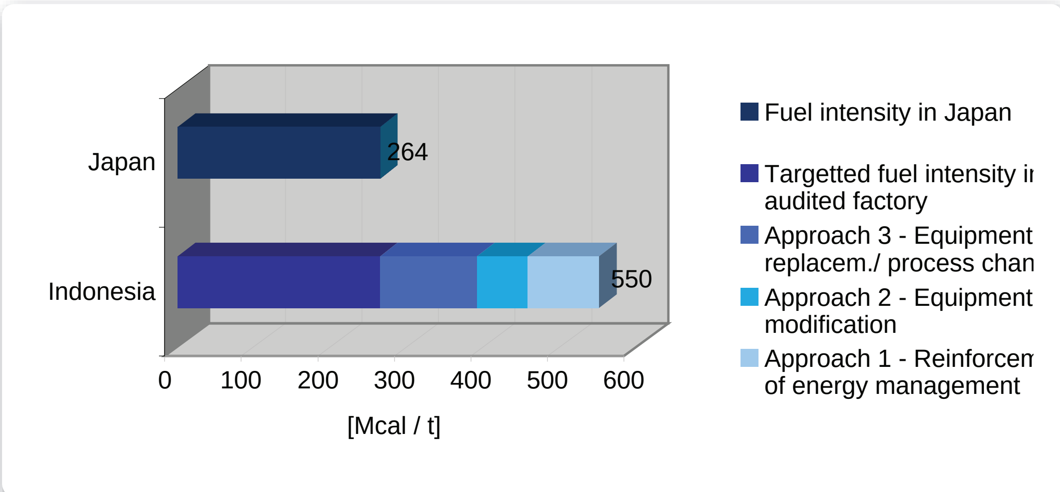

Figure 4-3: *Energy conservation potential in a steel plant - Furnace Reheating in Rolling Mills Source: [JICA, 2009].*

The stages of implementing potential energy conservation measures and GHGe reduction in Indonesian iron & steel industry are listed below:

Policy	2010-2015	2015-2020	2020-2030
Energy Efficiency	• Preheating furnace for 71 Industries • Improvement of preheating process • Smelt reduction • Development of optimized electrical furnace	• Recyling of product and its waste • Improvement of processs fuzzy based preheating process	• Dry coke quenching • Hydrogen Reduction and O2 Consumption on blast furnace • Scrap preheating
Alternative Energy	• Product gas combine cycle (coal) • Initiation of biomass utilization • Initiation of biogas consumption	• Product gas combine cycle (incl. biogas)	

Figure 4-4: *Implementation of energy conservation technology in the iron & steel industry*
Source: Ministry of Industry

4.1.2 Pulp & Paper

Pulp & paper production is a highly diverse, increasing global industry and belongs to the energy-intense industries. In 2003, developing countries produced 26% of paper and paperboard and 29% of global wood products[24] [IPCC, 2007].

Eighty-one pulp & paper companies operate in the Indonesian provinces of Riau, Jambi, North Sumatra, South Sumatra, South Kalimantan and East Kalimantan. They had a total production of 17 megatonnes of pulp & paper in 2007. Based on Ministry of Industry forecasts for pulp & paper production will rise up to 55 megatonnes in 2025. In 2005 emission intensity was estimated with 5.57tonnes of CO2 per tonne of pulp & paper produced [TNA, 2009].

[24] *The main paper and board grades are newsprint, printing and writing papers and most important industrial grades. Paper products are made of pulp. There are three main types of pulp: primary pulp (49%), recycled fibre based pulp (47%), non-wood pulp (4%) [WBCSD, 2003].*

Critical issues in pulp & paper production are the sustainable management of forest resources. The industry is heavily dependent on forest resources as a raw material, the large amounts of freshwater, which are needed in the production process, and furthermore emissions from energy generation, wastewater[25] and solid waste [WBCSD, 2003].

Direct emissions from the pulp, paper, paperboard and wood products industries are estimated to be 264 megatonnes CO_2 p.a. The industry's indirect emissions from purchased electricity are less certain, but are estimated to be 130 megatonnes CO_2 p.a to 180 megatonnes CO_2 p.a. [IPCC, 2007].

International best practices for sustainable pulp & paper production include maintaining carbon sinks by sustainable forest management, including logging and replanting, primary and/or secondary wastewater treatment and a continued move from fossil fuels in energy production to biofuels and other renewable energy sources [WBCSD, 2003].

Use of biomass as fuel

The pulp & paper industry is more reliant on biomass fuels than any other industry. In developed countries biomass provides 64% of the fuels used by wood products facilities and 49% of the fuel used by pulp, paper and paperboard mills. The primary biomass fuel in the wood-products industry is manufacturing residuals that are not suitable for use as bi-products. Besides the increased use of biomass and energy efficiency improvements in the pulp & paper industry during the last decades[26], the use of biomass fuels still offers the largest potential to reduce fossil fuel consumption by displacing carbon-intensive electricity from the grid with biomass-based generated electricity [IPCC, 2007].

Use of combined heat and power

The pulp & paper industry is one of the global leaders in the use of combined heat and power (CHP) systems or cogeneration. CHP systems produce electrical power and thermal energy from the same fuel, yielding more usable energy as either power or steam and hence reducing GHGe and the demand for fossil fuels. The pulp & paper industry in some countries derives more than half their energy from CHP systems [IPCC, 2007].

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[25] The pulp & paper industry produces large volumes of wastewater that contain high levels of degradable organics. Besides GHGe from energy use, the industrial sub-sector emits therefore also methane (CH4) from industrial wastewater. The IPCC value of 162 cubic meters of wastewater generated per tonne of produced pulp & paper. Between 0.03 and 0.2 tonne of CH4 would therefore be released per tonne of produced pulp and paper, if no CH4 is recovered for energy generation [IPCC, 2006].

[26] Since 1990, CO2 emission intensity of the European paper industry has decreased by approximately 25%, the Australian pulp and paper industry about 20%, and the Canadian pulp and paper industry over 40%. Fossil fuel use by the US pulp and paper industry declined by more than 50% between 1972 and 2002. Besides these improvement, the technical potential for GHG reduction is estimated further 25% and a cost-effective potential of 14% through widespread adoption of 45 energy-saving technologies and measures in the US pulp and paper industry [IPCC, 2007].

Black liquor gasification

Black liquor is the residue from chemical processing to produce wood pulp for papermaking. It contains a significant amount of bio-energy and is currently being burned as a biomass fuel. Research and development on the gasification of black liquor is currently aimed at increasing efficiency of energy recovery [IPCC, 2007].

Recycling

Recovery rates for waste paper in developed countries are typically at least 50%. A number of studies find that paper recycling reduces life-cycle emissions of GHGe compared to other means of managing used paper. The analyses however are dependent on study boundary conditions and site-specific factors and it is not yet possible to develop reliable estimates of the global mitigation potential related to recycling in the pulp & paper industry [IPCC, 2007].

Inter-country comparisons of energy-intensity in the mid-1990s suggest that fuel consumption by the pulp & paper industry could be reduced by at least 20% in a number of countries by adopting best practices. In Indonesia only a few pulp & paper companies have started to implement the described measures until today [IPCC, 2007].

Case Study – PT. Pindo Deli's Energy Conservation Initiative

Case study 1 - PT. Pindo Deli conducted an energy diversification programme from industrial diesel oil (IDO) to natural gas in the early 1980s. In the following years the company improved its water recovery systems to reduce fresh water, started to use poly disc filters and replaced its refiner blades to reduce electricity demand, implemented a steam trap treatment programme to reduce steam losses, started to recover heat, replaced its regular press with a shoe press roll system to save steam and started to use solid waste to substitute coal as a fossil fuel.

Figure 4-5*: Case Study – PT. Pindo Deli's Energy Conservation Initiative*
Source: [TNA, 2009]

Case Study – PT. Pura Bartama's Alternative Fuel Initiative

Case study 2 - PT. Pura Bartama implemented a project, which partially switches fuel from coal to biomass residues in boilers for electricity and heat generation. The project is registered at the CDM Executive Board of the UNFCCC. The company generates its own electricity and exports electricity to the utility of the state owned electricity provider PLN. In the past electricity has been generated using domestic coal as fuel. Under this project the utilisation of coal will be reduced by burning not coal alone, but also biomass residues, which are available in the surrounding area.

Figure 4-6: *Case Study – PT. Pura Bartama's Alternative Fuel Initiative*
Source: [TNA, 2009]

Based on the results of initiated energy audits, the energy conservation potential of the Indonesian pulp & paper industry is in the range of 10% to 20% of energy consumption reduction. Medium and long-term targets for pulp & paper production have been described in the National Industry Development Plan of the Ministry of Industry and include:

- *The increased use of raw materials from plantation and non-raw wood;*
- *The development of incentives for the use of eco-friendly technology;*
- *The increase of the application of ISO9000 and ISO14000;*
- *The improvement of the pulping- and dyeing process efficiency; and*
- *The use of organic waste and/ or biogas (with waste recycling) as substitutes for fossil fuels.*

The long-term aim is an environmentally adjusted productivity in accordance with generally accepted rules for sustainable forest management (SFM) and reduce energy consumption by using the mentioned methods [DEPPERIN, 2005]. The stages of implementing potential energy conservation measures and GHGe reduction in Indonesian pulp & paper industry are listed below:

Policy	2010-2015	2015-2020	2020-2030
Energy Efficiency	• Efficiency on pulping process • Boiler efficiency • Efficiency on drying process • Shoe press usage	• Recyling of product and its waste • Condebelt drying	• Increase efficiency of technology/ process via modification
Alternative Energy	• Initiation of biogas utilization	• Gasification process (natural gas) with black liquor	

Figure 4-7: *Implementation of energy conservation technology in the pulp & paper industry*
Source: Ministry of Industry

4.1.3 Textiles

The textile industry belongs to the less energy-intensive industry, but runs one of the longest production chains in manufacturing industry. The fragmentation and heterogeneity of its outputs makes it difficult to classify industrial practices and to compare Indonesian practices with international norms. Products are numerous and depend on the type of fibres used, the density and quality of the thread, the colours and the process being operated.

In Indonesia the textile industry ranks among the most important industries due to its size, encompassing more than 4000 medium- and large-scale textile factories. Centres of textile production are West Java, Yogyakarta and East Java.

GHGe from textile production are expected to increase by approximately 50% until 2025, if the industry continues to produce with the currently used old and inefficient technology. According to the working group on technology transfer, which accomplished the "Technology Needs Assessment on Climate Change Mitigation", the average GHGe to produce one tonne of textiles was 2.47 tonnes CO_2e *in 2005. Assuming that energy efficiency measures will not be undertaken in the near future, this figure will even increase until 2025 [TNA, 2009].*

Since textile is such a large industry in Indonesia and data collection is a challenging task, the mentioned figures represent the average of the industry's GHGe. More detailed information, clarifying the contribution of each of the textile industry's sub-sectors, has to be collected (by process and by different types of factories). For calculating the electricity and heat consumption in detail, the four main activities *of the production process have to be analysed:*

spinning[27], weaving and knitting[28], wet processing[29] and stitching (sewing)[30] [Energy Manager, 2008]. Besides CO_2 from energy use, the textile industry also releases methane (CH_4) from industrial wastewater of the production process.

"The Study on Energy Conservation and Efficiency Improvement in the Republic of Indonesia" suggests dividing the implementation process for energy efficiency and conservation aiming a reduction of energy consumption up to 30% until 2025 [JICA, 2009]:

- *1st Approach (2005 – 2015) - Energy management and operation improvement require almost no investment and will reduce the energy consumption by 10%.*
- *2nd Approach (2015 – 2020) – Modification of equipment requires relatively small investment and will reduce the energy consumption by 5%*
- *3rd Approach (2020 – 2025) – Replacement of technology and change of processes requires high investment, but will reduce the energy consumption by 15%*

In focus of the study is especially the dyeing process. According to the estimations the textile industry could save almost 20% of the currently used energy - mainly through heat recovery in the dyeing process [JICA, 2009].

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[27] *Spinning: The production from fibres to spun yarn takes place through the spinning process and constitutes the first stage. Spinning involves opening/blending, carding, combing, drawing, drafting and spinning. It uses four types of technologies: ring spinning, rotor spinning, air jet spinning and friction spinning. The advantage of ring spinning is, that it can be widely adapted for spinning different types of yarn [Energy Manager, 2008].*

[28] *Weaving: After spinning the yarn is weaved to make fabrics in looms. The two main technologies used during the weaving process are shuttle and shuttleless. Shuttleless has higher productivity and produces better quality of output [Energy Manager, 2008].*

[29] *Wet processing: Most woven fabrics retain the natural colour of the fibres from which they are made and are called "grey fabrics" at this stage. These fabrics then undergo several different processes including bleaching, printing, dyeing and finishing; these are grouped under the category of wet processing, which is the third stage. It covers all processes in a textile unit that involve some form of wet or chemical treatment. The wet processing process can be divided into three phases: preparation, coloration, finishing. It uses different types of technologies depending on the type of yarn/ fabric that are dyed. Jigger, winch, padding, mangle and jet-dyeing are some of the important dyeing machines. Similarly, there are different types of printing: direct printing, warp printing, discharge printing, resist printing, jet printing, etc [Energy Manager, 2008].*

[30] *Stitching: Finally, the stage from fabrics to garments is done by stitching [Energy Manager, 2008].*

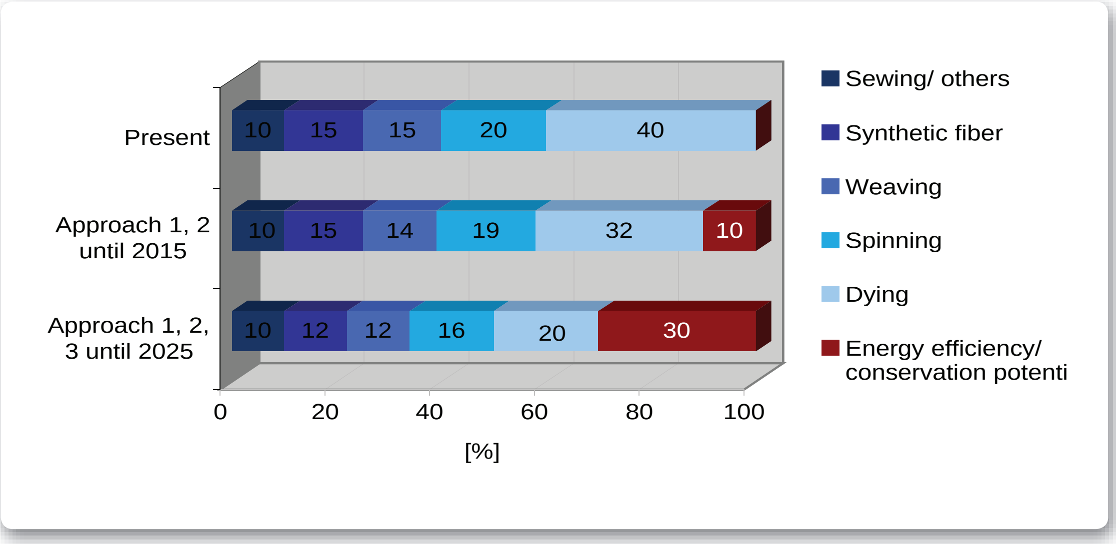

Figure 4-8: *Energy efficiency and conservation potential in the textile industry*
Source: [JICA, 2009]

The textile industry faced various economic barriers, which inhibited the implementation of mentioned measures. Textiles belong to the 5 major export products with a growth rate of 5.5% in 2008. The main export partners are Japan, United States (U.S.), Singapore, China, Republic of Korea, India and Malaysia. Due to the U.S. recession and the weak demand on the export market[31], banks began to be more selective in extending credits. Although in 2008 they showed stronger confidence in textile industry especially after the government offered incentives for export oriented industries, some banks do not risk to provide credits anymore for the textile industry.

Access to the market of the European Union (EU) on the other hand necessitates the supply of technical data of Indonesian textile companies in order to gain required certificates. Although the Ministry of Industry already cooperates with European Union Trade Support Program to fulfil this requirement, the Indonesian textile industry still relies on the mentioned export partners.

[31] *Until 1995 import quotas on textile were negotiated bilaterally and governed by the rules of the Multifibre Arrangement (MFA). The idea behind these quotas was, that the import of particular products would not cause damage to the industry of the importing country. In 1995 the Multifibre Arrangement was replaced by the World Trade Organization's Agreement on Textiles and Clothing (ATC), which is a transitional instrument aiming to gain distance to these quotas. Hence the textile faced a more intense competition, which in some regions already led to a shift towards more capital-intensive machinery. Electric energy consumption is expected to continue to rise over time due to increasing automation and higher running speeds for machines.*

4.1.4 Fertilizer and other chemical products

The chemical industry is highly diverse with thousands of companies producing tens of thousands of products in quantities varying from a few kilograms to thousand of tonnes. The chemical industry belongs to the energy-intense industries worldwide with a high contribution to global GHGe. According to the International Energy Agency (IEA) the share of industrial energy used for ammonia, ethylene, propylene and aromatics production (worldwide) has increased from 6% to 15% between 1971 and 2006 [IEA, 2007] and hence belongs to the top energy consumers in industry nowadays.

Among the different groups of chemical producers the key sub-sectors for the Indonesian Ministry of Industry is the petrochemical industry. Currently the Indonesian petrochemical industry's share of world's petrochemical industry's total production is around 0.5% to 1.5%. Although domestic demand is large and growing, it cannot met by domestic production alone. Therefore a high volume of products is imported. The Ministry of Industry sets targets for developing the petrochemical industry in its National Industrial Development strategy. In the medium-term it is expected that olefin, aromatic and petrochemical industry capacities will increase. The long-term objective is to meet the growing domestic olefin demand of 10% to 20% p.a. The regions focused on the development of the petrochemical industry are Banten, East Java and East Kalimantan [DEPPERIN, 2005].

Despite the planned economic development of the petrochemicals industry, energy conservation targets have also been set. Having not only industrial sub-sectors e.g. fertilizer industry, which operate the latest available technology in their production process, but also companies running old machinery, the Ministry of Industry estimates the energy conservation potential in the petrochemical industry in Indonesia to be 12% to 17% [TNA, 2009]. Data to access the current situation and the progress regarding GHGe mitigation of Indonesian chemicals producers is not available to the required extent though.

Separations, chemical synthesis and process heating are the major uses of energy in the chemical industry. The following sub-sectors have been identified as the top energy users in the chemicals industry [IPCC, 2007]: (1) Ethylene, (2) Fertilizer, (3) Chlorine, (4) Adipic Acid, (5) Nitric Acid, (6) Caprolactam, (7) HCFC-22.

According to IPCC drastic reductions are possible. Various energy efficiency and GHGe mitigation options are known and could be applied by the different groups and classes of chemicals producers. Many of the mentioned cross-sectoral technologies are already implemented by globally operating chemical companies [IPCC, 2007] [32].

[32] *Process integration and cogeneration of heat and electricity have also been applied, e.g. in the petrochemical industry and petroleum refining. If both industries are co-located, they can make use of the energy in bi-products that would otherwise be vented or flared [IPCC, 2007].*

The following figure shows the progress made in the EU between 1990 and 2006 by implementing energy conservation measures. Although production increased steadily energy consumption and GHGe could be reduced. Energy intensity, which is measured by energy input per unit of chemical product, could be reduced by 54% over the mentioned period of time.

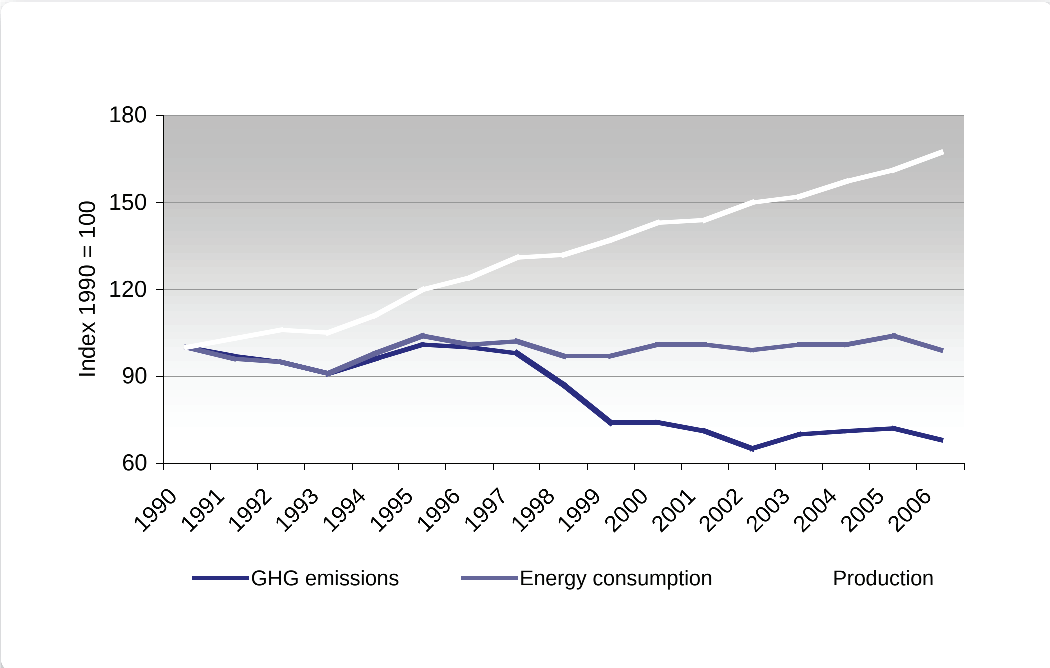

Figure 4-9: *EU chemicals industry GHG emissions, energy consumption and production*
Source: [CEFIC, 2009]

The United Nations Environment Programme (UNEP) in cooperation with the Swedish International Development Cooperation Agency (SIDA) launched a project in 2003, that focused on "Greenhouse Gas Emission Reduction from Industry in Asia and the Pacific" (GERIAP). As a preparation for the project a survey on barriers to implement energy conservation measures in industry in the Asia Pacific region was handed to the 40 participating companies from the cement, chemicals, ceramics, iron & steel and pulp & paper industry in Asia. As barriers for improving energy efficiency at their companies, chemical producers in Asia answered:

- *Environmental policies and legislation relating to energy are weak*
- *It is difficult to obtain financing for energy efficiency projects*
- *Authorities are not strict in enforcing environmental regulation*
- *There is a lack of coordination between external organizations*
- *The Government does not give financial incentives to become energy efficient.*

4.2 Greenhouse Gas Emissions and Mitigation Potential

4.2.1 Methodology

In its revised 2006 "Guideline for National Greenhouse Gas Inventories", the IPCC categorises GHGe from manufacturing industries into GHGe from energy use, GHGe from industrial processes and GHGe from industrial waste [IPCC, 2006]. This chapter covers GHGe from energy use (stationary combustion) only applying IPCC methodology. Therefore the following formula is applied.

$$\text{Emissions}_{GHG,\,fuel} = \text{Fuel Consumption}_{fuel} * \text{Emission Factor}_{GHG,\,fuel}$$

Where:

Emissions $_{GHG, fuel}$	*Emissions of a given GHG by type of fuel [kg GHG]*
Fuel Consumption $_{fuel}$	*Amount of fuel combusted [TJ]*
Emission Factor $_{GHG, fuel}$	*Default emission factor of a given GHG by type of fuel [kg GHG/TJ]*

Figure 4-10*: Energy use: GHGe from stationary combustion*

Source: [IPCC, 2006]

4.2.2 Data Sources and Limitations

In projecting energy consumption, forecasting methods are applied in this Industry Sector Roadmap, which use aggregated industry sector energy consumption data. Such data on energy consumption has been received from the Central Statistics Agency (BPS) and the Ministry of Energy and Mineral Resources. For the purpose of this Industry Sector Roadmap, it has been supplemented by Expert Judgement and reviewed by members of the MARKAL team of the Agency for the Assessment and Application of Technology (BPPT). MARKAL is an optimisation model, which is used by many countries and institutions to identify configurations of energy systems, which minimize the total cost of providing energy services. This cost-minimization is performed within constraints e.g. limits on CO_2 *emissions, technology availability, etc. The MARKAL model can be used to evaluate new technologies and priorities for Research and Development, to estimate the effects of regulations, taxes and subsidies and to project inventories of GHGe. For this Industry Sector Roadmap the MARKAL team of BPPT provided its energy consumption projections for the years 2005 to 2030.*

Certain key variables and assumptions have not been taken into consideration though, which can have a significant effect on the projection of future emissions.

4.2.3 Key assumptions

1. *GDP growth rate 2005 - 2010 is assumed to be around 5% p.a., and 2011 - 2030 around 7% p.a. (as stated in in the key assumption for cement industry in chapter 3.5.4).*
2. *According to the National Industrial Development Policy, growth in the industry sector is projected at an average annual rate of 8.58% for 2005 to 2009 [DEPPERIN, 2005]. In detail the Ministry of Industry predicted the following growth rates for cement industry and other manufacturing industries in 2009 (predictions are based on reference year 2004):*

Table 4-1: *Industry Sector – Annual Growth 2005 - 2009*

	Industry	Growth rate p.a. in 2009 (%)
1	Cement and other non-metallic minerals	10.13
2	Iron & steel and other basic metals	3.94
3	Pulp & paper	7.82
4	Food, beverages & tobacco	4.59
5	Textiles	6.65
6	Fertilizer and other chemical products	10.63
7	Transports, machinery & tools	12.46
8	Wood & wood products	4.91
9	Others	10.20
	Total	8.58

Source: Ministry of Industry

While projecting industrial growth up to 2030, some industries have experienced the impact of the economic crisis and had a growth rate that followed the national economic growth rate of only 5%. Assuming that the economic growth is still below what was expected, then the average growth rate of manufacturing industries after 2010 period is adjusted to a lower figure of 7% p.a.

3. **Business-as-Usual scenario**: *Each 5% of production increase will raise the energy consumption rate for production processes in the Business-as-Usual (BAU) scenario, which describes the energy consumption development without technology intervention.*

Table 4-2: *Industry Sector - Formula for Energy Consumption Projection in BAU scenario*

Fossil fuel		Applied formla
Diesel oil	=	*Fuel consumption* $_{Diesel\ oil,\ 2005}$ $* (1 + 20\%)^{exp5\%,(7\%)*}$
Coal	=	*Fuel consumption* $_{Coal,\ 2005}$ $* (1 + 40\%)^{exp5\%,(7\%)*}$
Natural gas	=	*Fuel consumption* $_{Natural\ gas,\ 2005}$ $* (1 + 50\%)^{exp5\%,(7\%)*}$

4. **Energy-Efficiency scenario**: *Energy consumption growth reflects the National Energy Policy targets for 2030 (Presidential Decree No. 5/2006). The implementation of National Energy Policy targets will lead to energy efficiency improvements in production processes. The effects can be summarized as follows:*

Table 4-3: *Industry Sector - Assumptions for Energy Consumption Projection*

Business-As-Usual scenario (BAU)	Share of fuel mix (%)	Energy-Efficiency scenario	Share of fuel mix (%)*
Fuel oil	+20	*Fuel oil*	-20
Coal	+40	*Coal*	+33
Natural gas	+50	*Natural gas*	+30

Note : Sign (+) represents increase, Sign (-) represents decrease

** target in accordance with Presidential Decree on National Energy Policy*

Table 4-4: *Industry Sector - Formula for Energy Consumption Projection in Energy-Efficiency scenario*

Fossil fuel		Applied formla
Diesel oil	=	*Fuel consumption* $_{Diesel\ oil,\ 2005}$ $* (1 - 20\%)^{exp5\%,(7\%)*}$
Coal	=	*Fuel consumption* $_{Coal,\ 2005}$ $* (1 + 33\%)^{exp5\%,(7\%)*}$
Natural gas	=	*Fuel consumption* $_{Natural\ gas,\ 2005}$ $* (1 + 30\%)^{exp5\%,(7\%)*}$

The emission reduction targets and the Industry Sector Roadmap finalization process were refined through several cross-sectoral meetings among Ministry of Energy & Mineral Resource, BPPT, State Ministry of Environment and Industrial Associations.

6.1.1 Energy consumption analysis, Business-As-Usual scenario and Energy-Efficiency scenario

In 1990 the Indonesian industry sector consumed 122.1 million of barrels of oil equivalent (BOE) p.a. Since then the energy consumption has more than doubled and reached 268.5 million BOE p.a. in 2005.

Table 4-5: *Industry Sector - Energy Consumption and resulting GHGe 1990 - 2005*

Year	Energy consumption (million BOE)	CO_2 emissions (mio tonnes)	Year	Energy consumption (million BOE)	CO_2 emissions (mio tonnes)
1990	122.1	36.67	1998	181.8	59.07
1991	126.8	38.59	1999	218.9	76.02
1992	138.5	42.87	2000	243.1	86.80
1993	147.9	47.18	2002	252.8	90.44
1994	159.8	49.50	2003	249.7	92.58
1995	170.7	54.45	2004	239.5	88.73
1996	171.9	55.09	2005	268.5	97.49
1997	182.4	58.50			

Source: [ESDM, 2006]

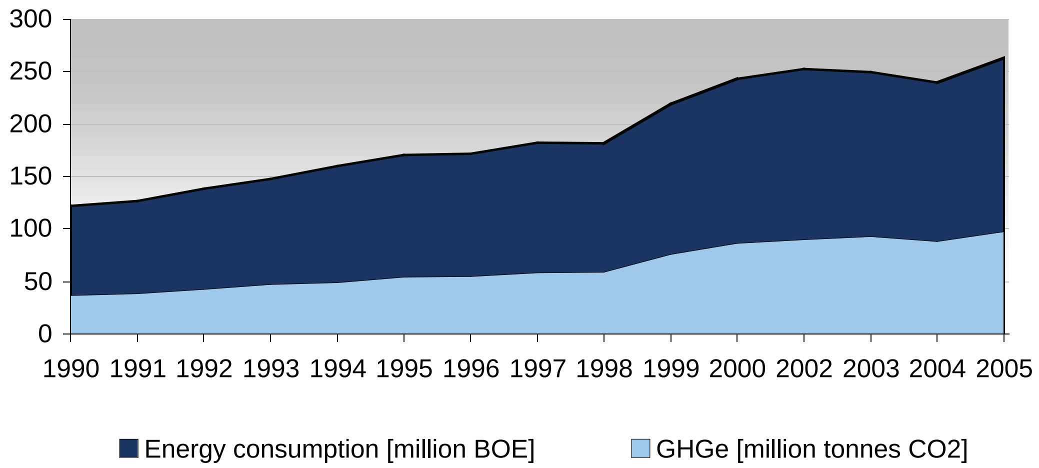

Figure 4-11: *Industry Sector - Energy Consumption and resulting GHGe 1990 - 2005*
Source: [ESDM, 2006]

Future energy consumption will be projected for the most energy-intense industries in Indonesia: Cement and other non-metallic minerals iron & steel, pulp & paper, textiles, fertilizer and other industries. Two scenarios were analysed (1) Business as Usual (BAU) and (2) Energy-Efficiency scenario, which is based on the implementation of National Energy Policy. The energy consumption projection is based on an exponential trendline.

Table 4-6: *Industry Sector - Energy Consumption under BAU scenario 2005 – 2030*

Industry	Type	2005	2010	2015	2020	2025	2030
Non-	Diesel oil (000 kl)	727.98	775.90	827.10	881.60	939.70	939.70
metallic	Coal (mio t)	11.21	12.60	14.20	16.00	18.00	20.20
	Nat. gas (MMSCF)	16,562.41	19,087.80	21,998.20	25,352.40	29,218.10	33,673.10
	Diesel oil (000 kl)	713.40	777.00	874.10	983.30	1,106.20	1,244.50
Iron &	Coal (mio t)	0.70	0.75	0.79	0.85	0.90	0.96
steel	Nat. gas (MMSCF)	81,752.27	88,393.10	95,573.30	103,336.90	111,731.00	120,807.10
	Diesel oil (000 kl)	1,262.27	1,374.80	1,546.60	1,739.90	1,957.40	2,202.00
Pulp &	Coal (mio t)	5.95	6.40	6.90	7.50	8.10	8.70
paper	Nat. gas (MMSCF)	31.36	33.70	35.90	38.30	40.80	43.50
	Diesel oil (000 kl)	461.17	491.60	523.90	558.50	595.30	634.50
Textile	Coal (mio t)	1.07	1.15	1.22	1.30	1.39	1.48
	Nat. gas (MMSCF)	206.70	223.50	241.60	261.30	282.50	305.40
	Diesel oil (000 kl)	766.77	850.90	1,003.00	1,182.40	1,393.80	1,643.00
Fertilizer	Coal (mio t)	5.99	6.50	7.10	7.80	8.50	9.30
	Nat. gas (MMSCF)	33,395.45	35,046.40	35,168.70	35,291.40	35,414.50	35,538.00
	Diesel oil (000 kl)	3,725.39	3,970.90	4,232.50	4,511.40	4,808.70	5,125.50
Other	Coal (mio t)	3.05	3.25	3.46	3.69	3.93	4.19
	Nat. gas (MMSCF)	114,353.80	123,643.00	133,686.60	144,546.10	156,287.70	168,983.20
	Diesel oil (000 kl)	7,656.97	8,241.04	9,007.28	9,857.08	10,801.00	11,789.20
Total	Coal (mio t)	27.97	30.58	33.64	37.01	40.74	44.87
	Nat. gas (MMSCF)	246,302.07	266,427.44	286,704.42	308,826.34	332,974.64	359,350.33
	Electricity (GWh)	98,050.00	75,720.00	109,230.00	154,530.00	218,740.00	222,790.00

Table 4-6 *above illustrates projected energy consumption projection in the Business-as-Usual (BAU) scenario without any intervention from efficient technology, and calculated based on domestic consumption rate only.*

Based on the assumption of achieving the energy diversification target of the National Energy Policy and implementing efficient technology that have been or will be applied on the energy-intense industries, the energy consumption of the Indonesian industry sector up to year 2030 is projected as follows:

Table 4-7: *Industry Sector - Energy Consumption under Energy-Efficiency scenario 2005 - 2030*

Industry	Type	2005	2010	2015	2020	2025	2030
Non-	*Diesel oil (000 kl)*	*727.98*	*673.30*	*622.70*	*575.90*	*532.70*	*485.00*
metallic	*Coal (mio t)*	*11.21*	*12.40*	*13.70*	*15.10*	*16.70*	*18.50*
	Nat. gas (MMSCF)	*16,562.41*	*18,155.30*	*19,901.40*	*21,815.40*	*23,913.60*	*25,807.20*
	Diesel oil (000 kl)	*713.40*	*659.80*	*610.20*	*564.40*	*522.00*	*482.80*
Iron &	*Coal (mio t)*	*0.70*	*0.77*	*0.85*	*0.94*	*1.04*	*1.15*
steel	*Nat. gas (MMSCF)*	*81,752.27*	*89,614.80*	*98,233.60*	*107,681.30*	*118,037.60*	
	Diesel oil (000 kl)	*1,262.27*	*1,167.40*	*1,079.70*	*998.60*	*923.60*	*854.20*
Pulp &	*Coal (mio t)*	*5.95*	*6.60*	*7.30*	*8.00*	*8.90*	*9.80*
paper	*Nat. gas (MMSCF)*	*31.36*	*34.40*	*37.70*	*41.30*	*45.30*	*49.60*
	Diesel oil (000 kl)	*461.17*	*426.50*	*394.50*	*364.80*	*337.40*	*307.20*
Textile	*Coal (mio t)*	*1.07*	*1.20*	*1.30*	*1.40*	*1.60*	*1.80*
	Nat. gas (MMSCF)	*206.70*	*226.60*	*248.40*	*272.30*	*298.40*	*333.20*
	Diesel oil (000 kl)	*766.77*	*709.20*	*655.90*	*606.60*	*561.00*	*518.90*
Fertilizer	*Coal (mio t)*	*5.99*	*6.60*	*7.30*	*8.10*	*8.90*	*9.90*
	Nat. gas (MMSCF)	*33,395.45*	*36,607.30*	*40,128.00*	*43,987.40*	*48,217.90*	*52,855.30*
	Diesel oil (000 kl)	*3,725.39*	*3,445.50*	*3,186.70*	*2,947.20*	*2,725.80*	*2,521.00*
Other	*Coal (mio t)*	*3.05*	*3.40*	*3.70*	*4.10*	*4.50*	*5.00*
	Nat. gas (MMSCF)	*114,353.88*	*125,351.90*	*137,407.80*	*150,623.00*	*165,109.30*	
	Diesel oil (000 kl)	*7,656.97*	*7,081.72*	*6,549.68*	*6,057.61*	*5,602.51*	*5,169.14*
Total	*Coal (mio t)*	*27.97*	*30.90*	*34.15*	*37.73*	*41.69*	*46.15*
	Nat. gas (MMSCF)	*246,302.07*	*269,990.34*	*295,956.86*	*324,420.72*	*355,622.11*	
	Electricity (GWh)	*98,050.00*	*71,860.00*	*99.52*	*134,650.00*	*182,650.00*	

**Non-metallic minerals including cement*

The conversion factors and emission factors, which were used to estimate GHGe of the Indonesian industry sector, are based on the default values suggested by the Intergovernmental Panel on Climate Change [IPCC, 2006].

Fossil fuel	**Conversion factor**	**Emission factor**
Diesel oil (kl)	*38,2 kl/GJ*	*0,0187 tonnes CO_2/GJ*
Coal (tonnes)	*28,6 t/GJ*	*0.0247 tonnes CO_2/GJ*
Natural gas (000 m^3)	*40.9 * 1000 m^3/GJ*	*0,0135 tonnes CO_2/GJ*

Table 4-8: *Industry Sector - GHGe from Energy Consumption under BAU scenario 2005 – 2030*

megatonnes CO_2

Industry	Type	2005	2010	2015	2020	2025	2030
Non-metallic minerals (incl. cement)	Diesel oil	5.34	5.69	6.06	6.46	6.89	6.89
	Coal	10.55	11.87	13.35	15.02	16.90	19.01
	Nat. gas	0.97	1.12	1.29	1.49	1.72	1.98
	Total	**16.86**	**18.68**	**20.71**	**22.97**	**25.50**	**27.88**
Iron & steel	Diesel oil	5.23	5.70	6.41	7.21	8.11	9.12
	Coal	0.66	0.70	0.75	0.80	0.85	0.90
	Nat. gas	4.81	5.20	5.62	6.08	6.57	7.10
	Total	**10.69**	**11.59**	**12.77**	**14.08**	**15.53**	**17.13**
Pulp & paper	Diesel oil	9.25	10.08	11.34	12.75	14.35	16.14
	Coal	5.60	6.00	6.49	7.02	7.59	8.19
	Nat. gas	-	-	-	-	-	-
	Total	**14.85**	**16.08**	**17.83**	**19.77**	**21.94**	**24.33**
Textile	Diesel oil	3.38	3.60	3.84	4.09	4.36	4.65
	Coal	1.01	1.08	1.15	1.22	1.30	1.39
	Nat. gas	0.01	0.01	0.01	0.02	0.02	0.02
	Total	**4.40**	**4.69**	**5.00**	**5.33**	**5.68**	**6.06**
Fertilizer	Diesel oil	5.62	6.24	7.35	8.67	10.22	12.04
	Coal	5.64	6.08	6.66	7.30	8.00	8.75
	Nat. gas	1.96	2.06	2.07	2.08	2.08	2.09
	Total	**13.22**	**14.37**	**16.08**	**18.04**	**20.30**	**22.88**
Other	Diesel oil	27.31	29.11	31.02	33.07	35.25	37.57
	Coal	2.87	3.05	3.26	3.47	3.70	3.94
	Nat. gas	6.72	7.27	7.86	8.50	9.19	9.94
	Total	**36.90**	**39.43**	**42.14**	**45.04**	**48.14**	**51.45**
Total	Diesel oil	56.13	60.41	66.02	72.25	79.17	86.41
	Coal	26.32	28.78	31.65	34.83	38.34	42.19
	Nat. gas	14.48	15.67	16.86	18.16	19.58	21.13
	Electricity	0.56	0.79	0.87	0.95	1.04	1.14
Subtotal		**97.49**	**105.64**	**115.40**	**126.19**	**138.13**	**150.87**

Without any intervention with energy efficiency measures GHGe from the industry sector will rise from 97.49 megatonnes CO_2 p.a. in 2005 to 150.87 megatonnes CO_2 p.a. in 2030. The implementation of the National Energy Policy is assumed to reduce GHGe from stationary fossil fuel combustion, as can be seen in the below.

Table 4-9: *Industry Sector - GHGe from Energy Consumption under Energy-Efficiency scenario 2005 - 2030 (megatonnes CO_2)*

Industry	Type	2005	2010	2015	2020	2025	2030
Non-metallic minerals (incl. cement)	*Diesel oil*	*5.34*	*4.94*	*4.56*	*4.22*	*3.90*	*3.61*
	Coal	*10.55*	*11.66*	*12.88*	*14.23*	*15.73*	*17.38*
	Nat. gas	*0.97*	*1.07*	*1.17*	*1.28*	*1.41*	*1.54*
	Total	**16.86**	**17.66**	**18.61**	**19.74**	**21.04**	**22.53**
Iron & steel	*Diesel oil*	*5.23*	*4.84*	*4.47*	*4.14*	*3.83*	*3.54*
	Coal	*0.66*	*0.73*	*0.80*	*0.89*	*0.98*	*1.08*
	Nat. gas	*4.81*	*5.27*	*5.78*	*6.33*	*6.94*	*7.61*
	Total	**10.69**	**10.83**	**11.05**	**11.36**	**11.75**	**12.23**
Pulp & paper	*Diesel oil*	*9.25*	*8.56*	*7.91*	*7.32*	*6.77*	*6.26*
	Coal	*5.60*	*6.19*	*6.84*	*7.55*	*8.35*	*9.22*
	Nat. Gas	-	-	-	-	-	-
	Total	**14.85**	**14.75**	**14.75**	**14.88**	**15.12**	**15.49**
Textile	*Diesel oil*	*3.38*	*3.13*	*2.89*	*2.67*	*2.47*	*2.29*
	Coal	*1.01*	*1.12*	*1.23*	*1.36*	*1.51*	*1.66*
	Nat. Gas	*0.01*	*0.01*	*0.01*	*0.02*	*0.02*	*0.02*
	Total	**4.40**	**4.26**	**4.14**	**4.05**	**4.00**	**3.97**
Fertilizer	*Diesel oil*	*5.62*	*5.20*	*4.81*	*4.45*	*4.11*	*3.80*
	Coal	*5.64*	*6.23*	*6.88*	*7.60*	*8.40*	*9.28*
	Nat. Gas	*1.96*	*2.15*	*2.36*	*2.59*	*2.84*	*3.11*
	Total	**13.22**	**13.58**	**14.05**	**14.64**	**15.35**	**16.20**
Other	*Diesel oil*	*27.31*	*25.26*	*23.36*	*21.60*	*19.98*	*18.48*
	Coal	*2.87*	*3.17*	*3.50*	*3.87*	*4.27*	*4.72*
	Nat. gas	*6.72*	*7.37*	*8.08*	*8.86*	*9.71*	*10.64*
	Total	**36.90**	**35.79**	**34.94**	**34.33**	**33.96**	**33.84**
Total	*Diesel oil*	*56.13*	*51.91*	*48.01*	*44.40*	*41.07*	*37.98*
	Coal	*26.32*	*29.08*	*32.13*	*35.51*	*39.23*	*43.35*
	Nat. gas	*14.48*	*15.88*	*17.40*	*19.08*	*20.91*	*22.92*
	Electricity	*0.56*	*0.47*	*0.52*	*0.57*	*0.62*	*0.68*
Subtotal		**97.49**	**97.34**	**97.54**	**99.55**	**101.83**	**104.93**

Comparing these two tables suggests that the Energy-Efficiency scenario will lead to very low levels of annual GHGe increase and will result in 30.45% less GHGe p.a. in 2030 compared to BAU.

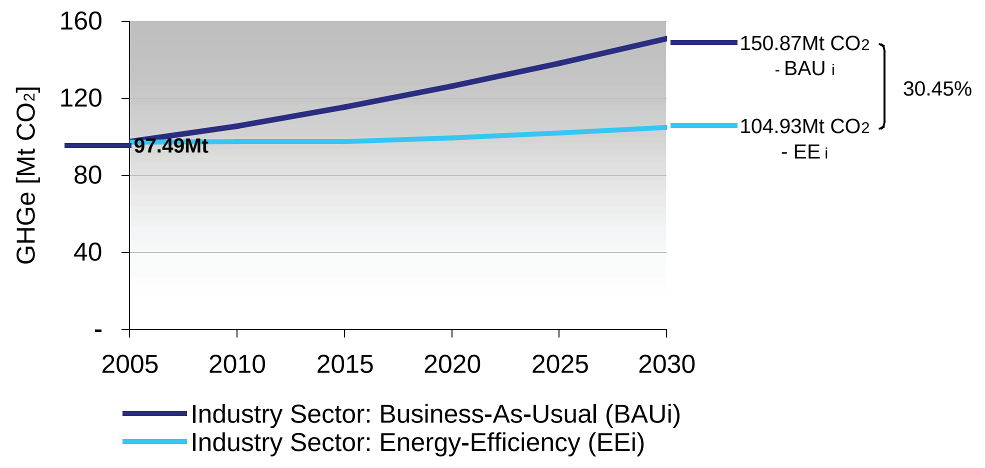

Figure 4-12: *Industry Sector – GHGe scenarios in comparison 2005 - 2030*

4.3 Technology costs for Greenhouse Gas Emissions Mitigation

In-depth roadmapping including a detailed analysis of potential GHGe mitigation technologies, programmes and policies for other manufacturing industries will take place in later reviews of the Industry Sector Roadmap. Therefore the following table shows a rough assessment of costs for GHGe mitigation in the Indonesian industry sector only.

Table 4-10: *Industry Sector – Cost estimation for suggested GHGe mitigation scenarios 2010 - 2030*

Recommendation for GHGe mitigation	*Programme*	*Cost estimation (million IDR)*			
		2010 – 2014	*2015 – 2019*	*2020 – 2024*	*2024 – 2029*
Improve energy efficiency and energy diversification in order to achieve Presidential Decree 5/2006	**1. Energy Conservation**	**20,000**	**20,000**	**19,000**	**18,000**
	Cement industry	*3,000*	*3,000*	*2,000*	*2,000*
	Iron & steel industry	*2,000*	*2,000*	*2,000*	*1,000*
	Pulp & paper industry	*3,000*	*3,000*	*2,000*	*2,000*
	Textile industry	*10,000*	*10,000*	*10,000*	*10,000*
	Transport equipment industry	*1,000*	*1,000*	*1,500*	*1,500*
	Food & beverages industry	*1,000*	*1,000*	*1,500*	*1,500*

Recommendation for GHGe mitigation	Programme	Cost estimation (million IDR)			
		2010 – 2014	2015 – 2019	2020 – 2024	2024 – 2029
Monitor GHGe	**2. GHGe monitoring**	**24,600**	**19,600**	**17,000**	**14,000**
	Cement industry	*3,600*	*4,600*	*4,000*	*3,000*
	Iron & steel industry	*5,000*	*1,000*	*1,000*	*1,000*
	Pulp & paper industry	*10,000*	*8,000*	*7,000*	*5,000*
	Textile industry	*2,000*	*1,000*	*1,000*	*1,000*
	Transport equipment industry	*1,000*	*2,000*	*1,000*	*1,000*
	Food & beverages industry	*3,000*	*3,000*	*3,000*	*3,000*
Modificate and replace technolo	**3. Technology modif. and replacement**				
	CO_2 emission reduction:				
	5%	*100,000*			
	10%		*350,000*		
	20%			*500,000*	
	30%				*1,500,000*

REFERENCES

Ref. 1: IPCC, 2007

Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change:

"Climate Change 2007: Mitigation", [B. Metz, O.R. Davidson, P.R. Bosch, R. Dave, L.A. Meyer (eds)], Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA., XXX pp.

Ref. 2: DEPPERIN, 2005

Ministry of Industry Indonesia:

"National Industrial Development Policy", 2005

Ref. 3: Worldsteel, 2009

World Steel Association (formerly: International Iron and Steel Institute):

"World Steel in Figures 2009", 2009, ISSN 1379-9746

Ref. 4: TNA, 2009

Working Group of Technology Transfer/ GTZ:

"Technology Needs Assessment on Climate Change Mitigation", Jakarta, 2009

Ref. 5: JICA, 2009

J-Power/ Japan International Cooperation Agency (JICA):

"The Study on Energy Conservation and Efficiency Improvement in the Republic of Indonesia", 19th-February-2009

Ref. 6: IPCC, 2006

Intergovernmental Panel on Climate Change (IPCC):

"Guidelines for National Greenhouse Gas Inventories", 2006

Ref. 7: WBCSD, 2003

Jaakko Poeyry Consulting in cooperation with the World Business Council for Sustainable Development (WBCSD): "Summary of international pulp and paper industry structure and best practice", 2003

Ref. 8: IEA, 2007

International Energy Agency (IEA):

"Tracking Industrial Energy Efficiency and CO_2 Emissions - Energy Indicators", 2007

Ref. 9: Energy Manager, 2008

Bureau of Energy Efficiency/ Ministry of Power India in cooperation with Deutsche Gesellschaft fuer Technische Zusammenarbeit (GTZ) GmbH:

"Energy Manager: Economic Analysis of Energy Efficiency Improvement Options in the Indian textile industry"

www.energymanagertraining.com/textiles/pdf/TextileSector-India.pdf, visited on 31-July-2009

Ref. 10: ECOFYS, 2009

ECOFYS International BV by order of Agence Française de Développement (AFD):

"Introduction to a green house gas emission reduction scheme in the cement sector in Indonesia", PCMANL084568, 2009

Ref. 11: PT. Indocement, 2009

PT. Indocement Tunggal Prakarsa Tbk./ HeidelbergCement Group:

"CO2 reduction concept in cement manufacturing", Interview with PT. Indocement Tunggal Prakarsa Tbk., on 20-Oct-2009 at PT. Indocement's Citeureup factory

http://www.indocement.co.id/new/env-commitment.asp, visited on 13-November-2009

Ref. 12: Worrell/ Galitzky, 2004

Environmental Energy Technologies Division of the Ernest Orlando Lawrence Berkeley National Laboratory sponsored by U.S. Environmental Protection Agency:

"Energy Efficiency Improvement Opportunities for Cement Making - An ENERGY STAR Guide for Energy and Plant Managers" by Ernst Worrell and Christina Galitsky, 2004

Ref. 13: Chungsangunsit, 2004

Thipwimon Chungsangunsit, Shabbir H. Gheewala and Suthum Patumsawad:

"Environmental Assessment of Electricity Production from Rice Husk: A Case Study in Thailand", Electricity Supply Industry in Transition: Issue and Prospects for Asia, 14-16 January-2004

Ref. 14: NEDO, 2008

New Energy and Industrial Technology Development Organization:

"Global Warming Countermeasures <<2008 Revised Edition>> - Japanese Technologies for Energy Savings/ GHG Emissions Reduction", 2008

Ref. 15: GERIAP, 2005

United Nations Environment Programme/ Swedish International Development Cooperation Agency:

"Energy Efficiency Survey. A survey on barriers to energy efficiency in industry in the Asia Pacific region and recommended solutions – Interim Report/ Greenhouse Gas Emission Reduction from Industry in Asia and the Pacific" (GERIAP) project", January 2005

Ref. 16: GERIAP, 2006

United Nations Environment Programme/ Swedish International Development Cooperation Agency:

"Energy Efficiency Guide for Industry in Asia – Company Case Study"

Urea Fertilizer Factory Ltd.: Company Case Study (Bangladesh)

Anhui Linquan Chemical Industry Co Lt.: Company Case Study (China)

Yuanping Chemical Co Ltd.: Company Case Study (China)

Activated Carbon India PVT. Ltd.: Company Case Study (India)

Siflon Drugs: Company Case Study (India)

Puyat Vinyl Products, Inc.: Company Case Study (Philippines)

Asian Chemical Company Ltd.: Company Case Study (Thailand)

Ref. 17: CEFIC, 2009

European Chemical Industry Council

http://www.cefic.org/factsandfigures/level02/downloads_index.html, visited on 24-June-2009

Ref. 18: RAN-PI, 2007

State Ministry of Environment of the Republic of Indonesia:

"National Action Plan Addressing Climate Change", 2007

Ref. 19: NSS-CDM, 2001

State Ministry of Environment of the Republic of Indonesia:

"National Strategy Study on the Clean Development Mechanism in Indonesia", Jakarta, 2001

Ref. 20: Econoler, 2006

Econoler International/ The World Bank:

"Assistance to the Government of Indonesia's Demand-side Management Program", Final Report, January 2006

Ref. 21: ZREU, 2000

Zentrum fuer rationelle Energieanwendung und Umwelt Gmbh:

"Biomass in Indonesia – Business Guide", 2000

Ref. 22: SNC, 2009

Republic of Indonesia:

"Second National Communication to the United Nations Framework Convention on Climate Change (UNFCCC)", 2009

Ref. 23: Mahasenan/ Natesan, 2003

Mahasenan, Natesan; Steve Smith, Kenneth Humphreys, Y. Kaya:

"The Cement Industry and Global Climate Change: Current and Potential Future Cement Industry CO_2 Emissions", Greenhouse Gas Control Technologies - 6th International Conference, 2003, Oxford: Pergamon, pp. 995–1000, ISBN 9780080442761.

Ref. 24: PEN, 2006

Republic of Indonesia:

"Blueprint of National Energy Coordinating Board 2005 – 2025"

"BLUEPRINT PENGELOLAAN ENERGI NASIONAL 2006 2025 -Sesuai Peraturan Presiden Nomor 5 Tahun 2006", Jakarta, 2006

Ref. 25: WBCSD, 2007

World Business Council for Sustainable Development – Cement Sustainability Initiative:

"Sectoral Approach - Briefing Note", as presented to the COP 13 Bali Conference in 2007

Ref. 26: ASI, 2008

Indonesian Cement Association:

Facts and figures, 2008

Ref. 27: Cemex, 2009

Cemex UK

http://www.cemex.co.uk/ce/ce_pp.asp, visited on 13-November-2009

Ref. 28: PT. Semen Gesik – Annual report, 2008

PT. Semen Gresik (Persero) Tbk.:

Annual Report, 2008

Ref. 29: PT. Indocement – Annual report, 2008

PT. Indocement Tunggal Prakarsa Tbk./ HeidelbergCement Group:

Annual Report, 2008

Ref. 30: PT. Holcim – Annual report, 2008

PT. Holcim Indonesia Tbk.:

Annual Report, 2008

Ref. 31: PT. Holcim – Sustainable development report, 2008

PT. Holcim Indonesia Tbk.:

Sustainable Development - Report, 2008

http://www.holcim.com/ID/EN/id/1610655653/mod/5_6/page/editorial.html, visited on 13-November-2009

http://www.holcim.com/CORP/EN/id/1610660425/mod/7_11_2_0/page/editorial.html, visited on 13-November-2009

Ref. 32: PT. Semen Gresik, 2009

PT. Semen Gresik (Persero) Tbk.:

1st Half 2009 Results Report

Ref. 33: ghgprotocol, 2009

Greenhouse Gas Protocol:

Scope 1 emissions as defined in the Greenhouse Gas Protocol,

www.ghgprotocol.com, visited on 13-November-2009

Ref. 34: SBSTA, 2009

UNFCCC, SBSTA:

"Second Synthesis Report on Technology Needs Identified by Parties not Included in Annex 1 to the Convention – Note by the Secretariat", 29-May-2009, presented at SBSTA 13th Session, Bonn 1 – 10 June-2009

Ref. 35: IEA, 2009

International Energy Agency (IEA):

"Technology Roadmaps Carbon Capture and Storage", 2009

Ref. 36: Kammen, 2009

Kammen, D. referenced in International Scientific Congress Climate Change Global Risks Challenges and Decisions, Synthesis Report, University of Copenhagen, 2nd Edition, 10 -12 March -2009, pp. 29

Ref. 37: Kamaruddin, 2002

Abdullah Kamaruddin, Laboratory of Energy and Agricultural Electrification, Department of Agricultural Engineering, IPB And Indonesian Renewable Energy Society (IRES):

"Biomass Energy Potentials And Utilization In Indonesia", 2002

Ref. 38: Cemaust, 2009

Cement Australia Pty Ltd.:

"Media Release - Dandenong answers industrial waste problem for Victoria", 7-May, 2009

http://www.cemaust.com.au/files/Geocycle%20media%20release7May.pdf

Ref. 39: RKP, 2003

Government of Indonesia:

"Peraturan Pemerintah Republik Indonesia tentang Rencana Kerja Pemerintah", 2003

Ref. 40: WBCSD, 2005

World Business Council for Sustainable Development – Cement Sustainability Initiative:

"Guidelines for the Selection and Use of Fuels and Raw Materials in the Cement Manufacturing Process", December 2005, Version 1.0, pp. 7

Ref. 41: UNFCCC, Art. 4

The United Nations Framework Convention on Climate Change:

"Article 4 of the Convention – Commitments", http://unfccc.int/essential_background/convention/background/items/2853.php, visited on 13-November-2009

Ref. 42: ICCTF, 2009

Republic of Indonesia:

"Blueprint for Indonesia Climate Change Trust Fund (ICCTF)", 11-September-2009

Ref. 43: UNIDO, 2008

United Nations Industrial Development Organization - McKane, A., Price, L. & de la Rue du Can, S.:

'Policies for promoting industrial energy efficiency in developing countries and transition economies", UNIDO, Vienna, 2008, www.unido.org/index.php?id=071852

Ref. 44: Battelle, 2000

Battelle Memorial Institute:

"Toward a Sustainable Cement Industry, Substudy 8, 2000, cited in [WBCSD, 2005]

Ref. 45: CEMBUREAU, 2009

CEMBUREAU, based in Brussels, is the representative organisation of the cement industry in Europe. http://www.cembureau.be/, visited on 13-November-2009

Ref. 46: SBY, 2009

H.E. DR. Susilo Bambang Yudhoyono, President of the Republic of Indonesia:

"Intervention on Climate Change" at the G-20 Leaders Summit, 25-Sep-2009, Pittsburgh/ Pennsylvania – USA, 13:00 pm Working Lunch

Ref. 47: ESDM, 2006

Ministry of Energy and Mineral Resources:

"Handbook of Indonesia's Energy Economic Statistics", 2006

Ref. 48: CIFOR, 2009

Center for International Forestry Research:

"The impacts and opportunities of oil palm in Southeast Asia", 2009, ISBN 978-979-1412-74-2

Ref. 49: KLH/ GTZ, 2009

Deputy for Hazardous and Toxic Waste Management of the Indonesian Ministry of Environment in co-operation with GTZ, PT. Holcim and PT. Indocement:

“Hazardous Waste Utilization for Co-processing in Cement Industry”, 2009

Ref. 50: PDD AF PT. Holcim, 2006

Project Design Document:

“Emission reductions through partial substitution of fossil fuel with alternative fuels in the 2 cement plants of PT Holcim Indonesia Tbk.“, Version 03, July 2006

Ref. 51: PDD AF PT. Indocement, 2006

Project Design Document:

“Indocement Alternative Fuels Project”, Version 02 (revised version: post-validation site visit), May 2006

Ref. 52: PDD BC PT. Indocement, 2006

Project Design Document:

“Indocement Blended Cement Project”, Version 02 (revised version: post-validation site visit), May 2006

Ref. 53: ICF, 2009

ICF International:

“Sector-based Approaches Case Study: Mexico” and “Sector-based Approaches Case Study: Brazil”, both 2009

Appendix 1

Current Policy Framework: Cross-Sectoral Issues

This Industry Sector Roadmap for GHGe abatement from the cement industry cuts across three other Roadmap areas – energy, waste and to a lesser extent, transportation and agriculture. These cross-sectoral issues are discussed below.

Energy Sector

Indonesia's energy sector is comprised of:

- *Electricity generation, transmission and supply (primarily from the combustion of oil and coal, with smaller proportions of hydro and geothermal); and*
- *Natural gas distribution and supply, including LNG.*

Presidential Regulation No.5/2006 – energy diversification and conservation aims to diversify Indonesia's energy supply from primarily oil-fired electricity to coal and gas-fired electricity as well as natural gas for direct use in industry and homes. The plan provides a wider coverage of grid-supplied electricity as well as an increase in the supply of natural gas. Despite a forecast of increased GHGe from energy usage in Indonesia, the GHGe intensity will decrease due to the role out of Regulation No.5/2006 and the lower greenhouse gas emitting fuels used in the production of electricity and supply of energy.

The existing electricity generation capacity and transmission system in Indonesia is presented on the map in Figure 3-6: Current Electricity Generation-Transmission Capacity & Potential of LNG/ Biomass for Electricity Generation. In 2005 the total installed production capacity was 24,000MW of which 18,500MW are located in the Java-Bali region.

The Government of Indonesia is planning to develop energy infrastructure to accommodate a forecasted growth in energy demand of 800% in 2030 on baseline of 2005.

For the Industry Sector Roadmap it is important to understand the full potential available for fuel-switching from carbon-heavy energy supply such as oil-electricity to natural gas and natural gas-fired electricity.

There is also a smaller, but significant potential for additional geo-thermal in some areas of Indonesia. Energy company Pertamina has identified at least 80 prospective geothermal sites with estimated geothermal production potential of 20,000 MW. The 400 MW worth of geothermal-generated electricity can replace or substitute typical fossil fuel produced heat, producing a significant GHGe reduction benefit [NSS-CDM, 2001].

Each of these opportunities is limited by the geographical location of industries, for example proximity to mini-hydro, geo-thermal sources or natural gas pipelines.

Many stakeholders have spoken about the opportunity of switching from coal-fired electricity to natural gas with lower GHGe and lower running costs. Public energy companies have made in-roads to rolling out natural gas pipelines from key generation areas, particularly in the north. Resourcing for further provision of natural gas is a key GHGe abatement opportunity discussed in the Energy Sector Roadmap.

Indonesia has between 170 and 180 trillion cubic feet (TCF) of natural gas reserves (proven and probable), equivalent to three times of Indonesia's oil reserves and will be able to keep current production rate for the next 50 years[3]. It is estimated that 55% of Indonesia's natural gas was marketed as LNG or liquefied petroleum gas (LPG) for export purposes, 7.7% for fertilizer and 2.2% for city gas and finally, less than 6% was flared. In 2020, gas export is projected to reach 32% of the total production[4].

It is expected that the biggest future market is in the industry sector (heat and feedstock), which is mainly located in Java. However the natural gas reserve off Java is not adequate to meet future industry and domestic demand. The government hopes to solve this problem, by installing the Receiving Terminals for LNG.

With specific reference to the cement industry, opportunities for cement factories to switch from oil and coal-fired electricity to gas:

- Near the city of Medan/ North Sumatra;
- North Jakarta (Bay)/ Java to supply Muara Karang, Muara Tawar and Tanjung Priok; and
- Near the city of Surabaya/ East Java to supply Grati and Perak.

For cement companies operating on Java, auto-production of electricity is not viable due to the provision of the national electricity grid. Therefore all cement companies, with the exception of PT. Semen Tonasa[33] and PT. Indocement[34], purchase their electricity from PT. PLN, the state owned electricity company.

The Energy Sector Roadmap provides additional information about future plans for providing carbon-light energy supply.

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[33] PT. Semen Tonasa operates its own coal-fired power stations with a capacity each of 25MW. They currently run at two-thirds capacity or around 35 MW.

[34] PT. Indocement operates its own power generator with a capacity of 300 MW at one of its factories in Citeureup/ Java partly with un-subsidised industrial fuel, instead of taking advantage of the lower power cost purchased from the national grid. To compensate this competitive disadvantage and to reduce the impact of rising energy costs, the company completed the conversion of two diesel power generating units into gas-fired power generators in 2008.

Waste Sector

The main wastes that impact the industry sector are:

- *Agricultural waste such as biomass;*
- *Municipal solid waste; and*
- *Hazardous wastes.*

Currently, there is no national policy regulating the ownership, disposal, collection or re-processing of agricultural waste. Waste management is usually the jurisdiction of the city or regional government. As most regions have a fee for dumping in landfill, agricultural waste is usually burned at or near the site of production. However, in recent years, Clean Development Mechanisms projects in particular have created a demand for agricultural waste (or biomass) in domestic and international markets. If biomass continues to be of high demand, then Indonesia would need to provide a policy framework in order to ensure that only "genuine" waste was being used for co-firing furnaces and steam turbines, and that native forests were not being felled for co-firing in power or industrial kilns. Policies should ensure that natural resources are being used for their highest value first.

There is currently no official data collection for the volumes of agricultural, industrial and domestic waste produced across Indonesia, although some estimates have been made, for example based on household disposal rates. Indonesian cement manufacturers have been collecting some waste data themselves to inform investment decisions regarding alternative fuels.

The opportunity of utilising agricultural waste as alternative fuel in Indonesia's cement kilns, proximity to food and fibre production is paramount. According to some stakeholders, switching to biomass is logical for factories located in Sumatra. A continuous supply of palm oil residues could be ensured there. In Java such supply could not be continuous. PT. Indocement in Tarjun, located in a rural area of Kalimantan, uses palm wastes as biomass sources.

Other biowaste sources include "urban waste" such as municipal solid waste (MSW) and used tyres. PT. Indocement in Citeureup is using urban biomass sources such as used tyres. Tyres are free of charge to industry but there is usually a fee paid to "lapak" (informal waste organisation) for collecting and sorting resources.

Hazardous waste is high regulated for its management and treatment. The regulation of hazardous waste management as stated in the Government Regulation no. 18/1999 covers stages of managing the waste such as collection, transportation, handling, processing and utilisation. Coupled with this regulation are decrees to regulate hazardous waste with permission. The decrees cover permits for each stage of hazardous waste management, procedures, technical requirements and documentation for handling the waste.

Some cement companies have already obtained permits to utilise hazardous waste as their alternative fuel and raw materials. The permits regulate the use of specific hazardous waste in the cement kiln. The cement industry has to conduct trial-burn tests first for the type of hazardous waste that they want to use in their factory. Copper slag and fly ash are hazardous wastes that are often utilised by the cement industry.

Based on the PROPER program conducted by Ministry of Environment, in 2006, there were 7 tonnes of hazardous waste generated by the industries under this program and only 34% that are already handled through 3R approach. There are also hazardous wastes that are produced by industries that are not in this program. Therefore, the opportunity of cement industries to use hazardous waste as a fuel source is still high.

Agriculture Sector

A popular way of reducing emissions from the cement industry is to blend cement with additive minerals, such as fly ash. The use of fly ash in cement production however is in direct competition with agriculture; it is an excellent soil conditioner. With the cross-sectoral consideration to food security, planners and public policy makers need to ensure that policies are consistent in supporting the "higher value use" principle to resources and "wastes".

Appendix 2

Indonesia's Primary Key Industries: Company profiles

All Indonesian cement manufacturers are members of the Indonesian Cement Association (ASI). HeidelbergCement (PT. Indocement Tunggal Prakarsa Tbk.) and PT. Holcim Indonesia Tbk. are also founding members of the World Business Council for Sustainable Development - Cement Sustainability Initiative (WBCSD CSI)[35]. As founding members of the CSI all companies have publicly reported aggregate greenhouse emissions since 2006.

Semen Gresik Group

PT. Semen Gresik is a cement producer founded by President Soekarno on August 7, 1957. Since September 5, 1995, PT. Semen Gresik merged with PT. Semen Padang and PT. Semen Tonasa, which is now known as the Semen Gresik Group. Major shareholders of the group are Government of Indonesia (51.01%), Blue Valley Holdings Pty Ltd (24.90%), and public shareholders (24.09%).

In the first half of 2009, Semen Gresik Group was able to maintain its domestic market share of cement (45.7%) [PT. Semen Gresik, 2009]. In 2008, the production capacity of the group was 18 megatonnes of cement. The group also exports its product to countries such as Timor Leste, Sri Lanka, Maldives, Seychelles, Mauritius, Qatar and Oman.

PT. Semen Gresik

PT. Semen Gresik is located in Tuban and Gresik, East Java. It operates three cement plants with installed capacity of 8.6 megatonnes cement p.a. PT. Semen Gresik also operates two ports that consist of PT. Semen Gresik Special Ports in Tuban and Gresik.

PT. Semen Padang

PT. Semen Padang is located in Indarung, West Sumatera and operates four cement plants with installed capacity of 5.9 megatonnes of cement p.a. Cement type produced by PT. Semen Padang includes OPC, PPC, PCC, OWC and SMC.

PT. Semen Padang also owns six cement packing plants that consist of Teluk Bayur, Belawan, Batam, Tanjung Priok, Ciwandan and Malahayati, in addition to having 14 warehouses.

PT. Semen Tonasa

PT. Semen Tonasa is located in Pangkep, South Sulawesi; the government planned the establishment of this PT. Semen Tonasa factory to fulfil the cement need of the eastern part of Indonesia.

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[35] *Please see "Appendix 5 - World Business Council for Sustainable Development – Cement Sustainability Initiative".*

It operates three cement plants with installed capacity of 3.5 megatonnes cement p.a. PT. Semen Tonasa also owns eight packing plants and equipped with piers that consist of Biringkassi, Makassar,Samarinda, Banjarmasin, Bitung, Ambon and Celukan Bawang, Bali. PT. Semen Tonasa owns five warehouses.

The types of cement produced by PT. Semen Tonasa include OPC, PPC, PCC and MC.

PT. Semen Tonasa uses limestone, clay, silica sand and iron sand as main raw materials, while silica sand and gypsum are used as supporting raw materials. Silica sand is consumed at PT. Semen Tonasa (Persero) with the rate of around 60,000 tonnes annually, while the consumption of gypsum is around 145 tonnes annually. As fuel, the factories consumption of coal reaches 158,400 tonnes annually. The power station is responsible of supplying electricity needed to operate the lightings and the equipment of the factory. Electricity at PT. Semen Tonasa is supplied by Bakarru Water Power Station (14 MW) and Diesel Power Station PLTD (four generators), capacity 8 MW (one standby generator).

Environmental performance of Semen Gresik Group

Efficiency Program to reduce the production cost:

1. *To increase the coal usage portion to achieve 99.7% (in the place of diesel oil).*
2. *To increase the use of cement additive materials to 13%, substituting the use of slag.*
3. *To maximize the use of Kraft 2ply 90gsm packs, to optimise the use of local Kraft paper with a competitive price, as well as to use 1 ply woven pack for outer islands of Java.*
4. *To arrange the pattern of equipment operation during peak periods by optimising the operation of equipment outside of peak periods.*
5. *To increase production to achieve 100.9%.*
6. *To improve the maintenance cost control by keeping the equipment damage rate down, to optimise overhaul output, to improve substitute spare part usage at a competitive price, and to implement Enterprise Asset Management (EAM).*

In 1990, to improve capacity and energy management:

- *De-bottlenecking/optimization project: additional capacity of 1,000,000 tonnes cement (conducting pre-heater modification by extending the calcinatory downpipe and cross flow pipes at all factories).*
- *The construction of two new cement plants in Java and Sulawesi with installed capacity of 2.5 megatonnes of cement respectively. The construction of the plant in Java to be completed in 2012 and the cement plant in Sulawesi in 2011.*
- *The constructions of 2 x 35MW power plants in Sulawesi, to be completed in 2011.*

In promoting the Group's care for environment, a co-processing activity, in which the cement plant has been used as a facility for conducting the 3R (Re-use, Recovery & Recycle), the Group has started to use Alternative Fuel and Raw Material (AFR) by utilizing the agricultural farming waste and industrial waste. Alternative raw materials used include fly ash, copper slag and gypsum. Alternative fuel used includes farming waste (biomass) and industrial waste, such as hulls of rice, dust tobacco and oil sludge.

For CDM Implementation, the Group has conducted cooperation with a CDM consultant for the CDM project development in PT. Semen Gresik. The activities conducted in 2008 include Alternative Fuel Project at Tuban Plant and Waste Heat Recovery Power Generator Project (in cooperation with JFE-NEDO) using exhaust gas from pre-heater and kiln in Indarung V for power generation.

PT. Semen Baturaja

PT. Semen Baturaja (Persero) is a state-owned cement company that is located in South Sumatra. The product of the company is cement Portland Type I. It has the capacity of 1.25 megatonnes cement p.a. and it has three plants, which are located in Baturaja, Palembang and Panjang. PT. Semen Baturaja is the main supplier for the region of southern Sumatra being the only cement plant in the area.

PT. Semen Bosowa Maros

PT. Semen Bosowa Maros started its operation in 1999. It is the youngest cement factory in Indonesia and the only one that is owned by national private company, which is Bosowa Corporation.

PT. Holcim Indonesia Tbk.

Global Company Characteristics – Holcim

Holcim's global headquarters are located in Switzerland. In 2008 Holcim was recognised as "Leader of the Industry" in the Dow Jones Sustainability Index and received the SAM Gold Class Certificate [PT. Holcim – Sustainable development report, 2008]. Globally Holcim has reduced GHGe per tonne of cement by 16.3% since 1990 with a goal of reaching 20% by 2010.

National Company Characteristics – PT. Holcim Indonesia

PT. Holcim Indonesia is owned by Holderfin B.V. (77.33%), foreign investors (10.41%) and the Indonesian public (12.26 %) of the authorised issued and paid-up shares quoted on the Indonesia Stock Exchange (IDX). PT. Holcim Indonesia operates cement plants at Narogong and Cilacap, and a cement grinding terminal at Ciwandan with a combined annual capacity of 8.5 megatonnes of finished cement.

PT. Holcim Indonesia has several types of cement produced, for example Holcim Serba Guna, which is blended cement containing pozzolana, fly ash and mineral components with cementitious properties. It also produces concrete, which are Ready Mix Concrete and MiniMix. PT. Holcim Indonesia is one of the leading suppliers of aggregates in Indonesia. Under the control of PT. Holcim Beton, a wholly owned subsidiary, PT. Holcim Indonesia operates some of the largest aggregates quarries in Indonesia and a *substantial downstream ready-mixed concrete supply network from Greater Jakarta to Surabaya in East Java. PT. Holcim's production type by location is: PT. Holcim Beton (Jakarta) ready mixed concrete and aggregates; PT. Readymix Concrete Indonesia (Surabaya) ready-mixed concrete; PT. Pendawa Lestari Perkasa (Surabaya) aggregates production; PT. Bintang Polindo Perkasa (Banten) cement milling and PT. Semen Dwima Agung (Tuban) cement production.*

Environmental performance

In 2008 PT. Holcim Indonesia achieved Green Status under the Indonesian Ministry of Environment's PROPER Awards. It has collaborated with the Indonesian Ministry of Environment to prepare industry guidelines for responsible waste co-processing in Indonesia. Co-processing of waste materials displaces primarily fossil fuel (coal in the case of Indonesia) in the production of heat for use in the clinker production process. Its wholly owned business unit, Geocycle Indonesia, provides a reliable and secure waste management service for most industrial wastes. It processes solids, sludge, liquids, and ozone-depleting and global warming gases. Thus, the waste management team in Geocycle finds hazardous and general waste for use in the cement production facilities thereby reducing environmental risk associated with limited landfills and illegal dumping.

In its 2008 Sustainability Report, PT. Holcim Indonesia states that its goal is optimal production with effective management of emissions and efficient use of energy and raw materials [PT. Holcim – Sustainable development report, 2008].

PT. Holcim Indonesia operates the largest biomass alternative fuel project under the UNFCCC's CDM and a first of its type for Holcim worldwide. In substitution for burning coal PT. Holcim Indonesia uses discarded rice husks and palm kernel shells (PKS), not only reducing the greenhouse profile of the fuel used in the kiln but reducing emissions from biomass decomposition, particularly methane [PDD AF PT. Holcim, 2006].

PT. Holcim Indonesia has reduced emissions by 14% from 2002 to 2008. In 2008, it produced around 7 megatonnes of cement [PT. Holcim – Sustainable development report, 2008]. PT. Holcim Indonesia has reduced its specific gross direct CO_2 from 787 kg CO_2/ t of cementitious materials in 2004 to 715 kg CO_2/ t of cementitious materials in 2008.

This has been achieved through a mixture of options including:

- *reducing the clinker factor from 92.5% in 2004 to 80.9% in 2008;*
- *improving processes (technologies and skills in process handling) to raise efficiency in power consumption (7% savings per kWh/tonne of clinker); and*
- *increasing thermal substitution from 0.75% in 2004 to 6.87% in 2008.*

PT. Indocement Tunggal Prakarsa Tbk.

Global Company Characteristics - HeidelbergCement

HeidelbergCement has its headquarters in Germany and has been in Indonesia since 2001 when it acquired a majority stake in PT. Indocement, the second largest cement producer in Indonesia.

Heidelberg data is verified externally but sustainability metrics are only reported every three years; 2011 being when the next report is due. Public sustainability reporting is currently global and not available at a national level for Indonesia, although some summary data is available directly on the PT. Indocement website www.indocement.co.id

In 2003, the company made a voluntary commitment to reduce its global net GHGe by 15% in 2010 compared with 1990. The specific GHGe have dropped from 783kg CO_2/tonnes cement in 1990 to 640kg CO_2/tonnes cement in 2008 (or a reduction of more than 18%). This was achieved by:

- *Improving energy efficiency;*
- *Reducing the proportion of clinker in the final products (down to 75%); and*
- *Increasing the use of alternative fuels such as biomass.*

HeidelbergCement has a global target to further decrease clinker proportion in cement to 70% by 2020. Because the company believes it has already implemented the "low hanging fruit" in terms of emissions reductions, it has turned its focus on development cement types containing a smaller proportion of clinker and on increasing use of biomass as fuel.

The company's strategy of reducing further GHGe globally is through replacing raw materials (such as the use of fly ash from coal-fired power stations and blast furnace slag from steel production) and using alternative fuels (such as sewage sludge, rick husks and hazardous waste).

- *In 2008, the proportion of alternative raw materials used in clinker and cement production was 10.2% or 12.9 megatonnes. In the same year the proportion of alternative fuels used in the fuel mix was 17.5% worldwide with sewage sludge and rice husks as the dominant biomass.*
- *HeidelbergCement has a global aim of increasing the proportion of alternative fuels to 22% by 2012 and share of alternative raw materials to 11% by 2012.*

HeidelbergCement is an investor in a Carbon Capture and Storage (CCS) project near their Brevik plant in Norway.

National Company Characteristics – PT. Indocement

Ownership of PT. Indocement as of June 30, 2009 is Birchwood Omina Ltd, England (51%), PT. Mekar Perkasa (13%) and public (34%).

Specifically regarding PT. Indocement's cement operations it has a total annual capacity of 17.1 megatonnes [PT. Indocement – Annual report, 2008]. As of June 2008 it owned and operated 12 plants in three sites - nine of which are located in Citeureup, Bogor, West Java (11.9 megatonnes); two in Palimanan, Cirebon, West Java (2.6 megatonnes); and one in Tarjun, Kotabaru, South Kalimantan (2.6 megatonnes).

The company's main products are PCC and OPC. It also produces other types of cement such as Portland Cement Type I and Type V, as well as OWC. PT. Indocement is the only White Cement producer in Indonesia.

In 2007 it acquired 51% of shares of PT. Gunung Tua Mandiri, a new developed aggregates quarry in Rumpin, West Java. In the same year, it began revamping Plant 8 at Citeureup providing additional annual designed production capacity of 600,000 tonnes of cement p.a.

PT. Indocement also has investments in ready-mix concrete, cement trading, terminal operations, aggregate mining, shipping, industrial estate and investment (Cayman Island) [PT. Indocement – Annual report, 2008].

PT. Indocement's product lines are marketed under a brand name of "Tiga Roda". The Ordinary Portland Cement and the newly produced Portland Composite Cement have been contributing more than 90% of total domestic sales and have recently become main products of the company. Besides the above products, PT. Indocement also produces special cement types, such as White Cement, normally used for tile adhesive and many decorative applications. Oil Well Cement is used for oil and gas drilling on-shore and off-shore. The company is also producing cement for marine and underwater structures that requires sulphate resistance. These are 2 types (which are) known as OPC Type II & V.

With respect to power generation, Citeureup (300MW) and Tarjun (55MW) cement factories have their own on-site electricity generation. Citeureup uses a combination of diesel and gas turbine as well as a waste heat-recovery system while Tarjun uses a coal-fired electricity generator. Cirebon purchases electricity from PLN the national power company, but also has its own back-up generating facilities. Diesel oil and natural gas is purchased from the Government-owned oil and gas company to power the electricity generation facilities.

Appendix 3

Table 5-1: Indonesian Cement Companies - Details

Company	Operation Since	Share Holders		Product	Process type
Semen Gresik Group		*51.01%*	*Government*		
		24.90%	*Blue Valley Holdings Pte. Ltd.*		
		24.09%	*Public*		
• PT. Semen Padang (SP)	*1910*			*Portland Type 1, 2, 3, 5; Oil well Cement, Class G HRS; Super Masonry Cement; Portland Pozzolan Cement*	*Dry Process*
• PT. Semen Gresik, Tbk. (SG)	*1957*			*Portland Cement Type 1; Super Masonry Cement; Portland Pozzolan Cement*	*Dry Process*
• PT. Semen Tonasa (ST)	*1968*			*Portland Type 1, 2, 3, and 5; Mixed Cement*	*Dry Process/ Integrated*
PT. Holcim Indonesia, Tbk (HI)	*1975*	*77.33%*	*Holcim*	*Portland Type 1, 2, 3, 5; Portland Composit Cement; Oilwell Cement, Class G HRS/MSR*	*Dry Process*
		22.67%	*Public and Creditors*		
PT. Indocement Tunggal Prakarsa, Tbk (ITP)	*1975*	*65.14%*	*HC Indocement GmbH*	*Portland Cement Type 1, 2, 5; Oilwell Cement, Class G HRS; Portland Composit Cement; Mixed Cement; White Cement*	*Dry Process/ Integrated*
		13.03%	*PT. Mekar Perkasa*		
		21.83%	*Public*		
PT. Semen Baturaja (SB)	*1980*	*100%*	*Government*	*Portland Cement Type 1*	*Dry Process/ Integrated*
PT. Semen Andalas (SAI)	*1982*	*88.00%*	*Cementia Holding AG*	*Portland Type 1*	*Dry Process/ Integrated*
		12.00%	*IFC*		
PT. Semen Bosowa Maros (SBM)	*1999*	*100%*	*National Private Company*	*Portland Cement Type 1*	*Dry Process/ Integrated*
PT. Semen Kupang (SK)	*1984*	*100%*	*Government*	*Portland Cement Type 1*	*Dry Process/ Integrated*

Source: [ASI, 2008]

Table 5-2: Clinker and Cement Capacity, Production and Utility by Cement Company

Clinker

(volume in tonnes)

Company	2005			2006			2007			2008		
	Capacity	Production	Utility (%)	Capacity	Production	Utility (%)	Capacity	Production	Utility (%)	Capacity	Production	Utility (%)
PT. Semen Andalas Indonesia	-	-	-	-	-	-	-	-	-	-	-	-
PT. Semen Padang	5,100,000	4,925,195	97	5,000,000	5,163,030	103	5,000,000	5,171,748	103	5,000,000	5,288,850	106
PT. Semen Baturaja	1,200,000	877,812	73	1,200,000	878,043	73	1,200,000	914,161	76	1,200,000	1,002,449	84
PT. Indocement Tunggal Prakarsa	14,800,000	10,689,193	72	14,800,000	11,724,320	79	14,800,000	12,870,842	87	14,800,000	12,772,758	86
PT. Holcim Indonesia Tbk	8,800,000	5,883,197	67	7,800,000	5,694,250	73	7,800,000	5,934,099	76	7,800,000	5,968,541	77
PT. Semen Gresik	7,400,000	7,023,311	95	6,600,000	7,030,035	107	6,600,000	7,068,586	107	6,600,000	7,550,172	114
PT. Semen Tonasa	3,380,000	3,134,133	93	3,320,000	3,179,634	96	3,320,000	2,714,902	82	3,320,000	3,359,436	101
PT. Semen Bosowa Maros	1,710,000	1,409,119	82	1,710,000	1,239,699	72	1,710,000	1,186,524	69	1,710,000	1,333,392	78
PT. Semen Kupang	300,000	62,302	21	300,000	60,715	20	300,000	52,902	18	300,000	25,573	9
Total	42,690,000	34,004,262	80	40,730,000	34,969,726	86	40,730,000	35,913,764	88	40,730,000	37,301,171	92

Cement *(volume in tonnes)*

Company	2005			2006			2007			2008		
	Capacity	Production	Utility (%)	Capacity	Production	Utility (%)	Capacity	Production	Utility (%)	Capacity	Production	Utility (%)
PT. Semen Andalas Indonesia	-	-	-	-	-	-	-	-	-	-	-	-
PT. Semen Padang	*5,440,000*	*5,112,440*	*94*	*5,240,000*	*5,402,822*	*103*	*5,240,000*	*5,473,573*	*104*	*5,900,000*	*5,840,189*	*99*
PT. Semen Baturaja	*1,250,000*	*893,630*	*71*	*1,250,000*	*925,274*	*74*	*1,250,000*	*1,010,227*	*81*	*1,250,000*	*1,049,849*	*84*
PT. Indocement Tunggal Prakarsa		*10,634,630*	*68*	*15,650,000*	*10,226,773*	*65*	*15,650,000*	*11,084,597*	*71*	*17,100,000*	*12,544,436*	*73*
PT. Holcim Indonesia Tbk	*9,700,000*	*5,647,850*	*58*	*8,700,000*	*4,557,317*	*52*	*8,700,000*	*5,517,564*	*63*	*8,500,000*	*5,807,522*	*68*
PT. Semen Gresik	*8,200,000*	*7,912,589*	*96*	*8,200,000*	*8,021,565*	*98*	*8,200,000*	*7,868,834*	*96*	*8,600,000*	*8,875,240*	*103*
PT. Semen Tonasa	*3,480,000*	*2,697,544*	*78*	*3,480,000*	*2,774,814*	*80*	*3,480,000*	*3,017,901*	*87*	*3,500,000*	*3,456,130*	*99*
PT. Semen Bosowa Maros	*1,800,000*	*949,323*	*53*	*1,800,000*	*1,041,776*	*58*	*1,800,000*	*994,256*	*55*	*1,800,000*	*1,349,154*	*75*
PT. Semen Kupang	*570,000*	*68,974*	*12*	*570,000*	*82,113*	*14*	*570,000*	*65,574*	*12*	*570,000*	*24,363*	*4*
Total		*33,916,980*	*74*	*44,890,000*	*33,032,454*	*74*	*44,890,000*	*35,032,526*	*78*	*47,220,000*	*38,946,883*	*82*

Sources: [ASI, 2008, PT. Semen Gesik – Annual report, 2008, PT. Indocement – Annual report, 2008, PT. Holcim – Annual report, 2008]

Table 5-3: Domestic Cement Sales by Cement Company

(volumes in tonnes)

Company	Domestic Sales				
	2007	Share (%)	2008	Share (%)	Growth (%)
PT. Semen Andalas Indonesia	1,399,861	4.1	1,551,128	4.0	10.8
PT. Semen Padang	4,836,439	14.1	5,124,201	13.4	5.9
PT. Semen Baturaja	1,015,887	3.0	1,062,524	2.8	4.6
PT. Indocement Tunggal Prakarsa Tbk	10,746,157	31.3	12,323,872	32.1	14.7
PT. Holcim Indonesia Tbk	4,972,938	14.5	5,372,601	14.0	8.0
PT. Semen Gresik	7,399,327	21.5	8,351,054	21.8	12.9
PT. Semen Tonasa	2,935,231	8.5	3,179,986	8.3	8.3
PT. Semen Bosowa Maros	1,003,624	2.9	1,358,264	3.5	35.3
PT. Semen Kupang	56,857	0.2	20,968	0.1	(63.1)
Total	**34,355,321**	**100.0**	**38,344,598**	**100.0**	**11.4**

Sources: [ASI, 2008, PT. Indocement – Annual report, 2008]

Table 5-4: Clinker and Cement Exports by Cement Company

(volumes in tonnes)

Company	Clinker		Cement	
	2007	2008	2007	2008
PT. Semen Andalas Indonesia	-	-	-	-
PT. Semen Padang	44,563	-	1,566,407	894,806
PT. Semen Baturaja	-	-	-	-
PT. Indocement Tunggal Prakarsa Tbk	3,288,744	2,226,344	528,171	111,343
PT. Holcim Indonesia Tbk	1,335,692	1,045,241	643,146	537,078
PT. Semen Gresik	-	-	112,191	-
PT. Semen Tonasa	16,518	-	110,690	117,971
PT. Semen Bosowa Maros	187,740	58,103	-	11,200
PT. Semen Kupang	-	-	-	-
Total	**4,873,257**	**3,329,688**	**2,960,605**	**1,672,398**

Sources: [ASI, 2008, PT. Indocement – Annual report, 2008]

Appendix 4

Eco Cement

Eco Cement[36][37] is made by blending reactive magnesium oxide with conventional hydraulic cements. The magnesium oxide will first hydrate using water and then carbonate, forming strength giving minerals in a low alkaline matrix. Many different wastes can be used as aggregates and fillers without reaction problems due to the low alkaline levels.

The reactive magnesium oxide is currently made from a compound of magnesium. As a natural resource (magnesium is the 8th most abundant element on earth), magnesium can be either be mined, extracted from sea water, or may even become available from power stations after it has been used to store CO_2 from their smoke stacks.

Magnesia hydrates to magnesium hydroxide in any concrete but only in porous materials like bricks, blocks, pavers and porous pavements will it absorb C02 and carbonate quickly. As a porous material it needs CO_2 to harden and set. The more magnesium oxide, the more CO_2 is absorbed. This forms stronger fibres that bond together bulky material such as sand and gravel. This needs to be balanced, as the more porous it is, the more the strength is compromised (70% of uses of cement can be low strength).

The absorption rate of C02 varies with porosity, from quickly at first, to slow towards completion. A typical eco-concrete block is expected to be fully carbonated (ie. full absorption of CO_2) after 1 year or so. Eco-cement has the ability to be almost fully recycled back into cement, should the concrete become obsolete.

Steps involved in making the cement:

1. *The Magnesite (a compound of magnesium) is heated in a kiln to around 650 or 700 degrees celcius. The lower firing temperature of the kiln makes it easier to use free energy such as wind, solar, or even waste power. Less fossil fuels are subsequently burnt, but the CO2 gases produced from the magnesium heating are ideally captured via a kiln and contained for further use or safe disposal.*
2. *The heating process produces reactive magnesium oxide (magnesia).*
3. *The magnesia (powder) is added to a pre-determined, but variable amount of hydraulic cement, and if desired, reactive wastes like fly ash.*
4. *The resulting blended powder is Eco-Cement.*
5. *When mixed with water and aggregates, such as sand, gravel and wastes, Eco-Cement concretes are ready for pouring into concrete or pressing into blocks.*

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[36] *http://www.abc.net.au/tv/newinventors/txt/s1296184.htm*

[37] *http://www.tececo.com/products.eco-cement.php*

Appendix 5

World Business Council for Sustainable Development – Cement Sustainability Initiative

The World Business Council for Sustainable Development (WBCSD) is a CEO-led membership based organization of some 200 international companies, representing more than 36 countries and 22 major industrial sectors. Its purpose is to provide business leadership as a catalyst towards sustainable development.

The Cement Sustainability Initiative (CSI) is a global effort by 18 leading cement producers, with operations in more than 100 countries. Collectively these companies account for about 30% of the world's cement production and range in size from very large multinationals to smaller local producers. All CSI members have integrated sustainable development into their business strategies and operations, as they seek strong financial performance with an equally strong commitment to social and environmental responsibility.

The Getting the Numbers Right (GNR) system is a sector-wide global information database that provides accurate, verified data on the cement industry's CO_2 *emissions and energy performance. To June 2009, the GNR is the system with the widest data coverage in the cement industry, providing aggregated data on more than 800 individual cement facilities worldwide over more than 100 countries. The database currently includes data for the years 1990, 2000, 2005 and 2006. Program participants from the CSI began independent third party assurance of their* CO_2 *emissions information with 2006-data.*

The database is independently managed by Pricewaterhouse Coopers (PwC), who provide data security to manage antitrust and confidentiality concerns. Participants and interested parties can only see aggregated data on global and regional performance. "GNR shows that an effective measuring, reporting and verification (MRV) system can be developed and managed by an industry. Furthermore, reliable and up-to-date emissions data is critical for emissions benchmark-setting in a sector like cement

Appendix 6

AFCM Sustainable Development Initiative

AFCM SUSTAINABLE DEVELOPMENT INITIATIVE[38] OUR AGENDA FOR ACTION JUNE 2008

The members of the ASEAN Federation of Cement Manufacturers (AFCM) believe that sustainable development is a fundamental challenge facing humanity today, and that our industry needs an agenda for action that will prepare it for this challenge.

This initiative aims to increase both our contribution to sustainable development and the public's understanding of that contribution. A sustainable future cannot be achieved by a single industry acting in isolation. Some of the measures we have committed to can be implemented in the short term while others will require a longer period of planning and adaptation.

We recognize the need to identify the key issues we need to tackle, and some potential solutions to the challenges they pose. We therefore set out to formulate an agenda for action that we can take over the next five years, including the partnerships we need to develop to deliver them. We will report our progress on the plan in 2012. In signing this document, we will voluntarily implement programs in the following areas:

- CO_2 *Management.*
- *Responsible use of fuels and raw materials.*
- *Health and Safety.*
- *Continuous compliance with the required standards on emissions of the country where our member cement companies are located.*
- *Contribute to the wellbeing of local communities where our member cement companies are located.*

We acknowledge that sustainable development presents our ASEAN Federation of Cement Manufacturers and our member cement companies with long-term strategic challenges. Individually, each of our companies has already taken effective action on a range of environmental and social issues, and has achievements to be proud of. But there is still much to be done. We have to continue to find ways of integrating strong financial performance with an equally strong commitment to social and environmental responsibility and an open and honest dialogue with our stakeholders.

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[38] *http://afcm-org.net/sustainable.html*

BRUNEI

INDONESIA

MALAYSIA

PHILIPPINES

SINGAPORE

THAILAND

VIETNAM

Appendix 7

Climate Change Levy

What is it?

The Climate Change Levy (CCL) was set up to encourage the business and public sectors to improve energy efficiency and reduce emissions of greenhouse gases through a price based signal on energy usage.

There are ten major energy intensive industries (aluminium, cement, ceramics, chemicals, food & drink, foundries, glass, non-ferrous metals, paper, and steel) and over thirty smaller industries with agreements to-date.

The CCL came into effect on 1st April 2001 and applies to energy used in the non-domestic sector (industry, commerce, and the public sector).

Rates of the levy are (p = British pence):

- *0.159p/ kWh for gas*
- *1.242p/ kg for coal*
- *1.018p/ kg for liquefied petroleum gas (LPG)*
- *0.456p/ kWh for electricity*

The levy rates for different fuels remained flat since their introduction in 2001, however from 1 April 2007 they were increased in line with inflation.

The levy does not apply to fuels used by the domestic or transportation sector, or fuels used for the production of other forms of energy (e.g. electricity generation) - there are also other specific energy sources that are exempt, including electricity generated from new renewables.

In order to protect the competitiveness of energy intensive industries subject to international competition, Climate Change Agreements (CCAs) were introduced alongside the levy which provide an 80% discount on the levy if challenging targets are agreed and met for improving energy efficiency or reducing GHGe.

The package of measures introduced with the Climate Change Levy also included the Carbon Trust and the Government's Enhanced Capital Allowances (ECAs) Scheme for investments in energy saving technologies and products. Both help businesses reduce their energy use and the development and adoption of low carbon technologies. The Carbon Trust is funded (at least in part) by the levy. The levy receipts also offset the tax revenues forgone by the Government due to the use of enhanced capital allowances.

ECAs are a straightforward way for a business to improve its cash flow through accelerated tax relief. The ECA scheme for energy-saving technologies encourages businesses to invest in energy-saving plant or machinery specified on the Energy Technology List (ETL) which is managed by the Carbon Trust on behalf of Government.

The ECA scheme provides businesses with 100% first year tax relief on their qualifying capital expenditure. The ETL specifies the energy-saving technologies that are included in the ECA scheme. The scheme allows businesses to write off the whole cost of the equipment against taxable profits in the year of purchase. This can provide a cash flow boost and an incentive to invest in energy-saving equipment which normally carries a price premium when compared to less efficient alternatives.

An example

So if your business pays corporation tax at 28%, every 1,000GBP spent on qualifying equipment would reduce its tax bill in the year of purchase by 280GBP. In contrast, for every 1,000GBP spent, the generally available capital allowance for spending on plant and machinery[39] would reduce your business' tax bill in the year of purchase by 56GBP. In other words, an ECA can provide a cash flow boost of 224GBP for every 1,000GBP it spends in the year of purchase[40].

Technologies include:

- *Air to Air Energy Recovery*
- *Automatic Monitoring and Targeting*
- *Biomass Boilers and Room Heaters*
- *Commercial and retail refrigeration equipment*
- *Compressed Air Equipment*
- *Heating Ventilation and Air conditioning (HVAC) zone controls*
- *Heat Pumps*
- *Industrial refrigeration equipment*
- *Lighting*
- *Motors and Drives*
- *Pipework Insulation*
- *Radiant Heating*
- *Solar Thermal*
- *Warm Air Heating*

[39] *20% a year on the reducing balance basis.*

[40] *ECAs provide 100% tax relief, so there is no further tax relief in later years. The general rate of capital allowances does not provide 100% tax relief so there is a balance of spending to carry forward on the reducing balance basis for relief in later years.*

Why does this policy suit the Indonesian condition?

There are three main reasons that the CCL applied to Indonesian industry – commencing with cement – is ideal for Indonesia.

- *Industry says that it needs both regulation (certainty of fair rules for all companies) and incentives to reduce emissions. On the list of priorities for the cement industry, reducing GHGe is low down. In order for the cement industry to elevate the decision for a new efficiency plant for example, it would need to be (a) helping meet compliance; (b) be profitable and (c) easy to do.*
- *The indusry is comprised of both private and publically owned companies. Policies to incentivise emission reductions have to be sensitive to both the different funding/financing policies of the companies as well as their responsibiliites to their respective stakeholders.*
- *Different plants have different abatement opportunities; one blanket prescriptive policy will not suit all plants. Policy has to be designed to enable each plant to find its most appropriate and viable emission reduction projects. In most cases, these will be least cost.*