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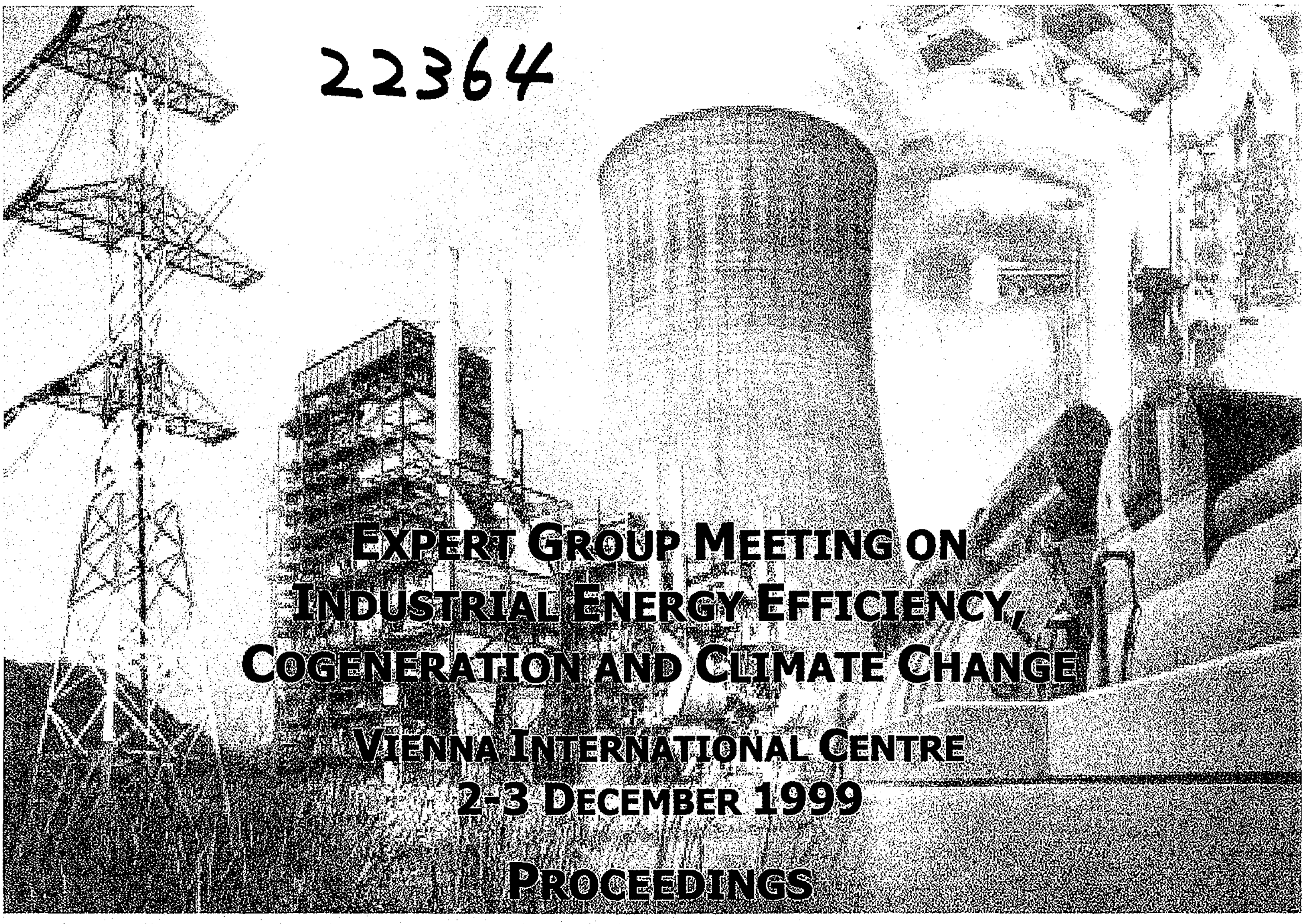

Expert Group Meeting on Industrial Energy Efficiency, Cogeneration and Climate Change

Vienna International Centre
2-3 December 1999

Proceedings

Organized by Kyoto Protocol Branch, UNIDO
in co-operation with
International Cogeneration Alliance &
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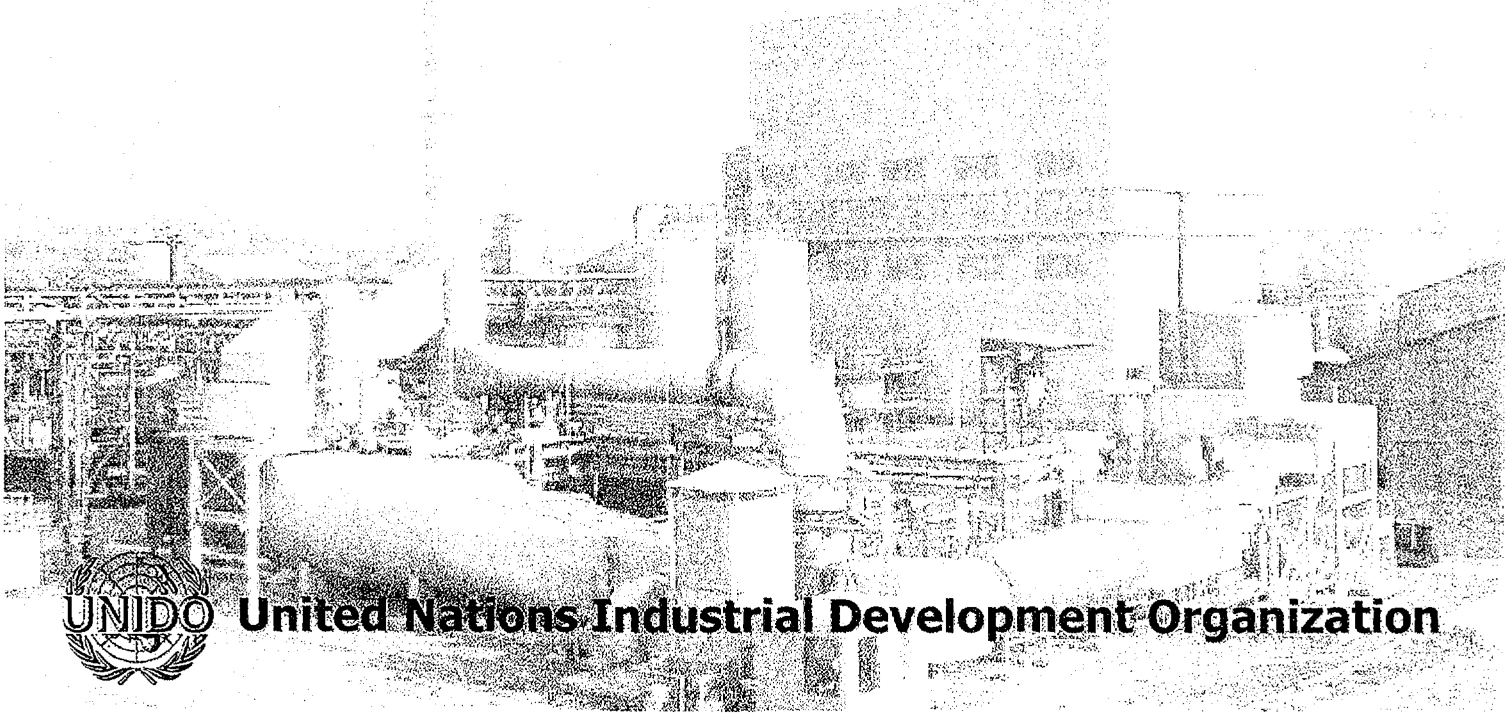

UNIDO United Nations Industrial Development Organization

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INTRODUCTION

1. Brief Description

The Expert Group Meeting (EGM) has provided a forum for improving the awareness of industrial energy efficiency (with a focus on cogeneration technologies), through identifying barriers to and opportunities for its effective deployment in developing and transitional economies.

The objective of the meeting was to address energy efficiency, cogeneration and greenhouse gas mitigation options in the national context of participating countries, as well as bringing about the necessary focus and action needed for strengthening the capacity of the industrial sector for their full participation in the Clean Development Mechanism (CDM). It has also provided an opportunity for discussing technical and managerial aspects of energy efficiency/cogeneration technologies and issues in project design and project financing in the context of CDM.

The meeting has bought together policy-makers, consultants, industry professionals and managers from developing countries and economies in transition in addition to representatives from international organizations dealing with climate change and energy efficiency issues.

2. Clean Development Mechanism(CDM) & Joint Implementation(JI)

The Kyoto Protocol introduces two project-based mechanisms that allow Parties with national emissions cap to achieve emissions reductions outside their boarders. Articel 6 of the Protocol introduces JI and sets the ground for the transfer of emissions reduction units (ERUs) among Annex I Parties.

The CDM allows legal entities in developing countries to undertake co-operative projects with partners from Annex I countries in order to generate certified emissions reduction units(CERUs). CERUs are transferable to Annex I investor countries and can be used to augment the allocated amounts of emissions in the first budget period (2008-2012). CDM projects are to be undertaken for the benefit of both parties and should lead to emissions reductions that are real, measurable and long-term. Such projects are also expected to result in demonstrable non-GHG benefits (i.e. environmental and socio-economic benefits) to the recipient developing country.

The modalities for the implementation of the CDM have yet to be developed and clarified through negotiations. To receive recognition as credits, project-based emissions reductions have to be additional to any that would have taken place in the absence of CDM or JI investment. Establishing additionality and baselines for project-based emissions reductions is one of the most challenging problems that have to be addressed in order to make the CDM and JI workable.

Additionality determination (in particular financial additionality) is a particularly challenging task for energy-efficiency projects, as these projects are regarded most cost-effective in reducing emissions. It will be difficult to make a distinction between cost-effective (and hence competitive) projects and those that are not financially additional. The EGM has briefly touched on this issue in Session IV.

3. Industrial Energy Efficiency

The industrial sector accounts for some 41 per cent of global primary energy demand and approximately the same share of CO_2 emissions. GHG emissions can be substantially cut in this sector through policies and initiatives that stimulate market transformation and new technologies which would help improve end-use energy efficiency by recovering waste heat (in the case of cogeneration).

Although industrial energy efficiency has improved greatly in industrialized countries, efficiency gains have remained low in developing countries and economies in transition. In some cases, the energy intensity and carbon intensity of industrial output has increased despite an economic slow down. The promotion of cogeneration and end-use efficiency in the industrial sector can not only reduce emissions but also contribute to improvements in productivity and competitiveness and in the security of energy supply.

These economic, environmental and social benefits of cogeneration suggest that there is a potential for developing CDM or JI projects which would support the introduction of cogeneration and promote industrial end-use efficiency as a climate change mitigation option in industry.

There are, however, barriers to such introduction some of which have been pointed out during the EGM as technical, financial, regulatory and institutional related. Detailed documentation on this can be found in EGM Conclusions and Recommendations.

4. Agenda

The EGM comprised 5 sessions.

Session I looked at country experiences in industrial energy efficiency and cogeneration, starting with India, Philippines, Argentina, Egypt and ASEAN region as a whole, moving on to economies in transition countries such as Russia, Ukraine and Georgia.

Session II examined technological and business aspects of industrial energy efficiency and cogeneration. Session III introduced sectoral experiences focusing on chemical, sugar, wood and agro-industry as well as Swiss Activities Implemented Jointly (AIJ) experiences with district heating projects in Romania.

Session IV dealt with the issues of barrier identification and removal for the effective deployment of industrial energy efficiency. This session also involved panel discussion on the issue and initial recommendations were put forward.

Lastly, Session V touched on developing CDM/JI energy efficiency/cogeneration projects and various methodological issues that need to be considered and complied in accordance with the Protocol.

CONCLUSIONS AND RECOMMENDATIONS

Energy and energy services play a central role in economic development. As a developing economy industrializes, its needs for energy per unit GDP increase steeply, before flattening out similar to those in the post-industrial service economies. Although there is no inherent incompatibility between environment and development, growing demand for energy and energy services has become associated with adverse consequences for the global and local environment, unless energy policy and environmental management shift towards a greater focus on structuring energy systems that promote sustainable development. Therefore, one of the key challenges that nations face today is scaling up industrial activities in an economically, socially and environmentally sustainable way. This requires a reform at the policy level where energy decisions are made. In particular, it will require replacing conventional top-down energy supply paradigm with the one that recognizes the merits of competitive market for energy generation and end-use efficiency.

Industry accounts for some 35 per cent of global economic activity and 43 per cent of global energy demand. Energy efficiency improvements in industry, including transport, should therefore continue to be an important component of energy policy.

Industrial energy efficiency measures include improved housekeeping procedures, maintenance, process control and automation, the replacement of outdated plant and equipment with the modern energy-efficient equivalent, and the recovery of embodied energy in recycled industrial post-consumer wastes. In many developing and transition economy countries, cogeneration of power and process heat/steam based on natural gas is a commercially attractive option. Biomass-based cogeneration, employing modern, efficient technology can be a cost-effective and low greenhouse gas-emitting option where biomass is available either as an agro-industry byproduct or from energy plantations.

Therefore, in order to develop industrial energy efficiency as a new mitigation strategy for greenhouse gases and other pollutants, enabling framework and policy initiatives will have to be created at national and international level. This may come into form in the first instance by international organizations providing information and technical or consulting support to entities within nations. The framework will encourage the transfer and deployment of energy efficient technologies/measures at the enterprise level which would then enable the industry to deliver energy efficient products and services to consumers.

The development of carbon trading is seen as a key mechanism by which energy and environmentally efficient investments can be encouraged from already energy-efficient companies. Achieving CO_2 reductions is much cheaper and more successful if new generating plant replaces older power stations. The credits received by the investor would then satisfy their CO_2 reduction targets. Many developing countries are in need of continuous investment flows and this is a key way of drawing modern investment.

EGM on Energy Efficiency/Cogeneration and Climate Change has identified some barriers that currently prevent the more rapid uptake of energy efficiency measures, which include the following:

- technical barriers, including lack of information source and flow;
- financial/economic barriers;
- regulatory barriers;
- institutional barriers; and
- lack of skilled personnel and behavioral barriers.

Technical barriers have been identified as inconvenient connectivity or inaccessibility to the grid for despatching excess power generated in the case of cogeneration plants. Moreover, lack of information or database on successful energy efficiency technologies, their adequate demonstration experiences and information dissemination have been pointed out as obstacles.

Financial/economic barriers have been recognized as high initial investment costs and inadequate financing instruments/mechanisms for implementing energy efficiency projects, lack of financial security in the project host country, very low tariffs for surplus cogenerated electricity sold to the grid, and the problem of government subsidies affecting energy prices. Also, uncoordinated gas and electricity prices were identified as a barrier.

Regulatory barriers have been pointed out as under-developed legislation for private power, ineffective compliance monitoring and enforcement of regulations on emissions of atmospheric pollutants, and lack of appropriate legislative incentives that recognize the overall efficiency of cogeneration.

Institutional/organizational barriers have been specified as inadequate capacity building of the stakeholders, lack of commercial/business and support service networks on a sustainable basis, lack of a coordinated approach by Government authorities, and unfavorable investment climate in a number of developing countries and economies in transition.

Lack of skilled personnel and behavioral barriers have been pointed out as insufficient training and human resource development in the energy efficiency-related field, and lack of awareness and realization of potential benefits from the key decision makers.

Based on an analysis of these barriers, recommendations at the international, national and industrial level have been put forward by the EGM.

International Level Recommendation

- Provide assistance to countries in formulating national strategies and policy frameworks for meeting energy efficiency targets;

- There is a need for an International (or Intergovernmental) Center for Energy Efficiency and Cogeneration for addressing industrial efficiency in developing countries and economies in transition. It was also recommended that the institution should be encouraged and developed to bring about concrete activities and outcomes;

- Work with national and regional stakeholders for facilitating the smooth introduction of energy efficiency measures, addressing in particular,
  - identification and validation of energy efficiency/cogeneration potential, particularly in the sector-specific context;
  - prioritization of sectors and measures for energy efficiency/cogeneration as well as policies and strategies for barrier removal;
  - information dissemination on best practice measures and good housekeeping;
  - encouraging stakeholder participation through conferences/workshops in regions where industrial energy efficiency measures have been overlooked;
  - CDM/JI studies on industrial sector energy efficiency/cogeneration projects as climate change mitigation options including the clarification of the baseline and additionality issues;
  - development of mechanisms and protocols for monitoring, reporting and verification of emissions reductions resulting from enhanced industrial energy efficiency.

National Level Recommendation

With international support as appropriate, countries need to focus on facilitating the development of CDM/JI opportunities stemming from industrial energy efficiency and cogeneration projects where significant and commercially attractive markets exist to justify the accelerated introduction of energy efficiency measures. In this light, countries need to:

- Support the development of programmes for promoting industrial energy efficiency in cooperation with appropriate national stakeholders and preferably with existing institutions;

- Facilitate access to information on energy efficient industrial technologies to help reduce associated transaction costs;

- Provide support in the identification of projects that offer opportunities to small CDM/JI projects in rural areas, contributing to sustainable development in rural communities.

Industrial Level Recommendation

- Industries need to identify "easy-win" efficiency projects with short payback and environmental benefits, such as the promotion of metering and data collecting;

- Development of pilot AIJ projects for capacity building to facilitate full participation in the CDM/JI mechanism;

Finally, both at the international and national level, there is a need to increase the knowledge base and also to provide training for propagating energy efficiency/cogeneration technologies in the industrial sector. This could be achieved by providing information, sources of information and a common ground for exchanging information through internet sites and/or other relevant infrastructure.

Industrial energy efficiency measures not only mitigate climate change, but also generate a wide array of socio-economic benefits, including reduced energy costs, increased productivity and greater market competitiveness. Meanwhile, other indirect economic benefits ripple through the economy as reduced energy bills release more disposable income for other needs and services. Nonetheless, energy efficiency technologies have been historically underutilized as environmental control strategies. Likewise, many investments in efficiency which are cost-effective for the energy user based on direct energy savings alone, are not being undertaken due to a variety of barrier, including the inability of the market to recognize associated positive externalities such as pollution reduction and economic development benefits. This is where UNIDO believes it could play a role – by addressing the barriers and facilitating the introduction of efficiency measures in developing and transitional economies

WELCOMING REMARKS

By Mr. A. D'Ambrosio,
Managing Director
Sectoral Support and Environmental Sustainability Division

Good morning, Ladies and Gentlemen,

It is a pleasure for me to welcome you, on behalf of UNIDO, to the Expert Group Meeting on Industrial Energy Efficiency, Cogeneration and Climate Change.

Energy production and energy end-use are at the heart of technological strategies for mitigating climate change, and industrial sectors will play a central role in this global efforts.

Reductions in CO_2 emissions will have to be achieved against a backdrop of increased demand for energy services. Energy demand is growing with particular rapidity in the developing countries, where energy consumption is tightly correlated with economic growth. Two-thirds of the 65 per cent growth in global energy demand in the period from 1995 to 2020 is expected to take place in the developing countries and China.

While it is unrealistic for the developing nations to reduce demand in energy services necessary for economic development, there is a need for weakening the correlation between energy consumption and economic growth. This could be achieved by reducing the energy intensity of industrial production and by breaking the link between economic growth and growth in greenhouse gas (GHG) emissions.

A way of moving towards this path is through the transfer of low-emission technologies including energy management and energy saving. These offer the means to increase the use of energy services while decreasing or avoiding the associated GHG emissions, both in energy supply and industrial energy end-use.

Improved energy efficiency means doing more with equal or less energy input. This is the core concept of energy efficiency, and it should be a top priority in shifting towards sustainable energy systems.

To mention a few energy-efficient technologies and practices identified by the IPCC that are both currently available and under development , they are:

- process improvements;
- general housekeeping and maintenance programmes;
- energy management and accounting systems;
- new low-emissions technologies and processes;
- fuel switching ;
- material substitution, material recycling and reuse; and
- cogeneration.

I would also like to note that, according to the IPCC, some of the global energy scenarios that make use of low-emissions energy-efficiency technologies, including the aforementioned options, would probably be able to deliver energy services at costs that do not exceed the projected costs for conventional energy systems.

It is spelled out in the UNIDO mandate for sustainable industrialization that UNIDO is to take the lead role in facilitating low-emissions technology transfer and the deployment of such technologies in the developing countries and economies in transition.

The objective of our meeting is thus to discuss energy-efficiency technologies, and in particular cogeneration technologies, and reviewing their technical and economic potential for energy savings, as well as identifying technical, economic and regulatory barriers to their deployment in developing and transitional economies. The discussion will also be in line with the flexible mechanisms of the Kyoto Protocol, namely the Clean Development Mechanism (CDM) and Joint Implementation (JI).

Another objective of this meeting is to look at the technologies from the perspective of developing CDM and JI projects that, as stipulated in the Kyoto Protocol, are to yield "real, measurable and long-term" reductions in GHG emissions. Behind these concepts there are a number of fairly complex and technical issues - such as baselines and additionality assessment, and the monitoring/verification of reductions.

My argument today is threefold. First, I would like to point out that because the natural turnover rate of capital stock for energy investments is slow, energy-related investments have a virtual "lock-in" effect in the developmental path of the industrial sector. It then follows *that from the perspective of achieving sustainable development, it is more cost-effective and reasonable to influence the choice of technologies at the time of normal stock turnover.*

As applied to the situation of developing countries and particularly those of the African continent, this conclusion spells out the need to act now, at a time when the capital stock is being built. This means that the process of development or economic transition present the opportunity to make climate-friendly choices. Each time we oversee such opportunities, we are making decisions that will impact the global climate for decades to come. Missing these opportunities in developing countries and economies in transition to safeguard the global climate will bring about negative consequences to our global efforts.

Therefore, clear incentives are needed to induce technological choices and the transfer of low-emissions and energy-efficient measures. In this regard, it is critical to identify and remove the barriers that exist in the deployment of such technologies in developing countries, and it is equally crucial to identify and enact a policy framework that will facilitate the operation of CDM and JI.

This is a challenge for policy makers today. It is also a challenge for international organizations to support the process with programmes and technical assistance. This is where UNIDO sees its role, particularly in relation to Africa, where the issue of appropriate technology choices and the timeliness of such choices could not be more acute.

Secondly, I would like to comment *on the scope and the opportunities for energy-efficient choices in industry.*

Today, the global energy efficiency in converting primary energy into useful energy is 37 per cent. There is great room for improvement in energy efficiency, and there are significant markets to encourage these improvements. For example, recent UNDP World Energy Assessment indicates that the potential for energy efficiency in the energy-intensive industrial sub-sectors in Eastern Europe is as high as 41 per cent for the building materials industry, and approximately 31 per cent, 25 per cent and 24 per cent for the chemicals, aluminum and food industries respectively.

This high potential for energy savings is a clear indication of a significant energy-efficiency market. Its worth in the case of the Eastern and Central European region alone has been estimated (by IIEC) at US$40 billion, with a payback of less than three years. Comparing this with the financial performance and investment risks in new generating plants with a payback of 10 to 15 years, the energy-efficiency markets indeed represent big opportunities.

However, if there are many cost-effective energy-efficiency investment opportunities with as much desirable aspects, why is it that they are not implemented without the help of certain policy measures?

The fact that there are unrealized opportunities implies the existence of significant barriers. It would be most beneficial if you could address this issue in the context of your deliberations, focusing first on the barriers to investment in and implementation of energy-efficiency measures and technologies that applies to all economies, then those specific to the markets and economic systems of the developing countries. We could then share our views on possible policy instruments designed to remove such barriers.

Such policy measures may vary and be market- and/or non-market instruments, regulatory approaches and fiscal incentives. What is common, however, is the global framework of co-operation required in order to address such barriers in the context of the global response to the climate challenge.

And this brings me to my third point. *Global problems require global solutions.* Efforts to promote energy efficiency in both industrialized and developing countries have illuminated the need for closer collaboration, especially in the areas of technological innovation, technology transfer and strengthening the local. Strengthening global cooperation at the level of industry is another objective of UNIDO's efforts in the area of climate-change mitigation.

The global climate, is a global public good in the sense that its consumption is non-rival and non-excludable. That is to say the quality of earth's atmosphere is the same for all and cannot be chosen in different quantities for different people in different parts of the world.

But the "consumers" of this public good ultimately decide through their behavior and investment decisions how efficiently energy is used and therefore how its generation and end-use can adversely impact the global climate.

This is what makes climate change mitigation also a special public good. From a global efficiency perspective, this public good can best be delivered by the market, taking advantage of the differences in abatement costs in developed and developing countries.

Building such markets for global co-operation is a role that should be undertaken by the system of international organizations. UNIDO's contribution to this effort is being provided by focusing our efforts on the specific needs of industry in order to enable the full engagement of the sector in the market mechanisms for climate change mitigation.

The global co-operation framework links the efficiency and the "publicness" of climate change mitigation as well as another dimension of a global effort - the equity between the developing and developed countries. It all comes together in the context of the frequently asked question: who should pay for investments in energy efficiency improvements in the developing countries?

Investments in energy efficiency compete with other investment opportunities across the sectors within the domestic economy and between the developmental priorities of developing countries and economies in transition. The crux of this issue is whether developing countries and economies in transition will be in the position to mobilize enough private and public domestic investment and/or attract foreign investment to meet their domestic energy-related needs as well as global climate needs.

The prospects for leveraging foreign investment in the context of CDM and JI represent in fact an opportunity to bridge the competing priories of efficiency and equity. These mechanisms - the CDM and JI - will be able to deliver abatement, which is efficient in economic terms of costs and equitable in the sense that additional benefit of sustainable development is embedded for the recipient countries, i.e. developing countries and economies in transition.

In this light, this EGM should provide a ground for exploring the extent of which these opportunities could be utilized for the objective of promoting greater energy efficiency through technical measures such as the wider dissemination of cogeneration technologies.

Most energy efficiency and cogeneration options have a high internal rate of return (IRR), relatively short payback periods and low or sometimes negative CO_2 abatement costs compared to other options. The questions is therefore whether these seemingly "no regret", "win-win" options do qualify as additional as specified by Article 6 and Article 12 of the Kyoto Protocol.

The question is therefore the issue of quantifying project additionality and baseline emissions that properly integrate foreseeable technological switch and possible leakages, be they positive or negative. These are real methodological challenges and UNIDO hopes to address these challenges through its work in capacity building and the development of internationally acceptable methodologies for CDM/JI project development.

Cogeneration and other energy efficiency measures represent a challenging case from that perspective and we hope to benefit from your presence here in order to shed more light on these issues.

Cogeneration and energy efficiency projects undertaken in the context of CDM/JI will also require monitoring at the utility end. Detailed monitoring mechanisms will therefore have to be developed. The other parts of this process are reporting and verification, which will require the development of detailed formats and protocols and which are inextricably linked with the issue of baselines and additionality determination.

In short, there is a set of fairly complex methodological issues which will have to be addressed and your meeting today represent, in my view, the most appropriate forum.

Ladies and Gentlemen, thank you for your attention.

EXPERT GROUP MEETING AGENDA

THURSDAY, 2 DECEMBER

08:00 - 09:00	REGISTRATION OF PARTICIPANTS
09:00 - 09:30	OPENING OF MEETING/INTRODUCTION Introductory Statement: *Mr. R. Williams, Officer-in-Charge, Kyoto Protocol Branch, UNIDO* Welcoming Remarks: *Mr. A. D'Ambrosio, Managing Director, Sectoral Support and Environmental Sustainability Division,* UNIDO
09:30 - 10:00	KEYNOTE ADDRESS BY ICA *Dr. S. Minett, Director, COGEN Europe*
10:00 - 10:30	COFFEE BREAK
10:30 - 13:00	INDUSTRIAL ENERGY EFFICIENCY AND CHP: COUNTRY EXPERIENCES, SUCCESS STORIES, LESSONS LEARNED Discussion Facilitator: *Prof. E. Grünhut, Ph.D., Technology Manager, CIPURE-INTI, Argentina* Discussion Rapporteur: *Dr. A. Khozam, General Manager, Mideast Energy and Environment Services, Egypt* Summary presentations of country papers: ***Mr. S. Natu,*** *Energy & Projects Group, Mitcon Ltd.,India.* ***"Industrial Energy Efficiency, Cogeneration & Climate Change: An Indian Perspective"*** ***Mr. L. Velasco,*** *Country Coordinator, IIEC, Philippines* ***"Opportunities & Challenges in Promoting Energy Efficiency under the CDM"*** ***Dr. E. Grünhut, Technology Manager, CIPURE-INTI,*** *Argentina* *"Industrial Energy Efficiency and Climate Change Abatement"* ***Dr. A. Khozam,*** *General Manager, MEES, Egypt* *"Current State & Trend of Industrial Energy Efficiency & CHP in Egypt"* ***Dr. L. Lacrosse,*** *COGEN Technical Adviser, EC-ASEAN Cogen Programme, Asian Institute of Technology, Thailand* *"Biomass Cogeneration in ASEAN, GHG Mitigation Potential and Barreirs"*
13:00- 14:00	LUNCH

14:00 -15:00	**INDUSTRIAL ENERGY EFFICIENCY AND CHP: COUNTRY EXPERIENCES, SUCCESS STORIES, LESSONS LEARNED (CONT'D)**
	Economies in Transition Experiences: ***Mr. S. Molodtsov**, Russian Center for Energy policy* *"Industrial Energy Efficiency and Cogeneration: Russian Experience & Prospects"* ***Mr. V. Djukov**, Director, State Scientific Enterprise "UKRENERGOEFFECTIVNOST", Ministry of Energy, Ukraine* *"Ecological Problems of Power Industry in Ukraine"* ***Mr. T. Gzirishvili**, UNFCCC National Agency, Georgia* ***"Industry Sector in Georgia & Potential for GHG Abatement"***
15:00 - 16:30	**MARKETS FOR ENERGY EFFICIENCY AND CHP: OVERVIEW OF TECHNOLOGIES AND CDM/JI BUSINESS OPPORTUNITIES**
	Introductory Remarks: *M. Ploutakhina, Industrial Development Officer, Kyoto Protocol Branch, UNIDO* Discussion Facilitator: *Mr. S. Natu, India* Discussion Rapporteur: *Mr. L. Velasco, Philippines*
	OVERVIEW OF CDM/ENERGY EFFICIENT TECHNOLOGIES AND NEW MARKET OPPORTUNITIES IN THE CONTEXT OF CDM/JI
	***Prof. Fyodor Shutov**, PhD, Dr.Sci.* *Center For Manufacturing, Tennessee Technological University* *" Effective Energy Savings using Plastics Waste Recycling Technologies"*
	Dipl.-Ing. Otto Starzer *Energieverwertungsagentur* *"Energy Efficiency in the Austrian Industry"*
	Mr. Pascal Stijns *Honeywell Europe* *"Shareholder Value versus Carbon Dioxide"*
16:30 - 17:00	**COFFEE BREAK**
17:00 - 18:30	**SECTORAL EXPERIENCES: ENERGY CONSERVATION AND CHP USE IN INDUSTRIAL AND DISTRICT ENERGY SYSTEMS**
	***Ms. A. Omanga**, Chemist, Kenya Sugar Authority* *"Background to the Sugar Industry in Eastern Africa"*
	***Mr. N. Nziramasanga**, Technical Director, Southern Centre for Energy and Environment, Zimbabwe* *"Electricity Cogeneration: Possible Contribution from the Sugar Industry in Africa"*
	***Mr. R. Hellebrand**, AH Marks and Co. Ltd., U.K* *"Using Energy Management, CHP & ISO 14001 to make Substantial Reductions in Global Warming Potential*

Mr. A. Lüchinger, Factor Consulting + Management AG
"Swiss-Romanian Thermal Energy Project"

Mr. L. Lacrosse, Asian Institute of Technology, Thailand
"Cogeneration in Wood & Agroindustry: Case Studies on GHG Mitigation"

Dr. A. Khozam, General Manager, MEES, Egypt
"Energy Efficiency Improvements & GHG Reductions - GEF/UNDP Project"

FRIDAY, 3 DECEMBER

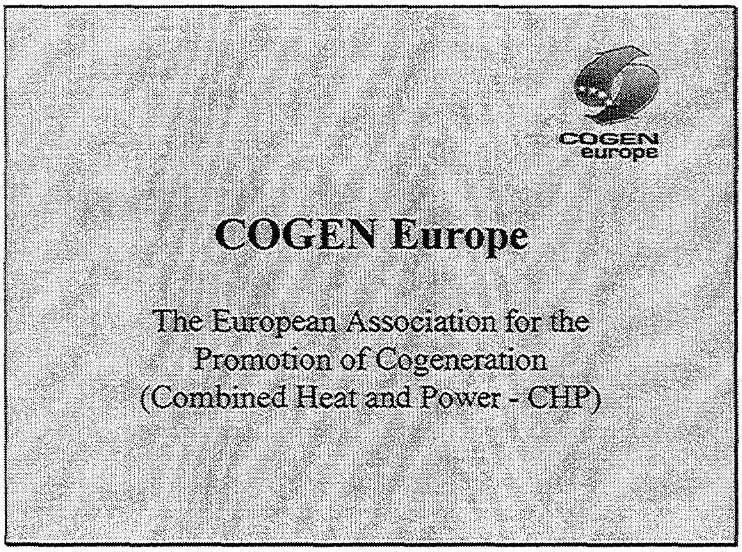
09:00 - 09:30	**REMOVING BARRIERS TO CHP AND INDUSTRIAL ENERGY EFFICIENCY: TECHNOLOGY, FINANCIAL, POLICY, REGULATORY AND CAPACITY BUILDING ISSUES**
	Facilitator: ***Mr. C. Gurkok, Director**, Industrial Energy Efficiency Branch, UNIDO*
	***Mr. R. Williams**, Officer-in-Charge, SES/KPR, UNIDO* *"Energy Conservation and GHG Emission Reduction in Chinese Township and Village Enterprises (TVE)"*
	***Dr. S. Minett**, Cogen Europe* *"A Major Challenge & Opportunity for Central & Eastern Europe"*
09:30 - 11:00	**PANEL DISCUSSION ON BARRIERS TO ENERGY EFFICIENCY & CHP (TECHNICAL, FINANCIAL, POLICY AND REGULATORY)**
	Discussion Facilitator: *Dr. S. Cogen Europe*
	Mr. S. Natu (Technical and Financial Issues) *Dr. L. Lacrosse (Barriers to Biomass Technology)* *Dr. L. Velasco (Capacity Building)* *Dr. S. Minett (Policy and Regulatory Issues)* *Dr. Grünhut (Barriers to Energy Efficiency)*
11:00 - 11:30	**COFFEE BREAK**
11:30 - 13:00	**DEVELOPING PROJECTS IN ENERGY EFFICIENCY AND CHP FOR CDM AND JI: ISSUES AND ANALYSIS**
	***Mr.U. Fritsche**, Coordinator, Energy & Climate Division Öko-Institut, Germany*
	"CDM Project Screening for Renewables, Energy Efficiency & Cogeneration using the EM & GEMIS Software"

	Mr. R. Williams, UNIDO *"IDENTIFY"*
	Ms. M. Ploutakhina, UNIDO *"Issues in Baselines and Additionality Analysis"*
	Mr. J. Jones, Manager, Lloyd's Register of Shipping, U.K *"Ensuring Effective Monitoring, Certification & Verification of Emissions"*
13:00 - 14:30	LUNCH
14:30 - 15:00	***Ms. P. Bhandary**, Convenor, Oil & Gas Area, Policy Analysis Division, TERI, India* *"Nature and Scope of CDM Projects"*
15:00 - 15:30	***Ms. H. Nussbaum**, Natsource, NY* *"Trading GHG in a World of Uncertainty: Managing Risk & Capturing Opportunity"*
15:30 - 16:00	**COFFEE BREAK**
16.00 - 17.30	**WRAP-UP/CONCLUSIONS** (RECOMMENDATIONS, ACTION PLAN, FOLLOW-UP TIME SCHEDULES FOR EACH ACTIVITY)
17:30	**CLOSING REMARKS**
18:00	**ADJOURN**

KEYNOTE ADDRESS BY ICA

Dr. Simon Minett, Director, COGEN Europe

Slide 1



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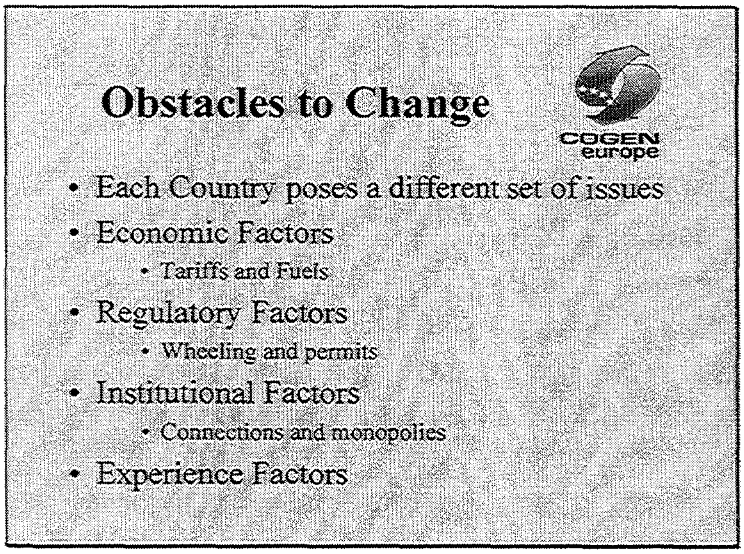


Slide 3

Overcoming Barriers

COGEN europe

- Acknowledging the benefits
- Strategy and Targets
- Getting both the gas and electricity industries aligned
- Long Term Planning
- Effective Programmes

Slide 4

Action Plan

COGEN europe

- A Positive Framework
- Fair Access Legislation
- Technology Development Programme
- Dissemination Programme (e.g. EU Best Practice)
- Co-ordination Body for Governments
- Fiscal Measures
- External Policy
- Promotional Networks
- Monitoring
- Own Use

Slide 5

National Action - 1

COGEN europe

- Targets
- Definitions
- National Planning Constraints
- Government Programmes
- Fiscal Measures
  - Accelerated depreciation
  - Rating System/VAT
  - Carbon taxation or a Climate levy
  - TPF/ESCOs
  - Grants and subsidies

Slide 6

National Action - 2

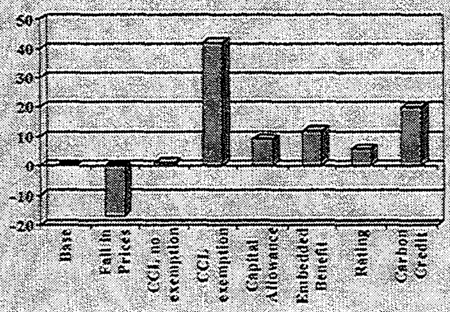
COGEN europe

- Interface with Electricity System
  - Transparency for connections
  - Load diversity benefits
- Standard Contracts for Small-Scale Cogeneration
- Fuel/Heat/Cooling Price Discrimination
- Authorisation Simplification
- Financial Rules - allow Inward Investment

Slide 7

Impact of Government Policies on Economics - % change in IRR

COGEN europe



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Blueprint for National Governments

COGEN europe

- Where possible use the market to achieve your environmental objectives;
- Remove market barriers to clean, decentralised forms of energy production;
- Avoid detailed regulation - it reduces efficiency and does not always work;
- Avoid subsidising pollution;
- Set clear and ambitious CO_2 objectives -
- Redouble political pressure to achieve international consensus on internalisation of environmental costs.

SESSION I. INDUSTRIAL ENRGY EFFICIENCY & COGENERATION: COUNTRY EXPERIENCES, SUCCESS STORIES & LESSONS LEARNED

1. Summary Presentation of Country Papers

1.1 India

Industrial Energy Efficiency, Cogeneration & Climate Change: An Indian Perspective

Mr. S. C. Natu, Vice President (Energy & Projects Group), Mitcon Ltd., India

Energy plays a central role in achieving India's priority development goals of poverty alleviation and sustainable economic growth. But the continued expansion of energy use may also lead to an increase in the GHG emissions and local pollutants that endanger the global and local environment unless policies to encourage energy efficiency and facilitate the deployment of low-emissions technologies are consistently applied.

Promoting energy efficiency and technologies that help industry to reduce emissions (particularly in the manufacturing sector) has been an important part of the country's development strategy for the past two decades. As a result of these efforts, some changes have been made to reduce CO_2 emissions, and the rate of increase of energy-related emissions in India has declined since the beginning of the last decade. Despite a favorable economic situation and gains in the efficiency with which energy is generated and used in the industrial sector, the pace of energy-efficiency improvements nevertheless remains slow and barriers to the deployment of energy-efficiency technologies continue to persist.

The latter are highlighted in the presentation by Mitcon, which demonstrates the relevance of energy-efficiency technologies to the objective of reducing energy intensity in the Indian economy in the context of a broader trend of expanding energy use to support economic growth.

The presentation outlines the current energy scenario in India, focusing on low energy productivity and the continuing dependence on coal-fired thermal capacities, energy shortages, price distortions and shortages of investment financing for energy projects. It also highlights the development incentives to the deployment of energy efficiency technologies and the barriers that are stifling this process. The presentation provides data on the potential for energy efficiency and CHP in such energy intensive industrial sub-sectors as pulp and paper, chemicals and petrochemicals, food, sugar, etc. It also indicates the scope for CDM projects in these sub-sectors by highlighting their carbon credit potential, the realizable potential for CHP and expected capacity replacement schedules.

The presentation concludes with an Action Plan suggesting the actions that need to be taken by various stakeholders and international organizations. This is for encouraging greater gains in energy efficiency, such as on-site generation, the use of biomass (including biomass cogenration) and the wider deployment of CHP as a means of reducing GHG emissions. A graphic representation of linkages showing the organization and networks of various stakeholders in facilitating energy efficiency and cogeneration CDM project is also provided.

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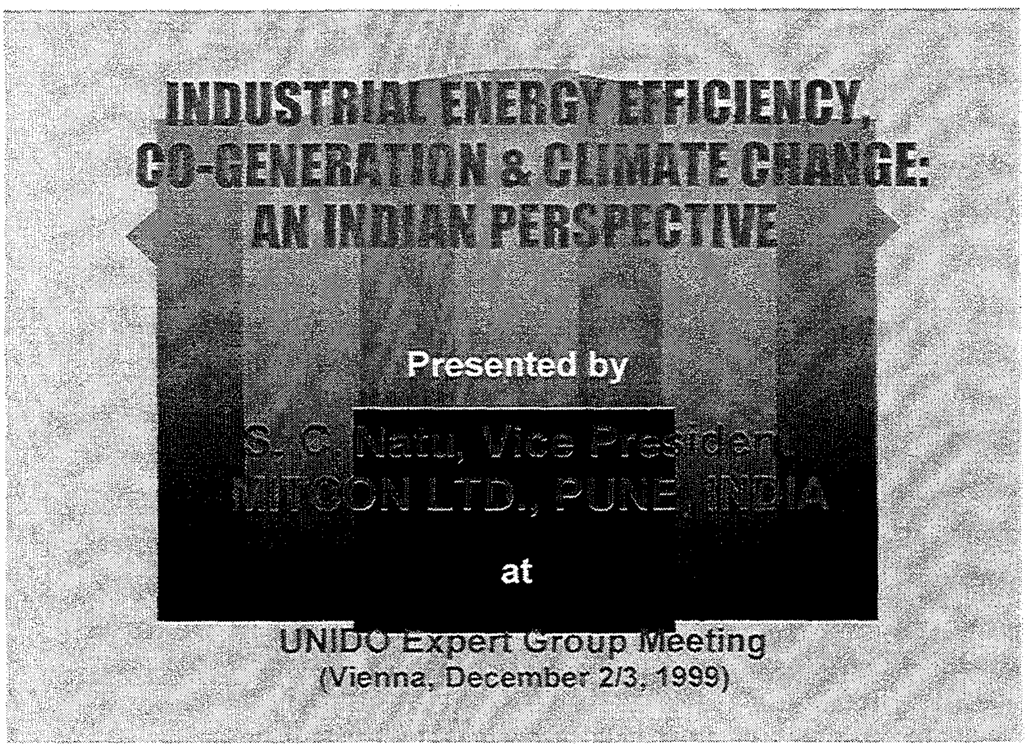

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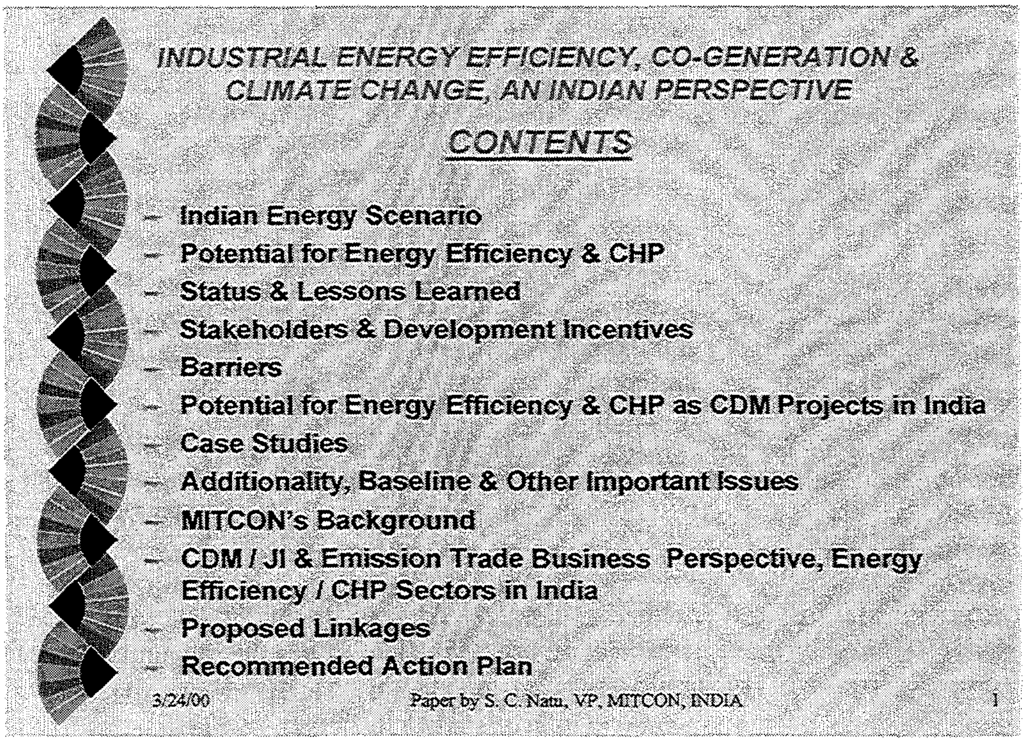

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INDIAN ENERGY SCENARIO

- Low per capita energy consumption (0.8 tonne of coal equivalent)
- Lower energy productivity (US $ 400, GNP/tonne of coal equivalent)
- Rising population & economic growth (respectively by 2-3 % & 4-5% per year)
- Continued dependence on depleting commercial sources (90,000 MW installed capacity, 70 % coal)
- Growth in energy consumption (10-12 % every year)
- Demand in excess of supply (additional 60,000 MW capacity required by 2004 / 5)
- Low pace of energy efficiency improvement
- Insignificant contribution from renewable sources of energy (<2%)
- Severe shortage of funds
- Delayed initiation of the power sector reforms
- 15-30 % T & D loss in different States
- Peak demand shortages of 8-30 %, in different States
- Energy availability shortages up to 15 %
- Un-realistic pricing of energy
- The obvious focus calls for
  - Drastic steps for energy efficiency improvement
  - Speedy tapping of the renewable sources of energy like bio-mass (including bagasse co-generation), wind and small hydro
  - Power from co-generation in other sectors, municipal and industrial solid / liquid waste
  - Environment efficiency improvement for sustainable development

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Slide 4

POTENTIAL FOR ENERGY EFFICIENCY & COMBINED HEAT & POWER (CHP)

Sr. No.	Sector / Sub-sectors	Total Potential (MW)	Realisable Potential (MW)
1.	**Energy Efficiency**		
1.1	Industry		
1.1.1	Steel	1500	1000
1.1.2	Cement	1800	800
1.1.3	Paper	1000	800
1.1.4	Fertilisers	1200	900
1.1.5	Other sectors	2300	1500
	Sub-total (1.1)	**7000**	**5000**
1.2	Agriculture	8000	2500
1.3	Commercial	4000	2000
1.4	Other Sectors	1000	500
	Sub-total (1)	**20000**	**10000**

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Slide 5

POTENTIAL FOR ENERGY EFFICIENCY & CHP (Cont'd.)

Sr. No.	Sector / Sub-sectors	Total Potential (MW)	Realisable Potential (MW)
2.	Combined Heat & Power (CHP)		
2.1	Sugar	4000	3000
2.2	Dairies, Distilleries & Breweries	3500	2500
2.3	Rice mills	1500	1100
2.4	Cotton textile & man-made fiber	1200	800
2.5	Paper & pulp	1000	750
2.6	Fertilizers	1000	750
2.7	Chemical (solvent extraction, sulphuric acid, caustic soda)	900	600
2.8	Petrochemical & refineries	800	600
2.9	Metal industries (iron & steel, sponge iron & alumina)	750	500
2.10	Cement, tyre & plywood manufacturer	600	400
2.11	Other Sectors (coke oven batteries, commercial sectors, etc.)	750	500
	Sub-total (2)	16000	11500
	Grand total (1+2)	36000	21500

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Slide 6

STATUS & LESSONS LEARNED

A. STATUS

Sr. No.	Sector / Sub-sectors	Realisable Potential (MW)	Status (MW)		
			Commissioned as of Sept. 99	Under construction / in pipeline	Total
1.	Energy efficiency				
1.1	Industry	5000	250	500	750
1.2	Agriculture	2500	100	200	300
1.3	Commercial	2000	100	200	300
1.4	Others	500	50	100	150
	Sub-total (1.1)	10000	500	1000	1500
2.	Combined Heat & Power (CHP)				
2.1	Sugar	3000	150	500	650
2.2	Dairies, Distilleries & Breweries	2500	50	100	150
2.3	Rice mills	1100	50	100	150
2.4	Cotton textile & man-made fiber	800	25	50	75
2.5	Paper & pulp	750	50	100	150
2.6	Other sectors	3350	300	500	800
	Sub – total (2)	11500	625	1350	1975
	Grand total (1+2)	21500	1125	2350	3475

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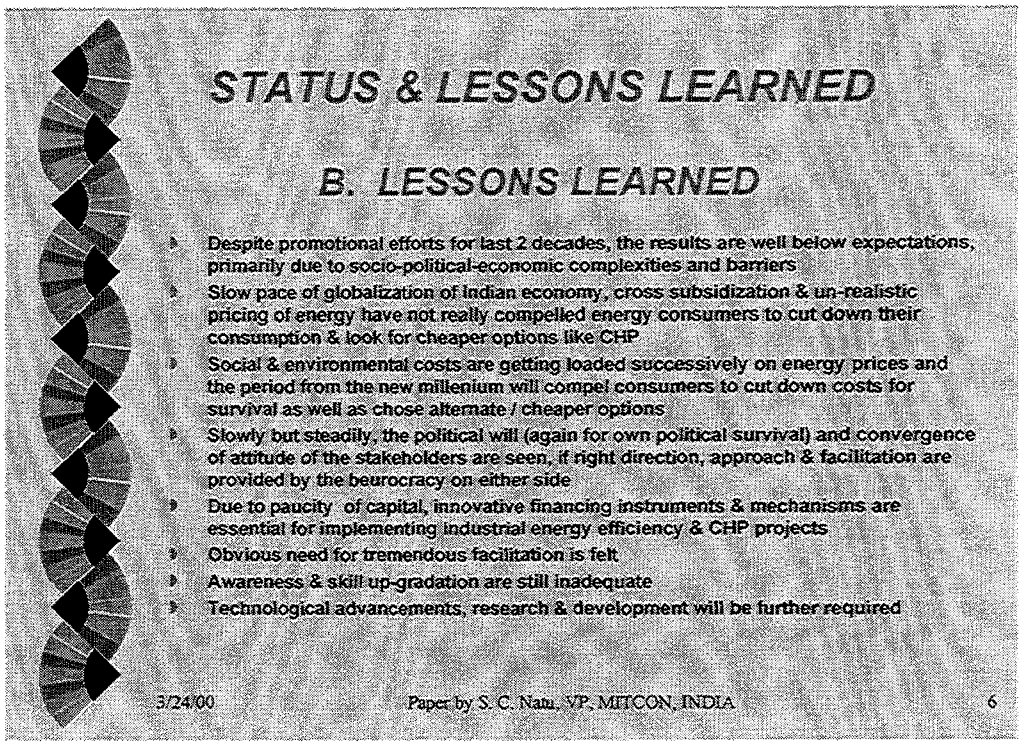

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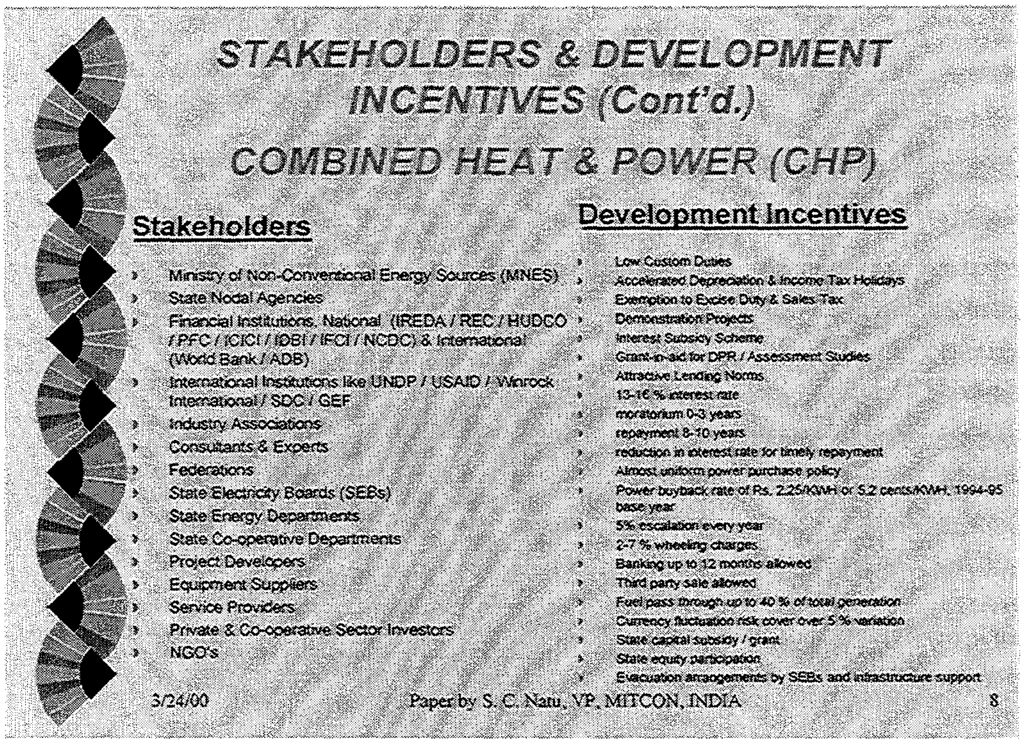

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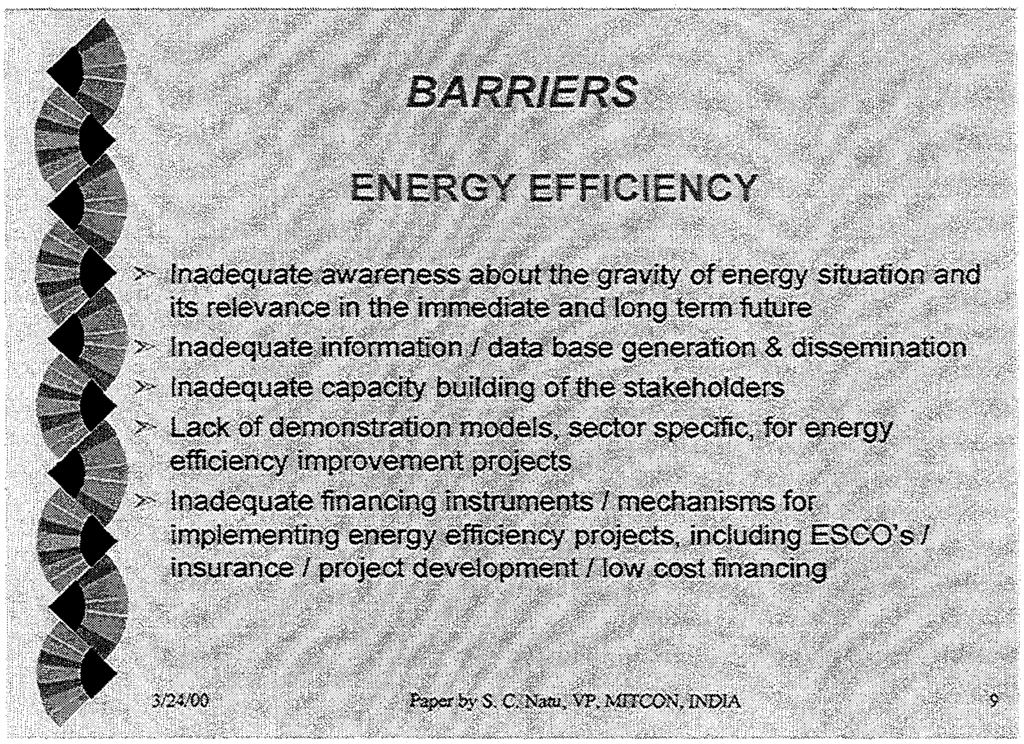

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BARRIERS (Cont'd)

COMBINED HEAT & POWER (CHP)

- Inadequate data base generation & dissemination
- Inadequate R & D and HRD initiatives
- Inadequate capacity of the stakeholders
- Inadequate demonstration experience for different options of technologies and project development models, for different / potential industry sectors
- Lack of adequate information on resource availability, techno-economic viability, technology evaluation / validation / bench marking, commercial & financial risks, etc.
- Lack of adequate facilitation for achieving convergence of mindsets of stakeholders, particularly SEB's and State Governments
- Lack of commercial / business and support service networks on sustainable basis

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POTENTIAL FOR ENERGY EFFICIENCY / CHP AS CDM PROJECTS IN INDIA

Sr. No.	Sector / Sub-sector	Realisable Potential (MW)	Sector Maturity Rating	Invest-ment (US $	Carbon Credit Potential	Expected Capacity Replacement / Addition (MW) & Carbon Credit Potential (M T / Yr.)		
				M / MW)	('000 T / Yr. / MW)	Up to 2001	2001 – 2005	2006 - 2010
1.	**Energy Efficiency**							
1.1	Industry	5000	B	0.50	8.54	500 (4.27)	1500 (12.81)	2000 (17.08)
1.2	Sectors other than industry	5000	C	0.50	8.54	100 (0.85)	300 (2.56)	500 (4.27)
	Sub-total	**10000**				**600 (5.12)**	**1800 (15.37)**	**2500 (21.35)**

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POTENTIAL FOR ENERGY EFFICIENCY / CHP AS CDM PROJECTS IN INDIA (Contd.)

Sr. No.	Sector / Sub-sector	Realisa-ble Potent-ial (MW)	Sector Maturity Rating	Invest-ment (US $ M / MW)	Carbon Credit Potential ('000 T / Yr. / MW)	Expected Capacity Replacement / Addition (MW) & Carbon Credit Potential (M T / Yr.)		
						Up to 2001	2001 – 2005	2006 - 2010
2.	Combined Heat & Power (CHP)							
2.1	Sugar	3000	A	0.75	6.41	250 (1.60)	750 (4.81)	1000 (6.41)
2.2	Dairies, Distilleries & Breweries	2500	B	0.70	7.68	100 (0.77)	300 (2.31)	500 (3.85)
2.3	Rice Mills	1100	A	0.70	7.68	50 (0.38)	200 (1.54)	500 (3.85)
2.4	Cotton textile & man-made fiber	800	B	0.70	7.68	50 (0.38)	100 (0.77)	200 (1.54)
2.5	Paper & pulp	750	B	0.70	7.68	50 (0.38)	100 (0.77)	200 (1.54)
2.6	Other sectors	3350	C	0.70	7.68	100 (0.77)	300 (2.31)	500 (3.85)
	Sub-total	**11500**				**600 (4.28)**	**1750 (12.51)**	**2900 (21.04)**
	Grand Total	**21500**				**1200 (9.40)**	**3550 (27.88)**	**5400 (42.39)**

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CASE STUDIES

ENERGY EFFICIENCY

Replacement of Conventional Vapour Compression Central Air Conditioning System by Energy Efficient Vapour Absorption System

Sr. No.	Parameters	Conventional	Energy Efficient
1.	System Capacity (TR)	125	125
2.	Type	Vapour Compression	Vapour Absorption, Water Cooled, FO Fired
	Energy Consumption		
3.	Chiller Power (kw)	108	7.87
	Cooling Water Pump (kw)	8.0	9.50
	Chilled Water Pump (kw)	10.0	10.0
	Lower Side Power (same)	-	-
	Total Power (kw)	126	27.37
4.	Fuel Consumption	Nil	0.33 kg/TR
5.	Cooling Water Requirement (lit/day)	17877	25920
6.	Equivalent Energy Saving per annum	-	24 lakh KWH
7.	Investment Cost, including machine, piping, fuel storage, freight, octroi, etc. (Rs. lakh)	15.25	47.04
8.	Total Operating Cost including Electricity, Fuel, Water, Maintenance, Interest, etc.	36.63	30.27
9.	Carbon Emission Reduction, MT/year (@ 1.067 kg/kwh)	-	2264
10.	Carbon Credit (@ US $ 15 / MT)	-	33960

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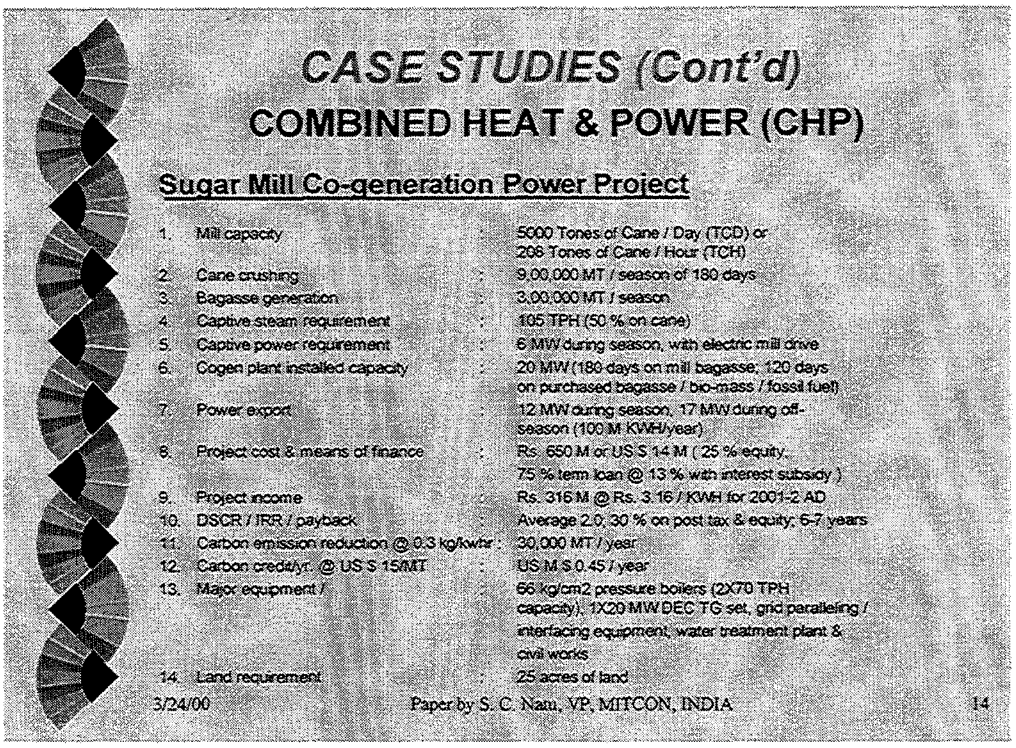

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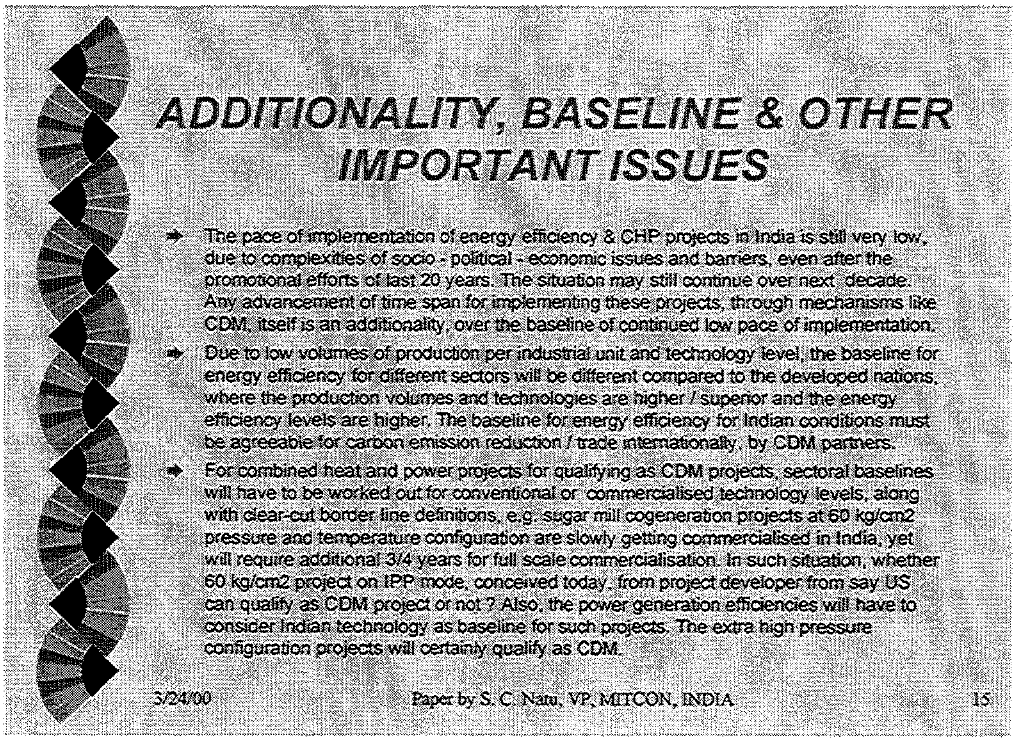

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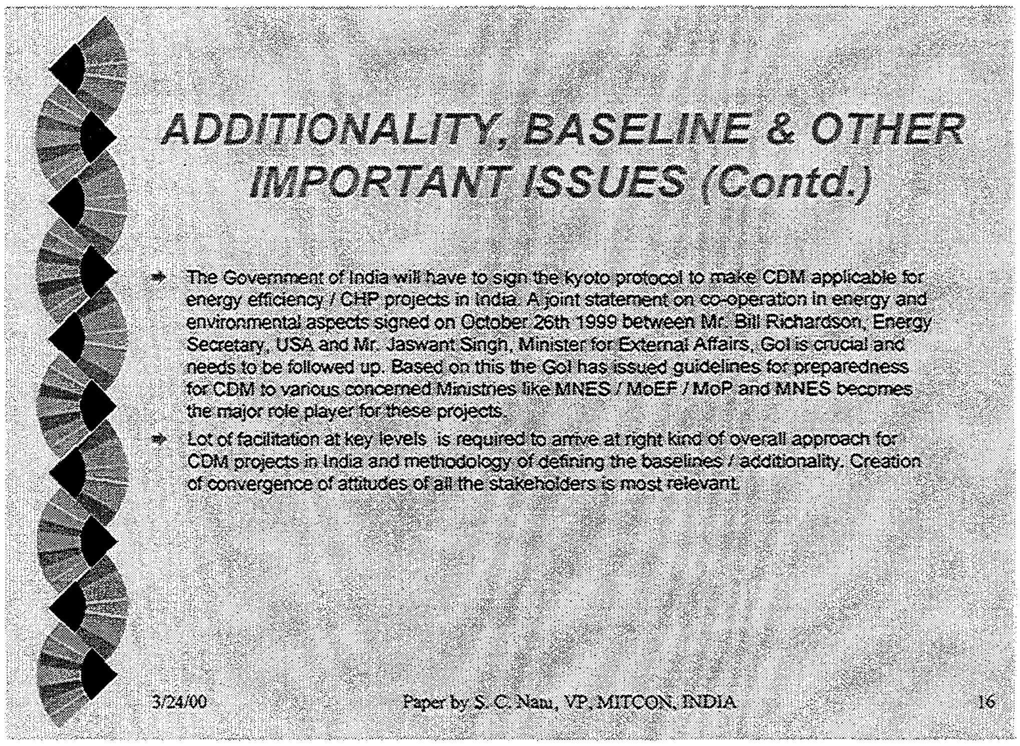

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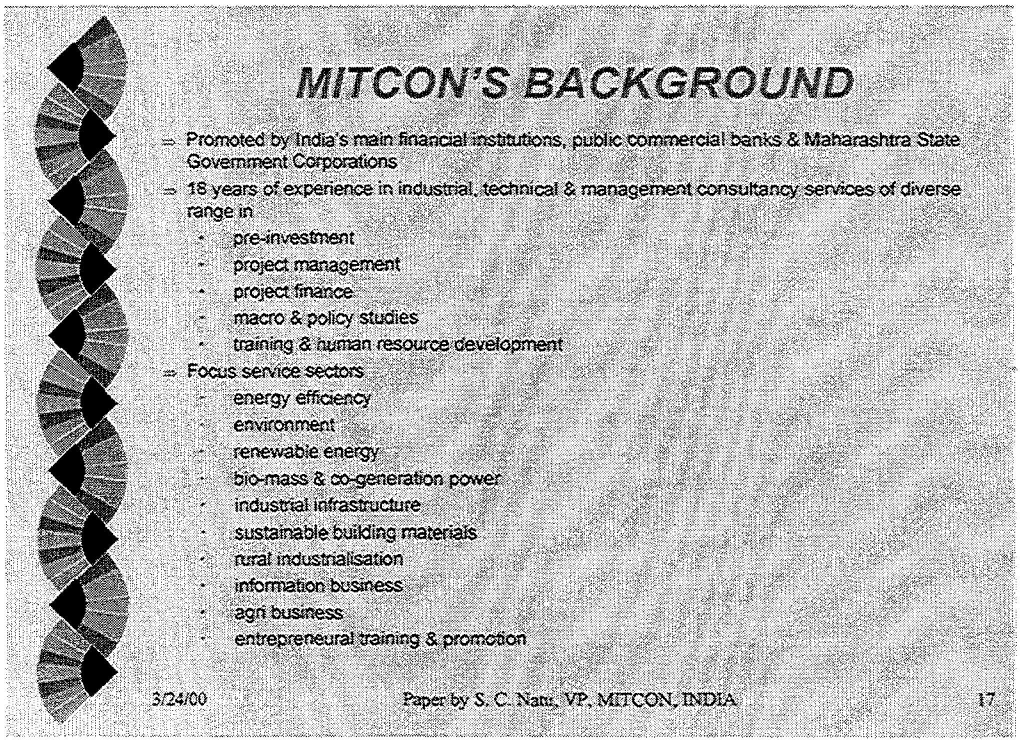

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MITCON'S BACKGROUND (Cont'd)

- ISO 9001 company, professionally managed company, well equipped offices in Pune, Mumbai & New Delhi
- Working relations with all major stakeholders for possible CDM projects in India, in all focus sectors
- Linkages with similar State level Technical Consultancy Organisation in 18 States of India
- Experience of major macro studies & assignments like
  - Situation report on energy, All India Bagasse Cogen Study
  - Application of energy efficiency data protocol for Indian sugar mills project brief for UNDP-MNES-GEF
  - Removal of barriers to bio-mass power generation project
  - Lead Programme Partner of MNES for development of bagasse co-generation and bio-mass power projects
  - Business Development Associate of IREDA
  - Implementation of demo project for environment / energy efficient Vertical Shaft Brick Kiln project for SDC, having huge multiplication potential
  - Project developer interface services
  - Range of pre & post investment services for bio-mass / bagasse power projects
  - Energy audits
  - Environment Impact Assessment studies
  - Loan / grant-in-aid syndication services

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CDM / JI & EMISSION TRADE BUSINESS PERSPECTIVE, ENERGY EFFICIENCY / CHP SECTORS IN INDIA

POTENTIAL

Sr.	Item	Period			
No.		Up to 2001 AD	2001 – 2005 AD	2006 – 2010 AD	2001 – 2010 AD Cumulative
1.	Capacity Additions / Reduction (MW)	1200	3550	5400	10150
2.	Carbon Credit Potential (Million MT / Yr.)	9.40	27.88	42.39	79.67
3.	Total Investment Required (US $ M)	732.50	2162.50	3330.00	6225.00
4.	Carbon Credit Business (@ $ 15 / MT), US $ M	141.00	418.20	635.85	1195.05

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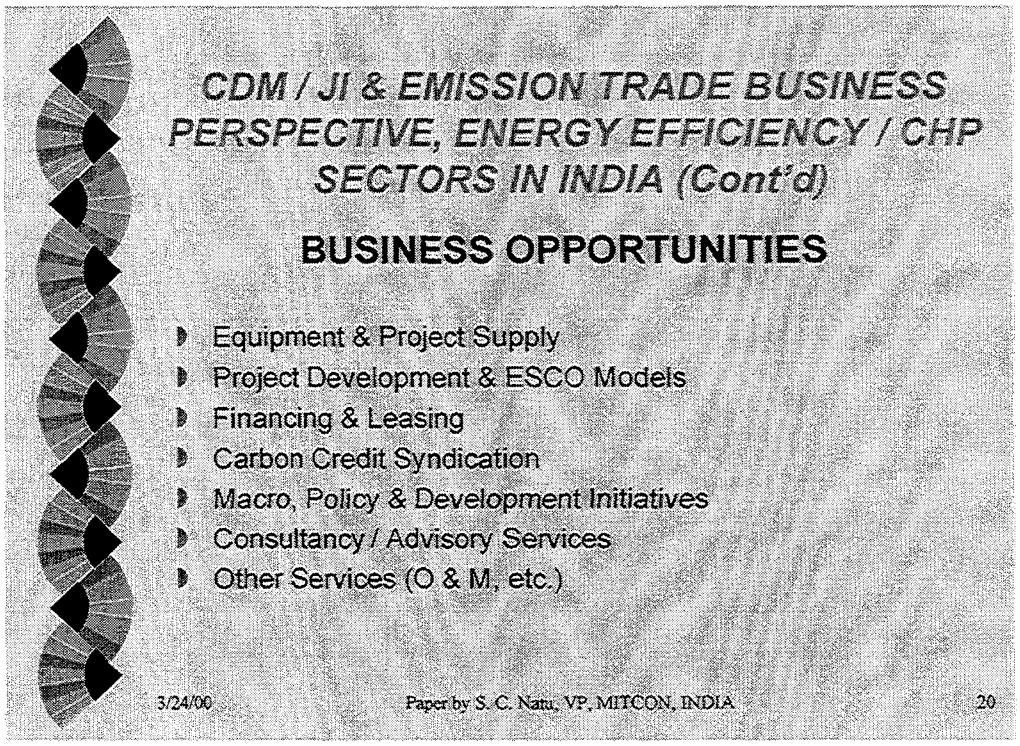

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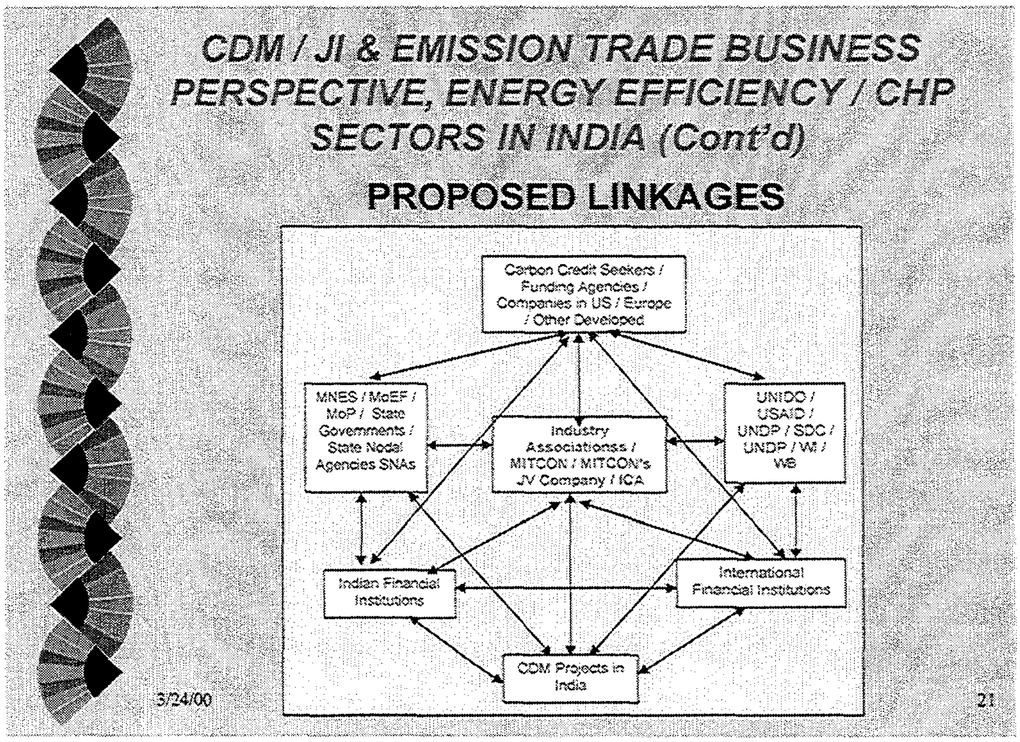

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RECOMMENDED ACTION PLAN

Sr. No.	Action Item	Resposibility	Suggested Time Schedule
1.	International intervention / facilitation witGoI for exact implications / preparedness for the CDM & further signing of Kyoto Protocol	MNES / MoEF / MoP / PMO / UNIDO / UNDP / CII / FICCI	Dec. 31, 2000
2.	Identification of concerned Ministries, stakeholders & potential facilitation agencies for industrial energy efficiency & CHP sectors in India	MNES / MoP / CII / FICCI / MITCON	Mar. 31, 2000
3.	Assessment & validation of total /realisable potential, sector and sub-sector specific	MNES / MoP / CII / FICCI / MITCON	Jun. 30, 2000
4.	Identification of projects in energy efficiency / CHP sectors meeting national / MNES priorities, potential for finance and technology in flows, etc.	MNES / MoP / CII / FICCI / MITCON	Jun. 30, 2000
4.	Analysis & validation of barriers & preparation of barrier removal plan	MNES / MoP / CII / FICCI / MITCON	Sept. 30, 2000
5.	Organisation of stakeholder's workshops, sector / sub-sector specific, & prepare promotion / development plan	MNES / MoP / CII / FICCI / MITCON	Sept. 30, 2000
6.	Preparation of CDM simulation case studies, sector / sub-sector specific, determination of funding additionality, formulation of baselines for qualifying emission reductionstandardisation of CDM project cycles, etc.	MNES / MoP / CII / FICCI / MITCON / International agencies	Dec. 31, 2000
7.	Develop the future institutional linkages	MNES / MoP / CII / FICCI / MITCON / International agencies	March 31, 2000
8.	Develop at UNIDO level, review / monitoring mechanism & schedule	MNES / MoP / CII / FICCI / MITCON / International agencies	Dec. 31, 2000

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1.2 Philippines

Opportunities and Challenges in Promoting Energy Efficiency under the CDM

Mr. L. Velasco, Country Coordinator, International Institute for Energy Conservation (IIEC)

INTRODUCTION

COP1 decision recognized energy efficiency as immediate and short-term measures to limit GHG emissions, these are "no regrets" measures for rapidly growing developing countries.

In addition CDM has provided a table for private sector participation in GHG mitigation and there is a need to set in place enabling institutions and policies for CDM to take place.

THE PHILIPPINES AND GHGS

In the Philippines, the energy sector contributes over 50% of the country's total GHG inventory. Within the energy sector, transport takes up 30% of total emissions followed by power generation (27%) and industries (24%).

In this light, promoting energy efficiency in rapidly growing cities and rural areas by integrating energy efficiency in local development planning process as well as establishing energy efficiency standards for mass housing projects are necessary. There also is a need to accelerate the transfer of climate-benign technologies and in-flux of investments. Project investment requirement for energy efficiency between the years 1994 and 2004 is expected to be around US$150 million.

Some challenges facing the Philippines are excess capacity about 2,000 MW until 2004, enabling policies for example setting in place green pricing, incentives and subsidy removal. Further challenges include alleviating bureaucratic process in approving CDM applications and developing transparency, capacity-building, rules and procedures for monitoring, evaluation, reporting and verification.

RECOMMENDATIONS

Some recommendations are as follows:

- Create multi-stakeholder agency that will process and monitor CDM projects
- Establish guidelines for CDM applications and identify priority projects
- Develop policy and fiscal packages for energy efficiency projects.
- Establish and enforce efficiency standards across sectors.
- Integrate energy efficiency in local development planning process.

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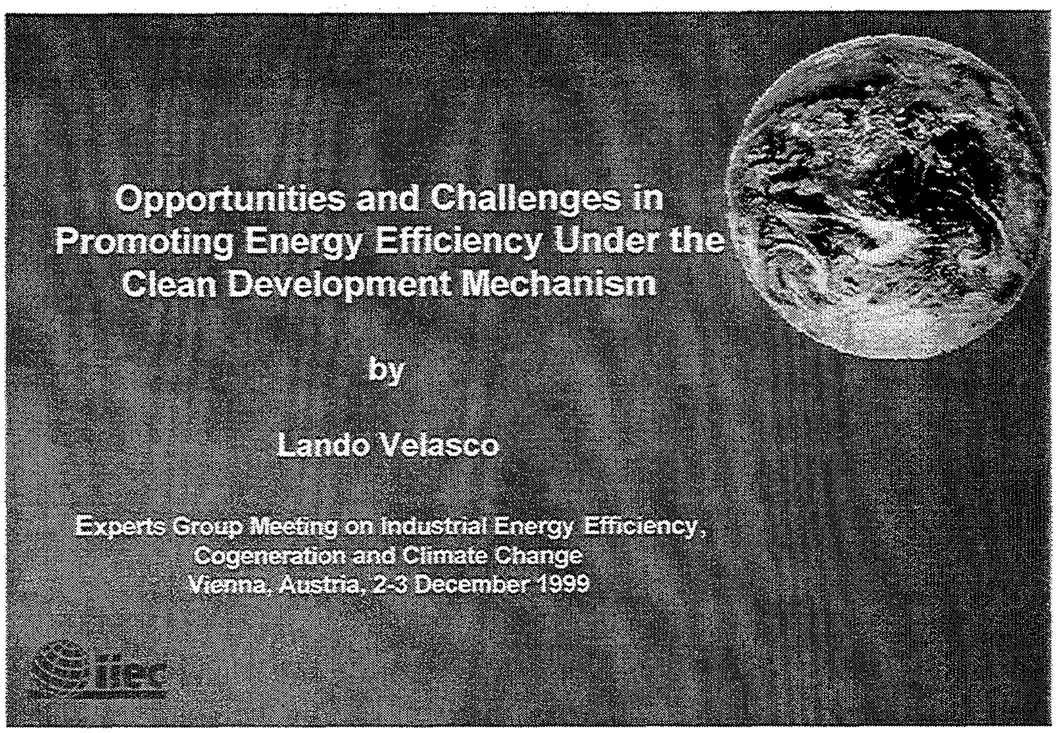

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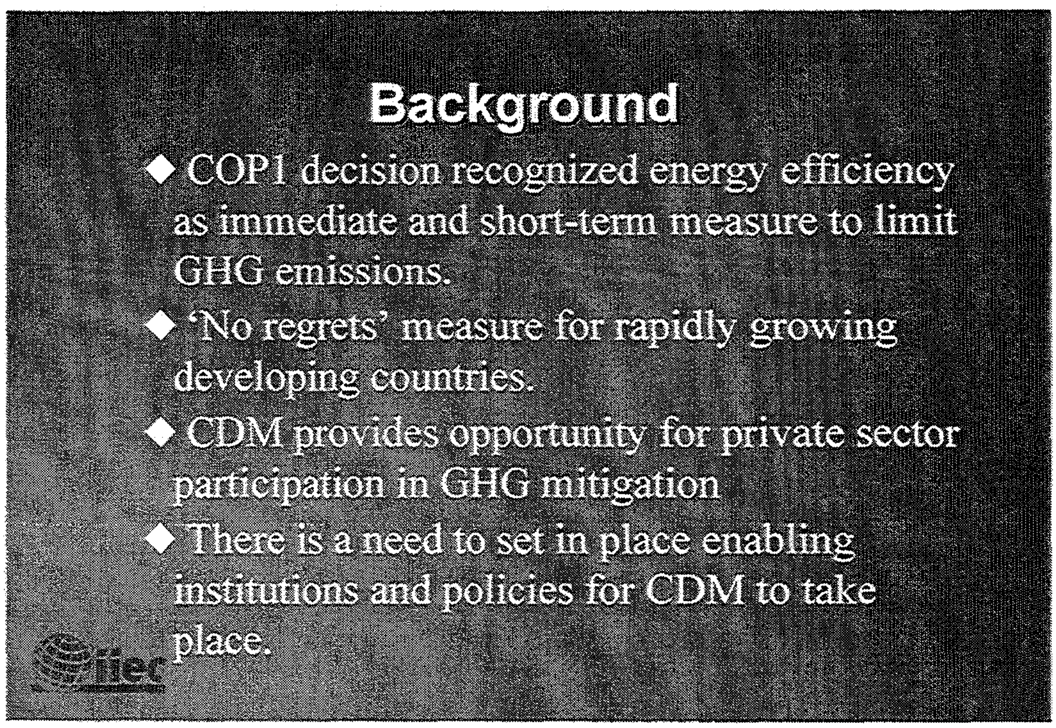

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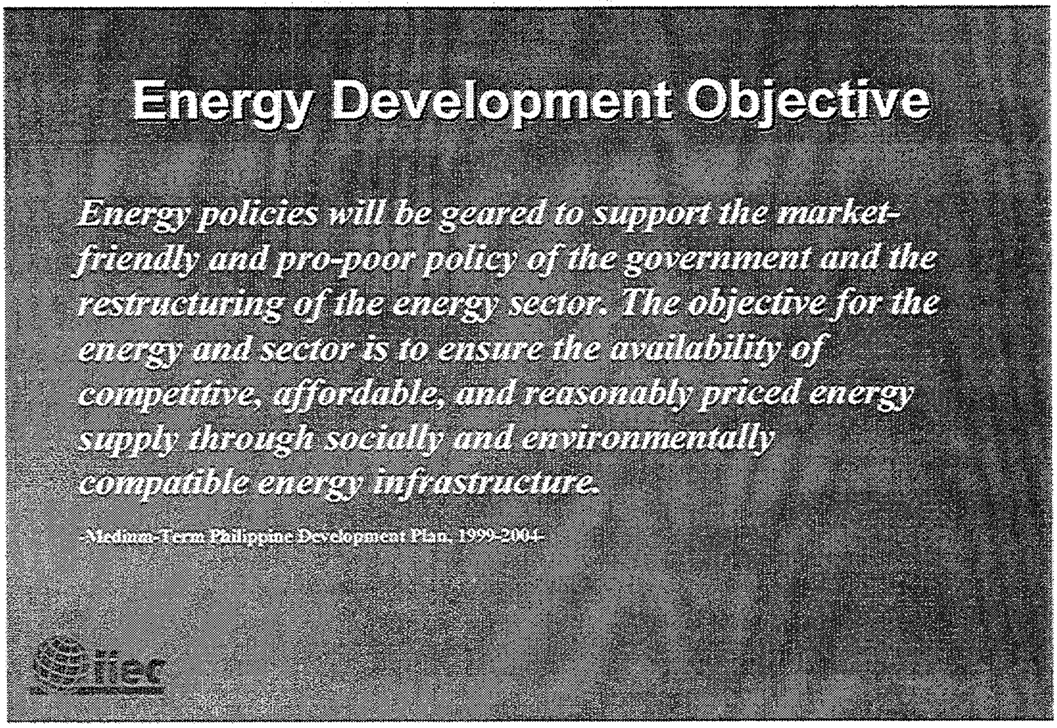

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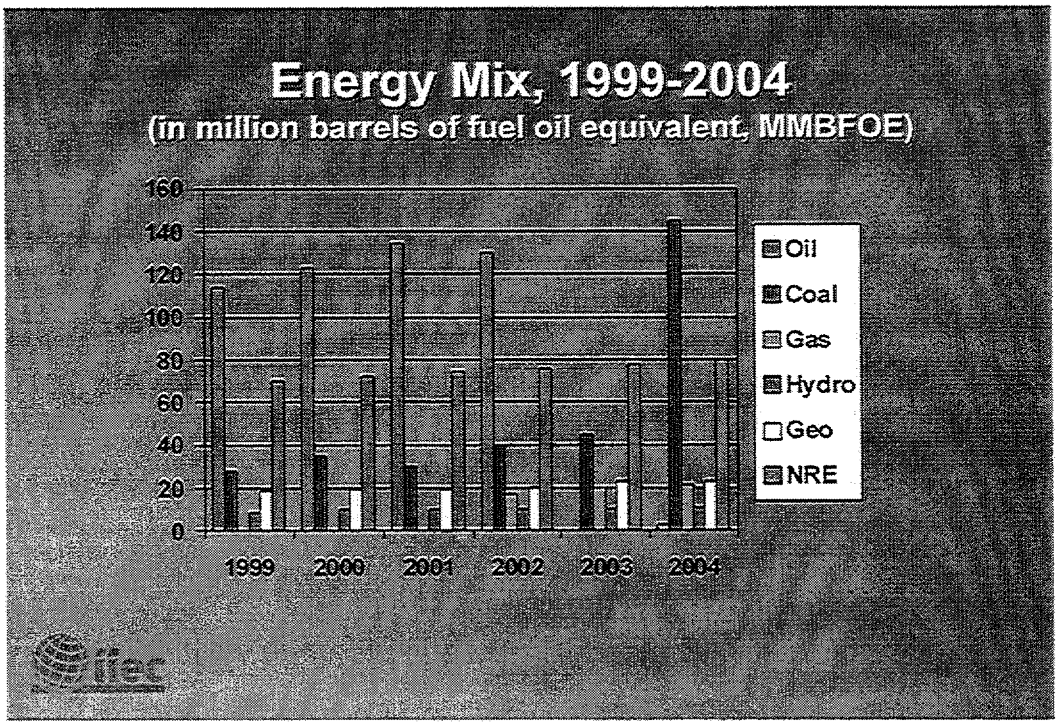

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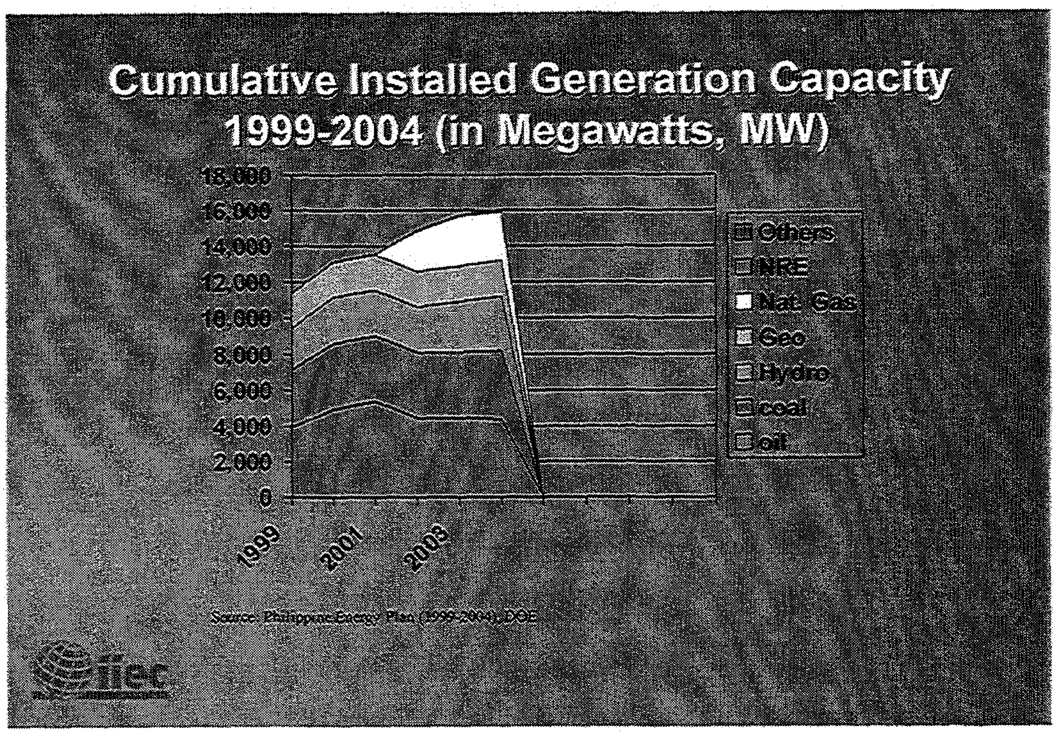

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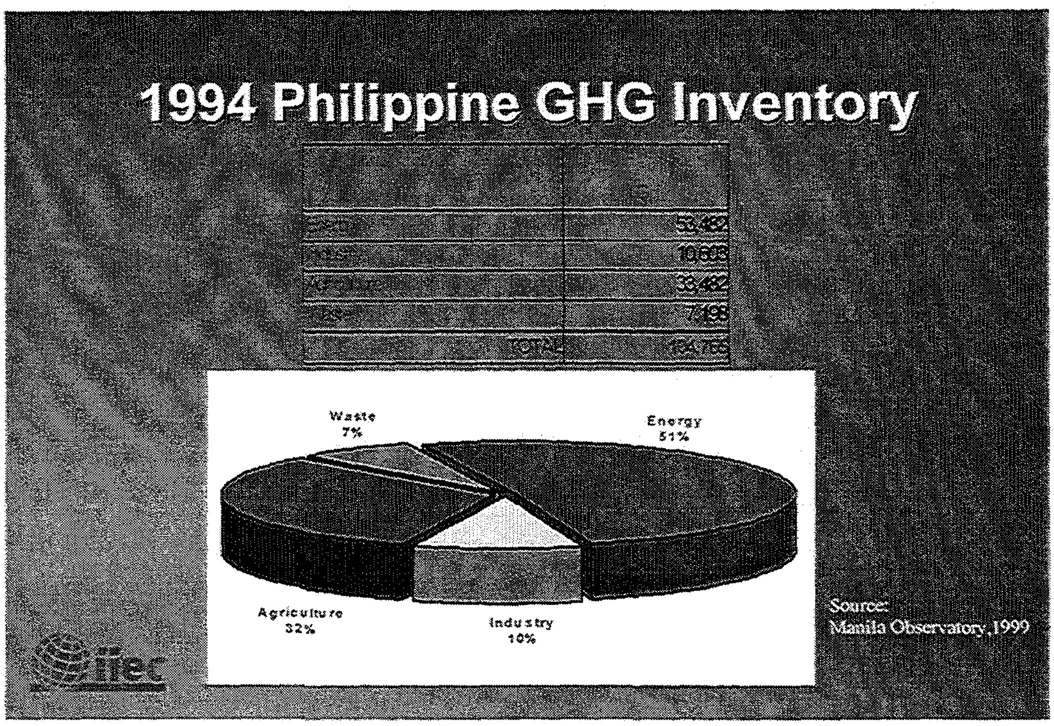

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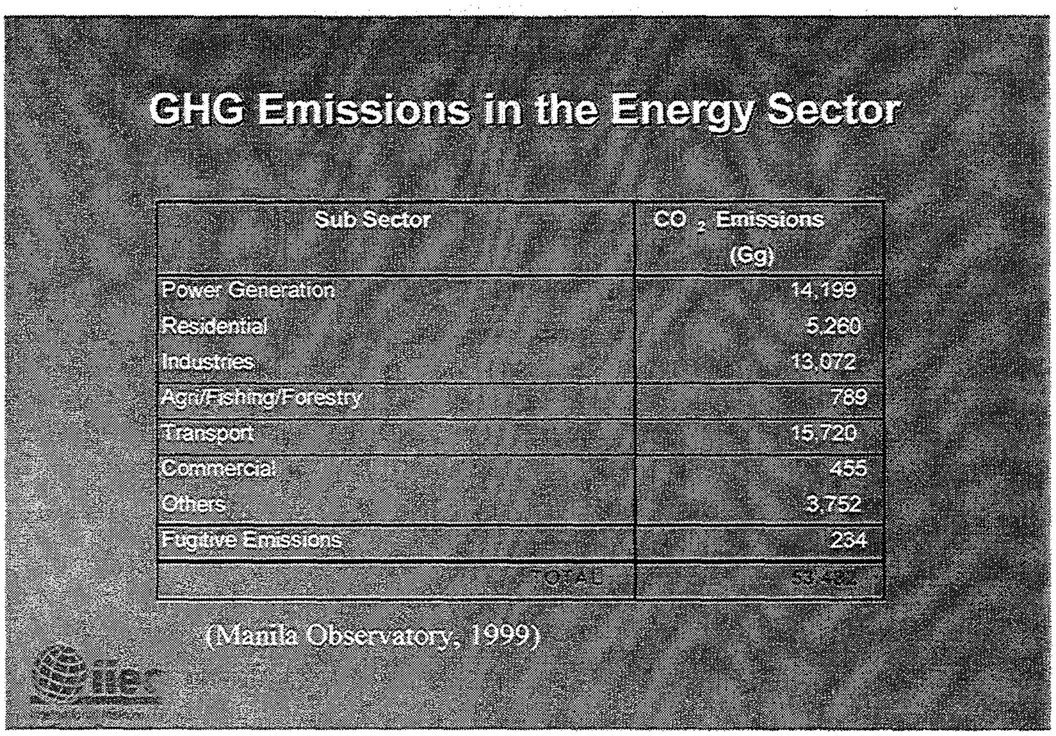

GHG Emissions in the Energy Sector

Sub Sector	CO_2 Emissions (Gg)
Power Generation	14,199
Residential	5,260
Industries	13,072
Agri/Fishing/Forestry	789
Transport	15,720
Commercial	455
Others	3,752
Fugitive Emissions	234
TOTAL	53,482

(Manila Observatory, 1999)

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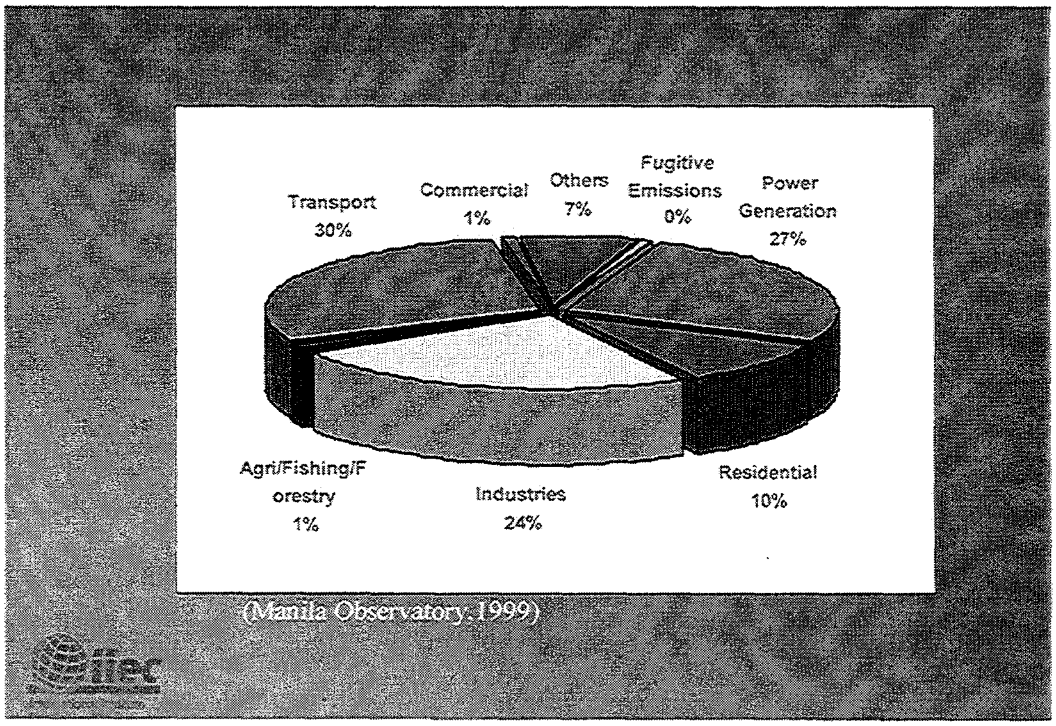

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Climate Mitigation Options

Implementation Time Frame	GHG Abatement Initiative	Potential GHG Emissions Reduction (million tons of CO2 equivalent)	Cost of Reduction (US$ per ton of CO2)
Energy Supply Side:			
Short to Medium Term	System Loss Reduction	69.7	(-) 17.20
Short to Medium Term	Heat Rate Improvement	157.7	(-) 5.10
Short to Long Term	New and Renewable Energy		
	Wind	7.3	(-) 1.64
	Solar	3.7	1.36
	Biomass	3.7	0.27
Medium to Long Term	Natural Gas	55	2.40
Energy Demand Side			
Short term	Use of CFL	33	(-) 25.30
Short to Medium Term	Hi-eff Air Con System	44	(-) 6.10
Short to Medium Term	Hi-eff Refrigerators	11	(-) 5.40
Short To Medium Term	Hi- Industrial Motors	7.3	(-) 13.70
Short to Medium Term	Hi-eff Boilers	11	(-) 26.00
Transport			
Medium to Long Term	Hi-eff Transport System	40.3	(-) 2.90

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Portal, UNDP-CDM Study, 1999

Slide 10

Opportunities

- *Legislative and policy measures are in place*
  - *- Demand-Side Management Regulatory Framework*
  - *- Passage of Clean Air Act*
  - *- Proposed Electric Power Industry Restructuring*
  - *- Proposed Energy Conservation Act*
- *Climate change provides additional (global) benefits to national development priorities.*
- *Promote energy efficiency in rapidly growing cities and rural areas*
  - *- Integrate energy efficiency in local development planning process*
  - *- Establish energy efficiency standards for mass housing projects*
- *Accelerate transfer of climate-benign technologies and in-flux of investments*
  - *- projected investment requirement for energy efficiency (1999-2004) is US$150 million.*

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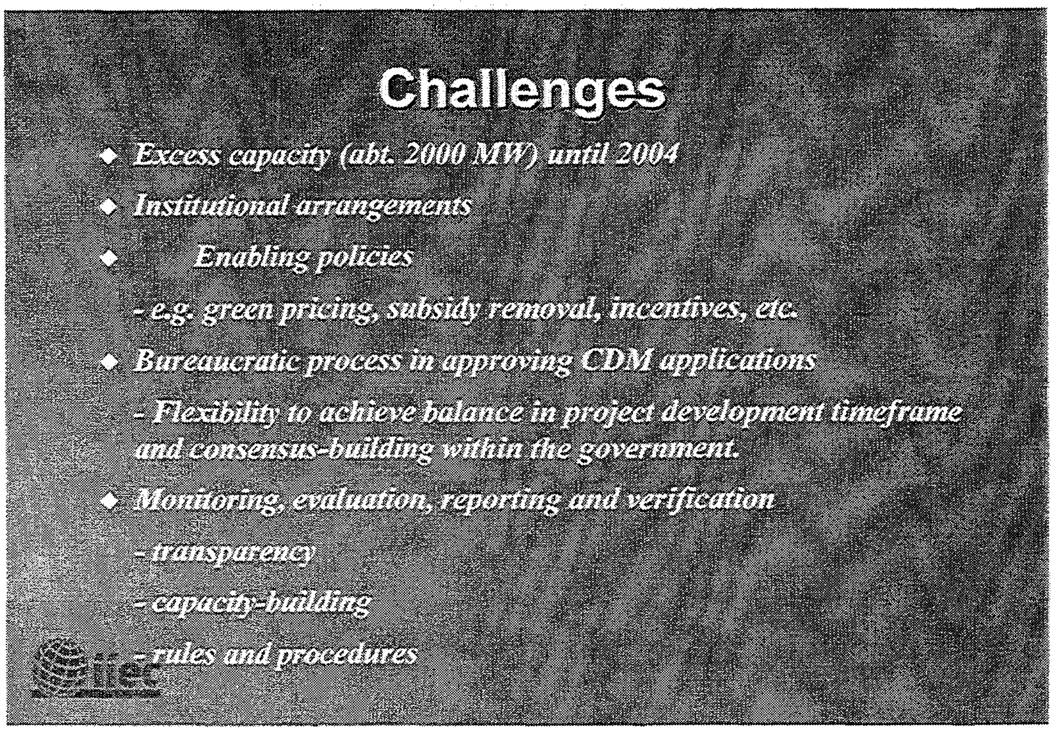

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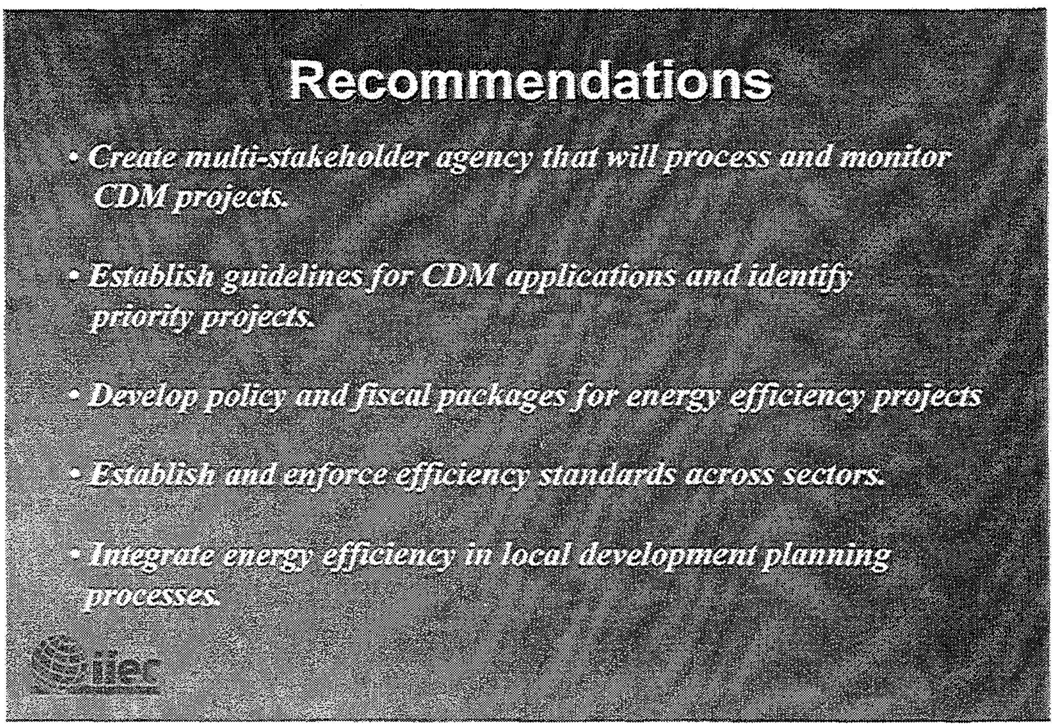

1.3 Argentina

Industrial Energy Efficiency and Climate Change Abatement: The Role of the Argentinean R & D Center for the Rational Use of Energy, and its Potential Impact in the Present Socio-economical Context.

Dr. E. Grünhut, Technology Manager,CIPURE-INTI

The R&D Center for the Rational Use of Energy (Centro de Investigación y Desarrollo para el Uso Racional de la Energía – CIPURE), is a Center of the National Institute of Industrial Technology, carrying out work in several aspects involving the energy - environment conservation relationship, including:

- The efficient and rational use of various types of energy, in industrial processes;
- Testing and assessment of new car models to ensure that the exhaust gases limits are not exceeded;
- The supervision and follow up of the technological conversion of the air conditioning and refrigeration industries, to minimize the use of refrigerant fluids which affect the ozone layer

Among them, and particularly in the light of GHG mitigation, the most important is the program assisting industry in achieving more efficient use of energy. This program which has been going on for several years, is carried out with the cooperation of the Government of Japan and the Interamerican Development Bank, through the Argentinean Technological Fund (Fondo Tecnológico Argentino – FONTAR).

The above programs have allowed us, not only to offer practical and theoretical training courses for engineers and technicians from industry, but also to carry out energy studies and audits in manufacturing plants and energy industries. This is for evaluating potential energy savings detected and to design and set up data acquisition and monitoring systems for the systematic and adequate control of the energy variables in equipment and plant systems.

The assistance to industry is permanent in aspects such as optimization of boiler operation, recuperation of residual heat of boiler exhaust gases, recuperation of condensate from process vapor, thermal insulation of pipes and conducts, installation of economizers or pre-heaters in boilers, use of variable speed motors, adjustment of boiler or furnace burners, etc.

Besides, in thermal power stations, and in some industries having self-generation and cogeneration, tests for certifying specific-consumption were done. This has given us close knowledge of how, in manufacturing and energy industries, energy is generated and employed.

Through our contacts and interviews with managers and CEOs of enterprises, we got to know where their concern for energy efficiency operation and consequent climate change mitigation stands.

Let us see what are the contexts in which energy conservation and industrial developments are carried out and what is the outlook for their future, under different scenarios. Later we will take a look at the socio-political framework within which CIPURE works. See Annex for details on cogeneration costs.

With reference to the politico-economical context, the present stage of the Argentinean development is characterized by privatization of the production of goods and services, and strong internationalization of the economy. The most important efforts have been found on price stability based in the convertibility law, setting the equivalency of one Argentinean peso equal to one dollar, deregulation and internal market liberalization.

Although there has been a continuous economic GDP growth, since 1991, the globalization has brought a great international dependence, appearing reactivation or recession according to the occasional existing conditions of external financing. Nevertheless it is expected that industrial sectors will keep their dynamism, within the MERCOSUR framework.

As regards the energy context, in the primary energy production, the use of oil (50%) and gas (36%) prevail. These percentages might be overestimated, since there is a lack of reliable statistical data with respect to the production and use of biomass. In electric power stations the use of oil products is low (7%) as compared with the use of gas (42%) and hydraulic generation (39%). Since the price of gas is relatively low, as compared with that of oil products, the latter is used when there are shortages of gas provision. For industry, commerce and residential thermal use, natural gas has almost totally substituted oil derivatives. If this favorable to natural gas option is kept in the future, the domestic market for oil derivatives will be defined basically by the evolution of the transport sector and in a minor proportion by the mechanization of agriculture.

In the electricity generation area, with a very dynamic growth since 1992, the private actors invested only in thermal stations fed by natural gas, which is driving the electricity industry to depend more and more on the price and availability of natural gas

The evolution of relative importance of different energy sources to satisfy the general energy consumption indicates the success reached in reducing oil and oil derivatives use and increasing the supply of natural gas and hydroelectricity, although there is a noticeable substitution of biomass.

Regarding industrial energy consumption, the past evolution of the industrial energy intensity shows a reduction in the industrial activity in the 1980s, where although the energy use dropped 5% during said period, the energy intensity tended to grow. The gain stage is due to a dynamic pulp and paper production, and to the basic metallic and automotive industries To this, the technological modernization of the food industry due to it transnationalization and automatization should be added.

The metal-mechanic industry, on the other hand, was specially hurt, with about 10-point loss in the IAV share, whereas the stability in the production of durable goods made it reach almost 40% of the IAV. The appearing decrease in the total energy intensity was due to a weakening of the tertiary sector.

The growth of the total energy intensity was motivated by the expanded residential and commercial energy use. The 1991-1994 stage is shown separated from 1995, to see the effect of the recession motivated by the Mexican crisis. The expansive stage where the industrial energy intensity is kept almost without change has to do with the intensive production of pulp and paper and of the basic metallic and automotive industries. Together with it took place a technological modernization of the food industries, due to their transnationalization and accompanying automatization. During the 1995 recession, specially harmed were the wood (-27%), metal-mechanics (-17%), non-metallic mineral products (-11.5%) and paper (-6.8%) industries; but the food and basic metallic minerals production expanded bringing an increase in the energy intensity.

The structural changes mentioned were accompanied by changes in the type of energy sources employed. The increase in the demand of natural gas and the fall of that in oil derivatives and biomass can be seen, although the latter surpass oil derivatives specially due to the use of agro-industrial residues (sugar, non-mineral oil). In the 80s there was an increase in the use of electric energy (being over 23%) due to technological modernization, structural industrial changes, and convenient low tariffs.

In 1997, of a total energy use of 2020.4 PJ, the energy industry took 621.12 PJ (30.7%) and all other industrial energy end-use was 373.81 PJ (18.5%).

It should be pointed out that the thermal electric power stations built in the period of 1993-1995 had the advantage of having access to natural gas at low prices, without the previous periodical restrictions during the mainly residential high consuming seasons; and not because they were more energy efficient that the already installed stations. They had an average specific consumption of 2600 kcal/kWh, which is low for open cycle turbo gas stations, but surpass the consumption of many already existing turbo vapor stations.

In the city of Buenos Aires and surroundings area one electricity company have put in operation one combined cycle using a turbo vapor unit it already had and two others have signed contracts to build new combined cycle units in their stations.

In an environmental context, it is a fact that although toxic waste disposal, water pollution and soil degradation are present in the minds of the general public as environmental problems, it is only recent that the public have been alerted about the high concentration of toxic substances found in the air, in certain areas of Buenos Aires.

Regarding CO_2 emissions, 70 % is generated by end-users, and 30% by the energy industry, being responsible industry for 16% of the emissions, although it is important to point out that in the 1970-1994 period, the amount of CO_2 produced per Petajoule offered, decreased 25%.

Although a change in the tendency is observed after 1994, the specific emission in 1997 was 16% below that of 1970. This would indicate that the Argentinean energy system has reached such a development stage, that it will make difficult to mitigate the effects of a future economic growth, on the CO_2 emissions. It is interesting to indicate that the about 23% drop in the specific emission of end use is a result of the strong substitution of energy sources. On the other hand, considering the local socioeconomic context, future estimations are based in an industrial profile oriented fundamentally to agro-industry and mining.

With respect to the followed methodology, to determine future emission estimations, there were based using system analysis done following World Environment Fund guidelines for climate change mitigation studies, in a study carried out 1997; and the data calculations were reviewed in 1999 using both the IPCC "Reference" and "Sectoral Approach. Considering the two scenarios initially developed, we have:

- A Base Scenario with an evolution expected under the system present dynamics without any action or particular policies referred either to the waning of GHG's emission or increase of it absorption capacity; with business strategies development in the expected context according to the future socio-politico-economic expected unfolding and considering furtherance of energy deregulation measures; and

- A Mitigation Scenario, which involves the implementation of, selected, easier to implement, climate change mitigation options and the evaluation of its consequent benefits.

The detail of the energy system operations was analyzed using the Long-Range Energies Alternatives Planning System (LEAP) model, which allowed to calculate the GHGs emissions compatible with the Inventory data.

When unrolling scenarios, it is considered that within the consolidated globalization process which does not seem to weaken out, at least in the medium range, many aspects and in particular the Argentinean socio-economic, technologic and energy-environmental developments will be affected by the international context.

Other facts being considered are the adjustment being carried out in industrialized countries, leading to the moderation of consumption patterns and unemployment increase; the geographic displacement of manufacturing production to emerging economies; the expectation that subsidies in industrialized countries and tariff barrier on some of the products sold to them and generated in the emerging economies, will be eliminated; and the increased stabilization of the international financial market, with more favorable rates and terms for loans.

In a longer-term hypothesis it is estimated that the introduction of new technologies stimulated by economic an environmental concerns will have a fast development.

The difficulty to reach government agreements in the commitment to mitigate GHG emissions, shows that the changes to be done in consumption patterns and economic configuration standards are very deep, in order to reach effective environmental protection. This will bring intensification in the pressure exerted on developing countries to increase climate change mitigation, through restrictions of their products, based on environmental considerations.

In relation to the international market of energy products, it has to be remarked that the evolution of local oil and gas prices depends on the crude oil international market price.

At the regional level, with MERCOSUR and the integration process, the increased trade exchange and the industrial sectors complementation implicated, the stability of the national economies will be more aided.

In the Argentinean industrial area, a growing specialization is going on in subsectors related with the processing of natural resources. The production of commodities such as non-mineral oils, iron and steel, petrochemicals, aluminum, etc., is going on in plants which have been, and are being, extensively restructured, reaching international competitivity levels, but in most cases at lower production scales. However the exporting profile have as major items, those related with the production of gas, minerals, fuels and commodities in general, with low industrial aggregate value.

It is thought that the production structure will suffer a concentration in sectors producing goods, with a relative decrease of service sectors. Notwithstanding an expected predominant reprimarization of the economy, it will come with an industrial strengthening, with a growth close but above the region's forecasted average. Benefits in the long term are also expected, coming from an assumed favorable price ratio of the prices of primary export products

Considering the above-indicated scenarios let us take a look to what results are expected locally.

Base Scenario:

It is assumed that the policies to be adopted will limit government intervention to the control of competition in the energy market, to stimulate the formation of regional energy markets on a competitive base, insuring future energy supplies and improving energy efficiency. The improvements in energy efficiency will come out genuinely without any specific incursion.

It is considered that the assumed cumulative growth per annum of the energy end use, between 1995 and 2020, is 3.8%; with the energy productivity (GDP/final consumption) increasing 14% in the same term. The evolution of the energy intensity and the per capita consumption. The final consumption increase from 1995 on, is thought to be +34% in 2005, +68% in 2010 and +157% in 2020, with natural gas becoming the main source, electricity also growing, and losing ground: oil products, nuclear, coal, pressurized liquid gas, and other gases.

The share of total energy consumption of the industrial sector increases 1.16 points (4.5%) by 2020 with respect to 1995, being the most dynamic sectors: agriculture, silviculture and fishing, with an increase of 1.63 points (27%) within the same term. For this scenario the so called dynamic frozen efficiency alternate was chosen, where equipment is replaced with new more efficient models, and modernization and innovation is done with technologies existent in the base year.

With respect to the energy source data it is especially interesting in our case to point out, that in the growth of electricity supply, 90% of it will be based in combined cycle thermal generation. The stations just built have a thermal efficiency of 52%.

In 1995 the industrial sector took 27.8% of the total final energy consumption down from the 1990 figure of 28.1%, with an increase of 28.4% in the 1990-1995 period. The energy sources used were, for 1990 and 1995 respectively: electricity 21.5% and 20.1% (offered by the public service plus autoproduced); distributed natural gas 48.6% and 51.5%; biomass 12.7% and 16.8%; with the biomass increase coming mainly from oleaginous seed shells and residues.

The characteristics of the energy consumption of selected subsectors are described as:

- Pulp and paper. - In the base year 32.99 millions of GJ were used, representing 7.17% of the manufacturing subsector energy utilization. The source most used was biomass (black liquor), 53.7%; complemented by distributed gas, 28.8%; electricity from public service, 6.1%; and self produced, 4.4%. Energy incidence on the cost: 11.57%.

- Cement, lime and gypsum.- The energy employed in 1995 was 38.76 GJ, 8.42% of manufacturing subsector total use. Distributed gas accounted for 89.1%; public service electricity, 9.3%; and self produced, 0.7%. Energy incidence in the cost: 17.27%.

- Slaughterhouse and meat packing.- Used 10.67 millions GJ in 1995, 2.32% of manufacturing subsector total use. With distributed gas employed 63.5%; electricity 19.5% (including 0.7% self production); fuel oil, 12.5%; and diesel oil, 3.5%. Energy cost incidence: 1.92%. It presented a specific consumption (SC) of 3.56 MJ/Ton of meat, against the 5 MJ/Ton of equivalent meat with bone indicated in the specialized literature.

- Vegetable oils and fats.- Demanded 29.66 millions GJ in 1995; 6.45% of manufacturing subsector total use. Employing biomass, 45.26%; and distributed gas, 41.62%. Energy cost incidence: 2.23%.

- Dairy Products.-Used 8.3 millions GJ in 1995; 1.8% of manufacturing subsector consumption. Employed distributed gas, 44.3%; fuel oil, 27.7% (mainly because gas distribution networks were far from plants); electricity 22.3% (including 0.6% self produced). The SC was in 1986 2.89 MJ/t and 2.93 MJ/t in 1995, below the 4.02 MJ/t accepted international standard.

- Textile fibers, fabrics and textile finishing.- In 1995 registered an use of 13.19 millions GJ; 2.9% of total manufacturing subsector; with distributed gas used 68.5% and electricity 30%. The SCs registered were: 41.43 GJ/t of cotton fiber in spinneries, and 31.23 GJ/t of unrefined wool.

Not detailed are other energy-intensive industries such as iron-and-steel and aluminum (with technologies at the best international levels), non-ferrous metals, petrochemistry, plastics, sugar (using mostly biomass), glass containers, ceramics. Together they represent 43% of the manufacturing subsector total energy use, with a demand of 197.13 millions GJ. It is estimated that the energy intensity of the indicated group of industries could be improved in about 12%.

Other non-energy-intensive industries , 59 subsectorial activities were surveyed, use 129.34 GJ, accounting for 28.12% of total manufacturing subsector demand. However, since they include the most energy inefficient industries, anyone of the known actions inducing a rational use of energy could be used including, of course, cogeneration. The thinking is that in this area an overall improvement of also about 12%, is possible to obtain.

Considering that for this base scenario, according to the socioeconomic framework, the estimated growth of the IAV are for the 1995-2005, 2005-2010, and 2010-2020 terms respectively 3.82%, 5.00%, and 5.20%, the average intensities will be 0.86 (2005), 0.89 (2010), and 0.88 GJ/1000 US$ (2020)

As result we will have energy consumptions in millions GJ and % growth rates respectively such as:

For energy intensive industries (EI): 268.88 (1995); 372.20 and 3.31 (2005); 463.69 and 4.49 (2010); 711.70 and 4.38 (2020); with an average 1995-2020 growth rate of 3.98%.

For non-energy intensive industries (NEI): 191.18 (1995); 264.12 and 3.28 (2005); 331.35 and 4.63 (2010); 523.57 and 4.68 (2020); with an average 1995-2020 growth rate of 4.11%.

As energy sources: biomass and distributed energy grow in both types of industries and electricity grows in NEI and remains with the same participation in the EI. In this way NEI increase the participation in the energy demand going form 41.6% (1995) to 42.4% (2020) of the total consumed.

Since among the mitigation options in a base scenario, technological efficiency is taken in, insisting in that it is assumed that the best technology available will be used, that is to say that the possible technological innovations which are not being used presently will be introduced within the binding period, and will contribute to the reduction of emissions conducing to a significant implicit mitigation. the expansion of cogeneration technology is considered important. Besides, in regard to the relation of cogeneration investments costs to CO_2 mitigation calculations made have given negatives values for the incremental cost in US$/t of equivalent CO_2, which is an very interesting positive economic aspect to consider.

Considering the importance of GHG emissions generated by the electricity industry, and following guidelines set by the Argentinean Energy Secretariat, it is assumed that the expansion of this industry will be based in power stations with combined cycles using the best technology available. The reasons for it are:

- Considerable improvement in the yields of combined cycles built with recently available technology (equipments with an average specific consumption of up to 1560 kcal/kWh are being deployed);
- Important investment cost reduction registered in combined cycle and turbogas units;
- Availability of natural gas with relatively low price;
- Rapid set up and operational in short time (with a faster recuperation of capital).

With reference to total GHG emissions in the 1995-2000 term, the most important is that of CO_2, which will account for 78% of it. However it is assumed that its total specific emission will remain relatively stable in the long term.

The gas industry, in expanding its production, will increase CH_4 emission by 12% and, although the power stations also release CO, 99% of this gas is generated by end users and its total share will account for less than 2%.

Let us see now what results are expected locally in the following.

Mitigation Scenario:

It is considered, during the treatment of this area, that the improvement of the energy efficiency may come from technological modernization and innovation of industrial processes (TMI) and/or incorporation of being developed cogeneration technology.

New official policies to mitigate climate change will lead electricity industry enterprises to adapt their evolution plans, implementing alternatives and actions, accordingly, unchanging – of course- their interests.

It is agreed that for steps to take to decrease energy consumption, the best is to orient efforts not only to transport, but also to the industrial sector; where cogeneration is being considered together with actions centered around thermal and mechanic aspects, considering technological process modernization and innovation, including good equipment maintenance and replacement. The impact of these undertakings is thought to become spectacular.

The difference between both scenarios will be 24.7% by 2020, accounting distributed gas for 55.0% and electricity for 20%. The consumption drop in the energy intensive industry will be 21.2% and 29.5% in the non-energy intensive one.

Estimating that the growth of the number of new electricity power plants will keep the same pace it have had until now, the improvement of the processes used to advance in competitiveness will result in saving the equivalent to 5000 MW in the set up of expanded facilities or new power stations, as compared with the base scenario. For the amount and type of energy sources used in power stations, fossil fuels will be decreasing their share reaching by 2020, 54% of the total consumption as compared with the 82% prefigured in the base scenario.

The primary energy use will grow 2.9% per annum in the 1995-2005 term and 3.5% per annum in the 2005-2020 period. In the 25 year term the share of oil and its derivatives drops 7%, increasing natural gas and renewables 3% each, and nuclear 1%. Total use of primary energy will be reduced 10 points as compared with the base scenario.

With respect to the GHG emissions the differences between both scenarios are clearer after 2005. Total CO_2 emission savings will reach 58000 Gg by 2020, meaning an almost 21% reduction with respect to the base scenario. Specific emission will go down through the whole 25 years period, showing a 7% decrease as compared with present values.

In Graph No. 8 the per capita GDP energy used and CO_2 emission pathways are shown.

Mitigation measures will take the Argentinean energy intensity down 3% below the 16% estimated in the base scenario although an expansive economy is forecasted, with 30% increase in per capita product, due to technological modernization and innovation, structural adjustment and increase in energy efficiency.

The average growth of the industrial sector is considered to be 3.8% per annum between 1995 and 2005; and the IAV will grow below 2% in the 1994-1999 period and at an average of 3.8% in the 1999-2005 term.

Adopting the model used in previous industrial energy analysis used as reference we shall begin looking now to the general characteristics and hypothesis of particular industries and afterwards to the application of cogeneration in the overall industrial sector.

- Pulp and Paper.-The SC was 32 GJ/t (1995); but international reports[1] indicate that SCs of 26 GJ/t and 19 GJ/t are suggested as feasible for the years 2010 and 2020 respectively, according to technologies being developed. In this way the SC may decrease at annual rates of 1.37% until 2010 and of 3% until 2020.

- Cement, lime, and gypsum.- The SC in the base year was 7.1 GJ/t. It is estimated that, with the utilization of new technologies, said value might drop to 2.34 GJ/t by 2020[2]

- Vegetable oils and fats.- The SC in this subsector was 7.95/t in 1995, estimating to reach 5.00 GJ/t by 2020; decreasing 1.84 % per annum.

- Dairy Products.- Includes milk, cheese butter, milk jelly, and yogurt. The Sc for the group of products was 2.97 GJ/t in 1995 and with updated technologies could reach 2.07 GJ/T by 2010. It is thought that the cheese area is where worthy energy conservation measures should be taken.

- Textile fibers, fabrics and textile finishing.- From a SC of 34 GJ/t in 1995, it is estimated that a value of 19 GJ/t could be reached by 2020, using technologies already known or being presently developed.

For the remaining industries it is considered that the energy intensive ones might lower the energy intensity by 12% and the non-energy intensive by 11.9% through the 1995-2020 term.

With reference now to cogeneration and referring to the concept of Energy Coefficient (R_1), heat demand/electricity demand, the interest is placed in those having R_1 in the 2.5-11 range, considered potential cogenerators industries.

Within them the ones having residues as a result of the processes applied are relevant, since even if these residues are now used to produce electricity in open cycles, when it becomes burned in cogeneration systems, not only the energy efficiency of the productive process will

[1] UNIDO/SEI – Industrial Technology Inventory – Vienna 1997
[2] US COUNTRY STUDIES/BERKELEY LABORATORY-Greenhouse Gas Mitigation Assessment: A Guidebook - 1995

improve, but also there will by a cost drop since the transport of said residues and the purchase of other fuels will be avoided. Examples of these types are several Argentinean agro-industries like the energy intensive sugar, cereal, and rice mills; and the non-energy intensive vegetable oil, sawmill, paper plants.

The suggested sources and consumption related with cogeneration are shown in table No. 1.

Within the branches under rest energy intensive, sugar mills are included; and under non-energy intensive, other agro-industries. No data was available to differentiate self-production from cogeneration developments for 1995, which explains the absence of % cogeneration figures.

The features of the hypothesis developed are:

- The pulp and paper subsector which for the year 2005 will have 35.17% of total electricity used (4.72 PJ), obtained with cogeneration;
- The rest of energy intensive subsectors, with 11.9% of the electricity used (52.54 PJ) generated with cogeneration, with the highest growth rate (7.5% per annum) by the year 2010;
- The decrease of the growth rates of cogeneration for pulp and paper and the rest of energy intensive ones, in the 2010-2020 term.
- Dairy products and vegetable oils appearing with the highest cogeneration growth rates, 10.3 and 5.3 per annum respectively, after the year 2010.

Once the assumed goals in relation on the mitigation to be attained, based on a rational use of energy (RUE), are set as we saw above; the question we ask ourselves is: To what extent can a center like CIPURE contribute with energy services to get industry to abate energy consumption and contribute to environment conservation as much as possible?

From the CIPURE experience, coming from the energy audits done, it appears that industry could save on the average about 15% of thermal energy and about 5% of electric energy used, with a minimum or no-investment at all.

It is evident that with the human resources and infrastructure at disposal, CIPURE could attend a demand much higher than the present one. Therefore a great effort is being done to get a deeper and wider penetration in the energy services market, through factory visits, the mailing of a periodical publication "con ENERGIA", published four times per year and the permanent appearance of articles in magazines of industrial and commercial interest.

Although any demand is welcomed and the fees charged by the energy services are relatively low, the fact is that great energy consumers (GECs) are the most inclined to request the services, since obviously the benefits expected from an energy auditing are bigger.

Let us now view this market in the politico-economic framework within which it carries out its development, and which measures are suggested to be taken in order to improve the interaction of energy services suppliers and enterprises, extend the RUE and contribute to the mitigation of environment contaminant gases.

Looking for the characterization of GECs, it was found that in those plants that use in the case of gas (9,300 kcal/m^3) over 10,000 m^3/day, the industrial sector and the electricity generating stations represent 65% of the market for gas. Of this 65%, the energy generating sector uses 41%; the production of oil and gas, the manufacturing of chemicals obtained from oil, coal, rubber and plastics takes another 25% and the basic metal industries another 15%.

Among the electricity consumer market as GECs were considered those with power demand contracts of over 100 kW (almost 75% of all the GECs), self generators which use part of the generated energy and send the rest to the market, cogenerators and self producers. The latter generate part of their demand and buy the rest from the market, and have a relatively important demand of about 12,900 GWh, of which they produce about 1/3 .

As a result of a survey carried out among a number of representative firms and agencies, to evaluate the degree of development with respect to cogeneration and efficient use of energy, the main factors driving the Argentinean energy market were found to be:

- Increasing competitivity. It is already present in the Wholesale Electricity Market (WEM) and starting to show in the oil and gas market;
- Integration of the electricity and gas market, with a mutual complementation and conditioning in relation to price and security of its supply;
- Regional integration and complementation with neighboring countries, especially with Bolivia, Brazil and Chile.

Within the present stable and consolidated regulatory framework, the big gas and electricity users have mainly commercial interests, such as its price, terms under which contracts are signed, etc.. This means that short-term competitivity considerations condition and limit any developments related with energy efficiency and cogeneration; although it is expected that growing concern about the quality and environmental impact of energy services will lead to new market niches.

What is the outlook in relation to rational use of energy (RUE) and cogeneration?

The feeling is that in the medium and long range, cogeneration looks to be a promissory good business and the potential sectors which might benefit from its implementation are not only the industrial GECs but also consumers from the tertiary sector, such as banks, shopping centers, supermarkets, hospitals, public buildings, etc..

With reference to RUE and the modernization of the technological processes, the urgency of its application by industry will depend on the evolution of the prices of the different forms of energy supplied, and the development of convenient ways of financing.

In financing there came out already several ways of help in the form of covering expenses for training people from industry in practical management of RUE, which can be discounted from taxes (regulated by the National Institute of Technical Education-INET)) and soft credits for industrial technological modernization, involving easy repayment conditions over a relatively long time span, offered through the Fondo Tecnológico Argentino (FONTAR). Since the private banking system is not interested in energy services, it will be up to the marketers to show creativity and initiative to design financial packages, and convince the bankers of the excellence of the projects proposed. It is expected that in the long range, and considering the magnitude of the involved businesses, they will be more inclined to collaborate with marketers than with energy service centers.

The steady increase in energy technical assistance services is becoming evident in the growth of its demand which has been taken place at CIPURE since about five years ago, which is not limited to big consumers, but also to small and medium size industries.
When promoting RUE and cogeneration, difficulties appear in what has to do with the interest and the decision to act in the field. Said difficulties arise from:

- The low cost of the electric energy in the WEM, relative to investment costs. There are several examples in Argentina related with this fact. One case, still remembered, happened in the Province of Buenos Aires when in 1993, after a survey of the possible and convenient cogeneration projects and with a potential of 600 MW then evaluated, the plan lost ground after the wholesale price of electricity dropped 50%, through the following four years. This behavior was stimulated by an improvement in the increasing reliability of thermal stations and excess power offer.

- The fact that although related with the electricity market there is a law and also general regulations mentioning cogeneration and dating back to 1992 and 1993, no specific regulation has come out thus far.
- The absence of tax incentives and limited diffusion of the relatively recent appearance of adequate financial help through FONTAR, mentioned above. The traditional loans given by commercial banks were based in the solvency of the demanding firms and not in the evaluation of the proposed investment projects.
- The "culture" and business practices of industrial managers. They are such that, although they have very urgent economic concerns to lower costs in the current macroeconomic recessionary situation, they are not very conscious of the economic importance of being efficient with the use of energy. It is not only the fact that they might ignore ways of avoiding wasting energy but it is very frequent to find firms which have a complete absence of practical energy management, where they don't know if the specific consumption of energy they are having is reasonable or not. And another interesting aspect is that we have found cases where the firm is concerned with environment conservation, but it has never thought about the greenhouse gases it produces from the burning of fuels.
- It is very common that in the case they have to select between investing in energy saving or increasing productivity, they choose the latter, even if the return rates are the same in both cases.
- Since there is no consciousness of energy conservation in the predominant politico-social culture, consequently no legal regulations have ever been elaborated.

Although, locally, appears to be a leaning towards the future provision of energy conservation services to consumers by electricity generating companies, due to the very competitive framework in which they have to carry out their business; the change of ownership of said enterprises compels us to be cautious about future developments in this respect.

It is interesting to bring out the fact that the electricity distributors, which have been working with "captive customers" but are facing a gradual opening of the market, are assisting big consumers in matters of RUE, plants maintenance or power factor, being more active in this sense than the gas distributors.

Also the makers and sellers of equipment related with industrial energy services, show propensity to participate in a future energy-services market, perhaps making strategic alliances with energy service centers, looking for an expansion of sale channels.

As a results it is considered that actions to be taken would be:

- With reference to GECs, the creation of a consulting board made up by RUE-related public agencies and energy operators associations, which would jointly coordinate and make the follow up of the activities. In this way a synergic positive effect involving aggregation of industrial energy services and possible impacts of regulations would be reached.

After improving the knowledge of the market involving small and medium industries, which might be potential users of RUE services, and widen its diffusion of the services; specific actions have to be identified in order to be implemented, coordinating private and public operators. All of it with a simultaneous diffusion of local successful cases of RUE implementation, and of the permanent existing possibilities for training personnel at manager or operator level.

The promotion of the use of the above mentioned INET, FONTAR, and other similar financial help, for training people from industry in practical management of RUE or for technological modernization, reinforced by project insurance coverage in particular cases with guarantee funds.

The idea of suggesting Argentinean provinces to evaluate the introduction of RUE criteria as a basis for the provision of subsidies from a tariff compensation fund, to carry out RUE projects, has been also mentioned.

Proposals have been made to evaluate and set specific standards in relation to RUE, to energy quality labeling in household appliances (already regulated by a resolution of the Secretariat of Industry, Trade, and Mining), to cogeneration (for instance, eliminating any obstacles for the connection to the electric network to sell any excess energy which is produced), to polluting emissions.

The importance of demonstration projects has been ratified by our Secretariat of Energy, and has recently approved the initiation of an ARCO project in cooperation with the European Union aiming at:

At the country level

- Develop more precisely the image of the cogenerator enterprise in the existing electric and gas regulatory frameworks;
- Become acquainted with the energy saving potential and the mitigation of polluting emissions, which can be attained through cogeneration and its incidence as a factor of sustainable local development.

At the electricity and gas distributor and generator enterprise level

- To promote the support of this energy suppliers to cogeneration in small and medium size industries, looking for their participation and monitoring in the demonstrative activities.

At the European equipment maker, builder, and/or engineering and service supplier level.

- To detect the potentiality of the Argentinean market for their products and services; and to promote partnership-with-local-supplier agreements.

At the consumer-enterprise level

- To show in the actual market conditions the advantages that cogeneration systems present, not only in its improved process efficiency but also in the economic benefit of its service.

Four projects will be carried out and it is expected that public and private sectors will improve their knowledge of world accepted and adopted thermal and electrical generation technologies.

In relation to the distributors (wires businesses), although a cautious interest is being shown in the supply of energy services, they are very skeptic with respect to the effective contribution that marketers may make. In the electric market field, the reaction is stimulated by the warding off of the eventual total deregulation of supplier selection, considered by the Energy Secretariat. There is the hope, however, that in the long range, wires businesses and marketers will find situations where they can complement each other.

in the context described is carrying its work CIPURE, showing a positive tendency the demand of assistance required by industry for an efficient use of energy. The feeling is that the barriers to the deployment of the latter, and to cogeneration will be overcome once the industry become conscious of the cost effectiveness of their application in a milieu which is mostly looking to minimize investment, maximize economic benefit, minimize risk, and immobilize resources for the shortest length of time.

Also, a decision over which emission abatement option is chosen in a certain case, will depend on whether the selection is done at a technical, economical or market level. That is whether the choice is done among any of the technically feasible options, among any of the cost-effective technically feasible options, or among the possible technical options that we could carry out under certain market conditions.

Usually, estimations and calculated costs do not consider an evaluation of the existing barriers to make the selected option a market option, and the extra costs involved in the process. The true mitigation costs are underestimated because they do not include the added costs involved in the mechanisms and activities needed to transform a wished solution in a feasible and effective one.

Finally, it is important to remember that we have to be careful when we generalize conceptual and methodological considerations because we should take into account the different politico-economic scenarios prioritizing different wellbeing goals.

REFERENCES

ECOENERGIA, "Grandes Consumidores de Gas Natural y Electricidad en la Republica Argentina, BID, NovIembre, 1998)

FUNDACION BARILOCHE. Programa de Medio Ambiente (MEDA/FB). "Inventario de Emisiones de Gases de Efecto Invernadero. Sector Energla: Quema de combustibles en Fuentes fijas y Emisiones Fugitivas, 1997". Informe Final, Buenos Aires, Julio, 1999

FUNDACION BARILOCHE." Plan de Trabajo para la Adopcion de Metas de Emisiones de Gases de Efecto Invernadero. Proyecciones y Opciones de Mitigacion del Sector Energia", Proyecto No. ARG/99/003, Buenos Aires, Agosto 1999

FUNDACION BARILOCHE - INSTITUTO DE ECONOMÍA ENERGÉTICA. "Estudio de Mitigacion de Gases de Efecto Invernadero", Proyecto Arg/95/g/31 – PNUD – SECYT, Buenos Aires, Diciembre, 1997.

ANNEX: COGENERATION COSTS[3]

They were developed based in a direct comparison between the costs associated to the Public Service generation and those corresponding to cogeneration, since the scenario assumed that cogeneration would take the place of Public Service generation.

In order to identify the most relevant barriers, the analysis include the comparison of a typical supply contract containing backup cost. And the Annual Equivalent cost was determined for the years: 2004, 2008, and 2012; for 5, 8, 10, 12, and 15% discount rates. For the medium term until 2004, where the cycle starting with the present equipment ends, incremental investments were considered and total investments were contemplated for the long term ending in 2008 and 2012

[YEAR 2004]

BRANCH	COGENERATION INVESTMENTS (US$kW)	OPERATION & MAINTENANCE COSTS (US$/MWh)	FUEL COST (US$/MWh)
ENERGO INTENSIVES	455	3.0	6.43
NON ENERGO INTENSIVES	585	4.0	6.83

[YEARS 2008 – 2012]

BRANCH	COGENERATION INVESTMENTS (US$kW)	OPERATION & MAINTENANCE COSTS (US$/MWh)	FUEL COST (US$/MWh)
ENERGO INTENSIVES	600	2.7	7.13
NON ENERGO INTENSIVES	750	3.6	7.23

To determine cogeneration penetration in the industrial sectors, the technical potential was evaluated and then, the actual market possibilities. This gave the following values for each one of the time periods.

[ENERGO INTENSIVES]

	2004	2008	2012
POWER (MW)	802	937	1070
ENERGY (GWh)	5592	6533	7461

[3] FUNDACIÓN BARILOCHE, Project ARG/99/003, Buenos Aires, August 1999

[NON ENERGO INTENSIVES]

	2004	2008	2012
POWER (MW)	276	322	368
ENERGY (GWh)	2070	2415	2760

As a result of the analysis developed, the below-tabulated values were obtained:

First Time Period

OPTION	INVESTMENT (10^6 US$)	O & M COSTS (US$/MWh)	ADDED POWER (MW)	DIRECT CO_2 SAVED (Ton/Year)	EQUIVALENT CO_2 SAVED (Ton/Year)
COGENERATION	526.0	9.70	1078	2140000	2250000
PUBLIC SERVICE	565.0	10.53	1412	-	-

DISCOUNT RATES	COST per Ton of CO_2 (US$)	COST per Ton of EQUIVALENT CO_2 (US$)
5%	-9.6	-9.2
8%	-10.6	-10.0
10%	-11.3	-10.8
12%	-12.2	-11.6
15%	-13.7	-13.1

The tendency decreases as the rate goes up, because to an almost equal investment costs, there are differences in the O & M costs.

Second Time Period

OPTION	INVESTMENT (10^6 US$)	O & M COSTS (US$/MWh)	ADDED POWER (MW)	DIRECT CO_2 SAVED (Ton/Year)	EQUIVALENT CO_2 SAVED (Ton/Year)
COGENERATION	804.0	9.77	135	790000	810000
PUBLIC SERVICE	657.0	11.13	46	-	-

DISCOUNT RATES	COST per Ton of CO_2 (US$)	COST per Ton of EQUIVALENT CO_2 (US$)
5%	-2.8	-2.7
8%	-2.4	-2.4
10%	-2.2	-2.1
12%	-2.0	-1.9
15%	-1.7	-1.7

Third Time Period

OPTION	INVESTMENT (10^6 US$)	O & M COSTS (US$/MWh)	ADDED POWER (MW)	DIRECT CO_2 SAVED (Ton/Year)	EQUIVALENT CO_2 SAVED (Ton/Year)
COGENERATION	114.0	10.17	133	910000	928000
PUBLIC SERVICE	93.0	11.75	46	-	-

DISCOUNT RATES	COST per Ton of CO_2 (US$)	COST per Ton of EQUIVALENT CO_2 (US$)
5%	-2.7	-2.6
8%	-2.4	-2.3
10%	-2.2	-2.1
12%	-2.0	-1.9
15%	-1.7	-1.7

FINAL GENERAL CONSIDERATIONS

The selection from both alternates was done by comparing generation costs under identical conditions and was based on the technico-economic characteristics of the generation equipment. To give to the analysis a general character considerations based on variations in the rationality of actors, comparison against tariffs, reserve power, etc., were disregarded.

In productive activities, investment in cogeneration compete with other investment possibilities which might be more attractive. Decisions may be based in earning rates rather than in a positive present net value at a given discount rate; managers tend to be concerned with profit making in the short term and risk minimization. Of course, the importance of investing in efficient use of energy grows when the energy cost percentage in the total cost increases. However the frequent change in the prices of fuels and of electricity, and the uncertainty of their evolution in the medium and long term is not a positive factor in promoting decisions related with investments for a more efficient energy consumption.

Big energy consumers, with great negotiating power, may get very convenient contracts from energy suppliers discouraging decisions over energy conservation; and restrictions to supply any excess cogenerated energy to the public service may also appear as a barrier to develop cogeneration systems.

With the above commentaries we want to point out that the tabulated figures indicate that there is an important technical and economic cogeneration potential, which, to be reached, has to take into consideration other influences besides market mechanisms. The added costs needed to overcome these extra motives, were not included in the above calculations.

1.4 Egypt

Current State and Trend of Industrial Energy Efficiency and CHP in Egypt

Dr. A. Khozam, General Manager, Mideast Energy and Environment Services

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1. INTRODUCTION

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1. INTRODUCTION

Energy demand in Egypt has been increased in recent years due to the improvement of standard of living, construction of new industrial zones and expansion of commercial and residential sector. On the other hand, the increased awareness of the limitation of oil and gas reserves, and valid expectation of higher future prices of imported energy, make the call for energy efficiency improvement should take a more serious dimension.

The first part of this paper presents an outlook to the energy efficiency improvement activities, experience gained and lessons learned during the last ten years, and case studies. The second part of the paper focuses on one the well-proven technology application, the Combined Heat and Power (CHP), or cogeneration. Now this technology application is given high priority due to its impact on fuel efficiency utilization and mitigating the green house gases.

2. PATTERN OF ENERGY CONSUMPTION

The primary energy consumption in Egypt has increased from about 36.7 mtoe in 1996/97 to about 39.9 mtoe in 1997/98 with growth rate of about 8.89%. Primary energy consumption in Egypt depends mainly on petroleum energy (petroleum products and natural gas) which represents about 93.1% of the total primary energy consumption in 1997/98.

Figure 1 illustrates the flow chart of energy supply and consumption in the year 1997/98. Figures in the diagram indicate the composition ratio of the total primary energy in that year which amounted about 43.6 mtoe (including biomass energy estimated to be 3.6 mtoe). The effective energy utilization ratio, or the total heat utilization ratio, was only 36% with the remaining 64% released into the air or the sea.

Table 1 shows that the sectoral consumption of petroleum products has increased in all sectors except the agriculture sector. The total consumption of petroleum products reached about 23.896 mtoe in 1997/98, shared between sectors as shown in Fig. 2.

As illustrated in Fig. 3, the peak electrical demand increased from 9235 MW in 96/97 to 9850 MW in 97/98, with an annual growth rate of 6.66%, while the total installed capacity was fixed at 13303 MW. The total electricity generation has increased from 57.7 TWh in 96/97 to 62.34 TWh in97/98 with an annual growth rate of 8.03%.

The sectoral consumption of electricity has increased from about 49.3 TWh in 1996/97 to about 53 TWh in 1997/98 with a growth rate of 7.39% (Table 2). The two major consumers of electricity are industry sector representing 41.68% of the total electricity consumption and commercial/residential sector representing about 38.64% in 97/98, followed by the government and public utilities sector representing about 15.66% and finally the agriculture sector representing only 4.02% of the total electricity consumption. Figure 4 shows the sectoral consumption of electricity in 1997/98.

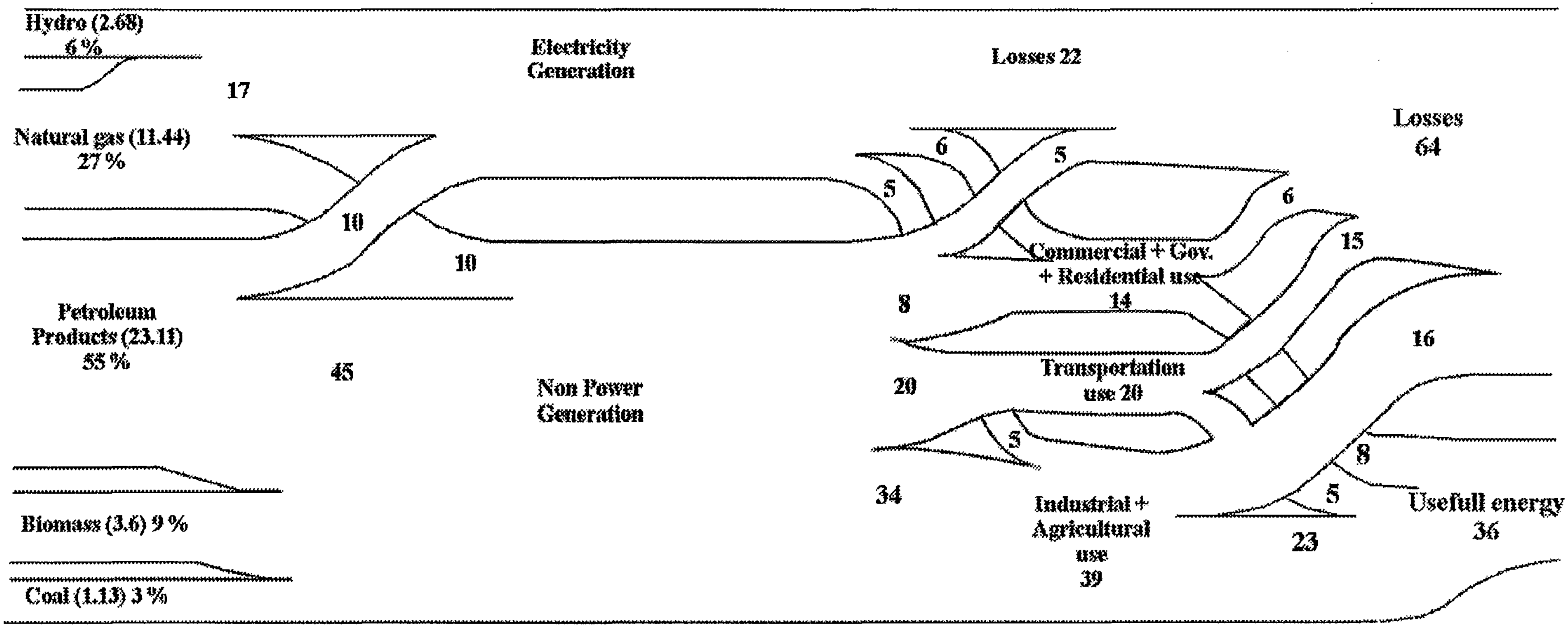


Figure 1 Flow Chart of Energy Supply and Consumption in Egypt
(1997/98)

TABLE 1
SECTORAL CONSUMPTION OF PETROLEUM PRODUCTS
(Million TOE)

SECTOR	97/98	96/97	GROTH RATE	SHARE (97/98)
INDUSTRY	6.248	5.866	6.51 %	27.77 %
TRANSPORT	7.986	7.347	8.7 %	35.49 %
ELECTRICITY	4.208	3.04	38.42 %	18.7 %
PETROLEUM	0.772	0.681	13.37 %	3.43 %
AGRICULTURE	0.099	0.093	6.06 %	0.41 %
RESIDENTIAL & COMMERCIAL	3.195	3.019	5.82 %	14.2 %
TOTAL	22.502	20.052	12.22 %	100 %

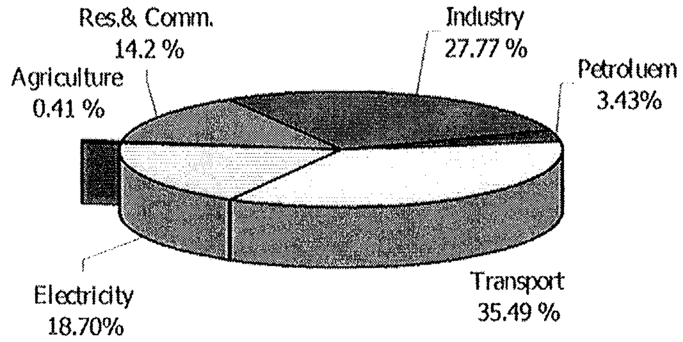


Figure 2. Sectoral Consumption of Petroleum Products for Energy Use (97/98)

TABLE 2
SECTORAL CONSUMPTION OF ELECTRICITY
(Million kWh)

SECTOR	97/98	96/97	GROTH RATE	SHARE (97/98)
INDUSTRY	22079	21150	4.39 %	41.68 %
AGRICULTURE	2131	1940	9.86 %	4.02 %
RESIDENTIAL & COMMERCIAL	20471	18962	7.96 %	38.64 %
GOVERNMENT / PUBLIC UTILITIES	8269	7285	13.88 %	15.66 %
TOTAL	52977	49336	7.33 %	100 %

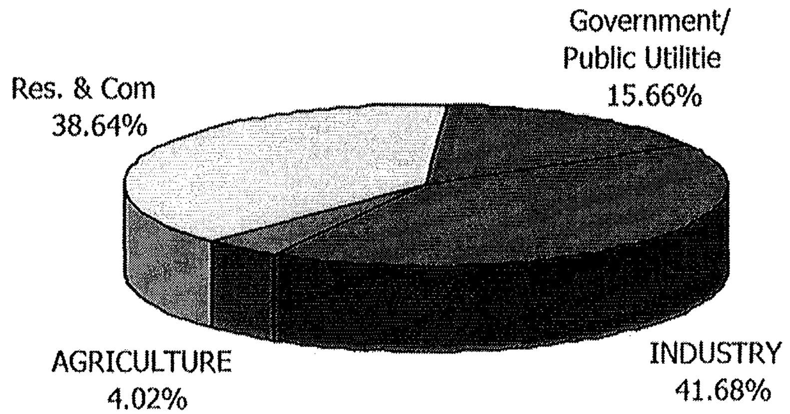
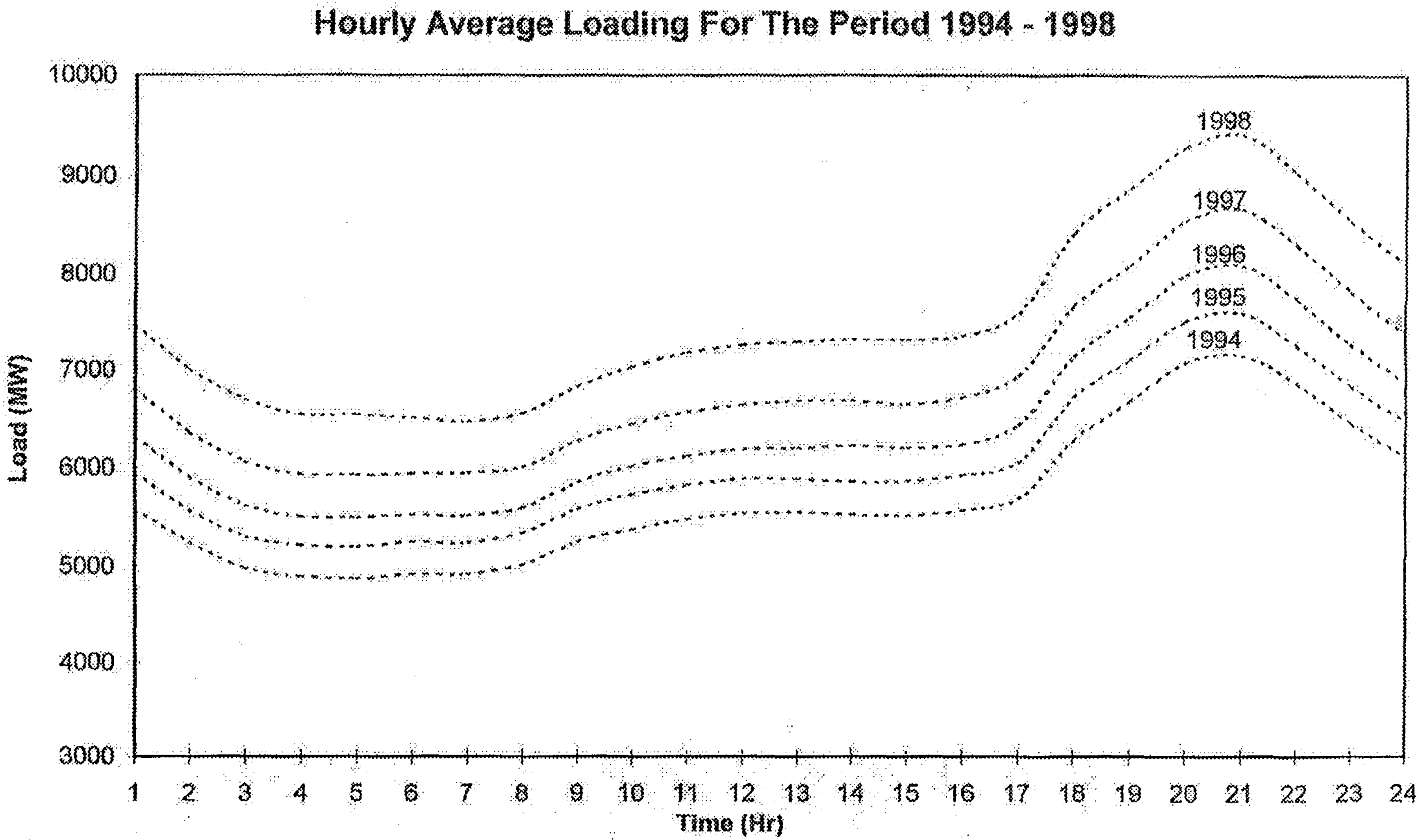


Figure 3. Sectoral Consumption of Electricity (97/98)

Figure 4.


Hourly Average Loading For The Period 1994 - 1998
Load (MW)
10000
9000
8000
7000
6000
5000
4000
3000
1998
1997
1996
1995
1994
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
Time (Hr)

3. ENERGY EFFICIENCY IN EGYPT: RESPONSIBILITY AND EXPERIENCE

Energy policy in Egypt is guided largely by the Ministry of Petroleum, responsible for all activities related to petroleum industry, and the Ministry of Electricity, responsible for generating, transmitting and distributing electricity. A Supreme Council of Energy (SCE), which is composed of all government ministers who have some deal with energy, is charged of all national energy policy. The SCE was established by a Prime Minister decree in 1979. The principal responsibility of the SCE is the planning of short and long-term energy programs and addressing and bringing to the president's attention major energy issues. The Ministers of Petroleum, Industry, Irrigation, Transport, Communication, Housing and Reconstruction, Agriculture, and Finance are all members of SCE, as well as the president of the Academy of Scientific Research and Technology and some selected energy experts known for their vast experience. The Technical Secretariat of the SCE is responsible for coordinating the efforts of three working groups entrusted with three main areas of concern in the energy field; namely: Resources, Production, and Consumption. The SCE policy would naturally consider alternative actions to rationalize energy pricing and subsidies.

3.1 The Organization of Energy Planning (OEP)

OEP was established in 1983 on the basis of Presidential Decree, No. 112/83, as an independent legal entity reporting to the Ministry of Petroleum to take the responsibility of providing technical support to the Supreme Council for Energy (SCE) and undertaking comprehensive and integrated energy planning and policy analysis within the economic framework. The experience of OEP in industrial energy efficiency improvement achieved the following outputs:

- More than 50 industrial audits conducted during the period: 1985-1999, with estimated energy savings about 995 ktoe of cost 7.1 million US $, investment 15 million US$, and simple payback period 2.1 years.
- Training of more than 4000 engineers and energy managers in about 200 establishments.
- Recently OEP had held many training courses in the field of Bio-climatic architect. This was ended by issuing a handbook named "Energy and Architect" in July 1998.

3.2 The Egyptian Electricity Authority (EEA)

Before 1995, EEA has focused its efficiency improvement efforts on the supply side, e.g., electric generation, switching to natural gas, rehabilitation of old power plants, transmission and distribution systems and not on the end-use efficiency. Recently, EEA has begun to have DSM programs in place and to explore time-of-use pricing as a load management measure.

3.3 New and Renewable Energy Authority (NREA)

NREA is a part of the Ministry of Electricity and Energy. The four areas encompassed by NREA's program are mini-hydro, direct solar, wind, and biomass. NREA started to look into solar energy in the early 1980, as a part of USAID-sponsored program. Current initiatives include the promotion of solar heaters for the residential and commercial sectors.

NREA is fully supportive of energy and DSM as a major energy resource in Egypt and sees renewables and energy efficiency as complementary approaches to improving Egypt's energy and environmental situation.

3.4 The Energy Conservation and Environment Project (ECEP), 1988-1998

ECEP is the third component of the broader science and technology for development project (STDP) No. 263-0140. The project was financed by USAID (50 million US$) and executed during the period from 1988 to 1998. The project was designed to encourage energy efficiency, and increase Egyptian institutional capability to implement energy conservation. Project components included technical assistance, management advice, training programs, promotion and information dissemination, and commodities procurement, with a specific focus on the conservation and efficient use of energy in industry.

Egyptian partners in implementation of the ECEP Project are:

- the Tabbin Institute for Metallurgical Studies (TIMS) for public sector activities;
- the Development Research and Technological Planning Center (DRTPC) of Cairo University for private sector activities; and
- the Federation of Egyptian Industries (FEI) for training and promotion activities.

3.4.1 Experience of ECEP in Industrial Energy Efficiency Improvement

The result of 10 years intensive and sincere efforts of the family of ECEP for the adaptation and implementation of energy efficiency technologies in Egyptian industries lead to the implementation of 16 applications in the public sector and 14 in the private sector. Despite that ECEP had originally targeted 10 technology applications, there are several factors, like the scale of implementation, practical considerations, and feasibility figures at design stage, that limited the number of implemented technologies into 8 of these targeted technologies, while added 3 new technologies into the track.

The targeted 8 technologies are: Improving Combustion Efficiency, Power Factor Improvement, Cogeneration, Waste Heat Recovery, High Efficiency Lighting, Process Control, Energy Management System, and Efficient Machinery and Motor Drives. The other 3 technologies are: Water Treatment for Improving Energy Performance of Boilers and Power Houses, Conversion from Liquid Fuel to Natural Gas, and Scrap Processing for the Improvement of Energy Efficiency of Steel Making Process.

The industries covered in these applications were: cement, fertilizers, metallurgical, refractories, glass, textile, engineering, and commercial building. The capital investment on imported equipment is ranging from 50,000 to 1,900,000 US$ per application and the simple payback period ranges from 0.11 to 4 years.

There are two case studies of successful implemented projects in the public sector : one is a study on a power factor improvement project implemented in "Transportation and Engineering Company", and second one is a combustion control project implemented in "The Egyptian Copper-works".

4. THE DSM PILOT PROGRAM

There is a significant opportunity to enhance the efficiency of energy use in Egypt at the end users through the implementation of demand side management (DSM) programs [3]. Through these programs, a number of benefits can be realized.

A preliminary survey [2], has shown that a remarkable savings could be achieved in these sectors by the application of DSM programs. These savings are summarized in Table 3 as percentage of each sector's energy source users.

TABLE 3
SUMMARY OF DEMAND-SIDE EFFICIENCY
IMPROVEMENT POTENTIAL RELATIVE
TO EXISTING EGYPAN ENERGY USE

Energy Source	Residential (%)	Commercial (%)	Industrial (%)
Electricity	5-15	5-15	10 - 40 Efficiency 1 10 - 30 CHP
Petroleum	10-30	NA	20 - 40

A DSM pilot program started in May, 1996 and ended in October, 1998, funded by USAID and implemented by ECEP in both public and private sectors. The program was conducted in industrial sector (large consumers) with the cooperation of the Alexandria Electricity Company (AEC), The Egyptian Electricity Authority (EEA) and the Organization for Energy Planning (OEP).

A protocol agreement has been established between these parties and a work plan was put to describe the responsibility of each organization in the performance of the program.
The objectives of this program are as follows:

1- Data Collection To Support Plant Screening.
2- DSM Training.
3- Selection of Plants.
4- DSM Energy Audits
5- Procurement of Equipment For No Cost / Low Cost Projects.
6- Installation of Equipment
7- Monitoring And Maintenance Of Results
8- Analysis of Results.
9- Report Preparation .
10- Promotion.

After screening of 13 plants, six potential candidates have been selected for detailed energy audits. The selected candidates covered the following industries: Cement, textile, paper, metal and plastic.

Table 4 Shows the results of energy audits, including the estimated cost of equipment and the simple payback period. To demonstrate the potential savings of DSM measures, several technology applications were implemented successfully in five companies as shown in Table 5. After retrofitting, some of these applications such as high efficiency lighting and installation of steam traps gave high amount of savings within 3 months monitoring period. Other applications are still under monitoring.

TABLE 4
RESULTS OF DSM AUDITS

Company	Annual Savings						Cost of Equipment (LE)	SPB Period
	Demand (kW)	Energy (MWh)	Mazout (Tons)	N.G. (m^3)	Solar (Liter)	Cost (LE)		
STIA	240	1,247,488	1068			334,996.2	147,538.3	5.29 M
KABO	373	372,760	1380		24,900	287,100	246,500	10.5 M
ELECTRICITY & P.		415,747.5	1,568			561,792.5	431,597	9.2 M
ELNASR CASTING	18,000	32.23×10^6		8,970,000	7,750,000	5,528,000	450,000	10 M
N.PAPER C.	3380	632.76×10^6	2805			1,875,942.4	3,036,000	9.22 M
ALEX. P. CEMENT	....	612,600	5858			1,892,756	2,550,000	1.35 Y
TOTAL		4518	12,679	8,970,000	7,774,900	10,480,587.1	6,416,180.2	7.5 M

TABLE 5
DSM TECHNOLOGY APPLICATIONS

APPLICATION	STIA	KABO	ELECTRICITY & PLASTIC	NATIONAL PAPER	ALEX. P. CEMENT
1. High Efficiency Lighting	♦	♦	♦		
2. Boiler Efficiency	♦	♦		♦	
3. Steam Traps	♦	♦		♦	
4. Automatic Control (DCS)					♦
5. Steam Line Insulation	♦				
6. Condensate Return	♦			♦	

5. CHALLENGE OF CHP IN EGYPT

The new Minister of Electricity, in his speech in Oct. 99, paid the attention to the importance of improving energy efficiency, in general, and Combined heat and power (CHP), or cogeneration, in particular. Experience of ECEP in industry have shown that CHP presents potentially significant opportunities for increasing plant energy efficiency.

5.1 Existing CHP Installed Capacity

In Egypt CHP is basically applied in the industrial sector. In 1992 the total installed CHP capacity was 363 MW_e ; from which only 10 MW_e is generated by diesel engines (simple generation) and the rest are using steam turbines. Table 6 shows the classification of this installed power in industrial sectors.

TABLE 6 EXISTING INSTALLED CHP CAPACITY
IN THE DIFFERENT INDUSTRIAL SECTORS (1992)

SECTOR	INSTALLED CAPACITY	SHARE
Food	108.5	30%
Chemicals	129	35.5%
Textile	116	32%
Mining and Refractories	9.04	2.5%
Metallurgical	---	---
Total	363	100%

From 1992 to 1998, very limited cogeneration projects have been added to the existing installed capacity. This due to the economic, regulatory and institutional barriers as well as the unclear picture of the electricity market. Two projects, mainly for demonstration and promotion of the technology, have been implemented by ECEP, one in the public sector (1.8 MW_e) and the other in the private sector (525 kW_e). The case study of the first project "Abou-Zaabal Fertilizers" is presented in Appendix B. Only in the 2^{nd} half of 1999, about 77 MW_e are added to the installed capacity; 17.25 MW_e was installed by Talkha Fertilizers and 60 MW_e by the Egyptian Petrochemicals Company, in which 45 MW_e is already installed.

5.2 Potential of Cogeneration in Egypt

In order to gauge the market for CHP, it would be necessary to obtain detailed energy use information on all major commercial and industrial facilities in the country. Unfortunately, for commercial and residential sector, such data are unavailable. Although data for industrial sector are sketchy, it give some indication about the potential of CHP in industry. Based on the latest study "Support for National Action Plan (SNAP)", conducted in 1996 by EEA in cooperation with the Organization of Energy Planning (OEP), the potential of CHP in industry was estimated to be 1070 MWe. The study was based on the assumption that all steam needed in the industry could be generated through CHP systems. Data used in this study was provided by OEP as a result of several previous surveys. A conservative approach was followed in this study assuming that cogeneration units are sized such that they only consume the fuel currently consumed by the existing boilers.

The was aimed, not only to estimate the potential of cogeneration applications in Egyptian industry, but also to investigate its impact on the national demand, energy use and the Green House Gases (GHG) emissions.

Table 7 summaries the potential of new capacity that could be added to the existing one at each type of industry.

TABLE 7 POSSIBLE CHP CAPACITIES IN MW_e
AT DIFFERENT INDUSTRIAL SECTORS

INDUSTRIAL SECTOR	POWER CAPACITY (MW_e)	SHARE (%)
Food	482.404	45.1
Chemical	131.025	12.25
Textile	154.643	14.4
Metallurgical	44.047	4.11
Pharmaceutical	23.33	2.2
Petroleum	175.912	16.44
Enterprises	59.242	5.5
TOTAL	1070.603	100%

The study included a case study over 30 companies, selected from the food sector. The potential of CHP in these companies was about 200 MW_e With annual consumption approximately 965 million kWh. Fuel saving from these units units will be around 290,000 TOE and the simple payback period ranges from 1 to 6 years. The total annual mass CO_2 reduction was estimated to be 0.86 million ton.

6. RECENT/CURRENT ENERGY EFFICIENCY ACTIVITIES IN EGYPT

Currently, three energy efficiency improvement projects are activated. One project is supervised by the Egyptian Electricity Authority (EEA) and the other two projects are sponsored by the Academy of Scientific Research and Technology. The projects aim to promote energy efficiency through the wider use of demand side management (DSM) and cogeneration with its many environmental and economic benefits.

i. The first project "Energy Efficiency Improvement and Greenhouse Gas Reduction" is sponsored by UNDP and GEF and implemented by EEA. The project started in March 1999 and is expected to take about 4.5 years. The detailed description of this project is presented in another paper.

ii. The second project is sponsored by the Academy of Scientific Research and Technology and implemented by "Tabbin Institute For Metallurgical Studies". The project started only two months ago, and will continue about two years. The objective of this project is to study the potential of energy conservation opportunities, including CHP, in the region of Upper Egypt. The project will cover all sectors, taking into consideration the application of new technologies and the implementation of renewable energy.

iii. The third project is the same, and in parallel with, the second one, but for the Sinai area.

7. BARRIERS

- Energy prices represent the most significant economic barriers, since the public sector companies receive a large subsidy than private sector companies.
- The new policy or legislation regarding private power is not yet well defined. Such a policy would be probably have to be initiated by the Supreme Energy Council, a multi-ministered group which overseas all energy policy in the country.
- The market is still unaware of CHP technology development that has expanded the potential for CHP.
- Current regulations do not recognize the overall energy efficiency of CHP or credit the emissions avoided from displaced grid electricity generation.
- The CHP applications are not widely known outside the industrial sector. This lack of "track record" poses serious barriers in terms of policy making and financing, since both government officials and bankers are unfamiliar with the concept (the technology and operational concept).
- Very low tariffs for surplus cogenerated electricity sold to the grid.
- The lack of incentives for CHP producers.

8. CONCLUSIONS AND RECOMMENDED ACTIONS

Due to privatization and changes in the energy sector, it is expected that more aggressive approach to pursuing energy efficiency, DSM and CHP, will be established in Egypt. The following conclusions and recommended further actions have to be considered:

- Implementation of database oriented to energy efficiency and CHP.
- Examine strategic options and develop national strategies for energy efficiency improvement, CHP and DSM in Egypt.
- Determine institutional roles and responsibilities of various Egyptian organizations.
- Explore the application of building codes and appliance standards to improve energy efficiency in Egypt.
- Pursue infrastructure development for the energy management services industry.
- Many efforts have to be done to eliminate, or reduce, the existing barriers, especially for CHP development.
- Financial and Environmental incentives have to be provided to encourage small power producers.
- The potential of CHP in the commercial and institutional buildings has to be thoroughly evaluated.

REFERENCES

1. "Energy in Egypt", Organization of Energy Planning, 1997/1998.
2. ECEP, RCG/Hagler Bailly, Inc., Demand Side Management (manual), 1994.
3. Assessment of Demand-Side Management (DSM) Potential in Egypt. Bechtel and Hagler Bailly. December 1994.
4. Egyptian Electricity Authority (1993/1994) "Annual reports of Electrical Statistics", Ministry of Electricity and Energy.
5. RCG Hagler Bailly/ OBI, "Profile of Energy Efficiency Business in Egypt", 1991.
6. OBI/ECEP "Prospects for Commercialization of Cogenerated Power in Egypt", 1991.
7. EEA/OEP "Support For National Action Plan", CHP Technology Assessment, May 1996.
8. OEP "Survey on The Potential of Cogeneration in Egypt", 1987.
9. A. Khozam "ECEP Case Study: Power Factor Improvement, Transport and Engineering Co.", 1996.

2. Economies in Transition Country Papers

2.1 Russia

Industrial Energy Efficiency and CHP Development in Russia

Mr. S. Molodtsov, Deputy Director, Russian Center for Energy Policy, Moscow

Ladies and Gentlemen, distinguished Colleagues, first of all I would like to thank the Organising committee of the Expert Group Meeting for the invitation to participate in this interesting and very important event.

Indeed the problems of efficient utilisation of fuel and energy as well as slowing down the growth rates of negative environmental trends that are due to fossil fuel combustion are the problems of primary importance for the world community.

I am representing here the Centre for Energy Policy (CEP), a non-governmental organisation for which the contribution in the solution of energy problems is the main direction of activities. CEP's experts took an active part in the process of preparation the Draft Law "On energy conservation" as well as the Draft Law "On renewable energy sources utilisation".

Let me acquaint you with the most important projects recently implemented by the CEP.

Slide 1:

CEP's Activities

- G8 Energy Ministerial meeting
- ECE Project "Energy Conservation as a Factor in Increasing the Energy Security of the Member-States of the Commonwealth of Independent States"
- SYNERGY Project (97-02) "Developing the Energy Policy Dialogue between EU and Russian Federations (RF)"
- TACIS Project (ERUS 9505) "Technical Assistance to the Ministry of Fuel and Energy of the Russian Federation"

The topic of my presentation is mainly oriented at the problem of energy efficiency improvement in Russia's economy (in particular in industry) and CHP development. Nevertheless I cannot do without a brief view on the role of energy conservation in solving environmental problems (including CO_2 emissions abatement).

There are several ways for slowing down a negative environmental impact connected with energy development. These ways are well known in Russia and throughout the world (slide 2, next page).

Increasing the share of natural gas in the structure of primary energy resources consumption in Russia will undoubtedly give positive effect on the environment. It can be proved by comparative analysis of carbon intensity of fossil fuels. Carbon intensity of natural gas is in 1.4 times lower than fuel oil and in 1.75 times lower than coal.

Environmental characteristics are very important driving forces of increasing the proportion of natural gas in the total production of energy resources and its expanded use in ecologically unfavourable centres and for rural gasification.

> Slide 2:
>
> **Environmeninlly Sound Opportunities in Russia**
>
> - To increase a share of natural gas
> - To carry out reforestation
> - To develop nuclear power
> - To enlarge a role of renewable energy sources
> - To introduce actively modern purification equipment
> - To focus on energy conservation

The main direction of gas utilisation in Russia is electricity and heat generation. The share of natural gas in the fuel balance of power engineering is constantly increasing from 56.9% in 1985 to 59.6% in 1990 and to 63% in 1997.

According to the Energy Strategy of the Russian Federation the volume of gas consumption by electric power plants will increase from 191 billion m3 in 1990 to 252-257 billion m^3 in 2010. It is expected that natural gas will have good prospects as a motor fuel. Today the share of natural gas in the total primary energy consumption in Russia is about 50% and it will increase to 57% by 2010.

However there are some limitations in increasing the share of natural gas in the fuel and energy balance connected with a problem of energy security ensuring as well as social problems. Let us now consider just briefly the next 4 opportunities. At the moment the prospects of reforestation in Russia are not very bright because the process of uncontrolled deforestation has been taking place in the country.

According to the Energy Strategy some growth of nuclear capacities in Russia is planned. The main problem is how to ensure needed financing taking into account a sharp lack of investment in the whole Russia's economy and in energy sector in particular.

The Russian Federation considers renewable energy sources as one of the very promising options to substitute fossil fuels in the fuel and energy balances of remote areas as well as other regions with suitable natural conditions for their utilisation. Our experts have evaluated total economically effective potential of renewables in the country at 190 mtoe.

Unfortunately the lack of economically competitive technical solutions as well as total deficit of financial means in the country will not allow the Russian Federation to make the contribution of renewables essential in the near future. Only 10% of available potential of renewable energy will be utilised by 2010.

As far as purification equipment is concerned, much capital outlay is required for creating such equipment. In case of creation of this equipment, its purchase and installation will greatly increase the cost of producing energy. It will make energy as well as industrial products and services unaffordable for many domestic consumers.

In conclusion of the brief analysis of opportunities for abatement of greenhouse gases emissions one can say that their potential in this field for the near future is limited.

Nevertheless I do believe that we have to strive to use any opportunity for diminishing negative environmental impact of energy development.

The last but not the least way to reduce a negative impact of energy development on the environment is energy conservation.

Since the beginning of 90's energy conservation is being declared as a corner stone of the Russian energy policy. Unfortunately not very much have been done in the country in the field of energy efficiency improvement.

The sharp decline of GDP (by 40%) and industrial production in Russia for the last years were the main reasons of reducing energy consumption and unhealthy emissions into the atmosphere (including 600 million. tCO_2 for the period of 1990-1996). On the other hand there was no any positive dynamics of energy intensity of GDP, the main characteristic of energy efficiency level in the country.

Now the level of energy intensity of GDP in Russia is 3 times higher than its average level in OECD countries. This situation in turn gives us a relatively high level of carbon intensity of Russia's economy. The indicators of CO_2 emissions per GDP unit in Russia, USA, OECD and EU countries are presented on slide 3.

Slide 3:

Carbon Intensity of Russia's Economy (Million tCO_2/1000US$)

Russia	2.5
USA	0.85
OECD	0.6
EU	0.44

For any state a major Indicator characterising the efficiency of fuel and energy consumption is the size of its energy conservation potential. At present the Russian Federation has accumulated considerable energy conservation potential.

Today non-used energy conservation potential in Russia amounts to 320-380 mtoe. The recovery of such a huge potential, which exceeds the volume of annual consumption of primary energy resources in the following Western European countries: Austria, Belgium, Denmark Finland, Iceland, Ireland, Netherlands, Norway and Sweden all combined, can and must bring the Russian Federation both economic and environmental benefits.

It is interesting to mention that the potential of energy conservation which could be realised at the cost of around 3 US$/toe is about 60 mtoe and twice more energy bulk could be saved at the cost of 30 US$/toe. In this respect it should be noticed that this part of low-cost energy efficiency measures has been already implemented in OECD countries.

Energy conservation potential in Russia is being realised through the Federal Programme "Energy Conservation in Russia for the Period of 1998-2005". The main objectives of this programme are presented on slide 4.

Slide 4:

Main Objectives of the Federal Programme "Energy Conservation in Russia for the Period of 1998-2005"

Achieved energy conservation, mtoe	255-305
Decreased energy intensity of GDP, %	13.4
Needed investment, bln US$	9.22
Economic effect, profit/investment	2.6-3
CO_2 emission decreased mln tCO_2	700-900

The figures presented on slide 4 show us well that realising energy conservation policy in Russia is a great value for money.

Indeed even in accordance with western standards it is a profitable business to invest 9 billion dollars and get an output in 3 times higher for 7 years. It is expected that budget savings due to reduced subsidies alone will account for 5.5. billion US$. The major problem is how to attract needed investment.

The funding structure for the programme is given on slide 5. It follows from this structure that the Russian Federation in its future investment policy in energy conservation mostly rely on commercial credits and loans as well as market forces and financial means of energy producers and consumers.

In this connection I would like to say a few words about the main barriers on the way of the creation of energy saving investment potential taking place in Russia.

I have to mention first of all unattractive investment climate in Russia's economy (for foreign and Russian private investors), absence of workable financial incentives for energy saving activities as well as incapability of Russian businessmen to make profit from energy efficiency.

The creation of favourable conditions for investment into energy saving in Russia is a very formidable but extremely urgent task, which will take a lot of organising and legislative efforts.

Coming back to the topic of our meeting it would be reasonable to have a look at the inter-branch breakdown of the Russian energy conservation potential (slide 5).

Slide 5:

The Structure of Russia's Energy Conservation Potential

Industry	34%
Fuel and energy complex	33%
Residential and commercial sector	19%
Transport	9%
Agriculture	5%

According to this breakdown industry and energy sector are the largest components of Russia's energy conservation potential (1/3 of the total energy conservation potential each).

INDUSTRY

The potential of energy conservation accumulated in the Russian industry on the base of energy consumption in 1995 is about 105-125 mln. toe, mainly within the energy intensive branches such as metallurgy (7-8% of total amount), industry for construction materials (45%), machine-building and chemistry.

An essential part of energy savings in metallurgy can be achieved through technological improvements in the production of rolled metal products and wider use of secondary materials. The saving effect due to these measures is 12-14 mtoe. More intensified use of scrap metal could save more than 7 mtoe.

Following measures aimed at energy saving in metallurgy can be named (slide 6).

Slide 6:

Energy Saving Measures in Metallurgy

- Utilisation of heat in the production processes
- Improved gas-air gas flows in drying processes
- Modernisation of roasting machines
- Introduction of modern melting methods
- Introduction of better furnaces in the rolled stock production
- Introduction of automated control systems for heating ingots
- Installation of recuperators
- Introduction of low temperature heating of metal for rolling
- Installation of more efficient gas burners

In particular, the steel melting processes can be improved by electric melting methods and continuous steel casting, the process of aluminum production can be sufficiently modernised by means of introduction of better electrolyzers and computer automation.

Within the construction materials industry the main potential for saving consists in transfer of the technology from the wet processes of receiving cement clinker to the dry ones. Even in the dry processes the specific energy consumption in Russia is 8-15% higher than in foreign countries. The saving potential here is at the level of 2.8 mtoe.

As to wall materials, the possibilities of energy conservation are estimated at 1 mtoe. This saving can be connected with increased production of ceramic bricks with the hollowness up to 40-50% and the wide output of products based on coal cleaning waste, ash and ash-slag waste from boilers.

Other energy saving measures aimed at decreasing energy intensity of this branch of industry are presented on slide 7.

Slide 7:

Energy Saving Measures in the Construction Materials Industry

- Intensification of the process of clinker roasting by more effective heat transfer and burners as well as expanded use of mineralizers, substitution of clay components in the raw material mixtures by other materials, utilisation of refractories that are infusible at extreme temperatures, reduction of moisture content in the clinker production by means of using diluters
- ·Iintensification of glass cooking systems and the introduction of electric and gas-electric cooking
- Iintroduction of new roasting machines and machines for production of expanded clay aggregate and other porous aggregates
- Improvement of renewal of fuel combustion in the shaft and rotating furnaces, wide use of fractional raw materials
- Improvements in the technology for production of building ceramics, mineral wool and sanitary engineering articles
- Substitution of obsolete gas burner devices with more efficient ones

The largest potential for energy saving in the machine building industry and some other branches is within improvement of flame thermal and heating furnaces by means of modern recuperators, modern automated burner devices, automated control systems for combustion and heat treatment. The efficiency of furnaces can be increased 2-4 times. Small boilers up to 3 Gcal/h and individual heating installations are characterised by obsolete construction (design) and absence of automated control. Surface heating of metal can reduce electricity consumption in this process dozens of times. The energy saving potential for heating and heat-treating furnaces in machine-building is estimated at 7-8 mtoe.

Within the industries of chemistry and petroleum a huge potential for saving can be obtained by renewing obsolete facilities. The main directions for achieving increased efficiency are:

- improvement of the technical processes for production of potash fertilisers, apatite, yellow phosphorus, caprolactum, carbonyl, sulphuric acid and other products;
- new equipment for multiple ammonia production;
- more productivity in production of poor nitric acid; new equipment for production of ammonia, butyl alcohol, ethylene and propylene;
- installation of new burner devices and heaters.

In the wood-pulp and paper industry savings can be obtained by increased use of wood waste, use of waste paper and decreased thickness of paper. The total saving potential is estimated at 4.5 mtoe for these industries.

Speaking about energy conservation potential in industry I would like to underline one more important direction of its realisation. I mean the improvement of discipline in the field of energy consumption and creation of energy saving style of business among industrial supervisors and managers of different levels.

Just a brief comment concerning discipline. A few years ago I was a member of the expert group responsible for energy audits implementation on a number of industrial enterprises of Moscow. I have already mentioned earlier that economic and industrial activities in Russia have been essentially decreased since the beginning of 90's. For example over 40% of staff of Moscow enterprise "Dinamo" dealing with production of machines and equipment were unemployed. Nevertheless the system of lighting was in workable conditions for 100%.

THE ROLE OF CHP

The potential of energy conservation in the Russian fuel and energy complex is approximately the same, like in industry. One of the ways to increase energy efficiency of this sector of Russia's economy is an active involvement of CHP plants in the structure of heat and electricity generating capacities. CHP development is also very important from the viewpoint of stabilisation and reduction of CO_2 emissions.

Total installed capacity of CHP plants in Russia in 1998 was 66.3 GW, which is the largest capacity in the world. The structure of generating capacities in Russia is given on slide 8.

I would not like to go in technical details. Let me attract your attention to the main problems of the future development of CHP in Russia and acquaint you with the priorities in this field.

Among the main problems on the way of the future development of CHP in Russia one can mention the lack of investment for modernisation of existing CHP and construction of new plants. Total installed capacity of CHP plants in Russia has not changed since 1995. At the same time the share of obsolete capacities of CHP now is about 20%. It is expected that this share can reach 3 5% by 2005.
Taking into account possible economic recovery in Russia a deficit of generating capacities can become a serious barrier on the way of covering growing energy demand.

Slide 8:

The Structure of Generating Capacities in Russia

Power Plants	Capacity, GW
Thermal electric power plant	150.7
CHP plant	66.3
Hydro	43.7
Nuclear	21.2
Total	215.6

CHP plants account for 20% of total installed generating capacity in Russia.

The efficiency of existing CHP could be much higher if needed investment would make. It is also to be mentioned a lack of R&D financing in the field of CHP.

Keeping in mind a very high capital intensity of the sector of power plants it is necessary to form essential financial means right now.

Concerning future CHP development in Russia, the wide application of modern combined cycle gas turbines can be considered as one of the most promising technologies.

Further expansion of existing CHP and establishment of new plants both large units and smaller decentralised plants (up to 25MW) (including industrial ones) are envisaged. The technical, economic and environmental characteristics of small CHP plants are on the highest world level. They cost two-fold less than foreign analogue.

At present a project is being planned envisaging the construction of incineration CHP plants equipped with three boilers each with a capacity of 25 tonnes of steam per hour and a total electrical capacity of 6 MW. The total electrical capacity will be 18 MW and the heat 100 Gcal per hour.

The annual amount of city's solid waste processed at this project could be 160,000 tonnes. The project also comprises plans for the utilisation of by-products from the process.

As far as forecasting estimates of the future development of CHP in Russia are concerned, total capacity of modernised CHP plants by means of gas turbines and the new installations will account for 40 GW by 2010. Realising energy conservation potential in industry and further development of CHP are the main components of the national energy saving and environmental policies of the Russian Federation.

It is to be realised both on a national level and through wide-scale international cooperation in institutional, legislative, financial, scientific and technical and information fields.

I do believe environmental challenges are able to become an additional driving force of intensifying activities in developing and implementing energy conservation policy in Russia on federal, regional and local levels.

2.2 Ukraine

Ecological Problems of Power Industry in Ukraine

Mr. V. Djukov, Director, State Scientific Enterprise, Ministry of Energy of Ukraine

In every country with today's level of economic development, the issue of the power sector and its direct connection to ecological problems draws attention. Energy saving is then considered a universal tool to alleviate environmental impact from power generation

In all countries, the power industry being the basic branch of economy, traditionally is subject to permanent governmental regulation. However, in crisis situations the degree of regulation increases. Today the manner and degree of regulation have changed in stable countries, where such regulation is carried out with an ecological emphasis.

In Ukraine the government policy for the power industry, ecology and energy saving are regulated by the following basic laws:
"On Electricity Power Industry"
"On Energy Saving"
"On Environmental Protection".

Three central executive bodies are engaged in these problems on behalf of the government:
- Ministry of Power Industry;
- Ministry of Ecology;
- State Committee for Energy Saving.

The revival of Ukrainian economy will require an increase of electrical and thermal energy generation. According to the Programs adopted by the Government of Ukraine, the electrical energy generation in 2010 shall exceed 200 billion kWh (in 1990 it was 211 billion kWh; in 1998 - 173 billion kWh).

It is a realistic objective for the power industry with installed capacity of 54 million kW. However, it becomes complicated due to a number of facts.

First of all, most of the power facilities at the thermal power stations have been out of operation for a long time (stand-by or mothballing), accompanied by corresponding troubles.

Secondly, from year to year it's getting more difficult to maintain satisfactory condition of the functioning equipment in the thermal power industry, as funds for repair and rehabilitation activities are never sufficient. Power process technologies of early sixties and equipment beyond its life time are not capable to meet the modern environmental protection requirements when burning domestic coal with up to 40 per cent ash content.

Thermal power industry enterprises discharge up to 30 per cent of pollutants from the total volume of pollutants discharged by stationary industrial sites, it is approximately 0.8 million tons of sulphur oxide, 0.4 million tons of ash, 0.2 million tons of nitrogen oxide.

Carbon dioxide discharges from thermal power stations belonging to the Ministry of Power Industry in 1990 reached almost 162 million tons. This year was considered as a basic year in the Kyoto Protocol.

The level of carbon dioxide discharges was 71 million tons in 1998. The decrease of such greenhouse gas discharges is explained by the known reasons - absolute drop of electricity generation at the thermal power stations. At the same time, there is a permanent tendency of deterioration of specific parameters of carbon dioxide discharges: from 2.08 kg/kg of equivalent fuel in 1990 to 2.23 kg/kg of equivalent fuel in 1998.

This negative tendency is a result of coal's specific weight increase in the fuel budget of TPS and decrease of technological parameters of power units. The coefficient of performance of 200 and 300 MW units is 25 to 30 per cent, while designed efficiency shall be 36 per cent. Coal has a poor quality; the power stations receive coal from 10-15 suppliers at the same time; the coal's quality varies dramatically.

The coal's calorific value sometimes reaches 3400 kcal/kg, while the designed value is 6000 kcal/kg. In 1999 specific consumption of fuel is within the limits of 372 g/kWh; in 1998 it was 369 g/kWh; in 1996 - 365 g/kWh.

The energy consumption during transmission on electricity networks is continuously increasing (average energy consumption within the Ministry up to 22 per cent; in certain power supplying companies 30 to 48 per cent). An incomplete structure of available generation facilities, insufficient quantity of flexible facilities force the power engineers to switch thermal units of 200 and 300 MW, that results in even larger losses due to disturbance of designed operation modes of the units.

In 1998, 173 billion kWh of electrical energy were generated and 128 billion kWh consumed. Balance is 45 billion kWh which represents losses of 26 per cent.

Taking into account the real conditions existing today in the power industry, in combination with ecological problems, it is possible to state certainly, that the growth of the gross domestic product (GDP) and increase of absolute electricity generation in Ukraine using the existing equipment is an unordinary problem, it is bipolar in a certain way.

The increase of economic growth (GDP) requires increase in power generation - on the one hand, and on the other hand it is necessary to ensure a reduce the environmental impact of harmful contamination, because such impact results in the following - the more power we generate, the more losses it brings.

It is necessary to seek reasonable and scientifically motivated compromises.

Using such a simple example it is possible to analyse losses of resources and environmental impact during operation of a 60-W electric bulb within the working hours during one year .

The reason of the deepest global environmental impact is greenhouse gases.

In 1990 (a basic year of the Kyoto Protocol) the total carbon dioxide discharges on the planet were within the limits of 6 to 8 billion tons, approximately 1 ton per capita.

Ukraine has joined the Kyoto Protocol and, pursuant to it, has issued the first National Message about greenhouse gases discharge.

According to the Kyoto Protocol and its "flexible mechanisms" concerning possible quotas trade, Ukraine has a potential chance to solve in a civilised manner the problem of meeting the needs of the economy in power and softening the technogenic environmental impact. Quotas trade is one of the potential ways to invest power-efficient technologies.

Ukraine will take into account these facts during formation of the long-term ecological government policy.

Firstly:
We treat activities within the framework of implementation of the agreements on global change of climate in direct connection with development of the large-scale power industry, its technical and ecological growth.

Secondly:
It is necessary to work harder for the particular result concerning actual decrease of specific power losses per GDP unit by introducing innovative and power-efficient technologies.

Thirdly:
Development of the small-scale power industry, non-traditional and renewable power sources shall be ensured. Co-generation technologies implementation shall escalate.

All these courses of the Ukrainian economy development are supported by the appropriate Government programs. There is quite a number of such programs, but frankly speaking, their implementation is neither sufficient nor satisfactory.

The power sector reforms have not brought desirable outcomes yet:
1) Creation of competitive environment in generation;
2) Attraction of the strategic investors has failed.

Finishing my speech, I would like once again to drag your attention that during solution of problems of energy saving, ecology and power supply there is a potential opportunity to transfer greenhouse gas discharge quotas on the commercial basis.

Quotas trading mechanisms between countries have not been created yet, but there is a constant tendency, that the international commonwealth shall solve this problem.

In Ukraine we are thinking on creation of such mechanisms, in order to take into account the interests of the state, its regions and particular companies where it is actually possible to create reserves of these quotas.

The regional level probably must be an optimal level in the view of implementing pilot projects for development and sophistication of mechanisms to create concern in energy saving and environmental measures. The regional experience further will allow to extend up to nation-wide level.

For example, it is possible to say, that in Donbass region, where technogenic impact per unit of territory twice exceeds average Ukrainian level, with participation of the Ministry of Power Industry, as agreed with Donetsk Region Administration, with participation of Center-Energo and Donbass-Energo, a discharges decrease pilot project implementation is being considered. It should become an example to develop the discharges trading mechanisms between two power companies. The thermal power stations of these companies are located in one region.

The project of mine methane recovery seems to us rather important. The methane is a gas, whose greenhouse effect 21 times exceeds such effect of carbon dioxide discharges.

In 1997 in Donbass mines 2 billion 428 million cubic meters of methane were released and only 207 million cubic meters were recovered, and the main volume has been discharged into the atmosphere.

And here I will continue this example.

About 12 billion tons of coal rest in Donbass layers. Its effective production is possible by the means of modern equipment and technologies.

The energy value parameter allows us to estimate methane resources in the coal deposits, which constitute between 12 to 25 trillion cubic meters.

However, there is a powerful industry for coal production, but there is only one specialised enterprise for coal deposits degasification.

Ukraine also has a significant potential for development of the co-generation installations.

The most suitable fields for co-generation structures implementation are housing and industrial heating, as well as industrial power system. Co-generation installations can be constructed on the basis of water and steam boilers, and also natural gas-firing stoves and furnaces used in light, chemical, cement-production, iron and steel industry, production of construction materials and other branches of industrial production.

Far to be completed, this list of energy saving activities indicates the possible ways of essential increasing of power efficiency of the Ukrainian economy.

The main difficulties in implementation of these activities are due to poor investments, shortage of domestic current assets, financial difficulties in all branches of the Ukrainian economy.

One of the possible ways to accelerate energy saving activities is development and implementation of the joint projects based on the conditions stipulated by the international agreements (Orkhuts Agreement, Kyoto Protocol etc.).

The mutual interest and mutual benefit of the parties to such joint projects is based on the following factors:

- conditions stipulated by the Kyoto Protocol, in combination with Ukraine's essential
- reserve of quotas for greenhouse gases discharge,
- attractiveness of Ukrainian economy for potential investors from those developed countries, where there is a shortage of such quotas;
- increase in foreign investments will allow Ukraine to intensify energy saving activity; and
- introduction of energy saving technologies and, therefore, reduce power consumption of GDP

One of such projects is now being implemented with participation of our organisation. It is the joint Ukraine-Netherlands project "Decrease of carbon dioxide discharges at Ukrainian TPS".

The project foresees an increase of efficiency by 1.0 to 2.0 per cent at five Ukrainian units.

I am convinced, that similar projects can become a basis for mutually beneficial co-operation between Ukraine and other countries.

Thank you for your attention.

2.3 Georgia

Industry Sector in Georgia and Potential for GHG Abatement

Mr. T. Gzirishvili, Acting Director of UNFCCC National Agency in Georgia

In Georgia industry till now is using inefficient and economically outdated production equipment. Many examples can be found of such technologies relating to end-use sectors, power plants, industrial plants, transportation etc. This phenomenon sometimes described as the "efficiency gap" is inter-related with general problems of our country, in particular market imperfection, constrained capital and foreign exchange.

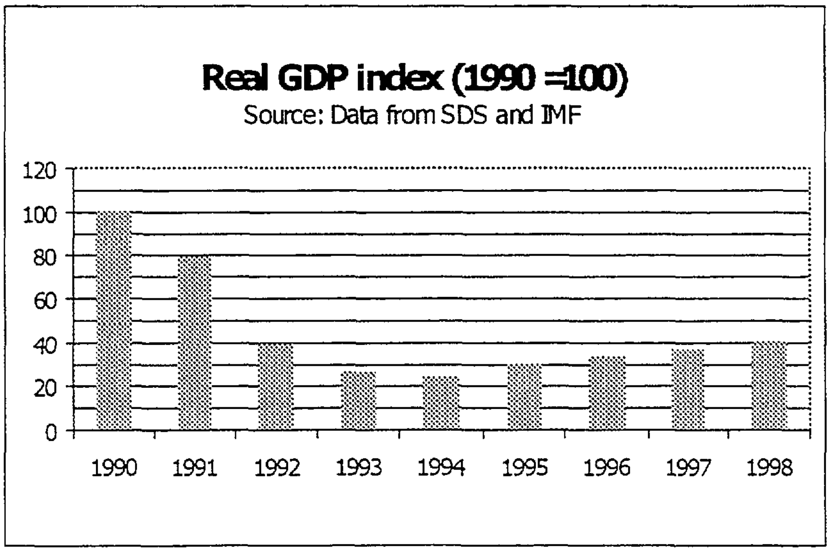
At the same time new technologies could save energy consumption and reduce GHG emission with a low cost and even sometimes with a benefit.

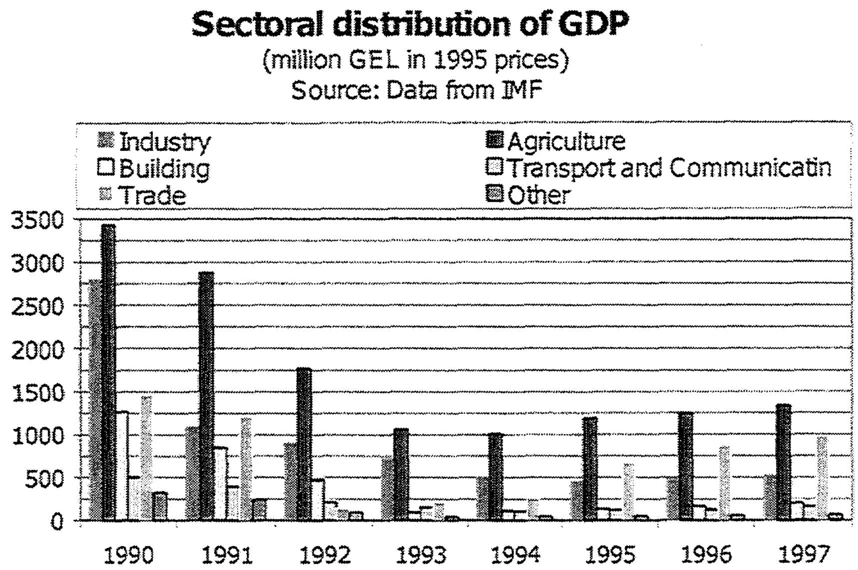
The challenge is to identify the barriers and removal policies to them that can help the implementation of the options.

In Soviet time Georgian industry was considerably dependent on other republics, especially have to be pointed off a raw materials, spare parts, market and fuel. 25% of electric power, consumed by Georgia in 1989 was imported, as well as almost all fuel and gas, over 80% of timber, approximately 50% of cement and almost 90% of raw materials used in the light industry. Before the separation of Georgia from the Soviet Union, industrial sector was well developed. Its main branches were machinery, metallurgy, chemical industry and production of building materials, light and food industry, production of airplanes and electronic industry. By the year 1990 40% of production belonged to food industry, next was light industry, producing consumer goods (fabric, shoes, furniture, etc.), mining industry and metallurgy decreased from 10% of the 1970 production to 4% in 1990.

Fig1 shows the common useful information with respect of economic situation in Georgia.

[Fig. 1]





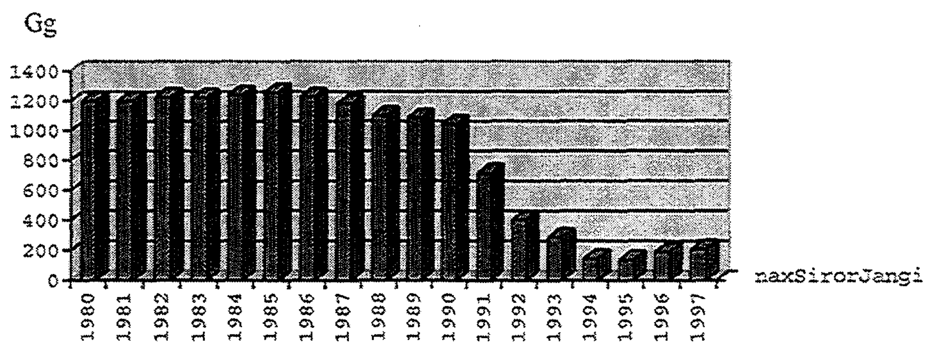
[Fig 1 cont'd]

Industrial processes of Georgia comprised in the past (and partially at the present) the production of cement, ammonia, Nitric Acid, coke, iron and steel, ferroalloys, cellulose and paper, food and beverages. CO_2 emission from these branches is presented in the Table 1.

[Table 1] CO_2 emission from industrial processes (Gg)

SOURCE CATEGORIES	1980	1985	1990	1995	1997
Cement production	833.2	785.3	642.4	30.6	46.4
Production of Ammonia	220.4	308.4	328.8	98.3	153.9
Iron and steel production	2.1	2.3	2.1	0.089	0.09
Production of Ferroalloys	141.8	160.9	67.9	6.7	6.2
Chemical recovery in ferrous metallurgy	2.2	2.0	1.1	0.031	-
Total	1199.7	1258.9	1042.3	135.72	206.59

CO_2 emission dynamics in Georgia from industrial processes during 1980-1997 is presented on the Fig 2.



[Fig 2]

There are several industry plants in Georgia which are large emitters of GHGs. The use of low-efficiency electricity, out of date technologies and industrial processes are the main sources of GHGs. Among these emitters are two cement plants of "Rustavi" and "Kaspian", paper factory in Zugdidi, electrolyze magnesium dioxide factory, chemical industrial complex of Rustavi. Table 2 illustrates some technical data of two cement plants.

[Table 2]

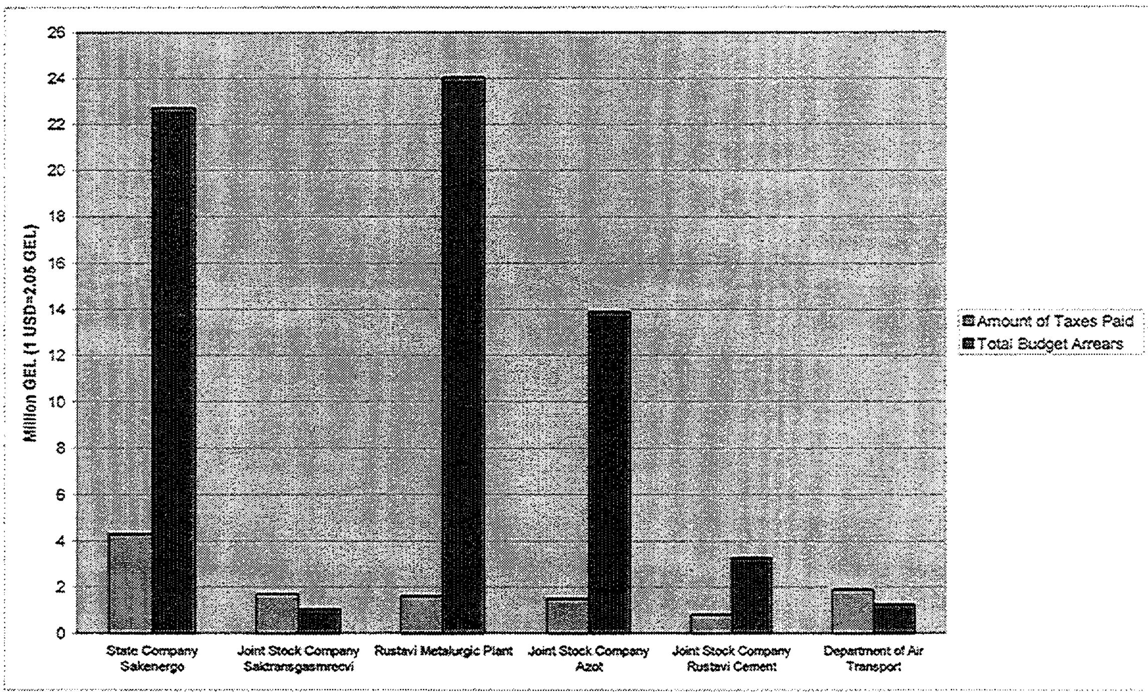
THE CEMENT PLANTS	RUSTAVI	KASPI
METHOD OF PRODUCTION	Three technical lines and rotating furnaces (25 t/h clinker, 28 t/h clinker, 28 t/h clinker). Wet method.	Three technical lines and rotating furnaces (15 t/h clinker, 24 t/h clinker, 50 t/h clinker).
PRODUCTIVITY	In 80-ties annual production was 800,000 t cement In 1996 annual production 46 500 t cement with 75 % content of clinker In 1998 plant produced 240 000 t cement annually. At the present (only one line is functioning) – 25 t/h clinker	In 1980-1990's, the plant produced 650 000 t of cement annually. In 1996 produced 29800 t cement Since 1998 plant produces 100 000t with 80 000 t of clinker.
INFLUENCE OF THE TECHNOLOGICAL IMPROVEMENT ON THE PRODUCTIVITY AND FUEL CONSUMPTION	After substitution of the old filters in 1996 and installation of the 6 cement mills efficiency increased to 90 %. As a result of this 11350 t of clinker has been saved annually. That means 2 270 000 m^3 unburned gas or 4 450 t CO_2 avoided annually.	At the present plant is functioning without filters and for producing 100 000 t cement the plant used 9 840 000 kWh. For per ton clinker is used 123 kWh electricity and 28 000 t conventional fuel. In case of using electric –filter it will be sufficiently for the production of the same quantity of the cement 8 960 000 kWh and 25 680 t conventional fuel.
GHG EMISSION FACTOR	After 1996 it was avoided annually 4450 t CO_2.	Taking into account electricity used by filter (583,000 kWh) the real economize of the electricity 297,000kWh and 2,320t of conventional fuel for each 100, 000t of cement, accordingly reduces 223 641 t equivalent of CO_2 from saved electricity and 3 610 t CO_2 from conventional fuel.

We should identify two more efficient ways for reducing the GHGs:

- Replacement of the wet process furnaces with dry process furnaces which demand less electricity
- Installation of electric filters.

As it is shown from this table after implementation of some measures there are positive changes toward the improving energy efficiency.
In spite of existence of the noticeable tendency of the economic and technological development and revival activities in industry still there are remained a number of unsolved issues those create meanwhile insurmountable obstacles to country's progress.

In order to demonstrate the hard situation in industry of Georgia we would like to show fig 3. Here is presented the share of paid taxes for 1998 and remained arrears of most important tax payers.



[Fig.3]

Described situation in industry is consequence of some barriers generally characterizing countries with economy in transition, for example existence of old technologies and outdated policy of work management.

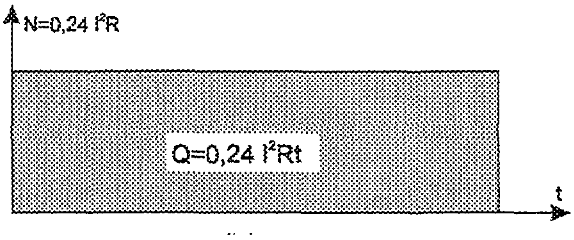
For the overcoming of above-mentioned barriers it is necessary to implement some efficient measures and among them transfer of new technologies for improvement of technological process and also development of local technologies. One of the efficient ways is promotion for the development and implementation of the indigenous know-how in the country. The implementation of the know-how for the improvement of energy efficiency in industry elaborated in Georgia will give opportunity to reduce the consumption of electricity using more energy effective technology.

In this connection, discussing the issues of the technology transfer process and the access to the know-how of developed countries international society should take into account that in Georgia and many other countries with the economy in transition there are many interesting know-how. Facilitation to the development of indigenous know-how will make the process of the substitution of the old-by the modern more efficient and cost effective technologies. Delegation of Georgia proposed to the Subsidiary Bodies at their meeting in Buenos Aires during COP4 to amend to the decision on technology transfer the issue for promotion the development of indigenous know-how and the proposal was adopted. We would like to demonstrate one of such proposal for the development of energy-saving know-how elaborated in our country. The patent examination showed that there exists no analogue to the proposed technology.

Unlike physical and biological systems, technical systems receive energy in a continuous mode and therefore their energy-saving efficiency is very low. If a technical system could be work principally in similar manner as a biological or a physical system, then the energy-saving efficiency will be higher.

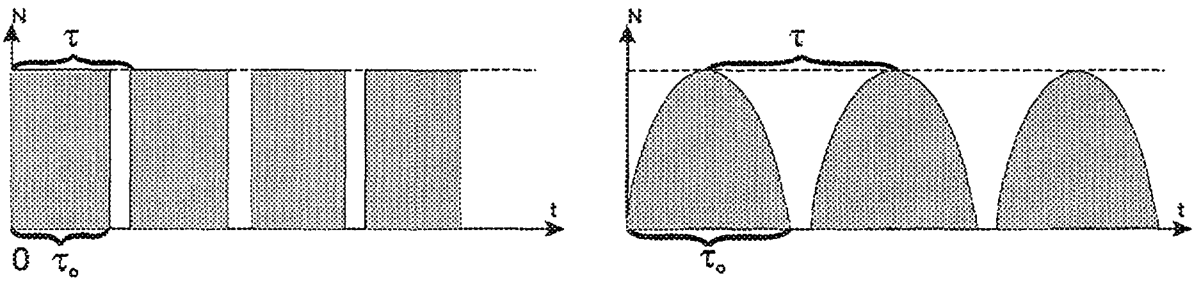
Using analogies between the general linear and non-linear theories of electrical circuits and of heat conduction, it was showed for the first time in which discrete mode a given technical system must operate to have the highest possible energy-saving efficiency.

In the technical system the heat energy supply has a continuous character (Fig. 4) and the supplied heat power does not change in time.



[Fig.4]

The periodic (pulsed) energy supply belongs to the regular regime (Fig. 5). In Fig. 5, τ_0 is the pulse duration and τ is the periodicity of the energy supply process. Comparing Fig. 5 with Fig.4, we see that during the regular (pulsed) energy supply, for rectangular pulses the energy saving occurs in the pause $\tau_P = \tau - \tau_0$ but for semi-sinusoidal pulses the energy quantity saved is much greater, since the energy is saved at the expense of both the pause and the pulse shape.



[Fig.5] Analysis of some experiments carried out using the proposed technology

In 1988–1992 numerous laboratory and technological experimental studies were carried out, which confirmed the validity of the proposed technology and its vast potential. For instance, in 1990-1992, at the Metallurgy Research Institute of the Georgian Academy of Sciences as many as 40 experimental meltings of silicon manganese and carbon ferromanganese were accomplished in a small capacity (250 kW) electric furnace. Energy saving was 10%. Despite the fact that in the discrete regime the furnace was supplied with less heat energy than in the continuous regime, for the discrete regime the energy density per unit volume in the active zone of the furnace skin-volume was 2.7 times higher as compared with the continuous regime. As a result, we obtained a greater output and a better quality of the melted metal.

For the implementation of this method in large-scale technological practice, 48 commercial silicon manganese melting were accomplished in Zestaphoni Plant of Ferroalloys by our energy-saving technology with the same calculated period value, using the powerful (75 MW) electric furnace (Tanabe Co., Japan).

In 1992-1993 the Rustavi Corporation "Azot" carried out studies at its electrolysis plant with an aim to study the problem of energy saving during the electrolysis process. Using our technology, corporation obtained a 40% rise in the product output, 30% energy saving per unit of the product and 14% improvement of the product quality.

The share of cast iron and steel production in overall emissions from industry was most substantial. The Ferroalloy Plant is in a better situation, since it has got 2% segment of the World's ferroalloy production quota. So, as whole, carbon dioxide emissions from metal production will be still substantially less by 2000 relative to the 1990 level.

During soviet time there were operating 6 CHPs in Georgia with total power capacity 200 MW and thermal capacity 1160 MW/hour. All equipments of these CHP are technically out of date.

Six steam-turbine thermal electric stations are existing in Tbilisi at present. Brief description and technical characteristics are given in the Table 3 overleaf

Currently all thermal stations are suspended, in winter, the Tbilisi thermal power plant is functioning only periodically. All energy equipment (boilers and turbines) of the main thermal power plants are obsolete, their working regime is stipulated for a steam low initial parameters, that results in the insignificance of cogeneration effect. For this reason the share of the cogenerational stations (thermal power plants) in the electricity generation capacity of the country (currently it is 4667 Mg) is considerably little – 4.23%.

Under the UNDP/GEF-Georgian Government joint project ""Enabling Georgia to Fulfil Its Commitments to the UNFCCC" and other feasibility study projects was studed each sector of economic of Georgia and identified barriers for rehabilitation of these sectors and concrete objects.

High initial investment cost which is the main barrier in the country with high risk-factors, high discount rate and without free local private or state capital for equity share and hence for reducing the risk for foreign investors. The tentative calculations show that the primary cost for currently producing electricity (average of the primary cost for thermal electricity and electricity from hydro-power plants) and accordingly, tariff for it are lower than the primary costs for electricity produced by CHP.

- Absence of the system for control the consumed electricity.
- Low payment even from the enterprises.
- The low efficiency of the existed mechanisms to withdraw money for electricity even from a tax-payers which already have returns.
- Cheap and unpaid electricity against the high cost energy resources.
- Lack of the investment subsidies for increase the energy efficiency by implementation of the indigenous "know-how."
- Quite short (4 month) heating season what decrease the efficiency of CHP in residential sector.

At this time it seems that industrial cogeneration would be more cost-effective in Georgia but lack of investments delays rehabilitation of existing CHPs and construction of new ones despite the shortages in energy.

These barriers are common for industry sector and heat and hot water supply sector.

[Table 3]

½	Name and purpose of thermal electric station	Installed capacity Electric Mg	Thermal kcal l/h	Thermal Mg (Thermal)	Quantity and types of steam boilers	Type of heater	Quantity and types of turbine unit
1	2	3	4	5	6	7	8
1	Thermal power plant of the Rustavi Metallurgical plant (industry)	149	414.7	482.2	2 sterling type boilers (each D=90 t/h) 2xTP-150 (150 t/h) 2xTP-170 (170 t/h) 2xTPM-153 (220 t/h)	Natural gas; Furnace gas; Mazut	2xAT – 12 2xAT – 25 1xVPT - 25-3 1xVPT-60-90/13
2	Thermal power plant of Batumi Oil Refinery (industry)	19.55	230	267.5	5xBKZGM(75 t/h) 2xGarbe-UMT(16 t/h) 1xCSK-5 (30 t/h) 1xSterling (36 t/h) 1xGarbe (36 t/h)	Mazut	1qGT "Bergman" 1 1xAE 4xP-6-35/10
3	Thermal power plant of Tbilisi	18	313	152.3	2xBG – 50 1xTM – 35 1xBG – 35 2 Peak water heating boiler: 3 PTVM - 50	Main heating natural gas, reserve mazut	1xAP-6 2xAT-6
4	Thermal power plant of the Kutaisi plant factory	5.7	70	81.4	2 Boilers "Averberg" (each – 35 t/h) 2xTR – 354 Water heating boilers – 2xPTVN-50	Mazut	Turbine unit "Scoda" 5.7 Mg
5	Thermal power plant of the Agara sugar factory (industry)	2.5	66	76.7	3xB-25/15GM (each – 25 t/h) 1xDKVR-10-13 (10 t/h) 1x "Fogot" (13 t/h)	Natural gas	1xOP-2.5
6	Thermal power plant of the Enguri paper producing industry	2.5	84	97.7	1xGM-50/14 (50 t/h) 3xB-25/15 (25t/h)	Gas	1xOP-2.5
	Total	197.25	995.7	1157.8	40 boilers (among them 4-water heaters)		18 Turbine unit

SESSION II. MARKETS FOR ENERGY EFFICIENCY & COGENERATION: OVERVIEW OF TECHNOLOGIES & CDM/JI BUSINESS OPPORTUNITIES

1. Introductory Remarks

Trends in Efficiency Markets and Forces that Shape Them

Marina Ploutakhina, Industrial Development Officer, Kyoto Protocol Branch, UNIDO

BACKGROUND

The demand for energy is growing rapidly in developing countries. But energy is produced and consumed with low levels of efficiency. Today the global energy efficiency of converting primary fuel to useful energy is 37 per cent. In other words, two thirds of primary energy is lost primarily as low temperature heat. Numerous economic opportunities exist for energy savings in the end-use sector , and that is particularly so in developing countries and economies in transition. Gains up to 40 per cent are feasible in economies in transition and a more modest, but still very significant 25 - 35 per cent range over current end-use efficiencies is feasible in other industrialized countries. The efficiency potential of developing countries lies somewhere between 25- 40 per cent.

This high potential for energy savings is a clear indication of a significant energy efficiency market. According to some studies, energy efficiency market in emerging economies will worth about US$55 billion per year, and as for the OECD market, around US $19 billion per year. So, what are the forces that shape the markets for energy efficiency?

THE FORCES

Growing energy demand in developing countries is certainly one of such forces.

The geographic composition of energy demand will change substantively during the projected period. Energy demand in developing countries is projected to more than double between the period of 1991 and 2010 compared to the OECD where the increase is projected in the magnitude of 20 per cent. Much of the expansion will occur in the newly industrialized economies.

World energy demand is projected to grow by 66% and CO_2 emissions by 70% between 1995 and 2020 unless new policies are put in place. Two-thirds of the increase in energy demand over the period 1995-2020 comes from China and other developing countries. Moreover, fossil fuels are expected to meet 95% of additional global energy demand from 1995 to 2020.

This growth in energy demand is driven by several related factors, such as growth of population, growth of per capita income, increased penetration of energy intensive products and technologies, growth of basic industries required to support industrial development, such as cement production, chemicals production, fertilizers, steel, etc. However, this dramatic growth is also a reflection of inefficiency with which energy is produced and consumed.

To sum up, the driving forces for energy efficiency are economic as well as environmental incentives. These provide significant opportunities and scope for the deployment of energy efficiency technologies in developing countries, and an opportunity to consider a new GHG emissions control strategy.

Another driving force for energy efficiency is the lack of investible resource necessary for meeting increasing energy demand. Fueled by the economic growth and development needs, the demand for energy is rapidly expanding. It's global distribution is also changing, which most of the 66 per cent of the increase originating from developing countries where energy consumption will double by 2020. This growth precipitates the need for investing in new capacity. In terms of the power generation capacity alone, it is estimated that about US$30 billion a year will be required in Asia, and 15 billion in Latin America. But the gap between the domestic savings and investment needs in the case of both Asia and Latin America is about US$50 billion. In total, to meet projected growth, developing countries will require US$100 billion per year. Foreign exchange required to service this investment will be in the magnitude of US$40 billion per year. Yet only US$10-12 billion is feasible form the multilateral and bilateral lending agencies that currently provide financing for investment in the energy sector.

This means that to bridge this gap countries will have to mobilize foreign investment. The investment flows have been extremely unbalanced in the past decade with China mobilizing for example almost US$ 42 billion in a single year in 1996 and Russia only US$2 billion. It is unlikely that the financing of this magnitude can be mobilized to meet all the energy investment needs, if increase in energy demand is to be met by expanding capacity.

Given these circumstances, it appears inevitable the energy demand will have to be met through improvements in end-use energy efficiency. In fact, energy efficiency is effectively becoming a source of new energy supply.

The total emissions of the OECD are projected to exceed the targets by somewhere in the vicinity of 580-1160 MtC in 2010. These figures come from various sources and the analysis of RIIA (Royal Institute of International Affairs). Roughly speaking, the demand for reductions is around 1000 MtC in Annex B and hot-air supply is between 100-300 Mtc. It is estimated that Annex B countries are expected to need about 440-830 Mtc reductions, which are to come partly from hot air and partly from CDM and JI.

In this light, it is quite obvious that the evolution of the Kyoto market is another important driving force of markets for energy efficiency. By placing an economic value on GHG emissions reductions, the emissions trading regime, including that of project-based trading, will greatly enhance the attraction of energy efficiency projects in developing countries.

Current estimates for the value of carbon vary, but several experts suggest that the market value could be in the vicinity of US$20 per metric ton. A typical coal-fired plant emits one metric ton of carbon dioxide for every 3 MWh generated.

Let's consider these facts:

- The ODA flow to developing countries is US$50 billion per year
- A CDM of US$10 billion comprises the addition of 20%
- The FDI flows are around US$240 bn and in this context the CDM is only 4%

The latter point is of interest here. It is unlikely that high cost CDM will be implemented. It is more likely that the cost of the reductions will be between 2-10 per cent of project costs. Thus could half the FDI perhaps be redesigned to fit the CDM criteria, and would this make the CDM a powerful tool?

If emissions reductions are integrated into the FDI flows we may be talking about hundreds of billions.

THE CHALLENGE

The challenge is then the question of how developing countries and economies in transition could take advantage of energy efficiency as a strategy for entering the emissions reduction markets through CDM and JI.

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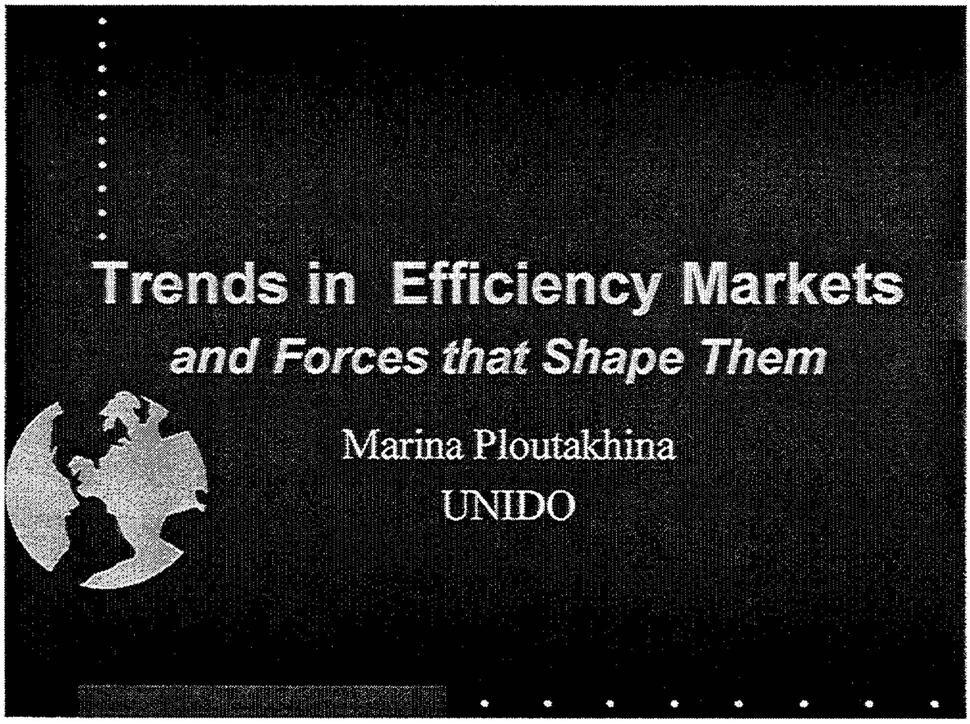

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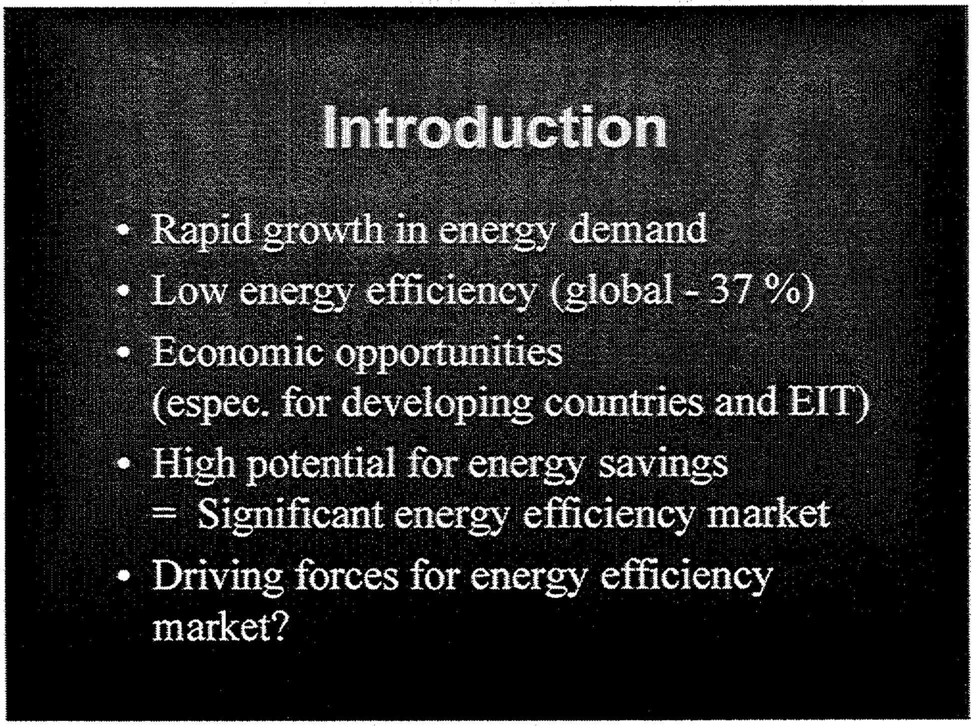

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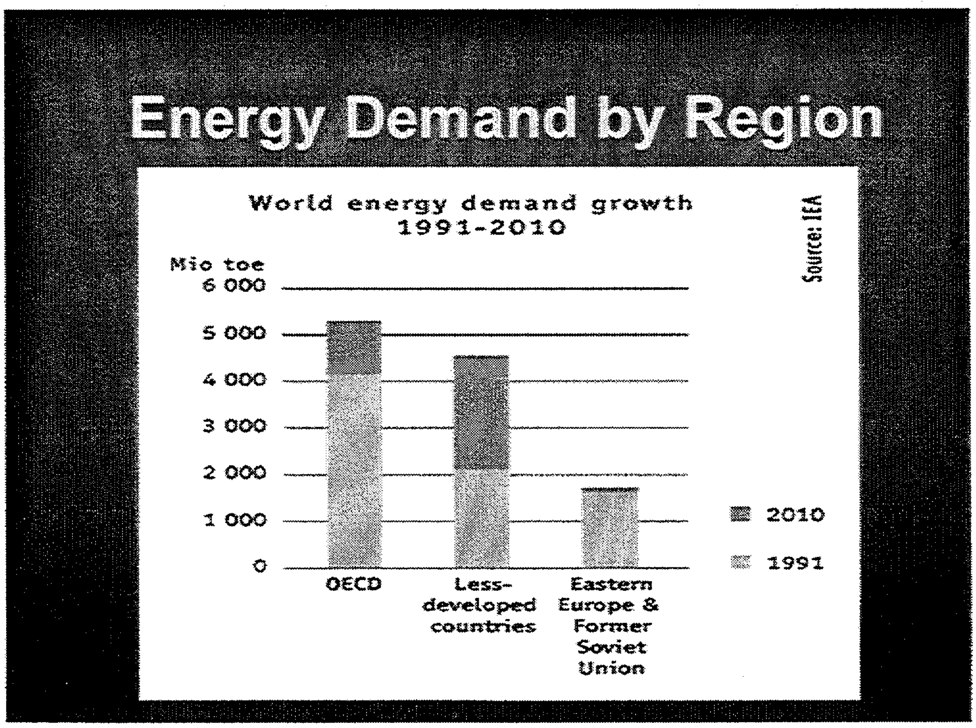

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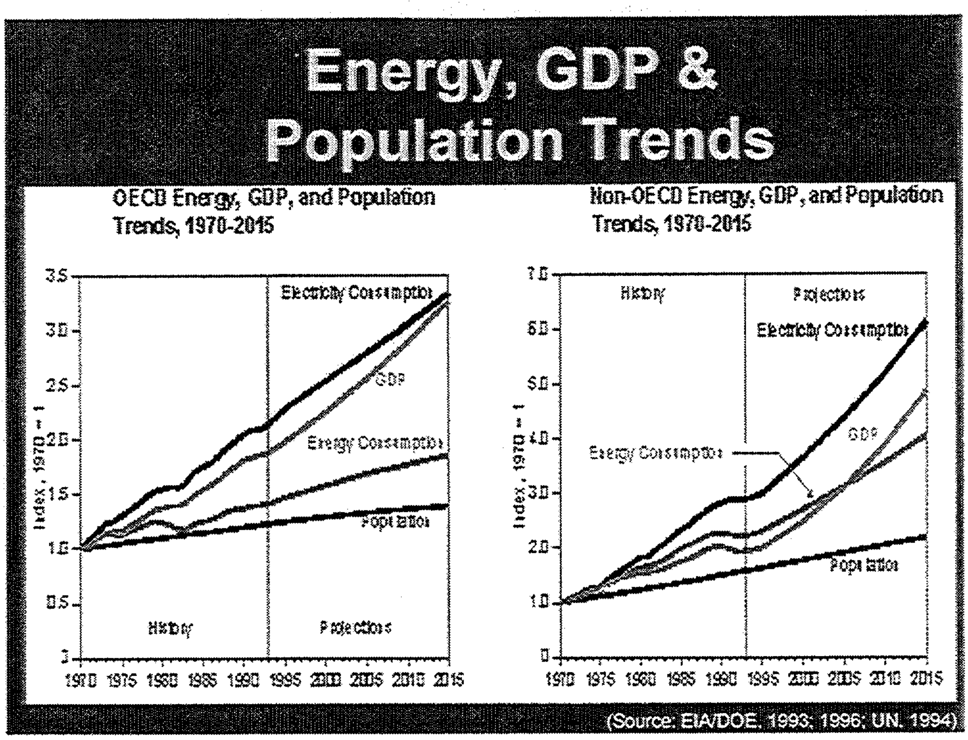

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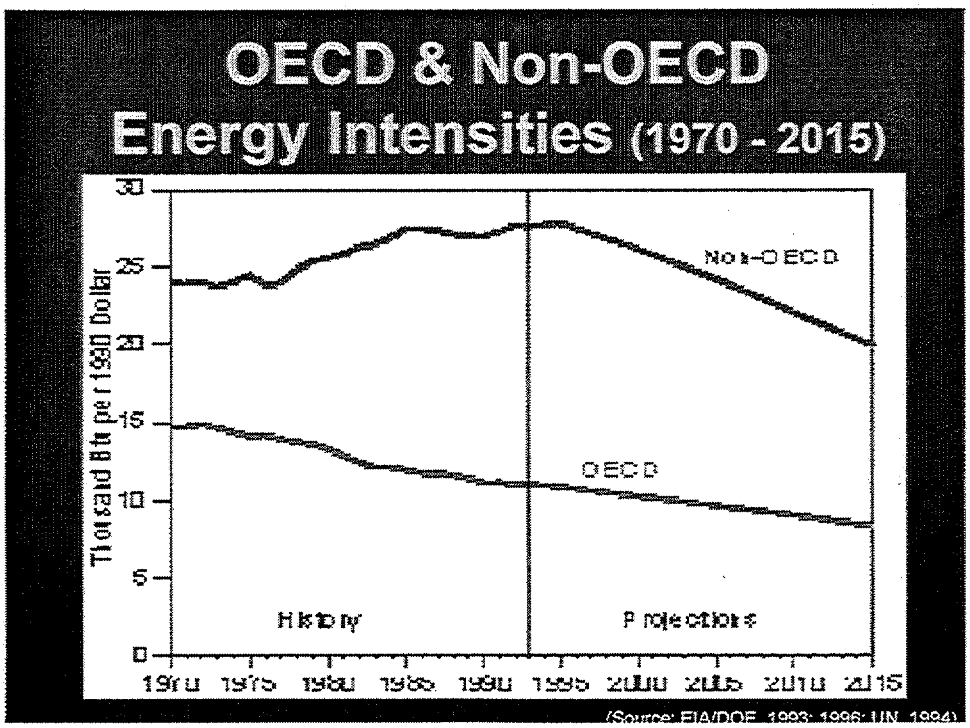

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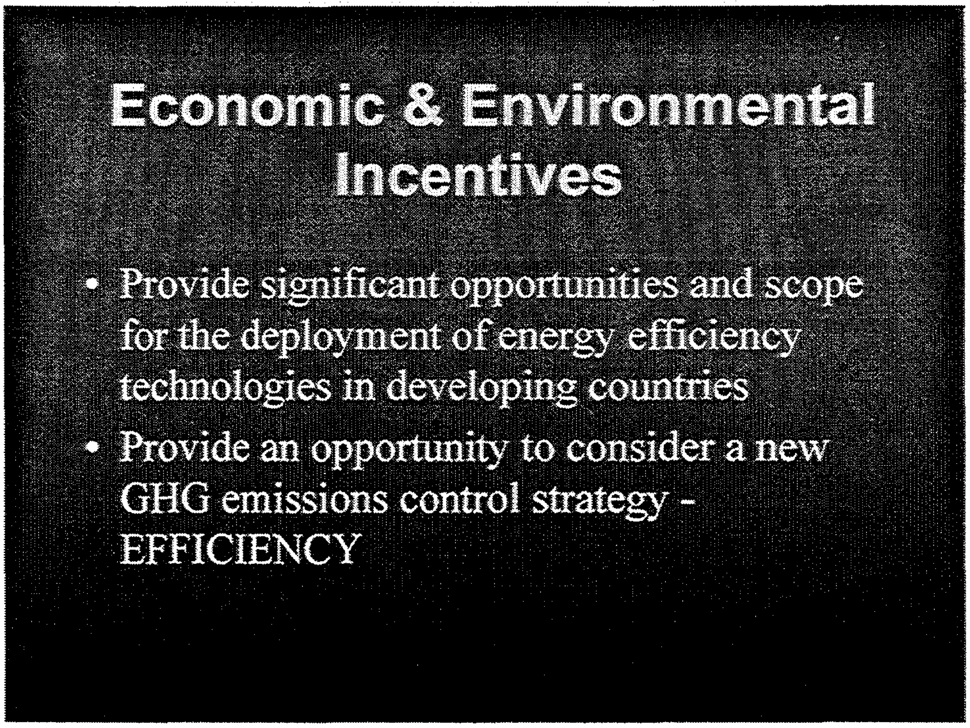

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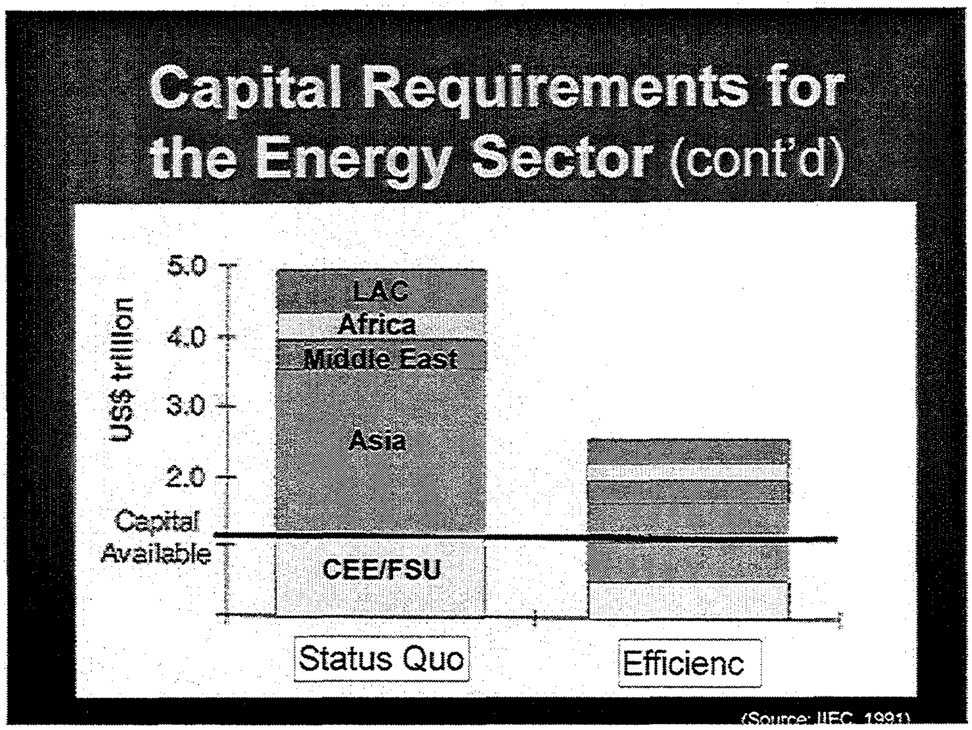

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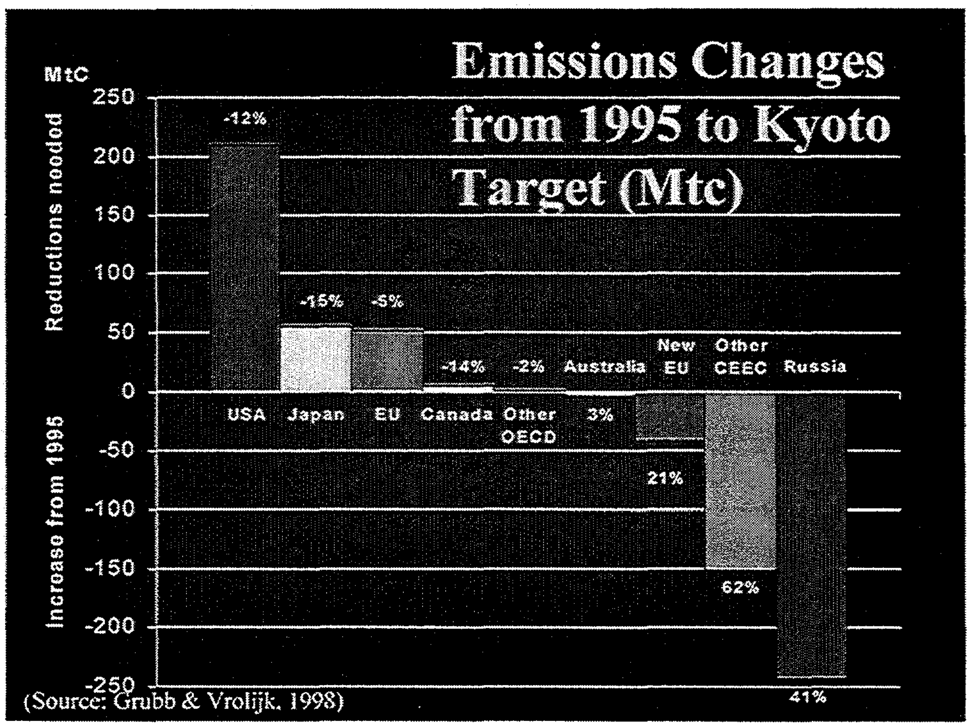

Slide 10

The CDM Market

- OECD: 580-1160 Mtc in 2010 in excess of the reduction target
- Hot Air supply: 100-300 Mtc
- Reductions needed to meet the target : 440-830Mtc

Slide 11

CDM Market Estimates
(from various studies)

Market Share (%)	Market Size (MtC)	Market Price ($/tC)	Market Value ($bn)
25-27	266-572	37	9.8-21
19-46	144-344	24-42	6.0-8.3
33-35	397-723	13-26	5.2-17.4

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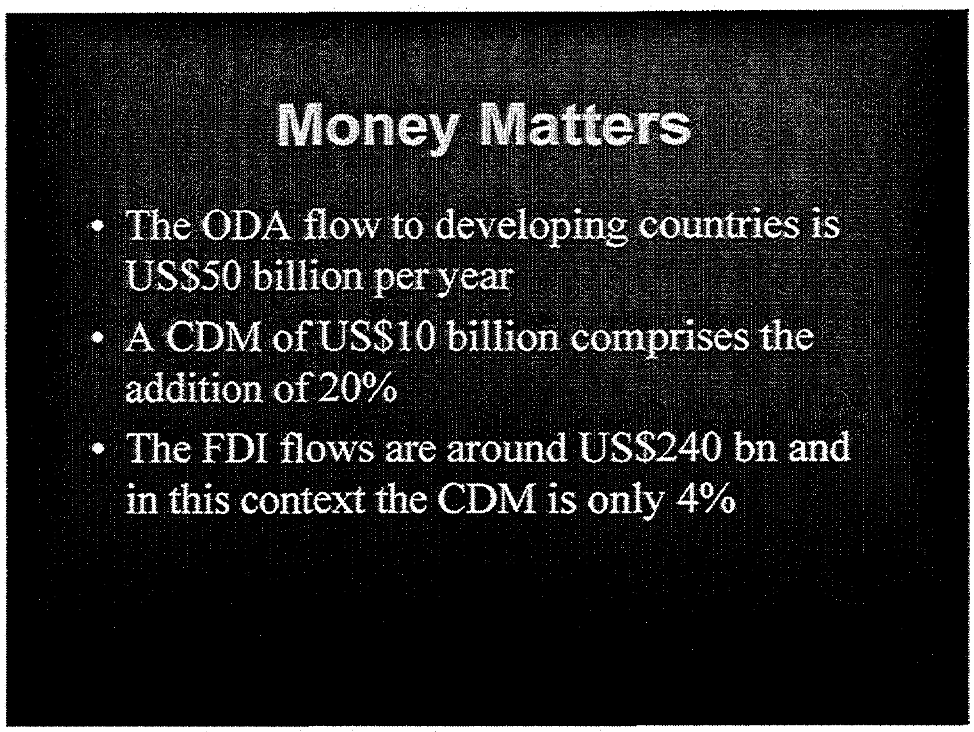

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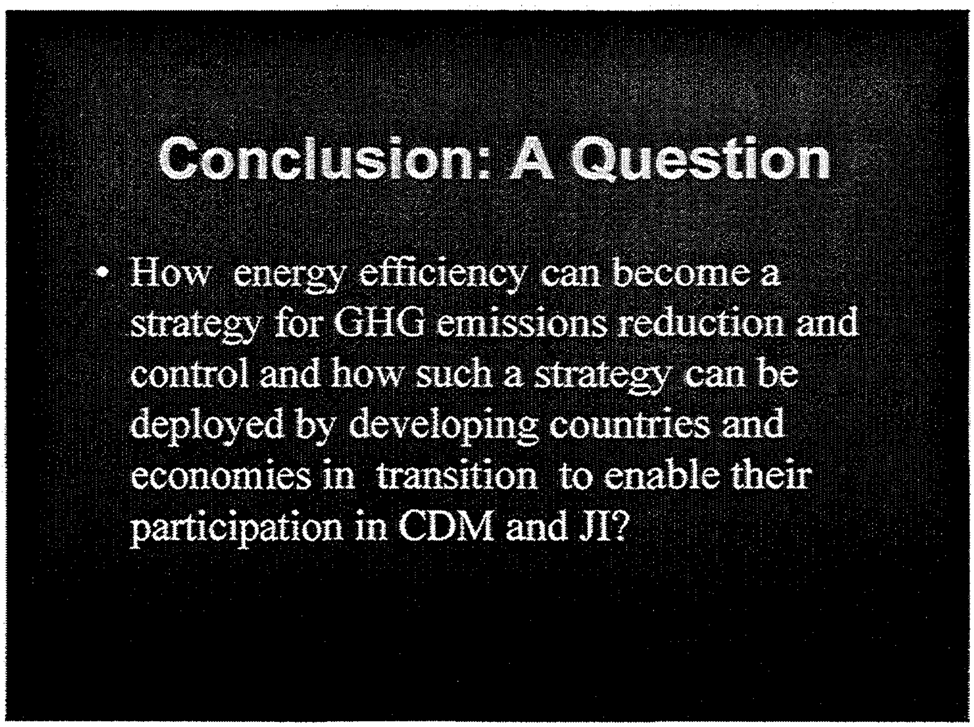


2. Overview of Technologies & New Market Opportunities in the Context of CDM/JI

2.1 Effective Energy and Gas Emissions Savings Using Plastics Waste Recycling Technologies

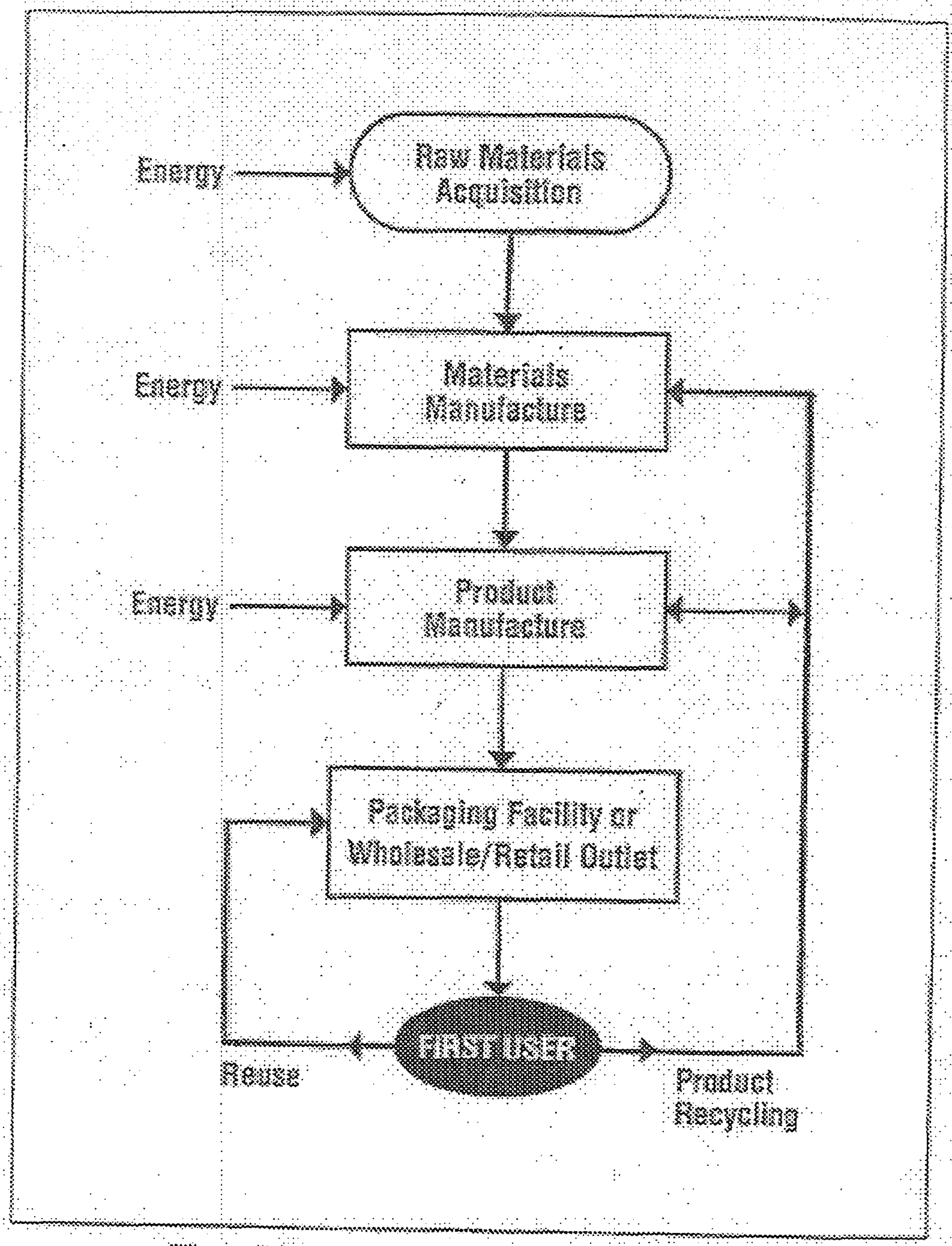
Prof. F. Shutov, Center for Recovery/Recycling of Industrial and Municipal Solid Waste, Department of Chemical Engineering, Tennessee Technological University

<u>CHAPTER OUTLINE</u>

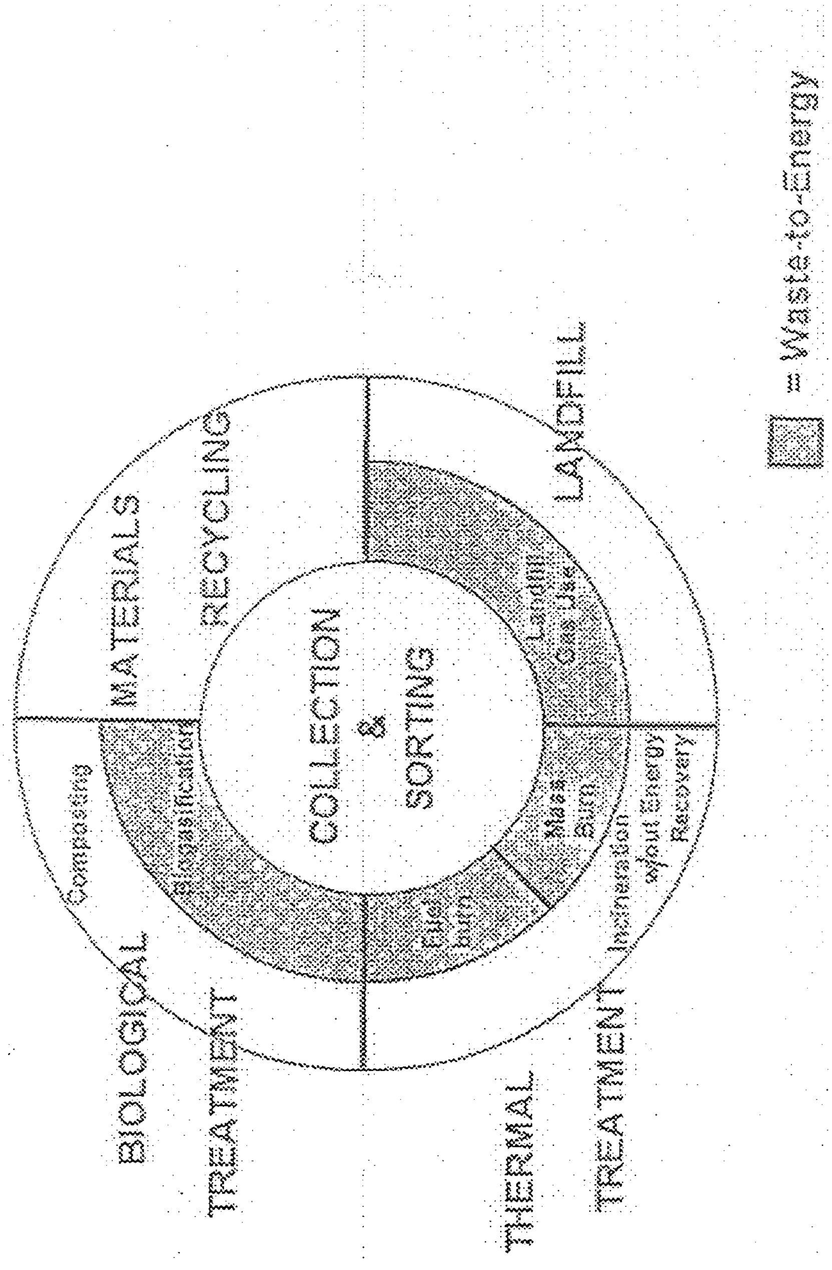
1. Waste-to-Energy Concept
2. Recovery and Recycling Plastic Waste Concepts
3. Life-Cycle Analysis of Plastic Products
4. Life-Cycle Energy Analysis: Embodied Energy
5. Potential Energy Savings from Plastic Waste Recycling
6. Recycling Processes
7. Density and Size Reduction of Plastic Waste for Recycling
8. Pulverization of Plastic Waste by PSP-Process
9. Developed at Tennessee Tech University, USA
10. Plastic Waste Recycling and Gas Emission
11. Summary

Acknowledgements

References

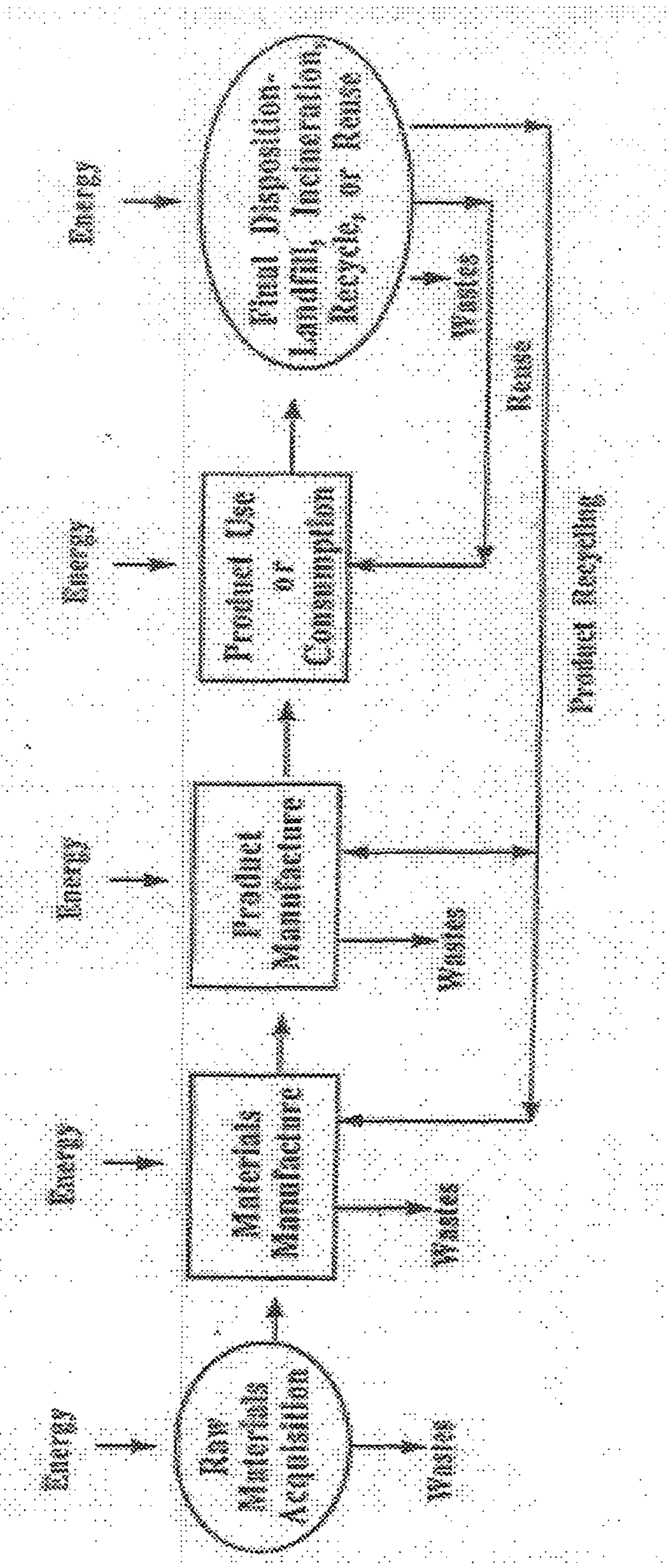


Total Energy and Materials Flows for Manufacturing and Recycling [Franklin Associates, 1993]



Elements of an Integrated Waste Management system [3]

General Flow for Life-Cycle Analysis of a Product Distribution System [1,2]



CHAPTER 2: RECOVERY AND RECYCLING PLASTIC WASTE CONCEPTS

Polymer recovery/recycling (Fig. 1) involves a variety of technologies; each of the technologies has technical, economic and institutional components. A decision to recover/recycle a polymer involves decisions on technologies for:

- Collection of discarded objects and parts.
- Polymer(s) separation
  - Sortation of the plastic object(s) and parts(s) containing the desired polymer.
  - Reclamation of the objects into polymer(s) streams for recycling and discard streams "tailings" for landfilling.
- Polymer processing
  - Reprocessing into objects, or
  - Chemical conversion into monomers, chemicals or fuels.

The decisions will be highly influenced by such factors as the quantity of the discard objects and parts in the waste streams, their composition and the availability of markets for products (objects) containing recycled polymers.

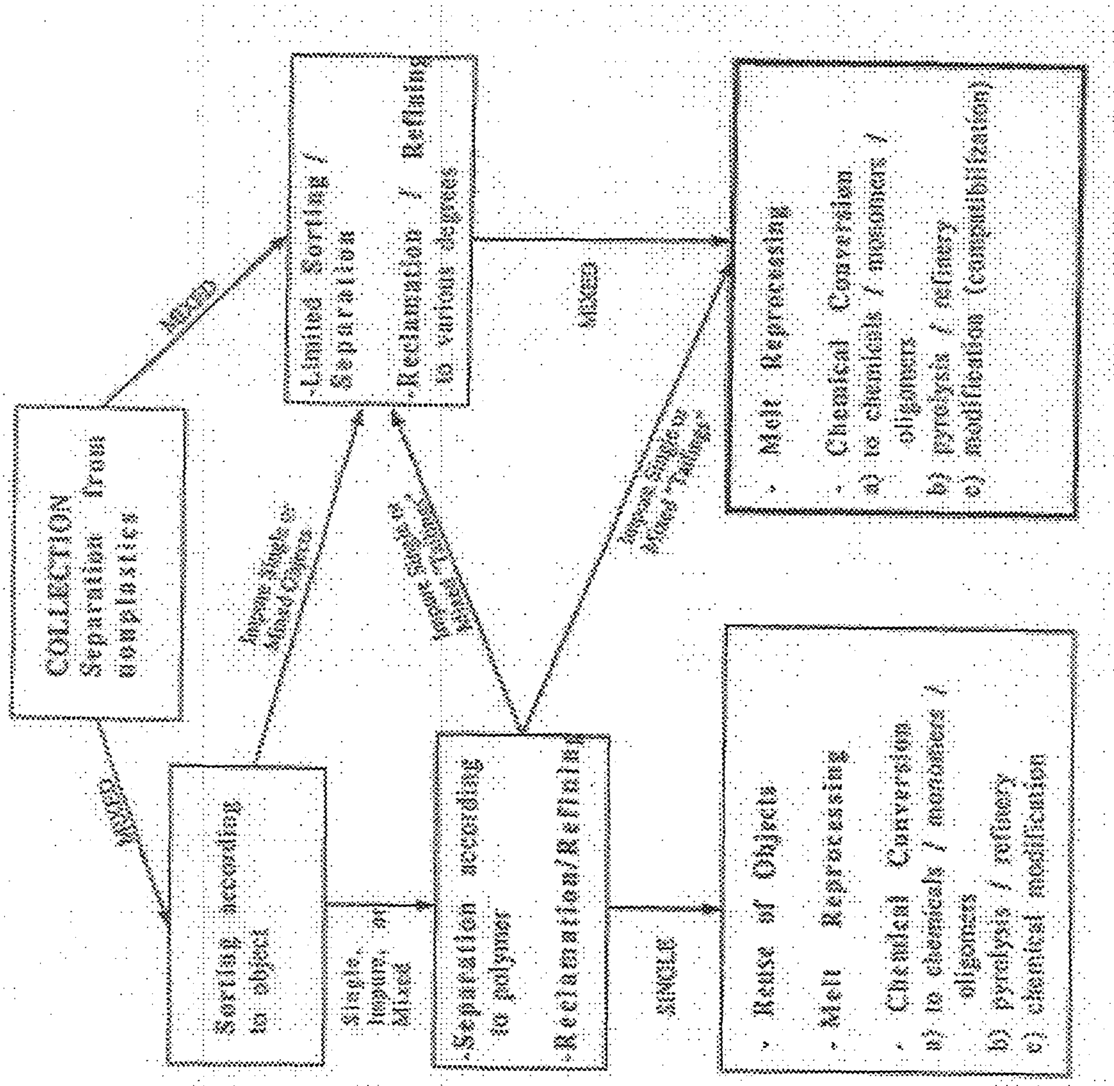
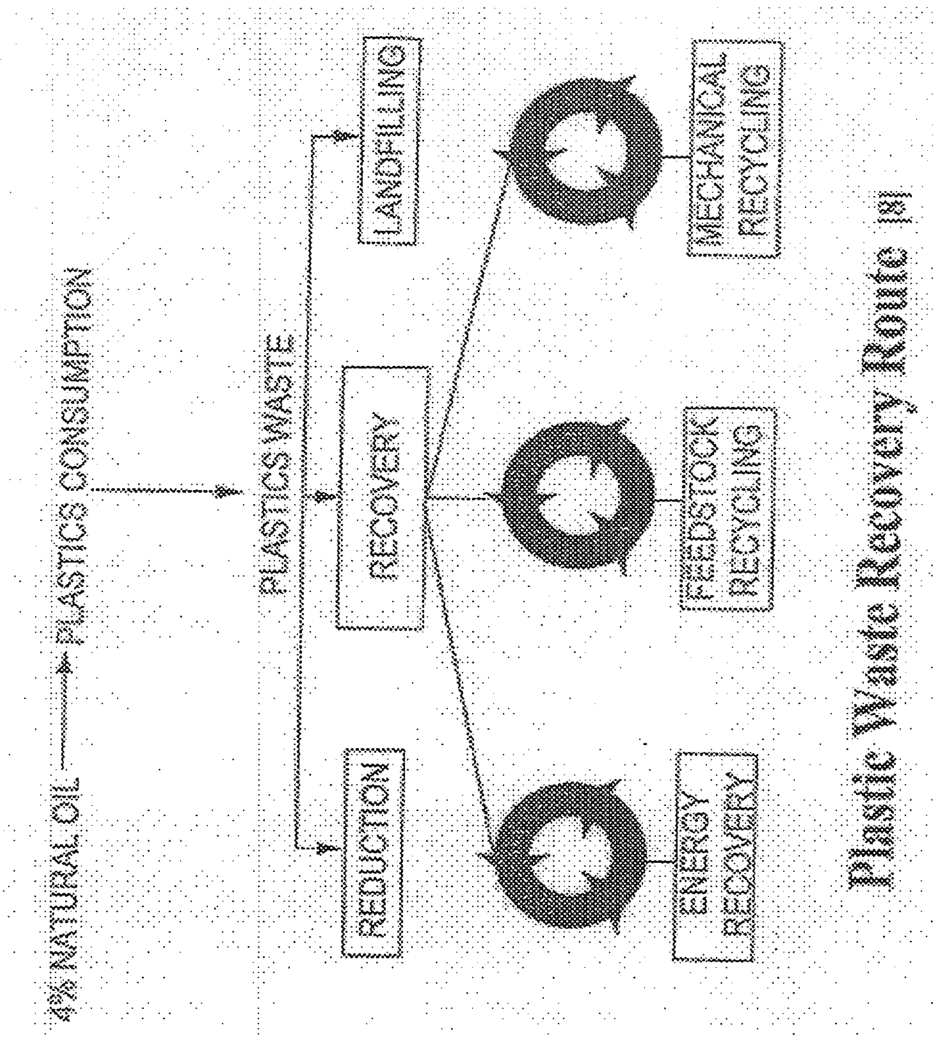


Figure 1. Scheme of Recovery/Recycling of Plastic Waste [1,2]



Plastic Waste Recovery Route [8]

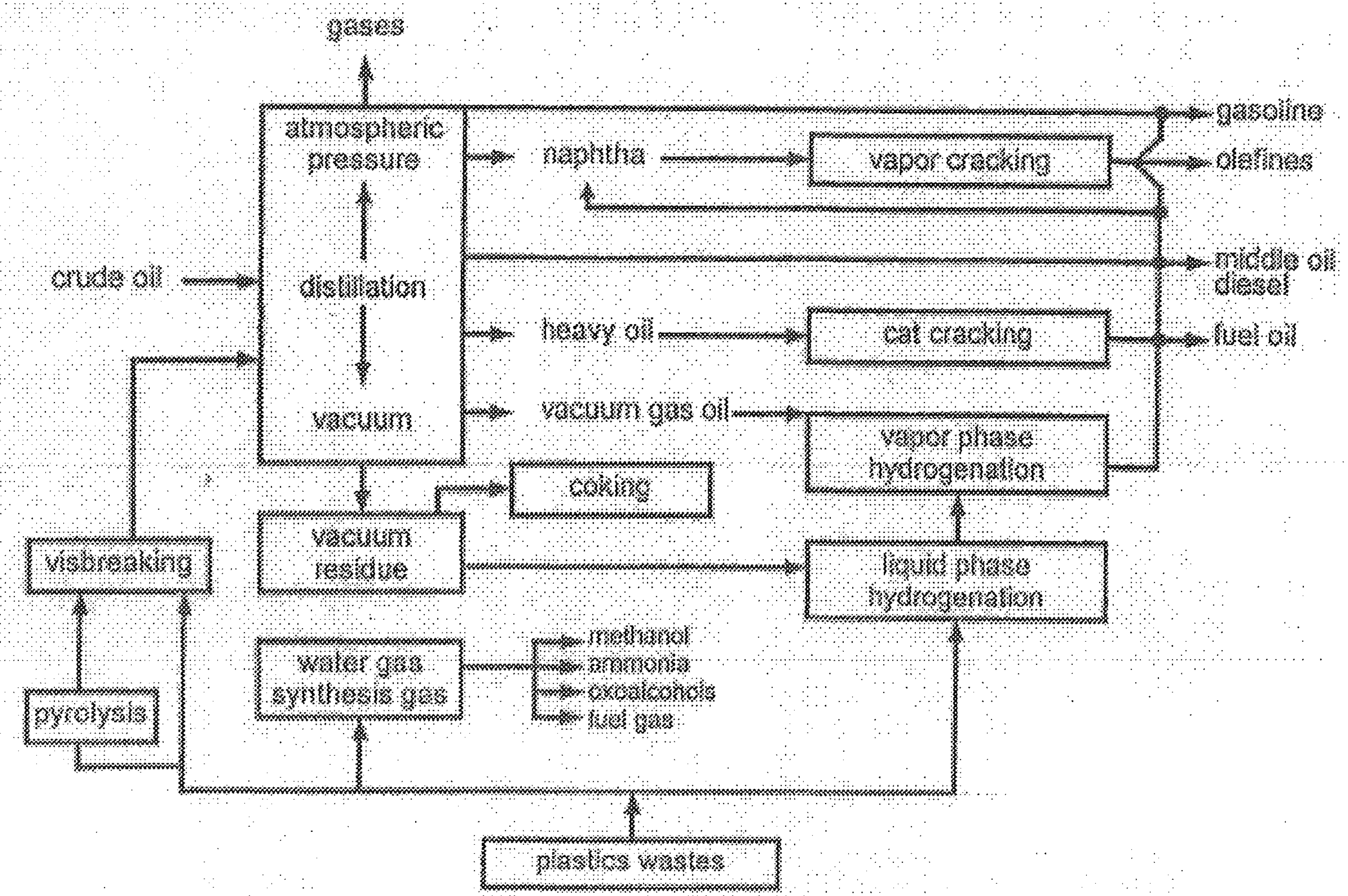
Routes for recovery [7]:

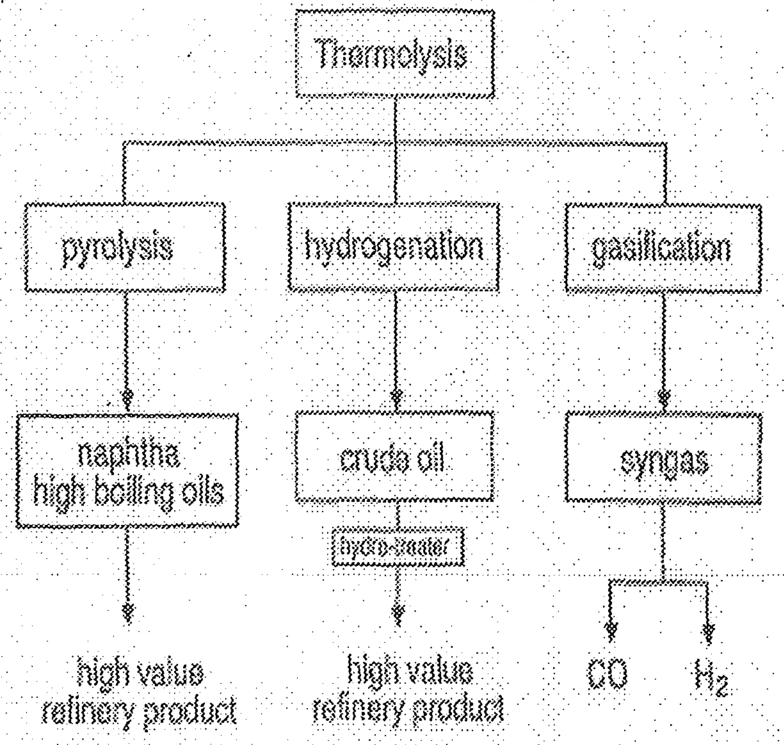
• Mechanical recycling:	*preferred solution for large (heavy) objects (bottles, bumpers ...)*
• Energy recovery:	
- Co-combustion	
· Municipal solid waste incinerators	*no need for sorting, plastics remain with the MSW*
· Cement kilns	*partly in operation*
· Power plants	*to be developed*
· Industrial incinerators	*expensive*
• Mono-combustion	
· Specific incinerators	*expensive*

What is their impact on the Environment?

- Preservation of non-renewable resources: how to 'restore' oil with the best yield?
- Pollution of air, water, soil is often correlated with energy consumption.

Feedstock recycling of plastics wastes [4]





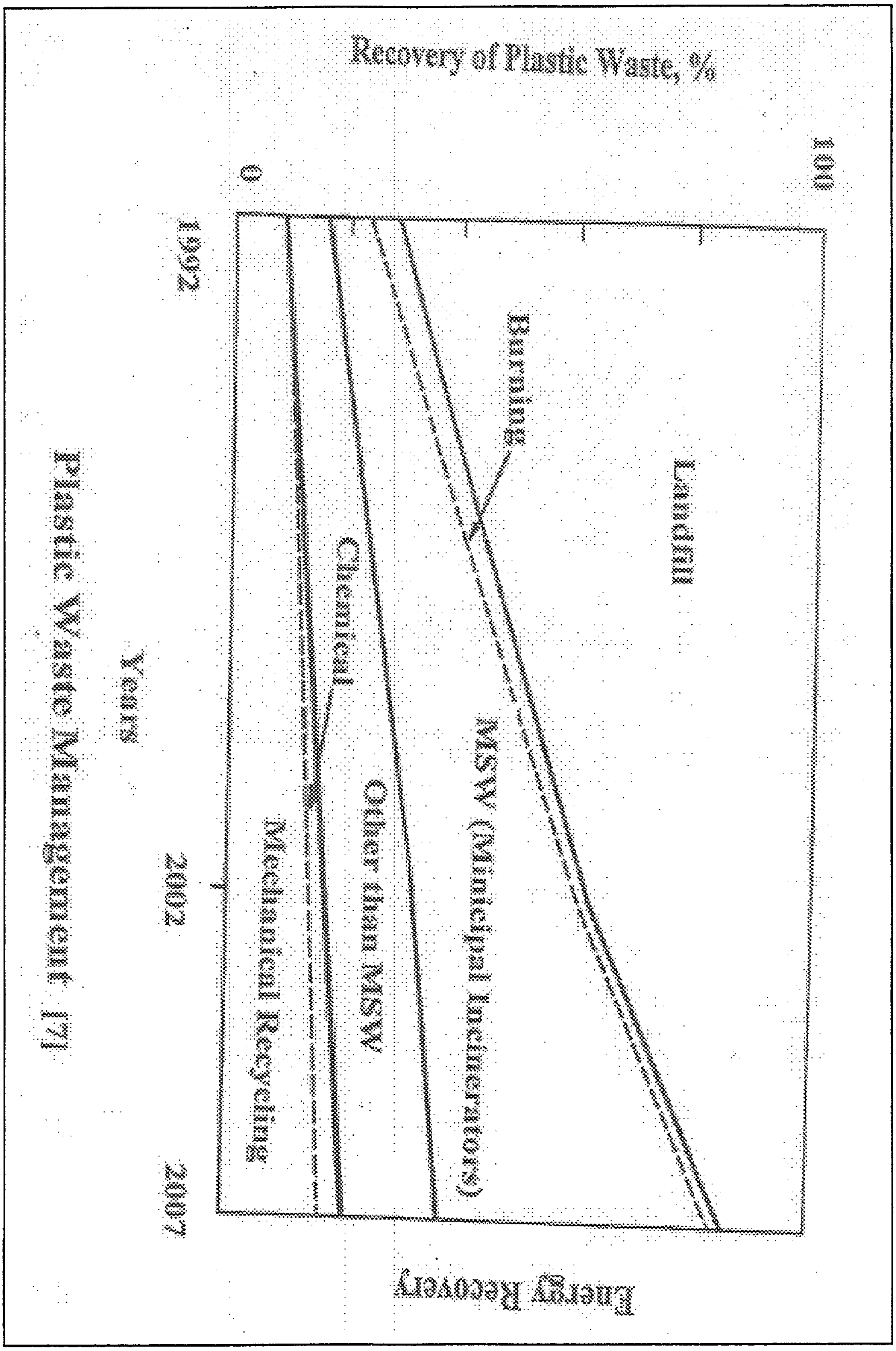
Overview of the main forms of feedstock recycling for waste plastics by thermolysis [9]

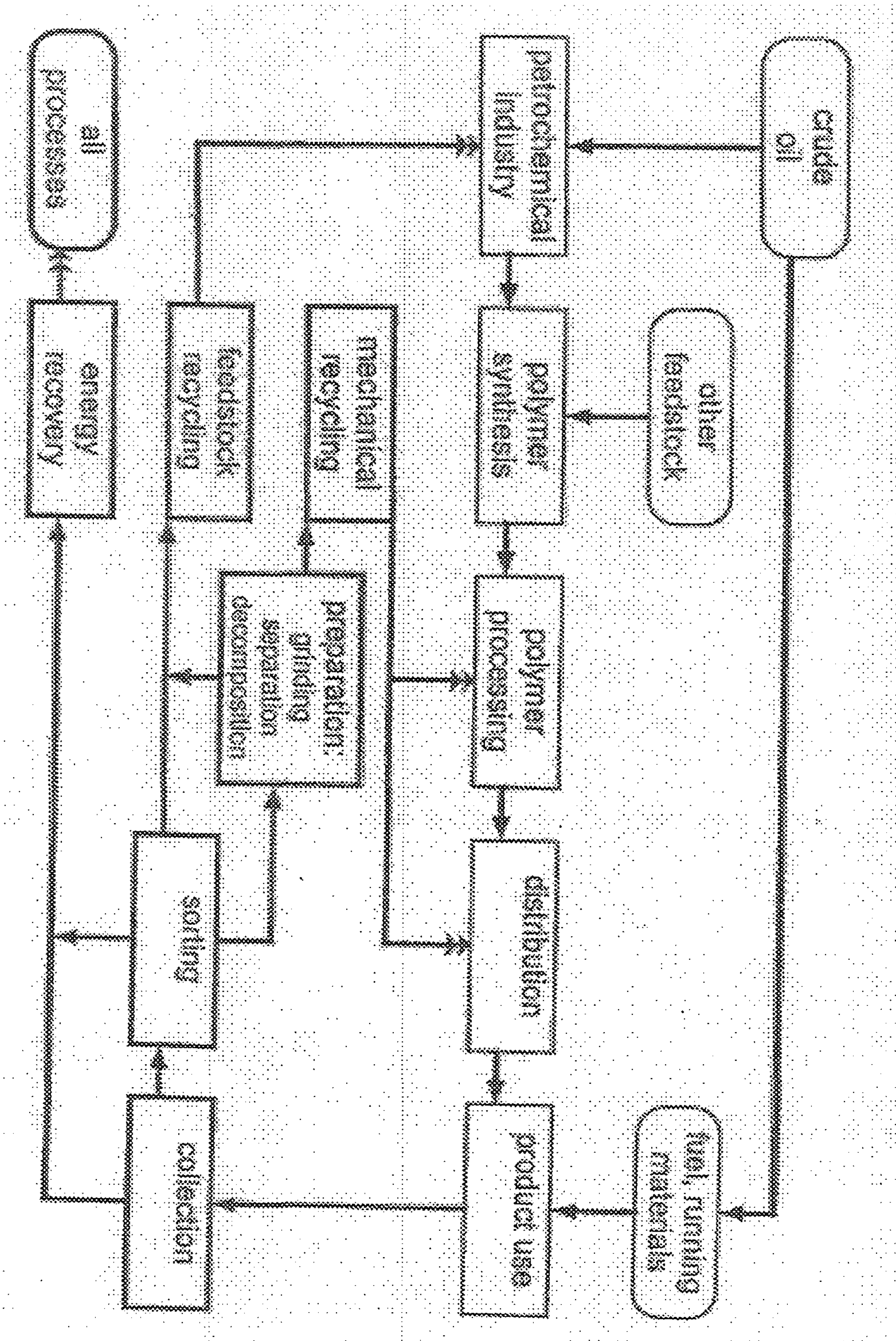
	1996	1997
Total plastics waste	16.87	17.45
Mechanical recycling	1.32	1.44
Feedstock recycling	0.25	0.33
Energy recovery	2.50	2.56
Total recovery	25%	25%

Plastics waste recovery performance (million tonnes)

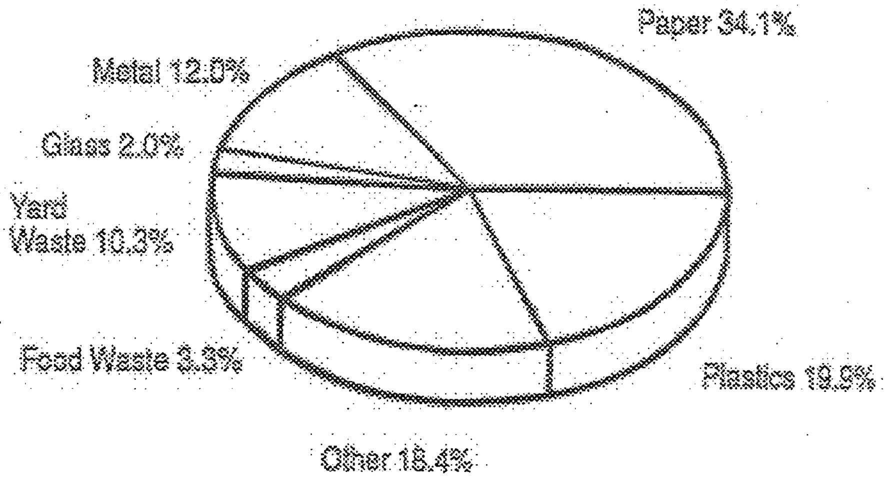
Western Europe 1996-1997

Source: APME (1999)

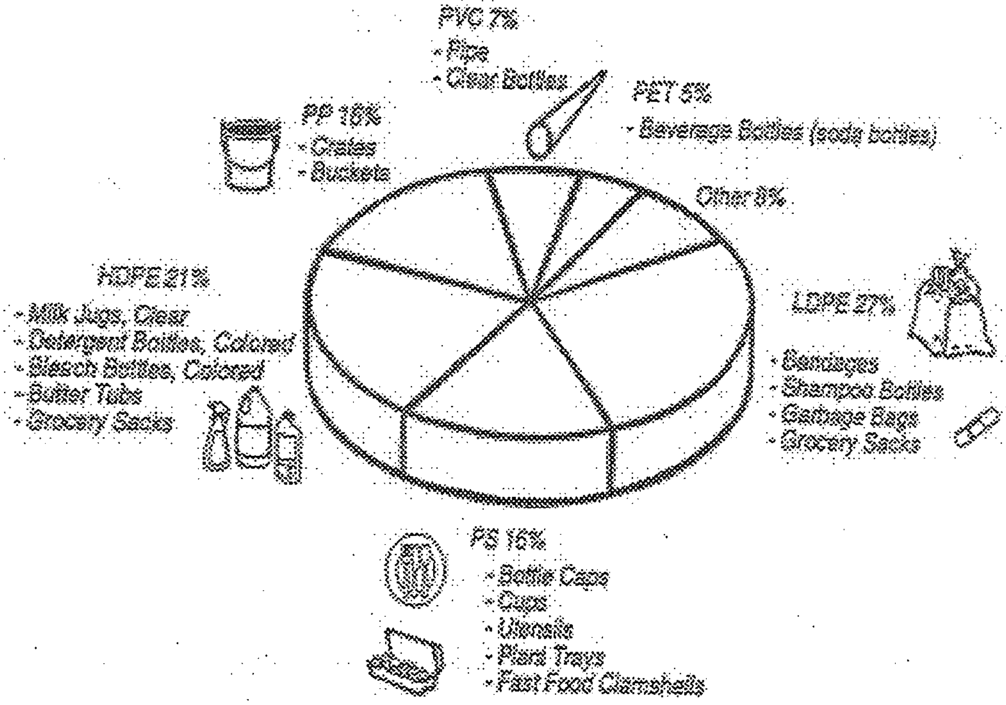

Plastic Waste Management [7]
Years
1992
2002
2007
Recovery of Plastic Waste, %
0
100
Energy Recovery
Landfill
Burning
MSW (Municipal Incinerators)
Other than MSW
Chemical
Mechanical Recycling



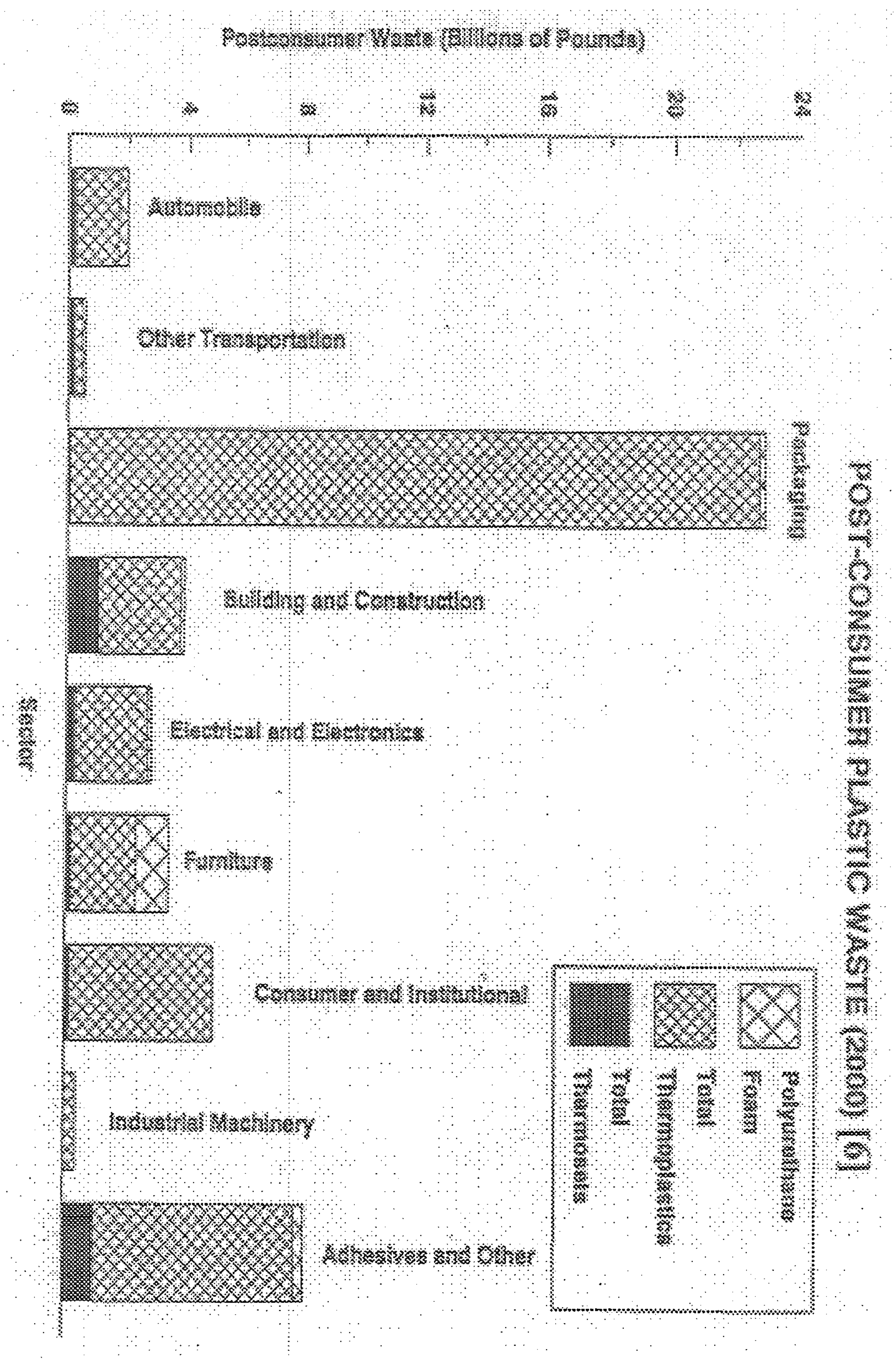
Life cycle of plastics [3]



Volume of Plastic Waste in Landfill [5]



Types of Plastics Waste Products in Landfill [5]


POST-CONSUMER PLASTIC WASTE (2000) [6]
Postconsumer Waste (Billions of Pounds)
0
4
8
12
16
20
24
Sector
Automobile
Other Transportation
Packaging
Building and Construction
Electrical and Electronics
Furniture
Consumer and Institutional
Industrial Machinery
Adhesives and Other
Polyurethane Foam
Total Thermoplastics
Total Thermosets

- Reprocessing of generic *__thermoplastics__* recovered by sortation/reclamation from post-consumer discard streams and industrial scrap regrind is done in conventional polymer processing equipment. The reclaimed resins are formulated in limited quantities with virgin resins and additives to obtain the desired properties in the plastic object being produced.

- The reprocessing of *__thermosets__* *is* not well advanced compared to thermoplastics Reprocessing has been limited to the incorporation of reclaimed/reground resin into new polymer formulations with a minimum of flow or additional deformation occurring during processing.

- Processing of *__mixed__* thermoplastics to produce marketable products is essential for the expansion of plastics recycling. Separation of many commingled polymers into generic resins cannot be done in a cost-effective manner at this time.

Estimated Life-Time of Selected Plastic Products [1,2]

Plastic Products	Life-Time, years
Transportation	11
Packaging	<1
Building and construction	25
Electrical and electronics	15
Furniture and fixtures	10
Consumer and Institutional	5
Industrial machinery	15
Adhesives and Other	4

Packaging Waste regulations for the year 2001 [7]:

European Union	% All materials together	
• Global recovery rate	50% to 65%	
• with recycling (mechanical or feedstock):	25% to 45%	Minimum 15% per material

CHAPTER 4: LIFE CYCLE ENERGY ANALYSIS.: EMBODIED ENERGY

An analysis of the flow of energy involved in the production of a product is one aspect of a life-cycle assessment, an "objective" process of analysis that attempts to evaluate the environmental burdens associated with a product, process, or activity by:

- Quantifying the quantities of energies and materials used and the quantities of waste released into the environment;
- Assessing the impact of energy and material uses and releases on the environment;
- Evaluating opportunities to effect improvements.

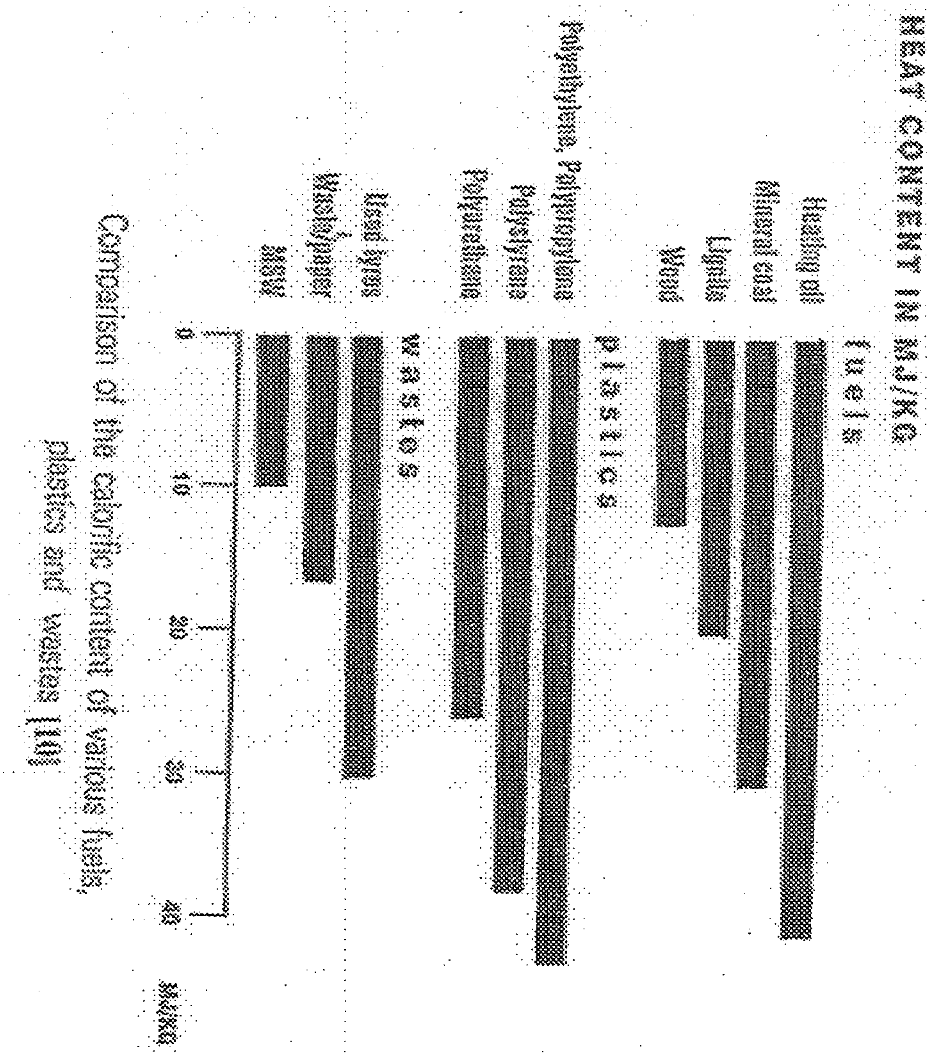
The assessment, if at all possible, should consider all the activities related to the manufacture of a product or operation of a process; this can include activities such as extraction and processing of raw materials, manufacturing, transportation and distribution, use/reuse/maintenance, recycling, and final disposal.

The total of the direct and indirect energies has been termed "embodied energy". For example, the energy embodied in an automobile includes the energy consumed directly in the manufacturing plant plus all the energy consumed to produce the inputs required for automobile manufacture, such as the glass and steel incorporated in the automobile.

Packaging waste v traditional fuels

Fuel	Net calorific value (MJ/kg)
Oil	40
Coal	25
PDF	20
RDF	15-17
MSW	10
Wood	8

PDF: mixed plastic and paper packaging waste
RDF: refuse derived oil
(APME, Brussels, 1996)



Comparison of the calorific content of various fuels, plastics and wastes [10]

PAPER VERSUS PLASTIC

This is the part that surprises everyone!

In true fact, paper processing requires
5 times more energy than plastic to process, and
50 times more energy than plastic to recycle.

To carry out a life cycle analysis requires that, the boundaries of the global system e.g. a set of subsystems must be defined precisely. The energy requirements for the hierarchy of alternatives are based upon the following global boundaries [1,2]:

Input
One (1) pound of discarded objects and parts in a waste stream that that can be either source separated, sorted, landfilled or combusted. Additional energy as required for each option considered[1].

Output
One (1) pound of identical finished plastic parts or objects and 18,000 Btu of energy.

Producing a fixed amount of energy, (that produced from combustion of one (1) pound of plastic, in a waste-to-energy combustion unit,) and an identical quantity of finished products places all the alternatives considered on a comparable basis.

The value of 18,000 Btu of energy was selected as a typical value for the heat of combustion of many plastics, e.g. polystyrene. In an efficient waste-to-energy unit integrated with power generation this would be equivalent to about 1.2 kWh of electric power.

The Embodied Energy of Plastic Products [1,2]

"Parts" (Products)	BTUs/lb
ABS	47,700
HDPE	42,200
LDPE	44,400
Melamine	48,500
Nylon 6, 6	63,500
Polycarbonate	68,200
Polyethylene terephthalate	45,800
Phenolic	38,400
Polypropylene	41,000
Polystyrene	50,400
Polyurethane	31,700
Polyvinyl Chloride	34,000
Polyester (25% Glass)	37,300
Urea-Formaldehyde	33,600

Franklin Associates, 1990

Life Cycle Energy Flow

1 Pound Plastics in Waste Streams
Converted to 1 Pound Plastic Products
and 18,000 BTUs of Energy

Disposal/ Recycling Alternative	Fraction of Plastic Content of Waste Stream Recovered	Energy Flow Index of Merit(1)
Landfill	1.0	138
Pyrolysis to Fuel Products	1.0	102
Waste to Energy	1.0	100
Pyrolysis to Monomers	0.6 0.9	91-96(2) 69-78(2)
Reprocess/ Modification	0.6 0.9	90 62
Reuse of Product or Object	0.6 0.9	84 54

(1) The Index of Merit has been developed relative to waste-to-energy incineration; the lower the merit number, the lower the energy consumption.

(2) Range reflects differences in selectivity to monomers.

Energy Contents of Plastics (BTU per pound of a plastic product) [1,2]

	Heat of Feed Combustion	Processing Energy	Total Energy Input	Product Heat of Combustion	Total Energy Minus Heat of Combustion
Thermosets	24,700	24,000	48,700	11,400	37,300
LDPE	28,100	10,400	38,500	20,000	18,500
HDPE	27,300	9,200	36,500	20,050	16,450
Polypropylene	28,000	6,200	34,200	20,000	14,200
ABS and SAN	24,570	8,280	32,850	18,045	14,805
Polystyrene	23,600	10,700	34,300	17,800	16,500
PBT/PET	24,700	24,000	48,700	11,400	37,300
Nylon	27,700	62,700	90,400	13,200	77,200
PVC	12,600	13,000	25,600	7,700	17,900
Polyurethane	21,840	7,360	29,200	16,040	13,160

Energy implications of plastics incineration [9]

Energy in manufacture (a), MJ/kg:	120
Energy from combustion (b), MJ/kg:	44
Efficiency of generation (c):	0.33
Electricity produced (d), MJ/kg (b x c):	14.5
Energy efficiency of plastics incineration (d / a):	12%

- An obvious use of plastic waste is to use its *Calorific Value* in industrial units which typically burn fuel
- *Co-combustion* of plastic waste together with MSW (Municipal Solid Waste)
- Plastics waste helps to resolve an environmental problem to *minimize air pollution* thanks to the substitution of more polluting fuels

CHAPTER 5: POTENTIAL ENERGY SAVINGS FROM PLASTIC WASTE RECYCLING PROCESSES

ENERGY-SAVING OPPORTUNITIES

Since the heat of combustion of plastic can be recovered as usable energy (to a maximum of about 80%), the energy savings that can be obtained through recycling over (i.e. in addition to) those obtained if the waste polymers were incinerated are shown in Table 3. The energy opportunity over incineration will be about 50 x 10^{13} Btu in 2010. However, one must keep in mind that:

- In Table 3 the potential gross energy savings are shown; from these savings the energy required to recover/recycle the plastics would have to be deducted.
- The replacement energies used to develop the potential gross energy savings in Table 3 need critical analysis and updating; for example, the energy opportunity shown for carpets is highly dependent on the high values of the replacement energy for nylon 6 and 6,6.
- The energy savings in Table 3 do not include the savings that will result from an expansion of current recycling programs for beverage bottles, battery cases, and some containers. We estimate that these activities could add another 20 x 10^{13} Btu annually to the total shown for 2010.

Table 3

Maximum Energy Opportunity Above Heat of Combustion [1,2]

	1990	1995	2000	2010
	10^{13} BTUs			
ASRs	3.6	4.2	4.6	6.0
Carpets	16.2	18.5	21.6	29.3
Wire and Cables	0.7	0.9	1.1	1.4
Tailings from MSW	0.4	10.0	12.0	16.0
Totals	20.9	33.6	39.3	52.7

ENERGY CONTENT (IN 10^{8} BTUS) OF POST-CONSUMER PLASTIC WASTES: 1990, 1995, 2000 [1,2]

	1990		1995		2000	
	(1)*	(2)**	(1)*	(2)**	(1)*	(2)**
Thermosets						
Epoxy	13	3	13	3	17	4
Polyester	41	10	50	12	47	11
Urea and Melamine	32	7	24	6	43	10
Phenolics	51	12	50	12	52	12
Other Thermosets	1	0	10	2	0	0
Total Thermosets	138	32	146	34	159	37
Thermoplastics						
LDPE	327	170	406	211	443	230
HDPE	258	142	273	150	327	180
Polypropylene	144	84	199	116	236	138
ABS and SAN	34	19	58	32	67	37
Polystyrene	150	78	155	81	173	90
PBT/PET	54	13	67	16	78	18
Nylon	33	3	41	6	43	6
PVC	92	28	132	40	128	39
Other Thermoplastics	35	19	62	34	61	33
Total Thermoplastics	1128	557	1393	685	1557	771
Polyurethane Foam	52	28	55	30	64	35
Total	1317	617	1594	750	1779	843

*(1): Total Energy Input
**(2): Product Heat of Combustion

HIERARCHY OF ENERGY SAVINGS FROM RECYCLING

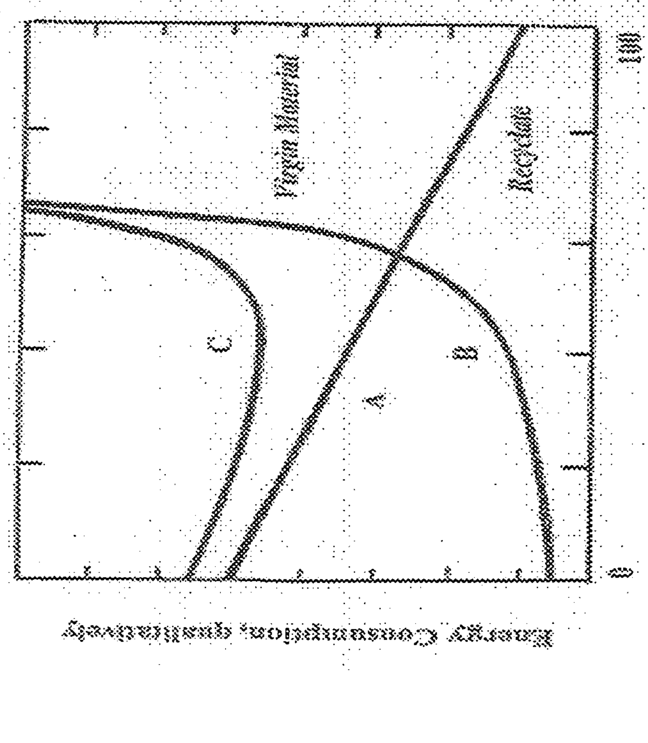
The savings in energy that might be achieved by the reprocessing of plastics recovered from waste streams, e.g., ASRs, carpets, wire and cable and MSW streams are not inherently obvious.

Life cycle analysis can be applied to the recovery and reprocessing of discarded plastics from waste streams to establish an *approximate* hierarchy of energy savings.

- Landfilled;
- Combusted in waste-to-energy units;
- Reused;
- Reclaimed and reprocessed into new finished products;
- Chemically modified to facilitate reprocessing;
- Converted, e.g., by pyrolysis or hydrolysis processes, into liquid/gaseous fuels, monomers or chemicals.

Waste Management of Discarded Plastic Objects and Parts [1,2]

Landfill	Waste-to-energy	Reuse	Reclamation/reprocess	Reclaim/compatibilize	Pyrolysis to fuels	Pyrolysis/hydrolysis to monomers
Collect	Collect	Source Separate	Collect	Collect	Collect	Collect
↓	↓	↓	↓	↓	↓	↓
Handle	Handle	Collect	Sort	Sort	Sort	Sort
↓	↓	↓	↓	↓	↓	↓
Bury	Combust (Recover Energy)	Inspect (Accept/Reject)	Transport	Transport	Transport	Transport
		↓	↓	↓	↓	↓
		Wash/Repair	Reclaim (Flake/Pellet)	Reclaim (Flake/Pellet)	Pyrolyze	Reclaim
		↓	↓	↓	↓	↓
		Inspect (Accept/Repair)	Fabricate Products	Transport	Fuels	Pyrolyze/Hydrolyze
		↓	↓	↓		↓
		Package	Package	Compatibilize/Modify		Purify Monomer
		↓	↓	↓		↓
		Transport to User	Transport to User	Fabricate Products		Transport
				↓		↓
				Package		Polymerize
				↓		↓
				Transport to User		Fabricate Products
						↓
						Package
						↓
						Transport to User



Energy Consumption for Recycling vs. Recycling Quota [8]

A – Energy for manufacture vs. recycle content

B – Energy for collection, sorting, transportation, etc.

C – Total energy consumption vs. recycling quota

Primary recycling is the conversion of waste plastic from a product into a new product similar in character to the original one.

Secondary recycling is the conversion of plastic wastes into new products that have less demanding physical and chemical characteristics than the original product had. This "cascaded performance" approach is easier to accomplish than primary recycling. Plastic waste can be melted and molded into new, non-food-packaging products that are essentially 100% recycled resin.

Tertiary recycling is the recovery of basic chemicals and fuels from waste plastics. The technology is available to break down waste plastics to their original polymeric form, clean them, and produce a repolymerized resin.

Quaternary recycling involves burning plastic waste to recover its energy content.

Estimated Energy Savings
from Alternative Plastic Recycling Technique [6]

RESIN	EMBODIED ENERGY (Btu/lb)	ENERGY SAVINGS (Btu/lb)		
		Secondary	*Tertiary*	*Quaternary*
PET	48,700	41,395	24,700	11,400
HDPE	36,500	31,025	27,300	20,050
PVC	25,600	21,760	12,600	7,700
LDPE	38,500	32,725	28,100	20,000
PP	34,200	29,070	28,000	20,000
PS	34,300	29,155	23,600	17,800
Other Resins	42,600	36,210	26,000	15,725

Secondary (remelting) Recycling: 85% of the total embodied energy the plastic waste is recovered.

Tertiary (refinery) Recycling: Energy savings are equal to the net heat of feed combustion and equivalent to the energy embodied in the crude oil; refinery recycling displaces crude oil feedstocks.

Quaternary (incineration with heat recovery) Recycling: Energy savings have been estimated as the product heat of combustion; energy savings are much less than for secondary recycling, and less than for tertiary recycling.

ALL embodied energy will be lost if plastic wastes are landfilled.

Technica1 and cost improvements in refinery recycling, pyrolysis, and dissolution processes offer thc potentia1 for significant expansion of plastics recycling, in that plastic waste streams currently landfilled or incinerated might bc recycled. However, whether this transition is advisable from a societal perspective must await further research. The question of environmental emissions from these tertiary processes as compared to landfilling and incineration remains open.

From an energy perspective, these processes hold obvious advantages as compared to landfilling, but less obvious benefits when compared to incineration with heat recovery. These processes may also allow resins that are currently recycled into products that displace wood or concrete to be recycled into products that displace virgin resins. Unfortunately, the environmental, energy, and materials tradeoffs associated with these various transitions await the findings of a comprehensive life cycle assessment.

Co-Combustion of Plastic Waste with Coal: Characteristics of Derived Fuel [12]

Sample	Gross heat of combustion (MJ/kg)	Original		As feed to combustor		
		Form	Bulk density kg/m3	Form	Packing density kg/m3	Particle density kg/m3
1. Polyurethane packaging foam	26.1-31.6	Foam	10	Briquettes φ60mm x 60mm	300	800
2. MDI based flexible polyurethane foam	26.1-31.6	Foam	20	3mm granules	400	900
3. Cast acrylic	26.6	Sheet	1180-1210	Chip	430	1200
4. Nylon hosiery	31.6	Hosiery	75	3mm extruded granule	380	465
5. Nylon polymer	31.6	3mm extruded granule	700	3mm extruded granule	700	1140
6. Metallised PET/PE film	26.8 (1)	Rolls	1000	3mm agglomerate	280	780
7. Photosensitive polyester film	19.1 (1)	Rolls	1000	5mm agglomerate	680	1040
8. Mixed PET/PP film	22.2-46.4	2mm flake	100	2mm flake	100	920-1400
9. Dumfries coal (2)	30.4	Lumps	670-830	Lumps	670-830	1300-1600

Notes:
Heats of combustion from "Heat Release in Fires", Ed. V. Babrauskas, S.J. Grayson, Elsevier 1992
DAF: Dry Ash Free Basis
(1) Estimated
(2) Source for Coal Data British Coal

Proper feed preparation techniques of wide range of plastic waste should be used, such as:

- Compaction,
- Briquetting,
- Shredding,
- Granulation,
- Coarse Grinding (Size of 10 mm).

In this case plastic waste could be converted to secondary fuels suitable for firing in a circulating fluidised bed boiler with a thermal efficiency of around 80% in terms of conversion of fuel calorific value into useable steam.

ASTM Classification of Refuse-Derived Fuels [13]

Type of RDF	Description
RDF-1	Municipal solid waste used as a fuel without oversize bulky waste.
RDF-2	Municipal solid waste processed to coarse particle size with or without ferrous metal. As a subcategory, c-RDF, which is subject to separation such that 95% by weight passes through a 6-inch square mesh screen.
RDF-3	Shredded fuel derived from municipal solid waste and processed for the removal of metal, glass, and other entrained inorganics. The particle size is such that 95% by weight passes through a 2-inch square mesh screen (also classified as "Fluff RDF').
RDF-4	The combustible waste fraction processed into powdered form, 95% by weight passing through a 10-mesh (0.035 inch square) screen (also classified as p-RDF).
RDF-5	Combustible waste fraction densified into the form of pellets, slugs, cubettes, briquettes, or some similar form (also classified as d-RDF).
RDF-6	Combustible waste fraction processed into a liquid fuel (no standards developed).
RDF-7	Combustible waste fraction processed into a gaseous fuel (no standards developed).

Over a period of time in Britain, refuse-derived fuel has gradually become accepted and understood in three categories: flock refuse-derived fuel (fRDF), crumb refuse-derived fuel (cRDF) - often taken in the U.S. to mean "coarse RDF," and densified refuse-derived fuel (dRDF).

From the emissions perspective, they should all perform equally well, and the only difference between them is the degree of densification that is applied. Thus, fRDF is not densified at all, but is generally reduced to a dry particle size of 95% less than .5" (10 mm). cRDF is densified to about 18.7 lb/ft3 (300 kg/m3), while dRDF densified to in excess of 37.5 lb/ft3 (600 kg/m3).

All that the densification does is affect the way in which the fuels handle, which in turn is dependent upon the design of the combustion plant fuel handling system.

Specific Surface Area (S) for solid powders:

$$S = 6/D\gamma$$

where:

D – average diameter of particles or pores,

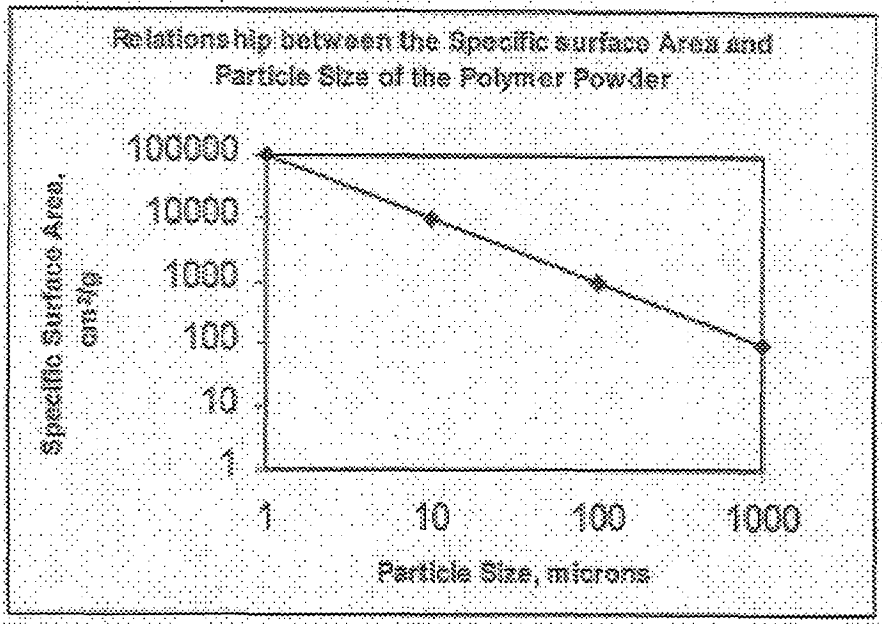
γ - apparent density of powder

For example, if the powder from Polyurethane Waste has an apparent (bulk) density

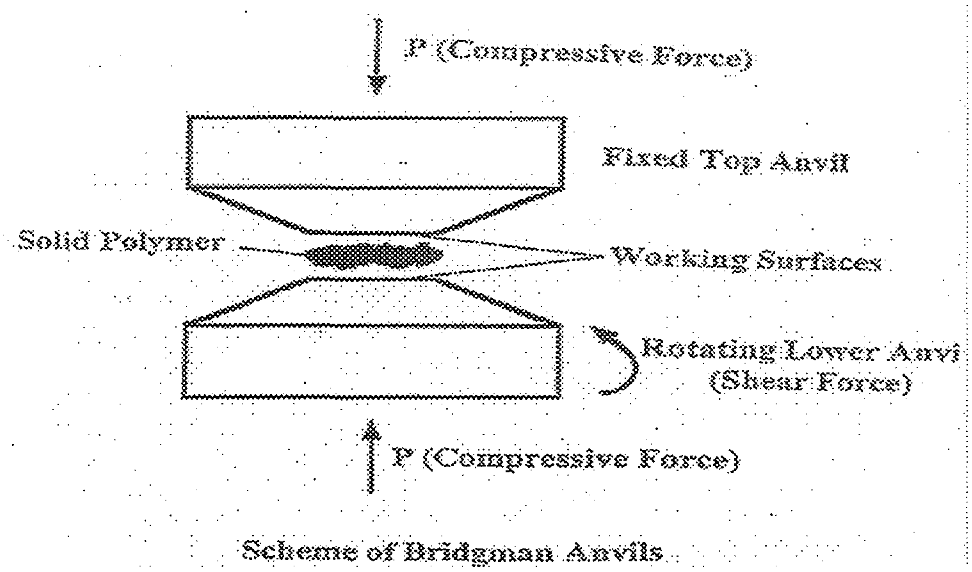
$\gamma = 0.6\ g/cm^3 = 6.0\ kg/m^3$,

and if the average particle size is 100 micron = 0.01cm, the specific surface area is as much as

$S = 10^3\ cm^2/g = 0.1\ m^2/g$.



CHAPTER 8: PULVERIZATION OF PLASTIC WASTE BY PSP-PROCESS DEVELOPED AT TENNESSEE TECHNOLOGICAL UNIVERSITY, COOKEVILLE, TN, USA



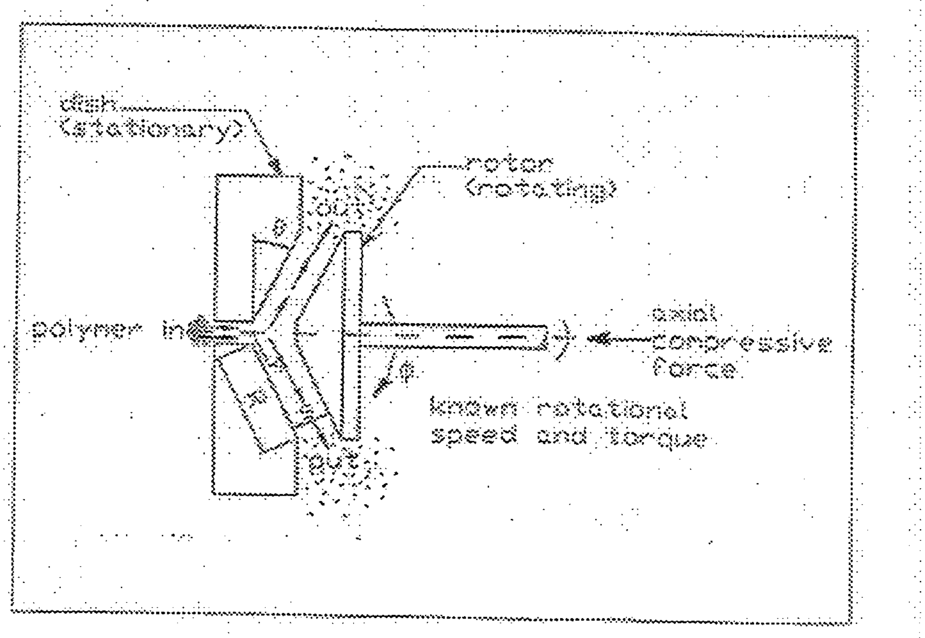
<u>*Patent USA 5, 769,335*</u>

METHOD AND APPARATUS FOR SHEAR PULVERIZATION OF POLYMER MATERLALS

Fyodor Shutov, Cookeville, Tenn., assignor to Tennessee Technological University.

Filed Jan. 31,1997, Ser. No. 791~200
Int. Cl.[6] B02C 7/12

U.S. Cl. 241--27 16 Claims



KEY FEATURES OF THE RECYCLING METHOD

- Pressure Shear Pulverization is non-cryogenic, non-extrusion, and environmentally safe proprietary process developed by researchers at Tennessee Technological University.

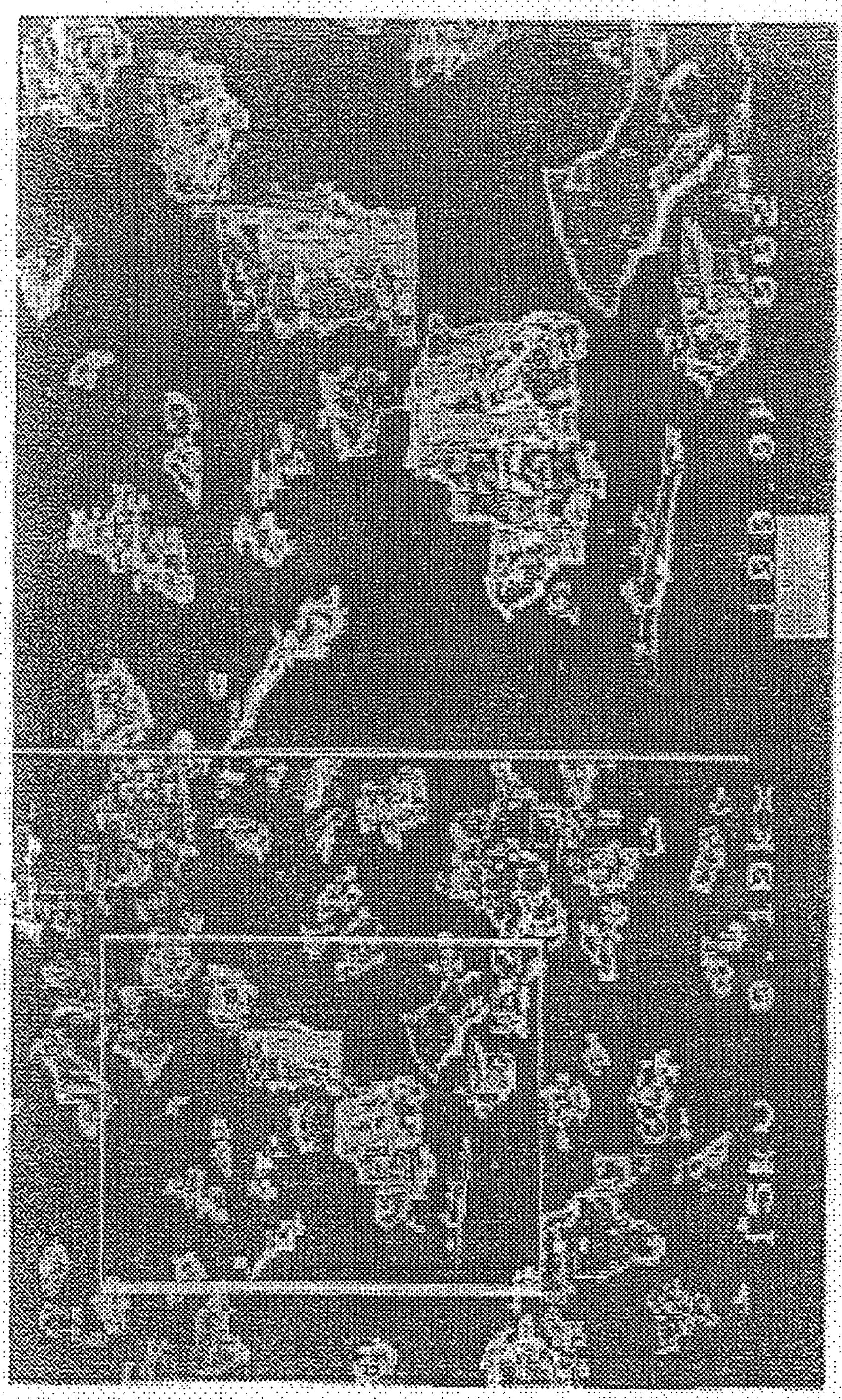
- Novel Principle: PSP process is realized in a specially designed pulverization head between very smooth mirror-like surfaces (no grinding at all) under combined action of pressure and shear stresses and it is based on Bridgman phenomenon.

- PSP is a high output and low energy consumption process.

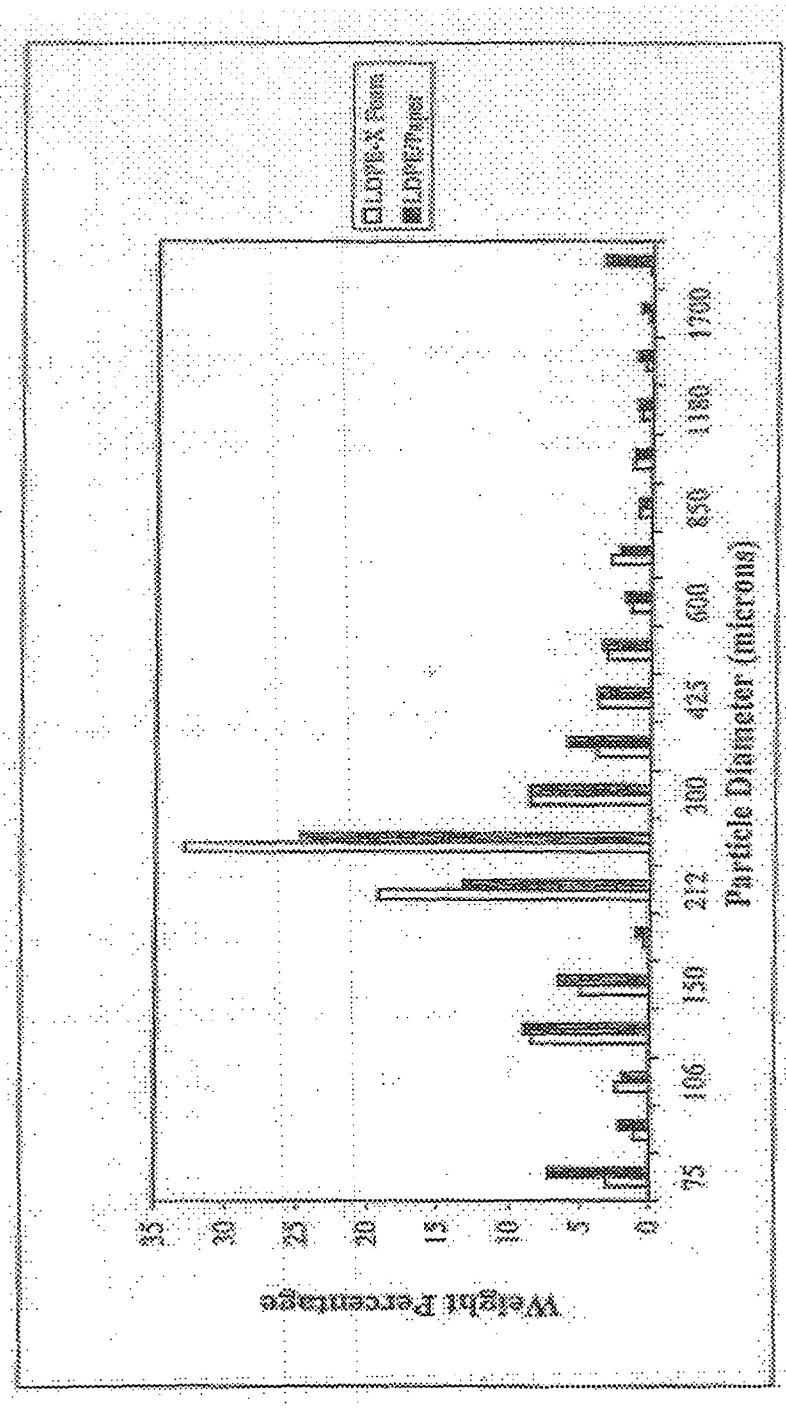
- Particle size distribution and average particle size can be controlled by manipulating the processing parameters of the process.

Energy Consumption Of Various Processes For Pulverization of Plastics Waste [7]

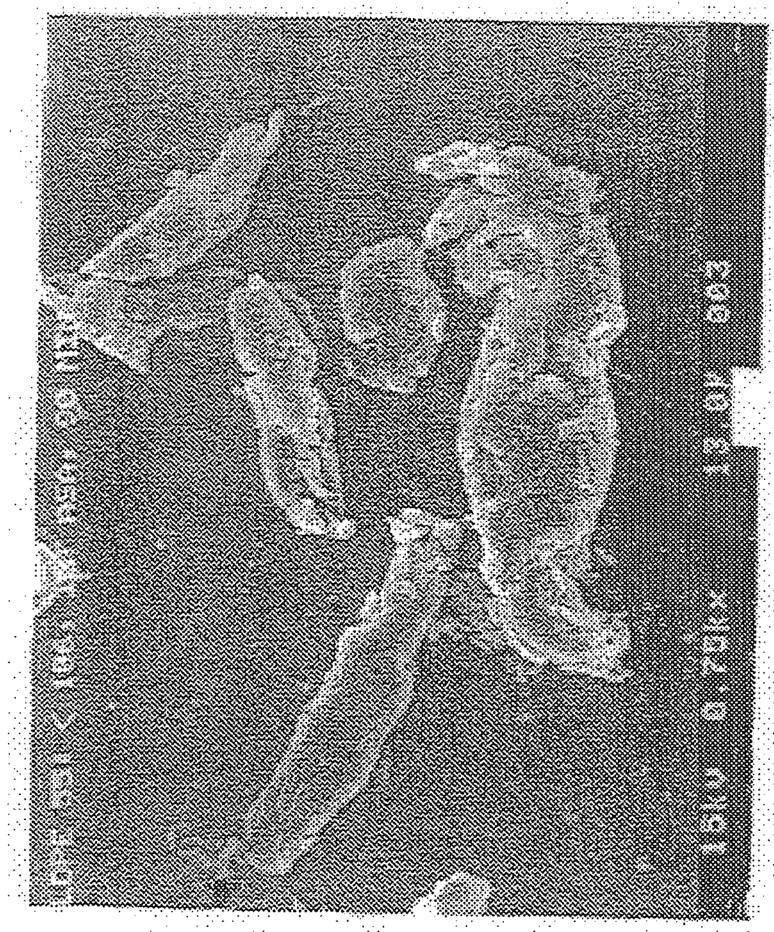
Industrial Processes: Ball, Hummer or Rotary Mills	Up to 5.0 KWH/Kg
Industrial Processes: Cryogenic(Liquid N_2) Grinding	1.5~3.0 KWH/Kg
Pilot Processes: Pressure Shear Pulverization(PSP)Process, TTU, USA	0.31~0.38 KWH/Kg



PSP Powder from Polyurethane Foam Scrap: Bulk Powder



PSP-Particle Size Distribution of two Types of Plastic Waste: Crosslinking PE Foams, and PE/Paper Mixture [15]



Scanning Electron Micrograph of PSP-particles from LDPE

PSP Process has been successfully tested for various types of Organic Solid Waste such as:

- Thermoplastic Polymers: PE, PP, PVC, PET
- Thermosetting Polymers: PUR, Phenolic, and Epoxy Resins
- Crosslinked Thermoplastics: PE, PVC
- Synthetic Rubber
- Mixtures of Thermoplastic Polymers
- Composites and Carpets
- Mixtures of Paper and Polyethylene

At TTU there are two PSP-machines with output 3 kg/hour and 70 kg/hour.

Advantages of Pulverization of Plastic Waste for Further Recycling Processes

- No equipment and energy consumption for densityfication, compaction, briquetting, etc.
- No equipment and energy consumption for remelting and granulation to make pellets
- Installation of pulverization equipment inside the existing technological lines incineration, pyrolysis, and energy recovery
- High fluidity of fine polymer powders through metering, mixing and injection equipment
- Regulation of the intensity of incineration, pyrolysis and energy recovery processes by the particle size of the powder
- Extremely high rate of thermal processes because of very high surface area the polymer powders

CHAPTER 9: PLASTIC WASTE RECYCLING AND GAS EMISSION

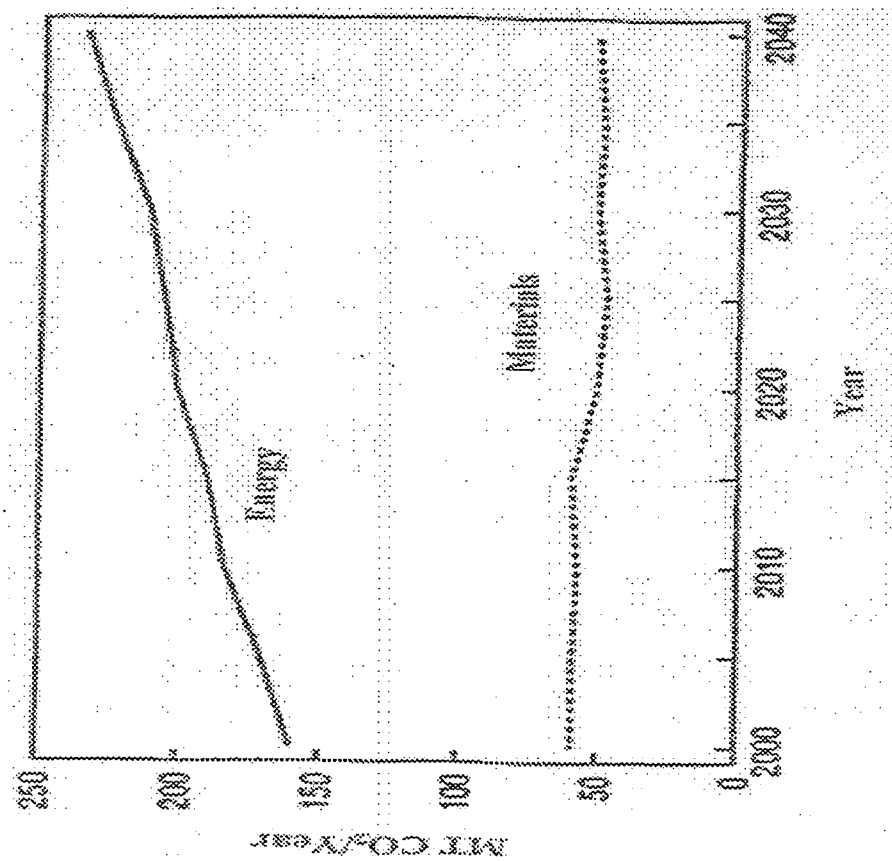
The life-cycle analysis could take into account 6 environmental parameters:

- Greenhouse effect (CO_2, CH_4)
- Air acidification (SO_2, NO_x, HCl)
- Oxidizing photochemical pollution (hydrocarbons, CO, CH_4)
- Water eutrophisation Toxic substance emissions to air or water (heavy metals, dioxins, additives ...)
- End waste products

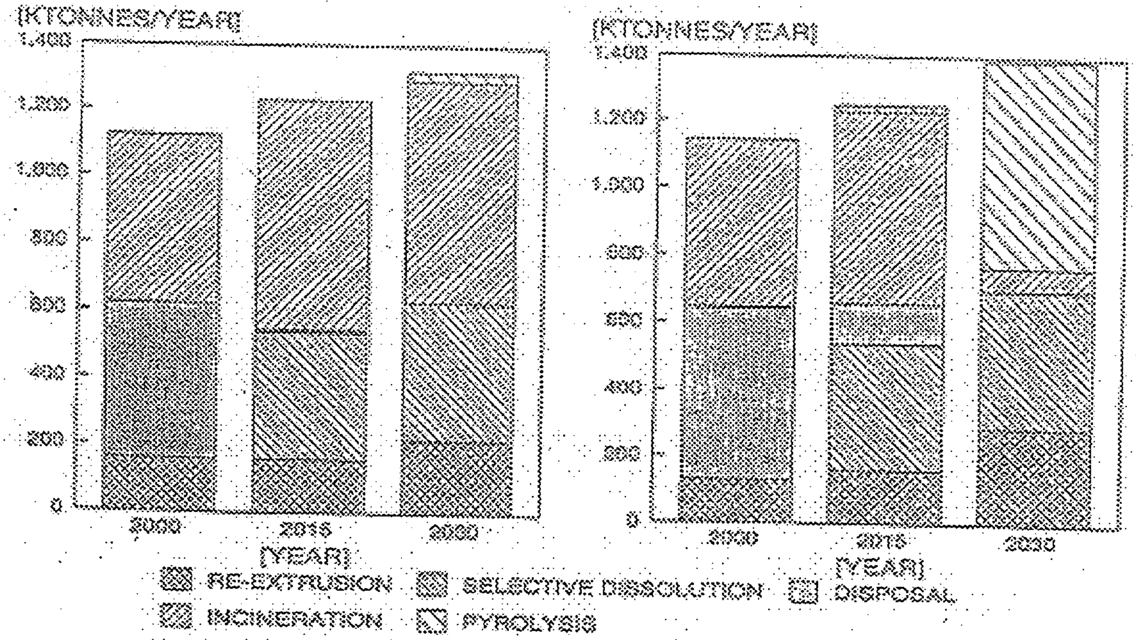
One of the great environmental concerns about the incineration of plastic waste is the emission of halogens, trace organohalogens like dioxins and furans, and heavy metals.

In answer to the criticisms being levied at it, the plastics industry in Europe has conducted a large series of tests to scientifically examine the environmental effect of plastic materials in municipal solid waste incineration. The study was undertaken "...to provide conclusive answers to some of the unknown quantities of this operation and examine the effects of future levels of plastics in the solid waste stream" [18].

In fact, higher concentrations of plastic waste produced a positive effect on emissions by ensuring stable combustion, resulting in lower emissions of car bon monoxide. The level of sulphur dioxide emissions, which is a major contributor to the formation of acid rain, is also reduced by the presence of plastics during incineration.



Model Results for CO_2 Emission in the Base Case Scenario(No CO_2 Reduction) for The Netherlands [17]



Shifts in Plastic Waste Technology:
Base Case Scenario(Left) and
with 60% CO_2 constraint (Right) [17]

Comparison of Costs for Incineration and Pyrolysis of Plastics Waste in 2025 [17]

	Base case		60% reduction case	
[NLG/t plastic waste]	Incineration	Pyrolysis	Incineration	Pyrolysis
Technology	+250	+275	+250	+275
Sorting		+875		+875
CO_2 emission			+785	+200
Product yield	-265	-700	-480	-1310
Net cost	-15	+450	+555	+425

Comparison of Different Routs for Recycling of Plastics Waste (Dow Europe S.A., 1993; APME, 1996)

		Landfill	Incinerate	Incinerate + Incinerate with energy recovery	Landfill + Recycle	Incinerate + Recycle	Incinerate + Incinerate with energy recovery + Recycle
Total energy requirements	(MJ/kg)	194	193	168	138	158	147
Total feedstock requirements	(MJ/kg)	59	59	59	32	32	32
Total fossil fuel requirements	(MJ/kg)	121	129	103	109	109	102
Total CO2 emissions	(kg/kg)	3	11	10	5	9	8
Total NOx emissions	(g/kg)	58	95	88	58	74	71
Total water usage	(l/kg)	57	87	58	64	84	84
Mineral waste generated	(g/kg)	241	239	113	231	230	210
Mass of plastic bottles to landfill	(g/kg)	1097	97	97	613	99	93

LANDFILL · INCINERATE WITH ENERGY RECOVERY · INCINERATE · RECYCLE

SUSTAINABILITY AND THE ROLE OF DESIGN

The current rate of consumption of natural resources cannot be sustained. Growing scientific evidence about the environmental effects of products, as well as the growing preclusion to landfill as a means of disposal, are leading to an increased need to designing products with minimal environmental impact. Waste management is just one of many frameworks for the implementation of 'Design for the Environment'.

In order to tackle the volume of plastic waste that requires disposal, close attention must be paid to reducing waste at every stage in a product's life; 'from cradle to grave'. The waste management hierarchy prioritizes different measures and techniques for dealing with waste according to their environmental impact.

Although the field of 'Green Design' is relatively new, the resource base of information about different techniques (e.g. life cycle analysis, design for recycling) and their effects is on the increase [18]

In existing waste incineration plants the plastic component of waste is only about seven per cent by weight yet produces nearly fifty per cent of the energy
Without the plastic content in the waste many tons of fossil fuels would be needed to fully incinerate the waste materials.

Despite its relative infancy it is clear that chemical recycling has apart to play in, plastic waste management.

However, due to the extensive use of both chemicals and heat in the processes, detailed studies into the net long term environmental effect of using these techniques are needed in order to determine whether it is better to use such techniques or to employ other waste management techniques.

STRATEGY FOR THE NEAREST FUTURE

To use Plastics Waste as "White Oil" Fuel:

- Maximize "White Oil" Energy Recovery
- Minimize Loss of "White Oil" to Landfill

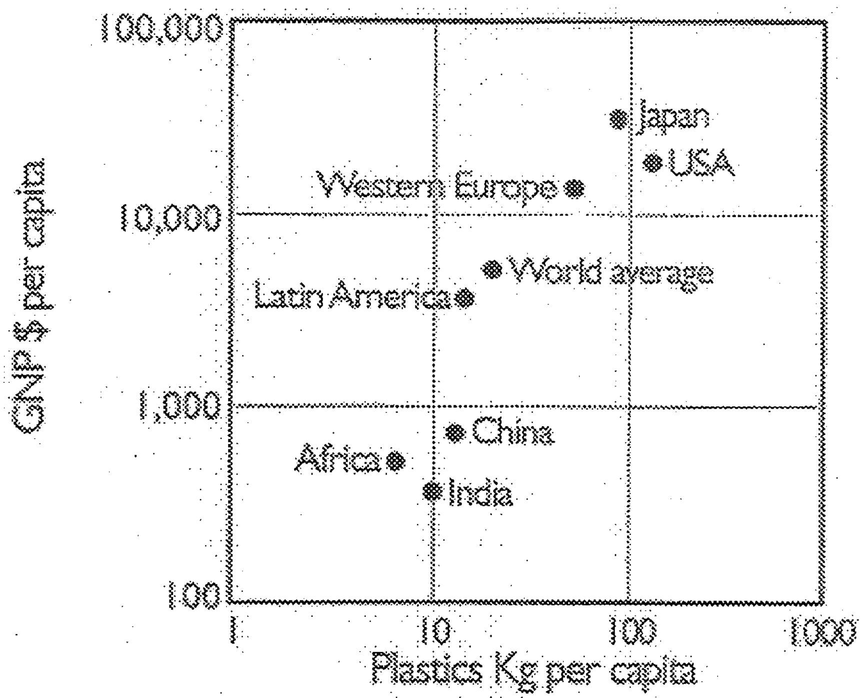
Plastics are indeed the only materials offering as many choices for recovery

- Mechanical recycling, like glass, metal and paper
- Energy recovery, like paper
- Feedstock recycling as none other

In 1995, 11 million tons of plastics were discarded in landfills and only 4.2 million tons were recovered in Western Europe. Towards 2002/2007 an additional 12 million tons could be recovered using an optimum mix of all three available plastics recovery options, saving the equivalent amount of oil, worth more than one billion Euro/year **[7]**.

Positive examples of recovery should help in convincing legislators and public opinion that:

- practical, clean and common sense solutions for plastics waste management do exist
- plastics in modern life are not a problem, they are a solution.



Plastic Consumption and GNP, 1996

[19]

The efficiency and viability of different approaches and techniques for energy savings using plastic waste recycling technologies depend very much on some ***non-technical*** activities.

Several management and social activities are important to attain energy savings for any plastic recycling process, such as:

- Organizations that collect and process the plastic waste,
- Householders that assist in the collection and separation (sorting) of plastic waste
- Federal agencies and the society as a whole, heightening awareness and concern for environmental and health externalities and arguments to conserve energy and materials.
- Activity of the *international organizations,* which are involved in environmental and ecological aspects of the problem: UNIDO, UNDP, UNEP.

Acknowledgements

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REFERENCES

1. A.L.Bisio and M.Xantos, "How to Manage Plastics Waste", Hanser Publishers, 1994.
2. "A Research Needs Assessment for Waste Plastics Recycling", Vol.2, US Department of Energy, Final Report, 1994.
3. P.R.White, Recycle'97, Congress Proceedings, Geneva, Switzerland, 1997.
4. M.Droscher, Polymer Recycling J., vol.2, No.1, 1996.
5. "Thermal Recycling of Plastics", University of North Dakota, ND, 1994.
6. T.R.Curlee and S.Das, J. Solid Waste Technology and Management, vol.23, No.3/4, 1998.
7. J.Desarnauts, Polymer Recycling J., vol.3, No.1, 1997/98.
8. J.H.Brophy, et al., Chemical Aspects of Polymer Recycling, Akcros Chemical, UK, 1996.
9. P.Mobbs, "Five Popular Myths about Incineration", www.gn.apc.prg, 1997.
10. J.Scheirs, Polymer Recycling, Wiley Publishers, 1998.
11. E.Weigand and W.Passhofer, Recycling of Polyurethanes, RAPRA Technology, 1999.
12. D.J.Soderberg, et al., Recycle'93, Congress Proceedings, Davos, Switzerland, 1993.
13. A.G.R.Manser and A.A.Keeling, Handbook of Processing and Recycling Municipal Waste, CRC Publishers, 1997.
14. F.Shutov, US Patent 5.769,335, Tennessee Technological University, 1998.
15. T.Patel and F.Shutov, ANTEC'99, Proceeding, Society of Plastics Engineers, New York, 1999.
16. A.Law and F.Shutov, Polymer Recycling J., vol.3, No.4, 1997/98.
17. D.J. Gielen et al., Recycle'95, Congress Proceedings, Geneva, Switzerland, 1995.
18. D.T.Lintell and J.S.Smith, Polymer Recycling J., vol.3, No.2, 1997/98.
19. F.Pardos, Plastic Engineering, November, 1999.
20. News and Views, Canada, vol.4, No.4, 1997.

2.2 Energy Efficiency in Austrian Industry

Dipl.-Ing. Otto Starzer, Energieverwertungsagentur

STATISTICAL DATA

Final energy use has been increasing steadily since 1960 in Austria, with transport increasing most rapidly from 17% in 1960 to 28% in 1995. Final energy use in the industry however has been gradually decreasing from 42% to 27% over the 35-year period, and the level CO_2 emissions have more or less stayed constant from 1980 to the end of 1990's.

In Austria, small and medium sized enterprises constitute the majority of the Austrian industry.

ENERGY EFFICIENCY MEASURES

The Austrian Energy Agency, E.V.A., together with industrial partners and in co-operation with involved actors undertake the following various measures to increase energy efficiency:

- National, European projects
- Pilot actions
- Seminars and conferences
- Dissemination of information
- Regional initiatives
- Platform for discussions

E.V.A.'s objectives regarding industrial energy efficiency is to promote win-win situations and disseminate cost-effective energy saving measures by reducing energy consumption and costs as well as strengthening the competitiveness of the Austrian industry.

The advantages of such measures are multiple, with direct cost savings and indirect improvements in quality, image, working conditions, relations with authorities, insurances and so forth.

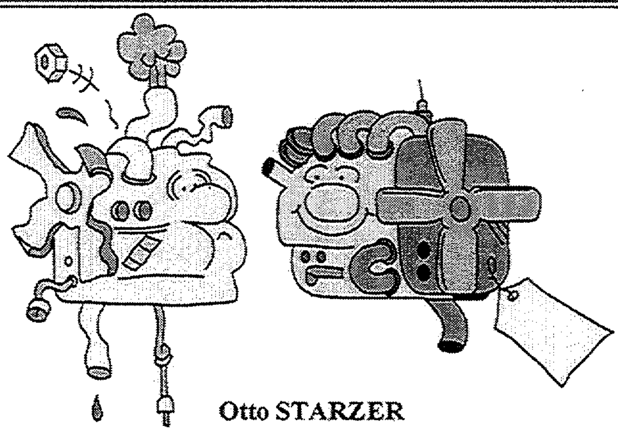
To meet these objectives, the E.V.A's activities concerning the industry include the following:

- Getting top management's commitment
- Producing data for augmentation
- Promoting energy management systems
- Supporting networks for energy efficiency
- Giving recommendations to policy actors
- Giving advice on financing energy efficiency.

Slide 1

Energy Efficiency in the Austrian Industry

ENERGIE VERWERTUNGSAGENTUR



Otto STARZER

E.V.A., the Austrian Energy Agency

Energy efficiency in Industry

Slide 2

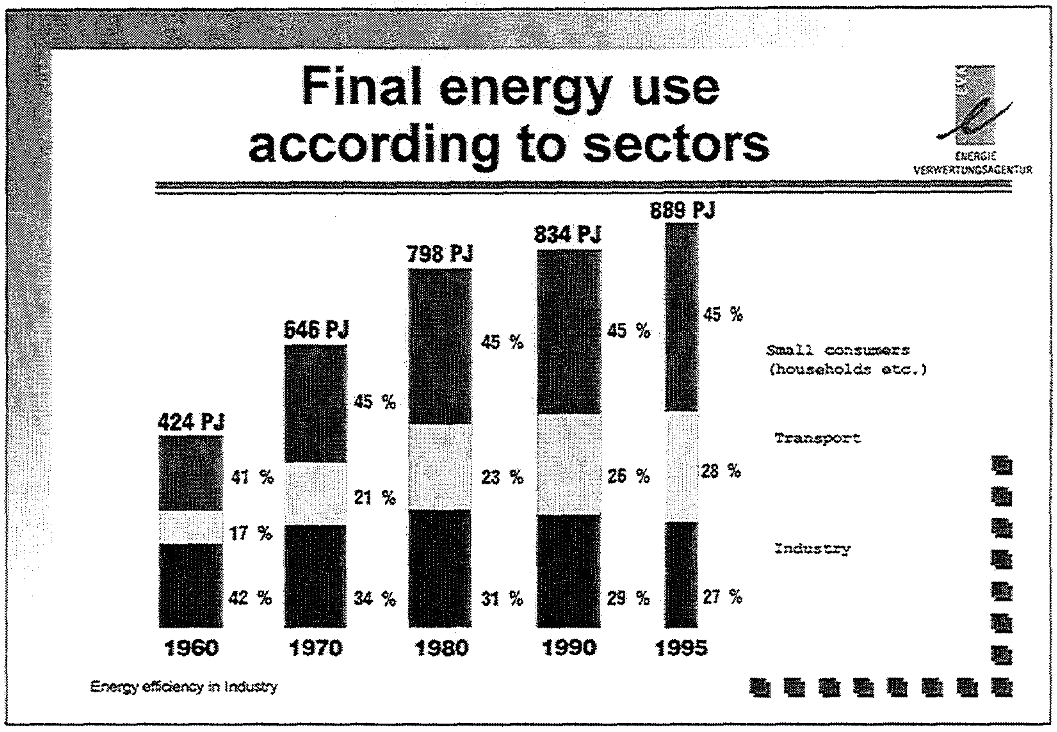
Content

ENERGIE VERWERTUNGSAGENTUR

1. Statistical Data
2. Instruments and Activities

Energy efficiency in Industry

Slide 3



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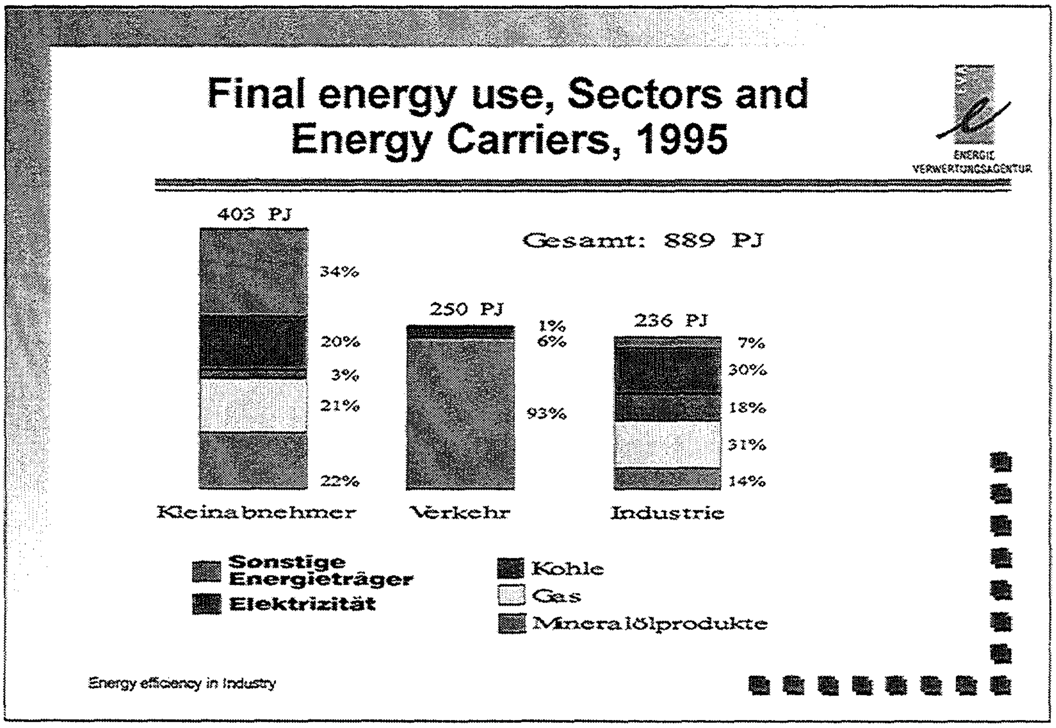

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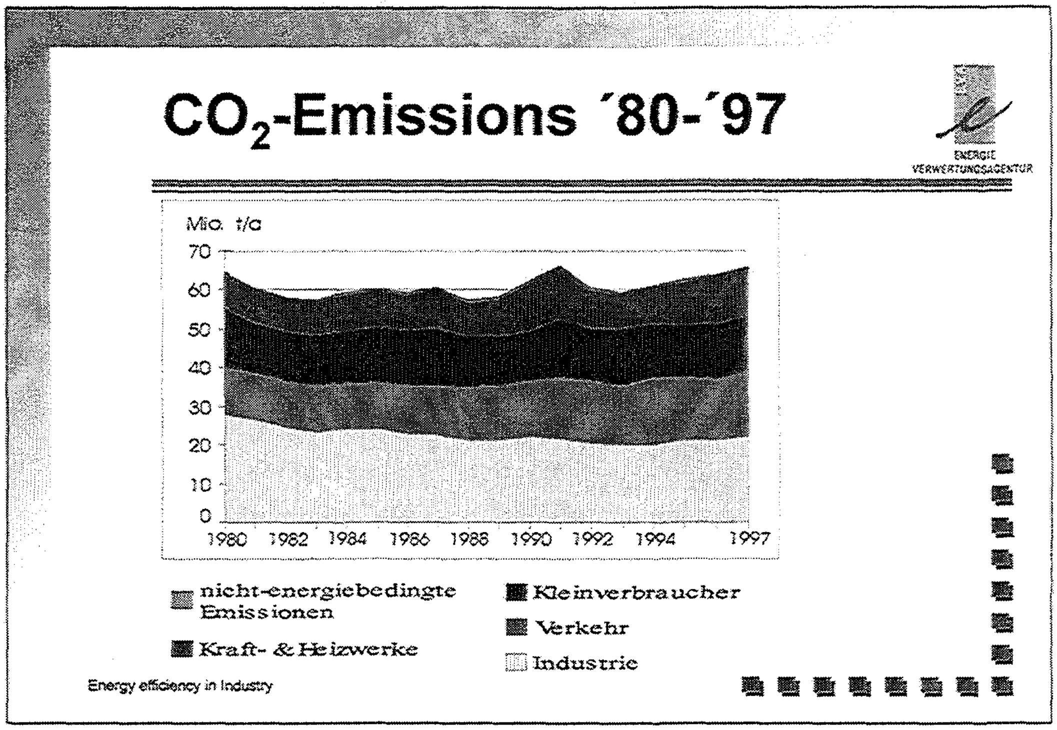

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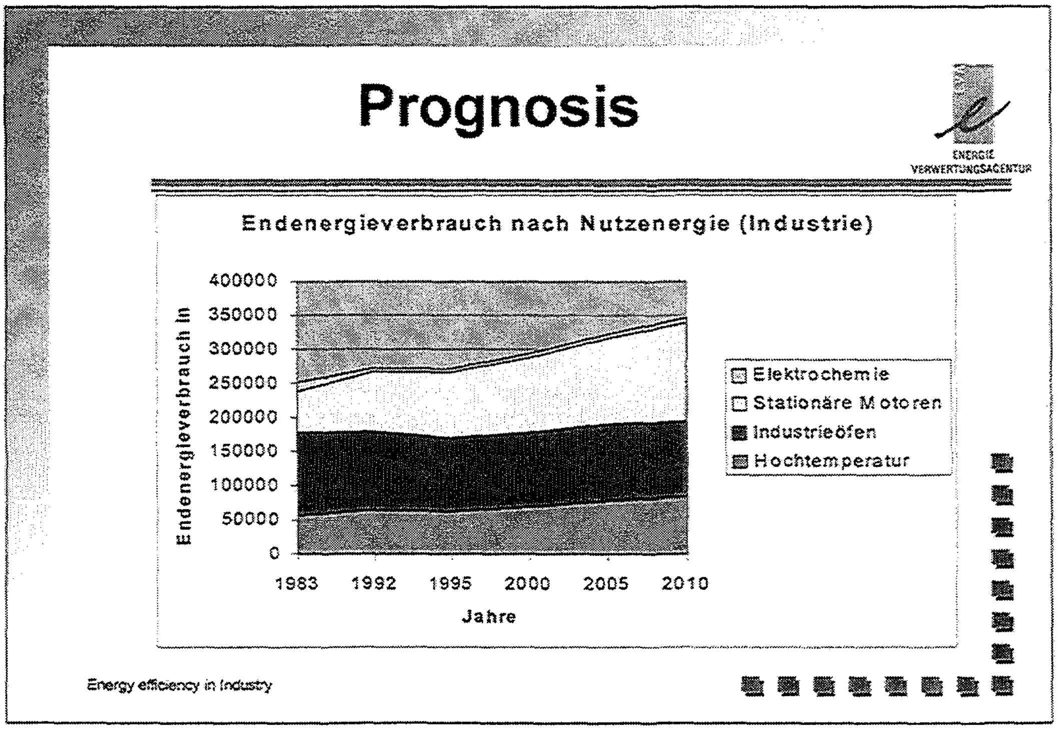

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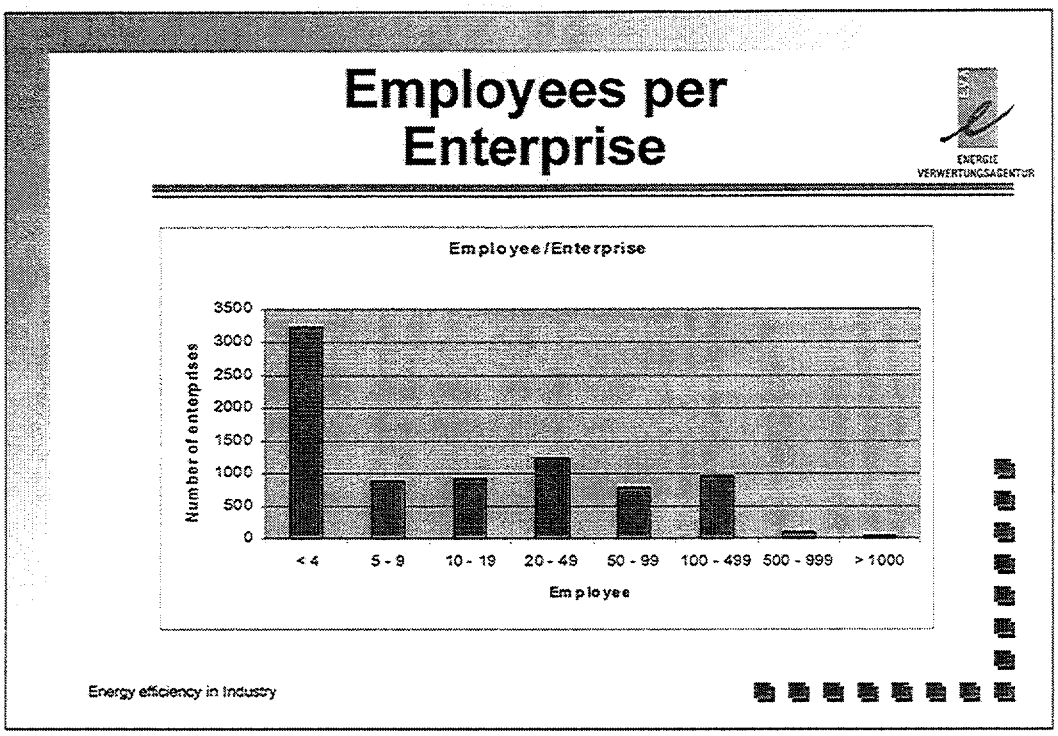

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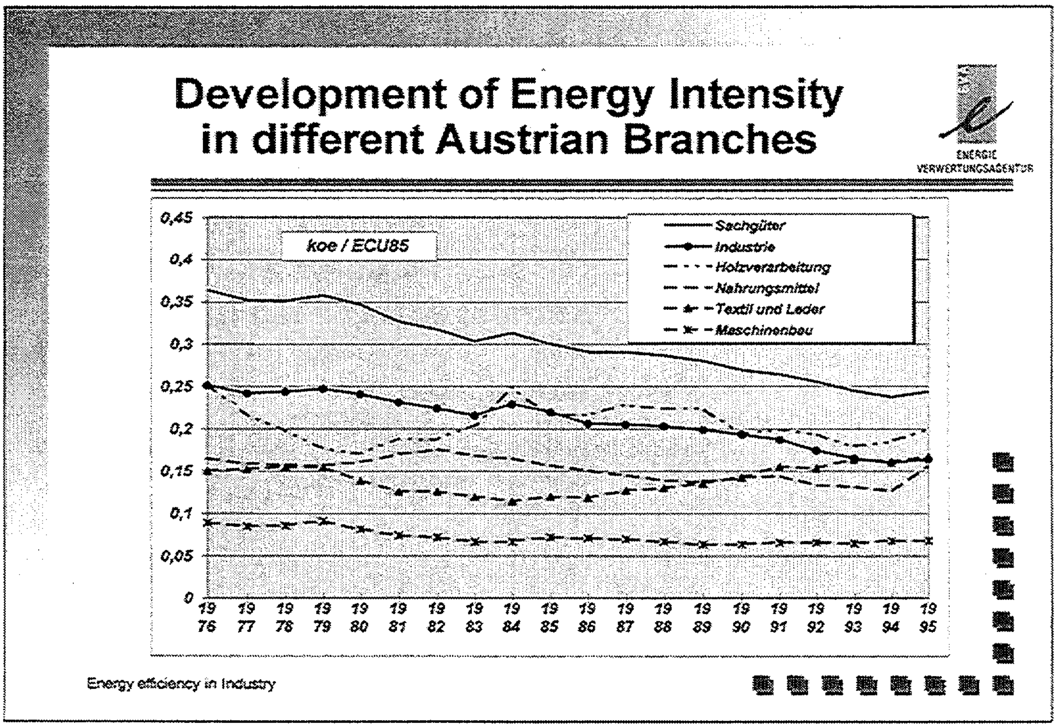

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Organitional structure of the Austrian Industry

ENERGIE VERWERTUNGSAGENTUR

- → Austrian Chamber of Commerce (WKÖ)
- → Economical Promotion Institute (Wifi)
- → Federation of Austrian Industry (IV)
- → Austrian Energy Consumer Association (ÖEKV)
- → OPET Austria (coordinator E.V.A.)

<u>Other energy efficiency activities:</u>

- → PREPARE / ECOPROFIT
- → ETA competition

Energy efficiency in Industry

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Industry and E.V.A.'s role as the Austrian Energy Agency

ENERGIE VERWERTUNGSAGENTUR

→ **Co-operation with involved actors and industrial partners to increase EE**

- ❑ national, European projects
- ❑ pilot actions
- ❑ seminars and conferences
- ❑ dissemination of information
- ❑ regional initiatives
- ❑ platform for discussions

Energy efficiency in Industry

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E.V.A.'s objectives in relation to Industry

→ Promotion of Win-Win Situation

→ Dissemination of cost-effective energy saving measures

- ❑ to reduce energy consumption and costs
- ❑ to strengthen competitiveness of Austrian Industry

Energy efficiency in Industry

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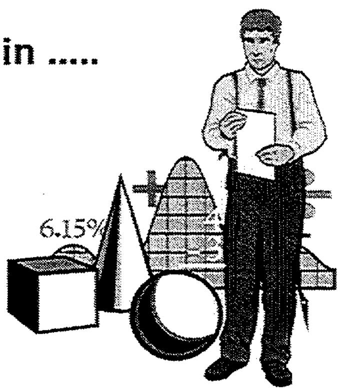
Advantages of Industrial Energy Efficiency

→ Direct: Cost savings!

→ Indirect: improvements in .....

quality
image
working conditions
relations with authorities
insurances



Energy efficiency in Industry

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E.V.A.'s industrial activities

ENERGIE VERWERTUNGSAGENTUR

- → Get top management's commitment
- → Produce data for argumentation
- → Promote energy management systems
- → Support (regional) networks for EE
- → Give recommendations to (policy) actors
- → Give advice on financing energy efficiency

Energy efficiency in Industry

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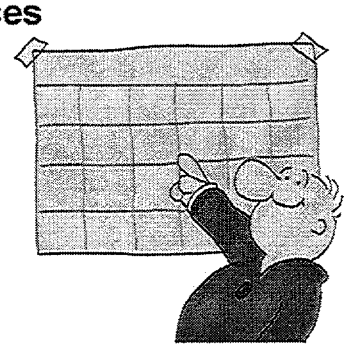
Get the top management's commitment

ENERGIE VERWERTUNGSAGENTUR

- → Articles in media
- → seminars and conferences
  - # e.g. European Conference on Industrial Energy Efficiency, 9/10 July '98, Vienna
    - ❑ successful companies
    - ❑ competitive advantages
    - ❑ different initiatives to stimulate energy efficiency in industry
    - ❑ forum for exchange of skills



Energy efficiency in Industry

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Data production for argumentation

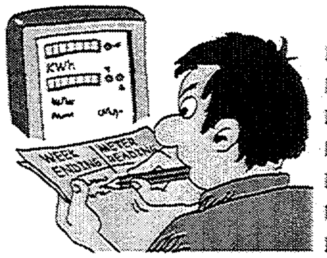
ENERGIE VERWERTUNGSAGENTUR

→ initiate / disseminate branch concepts

→ best practice examples (e.g. OPET)

→ pilot action for "Benchmarking"

- co-operation with ÖEKV, chamber of commerce, industrial sectors and WIFIs
- use existing structures



Energy efficiency in Industry

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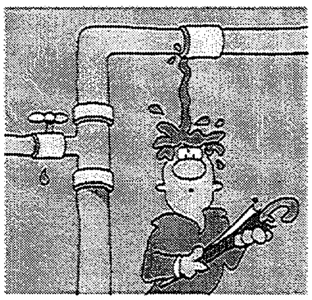
Promotion of energy management systems

ENERGIE VERWERTUNGSAGENTUR

→ use company-internal changes to start

- problems with energy systems
- breakdowns
- production enlargements

e.g. booklet for industrial energy management!



Energy efficiency in Industry

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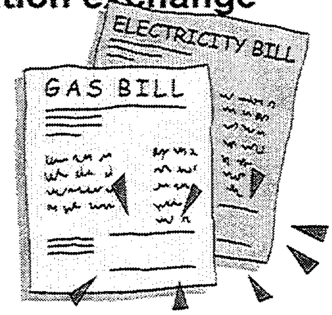
Supporting (regional) networks for energy efficiency

ENERGIE VERWERTUNGSAGENTUR

→ **ECOPROFIT: networks for information exchange with**

- business partners
- similar firms
- consultants
- authorities



Energy efficiency in Industry

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Recommendations to (policy) actors

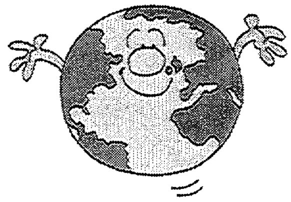
ENERGIE VERWERTUNGSAGENTUR

→ **Analysis of successful implementation of energy efficiency in industry (InterSEE, Joule)**

- 50 SME from 4 countries, 11 sectors
- case studies on successful companies and policies
- Recommendations to national and European policy makers

→ **"Economical subsidy fond" of Vienna**

- Recommendations on energy and climate related subsidies for enterprises



Energy efficiency in Industry

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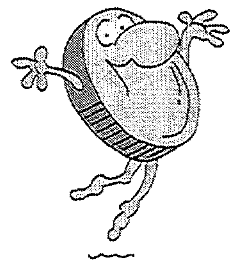
Give advice on financing energy efficiency

ENERGIE VERWERTUNGSAGENTUR

→ **Information on regional, national and European Programmes**
- on subsidies for industry, SMEs
- *information workshops and brochures*

→ **Financial instruments**
- Promotion of Third party financing (Contracting)



Energy efficiency in Industry

2.3 Shareholder Value versus Carbon Dioxide

Mr. Pascal Stijns, Power & Energy Marketing Europe, Honeywell Europe

EMISSION BASICS

There is no denying that energy production and consumption entail carbon dioxide (CO_2) emissions. As a matter of fact 66% of the energy content is transformed into some form of CO_2 emissions, which suggests a need for utilising the energy sources wisely to minimise the emissions while maximising the usable energy that ultimately provides energy services.

Cogeneration (CHP) in this context provides a good means for achieving this efficiency. It offers the same energy services with much less CO_2 emissions compared to coal, clean coal technologies, oil and gas combined cycle. Biomass CHPs can even be considered to have negative CO_2 emissions as it sequestrates CO_2 before being used as a energy source.

Globally, CO_2 emissions have increased since the 1980's, although it has been leveling off since the beginning of the 1990's. The EU, however, has had its emissions very constant for two decades. The distinctive sources of EU emissions come from power generation followed by industry and transport. The thermal efficiency in the EU has steadily increased since 1985 whereas globally, there has not been a constant trend with some years increasing and some years decreasing.

CHP IN THE EU

Denmark has over 50% of total energy production supplied by CHPs followed by Netherlands with over 40%. Finland and Austria also utilise CHP to produce over 30% and 20% of their total energy supply. Within the EU, nearly 10% of energy production comes from CHPs, leaving tremendous untapped CHP potential in the EU alone. However, with market deregulation and fierce competition, it is unknown to what extent this potential can be realised and tapped. Therefore, a positive, sustainable financial incentive and legal framework is necessary to boost this process.

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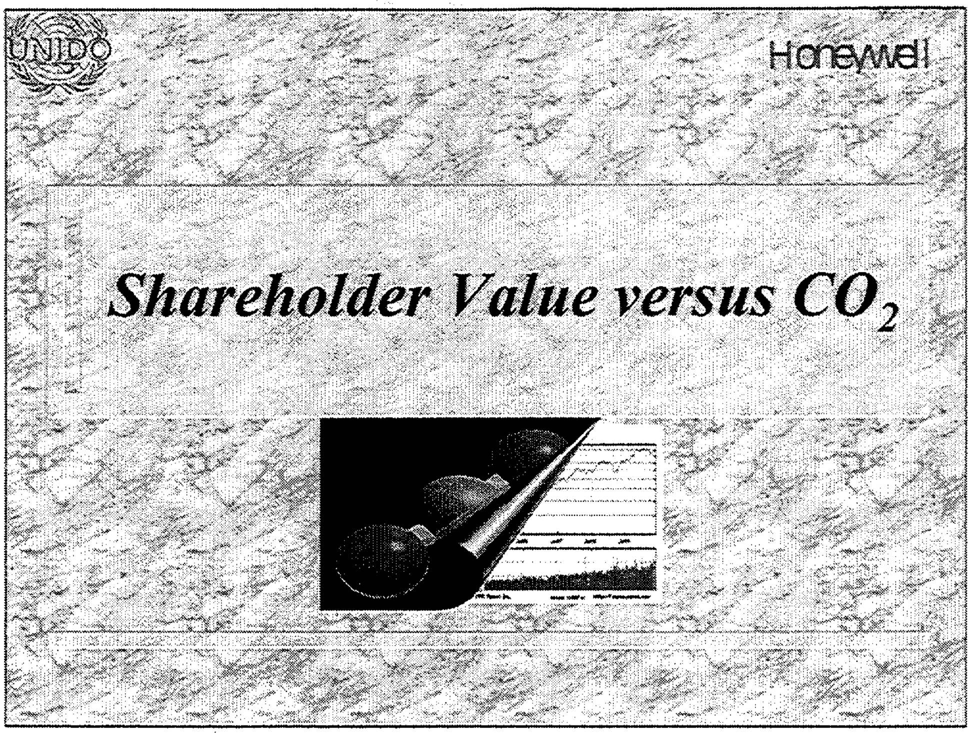

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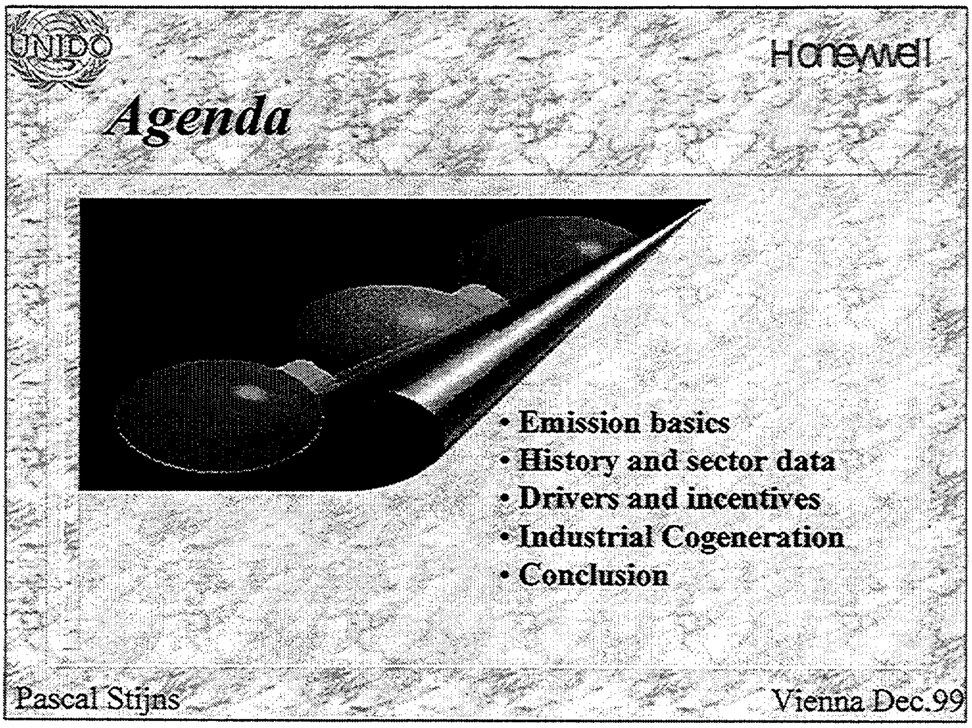

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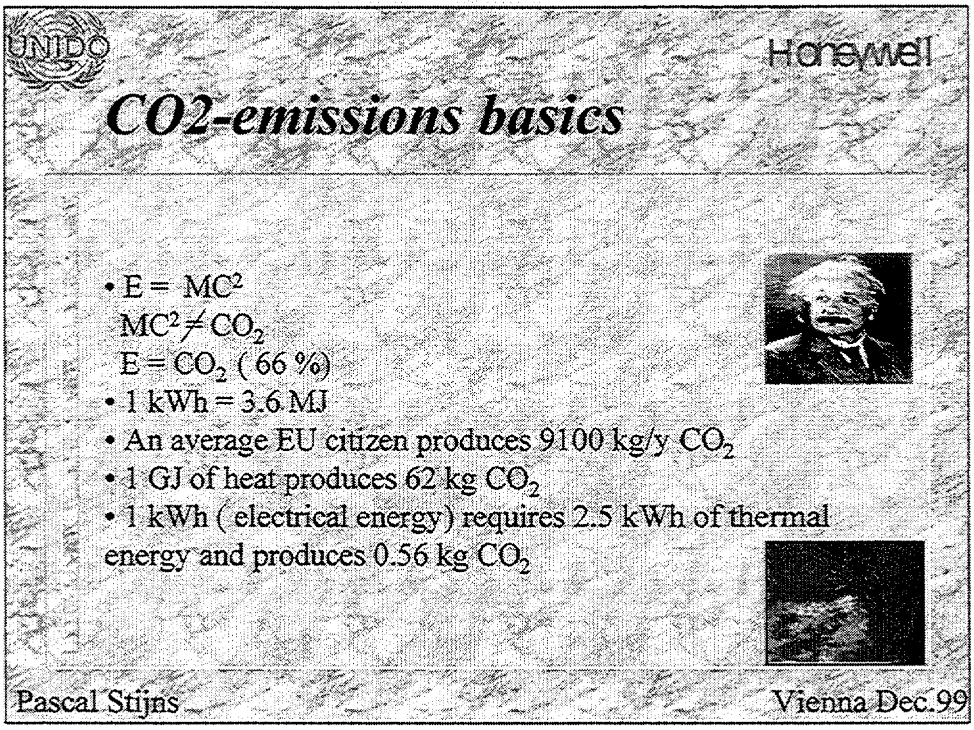

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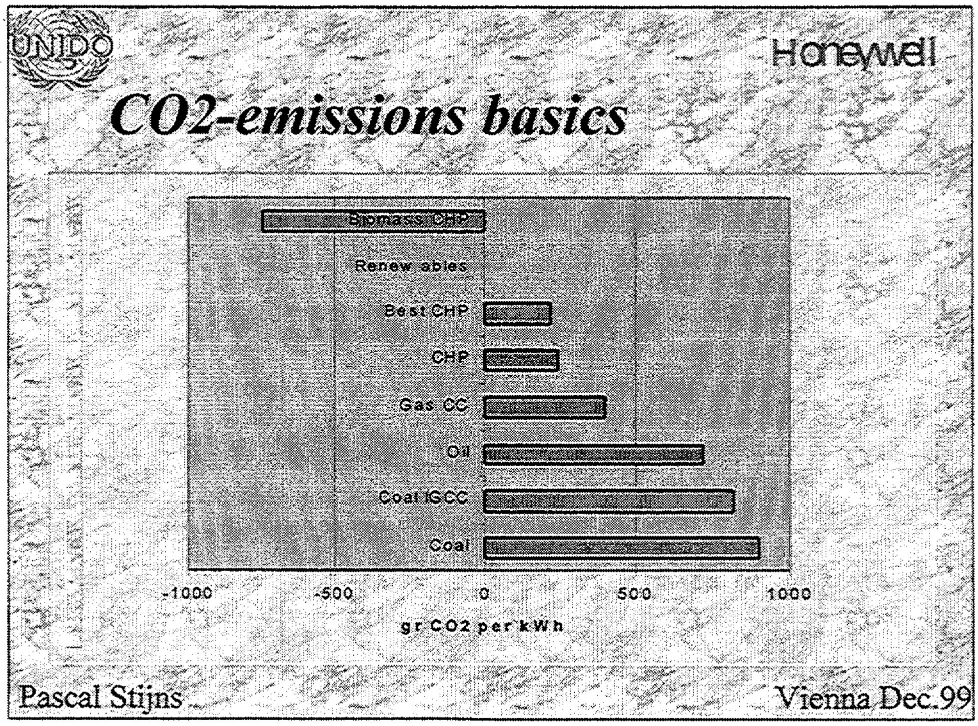

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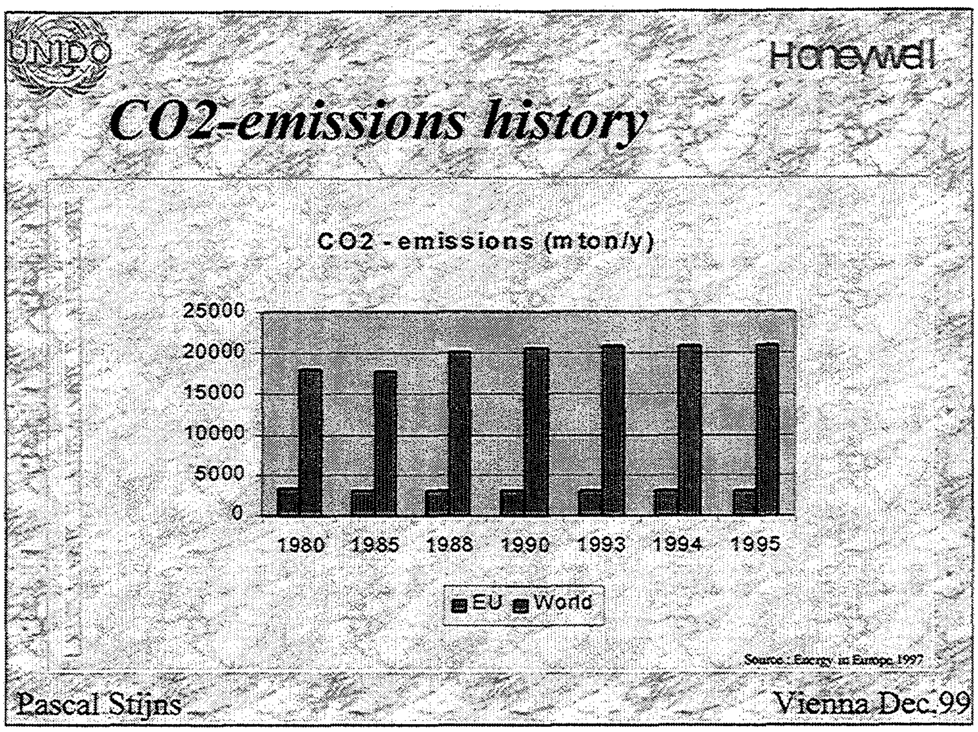

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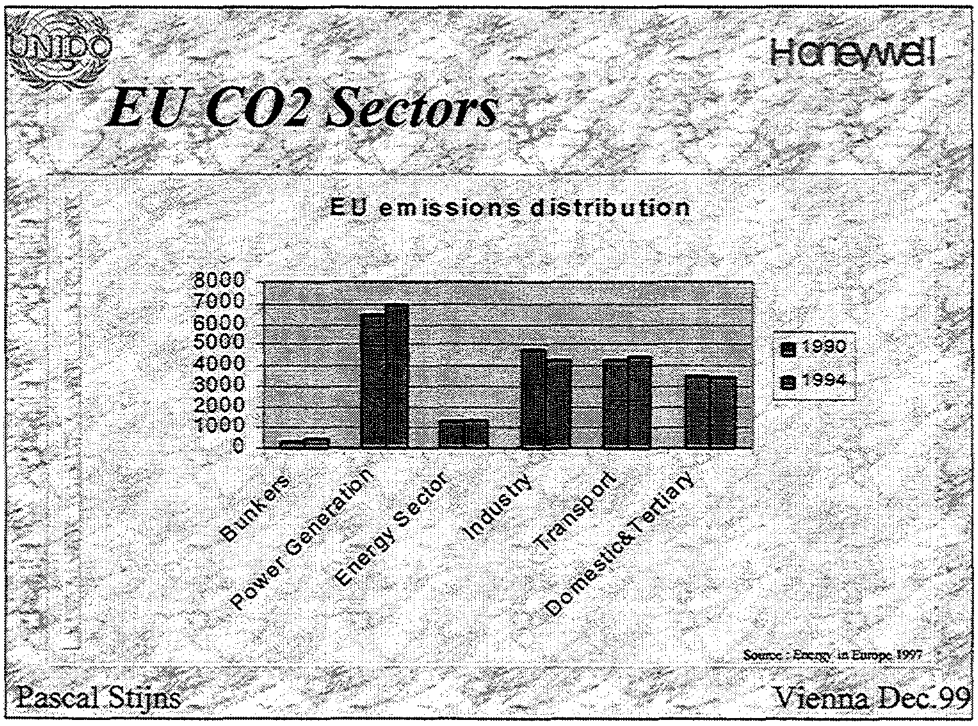

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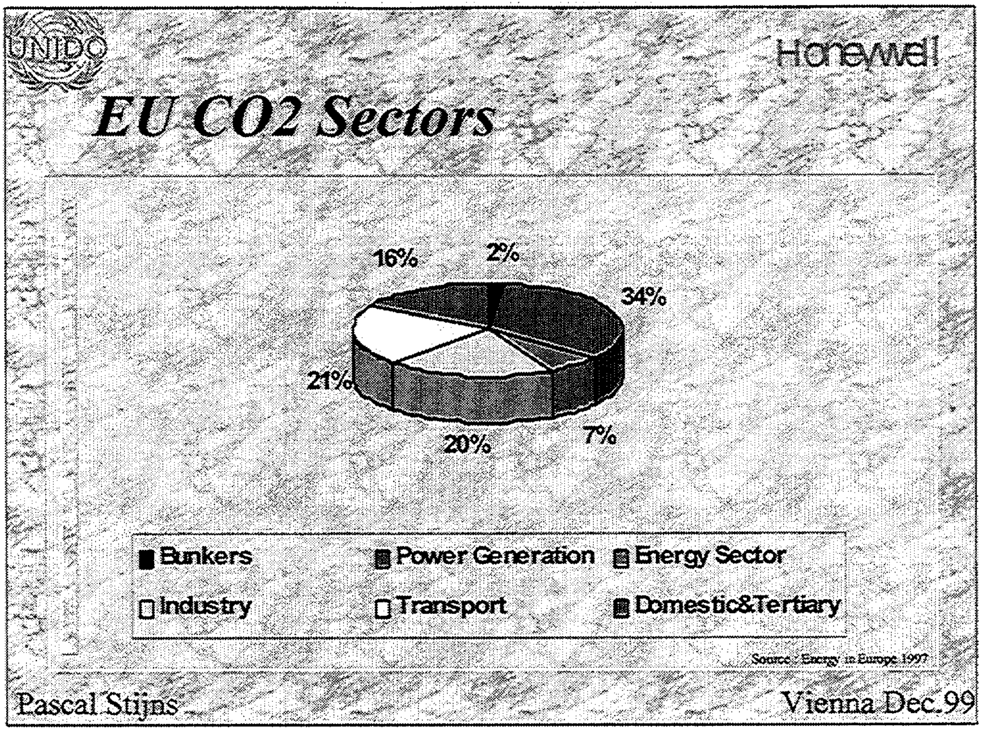

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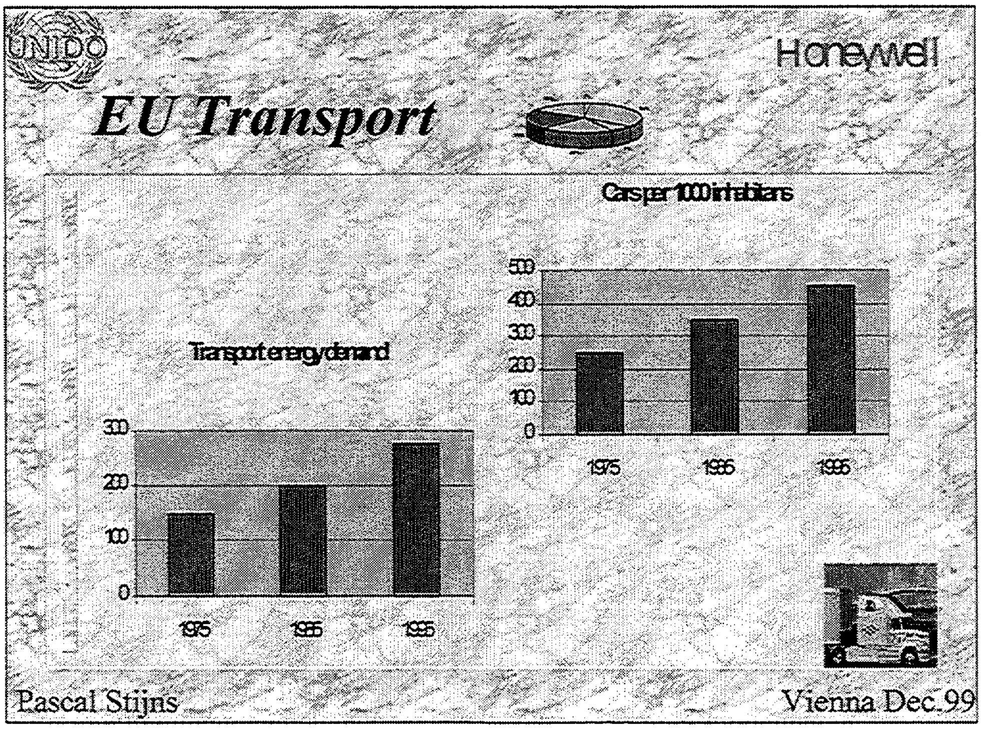

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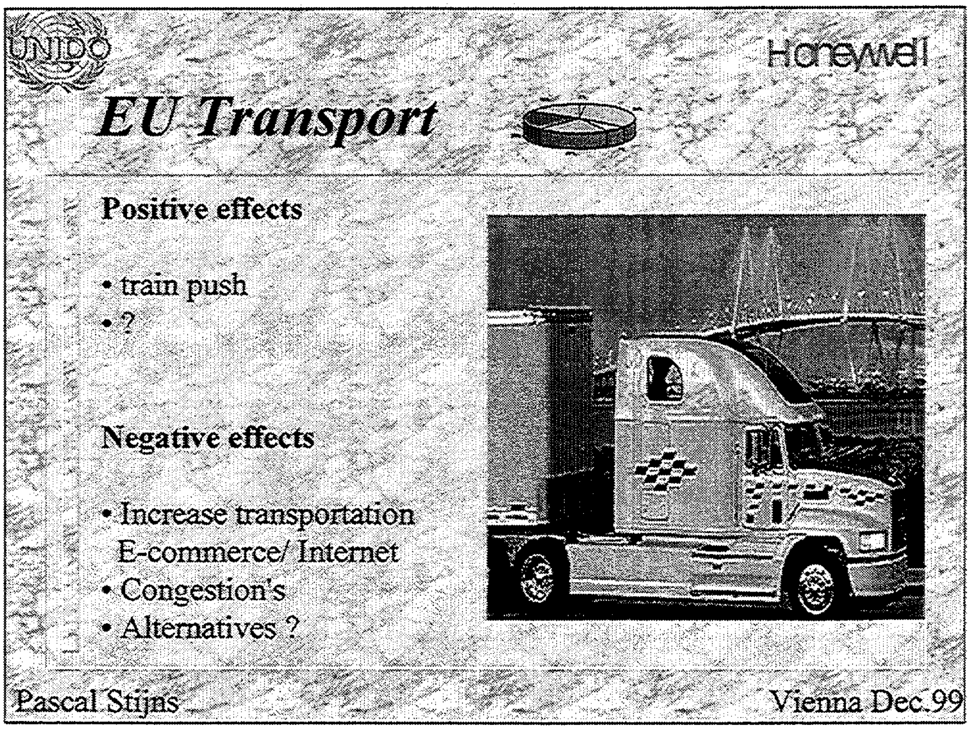

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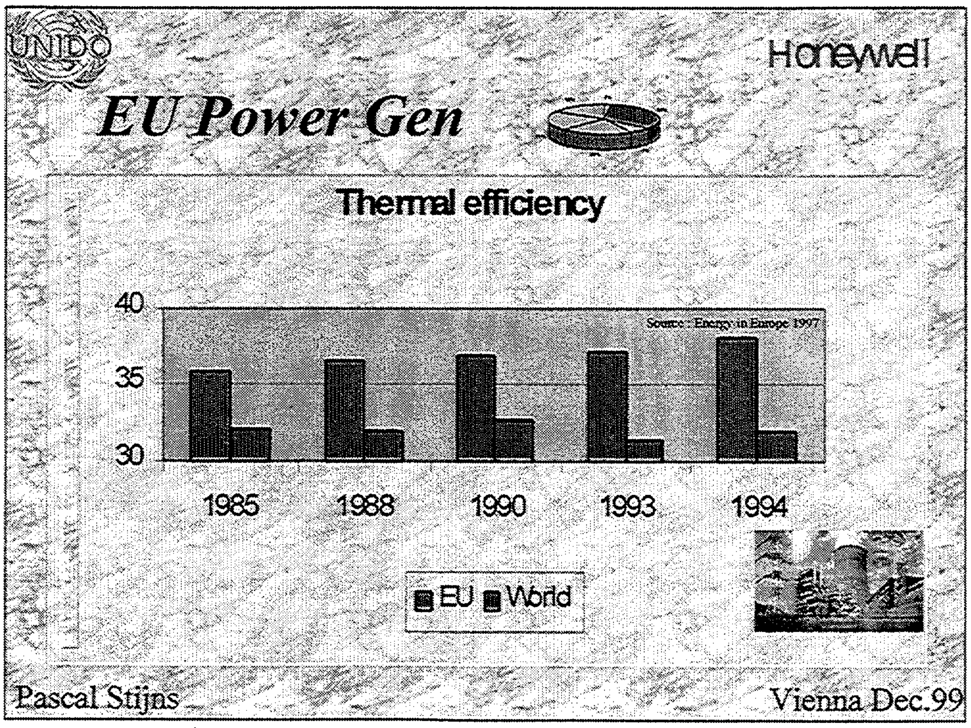

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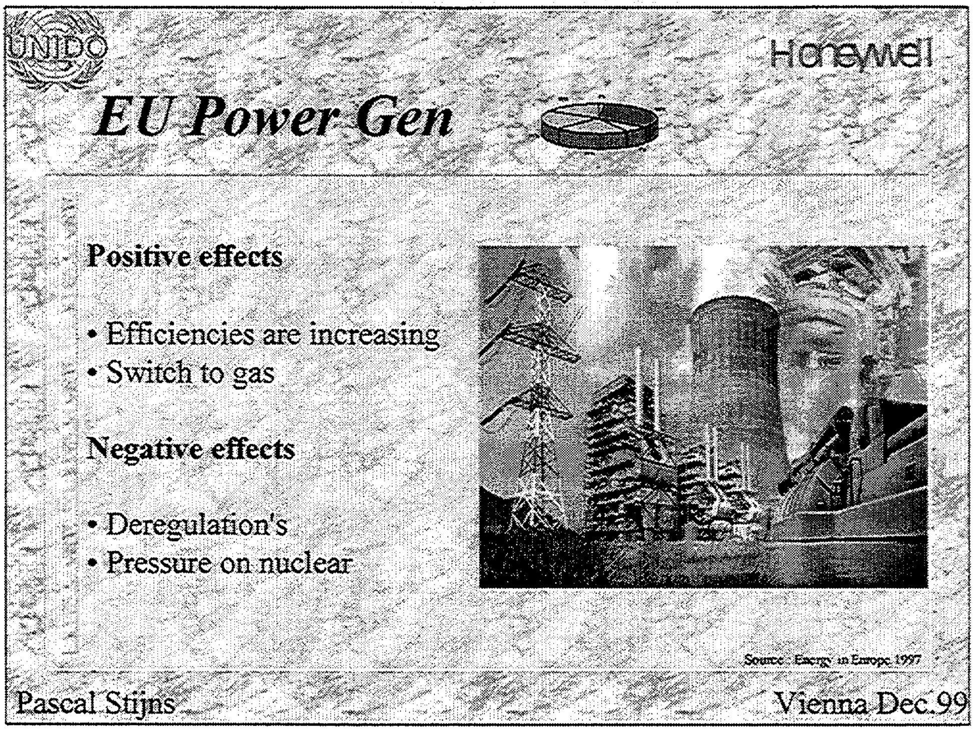

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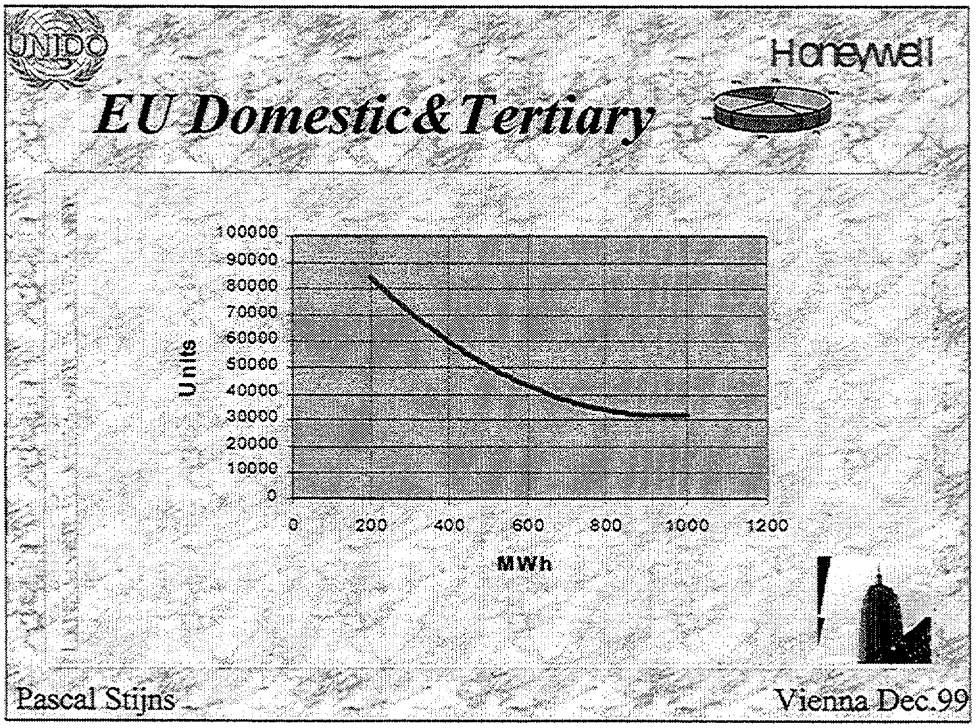

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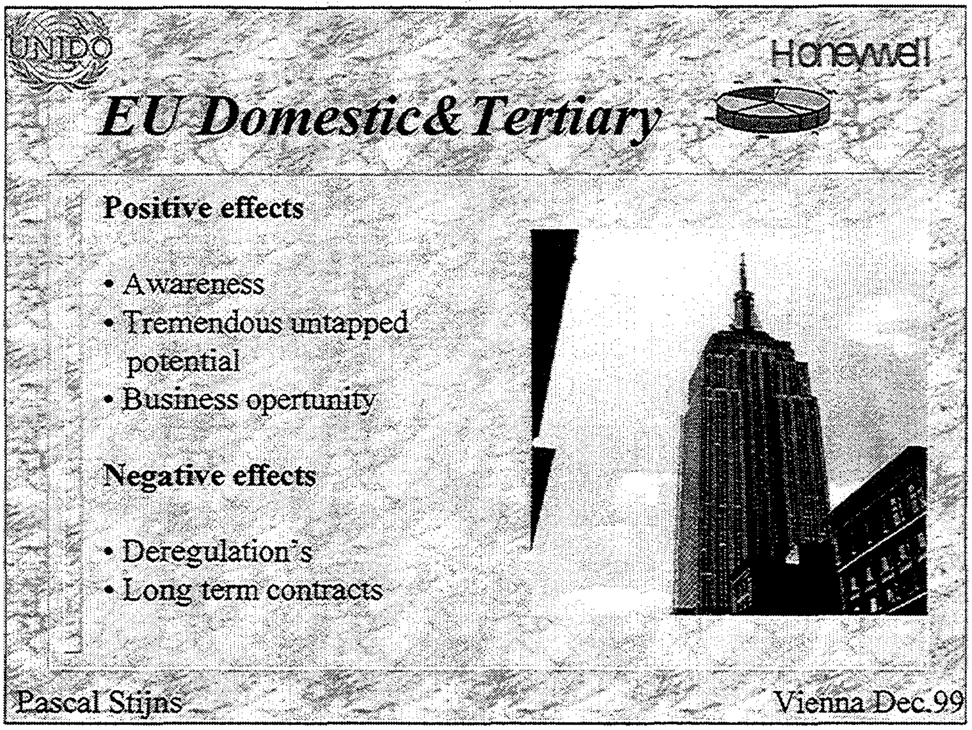

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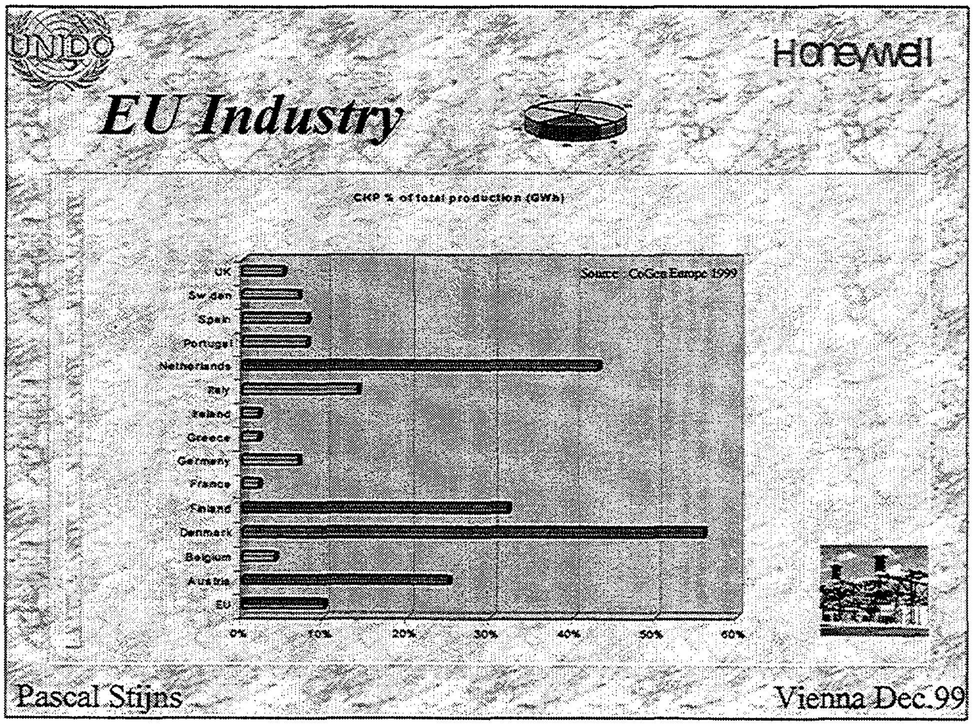

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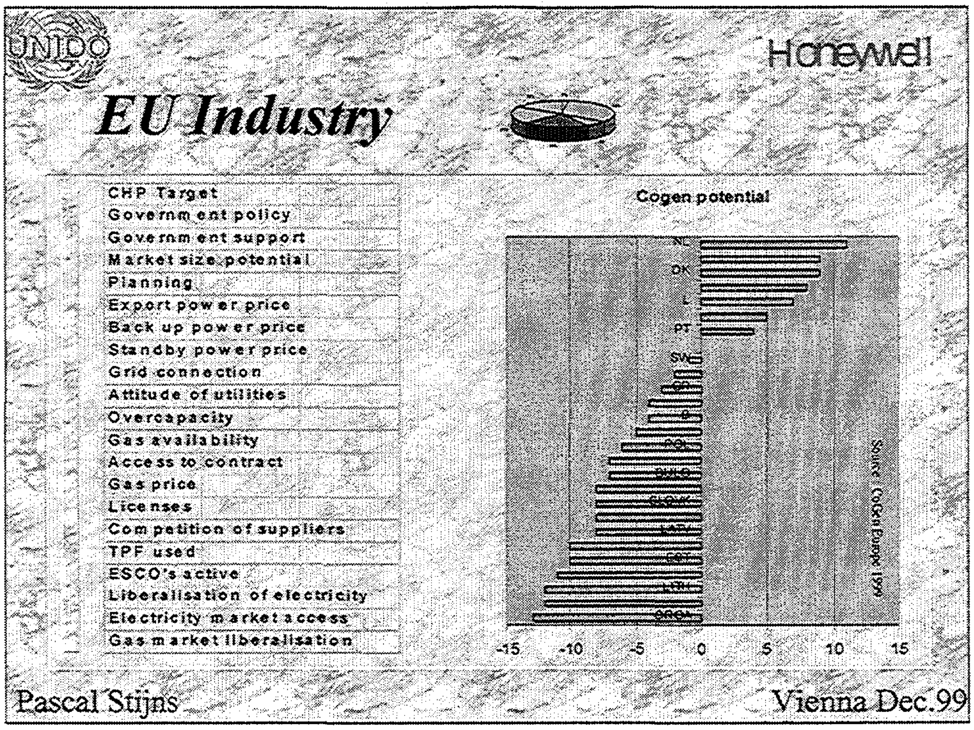

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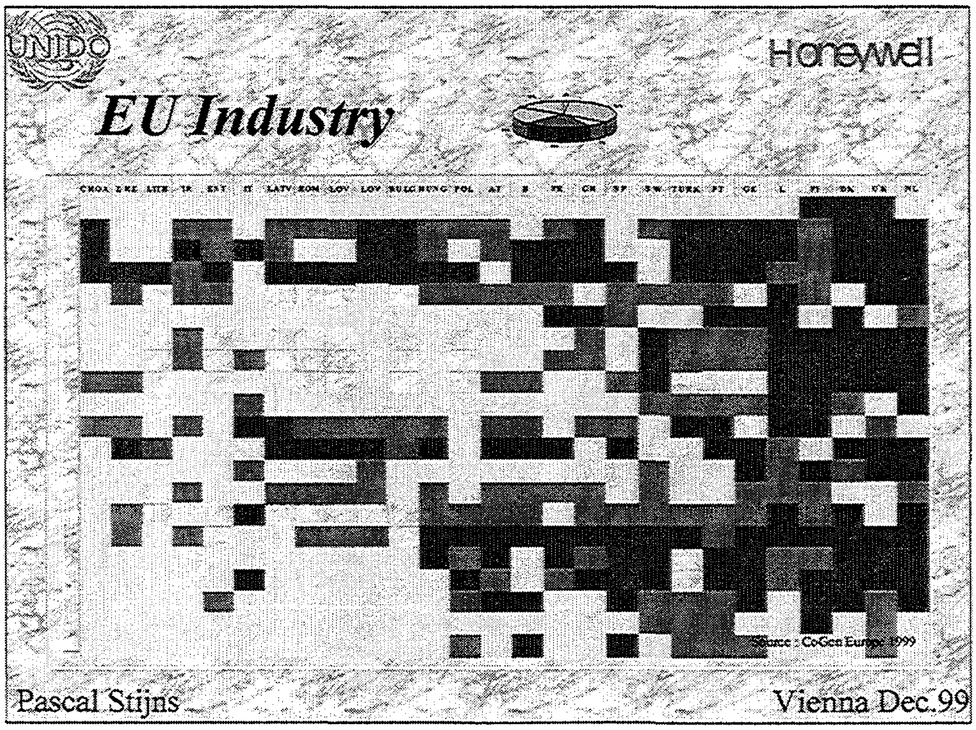

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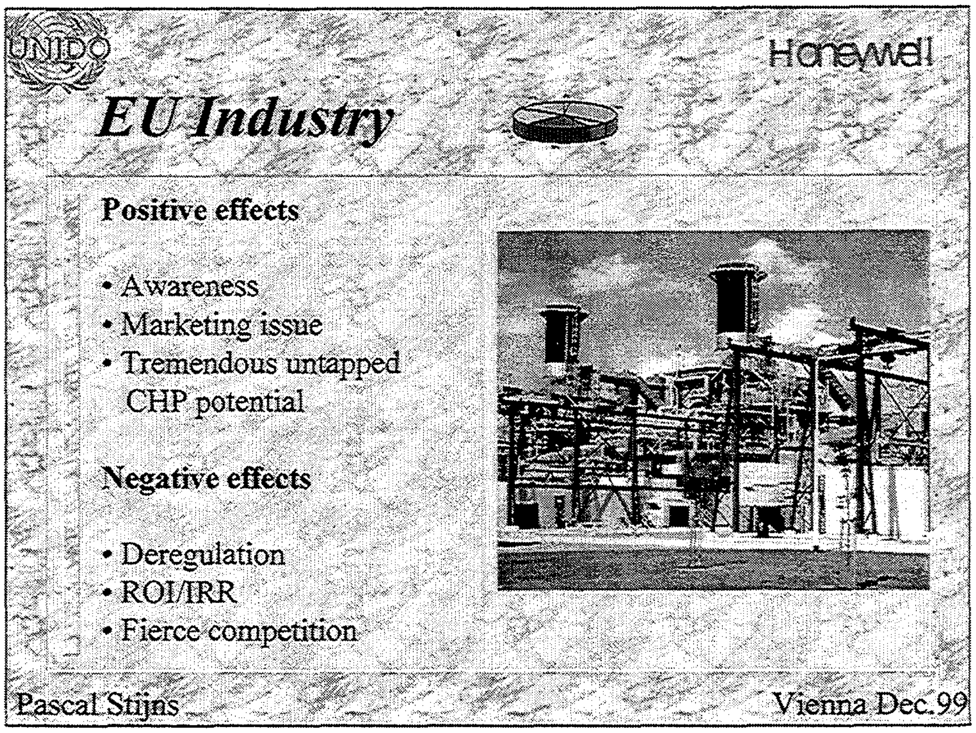

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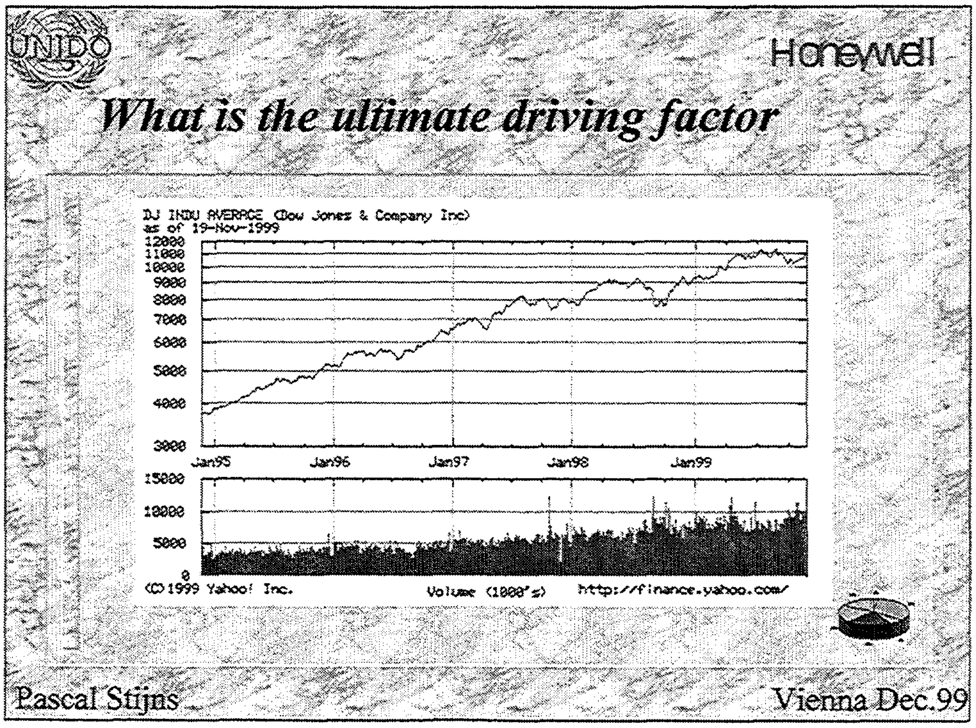

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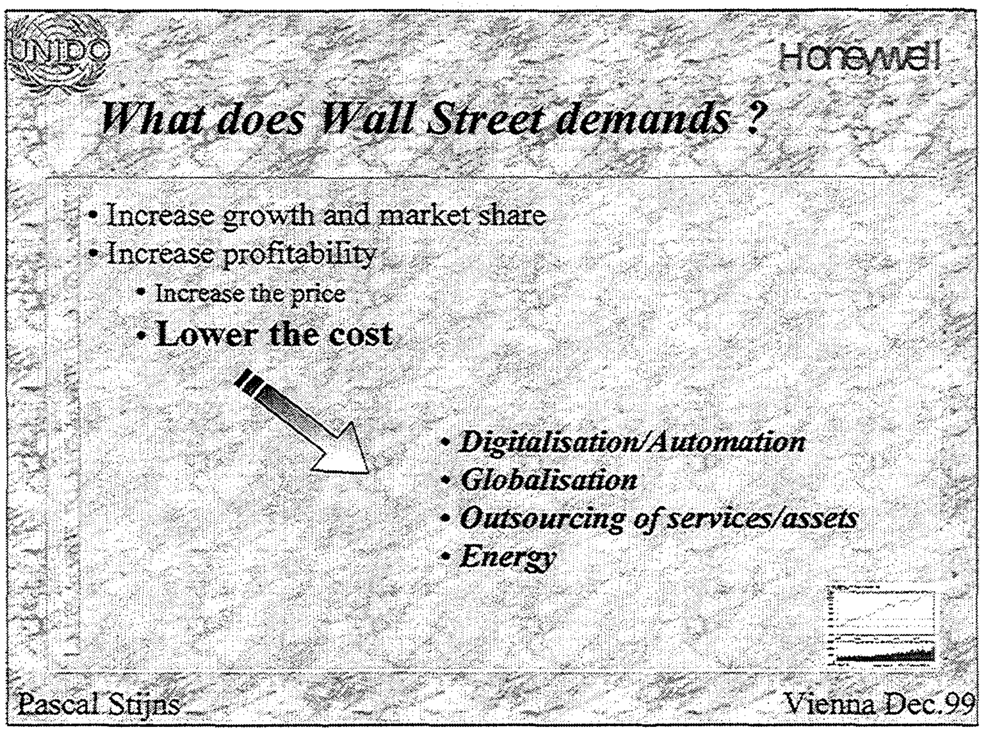

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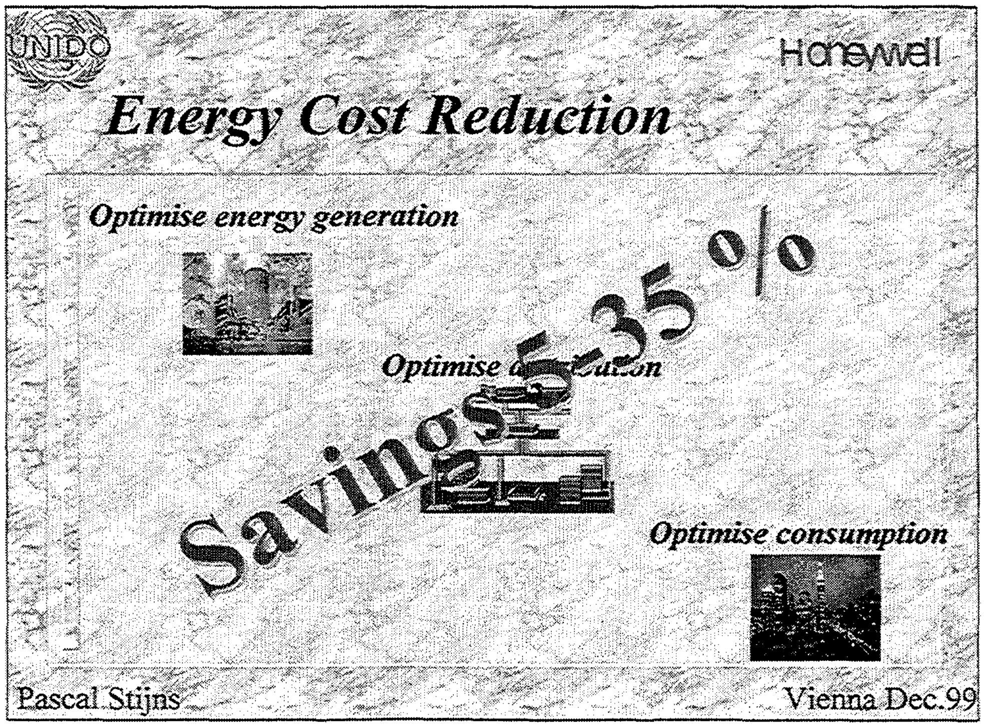

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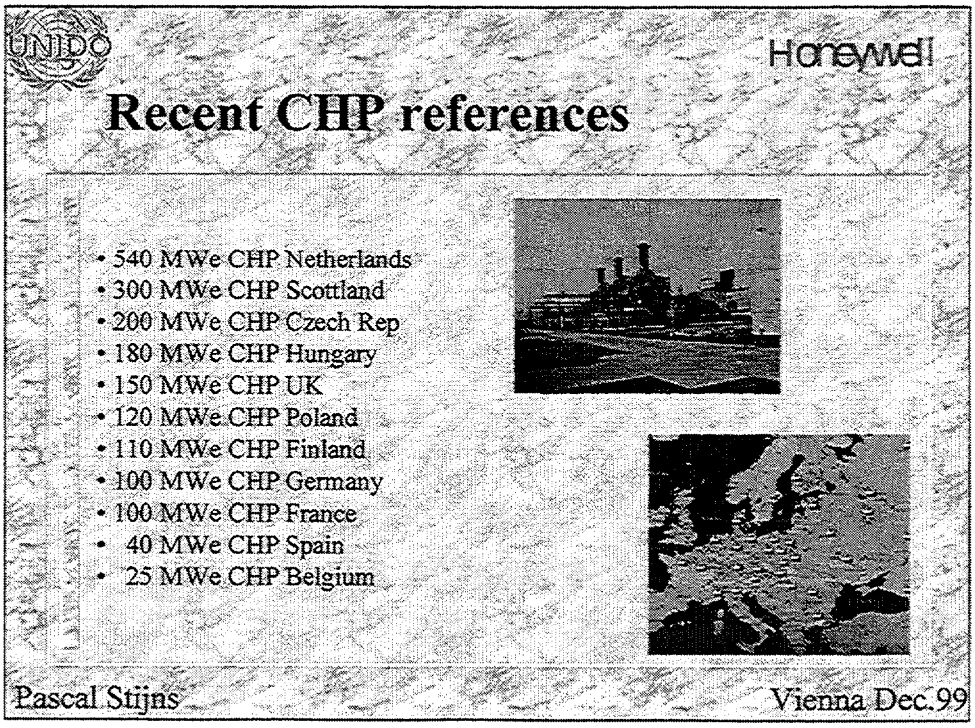

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UNIDO

Honeywell

Summary

- CO2 reduction is possible and can be implemented in short to medium terms everywhere
- Focus on co-generation (industry and buildings) to capture the potential and to leverage existing technologies
- A positive,substainable financial incentive and legal framework is necessary to boost the process

NO TIME TO WASTE

Pascal Stijns Vienna Dec.99

SESSION III. SECTORAL EXPERIENCES: ENERGY CONSERVATION & COGENERATION IN INDUSTRIAL & DISTRICT ENERGY SYSTEMS

1. Sugar Industry in Africa

1.1 Background to the Sugar Industry in Eastern Africa

Ms. Eunice Omanga, Chief Chemist, Kenya Sugar Authority, Kenya

INTRODUCTION

The purpose of this presentation is to introduce a major electricity co-generation initiative being developed by the Apex Bodies on Sugar in East Africa. If successfully implemented, this ambitious programme could have major gains for sustainable electricity generation in the region and could address some of the key social development problems facing Africa – namely urban primacy and the concentration of development infrastructure in urban areas. A major social imbalance in Africa is that of skewed access to electricity which favours the urban population. Sugar cane co-generation, if properly administered, offers an opportunity to address these problems. Needless to say, the gains for climate change are obvious – the use of bagasse in electricity generation provides a clean renewable and co2 neutral source of energy.

THE SUGAR INDUSTRY AND EAST AFRICA

Kenya

A total of 118,000 hectares of land is currently under sugarcane cultivation and these are located in the rain-fed sugar belt in the south western part of the country. In 1998, the total area harvested was close to 50,000 hectares. On the average, each hectare of land produces around 85 tonnes of cane. This implies that around 4.25 million tonnes (MT) of cane were processed, and with a recovery of 9.7% (tonne sugar/tonne cane), the sugar production in 1998 was 450,000 MT.

The sugar industry in Kenya currently supplies 60% of the total annual sugar demand of 750,000 MT. There are plans to further bridge the gap by opening new facilities such as the Busia Sugar Factory which could boost sugar production by 90,000 MT of sugar annually. Other planned developments are the Coveka Sugar Factory (2000 TCD) and the Soin Sugar Factory (1500 TCD). Discussions are also underway for establishing sugar factories in Transmara and the Siaya districts.

On the whole, the sugar industry is estimated to support approximately 2 million people, representing 6 to 8% of the total population. The industry currently provides close to 35,000 direct jobs and an estimated 70,000 indirect employment. Sugarcane production in Kenya is mainly (88%) carried out by around 100,000 small holders while the remaining 12% of total sugarcane is produced by the "nucleus" growers. The small holders, are also known as out-growers, are grouped into institutions of contracted sugar cane farmers who grow cane for supply to affiliated or particular sugar factories in their respective zones.

There are in all 7 sugar plants operating in Kenya and these are given in the Table 1 below.

[Table 1] Sugar Mills in Kenya

Sugar Mill	Capacity (Tonne Cane per Hour)
Mumias Sugar company Ltd	330
Chemelil Sugar Company Ltd	125
Nzoia Sugar Company Ltd	125
South Nyanza Sugar Company Ltd	125
Miwani Sugar Company Ltd	100
Muhoroni Sugar Company Ltd	90
West Kenya Sugar Company Ltd	40

Although the sugar mills are located close to major urban and rural electricity markets in the south west part of the country, there has been only limited effort in trying to develop co-generation of electricity for exports to the national grid.

Tanzania Sugar Industry Overview

Tanzania's agricultural sector produces 55 percent of GDP. Sugarcane, wheat and rice are grown mainly on a relatively small number of plantations. Sugar revenue as a percent of GPD is only 0.13% and as a percent of total agricultural production it is only 0.3%. The sugar industry in Tanzania provides around 25,000 jobs. Almost 50% of these are employed as field and estate workers and for operating the 5 sugar factories in the country. The remaining are self employed cane farmers and those employed by the cane farmers.

The total area under cane cultivation, which is annually harvested is around 20,000 hectares. In 1998/99, the total cane crushed amounted to 1.56 million tonnes ad this gave a total sugar production of 114,000 tonnes. This corresponds to 38% of the total annual national sugar demand of 300,000 tonnes. The current sugar production potential of the sugar industry in Tanzania is estimated to be close to 230,000 tonnes of sugar (SUDECO, 1998) and it is planned to increase this to 273,000 tonnes by 2004 and to 440,000 tonnes by 2009. A total investment of USD 203 million is planned for the next five years at least.

The cane processing capacities of the 5 sugar factories in Tanzania are given in Table 2 below.

[Table 2] Sugar Mills in Tanzania

Sugar Mill	Capacity (TCH)
TPC	110
Mtibwa Sugar Estate	100
Ruembe (K2)	100
Msolwa (K1)	80
Kagera	60

New investments in the sugar industry are planned for Ruipa in the Kilombo valley (100,000) Makurunga in the Mtwera region and in Ikongo in the region of Mara.

Uganda Sugar Industry Overview

In the early seventies, Uganda was self sufficient in sugar. In 1987, the sugarcane production was estimated to be around 600,000 MT (Williams, 1993). The three main sugar mills, namely the Lugazi Sugar Corporation, the Kakira Sugar Company and the Kinyara Sugar Company currently produce around 130,000 tonnes of sugar every year. Annual domestic demand is around 180,000 tonnes. The importation bill of sugar negatively offsets trade balances to the tune of USD 410 per tonne sugar imported. There are no specific sugar industry expansion plans under way, but the Government of Uganda wishes to expand local sugar production to 300,000 tonnes per year over the next 10 years. Privatisation of the sugar mills is being carried out within a privatization program whereby the private companies have to commit themselves to expand sugar production.

The sugar industry contributes only 4% of GDP and provides around 20,000 direct jobs out of which it is estimated that 8000 are permanent and 12,000 are casual jobs.

Sugar mills in Uganda already use bagasse for their own energy needs. Preliminary estimates (AFFREI, 1999) suggest that the sugar mills could expand their current total 7 MW of generation capacity to around 37 MW and hence sell excess power to the grid. Two of the three large sugar mills in Uganda (Kakira and Lugazi has plants to supply between 4.5 and 6.0 MW.

SOCIAL SIGNIFICANCE IF THE SUGAR INDUSTRY IN EAST AFRICA

By far the most significant importance of the sugar industry in all the three countries derives from the location of the sugar operations and their ability to touch the lives of that segment of the rural community involved in sugar cane production. In East Africa as in most African countries urban primacy ensures that all economic activities take place around the capital city or other major urban centres. This condition almost guarantees poverty in a non-market economy for the rest of the population of outside these centres. In all three countries, there is a substantial population of outgrowers, transporters and labour employed in sugar operations.

In Kenya, we have been able to assess a total of 100 000 outgrowers. We have not been able to determine the figure for Tanzania and Uganda.

Contribution to key social economic indicators is significant. In terms of GDP, contribution in Kenya is 4.7%. In Tanzania it is 0.13% and in Uganda it is 4%.

Employment figures reach 35000 direct jobs, 25000 direct jobs, and 20000 direct jobs in Kenya, Tanzania and Uganda respectively. Indirect employment increases this contribution significantly due to the presence in some of the countries, Kenya and Uganda of an informal sector sugar vending market. Estimates for Kenya show that the industry supports over 2000 000 people.

In Kenya, the sugar industry provides 60% of the total national sugar consumption which stands at 750000 tonnes a year. This is a major export bill saving and still further savings can be realised with expansions in this sector. There are plans at present to bridge this 40 supply shortfall. Initial plans are to expand the Busia Sugar Factory by 90000 tonnes a year, develop a new plant at Coveka with a capacity of 2000 TCD among other initiatives.

As indicated earlier, the sugar industry has a unique capacity to open up undeveloped hinterlands and to significantly involve poor rural populations in their operations. This has been more than amply demonstrated in Kenya, for example where 88% of the sugar cane crushed is supplied by out-growers.

OPPORTUNITIES FOR EXPANDED COGENERATION AND ASSESSED POTENTIAL

The sugar industry in the region is in transition. There are management changes where technical management contracts are awarded to enhance management efficiency; there are ownership changes where private ownership is expanding and there are technological changes where most plants are under major upgrading or refurbishment programmes.

A recent study just completed by Southern Centre for the Common Fund for Commodities and for the Apex Bodies and Sugar in East Africa (Uganda, Kenya and Tanzania) shows that both the technological transition and management and ownership transitions present a good opportunity for intervention in favour of expanded co-generation. This coupled with major changes in power sector policies which now allow for Independent Power Producers to operate in the generation, transmission and distribution of electricity, improves significantly chances of successful investment under this initiative.

The study has assessed that presently, a total of 49 MW of co-generation capacity is installed in the whole region with 30.7 MW in Kenya (based on 4 out of 7 plants), 9.5 MW in Tanzania (based on 2 out of 5 plants) and 8.8 MW in Uganda (based on all three plants). It further shows an expansion potential of 114 MW in total for the region distributed as follows: 58MW in Kenya 39 MW in Tanzania and 17 MW in Uganda.

These expansions can be achieved without expanded cropping area or crop productivity and are based on currently employed technologies.

The Apex Bodies on Sugar in East Africa are working aggressively to build additional co-generation capacity to take advantage of the power sector reforms and to contribute to the region's hard pressed power supply base. The next phase of activities following these just completed assessment is to determine regional and global investment partnerships to allow us to play a role in mitigating climate change and in supporting sustainable development by providing a renewable source of electricity generation fuel.

1.2 Electricity Cogeneration: Possible Contribution from the Sugar Industry in Africa

Mr. Norbert Nziramasamga, Technical Director, Southern Centre for Energy and Environment, Zimbabwe

FOCUSES ON ELECTRICITY CO-GENERATION.

- Co-generation must have a clear purpose and must solve some of the development problems faced by a country. This enhances its chances beyond the legitimate but narrow focus of a private investor.
- Co-generation must take place within a specified environment. In this case the present environment in most African countries is dominated by state electricity supply utilities although in some countries there are legislative changes toward privatization.
- There is also strong pressure to privatize with private electricity investors seeking a role in the power sector.
- There is still some resistance in some countries to such IPP participation; narrowly focussed co-generation will be harder to sell where state utilities predominate
- Showing a wider social effect will improve acceptance and state support.
- Co-generation in the Zimbabwe case is most attractive in commercial forestry, sugar cane factories, agro-processing industries with significant volumes of waste. This assumption could easily hold true for most African countries.

In terms of broader economic and social effects the sugarcane sector is perhaps most attractive because of the following benefits:

- A sugar plant ordinarily co-generates steam as a normal aspect of its operations
- It may also co-generate electricity for own use either as total supply or supplementing with grid supply
- It can expand electricity generation to supply excess to the grid

BENEFITS (ENVIRONMENTAL)

- Steam co-generation obviates the use of coal or other co2 raising fuels to generate process steam.
- Electricity co-generation for own use also obviates the use of grid electricity, which may be generated from coal leading to CO_2 emissions.
- Expanded co-generation for grid sales increases the environmental benefits significantly.
- Disposal of bagasse is a major environmental problem as bagasse ignites causing local and atmospheric pollution as well as water logging or where disposal is by under-ploughing in the fields, de-nitrification of the soil results leading to high costs of replenishment.

BENEFITS (SOCIAL)

- In most countries sugar cane plantations support what are termed satellite growers or out-growers. The factory provided technical agronomic support and a stable market for out-growers' cane. One factory can support up to 20,000 out-growers depending on capacity. This is a major social benefit and an easily calculable sustainable development gain.

- Expanded co-generation will lead to expanded out-grower participation and will yield additional income to the out-growers in the form of bagasse compensation. This will be made possible by bagasse assuming an intrinsic value as an electricity cogeneration feedstock.
- Sugar cane plantations are usually located in remote hinterlands, which are poorly developed and poorly serviced by electricity. With the correct social policies, sugar cane co-generated electricity can be a useful contribution to rural electrification with highly reduced grid extension costs.
- The social interchange between sugar factory co-generation and local communities is quite high. This presents a strong social drive for supporting co-generation.

TECHNICAL READINESS FOR EXPANDED CO-GENERATION

The technical readiness for the sugarcane co-generation is not in question. Traditional technologies are widely in use and major improvements with capacity to double electricity output from same quantities of feedstock are on the market.

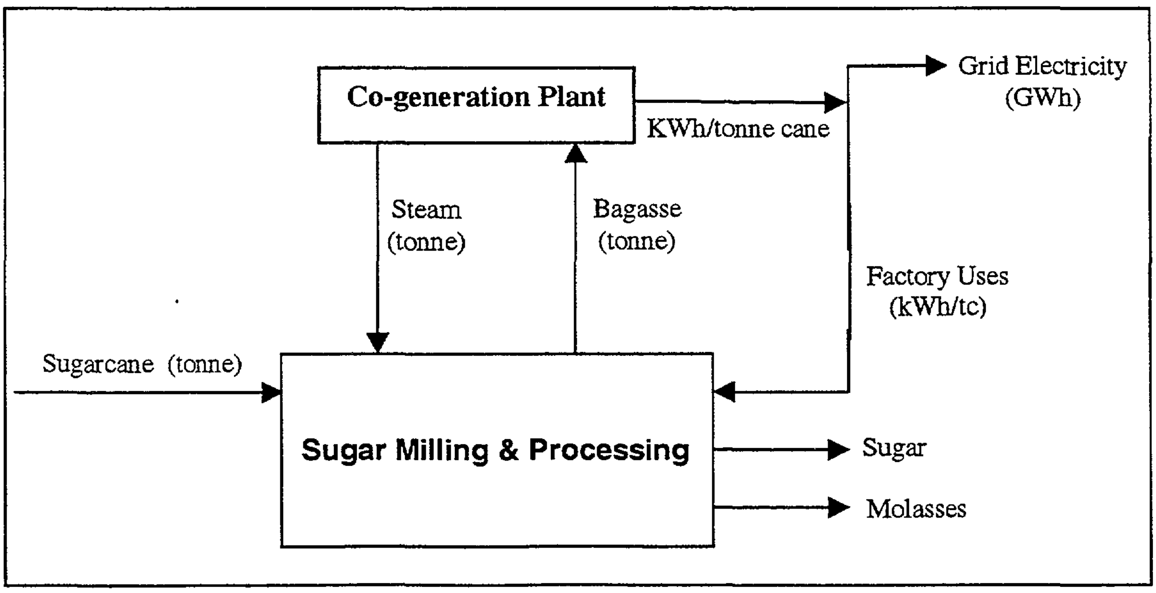
The actual bagasse output potential for every plant varies with how the plant is operated. But the basic approach to assessing potential is given in the next section.

BASIC ASSESSMENT METHOD FOR BAGASSE CO-GENERATION POTENTIAL

The key to the production of surplus electricity in a sugar factory is to optimise factory steam generation and utilisation so as to be able to save bagasse (as compared to inefficient combustion for bagasse disposal). Excess bagasse B_{ex} (tonnes) is a direct measure of the electricity production potential of a sugar processing facility.

For given steam conditions, it is possible to derive a performance equation for surplus power production. The generic model is shown in the Figure below.

[Figure 1] Generic Model for Surplus Electricity Production in a Sugar Factory



NECESSARY CONDITIONS TO SUPPORT CO-GENERATION

Electricity co-generation for own consumption is an internal decision of a firm. However, co-generation for sale to a third party or to the national electricity grid which in most cases now is owned by the state is a very complex issue. Once a factory decides to cogenerate for same, it becomes an independent power producer whose operations must be governed by appropriate legislation - usually the electricity act, in most African countries. This traditionally gives monopoly to state utilities to generate, transmit and distribute electricity and the minister responsible the power to set electricity tariffs. To allow for export co-generation, this act must be changed so that IPPs can operate and that commercial electricity tariffs can be charged between suppliers, electricity traders and consumers. In general export co-generation is governed by a number of factors which include:

- presence of electricity supply gap, which could be in the form of supply shortfall;
- unreliable supply regime;
- low levels of electricity access say by rural communities not connected to grid;
- relative cost of supply advantage;
- relative social gains advantage; and
- investment capacity among industries with co-generation potential.

TRENDS TOWARD ENABLING LEGISLATION

Most countries are taking steps to liberalise the power sector. These steps and resulting legislation generally include the following:

- Unbundling state utilities to include independent companies for generation, transmission and distribution.
- Creation of new legislation and regulatory boards
- Provision in the act for commercially negotiated power purchase agreements Direct sales to end-users (in some cases)
- Enablement for government to provide distribution infrastructure support where an IPP supplies certain rural areas - This is an important provision since the cost of distribution infrastructure inhibits IPP direct sales.

ELECTRICITY GAP AND RELATIVE COST OF SUPPLY ADVANTAGE

- There are major supply gaps in most African countries.
- Load shedding is common-place
- The quality of electricity supplied is poor with serious voltage fluctuations
- Local area network potential is high as most rural areas are not supplied and this presents a major opportunity for sugar cane suppliers who are usually located in remote areas
- Sugar cane crushing is mostly during the dry season - this is when most hydro based suppliers have fuel problems

The electricity supply gap is therefore, clearly defined.

RECOMMENDATIONS

- An assessment be made of climate change gains from sugar cane co-generation in order to remove the myth that this is a zero emissions sector
- An overview of regional co-generation in Africa's sugar growing areas be conducted to assess the potential
- This should be coupled with an assessment of state of the art technology that would enhance unit electricity output from bagasse.

2. Using Energy Management, CHP and ISO 14001 to make Substantial Reductions in Global Warming Potential

Mr. Ryszard Hellebrand, Effluent & Utilities Manager, A H Marks & Company Ltd., England

INTRODUCTION

This presentation covers the history of the company, the products we make and how we work to minimise the impact of our business on the environment.

A H Marks is a single site chemical manufacturing company established near Bradford in 1877 and owned by the Marks family since 1907. Today, the company has 17 batch manufacturing plants and over 470 employees. Annual product sales exceed £50 million. Three-quarters of these sales are agrochemicals and a quarter fine chemicals, with products exported to more than 200 countries.

COMPANY'S ENVIRONMENTAL STRATEGY & CHP

Last year, the company was accredited to the new ISO 14001 and EMAS environmental management standards in addition to its ISO 9001 and Investors in People accreditations.

There are a number of reasons why our EMAS environmental strategy has been so successful and why continuous improvement should remain possible for the future.

Firstly, A H Marks has been family owned since 1907. Our Chairman and Managing Director, Rhys Marks, aims to pass on a successful and sustainable company to his children.

We spend over a million pounds each year - 2% of turnover - on studies to monitor the potential ecological effects of our agrochemicals and confirm their safety. We send out an annual Environmental Report to over 5000 staff and neighbours. This sets out clear targets based on continuous improvement.

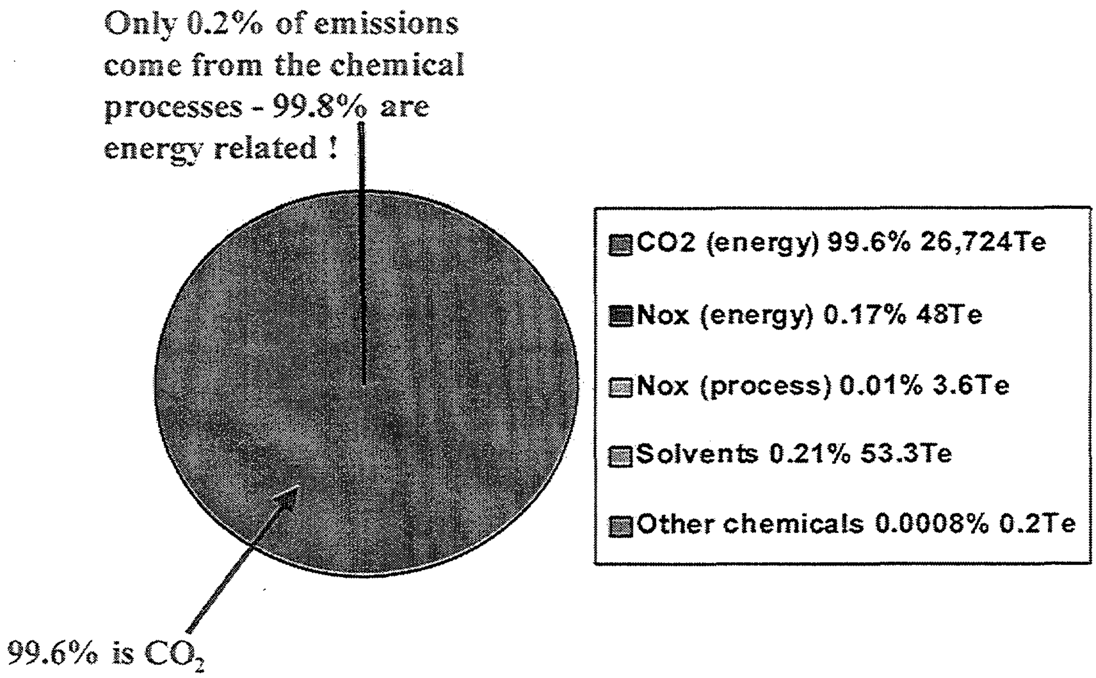
A Steering Committee comprising directors and managers drives the company's environmental strategy. It meets every quarter to review performance against targets and to plan further ahead. Energy, waste, traffic and any releases to air, land or water can have significant environmental effects, so they're tightly managed.

Wherever possible, we try to work closely with our neighbours to improve the local community.

In 1995, we formed a partnership with Yorkshire Electricity to build a combined heat and power plant. This plant generates electricity which is exported to the National Grid and which we use on site. It also generates steam from the waste heat. More importantly, the plant saves us a lot of money and also reduces greenhouse gas emissions by up to 30,000 tonnes each year.

Combined heat and power can generate energy very efficiently, but it's just as important to use it efficiently too. A H Marks has a proactive energy management policy and, over the last five years, we've reduced total consumption by the order of 56%. This is despite an expansion in production facilities over the same period.

Because of the widespread commitment amongst A H Marks' employees to environmental improvements, we have been successful in minimising many of our chemical emissions.



The pie chart above shows two slices. The big green slice is the carbon dioxide emitted to the atmosphere last year related just to energy use. The very, very thin slice is the part that relatesdirectly to the chemical processes themselves.

In fact, 99½% of all emissions are now energy related and nothing to do with emissions from the processes at all.

Conclusion: The Role of ISO 14001 & EMAS

Up to now, because energy production and use were not policed by enforcement agencies, many organisations ignored their environmental effects. ISO 14001 uses an initial review of company activities which have, or could have significant environmental impacts. This review highlights the need for energy reductions, which quickly becomes a key management activity.

Slide 1

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Using energy management, CHP and ISO 14001 to make substantial reductions in global warming potential

Presentation for UNIDO EGM on 2/3 December 1999

Ryszard Hellebrand, Effluent & Utilities Manager,
A H Marks & Company Limited, Wyke, Bradford, BD12 9EJ, England.

email rhellebrand@ahmarks.com

Slide 2

A H MARKS

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A H Marks company profile

- A single site, private company established near Bradford in 1877 and owned by the Marks family since 1907.
- 20 batch chemical plants and 405 employees make 80,000 tonnes p.a. of agricultural and fine chemicals
- Annual sales of £50M (DM150M) are exported to more than 40 countries.
- In 1997, A H Marks was registered to ISO14001 and EMAS. We were already certified to ISO 9001 and Investors In People.

More about A H Marks and its environmental performance is available in our annual Environmental Report, and on the Web at www.ahmarks.com

Slide 3

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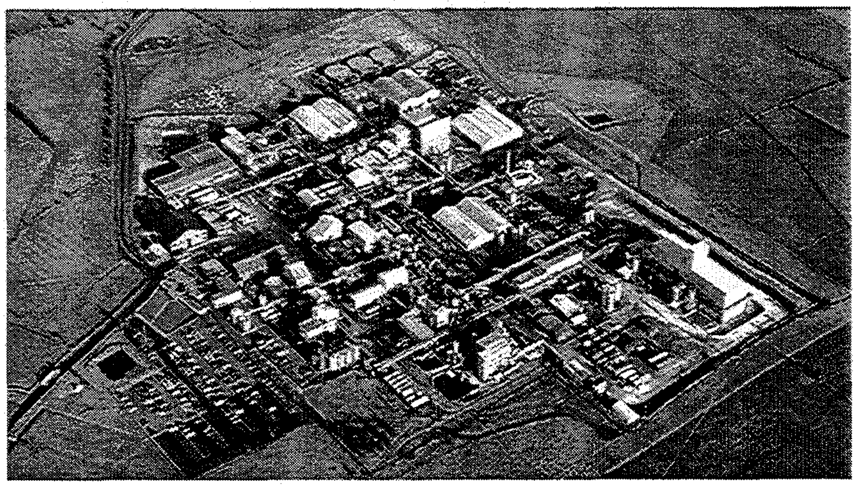
A H Marks' single site



Slide 4

A H MARKS

Key points about our ISO 140001 EMS

- A H Marks has been family-run since 1907. Our Chairman, Rhys Marks, aims to pass on a sustainable Company to his children.
- An annual Environmental Report is sent to over 5,000 staff and neighbours. It includes detailed environmental performance data, then sets out annual improvement objectives and targets.
- A Steering Committee (Chairman, directors and senior managers) drives our Company's environmental strategy. It meets quarterly to compare performance with targets and to plan further ahead.
- Energy, wastes, traffic and all releases to air, land and water have very significant direct environmental effects, so are tightly managed.
- An integrated team minimises waste of energy, utilities and effluent.
- Noise, complaints and visual appearance have indirect impacts on our neighbours, so they are also tracked.
- We work closely with our neighbours to improve the local community.

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Optimising energy consumption

Slide 6

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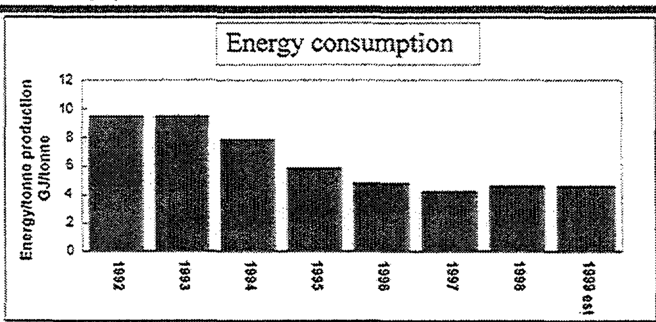
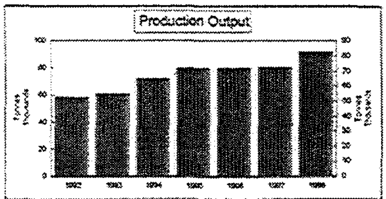
Energy Performance





80% of energy is used as steam, most of the balance is electricity.

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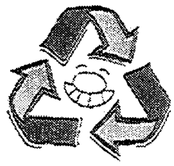
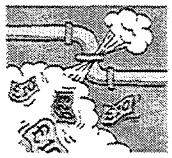
Key steam improvements



- Software and oxygen trim controls were fitted to our packaged boilers to minimise gas burned. Burners react to flow before pressure and are set to control air : fuel ratios.
- Steam condensate recovery was increased from 30% to nearly 90%. This also reduces water and effluent bills.
- Infrared thermography is used to identify heat losses. It is cheap but very effective.
- Unused steam pipes were disconnected and removed, reducing costly radiation losses.
- Automation of processes optimises steam heating systems.
- Steam flow meters networked to PCs and monitoring software highlight opportunities for further reductions.



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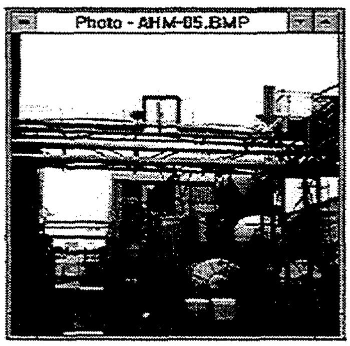
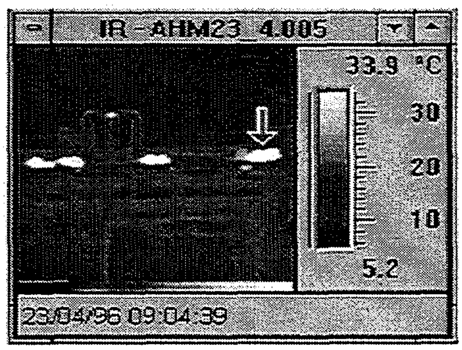
Infrared survey of steam mains





A one day, £400 IR survey identified 676 metres of poor insulation, which cost £10,302 to repair. The savings from this exercise were 5,413 tonnes steam p.a., equivalent to £23,763 p.a., giving a payback of just 5 months.

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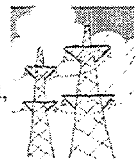
Key electricity improvements



- We have replaced reciprocating air and refrigeration compressors using intelligent screw compressors.
- Most of our refrigerant CFCs have been replaced by ammonia, which has zero Global Warming Potential.
- We designed out most extraction fans by sealing vessels, fitting remote sampling & auto charging devices.
- Thermostatic controls are fitted to all cooling tower fans.
- High efficiency lights, heat detectors and timers are used.
- Most processes are automatically controlled using high accuracy instrumentation to reduce energy consumption.
- 60 electricity meters networked to PCs and monitoring software highlight opportunities for further reductions.
- Once we had our energy consumption under control, we installed a CHP Plant, financed off balance sheet.

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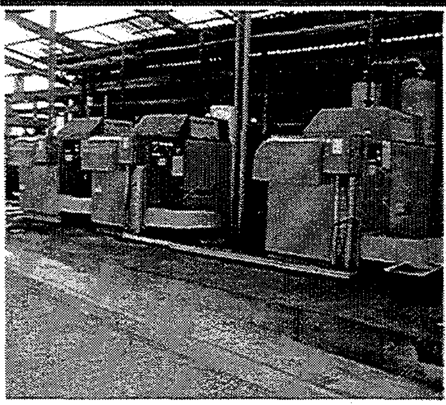
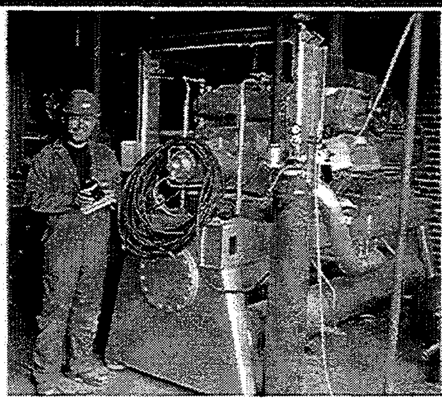
Screw type compressors



Intelligent air compressors



Non-CFC ammonia refrigeration

Modern controls and variable speed drives reduce electricity consumption by 20%

Slide 11

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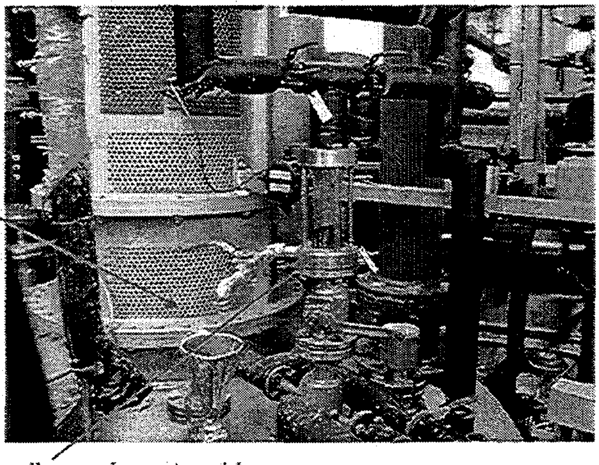
Vessel sealing removes need for fans

Fully enclosing mixing vessels avoids the need for local extraction fans, reducing electricity consumption.



Vacuum-driven sampling equipment avoids the need to open manway covers.

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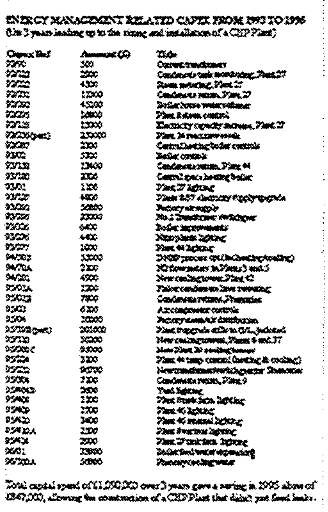
Capital investments and savings



ENERGY MANAGEMENT RELATED CAPEX FROM 1993 TO 1996

A capital spend of £1.0 million over the 3 years 1993-1995 resulted in an annual £847K reduction in energy costs.

Only when we had reduced energy waste did we then go on to have a CHP Plant which would generate energy efficiently.

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Generating energy efficiently

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Financing Combined Heat & Power

- A local utility company paid for, built and operates an on-site CHP (cogeneration) Plant. We spent no capital, but save £200K-£250K p.a. on energy costs.
- The exemption of CHP from the UK's new Climate Change Levy (CCL) from 2001 will result in further savings. Non-CHP users in the UK will pay a tax of 0.43p/kwh for electricity and 0.15p/kwh for gas and coal, so having a CHP Plant will avoid an annual tax bill of £279K.
- The CCL will strongly stimulate UK CHP growth.
- A H Marks' total annual savings therefore exceed £500K for no capital investment.

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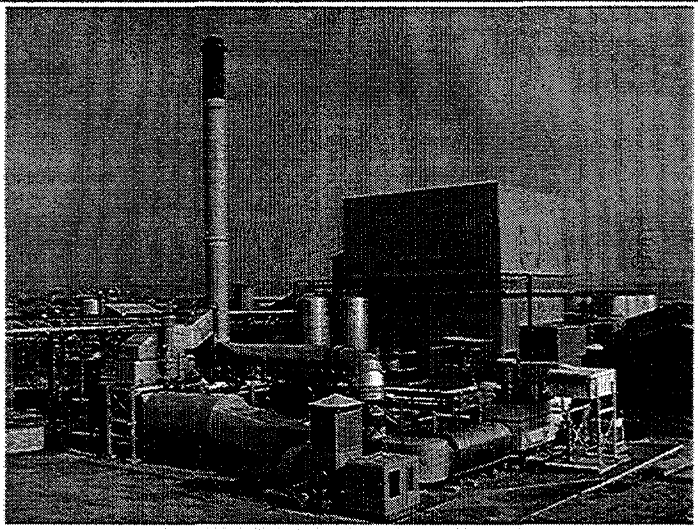
Combined Heat & Power Plant



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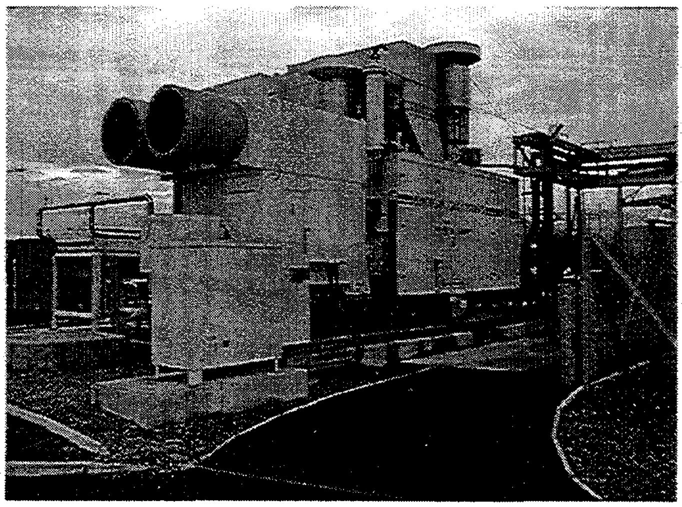
4.54 Mwe gas turbine/alternator



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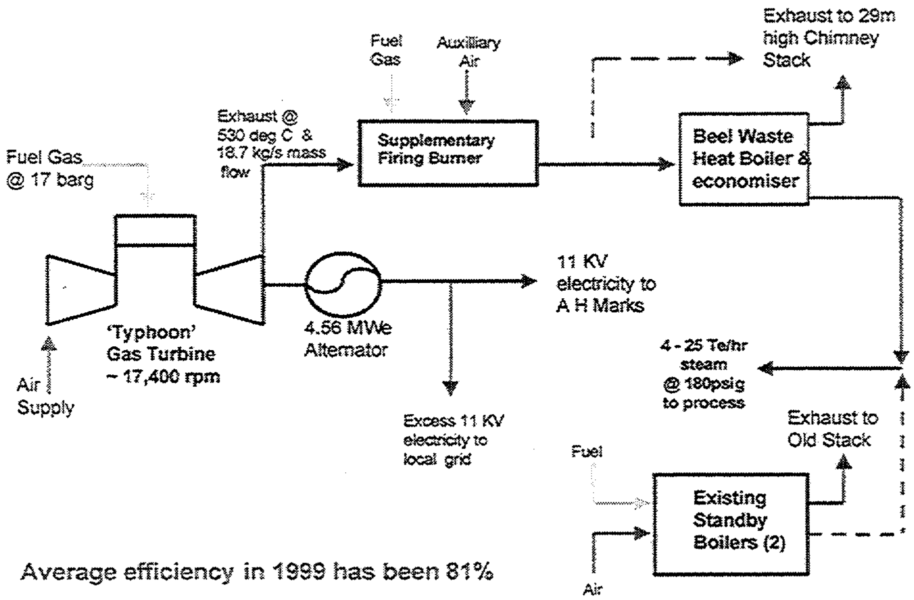
Combined Heat & Power Plant details



Average efficiency in 1999 has been 81%

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Offsite energy conservation

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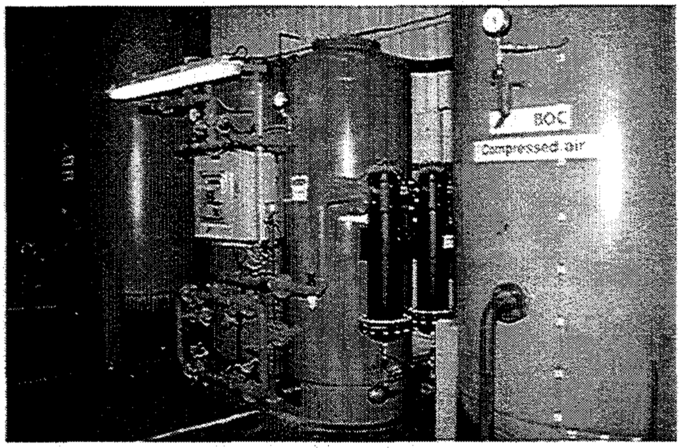
Pressure Swing Adsorption to make N_2



On-site Pressure Swing Adsorption plants make nitrogen gas using only 32% of the electricity for off-site cryogenic nitrogen

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Vehicles

Low emission Mercedes Actros lorries burn ultra- low sulphur diesel fuel

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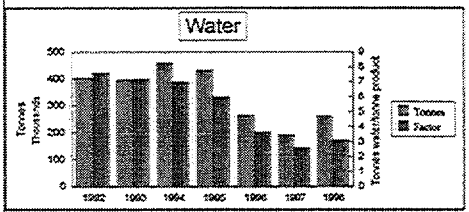
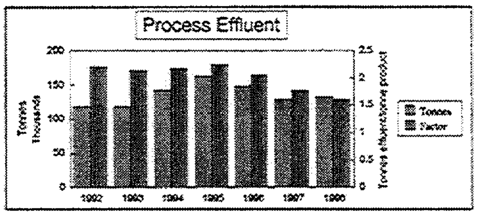
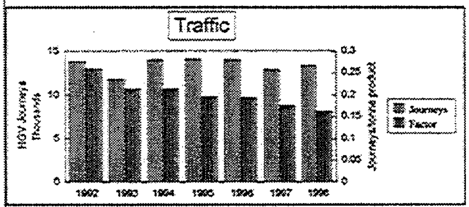
Indirect energy reductions







All of these graphs show improvements which indirectly reduce environmental impact through off-site energy consumption.

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Reducing greenhouse gas emissions

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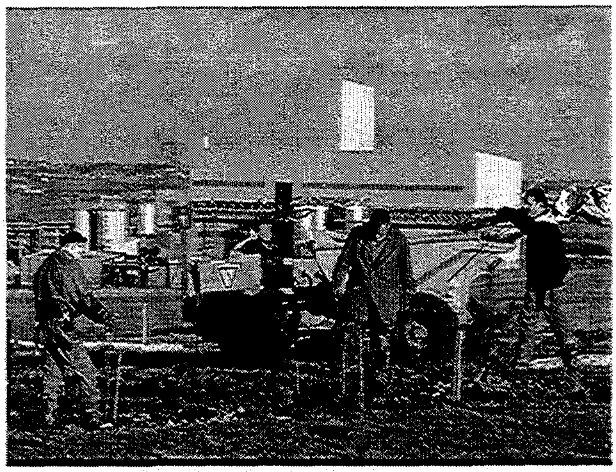
Non-process CO_2 reducers



23,000 indigenous trees have been planted around our site since 1990

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Non-process CO_2 reducers

A 5,000 m^2 nature reserve has been built for local school children to study

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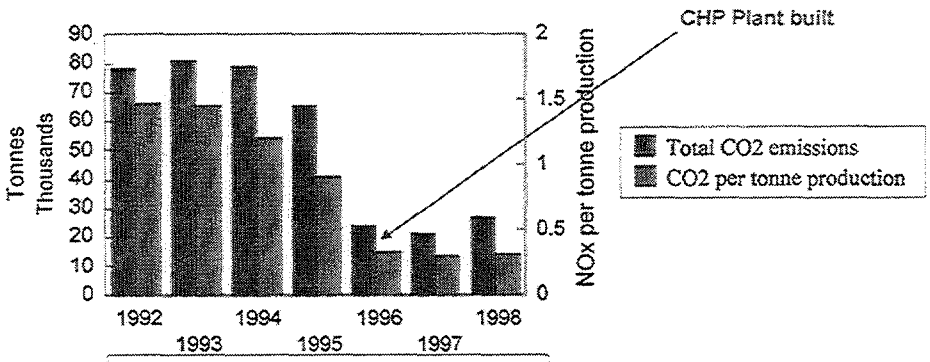
Energy carbon dioxide emissions



Emissions calculated using UK ETSU data.

The effect of planting 23,000 trees, which will absorb up to 2,500 Te CO_2/year, has been excluded. On-site of generation of nitrogen gas also saves 1,824 Te CO_2/year over off-site liquifaction.

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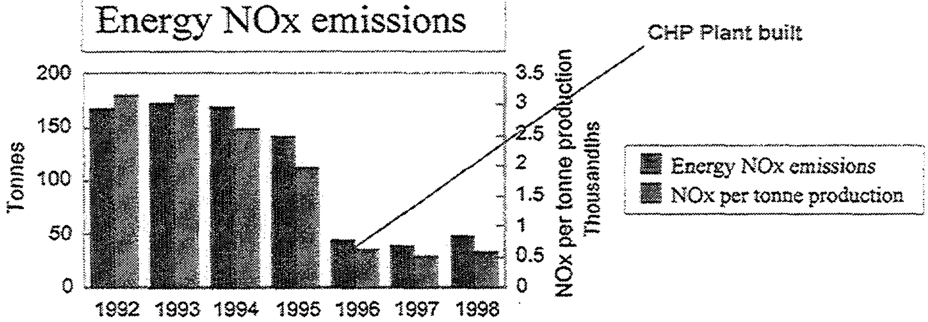
Energy NOx emissions

Energy NOx emissions



NOx emissions are calculated using ETSU data

Energy production generates 10x as much NOx as the Nitros processes

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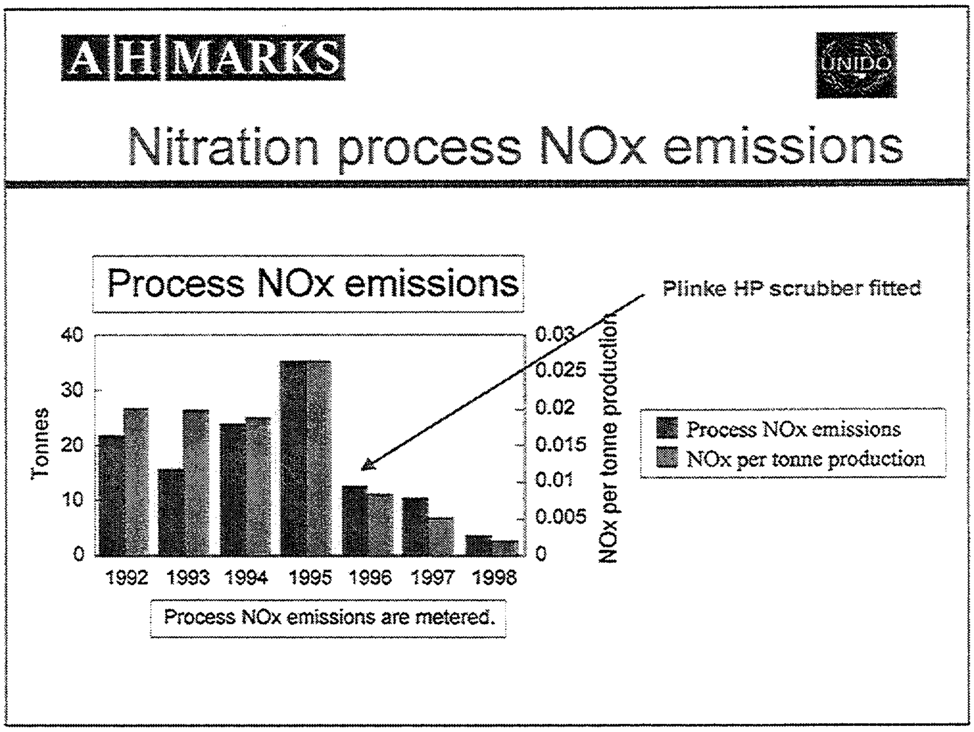

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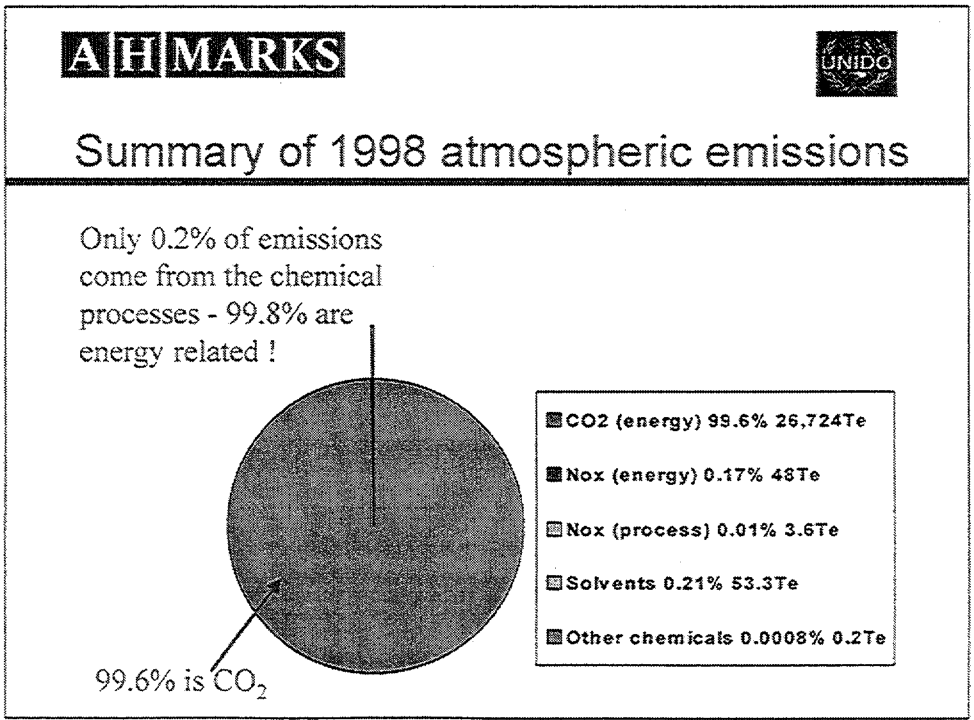

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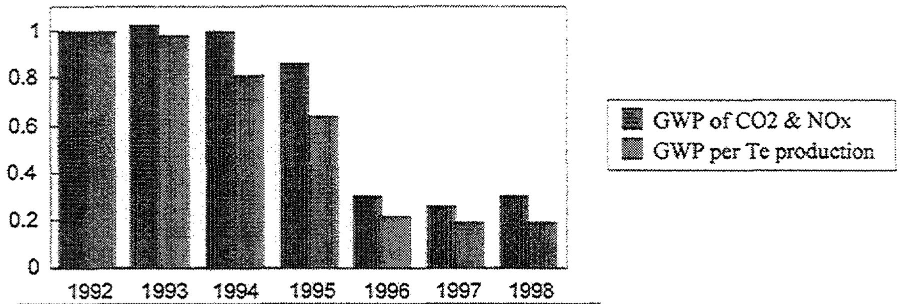
Tracking A H Marks' global warming potential



UNFCCC 1995 GWPs give CO2 as 1 and NO2 as 310.
Energy related emissions calculated using UK ETSU data.

Based on CO_2 and NOx energy/process emissions with 1992 as a datum.

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The role of ISO 14001 and EMAS

- Up to now, because energy production and use were not policed by enforcement agencies, many organisations ignored their environmental effects. Note - the CCL and IPPC should change this.
- ISO 14001 uses an initial review of company activities which have, or could have, Significant Environmental Impacts. This review highlights the need for energy reductions, which quickly become a key management activity.
- ISO 14001 requires that all employees are given their own specific environmental responsibilities and training.
- Free data from UN, EU and individual government agencies (e.g. ETSU in UK) can be used to quantify and monitor GHGs & GWPs.
- The same sources supply free, best practice case studies. These were the catalyst for many of A H Marks' energy improvements.
- Use of ISO 14001 aids continuous improvement in all areas and means that we don't let energy or other objectives slip. An audited Public Statement as part of EMAS makes this even more important.

3. Swiss-Romanian Thermal Energy Project

Alexander Lüchinger, Factor Consulting + Management Ltd., Zürich, Switzerland

INTRODUCTION

The Swiss-Romanian Thermal Energy Project (STEP) is Switzerland's first AIJ project, and it is among the first AIJ projects in Romania. Its purpose is to reconstruct two medium-sized district healings, one in the City of Buzau and one in Pascani. The project is funded jQintly by the Swiss and the Romanian Cities. The state of work is as follows: The feasibility study was completed in spring 1998. The Swiss and the Romanian have agreed to implement the project and have approved their respective parts of the funding. Swiss technology suppliers have been contracted. The facilities are expected operative by fall 2000.

TECHNICAL ASPECTS

The two existing district heatings serve about 5'700 persons in total. They are in a rather desperate shape: There are gas-fueled boilers, which have low efficiencies and break down frequently. The heat is transferred in old pipes-which are poorly insulated and often leaking Further significant losses occur in the basements of the supplied buildings. The overall efficiency of the systems is estimated at about 43%, which is very low.

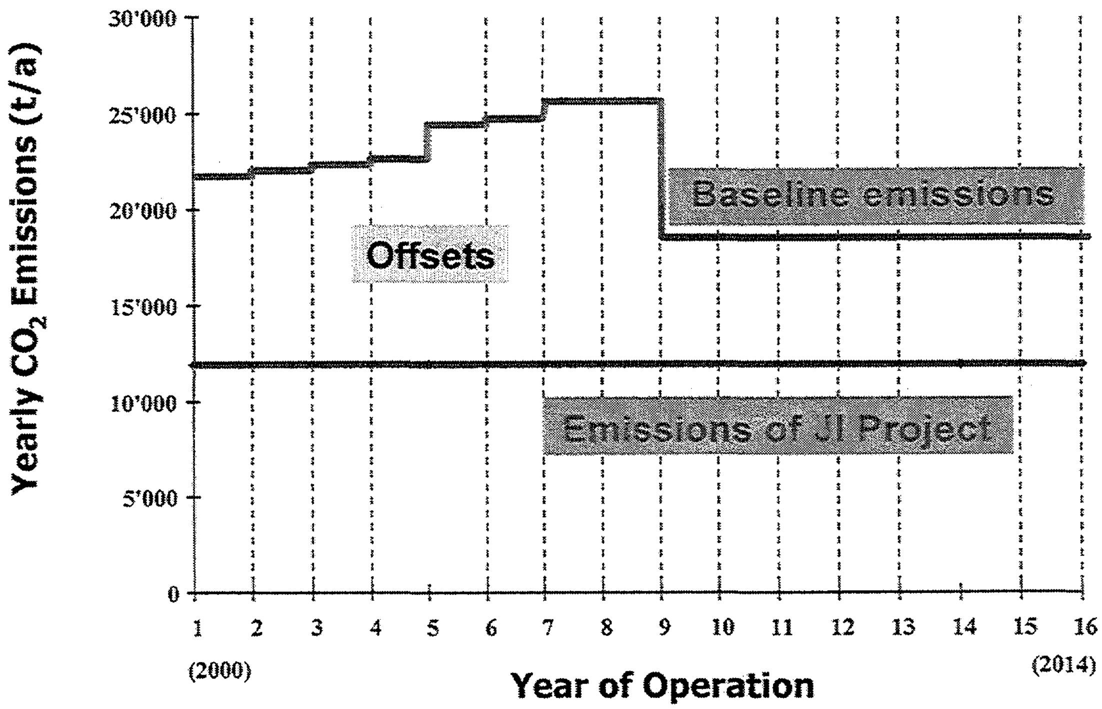
STEP will rehabilitate the two heating centrals with state-of-the-art equipment, and it will reconstruct the distribution networks and the basement piping. In addition, the Swiss engineers proposed the thermal rehabilitation of 2 buildings, in order to demonstrate how improved insulation can contribute to energy saving. But at present it is uncertain whether this component will be implemented.

STEP will cut the current heat losses by more then 50%. Beyond that, it will also be more energy efficient than the conventional systems, which are installed in Romania today, for instance with EBRD loans. This extra-high energy efficiency is due to two main reasons:

- STEP includes a two-track system with substations for the heat distribution instead of the 4-track systems common in Romania.
- The project also includes two combined heat & power engines (0.67 MW_e / 0.8 MW_{th} each). Electricity is sold in the grid.

KEY VALUES FROM THE JI PERSPECTIVE

In the feasibility study, the existing facilities were assumed as the baseline for the first 8 years of the project, and new, conventional, "EBRD-type" heating systems (without cogeneration) as the baseline for years 9-15. That gives us a sharp decrease in baseline CO_2 emissions after year 8, as is shown in the graph overleaf.



[Figure 1] CO_2 emissions of STEP and baseline

The baseline is the reference state that we use to calculate the costs and environmental benefits of a JI project. The baseline project is the situation that will take place if the JI project is not implemented.

Using this baseline, we can now calculate the environmental benefits and the costs of our project:

- Over the proposed crediting time of 15 years, the total CO_2 reduction (=offsets) will be approximately 140,000 tons.
- The required investments are about 6.5 million USD, of which 3.9 million will be covered by a Swiss grant (excluding the cost of rehabilitating the two pilot buildings).
- The incremental cost of the project, that is the extra cost compared to the baseline, is about 0.65 million USD over the whole crediting time. In other words, STEP will be more expensive than the baseline.
- The specific cost of CO_2 abatement is approx. 5 USD per ton of CO_2, or 8 USD if we discount the CO_2 offsets at 8%/yr. to take into account that credits would accrue annually after verification.
- STEP yields various secondary benefits, in particular: a higher standard of living for the supplied residents, transfer of know-how concerning small-scale combined heat & power generation, and reduced emissions of air pollutants.

STRENGTHS OF STEP

What are the strengths of a project like STEP from the JI viewpoint? Three of them need to be emphasized:

1. The project yields clear environmental benefits both for the local environment and for the global climate.
2. The specific cost of CO_2 reduction is rather low, which makes the project cost-effective.
3. Most importantly, there is a very large potential for analogous projects in Romania, with literally hundreds of district heatings awaiting reconstruction.

On the level of JI methodology, two major challenges had to be dealt with. On first sight, they are both about baseline calculation, but they will also lead us to conclusions on the institutional setting.

CHALLENGE-1: ACCOUNTING FOR THE POSSIBILITY OF ALTERNATIVE INVESTMENTS

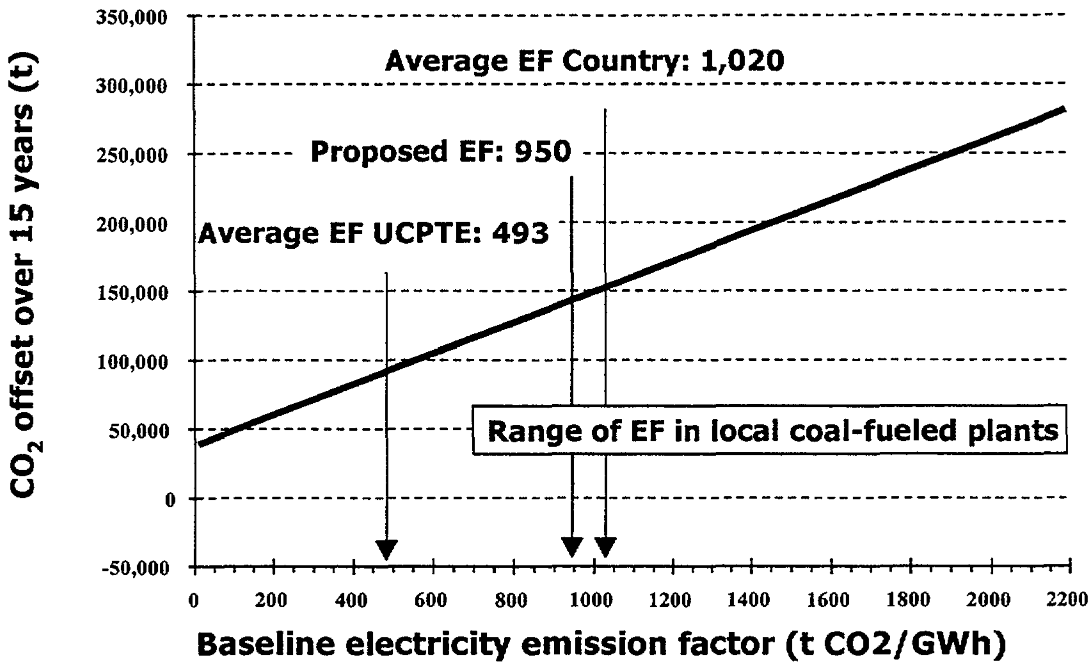
The possibility of reconstructing district heatings in Romania with EBRD funding has already been mentioned. The question is now whether (or when) such conventional projects would have been implemented in Buzau and Pascani in the absence of the Swiss projects. The responsible Regies (the municipal utilities) stated that they could not take additional EBRD loans in the next decade.

In the feasibility study we, nevertheless, assumed that the existing systems would have been rehabilitated with EBRD loans by approx. 2008, taking into account that such a rehabilitation would yield clear financial benefits due to the energy savings. This is, however, a rather crude approach. In the future, the problem of alternative investments in the district heating sector could be treated in a generalized way by estimating the average renewal rate of Romanian district heatings. This value could then be used to create a generalized baseline for further projects. In our opinion, such a task should best be carried out by the Romanian authorities themselves, which makes it an issue of the institutional settings discussion.

CHALLENGE-2: EMISSION FACTOR FOR BASELINE ELECTRICITY

A second challenge that we faced is related to the baseline for small-scale electricity production. The STEP electricity is fed into the grid of the state producer RENEL. It is reasonable to assume that this extra power will be balanced by a reduction in RENEL's own production. Consequently, the CO_2 emission baseline must not only account for CO_2 emitted at the district heatings themselves, but also for emissions in some RENEL power plant. The question is now: What emission factor should we use to account for this? As you can see from the graph, this question is crucial for our project from the JI perspective:

- If STEP replaces electricity from hydro-powered or nuclear plants, only small CO_2 offsets will be generated (about 36,000 tons).
- If STEP replaces electricity from the least effective coal-fueled plants, which are currently operating in Romania, the CO_2 offsets may be up to 275,000 tons.



[Figure 2] Influence of baseline electricity emission factor on CO_2 offsets achieved by STEP

Note that the emission factor that we are looking for should be valid over a period of 15 years. That's why its determination requires intimate knowledge of the Romanian electricity market. The problem is complicated by the fact that decisions which power plants should be built or shut down are often based on political as much as on economic reasoning.

After a detailed analysis, we came up with an average emission factor, which is typical for modem hard coal fueled plants. However, this factor will have to be re-evaluated before it can be generally applied to future projects. The state electricity producer RENEL would best be suited for such a task, possibly in cooperation with, for instance, the IEA. This is just one of the reasons why the Romanian Government should make sure that RENEL is adequately involved in the process of Jl capacity building in Romania.

CONCLUSIONS ON INSTITUTIONAL SETTINGS FOR JI PROJECT

In conclusion, we would like to point out what we learnt from STEP in terms of the institutional setting:

- First of all, the Romanian Government has to ensure adequate staffing and financial resources for the main authority in charge of Jl activities.
- This "national Jl authority" should then involve other relevant entities, and establish Jlspecific working relationships with them. In particular, other Ministries (Ministry of Finance, Ministry of Rural Planning and Public Works, etc.) need to be involved, because Jl activities are complex and cannot be handled by one single ministry alone. In addition, the state power enterprise RENEL will also be an important player. In the heating sector, the municipal utilities (Regies) should also be involved.
- Together with the involved partners, the Jl authority should establish transparent procedures and predictable, stable conditions for Jl projects. This means, for instance: (i)

efficient assessment and approval mechanisms, (ii) monitoring and reporting procedures, and, more specifically, (iii) a consistent policy for RENEL concerning the purchase of power from small-scale facilities like STEP.

- Last but not least, the JI authority should contribute to a simplified project assessment and to generalized baselines. We have mentioned two examples: the baseline emission factor for small-scale electricity, and the baseline renewal rate for existing heating facilities.

To reach these goals, the idea of JI must be anchored at the top levels of the national government to ensure adequate staffing and financial resources. Only back-up and promotion by the top authorities will allow Romania and other potential JI/CDM host countries to stay at the forefront of worldwide JI/CDM activities, and to secure the corresponding benefits.

In this context, the World Bank's and Swiss Government's Initiative for National Strategy Studies for GHG Emission Reduction need to be mentioned. These studies contribute to establishing a governmental strategy in potential JI/CDM host countries by estimating GHG offset potentials, international demand for these offsets, and associated local benefits. The studies also formulate institutional requirement for efficient handling of JI/CDM, and a pipeline of potential JI/CDM pilot projects is established. The National Strategy Studies, one of which is about to start in Romania, will help to make the idea of joint mitigation of climate change operative. Cogeneration will certainly play a major role in this process.

Slide 1

Swiss AIJ Cogeneration Projects

- Framework of Swiss AIJ Program
  - practical experience
  - cooperation with host countries
  - development of guidelines, baseline setting,....
- Projects under AIJ phase
  - in realization: Romania, Slovakia
  - under consideration: Poland, Lithuania, Russia, Costa Rica
- Pilot projects as starting point for private actors
  - Multiplication, replication

Slide 2

The Swiss - Romanian AIJ Project (STEP)

- Swiss - Romanian financial assistance
- 230 Romanian cities
- Lack of maintenance and rehabilitation
- EBRD project for 5 cities
- Request for cofinancing by Switzerland
- Large replication potential (not only in Romania)

Slide 3

Technical Solution (STEP)

- New boiler houses
  - low NOx burner boiler systems
  - cogeneration units, gas engines
  - automatisation
- Two pipe and preinsulated heat distribution system (financed locally)
- Substation in each building (heat and sanitary water)
- Pipework in the building (system security)
- Option: demand side measures, energy related building rehabilitation

Slide 4

GHG Abatement by STEP

Burners / boilers	From 50 % to 95 % efficiency
Cogeneration	Replacing grid electricity (coal) by efficiently produced gas electricity
Overall automatisation	Expected reduction higher than 10% overall
Distribution system and substations	Increased efficiency, reduced water losses
Building insulation	Reduced heat demand

Slide 5

Emissions without the STEP Project

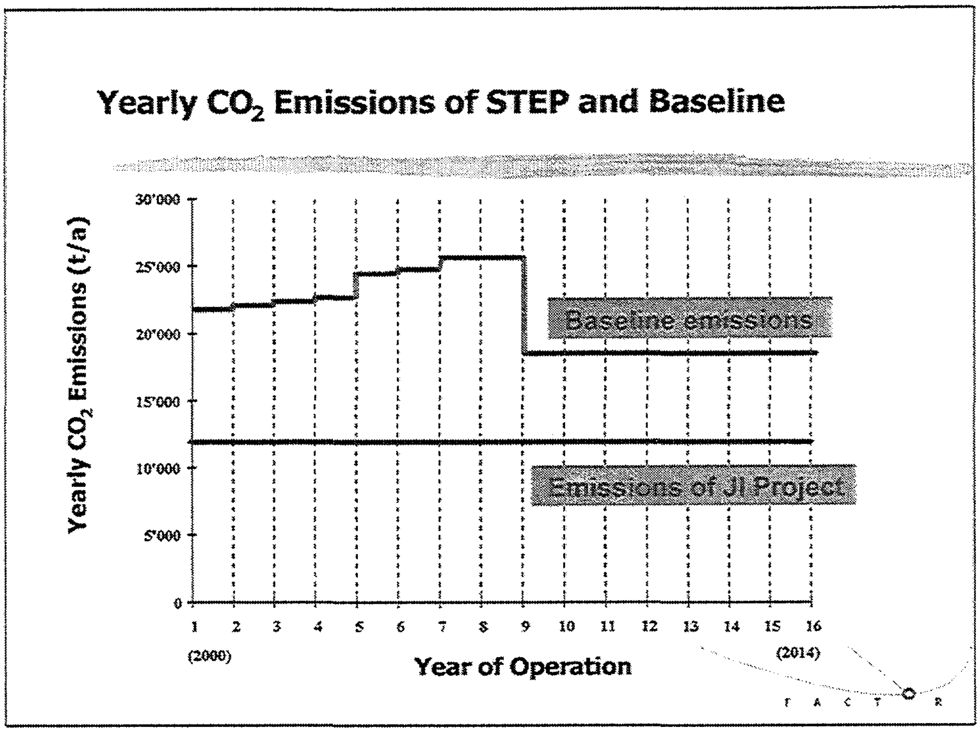
- Will increase due to further deterioration of the system
- Will increase due to increasing water losses
- Will increase due to increasing standard of living (higher room temperatures 15°C → 20°C)

Slide 6

What would happen if STEP would not be implemented?

- Baseline scenarios assessed:
  - no investment for the next 4 years and temperature level in the apartments of 15°C maintained
  - later minimal investment to keep the system operative, 15°C
  - later minimal investment with a corresponding increase to 20°C
  - alternative (different) investment using an EBRD credit after year 8

Slide 7



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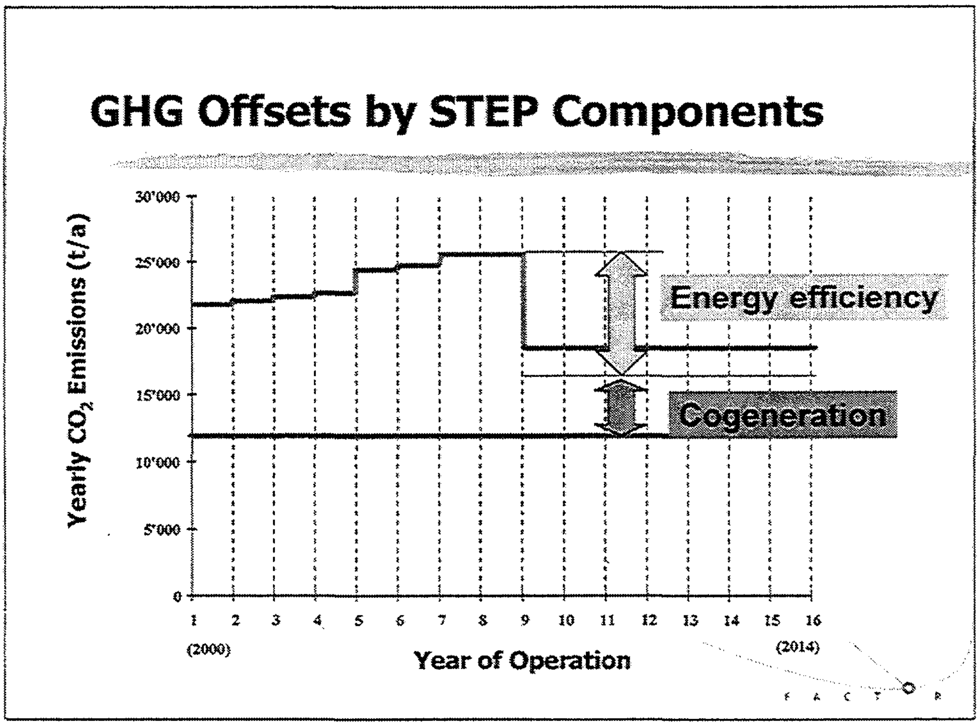

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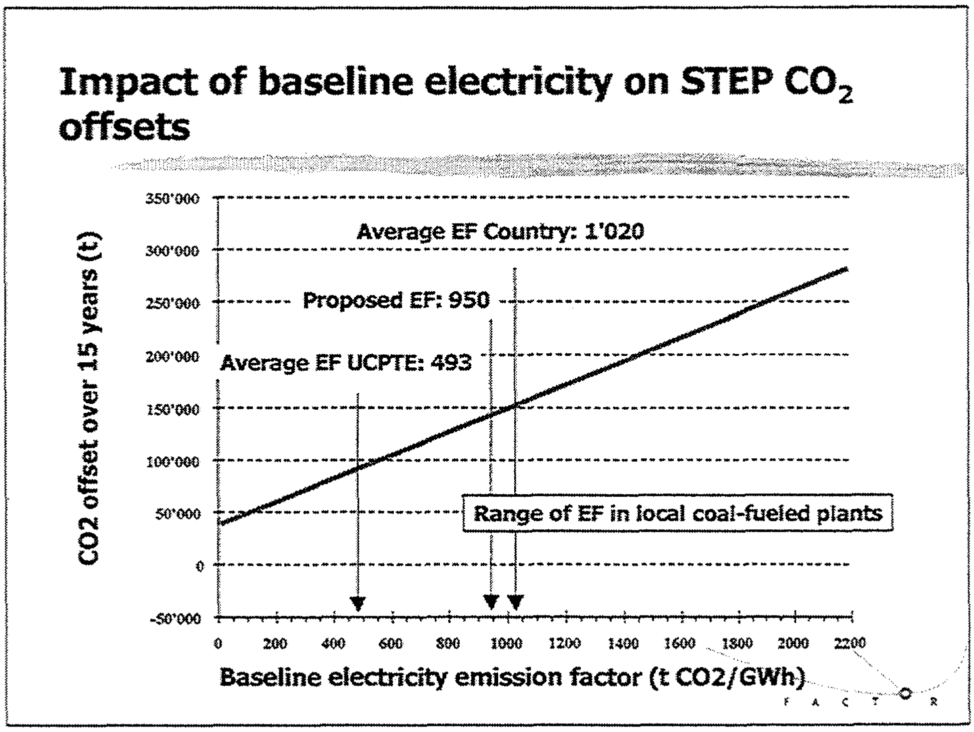


Slide 10

Key Values of STEP Project

- Results in
  - 140'000 tons of CO2 emission reduction over project lifetime
  - 3.9 Mio $ Swiss investment
  - 2.6 Mio $ local investment
  - 8$/per ton CO2 abatement cost, discounted at 8%
  - 3.9 Mio $ net benefit for the Romanian partner

F A C T O R

Slide 11

Memorandum of Understanding

- reference to the CoP and the UNFCCC
- Romanian and Swiss focal points
- JI between Annex I
- one or more projects defined in a project agreement
- fulfilling the criteria of UNFCCC
- monitoring plan is mentioned and third party verification ex - post
- reporting jointly to UNFCCC
- ERU transfer when allowed under UNFCCC

Slide 12

Project Implementation Agreement

- Joint Implementation aspects
  - baseline definition
  - monitoring and verification / notification and reporting
  - credit sharing
- participants responsibilities
- guarantee of local financing
- contracting Swiss and local deliverer and constructing firm

Slide 13

State of the STEP Project

- MoU and all agreements signed
- Delivery contracts to be signed
- Building and montage work first half of 2000
- Operation autumn / winter 2000

- Private Swiss investors start to consider replication

FACTOR

Slide 14

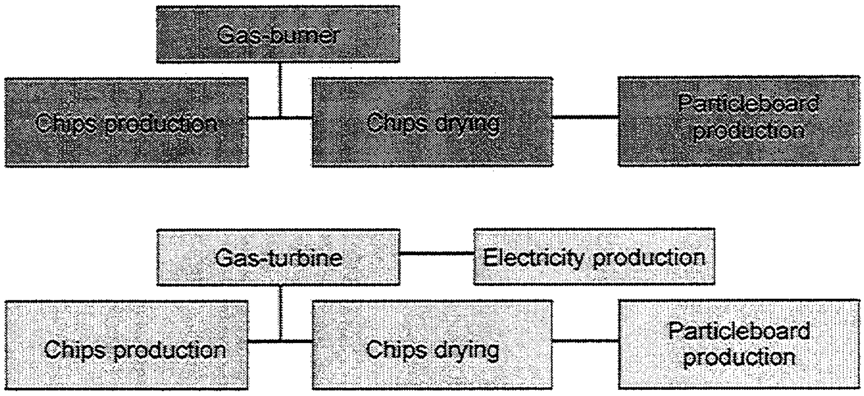
The Swiss - Slovak AIJ Project

- Energy efficiency project in private wood processing plant Bucina Zvolen
  - producing chip boards and semi products
  - energy intensive drying process
- Feasibility study completed
- Delivery conditions agreed
- JI Agreement Slovakia - Switzerland under negotiation
- Implementation scheduled summer 2000

FACTOR

Slide 15

Old / New Process



Slide 16

JI Characteristics of the Bucina Project

CO_2 offset achieved by turbine component in 8 years	100 000 tCO_2
Additional CO_2 offset achieved by control system in 8 years	50 000 tCO_2
Total CO_2 offset achieved by Swiss project in 8 years	150 000 tCO_2
Investments	2.7 Mio $
CO_2 abatement cost (offsets discounted at 12 %)	-18 USD/tCO_2

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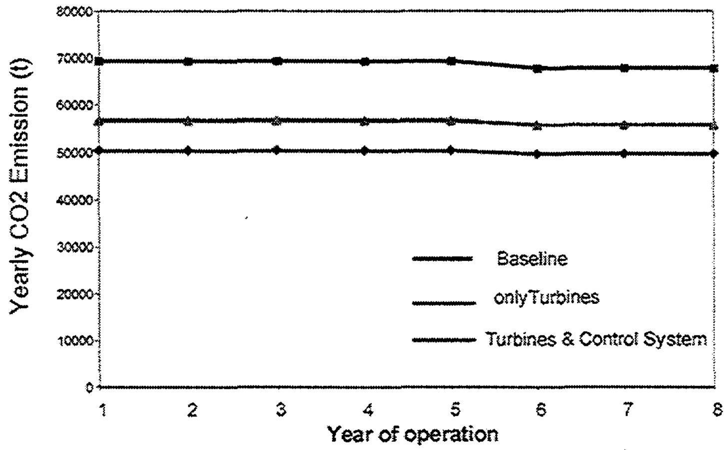
GHG Emissions of Project and Baseline



Slide 18

Baseline Consideration

- An EBRD loan to Bucina has already been spent
- until the loan is paid back, no additional loans are allowed
- ➡ Bucina would not be able to invest in the next 8 years

Slide 19

Conclusions

- Decentralized Cogeneration offers a chance to increase energy efficiency
- Financially viable if electricity prices are fair (undistorted markets)
- Emission Reduction Units are an additional market product of cogeneration units
- JI/CDM is an additional source to finance cogeneration
- Technology is available

→ let's multiply the pilot-projects

F A C T O R

4. Biomass Cogeneration in ASEAN, GHG Mitigation Potential and the Barriers

Dr. Ludovic Lacrosse, Arul Joe Mathias
EC-ASEAN COGEN Programme, Asian Institute of Technology, Bangkok, Thailand

ENVIRONMENTAL IMPACT OF BIOMASS COGENERATION

Cogeneration is the sequential generation of two different forms of useful energy, generally electrical and thermal, from a single primary energy source. Overall efficiency of cogeneration can reach 90 % or more. This is significantly higher than the efficiency of conventional systems generating electricity and heat separately. Hence, cogeneration produces much lower emissions for each unit of energy produced.

Most Asian countries are endowed with wood and agricultural resources which, when processed in industries, generate large amounts of residues, varying between 30 to 70 % depending on the process and the raw material input. These residues often have a very low economic value, sometimes even negative, because of the costs involved in disposing them.

Although very inefficient, biomass cogeneration has been widely applied in sugar mills and palm oil mills. As the trend in wood industries is to shift towards integrated wood complexes, high efficiency cogeneration plants are increasingly being implemented in this sector, too. There is also a cogeneration potential in large rice mills, with a minimum milling capacity of 5 tonnes of paddy per hour. If appropriate technologies are implemented, cogeneration can not only render these wood and agro-industries self-sufficient in energy, but also help some of them to earn profit by exporting excess electricity to the national grid or to neighbouring industries.

The combustion of fossil fuels gives rise to emissions, such as carbon dioxide, nitrous oxides, sulphur oxides, carbon monoxide, particulates, organic compounds, trace metals, etc. Aside from its local effects, the global issues are the greenhouse effect and the acid rain phenomenon. Biomass, on the other hand, acts as a sink for atmospheric carbon dioxide. If biomass is being regrown at the same rate as it is being harvested, the net flux of CO_2 to the atmosphere is zero. Biomass is a low sulphur fuel - contributing much less than fossil fuels to the acid rain phenomenon. The use of biomass wastes in modern boiler also reduces the environmental hazards associated with open-burning or dumping.

The EC-ASEAN COGEN Programme (COGEN), a techno-economic co-operation programme between the EU and the ASEAN, has been involved in the promotion of energy efficient and environmentally friendly biomass energy projects. Over the last 8 years, fourteen full scale demonstration projects (FSDPs) have been implemented in the wood, rice and palm oil industries. These projects, are not only economically viable and technically reliable, they have a significant positive effect on the environment, particularly through emission mitigation.

The COGEN Programme has conducted GHG emissions studies for these FSDPs. This paper discusses the methodology, which was developed by COGEN for calculating GHG and other emissions mitigation potential. It also presents two case studies related to a wood waste-fired cogeneration plant and a rice husk-fired cogeneration plant.

METHODOLOGY FOR GREENHOUSE GAS EMISSION MITIGATION CALCULATIONS

The methodology developed by COGEN to calculate the GHG emissions mitigation potential for biomass energy projects is shown in Table 1 and Figure 1. Major references were made to the Intergovernmental Panel for Climate Change (IPCC), the US Environmental Protection Agency (US-EPA), and the World Bank (WB) in elaborating this methodology.

The study takes into account GHG emission mitigation due to fossil fuel substitution and due to non open-burning of the biomass residues. It compares the emission of GHG between the current scenario (biomass energy projects) and alternative scenarios. CO_2, CH_4 and N_2O emissions are converted into CO_2 equivalent, considering the global warming potential (GWP), which is 1, 21, 290, respectively for CO_2, CH_4 and N_2O, for a time frame of 100 years. The global warming potential (GWP) defines the warming effects caused by a unit mass of a given gas relative to that of CO_2. Thus, emission in CO_2 equivalent (t.CO_2eq.) is calculated as follows:

Emission in CO_2 equivalent = CO_2 emission + CH_4 emission x 21 + N_2O emission x 290

[Table 1.] Methodology for assessment of emission mitigation potential of biomass heat and/or power generation projects.

Type of application	Base case emission (A)	Alternative case emission (B)	Emission mitigation potential
Heat only	Emissions from biomass boiler	Emissions from fuel oil boiler Emissions from open burning of biomass	B - A
Power only	Emissions from biomass boiler	Emissions from grid and/or diesel genset(s) Emissions from open burning of biomass	B - A
Cogeneration	Emissions from biomass boiler	Emissions from fuel oil boiler Emissions from grid and/or diesel genset(s) Emissions from open burning of biomass	B - A

CASE STUDY OF A WOOD WASTE-FIRED COGENERATION PLANT

This case relates to a 1.5 MWe wood waste-fired cogeneration plant of a wood working complex in Malaysia. The cogeneration plant is supplying power to a wood working complex and heat to kiln dryers. The management decided to implement this wood waste fired energy plant, for its new wood working complex due to the high comparative running cost of diesel generators and the regulations for environmental protection preventing waste disposal by incineration.

There is no wood waste disposal problems, and the wood mill enjoys security in terms of power supply and heat requirements for timber drying, both power and heat being sourced from their own 1.5 MWe wood waste-fired cogeneration plant.

In the case of this particular energy plant, the base case is related to the emissions from the wood waste-fired boiler. The alternative case relates to the emissions from a fuel oil boiler for heat production and the emissions that would have been generated to produce electricity from diesel gensets as well as emissions caused by open-burning of biomass. Results of the analysis are shown in Table 2.

CASE STUDY OF A RICE HUSK-FIRED COGENERATION PLANT

This case is about a 2.5 MWe rice husk-fired cogeneration system installed in a rice mill in Thailand. The rice mill processes 500 tonnes of paddy per day and produces more than 120 tonnes of rice husk per day. Rice husk is used as a fuel in an efficient cogeneration system, which produces 2.5 MW electricity and heat for paddy drying.

In this rice husk-fired cogeneration plant, the base case is related to the emissions from the rice husk-fired boiler. The alternative case relates to the emissions from a fuel oil boiler for heat production and the emissions that would have been generated to produce electricity from the grid as well as emissions caused by open-burning of rice husks. The results of the analysis are shown in Table 3.

BARRIERS TO BIOMASS COGENERATION

The successful dissemination of cogeneration depends on four main components in the technological infrastructure of the main technologies identified. These are the technical, human, information and organisation related components. The description of these components and the barriers related to each component and some possible solutions to overcome them are given below.

The "technical" component refers to the performance and the stage of the development of the technological solutions. This includes aspects such as operational performance, reliability of the equipment, and their references showing that the technologies are proven.

The "human" component touches on issues related to the people's perception of the technology, as well as some cultural influences in the adaptation of the technology.

The "information" component relates to the sources of information available to the potential customers about the use of the technologies, such as their record of references, availability of assistance centres to obtain information regarding equipment suppliers, financing, etc.

The "organisation" component covers aspects related to the structure of the industry, transportation, as well as policy, legal and governmental issues. Some of the major underlying barriers fall with in this component.

Components	Barriers	Possible solution
Technical component	• lack of successful references • seen as complicated to operate • the quality of biomass as a fuel is not homogeneous	⇒ implementation of demonstration projects ⇒ suppliers to simplify operation; training of operators ⇒ adequate testing of samples
Human component	• energy not a core business of potential users • risk of being the first to fail	⇒ create awareness of benefits and opportunities ⇒ references in similar environment; demonstration projects
Information component	• lack of institutions giving information and advice • lack of awareness among users on government rules and incentives • not enough technical and economic information to make a decision	⇒ strengthening of relevant networks ⇒ information drive ⇒ availability of funds or services to conduct feasibility studies
Organisation component	• structure of the industry - size of mills - transportation problems - seasonality • uncertainty of biomass fuel supply • policy, legal and government issues • financial barriers	⇒ thorough investigation of these aspects in the feasibility of projects ⇒ initiatives to boost yield and productivity ⇒ government incentives/ support measures? ⇒ innovative financial strategies; government incentives?

CONCLUSIONS

With its abundant existence in the wood and agro-industries, biomass residues can help meet the increasing demand for power in developing countries. When used in cogeneration systems, big improvements in efficiency and fuel utilisation are also realised. The implications of replicating small cogeneration plant running on biomass, can constitute high GHG emission mitigation potential.

The successful diffusion of biomass cogeneration in developing countries, still leaves much to be desired. If tapped to the fullest, one can simply wonder about its enormous positive global consequence. However, there are some barriers for the successful diffusion of biomass cogeneration . Once the barriers are removed, there is ample scope for such projects to be selected under Clean Development Mechanism.

REFERENCES

Arul Joe, M. 1997. Potential of Greenhouse Gas Emission Mitigation Through Efficient Use of Selected Agricultural Residues, Thesis ET 97-29, Asian Institute of Technology, Thailand.

Climate Change Information Kit, UNEP`s Information Unit for Conventions, 1997.

Michael Brown, 1998. Emission Trading and Joint Implementation: The implications for cogeneration. Cogen Europe, May 1998.

Intergovernmental Panel on Climate Change, "Greenhouse Gas Inventory Reference Manual", Vol. 3, IPCC WGI Technical Support Unit, United Kingdom, 1995.

Joule-Thermie Programme of the European Commission, *"Environmental Aspects of CHP Systems: NO_X Abatement Techniques"*, United Kingdom, 1997.

Mohanty, B. and Aung N. O., !997. Fundamentals of Cogeneration, Asian Institute of Technology, Bangkok.

OECD, *Energy and Environmental Technologies to Respond to Global Climate Change Concerns.* International Energy Agency. Organisation for Economic Co-operation and Development, France, 1994.

United State Department of Energy, 1997. "A Fossil Energy Issue Review".

United States Department of Energy, 1996. Inventory of technologies, Methods, and Practices for Reducing Emissions of Greenhouse Gases.

United States Environmental Protection Agency, "Compilation of Air Pollution Emission Factors", Vol. 1: Statutory Point and Area Sources, U.S.A., 1995.

World Bank, "Energy Investments and the Environment", ed. C. M. Siddayao, Washington D.C., 1990.

World Bank, "Energy and the Environment, Some Key Issues", ed. T. Vukina, Washington D.C., 1992.

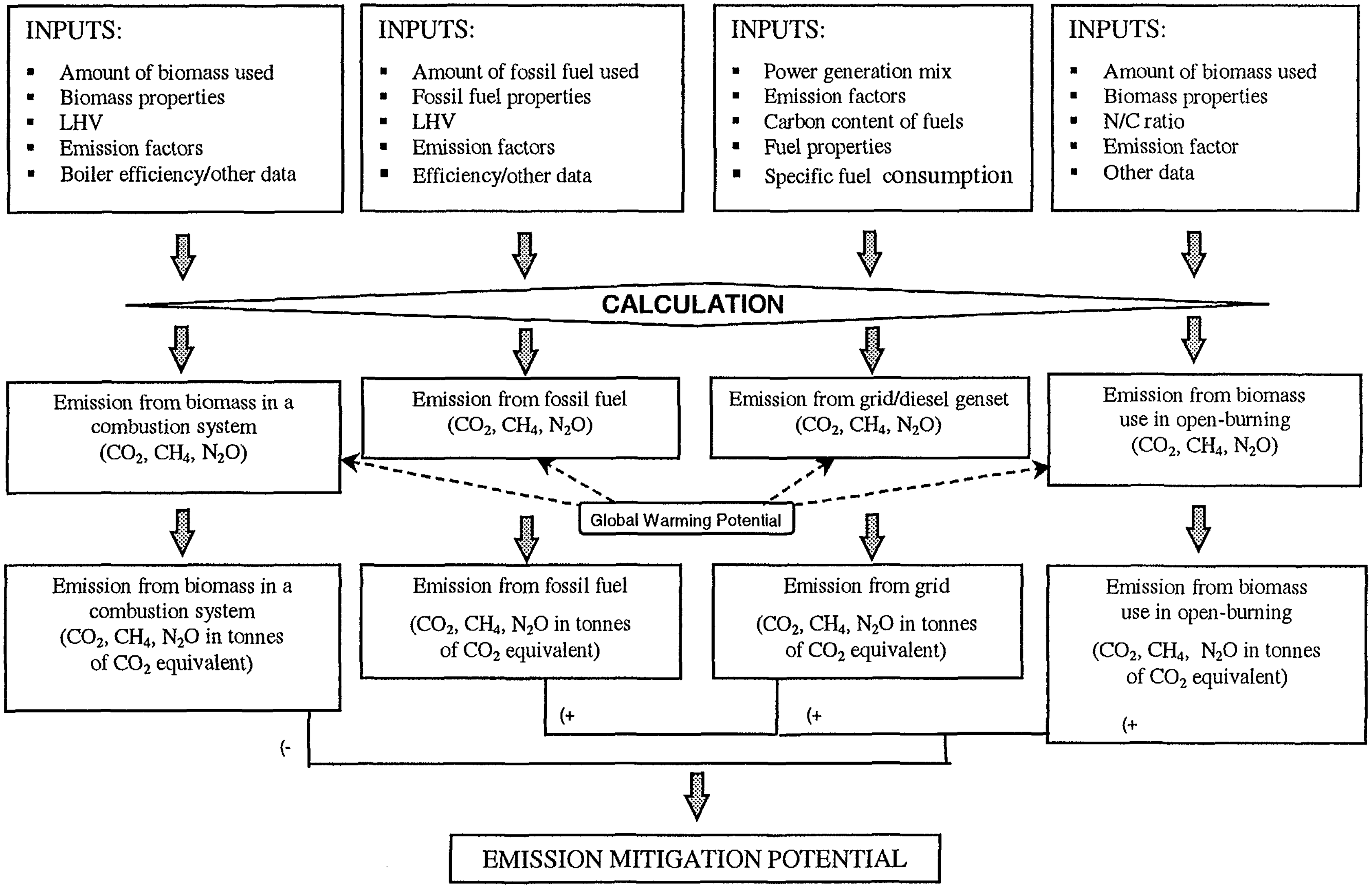
Table 2 Emission mitigation potential for the 1.5 MWe wood waste-fired cogeneration plant

GHG Gases	CO_2 (t/year)	CH_4 (t/year)	N_2O (t/year)	GHG (t of CO_2 equi./year)	CO (t/year)	NMVOC (t/year)	NOx (t/year)	SOx (t/year)
A. Emissions from biomass in a cogeneration system	0	6.284	1.676	617.90	247.159	20.946	27.229	12.986
B. Emissions from fuel oil boiler	6994.49	0.276	0.028	7008.30	1.381	0.460	15.651	90.040
C. Emissions from diesel genset	7117.88	0.420	0.060	7144.73	32.400	4.460	141.750	25.060
D. Emissions from open-burning of biomass residues	0	77.931	1.929	2195.91	1636.560	20.946	69.712	12.986
Emission mitigation potential (B + C + D – A)	**14112.36**	**72.340**	**0.340**	**15731.04**	**1423.180**	**4.920**	**199.880**	**115.100**

Table 3 Emission mitigation potential for the 2.5 MWe rice husk-fired cogeneration plant

GHG Gases	CO_2 (t/year)	CH_4 (t/year)	N_2O (t/year)	GHG (t of CO_2 equi./year)	CO (t/year)	NMVOC (t/year)	NOx (t/year)	SOx (t/year)
A. Emissions from biomass in a cogeneration system	0	7.354	1.961	723.140	289.255	24.513	31.867	15.198
B. Emissions from fuel oil boiler	2053.910	0.081	0.008	2057.970	0.406	0.135	4.596	26.440
C. Emissions from grid	12708.38	0.170	0.080	12736.040	7.770	0.870	35.150	28.120
D. Emissions from open-burning of biomass residues	0	82.031	2.030	2311.430	1722.650	24.513	73.380	15.198
Emission mitigation potential (B + C + D – A)	**14762.30**	**74.93**	**0.16**	**16382.30**	**1441.57**	**1.00**	**81.26**	**54.56**

Figure 1 Methodology Chart for GHG Emission Mitigation Potential Calculations



Note: Sustainable biomass is CO_2 neutral

Slide 1

UNIDO Expert Group Meeting on Industrial Energy Efficiency, Cogeneration and Climate Change

2 - 3 December 1999, Vienna

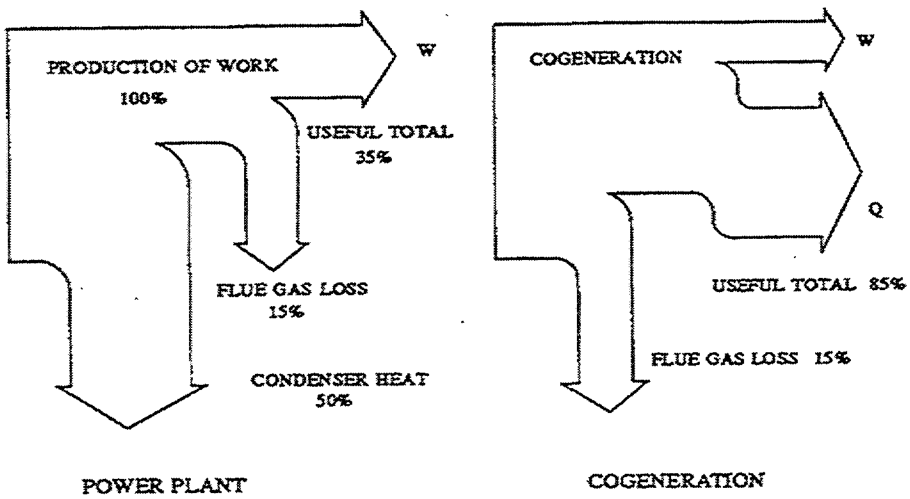
Biomass Cogeneration in ASEAN, GHG Mitigation Potential and the Barriers

Dr. Ludovic Lacrosse, Arul Joe Mathias
EC-ASEAN COGEN Programme

COGEN

Slide 2

CONVENTIONAL POWER GENERATION AND COGENERATION



Slide 3

BIOMASS COGENERATION - APPLICATIONS

- LARGE WOOD AND AGRO-INDUSTRIAL SECTORS
  - ASEAN countries are world leaders in many sectors
- EC-ASEAN COGEN PROGRAMME FOCUSES ON FOUR SECTORS
  - Rice
  - Sugar
  - Palm Oil
  - Wood

COGEN

Slide 4

WOOD AND AGRO-INDUSTRIES - COMMON PRACTICE

- Power requirements
  From grid or diesel genset(s) or inefficient biomass plant
- Process heat requirements
  From oil boiler(s) or inefficient biomass boiler(s)
- Biomass residues
  Dumping, open-burning, incineration or
  inefficient biomass boiler(s)

COGEN

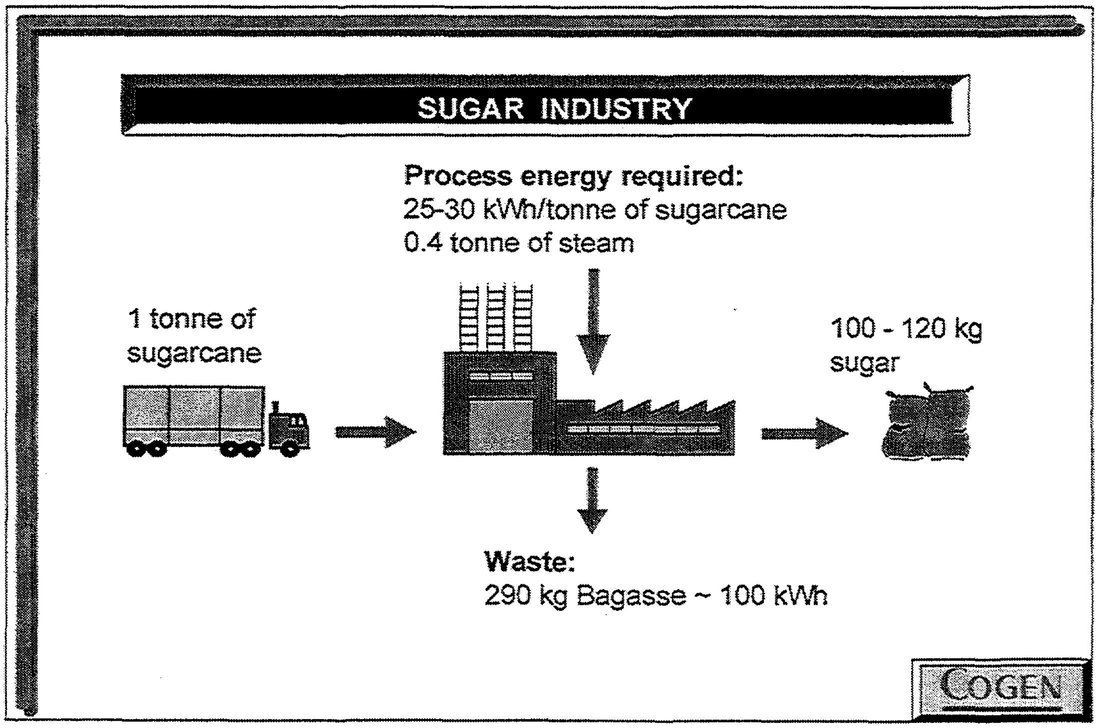
Slide 5

BIOMASS COGENERATION - CURRENT STATUS

- Technology
  Most advanced technologies are available
- Economic viability
  Pay-back period ranges from 2 to 5 years
- Environmental performance
  Local, regional and global benefits
- Others
  Sustainable development

COGEN

Slide 6



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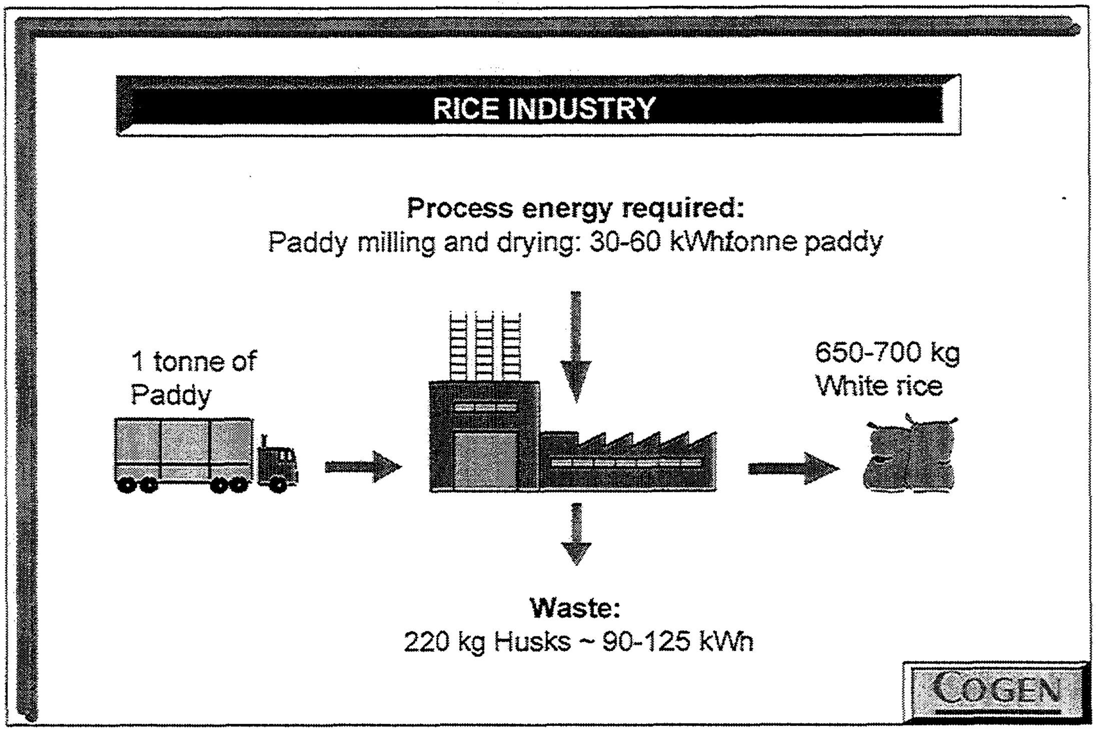

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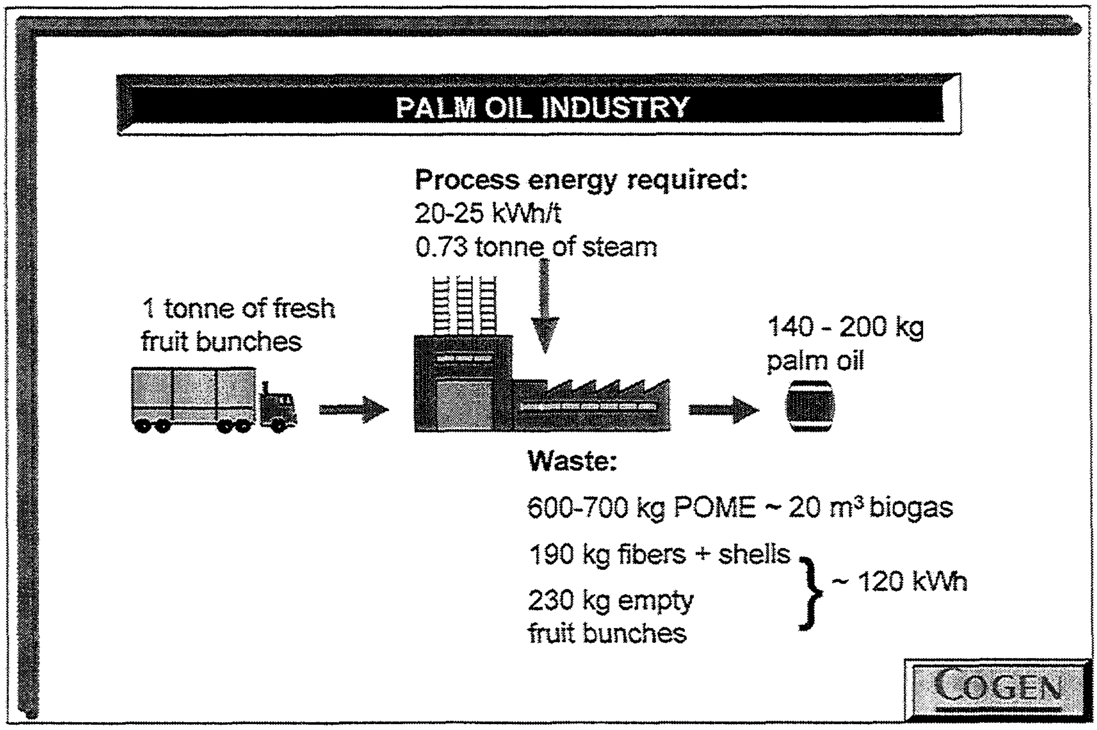

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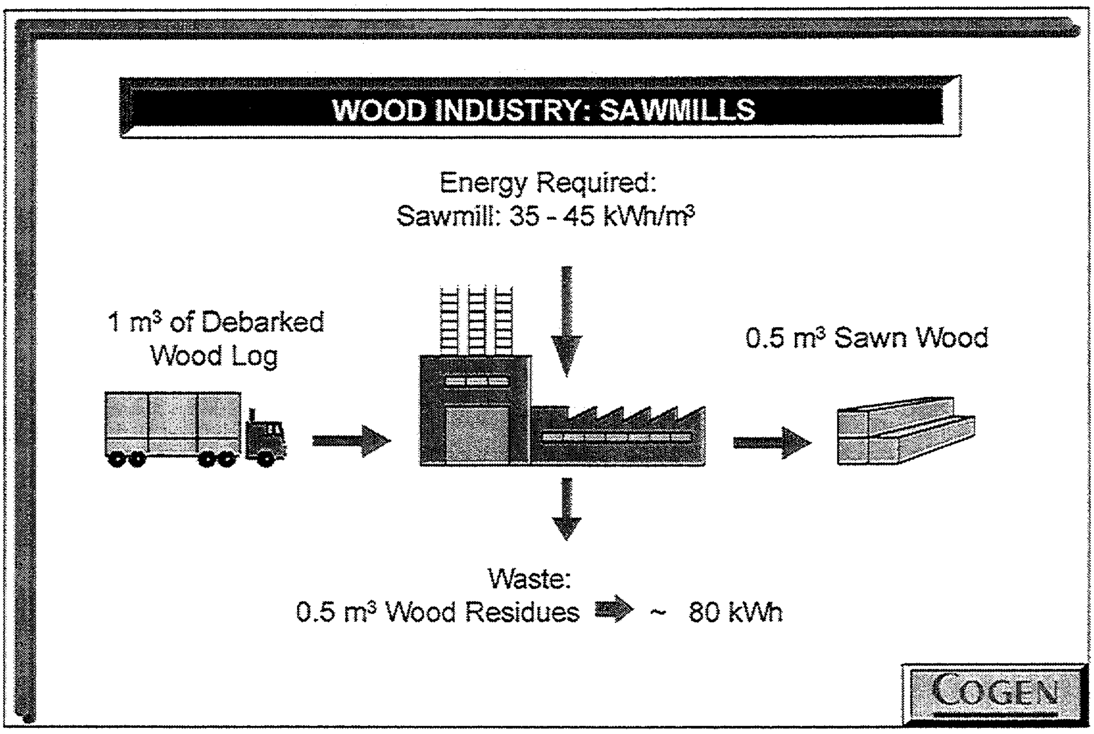

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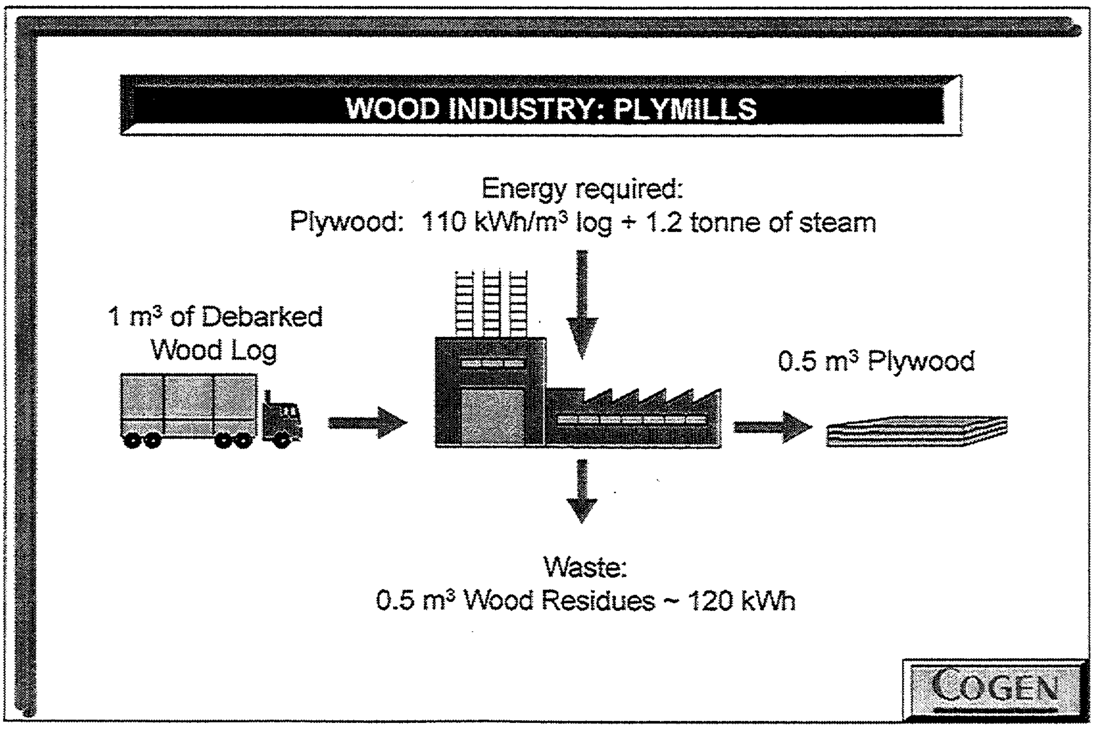

Slide 11

ENVIRONMENTAL IMPACT OF BIOMASS COGENERATION

- Substitution of fossil fuels
- High energy efficiency leads to less emissions
- Less contribution to acid rain phenomenon
- Significant reduction in greenhouse gas emissions
- Elimination of unwanted solid wastes

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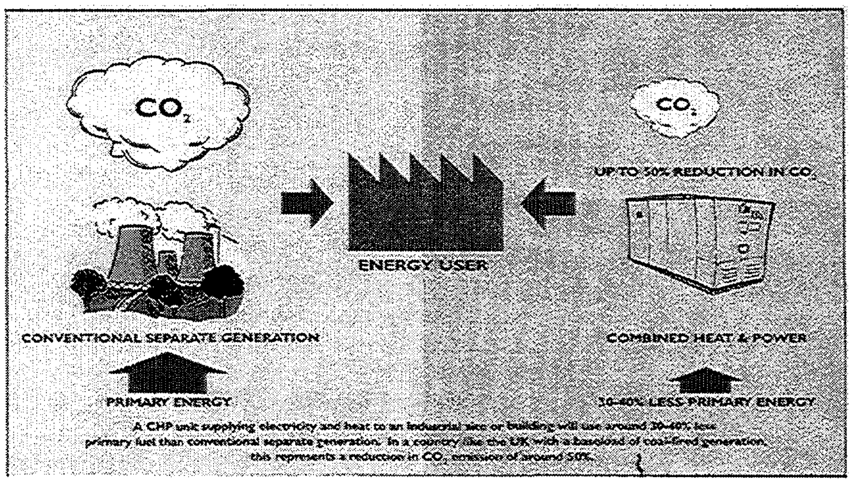
Slide 12

ENVIRONMENTAL IMPACT OF BIOMASS COGENERATION



Source: Joule Thermie, 1997

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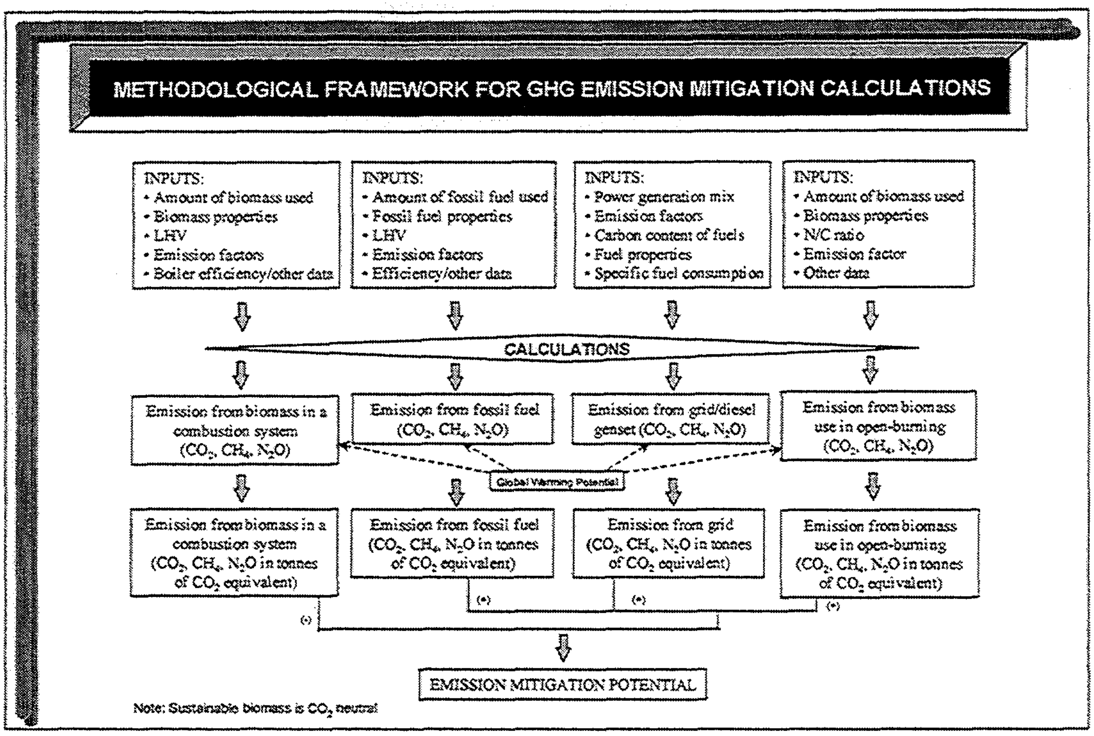

Slide 14

METHODOLOGICAL FRAMEWORK FOR GHG EMISSION MITIGATION CALCULATIONS

Type of application	Base case emission (A)	Alternative case emission (B)	Emission mitigation potential
Heat only	Emissions from Biomass boiler	Emissions from fuel oil boiler Emissions from open burning of biomass	B - A
Power only	Emissions from Biomass boiler	Emissions from grid and/or diesel genset Emissions from open burning of biomass	B - A
Cogeneration	Emissions from Biomass boiler	Emissions from fuel oil boiler Emissions from grid and/or diesel genset Emissions from open burning of biomass	B - A

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CALCULATIONS FOR NATIONAL GRID EMISSIONS - DATA REQUIRED

- Efficiency of coal, diesel, fuel oil and natural gas power plants
- Lower heating values of fuels
- Carbon content of fuel
- Specific fuel consumption (kg/kWh)
- Emission factors for utility boiler in kg/TJ
- Electricity generation mix for the country
- Transmission and distribution loss

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ASEAN ELECTRICITY GENERATION MIX

Country	Hydro %	Geothermal %	Fuel oil %	Diesel %	Natural gas %	Coal %
Indonesia	14	2.8	28.21	28.01	10.51	16.48
Malaysia	10.9	0	21.1	2.6	55	11
Philippines	22.08	20.9	28.69	19.29	0	9.04
Thailand	4.5	0	28.28	2.58	45.74	18.9
Singapore	0	0	68.2	1.6	30.2	0

Source: AEEMTRC, 1996

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ASEAN GRID EMISSION FACTORS

Emission	Indonesia	Malaysia	Thailand	Philippines	Singapore
CO_2 (kg/kWh)	0.657	0.596	0.687	0.458	0.692
CH_4 (mg/kWh)	7.75	8.47	9.06	5.25	9.14
N_2O (mg/kWh)	4.78	3.07	4.50	3.12	2.40
NO_x (g/kWh)	1.77	1.73	1.90	1.22	1.94
SO_x (g/kWh)	2.02	1.03	1.52	1.55	1.84
CO (g/kWh)	0.28	0.37	0.42	0.15	0.24
NMVOC (mg/kWh)	41.75	43.56	46.82	28.65	49.20

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EMISSION FACTORS

- CO_2 emission depends on:

  Amount of carbon content in fuel

- SO_x emissions depends on:

  Amount of sulphur content in fuel

- Other emissions depends on:

  Fuel type, technology, operating conditions

  Maintenance and vintage of technology

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Slide 19

CASE STUDY OF A WOOD WASTE-FIRED COGENERATION PLANT

Current scenario:	1.5 MWe wood waste-fired cogeneration
Old use of residues:	Open-burning
Alternative scenario:	Diesel genset for power generation + fuel oil boiler for heat requirements
Quantity of residues used:	31,640 tonnes per year
Quantity replaced:	
- Diesel power	10,125,000 kWh/year
- Fuel oil	2,251 tonnes/year

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CASE STUDY OF A WOOD WASTE-FIRED COGENERATION PLANT

Emission Mitigation Potential

CO_2 emission reduction potential	tonne/year	14112.36
CH_4 emission reduction potential	tonne/year	72.34
N_2O emission reduction potential	tonne/year	0.34
GHG emission reduction potential	tonne of CO_2 eq./year	15731.04
CO emission reduction potential	tonne/year	1423.18
NMVOC emission reduction potential	tonne/year	4.92
NOx emission reduction potential	tonne/year	199.88
SOx emission reduction potential	tonne/year	115.10

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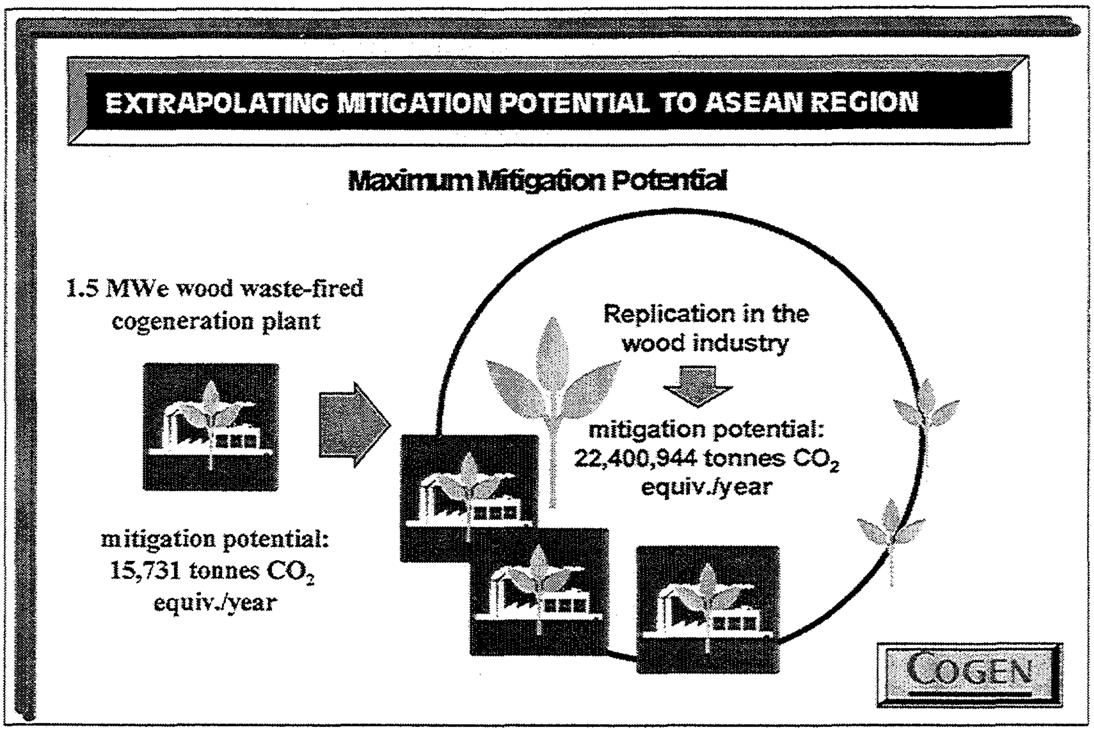

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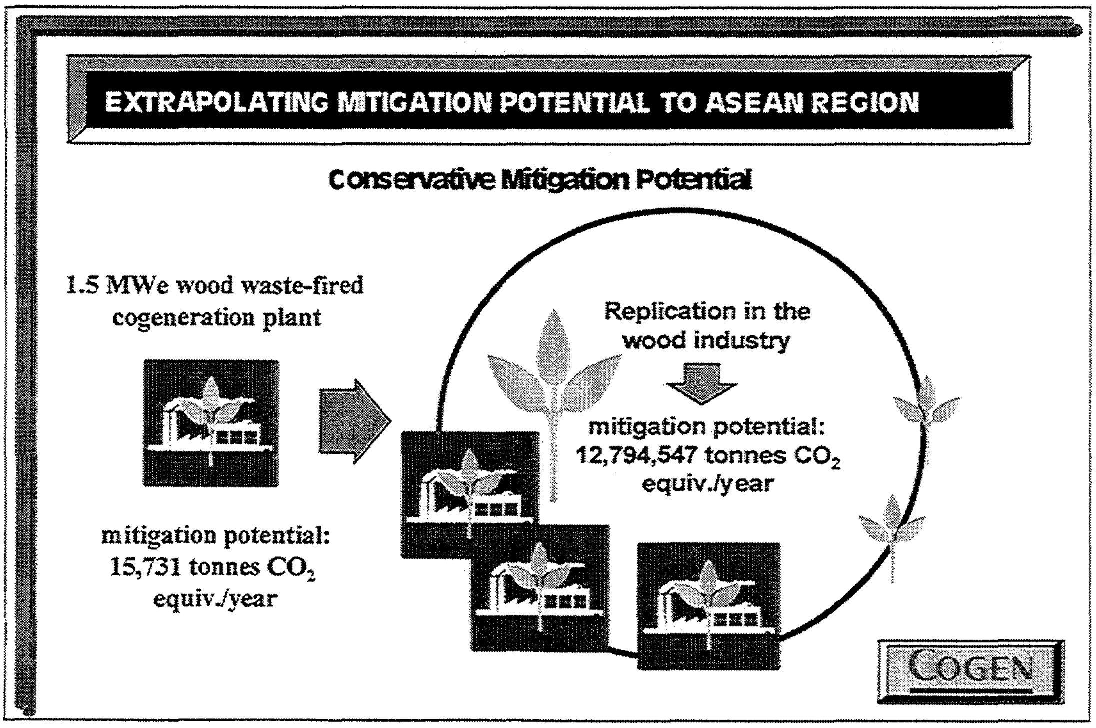

Slide 23

CASE STUDY OF A RICE HUSK-FIRED COGENERATION PLANT

Current scenario:	2.5 MWe rice husk-fired cogeneration
Old use of residues:	Open-burning
Alternative scenario:	Grid for power requirements + fuel oil boiler for heat requirements
Quantity of residues used:	34,919 tonnes per year
Quantity replaced:	
- Grid power	16,875,000 kWh/year
- Fuel oil	661 tonnes/year

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CASE STUDY OF A RICE HUSK-FIRED COGENERATION PLANT

Emission Mitigation Potential

CO_2 emission reduction potential	tonne/year	14762.30
CH_4 emission reduction potential	tonne/year	74.93
N_2O emission reduction potential	tonne/year	0.16
GHG emission reduction potential	tonne of CO_2 eq./year	16382.30
CO emission reduction potential	tonne/year	1441.57
NMVOC emission reduction potential	tonne/year	1.00
NOx emission reduction potential	tonne/year	81.26
SOx emission reduction potential	tonne/year	54.56

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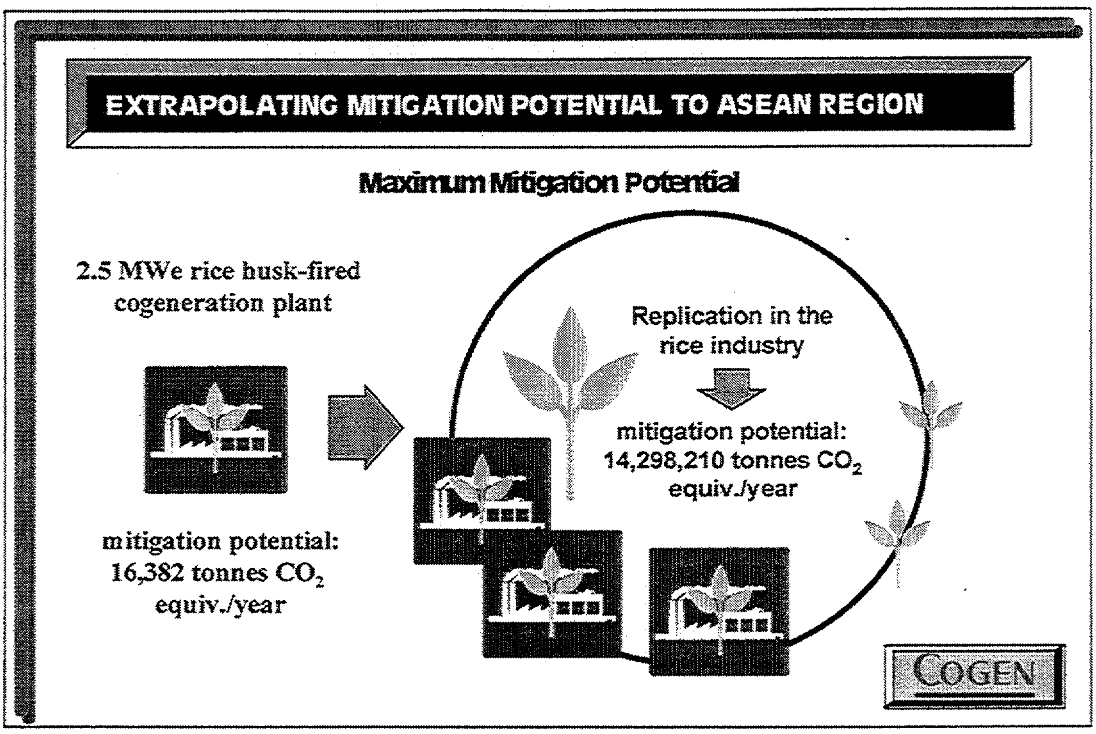

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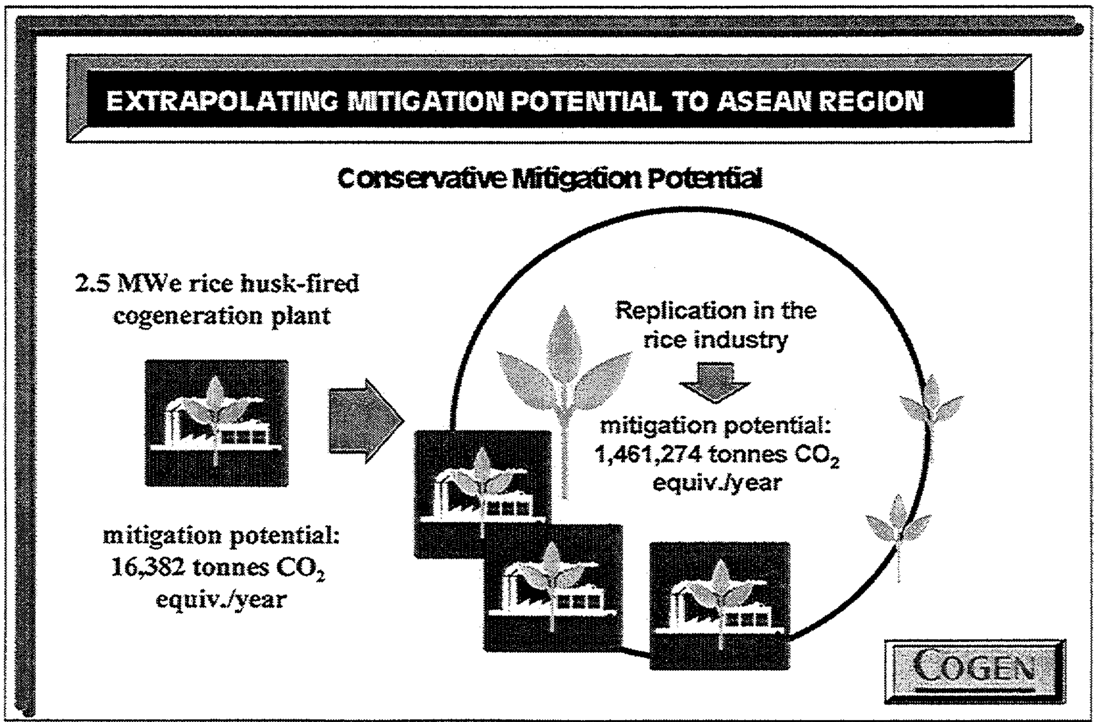

Slide 27

Barriers and Possible Solutions

• lack of successful references	⇒ implementation of demonstration projects
• seen as complicated to operate	⇒ suppliers to simplify operation; training of operators
• the quality of biomass as a fuel is not homogeneous	⇒ adequate fuel preparation

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Barriers and Possible Solutions

• energy not a core business of potential users	⇒ create awareness of benefits and opportunities
• risk of being the first to fail	⇒ references in similar environment; demonstration projects

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Barriers and Possible Solutions

• lack of institutions giving information and advice	⇒ strengthening of relevant networks
• lack of awareness among users on government rules and incentives	⇒ information drive
• not enough technical and economic information to make a decision	⇒ availability of funds or services to conduct feasibility studies

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Barriers and Possible Solutions

• structure of the industry - size of mills - transportation problems - seasonality	⇒ thorough investigation of these aspects in the feasibility of projects
• uncertainty of biomass fuel supply	⇒ initiatives to boost yield and productivity
• policy, legal and government issues	⇒ government incentives/ support measures?
• financial barriers	⇒ innovative financial strategies; government incentives?

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CONCLUSION

After having been demonstrated that clean and efficient biomass cogeneration projects are technically reliable and economically viable, ASEAN governments are now setting up the right institutional framework to encourage the implementation of such projects. Let us hope that this will help tap this huge renewable energy potential.

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5. Energy Efficiency Improvement & Greenhouse Gas Reduction Project – GEF/UNDP

Dr. A. Khozam, General Manager, Mideast Energy & Environment Services

INTRODUCTION

The duration of project execution is four years and six months with total budget of around 5.9 million USD, of which the Global Environmental Facility (GEF), UN Development Program (UNDP) as well as the Egyptian government shared the costs.

OBJECTIVES

The overall objective of the project is to assist Egypt to reduce the long term growth of GHG emission from electric power generation and from consumption of non-renewable fuel resources. This will be achieved through the following:

- Supporting efficiency improvement and loss reduction in generation transmission and distribution of electric power
- Facilitating adoption an implementation of energy conservation measures in residential, commercial and industrial sectors through education, promotion financing and standard-setting activities.
- Stimulating and guiding the private sector in the development of capability for end sue energy efficiency service planning, feasibility analysis, conceptual design and project implementation including manufacture of energy efficient products.
- Assist in international and regional transfer of technology and experience that could be instrumental in GHG emissions reduction.
- Promoting public and private sector investment in energy projects that are beneficial for the global environment.

PROJECT COMPONENTS

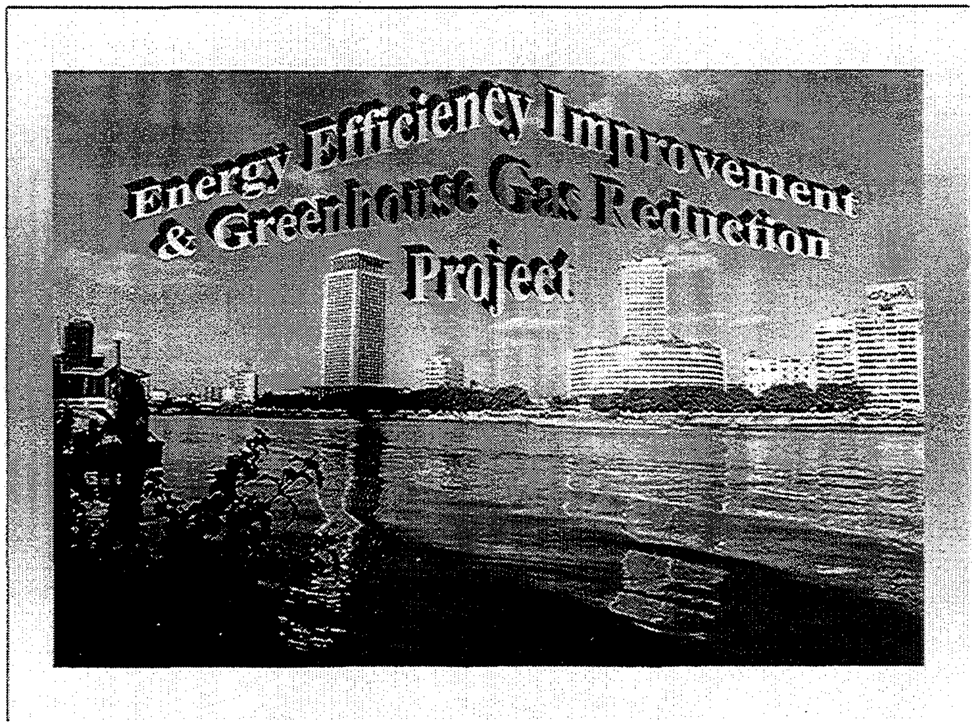
Component 1: Loss reduction. Load shifting and load management in the UPS
Component 2: Energy efficiency market support
Component 3: Cogeneration

EXPECTED RESULTS

With the adoption of developed measures, the full impact of the project activities is expected to be achieved by the year 2010. Energy savings and CO_2 emissions reduction by that year from the project components are expected to be as follow:

GEF-UNDP Project Improvement in Egypt	Savings % of Total Energy Consumption	CO_2 Reduction
Component 1	0.4 %	0.48 M tons
Component 2	7.4 %	8.25 M tons
Component 3	2.7 %	3.00 M tons

Slide 1



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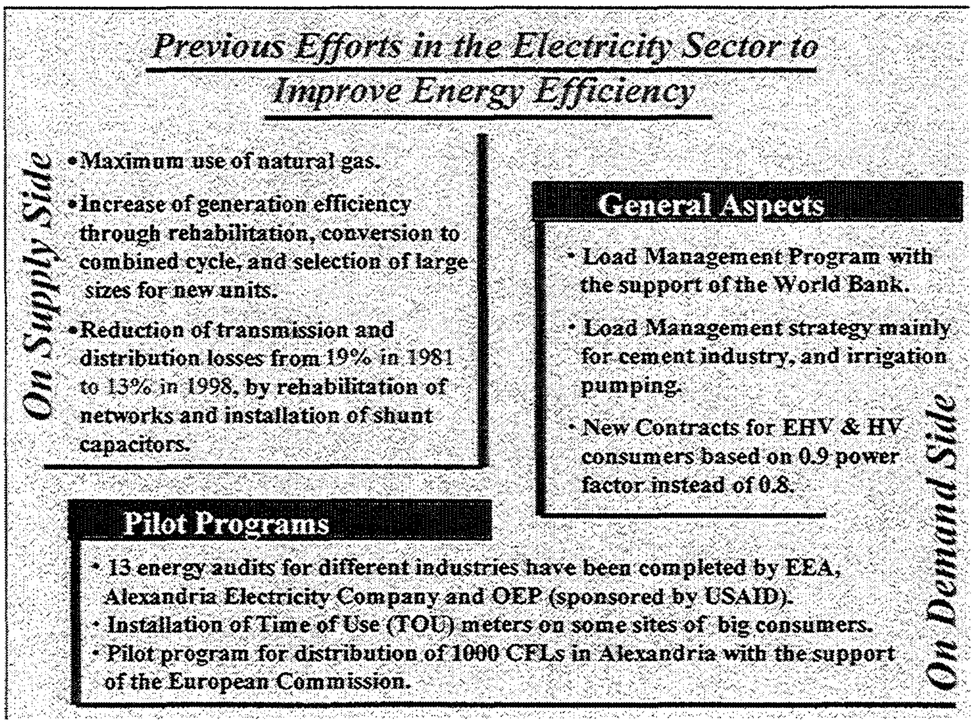

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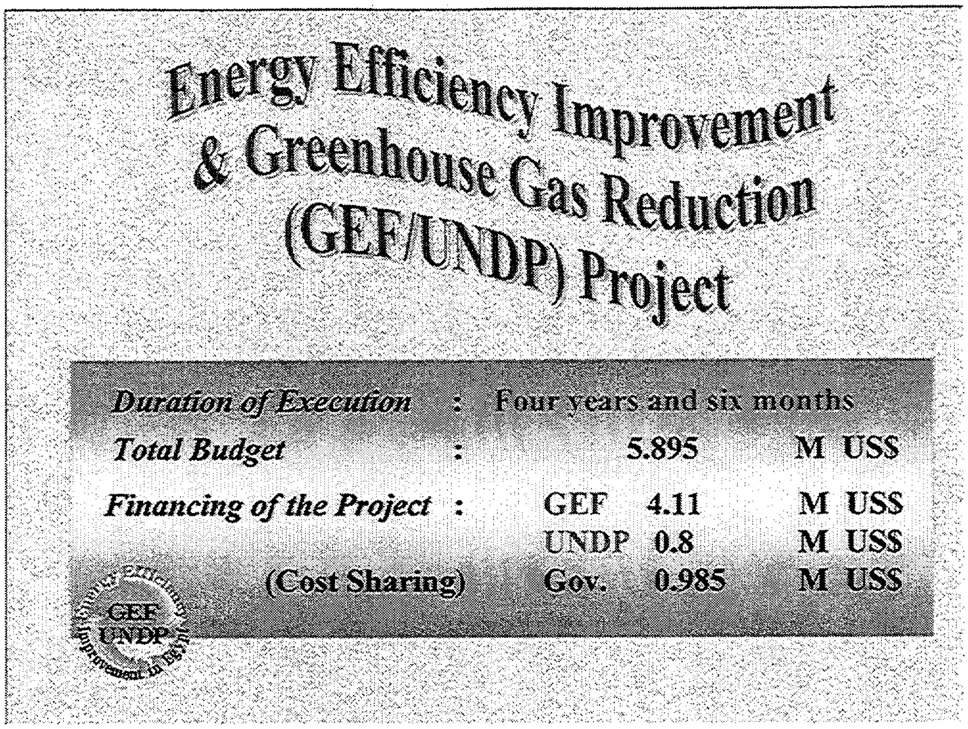

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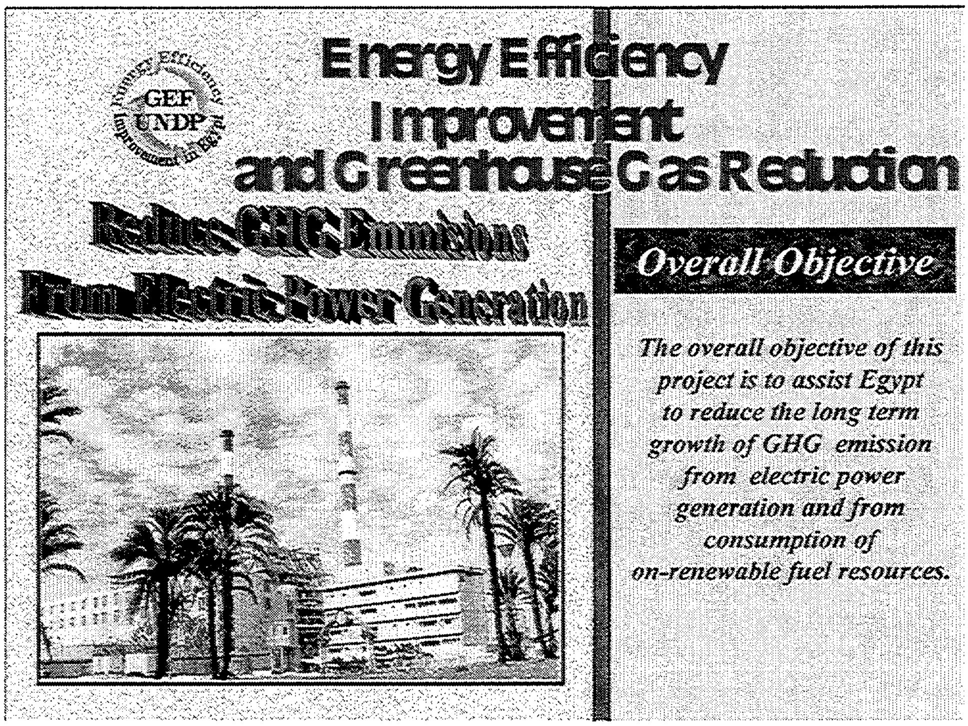

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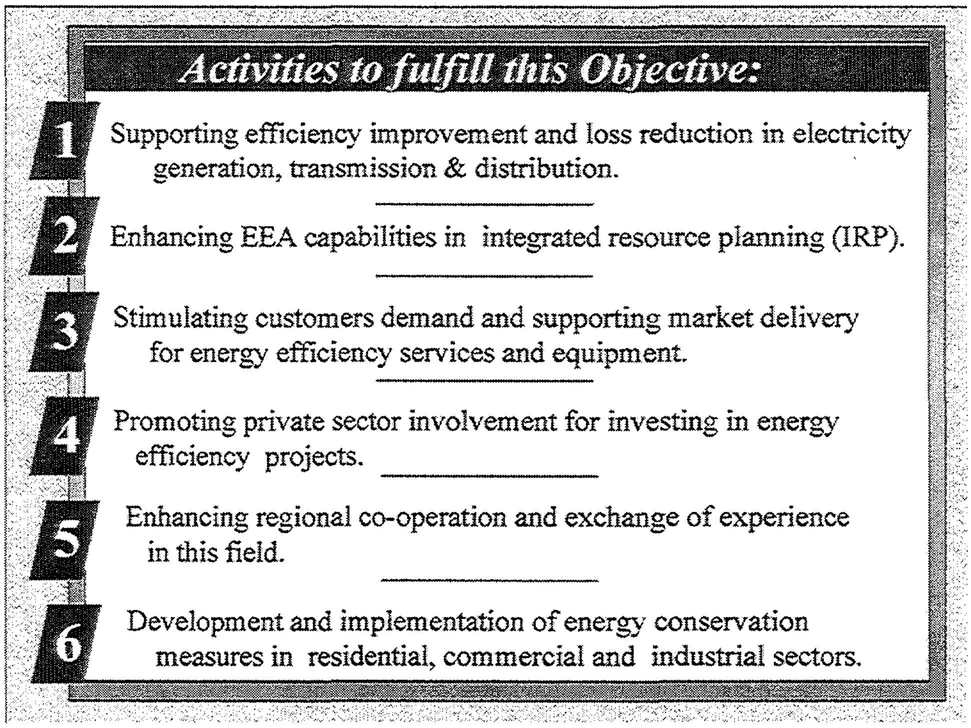

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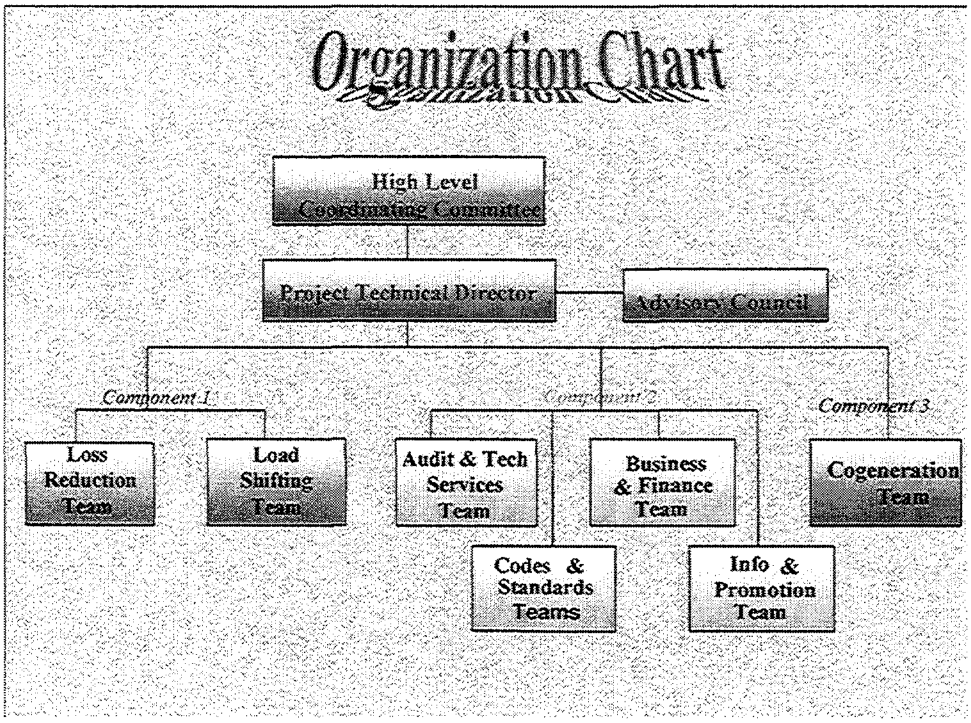

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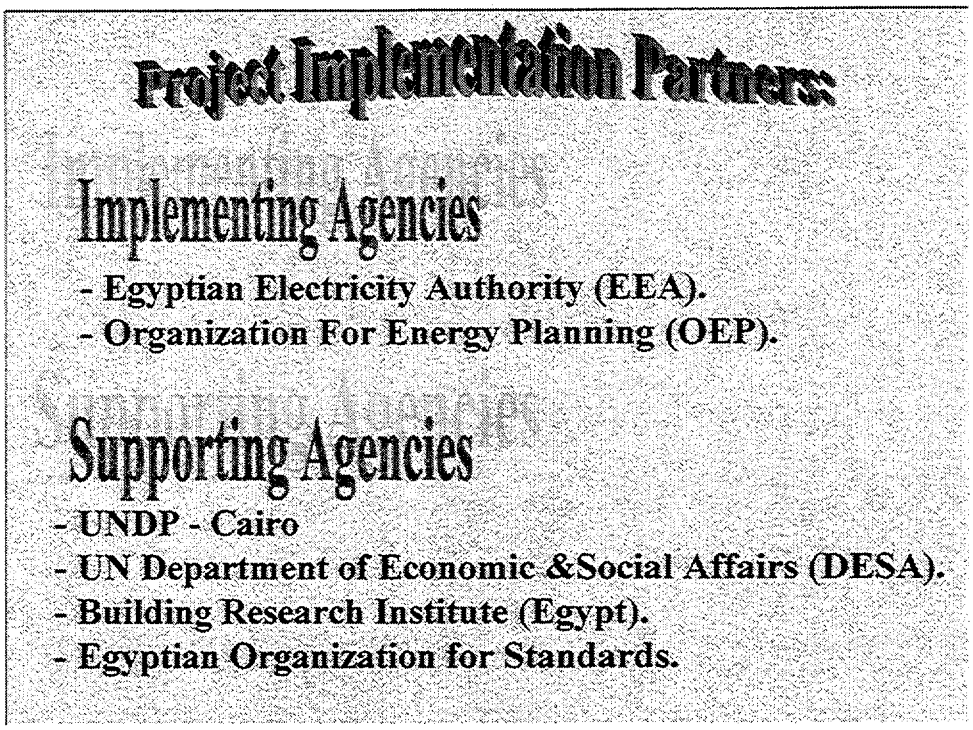

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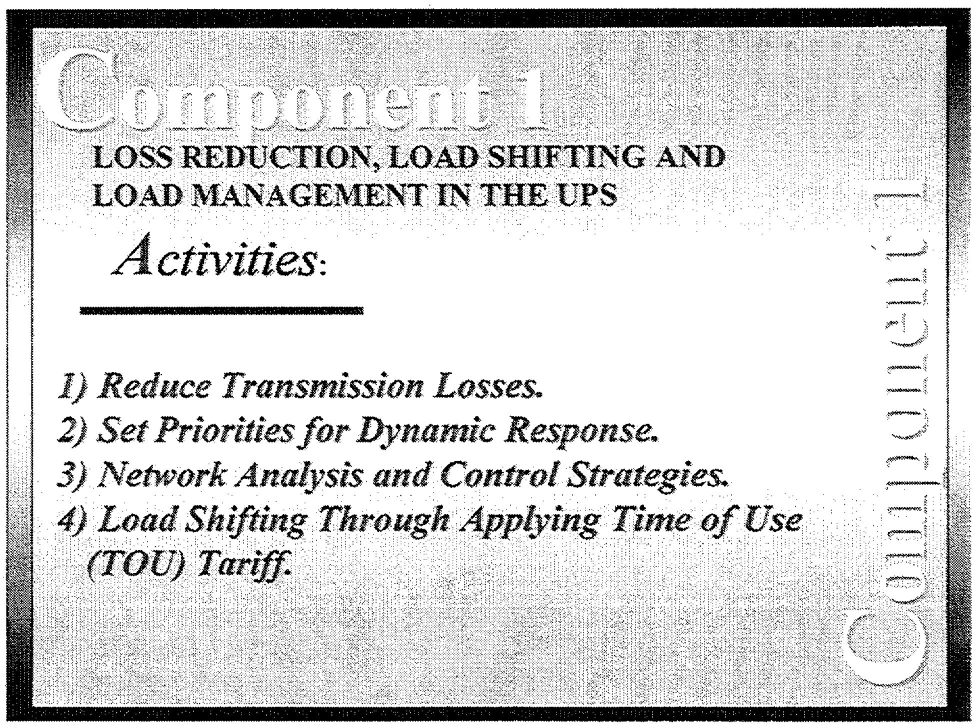

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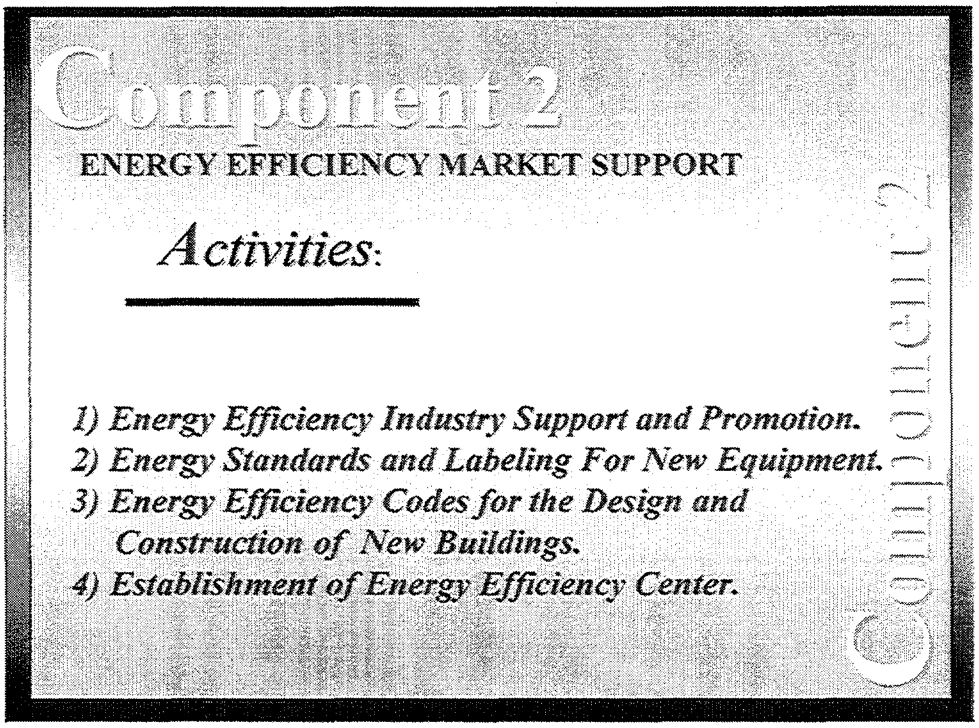

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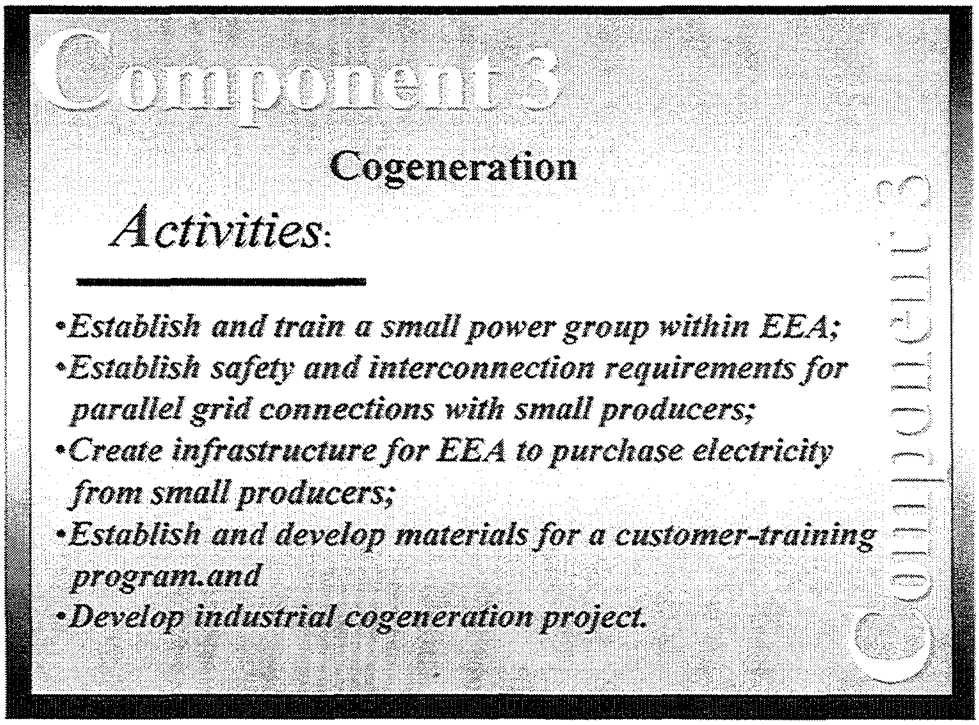

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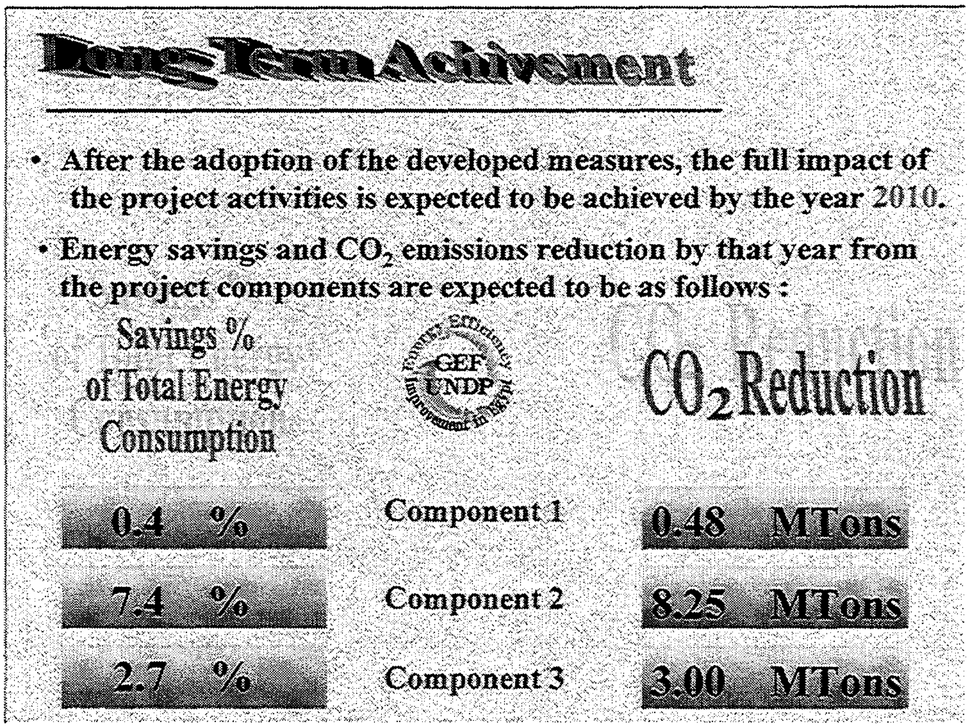

Long Term Achivement
• After the adoption of the developed measures, the full impact of the project activities is expected to be achieved by the year 2010.
• Energy savings and CO_2 emissions reduction by that year from the project components are expected to be as follows :
Savings % of Total Energy Consumption
Energy Efficiency Improvement in Egypt
GEF UNDP
CO_2 Reduction
0.4 %
Component 1
0.48 MTons
7.4 %
Component 2
8.25 MTons
2.7 %
Component 3
3.00 MTons

SESSION IV. REMOVING BARRIERS TO COGENERATION & INDUSTRIAL ENERGY EFFICIENCY: TECHNOLOGY, FINANCIAL, POLICY, REGULATORY & CAPACITY BUILDING ISSUES

1. Introduction: A Major Challenge and Opportunity for Central and Eastern Europe

Dr. S. Minett, Director, Cogen Europe, Brussels

TRENDS & POTENTIAL

Western Europe is undergoing liberalisation and greater decentralisation. Moreover, various measures are being investigated as well as being initiated in response to Kyoto. Central and Eastern Europe (CEE) and Commonwealth of Independent States (CIS), however, are in accession and investing in building their infrastructure.

CHP is nothing new in the transition countries with countries such as Estonia at 39% of national power production coming from cogeneration.. However, many needs upgrading and new infrastructure needs massive investment as well as fuel supply issues and political structure in need of reform.

Cogen Europe's estimates on cogeneration potential for some CEE countries are as follows:

Poland	15,000Mwe
Ukraine	40,000MWe
Hungary	40% of demand (2,500MWe)

HUNGARY & POLAND

Hungary produces 7,500 Mwe and 30TWh/yr of electricity with cogeneration currently constituting 11% of electricity. It has restructured its energy sector. Hungary's energy policy goals include reducing import dependence, restricting control to a minimum, improving energy efficiency, liberalise tariffs to reflect economic costs, environmental priorities, moving to the market economy and adopting least cost solutions. However, there are many difficulties obstructing the wide spread of efficient CHP usage.

Poland, however, has 80 years of congeneration history. First industries to adopt cogeneration are sugar,, chemicals and mining industries. District heating also grew from the 1950's especially in the large urban areas.

PROBLEMS

Problems with CHP is that industrial CHP is not fully used due to market constraints, and some industrial schemes are closing. Moreover, some of the district heating CHPs are not full CHPs and much of the CHP in CEE regions is coal-fired and not best in class. The investment climate is improving but very slowly.

Slide 1

COGENERATION
A Major Challenge and Opportunity for Central and Eastern Europe

Dr Simon Minett

Director

COGEN Europe

Slide 2

Qualifications

- Worked in Ukraine, Belarus
- Directed staff working in Russia, Slovenia, Poland, Hungary, Romania and Estonia
- Market Prospects for Cogeneration in Poland, Hungary and Czech Republic
- Membership for COGEN Europe
  - National Members in Slovenia, Estonia, Hungary, Poland, Croatia and Czech Republic
  - ESCOs
  - Links to all the other countries in Region

Slide 3

COGEN EUROPE

- European Trade Association for CHP
- 195 Members
- 30 Countries
- Promotion of Cogeneration
- Climate Change
- Reducing Barriers
- Studies/Literature

Slide 4

Coverage

- Trends
- The Challenge
- Hungary
- Role of ESCOs
- Getting the Policy Right
- Be Bold!

Slide 5

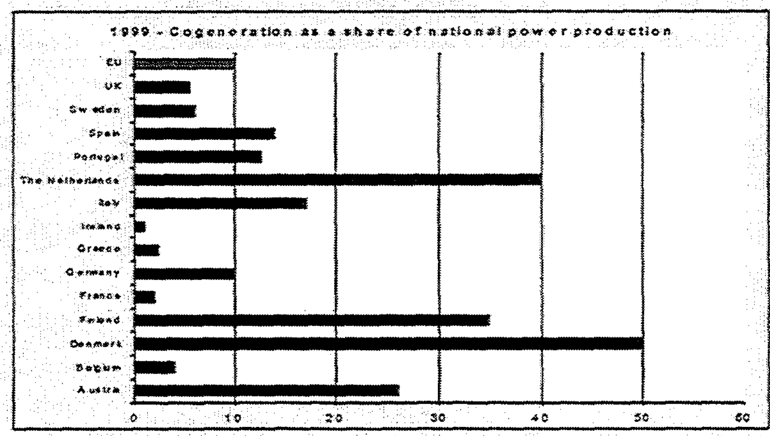
Trends

- Europe
  - Liberalisation
  - Greater Decentalisation
  - Response to Kyoto
- Central & Eastern Europe and CIS
  - Accession
  - Investment in Infrastructure
  - District Heating versus Point of Use

Slide 6

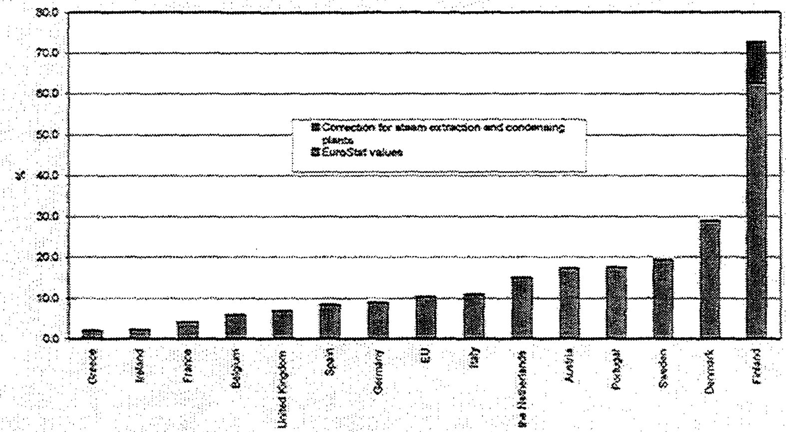
CHP in Europe

(% of generation)



Slide 7

Share of CHP in Heat Production 1994



Source: Eurostat/1994 Combined Heat and Power Plant Statistics in the EU (Working Paper) and Statistics, Finland

Slide 8

CHP in Transition Countries

Cogeneration as a share of national power production

Bulgaria	13%
Croatia	10.1%
Czech Republic	10%
Estonia	39%
Hungary	10%
Latvia	31%*
Lithuania	10%*
Poland	15.4%
Romania	n.a
Slovakia	n.a
Slovenia	4.5%

* Figures correspond to share of installed capacity and not share of electricity production.

The figure on Estonia corresponds to share of production from CHP plants, but part of this might not have been produced in a cogeneration mode.

Slide 9

Scale of the Challenge

- Infrastructure needs massive investment
- Modernisation of industry, bankruptcy and markets
- 185 million on District Heating
- Fuel Supply issues
- Political Structures in need of reform

Slide 10

Scope for Savings

• District Heating	30-60%
• Building Energy Use	20-40%
• Industrial Energy Use	10-30%
• Electricity Distribution	10-20%
• Electricity Generation	10-12%

Slide 11

Potential

- COGEN Europe's estimates
- Poland 15.000 MWe
- Ukraine 40.000 MWe
- Hungary 40% of demand = 2.500 MWe
- Official Forecasts
- Poland 20-30% (now 10%)

Slide 12

Focusing on Hungary

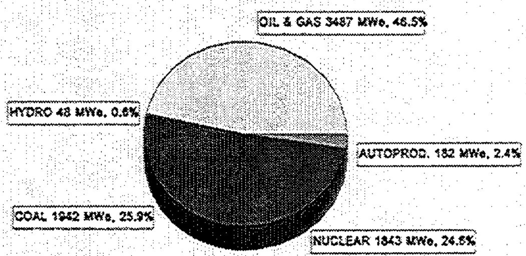
- Dynamic Country in first wave for EU
- Electricity 7.500 MWe and 30 TWh/yr
- Gas 12 million cubic metres, 40% of energy
- District Heating 108 localities, 8.400 MWth
- Cogeneration currently 11% of electricity
- Restructured energy sector

Slide 13

Hungary's Electricity Sector

Installed power capacity

1 January 1998 - Total: 7502 MWe



Slide 14

Hungary's Energy Policy

- Goals
  - reduce import dependence
  - restrict control to a minimum
  - improve energy efficiency
  - liberalise tariffs to reflect economic costs
  - environmental priorities
  - move to the market economy
  - adopt least cost solutions

Slide 15

Difficulties

- Prices for gas and electricity are unfavourable for cogeneration
- No capacity fee
- Partial reform of the energy prices
- Restrictions on the use of gas
- Attitudes to District Heating - old regime
- Non payment of heating bills

Slide 16

Potential

- Cogeneration on DH 1.800 MWe
- Cogeneration in industry 450 MWe
- Cogeneration in tertiary sector > 300 MWe
- Current capacity ~ 800 MWe
- Potential = 40% of demand

Slide 17

Poland in Perspective

- 80 years of cogeneration history
- First installed in industry: sugar, chemicals and mining
- District Heating growth from 1950, especially the large urban areas such as Warsaw, Wroclaw and Gdynia
- Now 3.000 MWe in industry and 4.800 MWe on District Heating

Slide 18

Cogeneration's Share

- Total installed capacity - 33.717 MWe
- CHP on District Heating - 4.800 MWe
- CHP in Industry - 3.000 MWe
- Total CHP - 7.800 MWe = 23%
- Total production - 142.769 GWh
- CHP Production - 22.050 GWh = 15%

Slide 19

Problems with CHP

- Statistics:
  - Industrial CHP is not fully used due to market
  - Some industrial schemes are closing
  - Some of the DH CHP is not full CHP
- True CHP share of market is nearer 10%
- Much of the CHP is coal-fired and not best in class
- The investment climate is improving slowly, but...

Slide 20

Energy Scene

- New Energy Law in place,
- Secondary legislation mostly complete
- Still political interference in tariffs
- Tariffs are not fully cost reflective, but they are improving,
- Principles for independent generation in place
- Public perception that DH is the past

Slide 21

New Projects

- Katowice 120 MWe coal cogeneration scheme due in November 1999
- Jaworzno III 140 MWe coal cogeneration due September 1999
- Gorgow 55 MWe gas CCGT cogeneration handed over in January 1999.

Slide 22

Potential

- Major potential for cogeneration on the District Heating through re-powering of DH boiler houses.
- Question mark over decentralised CHP.
- As the Polish industry picks up major opportunities in this sector too.
- We estimate potential is at least 50% of electrical demand = 15.000 MWe

Slide 23

What Should be Done?

- Set the right frameworks - regulatory and legislative
- Address all the issues affecting cogeneration
- Encourage and ensure the conditions are right for foreign investment
- Develop a strategy and set a target

Slide 24

Role of ESCOs

- Transfer of technology from west to east
- Financing of energy projects and CHP
- EBRD support
- Players - Honeywell, Landis&Gyr, Compagnie Generale de Chauffe and ESCO International,

And more....?

Slide 25

Policy Actions

- Electricity Regime
- Heat Regime
- Planning, Taxation, Environment
- Investment Climate
- Reduce Barriers
- Co-ordinated Promotion

Slide 26

The Next Few Years Are Critical

- Debate between District Heating, Decentralised Cogeneration and Centralisation of Electricity
- Set Targets
- Get the Investment Climate Right
- Cogeneration has a major role to play in changing the economic well being of the region

Slide 27

Boldness is necessary!

- This is not an academic exercise
- Cogeneration is a key part of realising the EU's legally binding commitments made in Kyoto
- The Strategy target to double cogeneration must therefore be achieved
- We MUST find the will to achieve growth in the new liberalised world

Slide 28

Be Bold

- There are 10 years left to double cogeneration's share of the market.
- This is 60-70.000 MWe in the EU 15
- Plus 20.000 MWe replacement of existing plant
- Plus Transition Economies (0 to 30 GWe)
- Thus ~ 100 GWe or 10.000 MWe per year
- Around 4 times current activity

2. Panel Discussion on Barriers to Energy Efficiency & CHP: A Brief Summary

Dr. Minett opened the meeting by providing an overview of the opportunities for and challenges to cogeneration in Eastern and Central Europe. Using the examples of Hungary and Poland, he commented on the current share of cogeneration in energy production and on the prospects for deploying additional cogeneration capacity given the trends in the energy policies, environmental priorities and regulations of these countries. He stressed the importance of cogeneration as a key technological opportunity for countries with quantified emissions limitations and reductions objectives (QELROS) to meet their commitments and for contributing to the sustainable development of non-Annex I countries through the CDM.

The discussion lead to the fact that despite cogeneration and other energy technologies with a high generating efficiency are economically and environmentally advantageous, their large-scale deployment had not occurred in developing countries. This is due to barriers that participants described as financial, regulatory and related to information, market organization and price distortions. Technical barriers were also addressed, although they are few in number and are primarily caused by synchronization problems with the grid and with production processes.

The comment was made that, given the barriers, the rapid and widespread deployment of technologies offering greater efficiency in generation and industrial end-use would require the development and implementation of supportive programmes and policies. These would involve the private and public sectors, bilateral and multilateral techno-economic cooperation programmes, national and international industrial associations and coalitions, and other stakeholders supporting the deployment of energy technologies.

Barriers to biomass cogeneration were addressed in some detail in the presentation by the EC-ASEAN COGEN programme. The focus on biomass cogeneration illustrated the fact that, although market barriers can be described in generic terms and to some extent are common across various technology deployment profiles, they are best understood in relation to particular technologies. The presentation provided valuable information on the technical, economic and environmental aspects of biomass cogeneration and a comprehensive review of the barriers to deployment as well as possible solutions for the removal of such barrier.

Using data and analyses based on concrete case studies in biomass cogeneratin in the sugar, rice, palm-oil and wood industries, the presentation discussed the economic and environmental impacts of biomass cogeneration and provided a methodological framework for GHG emissions mitigation calculations resulting from biomass cogeneration projects, carefully separating all the input data required for the calculation of emissions from each sub-system and clearly showing the baseline emissions profile that is directly impacted by the project.

The presentation also provided some useful data on the ASEAN electricity generation mix, ASEAN grid emissions factors, and the mitigation potential of various sub-sectors (such as the wood industry and the rice industry) as well as sector-specific barriers and possible solutions for their removal, including such enterprise-specific barriers as "the risk of being the first to fail" and "energy not being a core business of the industrial user". The degree of specificity derived from concrete examples based on biomass cogeneration made this presentation particularly useful for the analysis of barriers to cogeneration technologies since it went beyond the generic set usually comprised of the financial, information, cost and other barriers common to other energy technologies.

The following barriers to successful dissemination of energy efficiency and cogeneration technologies have been pointed out during the discussion:

- Inadequate information and data base generation and dissemination
- Inadequate capacity building of the stakeholders
- Lack of demonstration models, sector specific energy efficiency improvement projects, i.e., lack of successful references.
- The market is still unaware of CHP technology developments that have expanded the potential for CHP, and CHPs are considered as complicated to operate
- The quality of some energy sources (for example biomass) as a fuel is not homogeneous
- Lack of institutions giving information and advice
- Not enough technical and economic information to make a decision
- .Inadequate financing instruments and mechanisms for implementing energy efficiency projects, including ESCO's, insurance, project development and low cost financing.
- Energy prices, since the public sector companies receive a large subsidy than private sector companies
- Ill-defined new policy or legislation regarding private power.
- Insufficient recognition by the current regulations on the overall energy efficiency of CHP or the avoided emissions from displaced grid electricity generation.
- Lack of "track record" as CHP applications are not widely known outside the industrial sector, which poses barriers in terms of policy making and financing, since both government officials and bankers are unfamiliar with the concept.
- Very low tariffs for surplus cogenerated electricity sold to the grid.
- Lack of incentives for CHP producers

To alleviate these barriers, Dr. Minett concluded the discussion by conveying the importance of acknowledging the benefits, setting strategies and targets, getting affiliated industries aligned and implementing long-term planning. In addition, it is important for the government to set examples and give out signals to the market.

SESSION V. DEVELOPING PROJECTS IN ENERGY EFFICIENCY & COGENERATION FOR CDM & JI: ISSUES & ANALYSIS

1. The Environmental Manual: A Tool for Analysis of Energy Efficiency Projects

Mr. U. Fritsche, Co-ordinator, Energy & Climate Division, Öko-Institut, Germany

OVERVIEW OF THE EM PROJECT

Since the early 1970's, concerns on environmental impacts of energy technologies have been raised world-wide, and there are different areas of environmental problems associated with energy:

To deal with these problems, one needs knowledge about energy and the environment - and it is no easy task to consistently manage these data together with the cost implications of alternative options.

In 1990, German GTZ together with the World Bank, and other donor agencies jointly started to develop a computerized tool for this task - Oeko-Institut gave scientific support for the model and data development.

The model was called "Environmental Manual for Power Development (EM)" which should help in the evaluation of lending projects, and also help partners in developing countries to manage energy/environmental problems, and their associated costs.

After a couple of years of development, testing, and case studies, the first version of this tool - the EM version 1.0 - was introduced in 1995 during a regional seminar in Manila to 10 countries in South-East Asia. Since then, the EM is used in more than 20 countries all over the world, and four EM updates were prepared. Currently, the EM version 1.4 is available, and version 2.0 under development.

The EM is both a database for information on environmental and cost aspects of energy and transport technologies, and an analysis tool to compare these aspects in scenarios. The EM database is especially compiled for technologies in developing countries.

The EM analyzes and compares airborne and greenhouse gas emissions, solid wastes, and land use, as well as internal and external costs associated with the investment and operation of all kinds of energy and transport technologies, including their life-cycles (upstream fuel-cycles, material acquisition).

The EM can run scenarios to compare single power plants or boilers, but also whole electricity generation (and transport) systems of a region or a country, and can identify the emission and cost tradeoffs between different options to meet future energy (and transport) demands.

To allow for all that, the EM is a computeried tool consisting of the following key elements:

- database with relevant information on energy and transport processes, including
- references for data sources, and data quality indicators
- scenario section in which a variety of energy and transport systems can be compared
- analysis module in which results from scenarios runs can be analyzed
- graphics to show results, and emission/cost tradeoffs
- interactive help system which includes user help, user guide, and documentation.

The EM is used in a variety of applications all over the world - from project analysis, utility planning and regional GHG mitigation analysis to sectoral environmental assessments of the World Bank, and Agenda 21 activities on the city level.

SOME EXAMPLES ON WHAT YOU CAN DO WITH THE EM

- *Learn about fuels*: For thermal power plants and boilers, environmental and costs characteristics depend mainly on the fuels they use. In the section of the EM database, you can check cost and emission data for over 50 fuels, and can adjust the data or add your own records. You can also vary e.g. the sulfur content of a fuel, and check simultaneously the impacts of such changes to the emissions of a power plant using this fuel.
- *Compare single energy processes*: To learn about the direct cost and emission impacts of a variety of energy technology, you can open the section of the EM database, and can access a variety of information "cards" for more than 200 different energy and transport technologies. You can add pre-defined emission control technologies to thermal power plants or boilers, and see immediately which cost and emission tradeoffs such changes will imply. You can also test the sensitivity of assumptions on the plant level, e.g. the impacts of reduced efficiency, or increased lifetime.
- *Run scenarios for future developments*: To analyze impacts from a variety of energy options or transport modes, you can open the section of the EM, and create demand/supply relations for a variety of electric or thermal or transport end-uses, and mixes of energy technologies to meet these demands. The EM helps to balance demand and supply, and to select the appropriate supply options from its database.
- *Check compliance with standards*: To test if energy technologies comply with emission standards, you can open the part of the EM database, and see which emission regulations are available. In the processes database, you can then test which power plants or boilers comply with these standards, and can modify processes by adding emission control technologies, or changing fuel characteristics
- *Check data sources and quality*: To track down where data come from, the EM offers a library of references to which data records are linked. You can open the section to see which data sources are linked to a database record. You can also check the data quality of each record in special references cards.

In addition to the EM, there exists a special information system called EM PowerInfo which offers information on non-quantifiable environmental impacts, mitigation technologies and emission regulations as well as environmental impact assessment methods and procedures.

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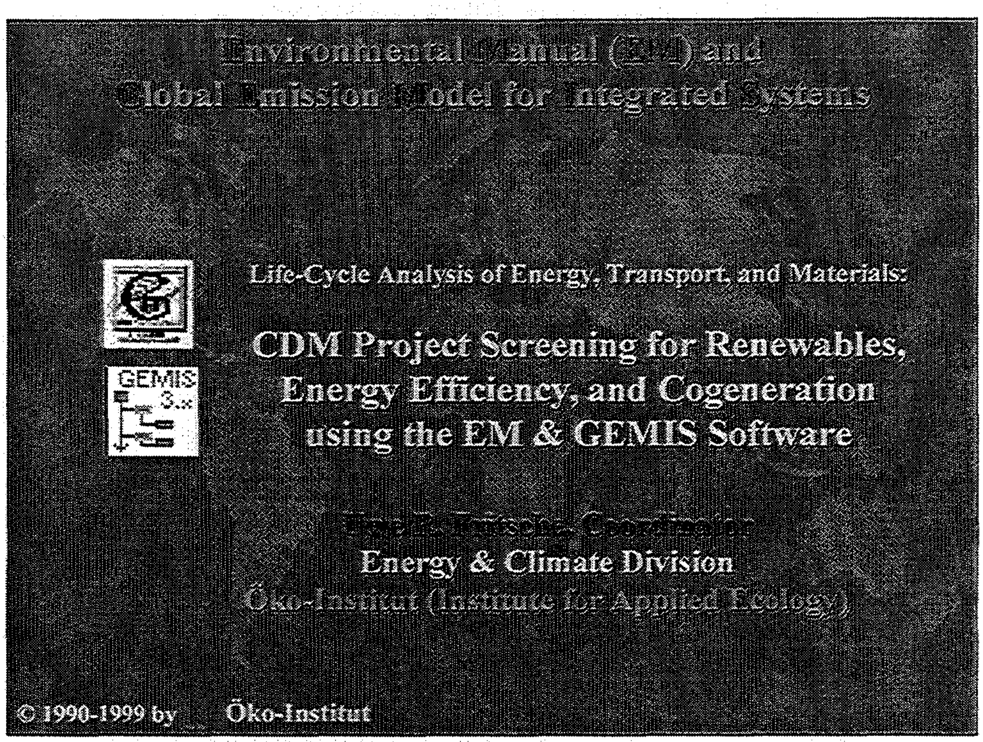

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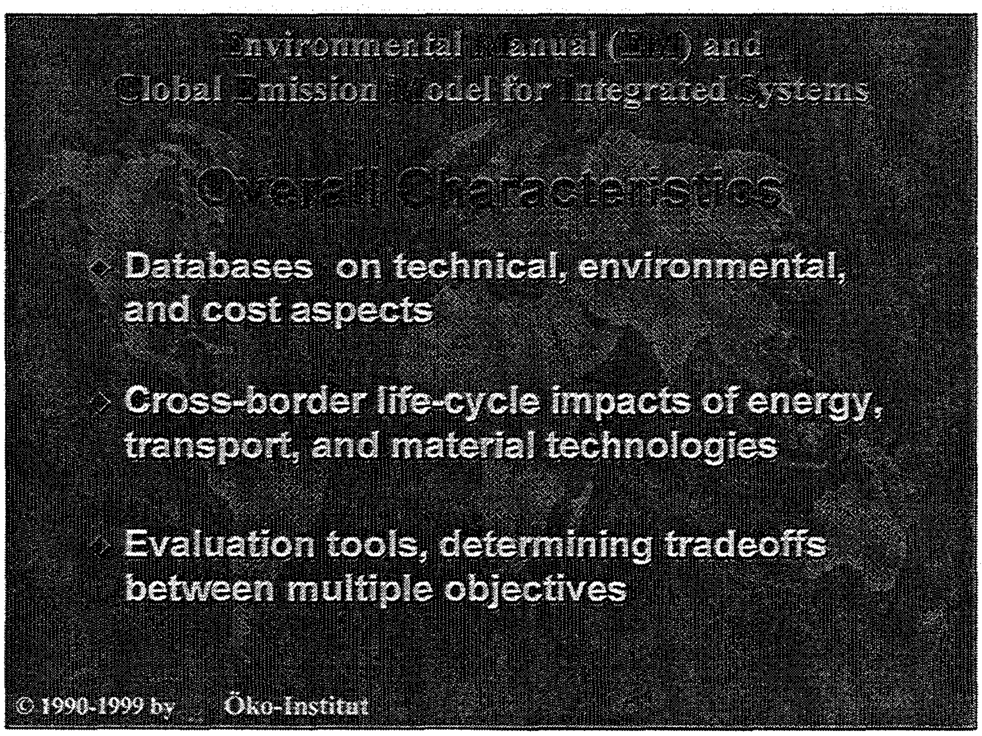

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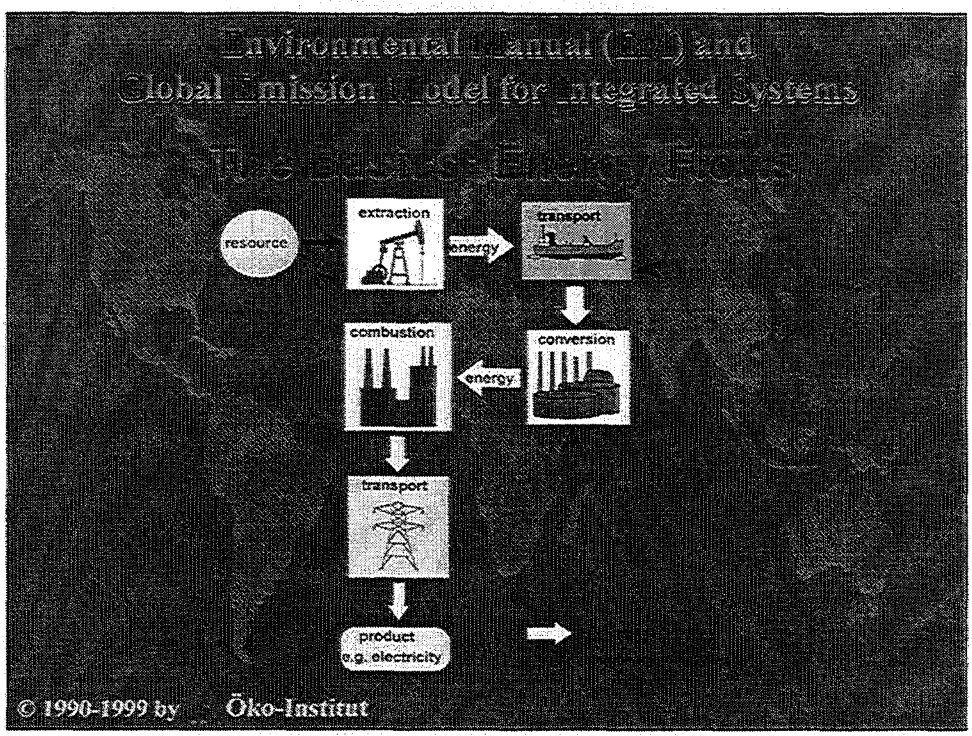

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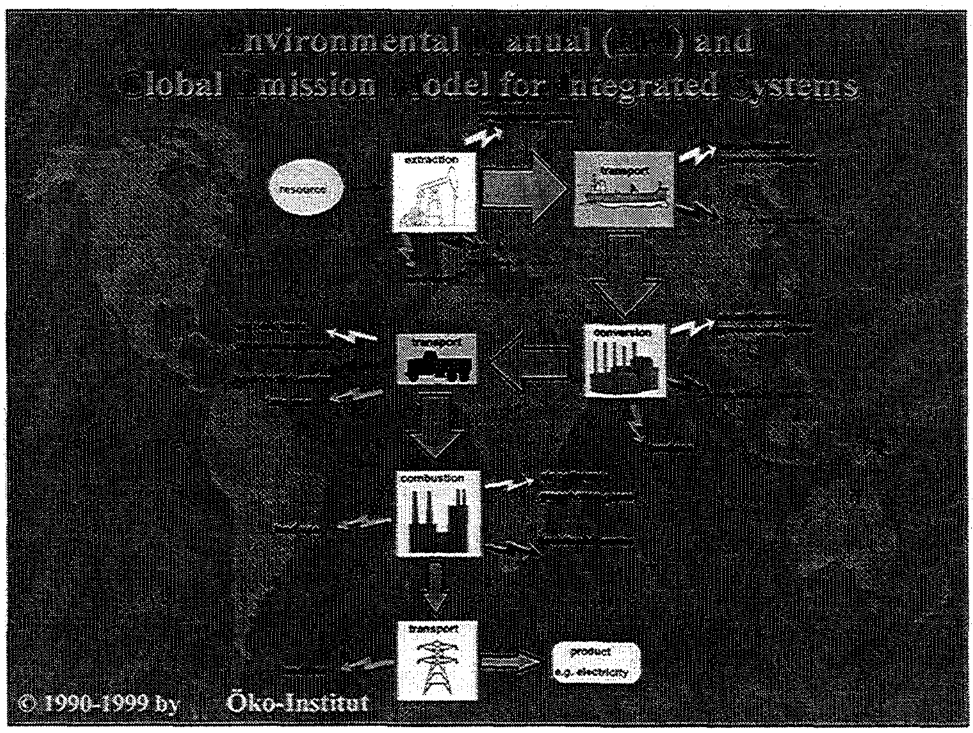

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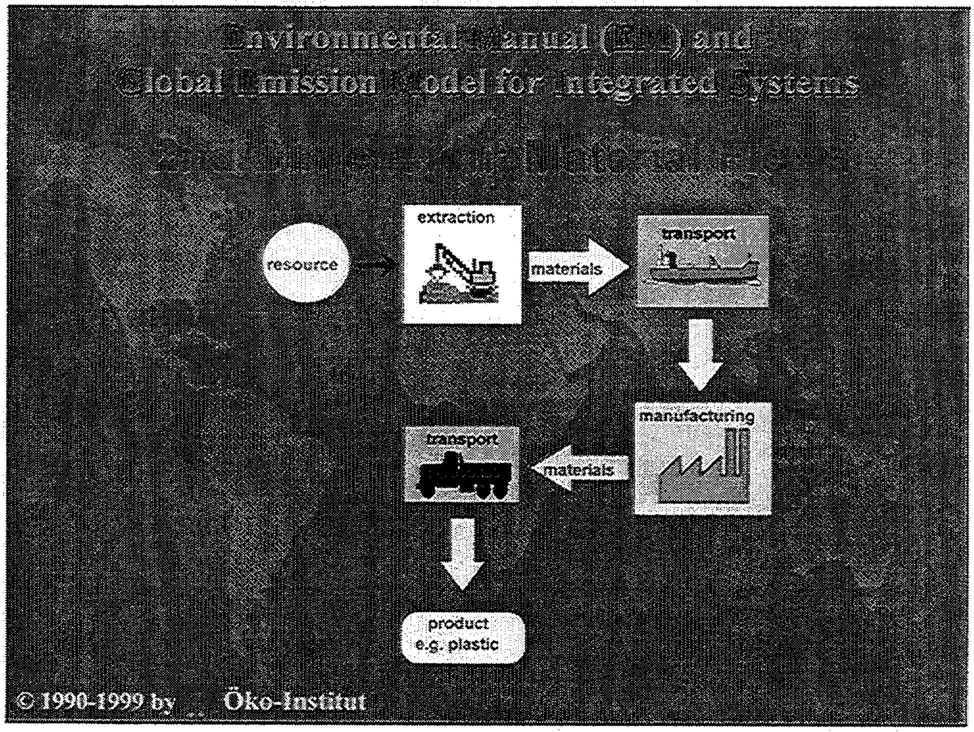

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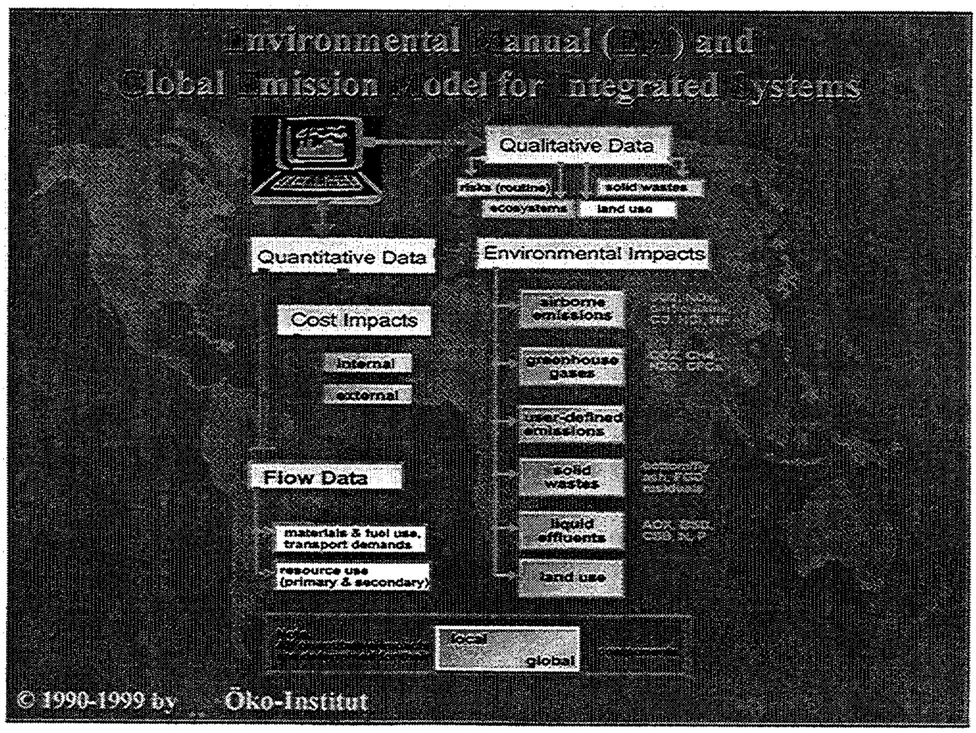

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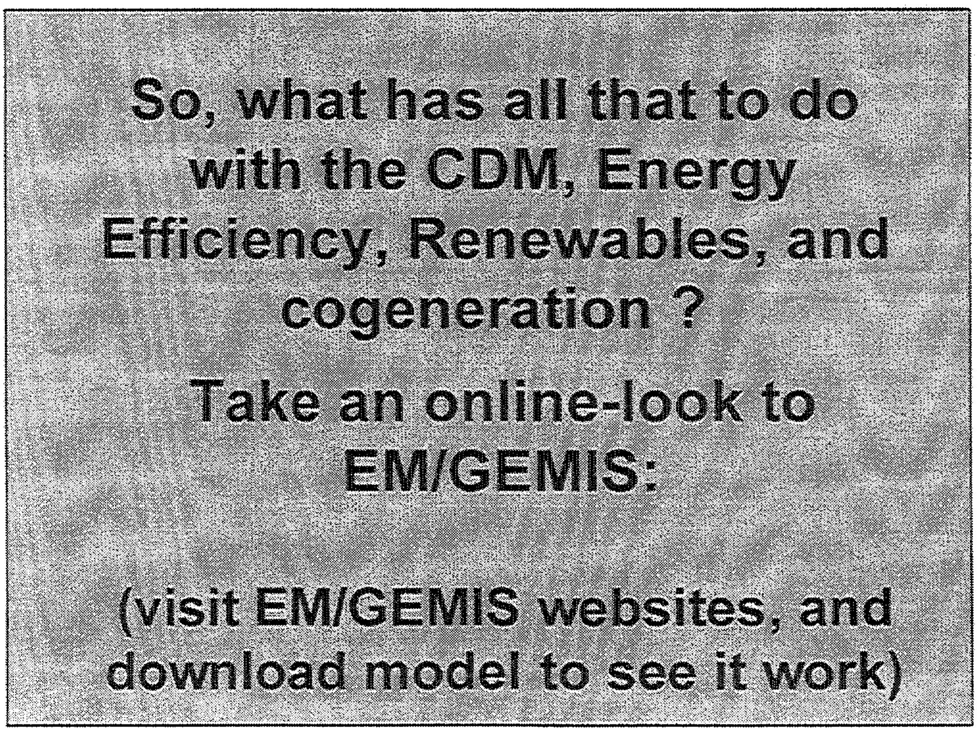

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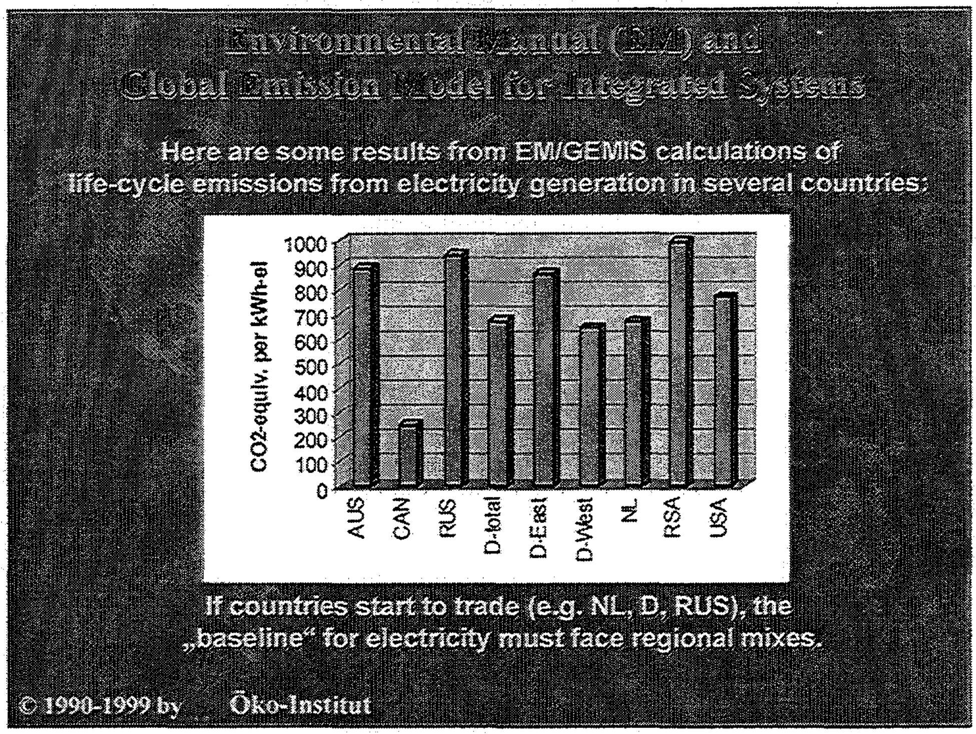

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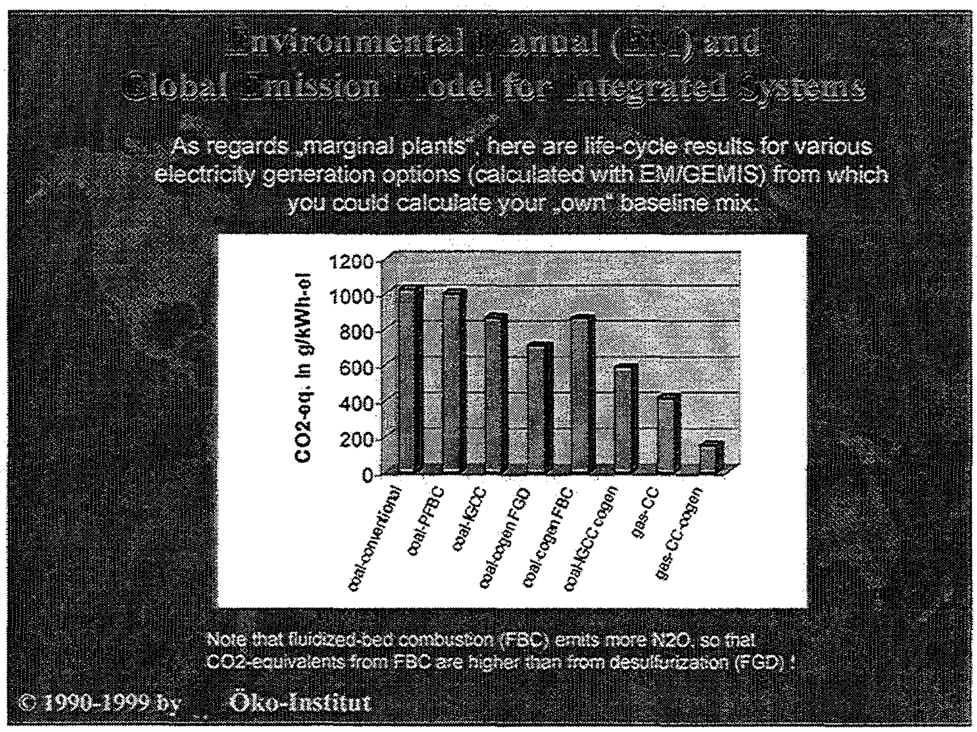

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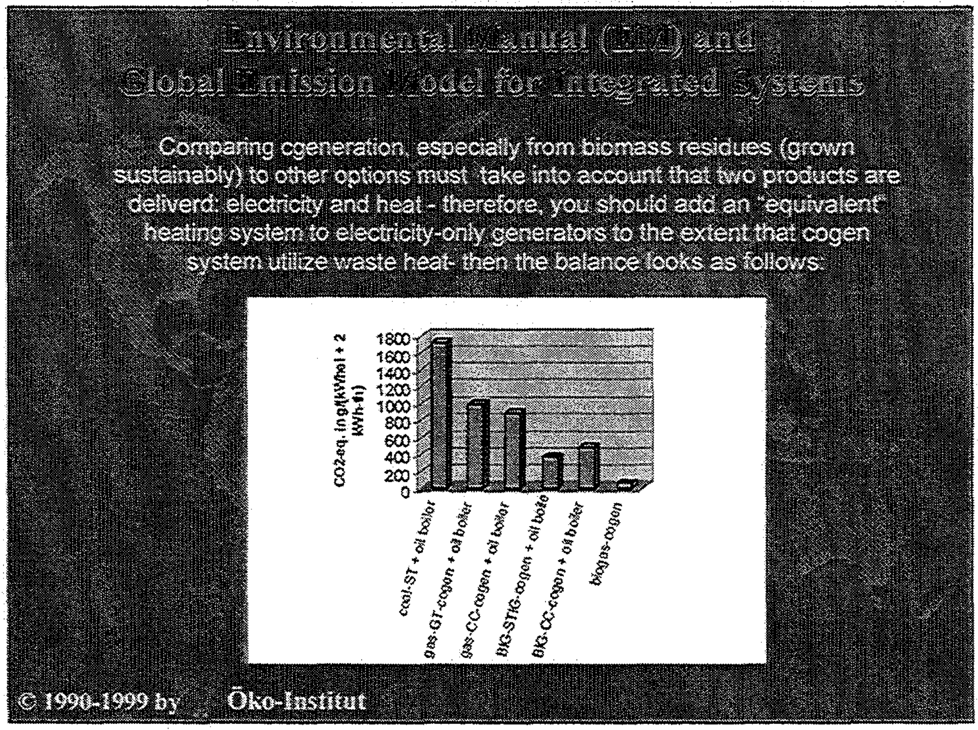

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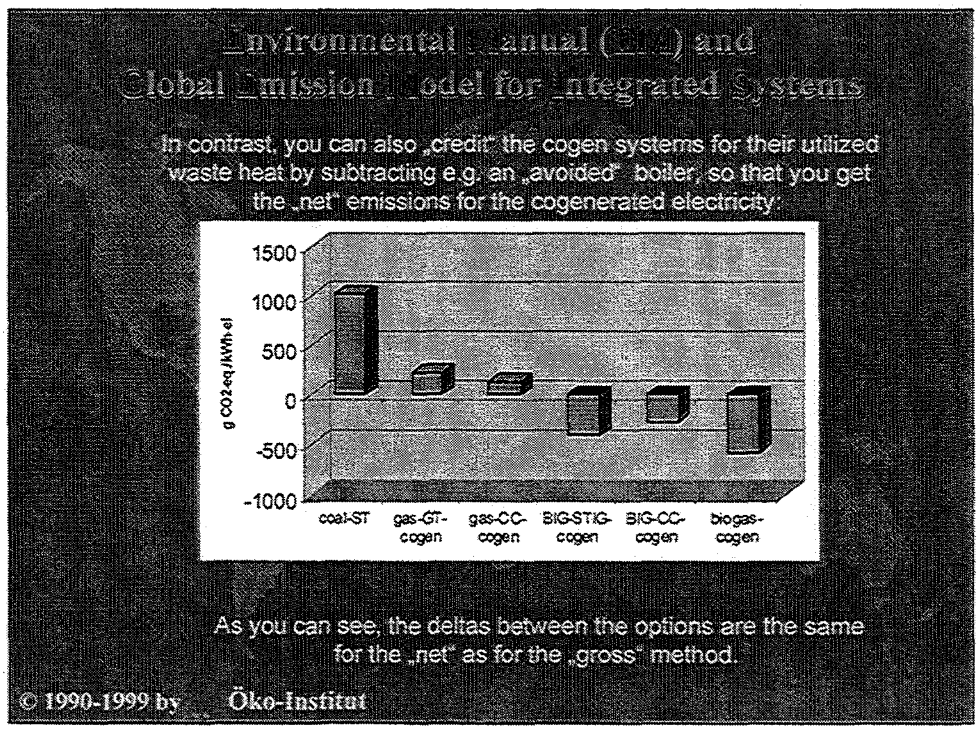

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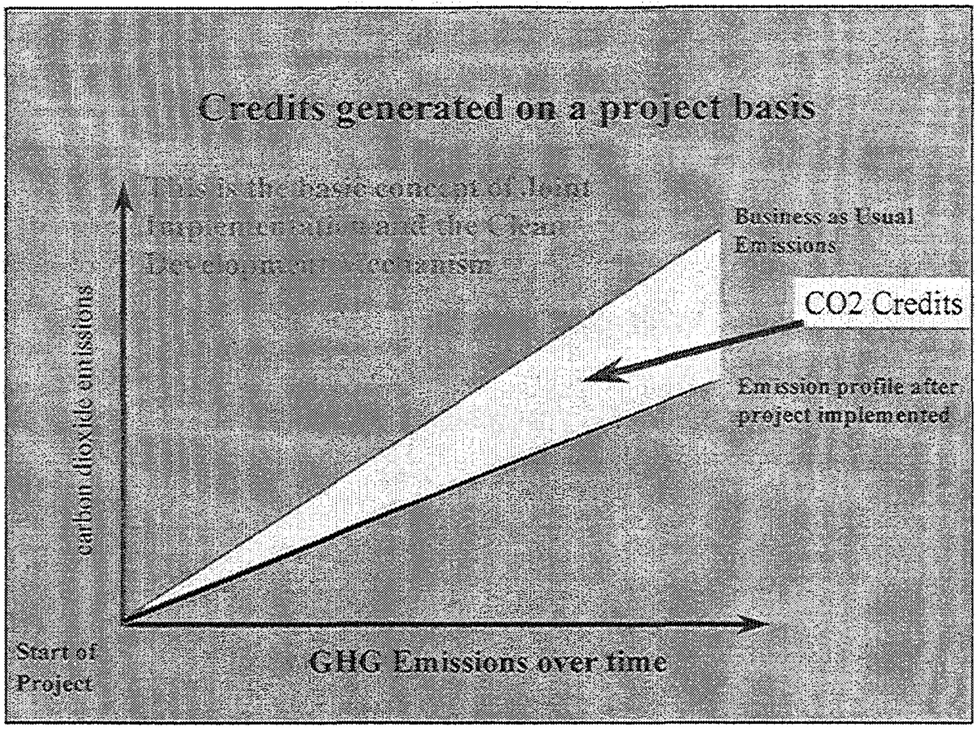

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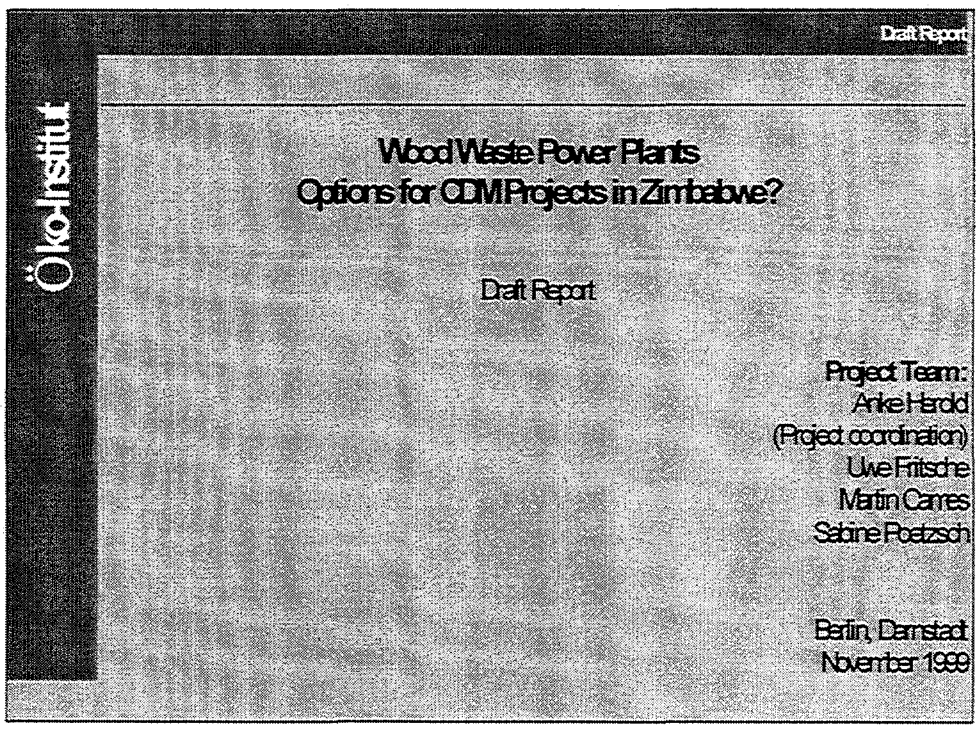

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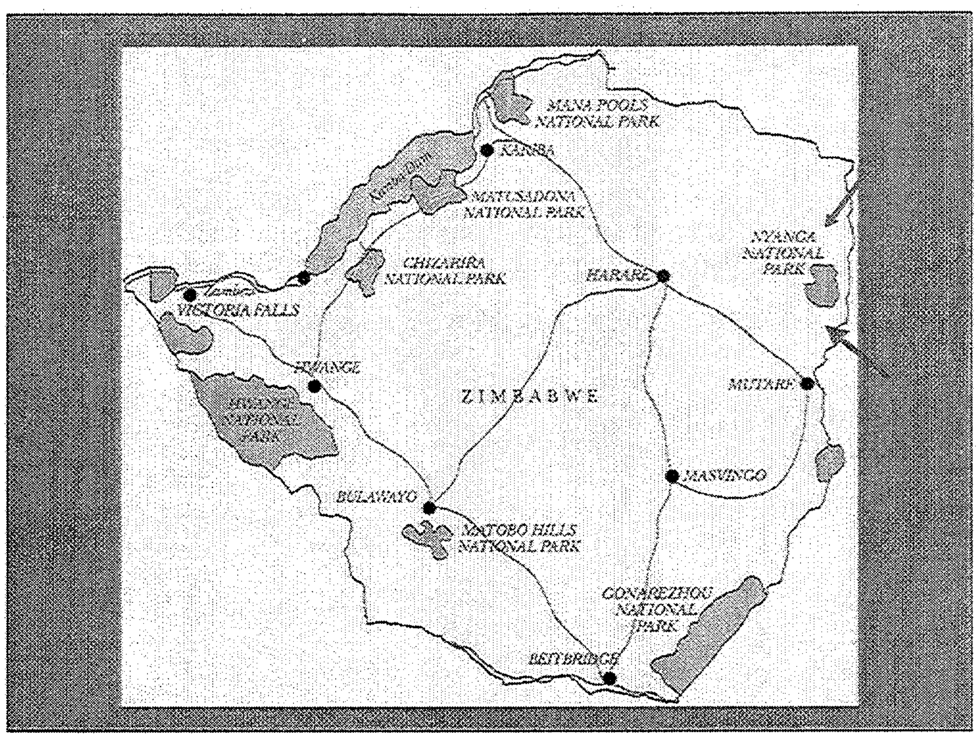

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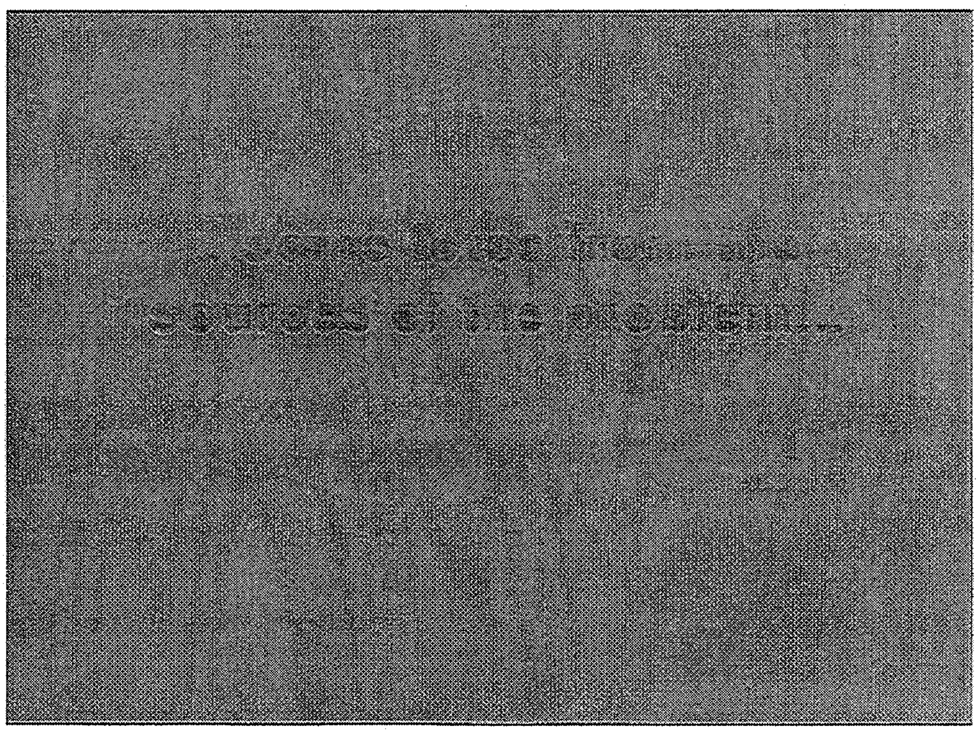

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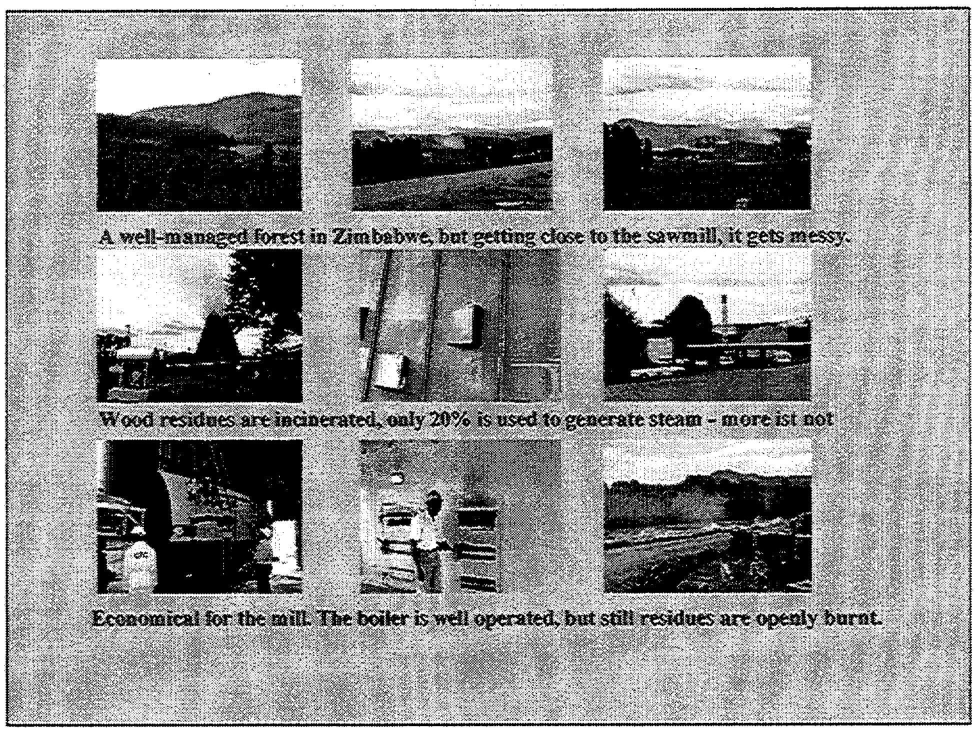

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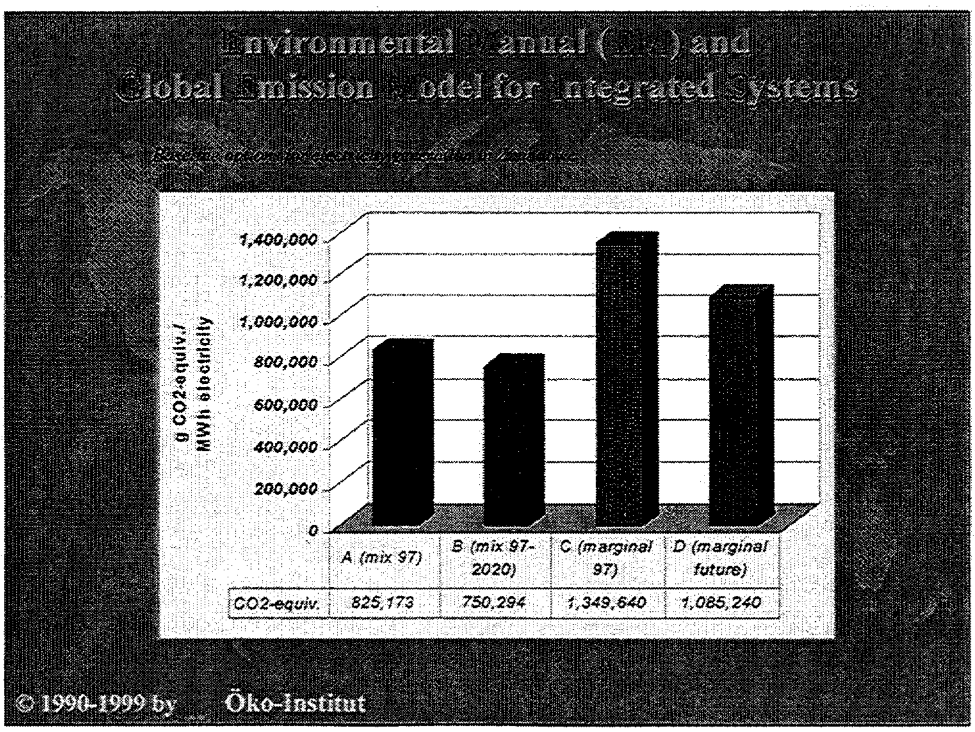

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Environmental Manual (EM) and Global Emission Model for Integrated Systems

Once a set of such baselines was established, we analyzed the possible impacts of emissions credits resulting from these baselines for the projects in terms of additional revenue.

These „proceeds" of the projects would be significant (see next slide) and could help to attract investors to bring forward the projects (note: Host country & vulnerability „fund" would also take their „share of proceeds")

Slide 20

Environmental Manual (EM) and Global Emission Model for Integrated Systems

	Worst Case	Best Case
Assumptions		
Discount rate, %	12,5	12,5
Specific mitigation cost, US$/t CO_2equivalents	1	10
Crediting time, years	5	10
	1,000 $US\$_{1999}$	
Nyanga cogeneration (3.5 MW el, 24,528 MWh)		
Option A (mix 97)	72	1.121
Option B (mix 97-2020)	66	1.019
Option C (marginal 97)	118	1.833
Option D (marginal future)	95	1.474
Nyanga power plant (6 Mwel, 42,048 MWh)		
Option A (mix 97)	124	1.921
Option B (mix 97-2020)	112	1.747
Option C (marginal 97)	202	3.142
Option D (marginal future)	162	2.526
Chimanimani cogeneration plant (3 MW el, 21,021 MWh)		
Option A (mix 97)	62	960
Option B (mix 97-2020)	56	873
Option C (marginal 97)	101	1.571
Option D (marginal future)	81	1.263

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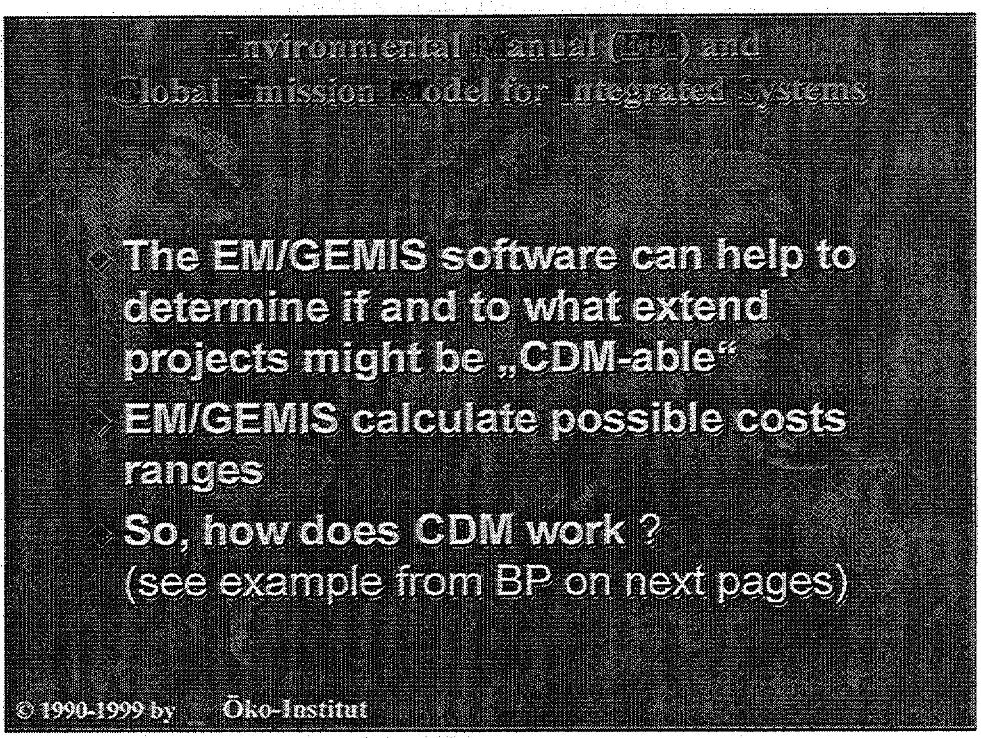

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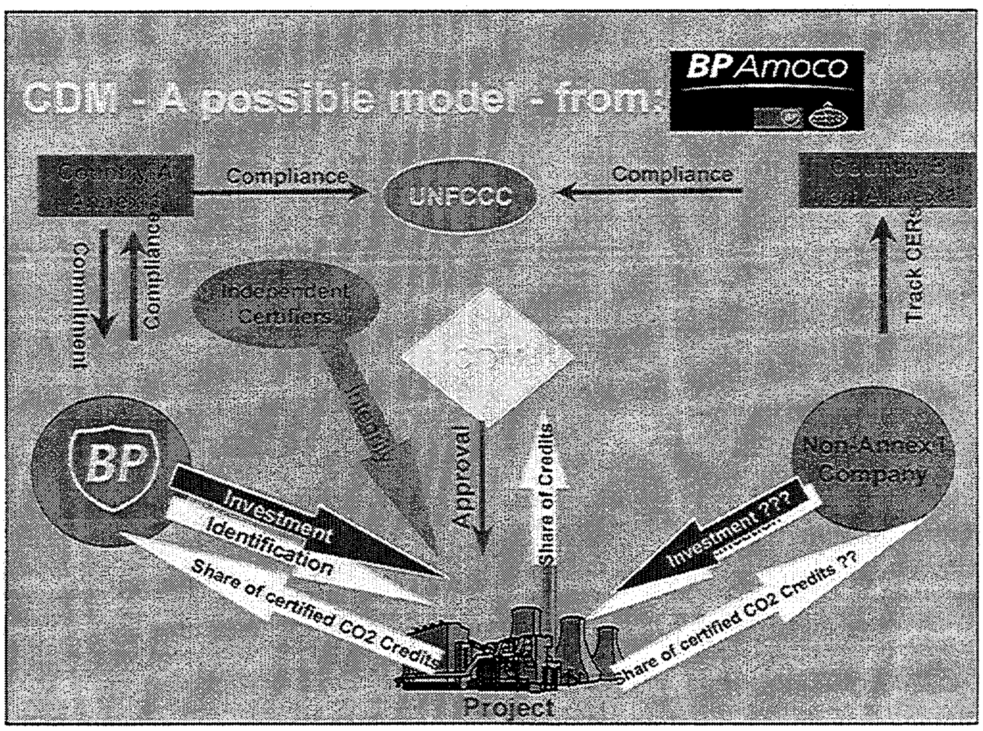

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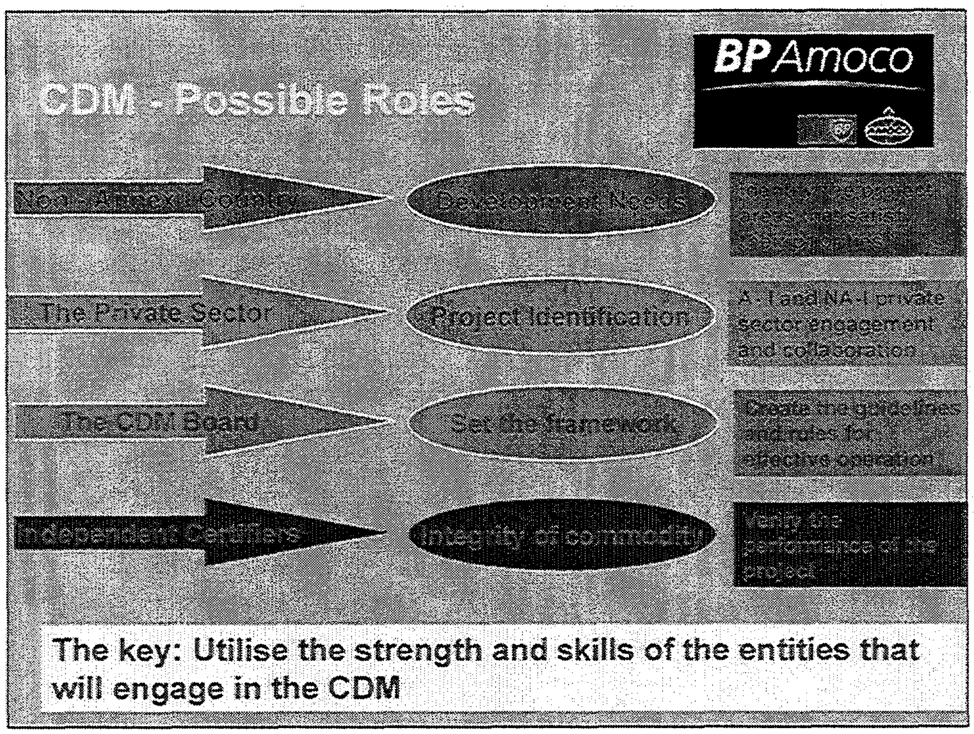

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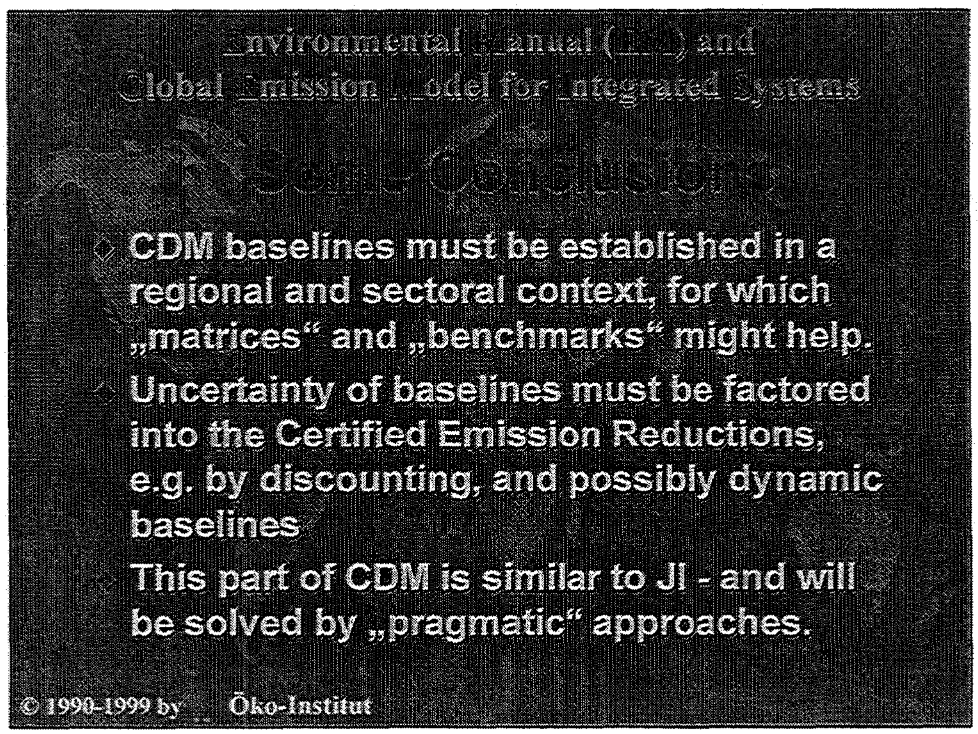

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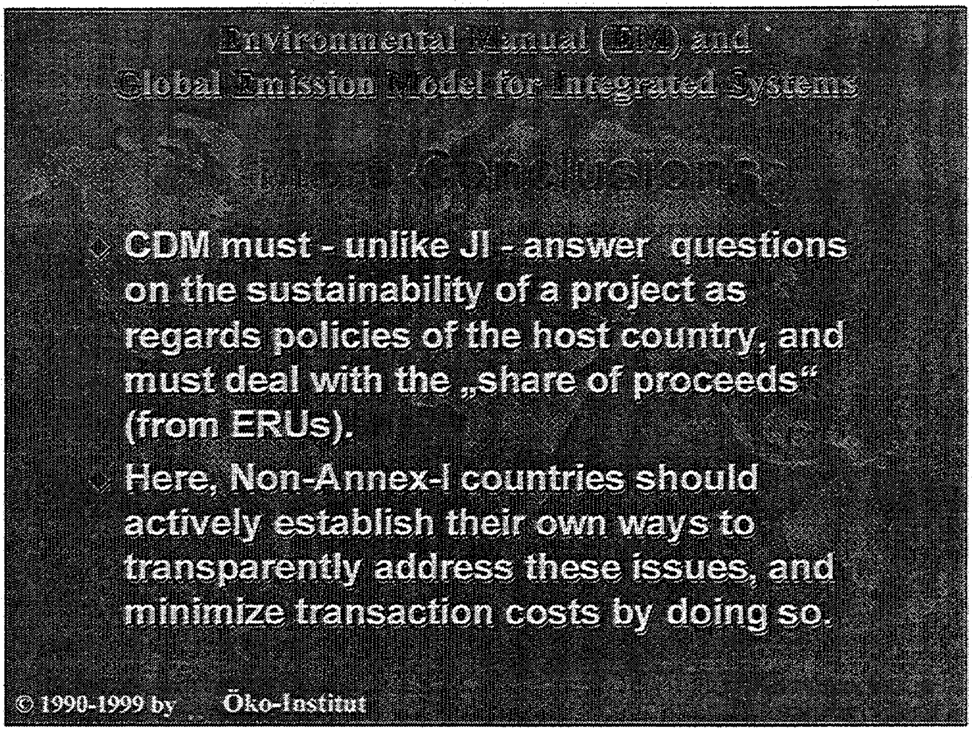

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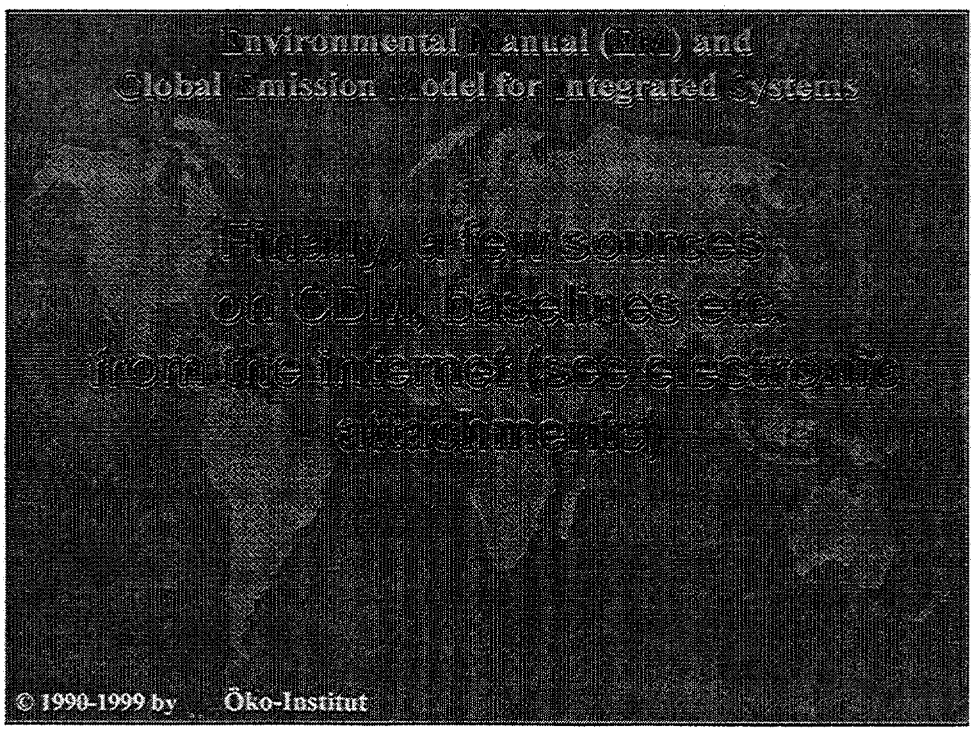


2. The IDENTIFY Analysis Tool

Mr. R. Williams, Officer-in-Charge, Kyoto Protocol Branch, UNIDO

2.1 Introduction

The IDENTIFY Analysis Tool provides a means for assessing the costs and benefits of industrial greenhouse-gas mitigation strategies. The tool is intended to be used by anyone with an interest in analyzing industrial greenhouse-gas mitigation options: government planners, researchers, NGOs, consultants or industry managers. It walks the user through the steps needed to evaluate the greenhouse-gas emissions, energy-consumption patterns and costs of different industrial technologies (including both new plants and retrofits) by performing cost-benefit analyses of energy-efficiency and fuel-switching investments.

The tool, is currently implemented as a prototype Excel spreadsheet, making it easy to use but also flexible and simple to adapt to different user needs and data requirements. The user specifies information about the basic physical, cost and emissions characteristics of alternative industrial-sector mitigation options, and projects how costs might change over time. The tool includes specialized calculations for the emissions produced both by on-site fuel use and by off-site generation of electricity or production of steam.

2.2 Types of Analysis

Two types of analysis can be carried out with the spreadsheet tool: project analysis and comparative analysis.

Project Analysis: Project or absolute analysis is concerned with the overall viability of an option. The benefits of the project, comprising the economic value of the products produced by an industrial facility (e.g. tonnes of cement or steel), are compared to the costs of building and operating the project.

Comparative Analysis: Comparative analysis allows a user to compare any option to a baseline option. Benefits comprise the cost, energy and emission savings of an option relative to the baseline option. This kind of analysis can be particularly useful when examining retrofit options for reducing emissions from an existing plant. It is important to note that an option which appears favorable under a comparative analysis (for example when compared to a currently operating facility) will not necessarily appear favorable when analyzed using the absolute analysis described above.

The spreadsheet projects costs over a 30 year period in order to calculate a range of standard indicators such as the net present value, internal rate of return, and simple payback period for investments. It also calculates key mitigation analysis results including annual avoided carbon emissions, the costs of saved carbon (or benefits, in the case of "no regrets" options), and the cost of saved energy. The spreadsheet reports additional key indicators useful in determining local and global benefits, and identifying financing needs, where needed, to pay for incremental costs. In addition, it displays a range of more detailed reports and graphics including the types of fuels used by each option and the breakdown of costs (capital, operating and maintenance, fuel costs, administration, etc.) for each option. Carbon externality costs can be included optionally in the analysis by simply entering a cost per tonne of carbon emitted, and then clicking on a check box to include the cost in the calculations.

2.3 Examples of Energy-efficient Technologies and Process Improvements

The list below presents a sampling (only) of technological and process improvements that can be applied to the major energy consuming sub-sectors described earlier in this paper, plus a list of some of the more "generic" measures that can be applied in a variety of industrial settings. Most of these examples are derived from WEC (1995), except as noted. Additional information on energy efficiency in the industrial sector is provided in work by the U.S. Office of Technology Assessment (OTA, 1993).

Users of the analysis tool should use this list along with the data collected and presented in the technology inventory to help formulate the options being examined in their analyses.

Specific Options for the Iron and Steel Industry

- The continued replacement of open-hearth furnaces with basic oxygen furnaces (can save 1 to 3 GJ per tonne of steel -- about 5 to 15 percent relative to current OECD practice)
- Increase the use of scrap steel
- Use of power recovery turbines on blast furnaces
- Use of continuous casting of steel products (as opposed to ingot casting, in which steel ingots must be re-melted to produce products in their final form, and rolling of steel before it has cooled

Specific Options for the Chemicals Industry

- Use of improved catalysts for key types of chemical reaction
- Improvements in distillation equipment
- Improvements in gas turbine efficiency
- Expanded process integration to conserve heat generated during reactions
- Use of membrane technologies for separation of reactants

Specific Options for the Refining Industry

- Pre-heating of crude oil input
- Use of reflux-overhead vapor compression
- Use of mechanical vacuum pumps
- Integration of heat use between distillation units
- Improved catalysts

Specific Options for the Pulp and Paper Industry

- Continuous pulp digesters, alternative chemical and chemi-mechanical pulping processes, alcohol-based solvent pumping
- Oxygen or ozone bleaching and delignification
- Chemical recovery, including freeze concentration or gasification of black liquor
- Wet-pressing of paper products, high-consistency forming, impulse drying, and microwave drying

Specific Options for the Cement Industry

- Materials preparation efficiency measures including waste-heat drying, differential grinding of limestone and clay, fluidized-bed drying with low-grade fuels
- Kiln combustion system improvements and modifications to reduce heat loss, use of waste heat from product cooler, use of fluidized-bed kilns and all-electric or hybrid kilns
- Blending cements so as to reduce the energy required for production
- Modified product grinding equipment, including better control of particle size (for example, high-efficiency air classifiers; IPCC, 1996)

Generic Options Important in Many (if not most) Industrial Sub-sectors

- The use of heat recovery (in many different sub-processes) for steam generation, pre-heating of combustion air, including the use of ceramic recuperators (IPCC, 1996)
- Fuel-switching to natural gas (where available)
- Improved industrial boilers and furnaces, including improved fuel pre-treatment, computerized boiler control, and natural gas pulse-combustion boilers (IPCC, 1996)
- Expanded use of cogeneration of heat and power
- High-efficiency electric motors and electronic adjustable-speed drive systems
- High-efficiency lighting systems
- Computerized process optimization, control, energy management, and environmental management (that is, pollution emission sensing and control) systems
- Good housekeeping and minimization of materials waste, including pre- and post-consumer recycling of raw materials

2.4 Identify Inventory

The IDENTIFY Industrial Technology Inventory is a spreadsheet-based database, intended to support users of the IDENTIFY Analytical Tool. It provides quick and easy access to formation about technological options for reducing greenhouse-gas emissions in the industrial sector.

Information on greenhouse-gas mitigation options for the industrial sector can be found in a wide array of sources. Considerable research effort is often needed to collect the books, reports, and other literature that can help to identify promising technologies, to determine where they have been used, and to show the benefits that can be achieved through their application. A primary goal of the Inventory is to enable access to the data available from many disparate sources and to present them in a cohesive, consistent manner.

The Inventory can be used to identify and compare industrial practices within a sector or across countries. For example, one can quickly access information about the iron and steel industries in China, Japan, Brazil, India, and the United States. At the same time, one can compare information on current practices in the U.S. iron and steel industry with projections to the year 2010 under both "state-of-the-art" and "advanced" scenarios.

3. Issues in Baselines and Additionality Analysis

Ms. M. Ploutakhina, Industrial Development Officer, Kyoto Protocol Branch, UNIDO

INTRODUCTION

The Kyoto Protocol allows the emissions reduction achieved during 2000-2008 to be used to assist in achieving compliance in the period 2008-2012. The time for launching the CDM operations is thus due to start in the year 2000. However, a number of critical issues with regard to functioning of the market in credit transfers are still unanswered. The subjectivity and ambiguities in making *ad hoc* assessment of various key issues in project formulation, development and approval poses perhaps the most vexing challenge as regards developing the system and operational modalities for efficient and effective CDM.

As the AIJ phase has shown, high transaction costs and risks arising from the lack of clarity on methodological and operation issues could significantly inhibit the participation of the private sector in joint implementation, which of course has a lot in common with the CDM.

The objective of this presentation is to highlight the transaction costs that are likely to be encountered by project developers in the context of CDM operationalization. Moreover, it is intended to suggest possible ways for standardizing and streamlining the methodologies and approaches in the development of operational and regulatory framework for CDM. These measures will improve the quality of project development, reduce the transaction costs associated with the process and encourage the private sector participation in the CDM.

ASSOCIATED RISKS

Risks involving transactions in project-derived credits can broadly be divided into technical, operational and country risks. Country risks also include those facing the recipient country with regard to technology transfer, net capital flows, and other non-GHG impacts (e.g. socioeconomic and environmental impacts). Operational risks are those including:

- Project risks, or risks facing investors at various stages of project development and implementation: This risks are essentially about the quality of expected reductions, i.e., whether the reductions are indeed real, measurable and long-term and can be generated at estimated cost per ton. In other words these are risks involved in the assessment of environmental additionality of reductions and quantification of baselines. Other areas of project risks are associated with the accuracy of monitoring, verification, and certification activities and the transaction costs of these activities.
- Country or sovereign risks, or risks which include the incentives and regulatory structures of both host and recipient countries and normal, macroeconomic risks associated with rates of inflation, exchange rate, interest rate as well as political and economic stability.
- Risks associated with market characteristics, such as low volume of transactions, low liquidity, lack of homogeneity of traded goods, imperfect flow of information, supply deficiency and other characteristics of imperfect markets.
- Technical or methodology-related risks stem to a large extent from the subjectivity and uncertainty surrounding the calculation of baselines and additionality. Yet, miscalculating project baseline poses risks not only to environment, but also to the market for project-derived offsets as the "non-additional reductions" tend to lower the market price of offsets and crowd out suppliers of "additional" credits.

The experience with AIJ has shown the disadvantages of the subjective approach to additionality assessment at a project level. Numerous reports cite the lack of international standards in these areas as the major deterrent and the key source of risk for private investor.

BASELINES

Project development involves identification of mitigation options, their assessment in terms of scope and boundaries of the mitigation activity and the construction of a "reference line", i.e. baseline against which the CO_2 reductions will be measured.

The construction of the baseline scenario is one area where standardization of approaches would help to reduce transaction costs and uncertainty. UNIDO is currently working on developing a tool, which will help to translate available data and methods for baseline setting into algorithms. This will improve the quality of and harmonize the baseline setting process, reducing the transaction costs of project development and improve the comparability between projects. This in turn will help to reduce risks associate with CDM investment, facilitate the private sector participation and stimulate the CDM transactions and resources flow towards countries with low marginal cost of abatement.

So, why is baselines estimation so notoriously unclear and difficult and what kind of data are required for additionality assessment? Establishing realistic and credible baselines involves decisions with regard to the boundaries of the system which include the reference case and the mitigation option. It also involves determining the timeline, or the project duration over which the CDM project will yield emissions reductions for the investor. It is also important to establish a reliable input-output balance for the proposed activity and the baseline. That is to say, it is important to match the reductions with the source (i.e., marginal generation source) of emissions - the source that would be displaced by the implementation of the mitigation option. If for example, a mitigation option reduces the carbon intensity of an energy system, then it is important to the baseline and projected emissions to make sure that the carbon intensity of the displaced capacity matches the emissions reductions.

Obviously, the longer the time line of the project, the greater the benefits per unit of mitigation cost it is more likely that the project will attract investors. In order to be credible, the project-specific baselines need to account for free riders (i.e., the possibility that some participants of the project would have installed the measures anyway leading to CO_2 reductions in the absence of the project). At present there are no international methodologies on how to set the boundaries of the system or on how to account for the free riders effect. A possible solution to this problem would be the establishment of performance benchmarks, that would indicate the technology and equipment representing the high performance end of the spectrum of current commercial practice. UNIDO is currently working on the construction of such technology matrixes for the cement industry. A region-by-technology matrix will be developed for facilitating baseline assessment.

MERVC

Monitoring is closely linked with the quantification of net emissions reductions, because it is through the monitoring activities that the dynamic changes in baselines can be captured.

There are different approaches to the possible models for monitoring, evaluation, reporting, verification and certification (MERVC). While the key decisions on the modalities are to be left to the Parties who are the ultimate decision-makers, it is clear that a certain separation of these activities is necessary to avoid a conflict of interest. A project developer may decide to conduct monitoring and evaluation, or to subcontract these functions to a company or a technical agency. Verification and certification must be carried out by an independent third party. This is in fact consistent with the wordings of Article 6 and Article 12 (e.g. "certified project activities", "independent auditing and verification" and "certified emissions reductions").

SUSTAINABLE DEVELOPMENT

Compatability with local needs and a measurable contribution to sustainable development is a requirement for all the CDM projects to be carried out in non-Annex I countries. However, there is no blueprint to determine whether a project contributes to a country's sustainable developments. Attempts are underway to find indicators for sustainable devleopment. UNIDO, which defines its activities in terms of three "E"s – Environment, Economy and Employment – is actively participating in this effort.

In principle, CDM is to be a recipient-country led and developing countries themselves are to decide on whether a proposed CDM activity is in line with their priorities for sustainable development. However, in the absence of formal methodology, there is a danger that competition for projects will lead to the neglect of projects' contribution to sustainable development. Some researches proposed a solution by limiting eligibility for CDM participation only to projects with proven contribution to sustainable development. This in fact is compatible with the technology matrix approach, which can be a useful tool for the assessment of the CDM projects. If the sustainability criteria are taken into account, then only technologies and options with demonstrable contribution to sustainable development are eligible.

The non-GHG environmental impacts should also be mentioned at this stage. Some mitigation options may have environmental impacts addition the CO_2 reduction. For example, many options will result in SO_2, NOx and VOC reductions. This additional environmental impacts could be a consideration in the assessment of the sustainable development impact and perhaps even evaluated in terms of costs and benefits of the overall CDM mitigation option .

CONCLUSION

The complexities, uncertainties and the high degree of arbitrariness in the determination of baselines and additionality are among the key sources of high transaction costs and project risks, which inhibit private sector participation and the volume of CDM investment.

These costs can be significantly reduced if approaches to quantification of baselines are standardized and streamlined through the development of algorithms that will specify the data requirements and translate the data into methodology that take into account state-of-the-art work on baseline setting.

This will entail further systematization and streamlining of the procedures involved in baselines setting and a generation of guidelines which will introduce consistency and transparency across project types, increase credibility with stakeholders in recipient and host countries and reduce costs in project development and approval.

It is a work that UNIDO is currently engaged in and the next phase of this work will be the development of a workbook for energy efficiency projects that will support the full evaluation of CO_2 mitigation options and the monitoring and evaluation of CDM projects.

Slide 1

Issues in Baselines and Additionality Analysis

UNIDO
EGM on Energy Efficiency and Cogeneration
Vienna, 2-3 Dec. 1999

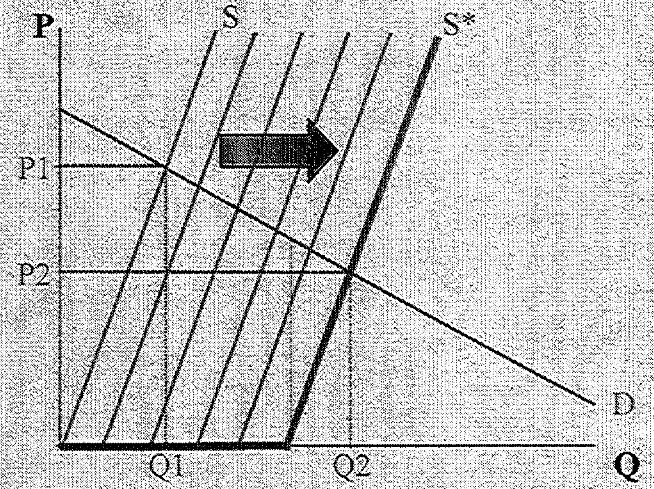
Slide 2

Introduction

- Risks in Project-level Trading of Emissions Reductions
  - Operational Risks (project level risks, country risks, market risks)
  - Technical/Methodology-related Risks (baselines and additionality, MREVC)
  - Risks Facing the Recipient Country

Slide 3

Trading in Non-additional ERs:
Environmental & Market Implications



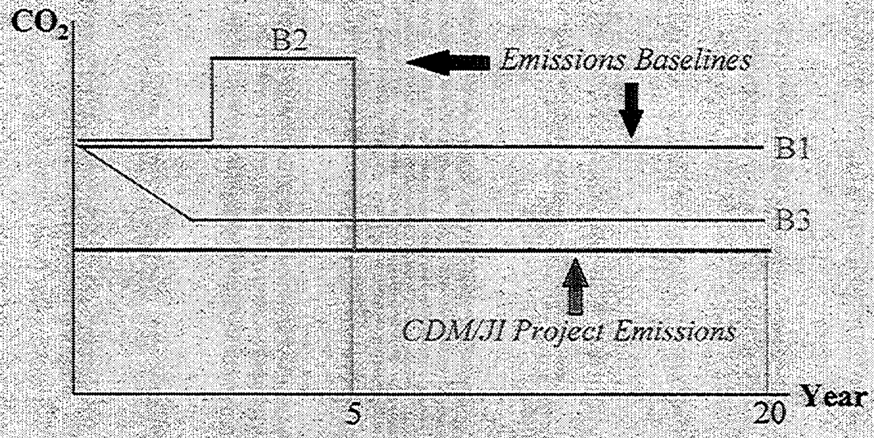
Slide 4

Project Risks

- Project Design and Development
  - Technical/Methodology-related
- Project Implementation
  - Monitoring
  - Reporting
  - Evaluation
  - Verification
  - Certification

Slide 5

Alternative Baselines for a Fuel Switching Project



Slide 6

Calculating & Reporting Baselines

- System Boundaries
  - Leakages and matching
- Timelines/Project Duration
  - Baseline dynamics
- Free Riders
  - Technology matrixes / Benchmarks

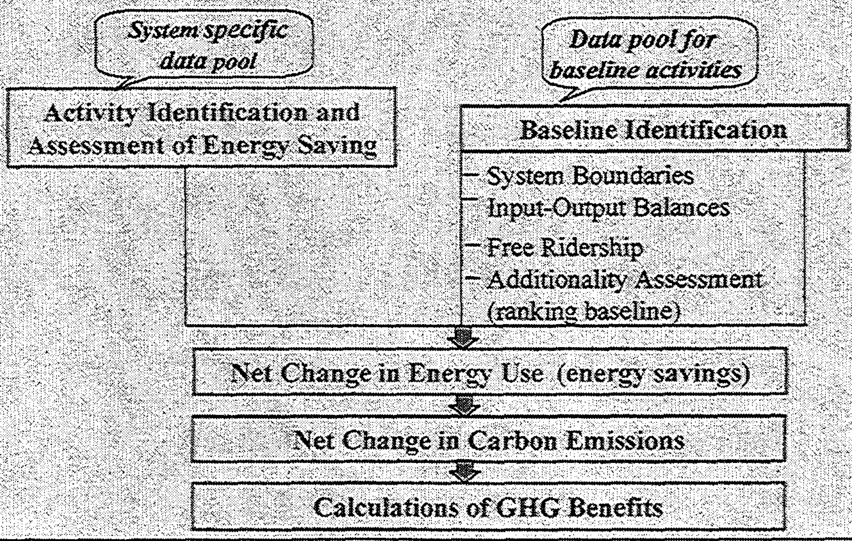
Slide 7

Conceptual Framework for Standardized Approaches to Baselines Assessment

- Assessment of Mitigation Activity in terms of Technical and Financial Parameters
- Ranking Baseline Options in terms of the likelihood of Occurrence
- Calculation of GHG benefits

Slide 8

A Generic Algorithm for the Determination of Baselines



Slide 9

Monitoring, Reporting, Verifying & Certifying Emissions Reductions

- Monitoring Domains
- Monitoring and Verifying Project Performance
- Design Options for the Verification and Certification System
  - The role of international organizations

Slide 10

Contribution to Sustainable Development

- Non-GHG impacts
  - Environmental
  - Socio-economic

Slide 11

Concluding Remarks: The Next Steps

- The Need for Guidelines on Baseline Setting and MRVC
- The Considerations for Developing the Guidelines
- The Next Steps

4. Ensuring Effective Monitoring, Certification and Verification of Emissions

Mr. J. Jones, Manager, Special Product Development, Lloyd's Register, UK

INTRODUCTION

Rules, modalities and guidelines for flexible mechanisms in the Kyoto Protocol are to be decided upon by the Conference of the Parties. However, one possible solution is through accreditation and certification similar to the system used in quality and environmental management system regulations. There are many accreditation bodies throughout the world and there are clear differences in the interpretation of the accreditation criteria by the various accreditation bodies.

The objectives of accreditation and certification is to create confidence that the regulations are being properly applied in a consistent manner to maintain integrity world-wide. It also ensures applications are equitable and free from anomalies, cost-effective, independent, rigorous and auditable.

DEFINITIONS & CREDENTIALS

Accreditation is the recognition, by a responsible authority, that an impartial body is competent to undertake defined activities. *Certification* is the authoritative act by which an independent accredited body document that a process or procedure is compliant with pre-set standards or criteria. *Verification* is a confirmation, by examination and provision of objective evidence, that results have been achieved or that specific requirements have been fulfilled. *Monitoring* is the systematic surveillance and measurement of defined parameters.

The Accreditation Body must have the following credentials:

- Experience in certification processes
- Financial independence
- Experienced resources
- Commitment to setting and maintaining high standard

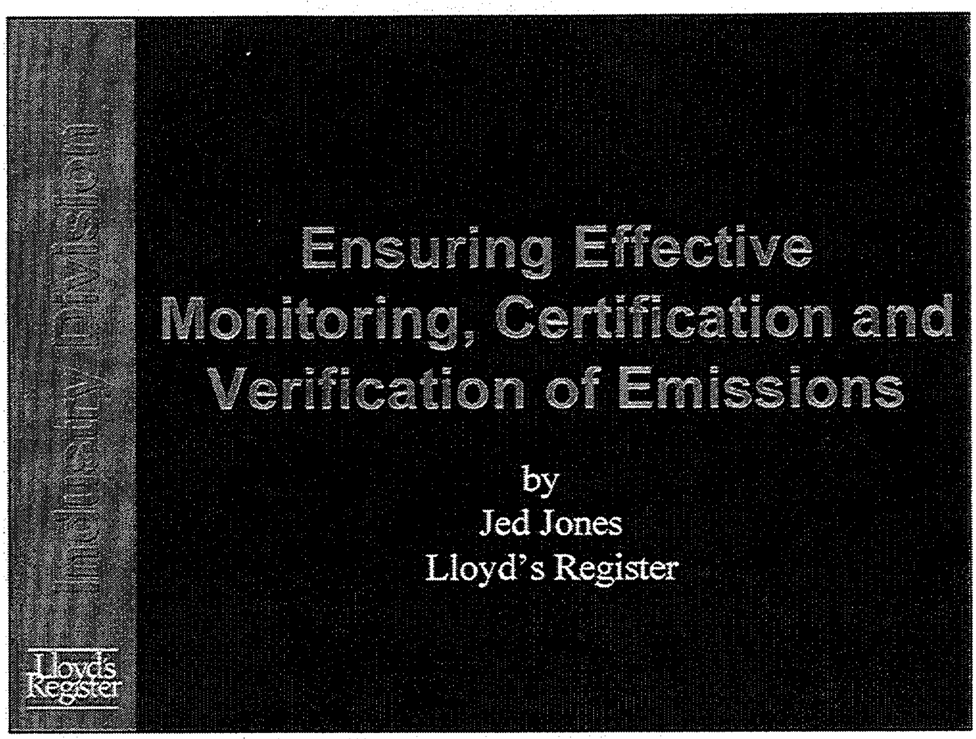
As for the Certifying Authorities, credentials are the same as the Accreditation Body, but with a much larger pool of auditing resources.

Typical activities for certification will include certifying emission records, project baselines and credit permits. Verification is an audit process which involve data collection and processing, data recording and auditing the records and processing procedures.

CONCLUSIONS

It is important that rules must be consistently applied. Certification must result in created entitlements being fungible with assigned amounts. In addition, Parties must agree and accept penalties for non-compliance. Certification must also result in a system, which is transparent, efficient and accountable.

Slide 1



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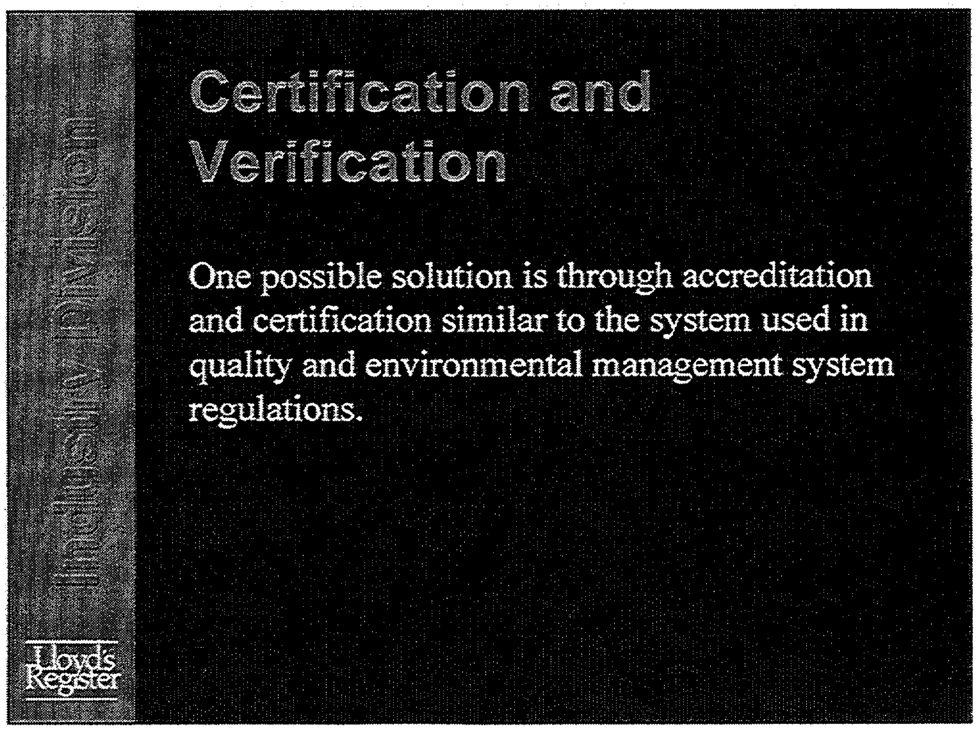

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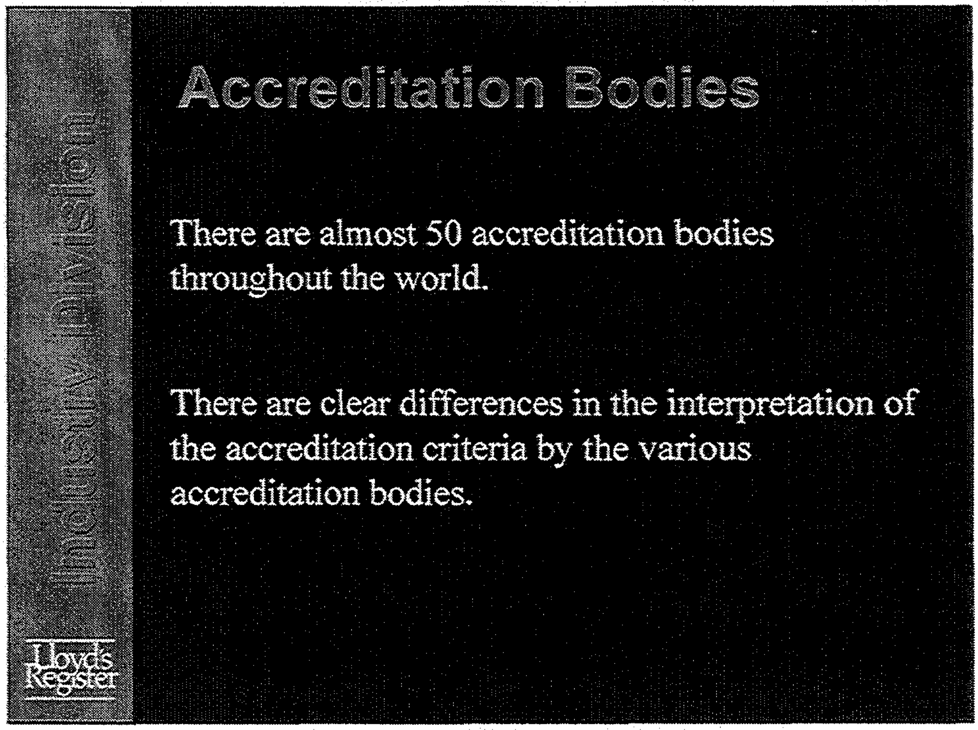

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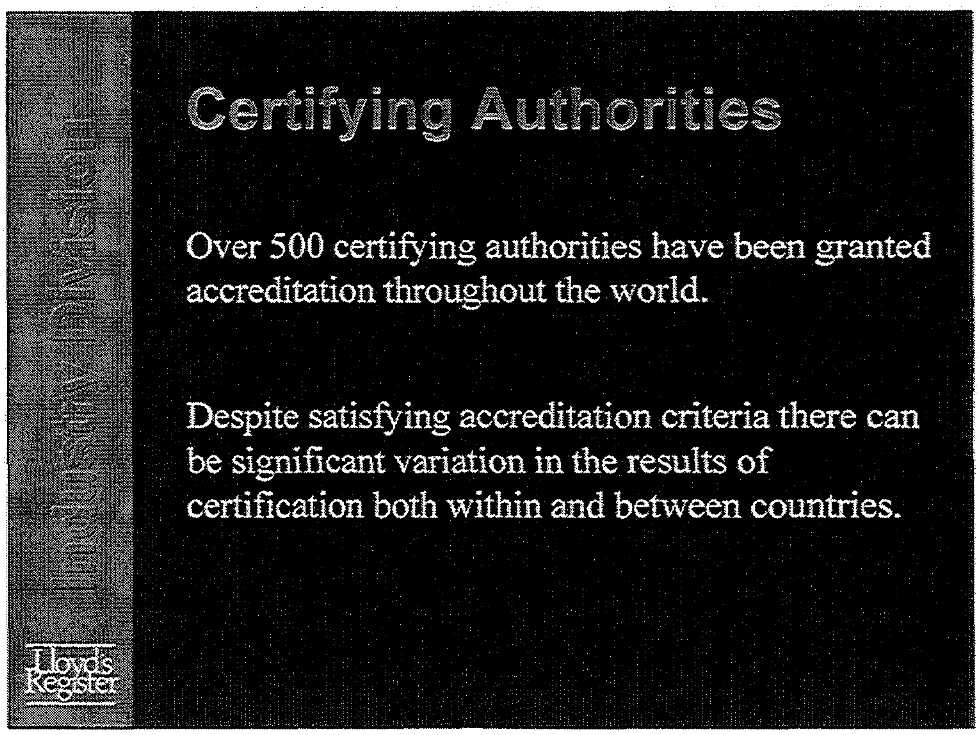

Slide 5

Industry Division

Definitions

Accreditation:

The recognition, by a responsible authority, that an impartial body is competent to undertake defined activities.

Certification:

The authoritative act by which an independent accredited body documents that a process or procedure is compliant with pre-set standards or criteria.

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Slide 6

Industry Division

Definitions II

Verification:

Confirmation, by examination and provision of objective evidence, that results have been achieved or that specific requirements have been fulfilled.

Monitoring:

The systematic surveillance and measurement of defined parameters.

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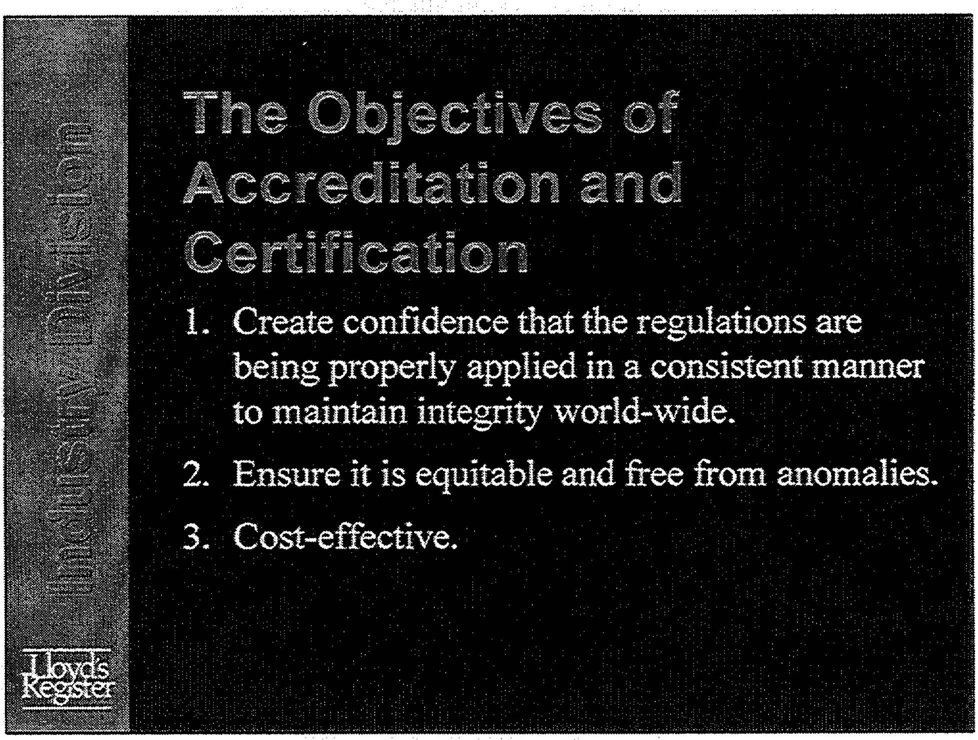
Slide 7



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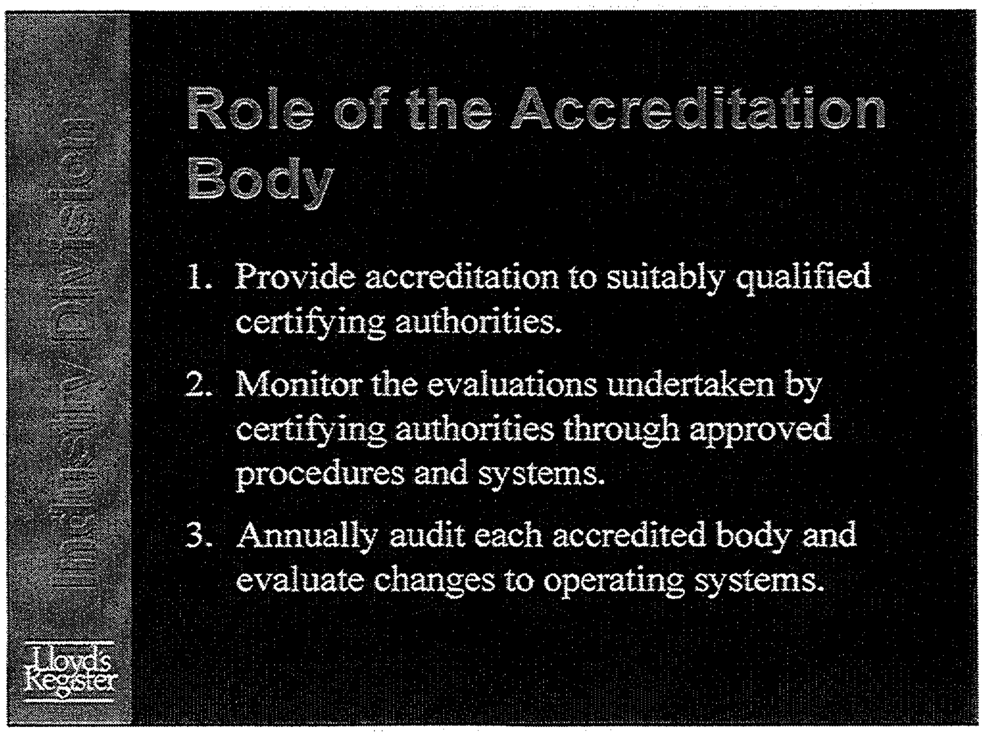

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Role of the Certifying Authority

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1. To audit emission records of entities participating or wishing to participate in the trading scheme.
2. To validate through the certification process the permits participants wish to trade.
3. Certification services as required by domestic arrangements.

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Slide 10

International Accreditation Body

Industry Division

The IAB would need to have the following credentials:

- international experience in certification
- financially independent
- must have high calibre assessors
- set and maintain high standards
- apply sanctions when necessary

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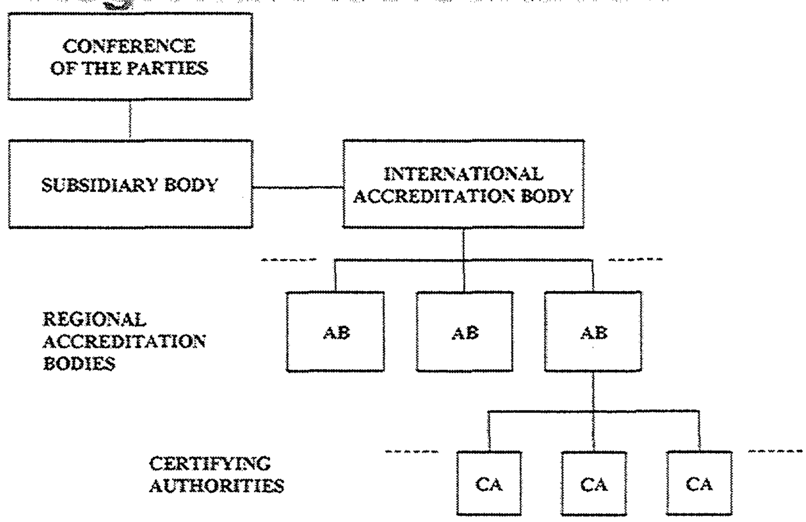
Slide 11

Certifying Authorities

The accreditation of local certifying authorities should be encouraged provided they satisfy accreditation criteria agreed by the Conference of the Parties.

Slide 12

Structure for International/ Regional Accreditation



Slide 13

Requirement for Baselines

Both Article 6 and Article 12 require emission reductions to be additional to those which would otherwise have occurred.

This requires an emissions baseline for each JI and CDM project.

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Slide 14

How do you set the baseline?

- National baselines
- Sectoral baselines
- Project specific baselines

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Slide 15

Baseline Approval

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For CDM projects this could be the responsibility of the executive board of the CDM.

For JI projects and sequestration projects under Article 3, paragraph 3, responsibility for approval is less clear.

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Slide 16

Article 6 - Joint Implementation Projects

Industry Division

An agreement between developed countries to undertake a project which will create emission reduction units through either:

- reducing emissions by source, or
- enhancing removals by sinks, i.e. carbon sequestration projects.

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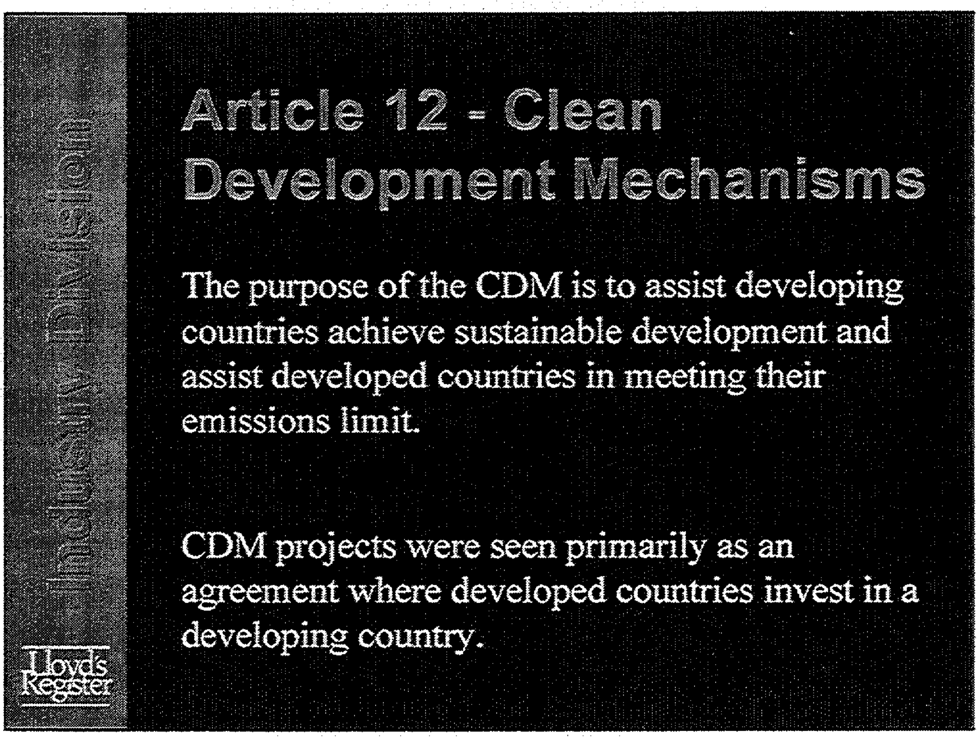
Slide 17



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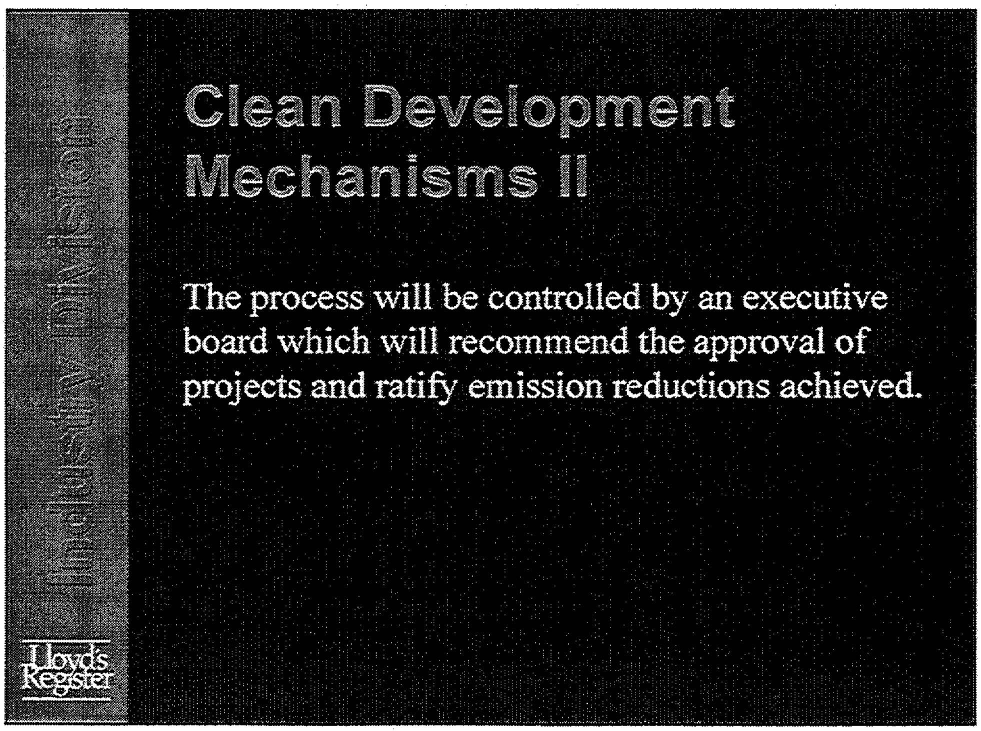

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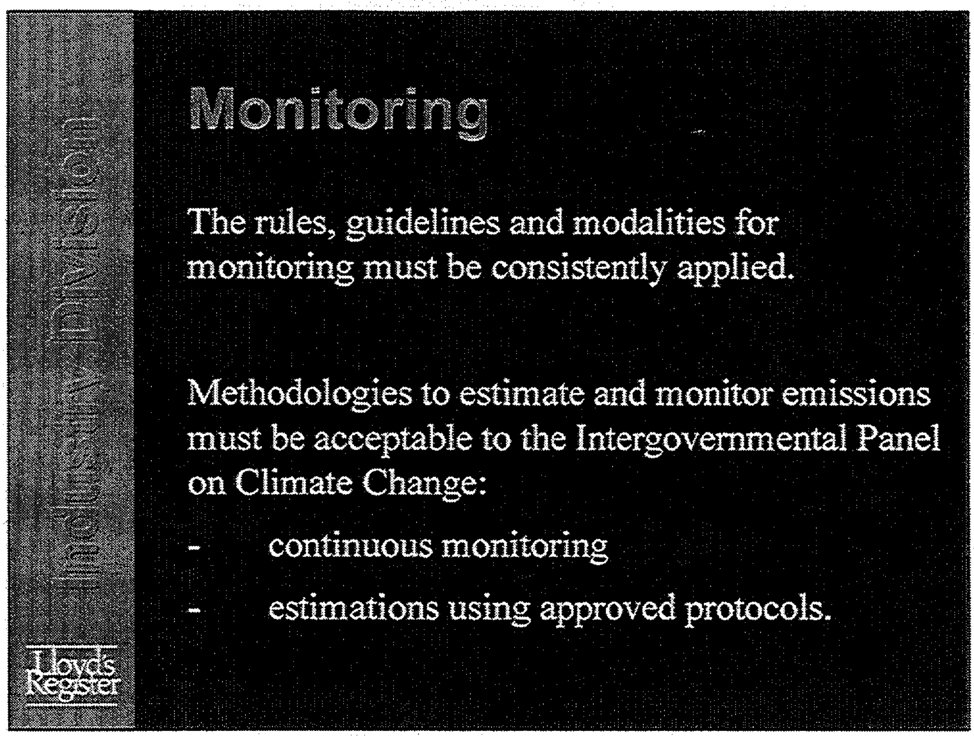

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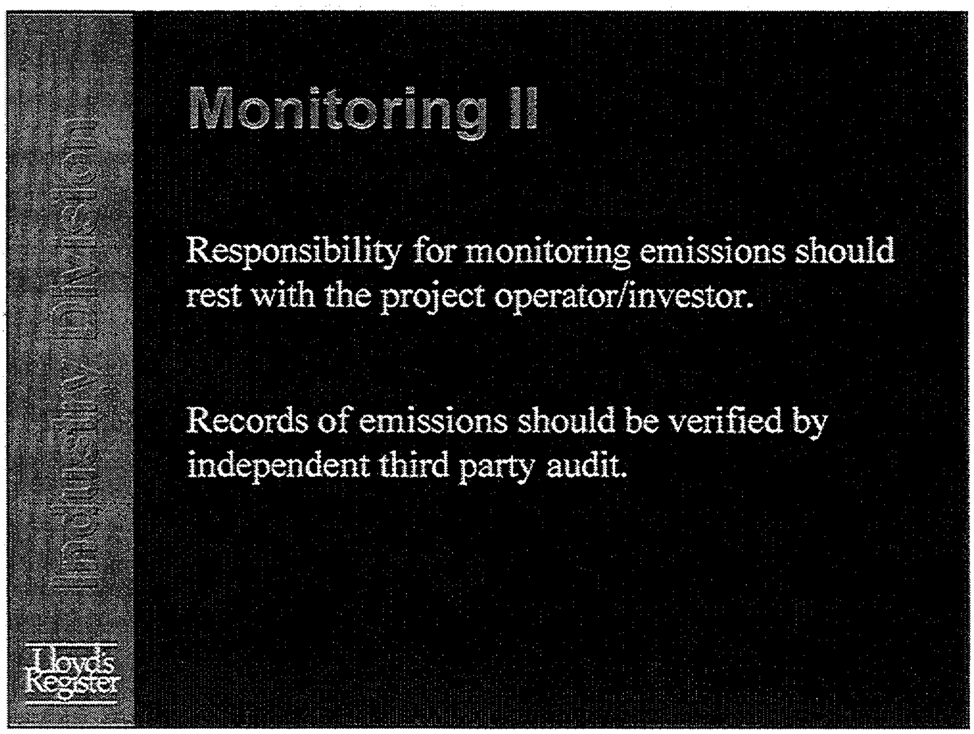

Slide 21

Scope of Certification and Verification

There are 3 broad activities associated with the flexible mechanisms:

- Project Assessment
- Periodic Audit
- Compliance

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Project Assessment

	Article 6	Article 12	Article 17
Approval of Parties	V	V	-
Sustainable Development	-	V	-
Baseline (Additionality)	C	C	-
Project Registration	-	V	-

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Periodic Audit

	Article 6	Article 12	Article 17
Validity of Baseline	V	V	-
Cert. of Actual Emissions (Monitoring)	C	C	-
ERUs Created	V	-	-
ERUs Sequestered	V	-	-
Certification of CERs	-	C	-
Certification of Carbon Sequestered	C	C?	-

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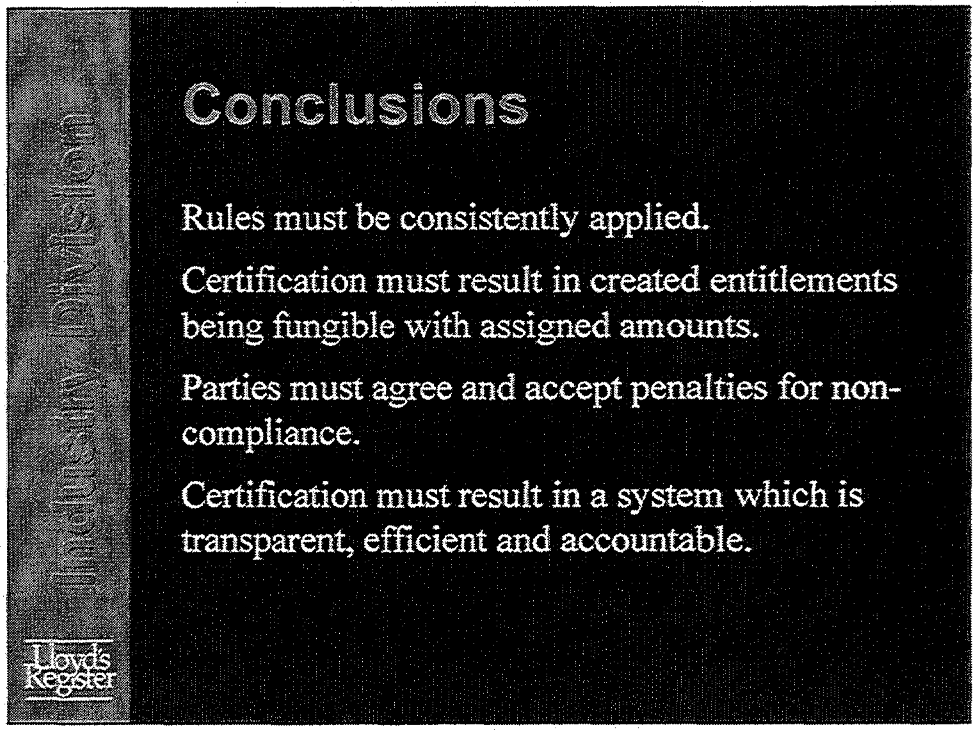
Compliance

	Article 6	Article 12	Article 17
Article 5	V	V	V
Article 7	V	V	V
Article 8	V	V	V
Supplementarity	V	V	V
Additionality	V	V	-
Sustainable Development	-	V	-
IPCC Methodologies	V	V	V
Government Approval (Seller)	-	-	V
Validity of Permits	-	-	V

Slide 25


Industry Division
Conclusions
Rules must be consistently applied.
Certification must result in created entitlements being fungible with assigned amounts.
Parties must agree and accept penalties for non-compliance.
Certification must result in a system which is transparent, efficient and accountable.
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5. Nature and Scope of CDM Projects

Ms. P. Bhandary, Convenor, Oil & Gas Area, Policy Analysis Division, TERI, India

This summary outlines energy efficiency and cogeneration as climate change mitigation options that can be implemented in developing countries and economies in transition as a part of the project-level credit trading envisaged in the Kyoto protocol.

Issues in Cogeneration:
Cogeneration is a well-established technology and has almost no technical barriers. Technical barriers exist in those cogeneration plants, which are synchronized with the grid. This is primarily due to poor power supply quality in the grid. The grid power quality fluctuates because of over and under voltage and frequency variations. This needs to be tackled at the utility end.

Climate Change Related Issues:
Cogeneration technologies are more than win-win situation because the benefits are significant, which are not only economic but also environmental. Substantial emission reductions are possible in CO_2 and other pollutants, which are indicated in the table below:

FUEL USED	COGENERATION MODE		
	Reduction in CO2	Reduction in SO_X	Reduction in NO_X
1. Coal	38%	55%	35%
2. Oil	22%	48%	50%
3. Natural Gas	36 %	50%	50%

Some of the industrial processes (e.g. sugar mills, fertilizer plants, petroleum and petro-chemical plants etc) have integrated cogeneration systems. Such processes have potential to maximize power production and export surplus power to the grid. These processes have not been exploited to derive the benefits from cogeneration.

The energy bill in cogeneration projects is significantly reduced due to lesser consumption of purchased electricity and fuel. In spite it being a financially attractive proposition, cogeneration has not succeeded in most developing countries due to the following reasons:

- Lack of knowledge about the technology and the benefits
- Poor local availability of technology
- Inability to synchronize the cogeneration plant with the production process
- The major barrier to export power is the low power purchase price by the utility
- Withdrawal of technical guarantee by the technology supplier in case modification is carried out in the process to integrate the cogeneration system
- Lack of ability to size and package cogeneration technologies to suit different processes.
- High initial investment

Issues in CDM:
Most cogeneration options have a high IRR and low CO_2 abatement costs compared to most Greenfield projects. The issue of additionality in the case of cogeneration is easy to address. The baseline in each of these cases should be based on individual projects and not on at the sector level. The baseline case in plants not adopting cogeneration is "no cogeneration" and in the CDM case is that of "cogeneration". In case of plants having cogeneration but would like

to enhance the power output by adopting an improved technology the baseline case would be the "normal cogeneration" and in the CDM case it would be the "enhanced cogeneration".

However, the calculations to prove *emissions additionality* are slightly complicated in both cases of cogeneration. In the case of enhanced cogeneration mode, CO_2 and other GHG reduction is calculated based on the grid electricity displaced and the mix of power generation at the utility's end. Whereas, in the case of normal cogeneration (i.e. with no exports to the grid) the CO_2 emissions would depend on the fuel consumption before and after the installation of the cogeneration plant and on the amount of purchased electricity.

This would require *monitoring* at the utility's end as well as at the plant under consideration. A detailed monitoring mechanism will have to be drawn-up at both ends. A framework for utility *reporting* will be required so that all energy efficiency and cogeneration projects use the same figures for energy savings and electricity displaced in the grid. Issues related to *verification* are linked to the monitoring procedures. The process of verification must be integrated with the monitoring process.

Verification of CO_2 and other GHGs in the case of energy efficiency projects can be a difficult task. The complexity arises due various factors as indicated here below:

- The specific energy consumption in most cases is not a linear function of production.
- The energy efficiency project is most likely to be a part of the main process and quantification of GHG reduction due to the energy efficiency project can be difficult as well as expensive.
- The complication is significantly increased in processes, which use more than one form of fuel and energy utilization.

The issues of monitoring and verification are best addressed sector-wise involving a multi-disciplinary team of energy auditors, financial auditors and process experts from the sector.

Slide 1

Nature and Scope of CDM Projects

Presented at
The Expert Group Meeting
on Industrial Energy Efficiency,
Cogeneration & Climate Change
December 2-3, 1999

Slide 2

Objectives of the CDM

- Assist non-Annex I countries in achieving sustainable development
- Assist Annex I parties in achieving compliance with their quantified emissions limitation and reduction commitments (QELRC)
- Contribute to the ultimate objective of the Framework Convention on Climate Change

Slide 3

CDM Market Estimates

	Share %	Size (MtC)	Price ($/tC)	Value ($ bn)
Haites	27-57	266-572	37	9.8-2.1
US Admin	19-46	144-344	24-42	6.0-8.3
Austin et al	33-45	397-723	13-26	5.2-17.4

Slide 4

Other CDM Highlights

- Voluntary participation by each Party involved
- Real, measurable and long-term benefits
- Emission reductions are additional
- Share of proceeds to the Adaptation Fund
- Banking of Certified Emissions Reductions (CERs) from 2000

Slide 5

Additionality Requirements

- Environmental
- Financial
- Technological

Slide 6

Additionality & Baselines

- Technologies with better performance

  Baseline would be performance of last few units
- New technologies

  Baseline would be the performance of current technology providing same service to same kind of user
- Government incentives

  Baselines would be conventional technology if no incentives are utilized; newer technology performance if incentives are utilized

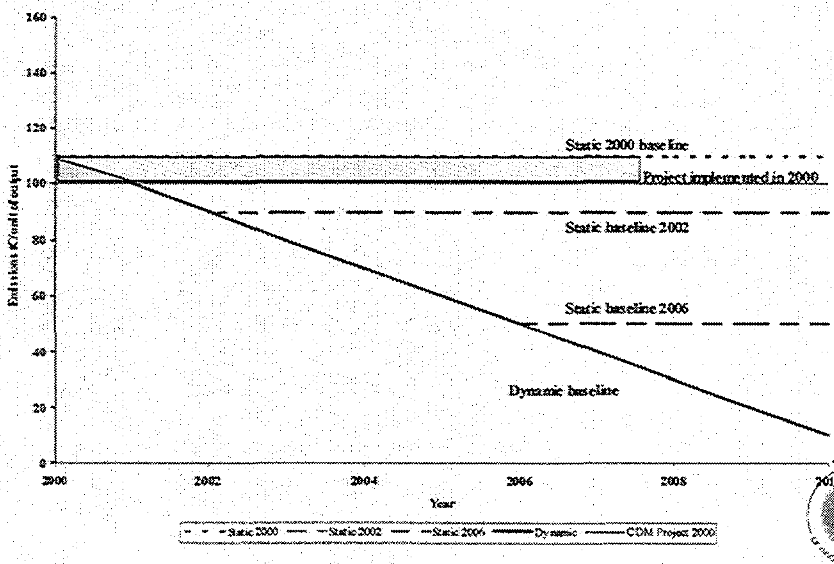
Slide 7

Baselines

- Macro level (e.g. to ensure technological additionality)
- Project level
- Dynamic vs Static
- Reduce uncertainty
  - baselines
  - guidelines for system boundaries

Slide 8

Baselines



Slide 9

Main unanswered questions (1)

- Criteria for defining sustainable development
- Transparent monitoring, verification and certification process for the CERs.
- Ownership of CERs/Secondary markets for CERs

Slide 10

Main unanswered questions (2)

- Definition of "proceeds of CDM projects"
- Fungibility among the three Kyoto Mechanisms (CDM, JI and ET)

Slide 11

Uncertainty

- **Baselines**
  - static versus dynamic
  - macro (national/international) versus project based
- **Form of financial participation**
  - equity / loan/ purchase of CERs
- **Technology**
  - proven versus experimental
  - high-tech versus low-tech

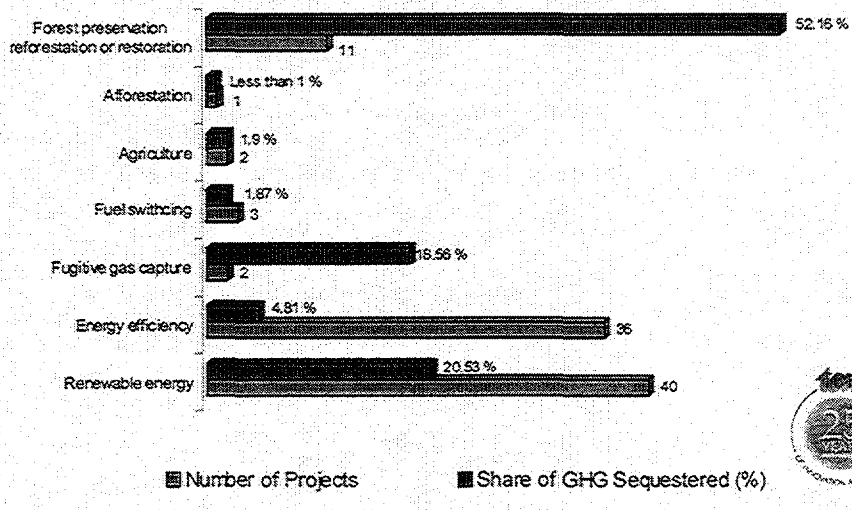
Slide 12

Structures for CDM

Structure	Mechanism	Distribution	Funds	Credit ownership
Bilateral (unilateral)	Market	Regulation – High	Private (impact FDI)	Investor & Host (st secondary markets)
Portfolio or Multilateral	Clearing house (EB)	Regulation – Low	Public (impact ODA)	Executive Board (monopoly?)

Slide 13

AIJ: Activity Type



Slide 14

Case studies

Power sector options as CDM projects

- **Cogeneration**
- **Renovation and modernization**

Slide 15

Win-Win /No regrets Options

- Definition??
- Options which make economic sense but are not taken up due to barriers
- Negative cost options: options that reduce emissions and produce net savings
- Divergent estimates possible (underlying assumptions of technology, price, time-scale)

Slide 16

Key issues

- Is the project additional ?
- What is the baseline technology for the same application ?
- What is the baseline performance against which the carbon emissions are to be measured ?
- Does the project assist in sustainable development

Slide 17

Bagasse- based Cogeneration

- Major producer of sugarcane
- Enhanced Cogeneration potential of 3500 MW
- Abatement cost of (-) $ 2.2/tonne of CO2
- Win-win option

Slide 18

Litmus test for CDM

- Development Priorities

  Ministry of Non-Conventional Energy Sources and Ministry of Power Incentives

- Baseline ??

Sugar Sector or Project specific baseline

- – No enhanced cogen
- – Enhanced cogen at the margin

Slide 19

- Project Additionality
  - Despite incentives, actual cogen based capacity only 150 MW
  - Deterrent : PPA by SEBs

- Financial additionality
  - None

Slide 20

- Emissions additionality
  - Distinction between plants exporting electricity to the grid and otherwise
  - Distinction in types of projects: enhanced cogen vs normal cogen
  - Emissions from the type of electricity (coal, gas, hydro, nuclear) displaced relevant
  - Alternative: Coal at the margin or the mix of generation

Slide 21

Renovation & Modernisation

- 30,470 MW of 86157 MW candidates for R&M
- Bulk of these are thermal units
- Benefits from R&M = 5000 MW

Slide 22

CDM criteria

- Sustainable development
- Project & Financial Additionality
  - R&M program size Rs 23830 million for 20869 MW
  - But only 10046 million Rs invested
  - 5000 MW capacity additional (replacing investments in greenfield plants)

Slide 23

Baseline

- Sector : Enhanced R&M programme
  - Uniform average (operating efficiencies range 20-37%)
- Project: With and Without case
  - Size and Vintage
  - Current operating efficiency as baseline
- Emissions additionality
  - Heat rate improvement from 2700 to 2500 kcal/kWh (for a recently completed plant)
  - Emissions from 1.2 to 1.1 kg of CO_2/kWh

Slide 24

Gray areas

- Cost-effectiveness/ CER cost
- Not all R&M activities result in efficiency improvement
- Time frame for which CERs accrue
  - Extended life of the plant (20 years)
  - Time frame within which investments take place, advancement vs delay
- Information asymmetry maybe large: Negotiation important

Slide 25

Limitations

- **Baseline definition**
  - Expansion of Incentive-based programmes: **baseline of current performance or of baseline technology without incentives; project does not avail incentives**
  - Promotion of Efficient Technologies: **baseline of current performance or that of few of the newest plants**
- **Procurement of baseline data**
- **Agreement on parameters that need to be monitored**

Slide 26

Environmental additionality and transparency

vs

Transaction costs and risks

6. Trading Greenhouse Gas in a World of Uncertainty: Managing Risk and Capturing Opportunity

Ms. Hillary Nussbaum, GHG Broker, Emissions Brokerage Desk, Natsource LLC

ABOUT NATSOURCE

Natsource acts strictly in the role of introducing broker for emission credit transactions.

In a typical transaction, Natsource matches buyer and seller of emission credits and negotiates terms and conditions with both parties.

Natsource assists in tailoring a variety of transactions, including:

- *Immediate settlement transactions*: The most common type of trade; follows the standardized terms that payment for credits is to be made within 3 to 5 business days of the confirmation that credits have been transferred to the account of the buyer.

- *Forward transactions*: Forward transactions may either be structured as pay now (discounted) receive later or as pay later, receive later. The second transaction type is the most common; however they are often restricted to those with investment grade credit. Credit problems often may be solved through negotiation.

- *Vintage Swaps*: Swaps between vintages allow those with immediate needs to meet them without having to outlay or receive cash. These structures enable a utility or others to avoid capital gains or losses through the IRS treatment of this transaction as a "like kind" exchange.

- *Options*: At present the majority of options have been structured as European call and put options with expiration dates as far out as ten years. Other structures including zero cost collars, strangles and call spreads are also available.

- *Inter-pollutant and Inter-commodity Swaps/Exchanges*: We have structured numerous interpollutant credit swaps, including the exchange of NOx allowances for SO_2 allowances and emission reduction credits (ERC) for SO_2 allowances. We have also structured swaps of emission credits for other commodities such as coal or wholesale power.

EMERGING GREENHOUSE GAS EMISSIONS MARKET.

Not only does a global market for GHG emissions appear likely, but the potential rewards for smart players in the field are enormous.

While we anticipate the creation of a standardized tradable GHG commodity, the rules for what may "count" as an emission reduction for trading purposes have yet to be finalized. Natsource is assisting customers in building a "portfolio" of GHG emissions reductions, where credits vary in quality based on how they were generated, reporting procedures, and third party verification. In addition to quality provisions, in some transactions we are adding contingency terms to address the concern that credits may not be recognized under a mandatory program in the future.

Slide 1

Trading Greenhouse Gas in a World of Uncertainty: Managing Risk and Capturing Opportunity

UNIDO - Expert Working Group on Energy Efficiency
Vienna, 3 December 1999

Presented By Hillary Nussbaum
Natsource Emissions Brokerage Desk
e-mail: hnussbaum@natsource.com

NATSOURCE

Slide 2

Natsource

- Market leader in natural gas, electricity, coal, emissions, weather derivatives
- Client base: utilities, banks, energy producers + marketers, insurance and industry
- Over $1.7bn by volume in emissions transactions
- Global reach: joint venture with Tullett & Tokyo to develop energy and environment brokerage worldwide.
- Associations:
  - Founding member of the Emissions Marketing Association (EMA)
  - Member of US Center for Clean Air Policy GHG Braintrust
  - Participate in the UK Emissions Trading group

NATSOURCE

Slide 3

The Greenhouse Gas Market

YES, THERE IS A MARKET

- Increasing numbers of transactions
- Major portfolios being developed: including portfolios of CERs/ERCs from international initiatives
- Early action pilot trading programs and crediting legislation in several countries
- US State GHG reduction initiatives (OR, MA, NJ)
- Climate neutral companies and products

NATSOURCE

Slide #3

Slide 4

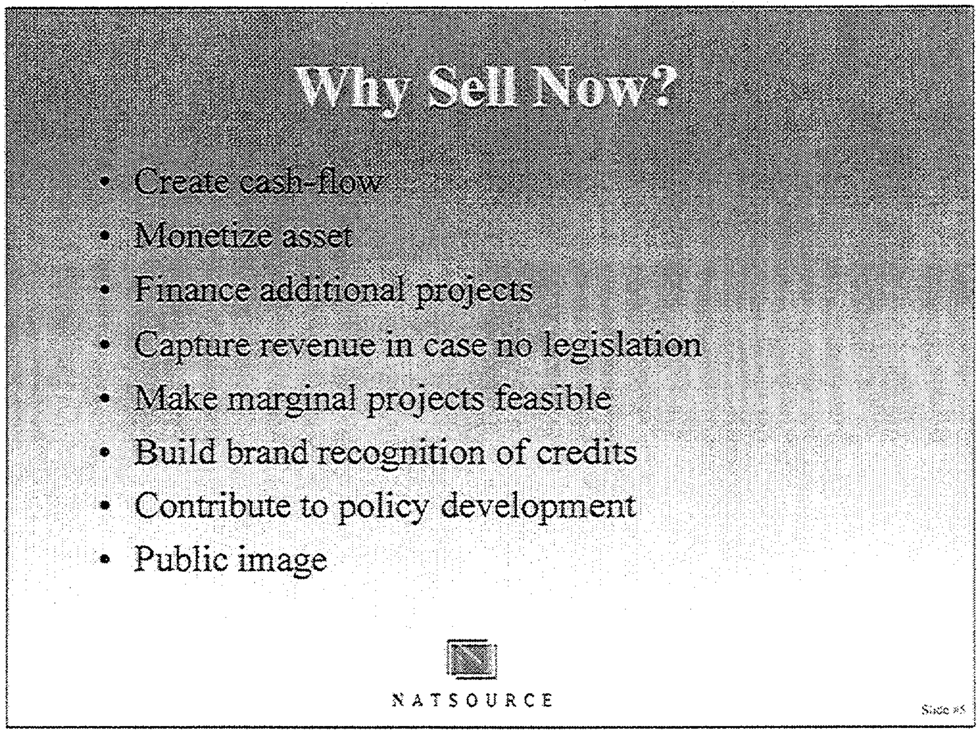
The Product

- **The tradable unit is metric ton units of CO2 equivalent emission reductions (CO2E)**
- **Emission reductions should meet basic criteria including:**
  - Specific and identifiable reduction of emissions
  - Measurable by accepted methodology
  - Surplus, not otherwise required by law
  - Reviewed/verified by independent third party
  - (Additionality: where necessary for JI + CDM)

NATSOURCE

Slide #4

Slide 5



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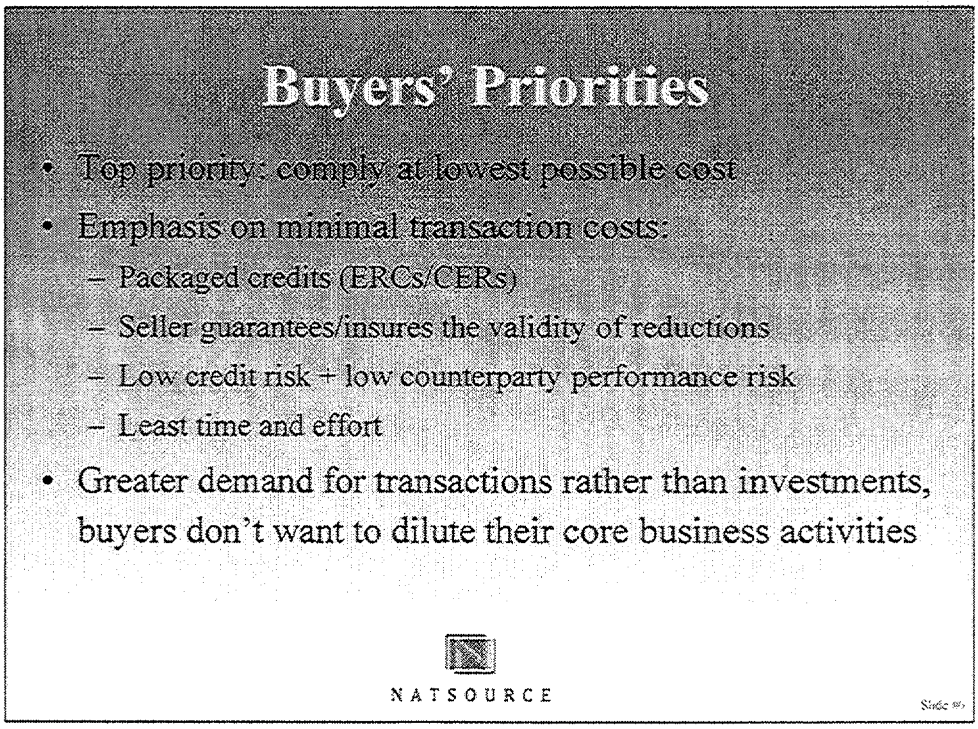

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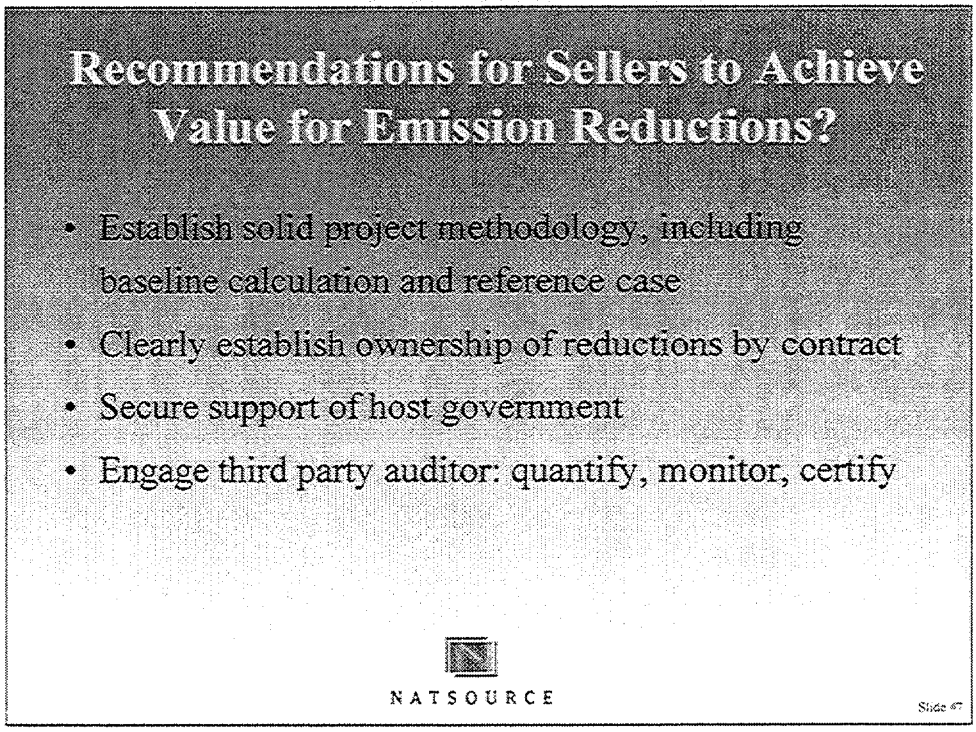

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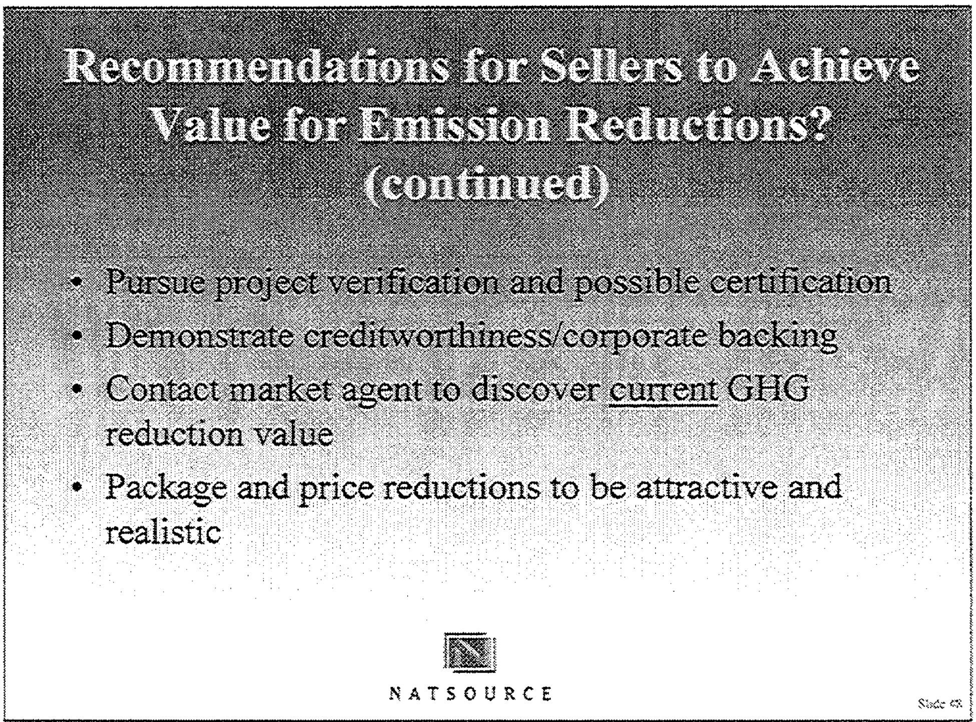

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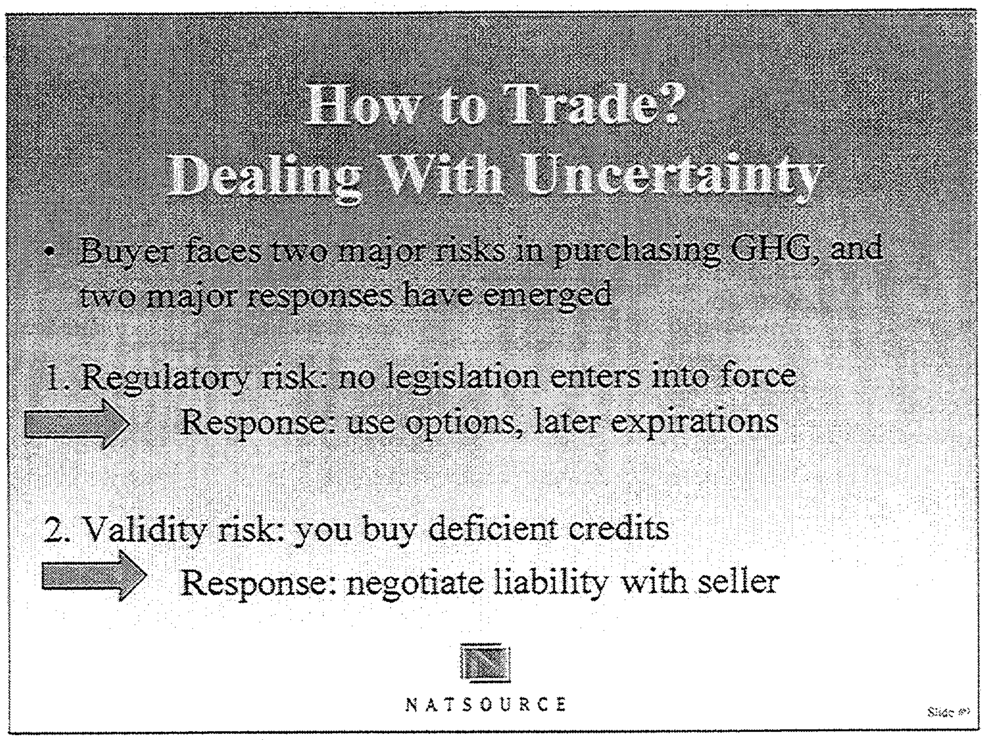

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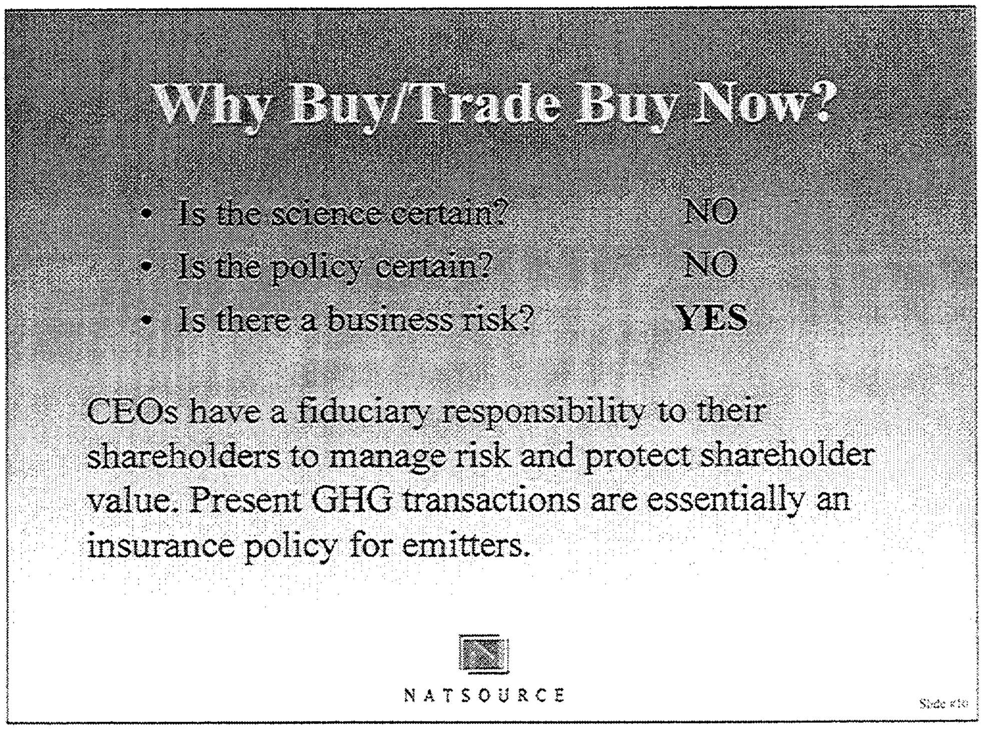

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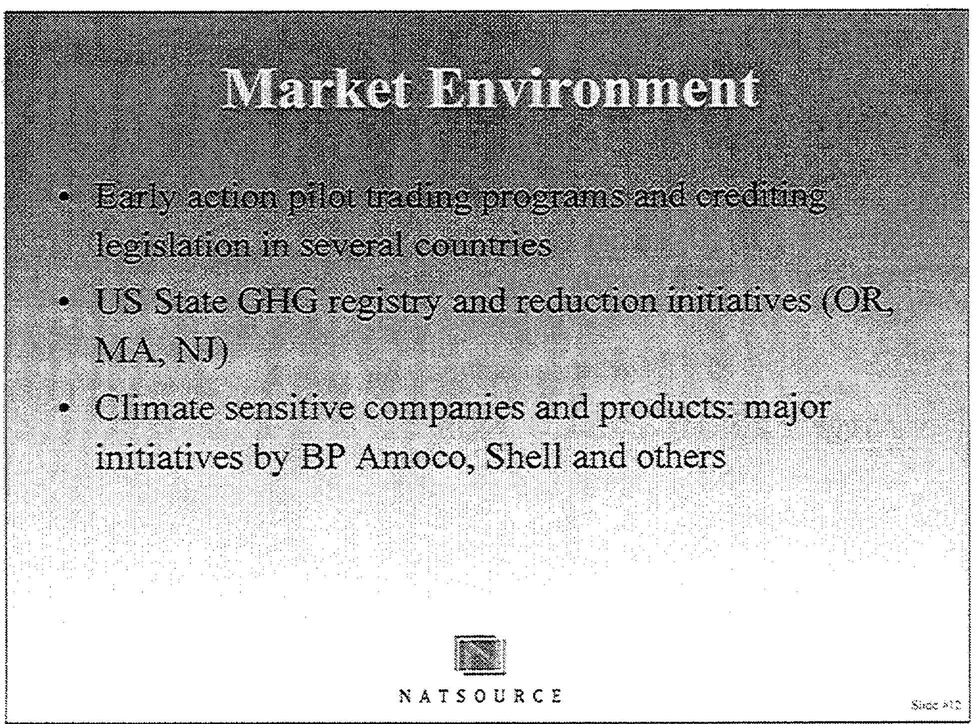

Slide 13

Transaction Structures

- Immediate Settlement
- Forward Settlement
- Options
- Interpollutant swaps
- Bundling emissions reduction credits with power, coal, etc.
- Liability

NATSOURCE

Slide #13

Slide 14

Role of the OTC Broker in the GHG Market

- Price discovery - market liquidity
- Honest auctioneer, match buyer + seller
- Negotiate commercial terms
- Develop transaction structures
- Assist development of market conventions
- Provide education and seminars

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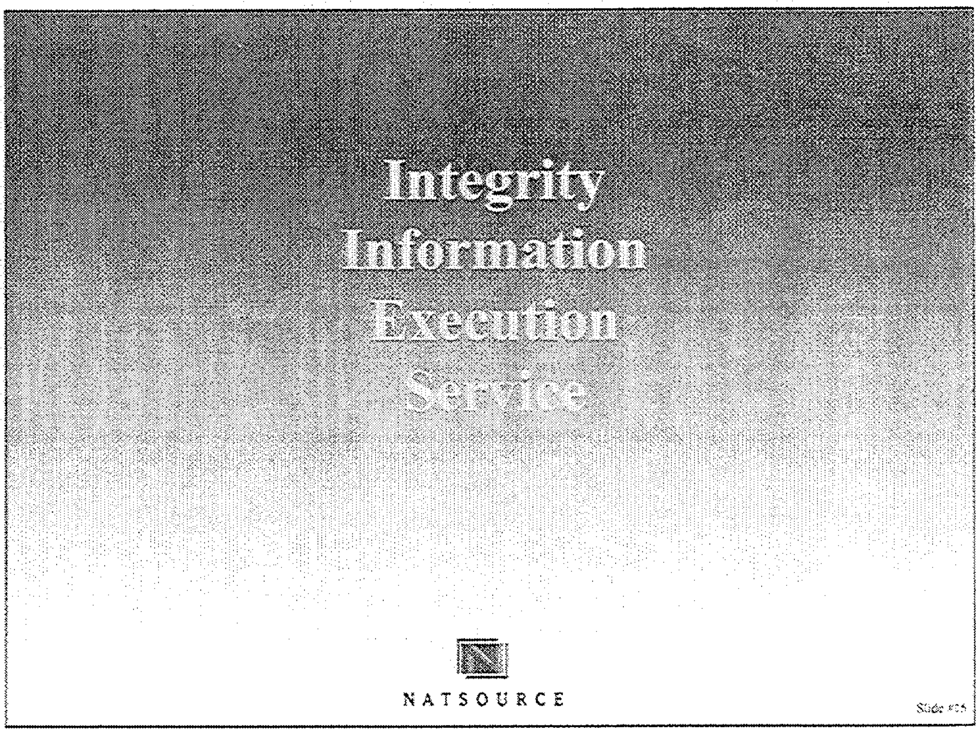
Slide #14

Slide 15



ANNEXES

ANNEX I: LIST OF PARTICIPANTS

COUNTRY	NAME & ADDRESS
Argentina	Prof. Enrique Grünhut, Technology Manager CIPURE-INTI P.O. Box No. 11, Suc. 28 (B), 1428 Buenos Aires, Argentina E-mail: enri@inti.gov.ar
Austria	Dipl.-Ing. Otto Starzer Energieverwertungsagentur Linke Wienzeile 18 A-1060 Vienna E-mail: starzer@eva.wsr.ac.at
Belgium	Dr. Simon Minett Cogen Europe 98 Rue Gulledelle B-1200 Brussels Belgium E-mail: simon.minett@cogen.org
Belgium	Mr. Pascal Stijns Power & Energy Marketing Europe Honeywell PACE Avenue du Bourget 1 1140 Brussels E-Mail: pascal.stijns@belgium.honeywell.com
Egypt	Dr. Ahmed Khozam General Manager Mideast Energy and Environment Services (MEES) E-mail: menenv@intouch.com
Georgia	Mr.Tengiz Gzirishvili Acting Director of UNFCCC National Agency in Georgia, UNFCCC National Focal Point 150 Agmashenebeli Ave., Tbilisi 380012, Georgia E-mail: gzirishvili@caucasus.net

COUNTRY	NAME & ADDRESS
Germany	Mr. Uwe R. Fritsche Coordinator, Energy & Climate Division Oeko-Institut (Institute for Applied Ecology) Elisabethenstr. 55-57, D-64283 Darmstadt, Germany E-mail: fritsche@oeko.de
India	Mr. S. C. Natu Vice President (Energy & Projects Group) Mitcon Ltd. 1st Floor, Kubera Chambers Dr. Rajendra Prasad Path Shivajinagar, Pune – 411 005, India E-mail: natu@mitconindia.com
India	Ms. Preety M Bhandari Convenor, Oil & Gas Area Policy Analysis Division Tata Energy Research Institute Darbari Seth Block India Habitat Centre, Lodhi Road New Delhi - 110 003, India E-mail: preetyb@teri.res.in
Kenya	Ms. Eunice A. Omanga Kenya Sugar Authority Bishops Road, N.S.S.F.Complex , 10th floor Nairobi, Kenya E-mail: KSA@Users.Africaonline.co.ke
Netherlands	Mr. Kieskamp, P. & Mr. Van den Akker, J.H.A ETC Energy Kastanjelaan 5, P.O Box 64, 3830 AB Leusden The Netherlands E-mail: j.vandenakker@etcnl.nl p.kieskamp@etcnl.nl
Nigeria	Mr. F.B. Dayo Managing Director Triple 'E' Systems Associates Ltd. Goodwill House 278 Ikorodu Road, Lagos, Nigeria E-mail: triple-e@triplesys.com
Philippines	Mr. Yolando T. Velasco Country Coordinator International Institute for Energy Conservation Rm. 5, Manila Observatory Building, Ateneo de Manila University, Katipunan Road, Quezon City 1108, Philippines E-mail: lvelasco@i-next.net

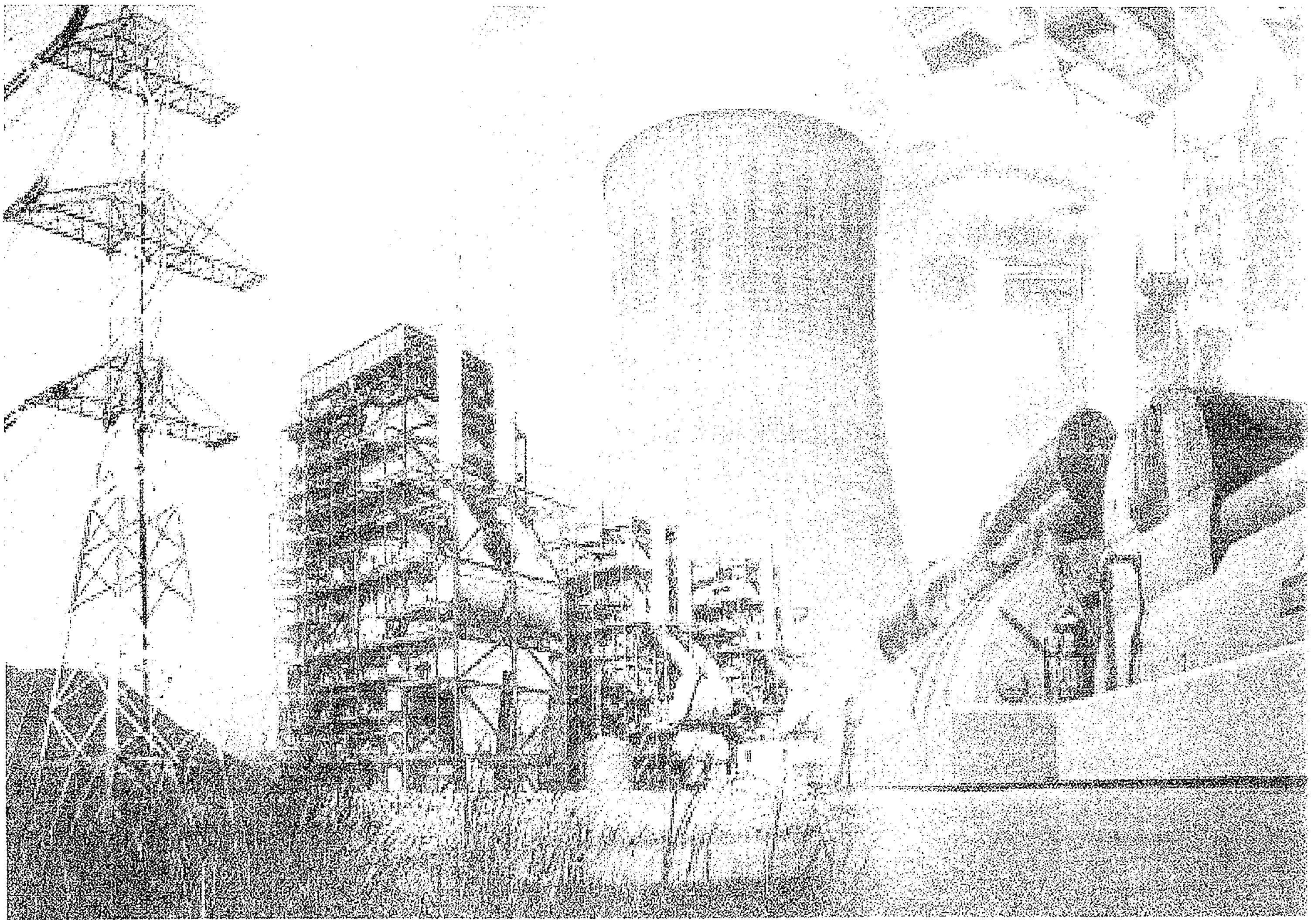
COUNTRY	NAME & ADDRESS
Russian Federation	Mr. Sergey Molodtsov Deputy Director Russian Center for Energy Policy Moscow Tel: 7095- 200-4506 Fax: 7095 -200-4479 E-mail: aslan@energy.ru
Switzerland	Mr. Alexander Lüchinger Factor Consulting + Management AG Binzstrasse 18 8045 Zuerich, Switserland E-mail: alexander.luechinger@factorag.ch
Thailand	Dr. Ludovic Lacrosse, EC-ASEAN Cogen Programme Asian Institute of Technology, Outreach Building 301/1, PO Box 4 Klong Luang, Pathumthani 12120, Thailand. E-mail: cogen@ait.ac.th
U.K.	Mr. Richard Hellebrand AH Marks and Co. Ltd Wyke Bradford West Yorkshire BD129EJ England E-mail: rhellebrand@ahmarks.com
U.K.	Mr. Jed. Jones Manager Lloyd's Register Special Product Development London, U.K E-mail: jed.jones@lr.org
Ukraine	Mr.Vladimir Andreevich Djukov Director State Scientific Enterprise "UKRENERGOEFFECTIVNOST", Ministry of Energy of Ukraine Kiew, Ukraine E-mail: ukree@ambernet.kiev.ua
USA	Prof. F. Shutov Center for Recycling of Industrial and Municipal Waste Department of Chemical Engineering Tennessee Technological University Box 5077, 115 West 10th Street Cookeville, TN 38505, USA E-mail: fshutov@tntech.edu

COUNTRY	NAME & ADDRESS
USA	Ms. Hillary Nussbaum Natsource LLC 140 Broadway, 30th fl. NY, NY 10005 E-mail: hnussbaum@natsource.com
Zimbabwe	N. Nziramasanga Technical Director Southern Centre for Energy and Environment 31, Frank Johnson Ave, Harare Zimbabwe E-mail: rs@samara.co.zw
UNIDO	Mr. A.D'Ambrosio Managing Director Sectoral Support and Environmental Sustainability Division E-mail: adambrosio@unido.org Mr. C. Gürkok Director Industrial Energy-Efficiency Branch E-mail: cgurkok@unido.org Mr. R. Williams Officer-in-Charge Kyoto Protocol Branch E-mail: rwilliams@unido.org Mr. G. Jimenez Senior Technical Adviser Kyoto Protocol Branch E-mail: gjimenez@unido.org Ms. M. Ploutakhina Industrial Development Officer Kyoto Protocol Branch E-mail: mploutakhina@unido.org Mr. P. Pembleton Kyoto Protocol Branch E-mail: ppembleton@unido.org Ms. Inhee Chung Intern Kyoto Protocol Branch E-mail: ichung@unido.org

ANNEX 2: LIST OF ABBREVIATIONS & ACRONYMS

AIJ	Activities Implemented Jointly
ASEAN	Association of South East Asian Nations
Btu	British Thermal Units
CDM	Clean Development Mechanism
CEE	Central and Eastern Europe
CEP	Centre for Energy Policy
CHP	Combined Heat and Power (also referred to as Cogeneration)
CIS	Commonwealth of Independent States
CO_2	Carbon Dioxide
COP	Conference of the Parties
DSM	Demand-Side Management
E.V.A	Austrian Energy Agency
EBRD	European Bank for Reconstruction and Development
ECEP	Energy Conservation and Environment Project
EEA	Egyptian Electricity Authority
EGM	Expert Group Meeting
EM	Environmental Manual
EU	European Union
FDI	Foreign Direct Investment
GDP	Gross Domestic Product
GEF	Global Environment Facility
GEMIS	Global Emission Model for Integrated Systems
GHG	Greenhouse Gas
ICA	International Cogeneration Alliance
IEA	International Energy Agency
IIEC	International Institute for Energy Conservation
IRR	Internal Rate of Return
JI	Joint Implementation
MEES	Mideast Energy and Environment Services
MERVC	Monitoring, Evaluation, Reporting, Verification and Certification
MSW	Municipal Solid Waste
mtoe	Million Tonnes of Oil Equivalent
MW	Megawatt

Mwe	Megawatts Electric
NREA	New and Renewable Energy Authority
ODA	Overseas Development Agency
OECD	Organisation for Economic Co-operation and Development
OEP	Organization of Energy Planning
PSP	Pressure Shear Pulverization
R & D	Research and Development
RDF	Refuse Derived Oil
RUE	Rational Use of Energy
SCE	Supreme Council of Energy
STDP	Science and Technology Development Project
STEP	Swiss-Romanian Thermal Energy Project
tCO_2	Tonnes of CO_2
TERI	Tata Energy Research Institute
TPS	Total Power Supply
TWh	Terawatt Hour
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
UNIDO	United Nations Industrial Development Organization
US AID	United States Agency for International Development
USD	U.S. Dollars
VOC	Volatile Organic Compound



Kyoto Protocol Branch
Sectoral Support & Environmental Sustainability Division
United Nations Industrial Development Organization
Vienna International Centre
P.O. Box 300, A-1400 Vienna, Austria

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UNIDO United Nations Industrial Development Organization